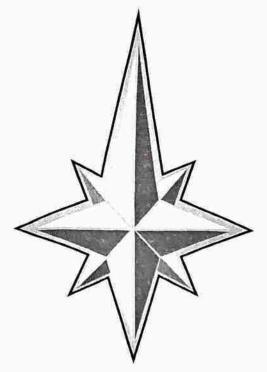


Terrain Modeling and Animation Software by

Questar Productions





Operator's Manual

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Introduction

Congratulations! You have just purchased the most sophisticated terrain modeling program available on any platform. With it you will soon be creating images of the landscape that can scarcely be distinguished from photographs. Of course you won't be limited to replicating nature. The infinite realm of surrealism is also at your fingertips.

What's more, WCS is actually a 3-D Geographic Information System capable of generating maps and renderings of virtually any kind of geo-referenced spatial data. Use it to study demographics or plan your next family vacation, perform environmental modeling or design a community infrastructure.

With its integrated key frame animation system, you can use WCS to fly through realistic earth landscapes or strange alien environments.

Many years of programming and nature study have gone into the development of World Construction Set. Every effort has been made to create a flexible yet user-friendly product. As with any program of this complexity, the learning curve may appear formidably steep when looking up at it from the bottom. If you already have some familiarity with conventional 3-D modeling or understand the rudiments of ecology you are already well on the way to mastering this software.

If this is your first introduction to 3-D modeling have no fear. A mountain is scaled one foot at a time. We will take you step by step to the top. Along the way you will not only learn about modeling landscapes but also some of the basic rules nature applies in designing her landscapes (and most people agree: She does a very realistic job).

Hopefully in the process of learning to use World Construction Set you will gain a greater appreciation for the diversity and

beauty that is our home -- Planet Earth. Nature's true complexity and design are beyond the comprehension of even our greatest scientists who have accumulated the learning of a hundred generations and more. Fortunately, for our purposes total comprehension is unnecessary. It will suffice to grasp a few fundamentals and to marvel at the rest.

Acknowledgments

As authors are wont to say in this context, there are far too many people that have had some part in the development of this program to thank them all individually. Nevertheless, there are some whose contributions have been far above and beyond the call of kindness or duty. Those we shall mention by name as a small token of our endless appreciation.

First and foremost are my parents, Bob and Helene, without whose bountiful support this project would have been stillborn. Second by only a scant margin is my programming partner, Chris "Xenon" Hanson. For months he patiently guided me through the nuances of the Amiga and C Programming Language without expectation of reward. He provided so many thoughtful insights and suggestions to improve the product that eventually I asked him to join in the effort as a partner. That he enthusiastically did and his efforts are everywhere seen in the quality of the result.

We would like to thank Bill and Judy Fleming, Directors of Colorado's Ocean Journey, and all the members of COJ's Scientific Advisory Board for the lively discussions that led to the inception of this project. Now we can really do those interactive exhibits we talked about.

Thanks also go to my mentor in the Geographic Information System arena, Ed Russell of Computer Terrain Mapping, Inc. He was gracious enough to provide some data to get us started and since has become a staunch ally in the cause of getting this product to market. And to Ed's cohabitants in the dungeons of 14th and Wal-



nut, Bill Thoen and Martin Wright, who were always there for us when we needed them, our thanks.

We would like to extend our gratitude to those bold individuals who banked their professional reputations on us and provided us with opportunities to test our wares in real-life situations: Tor and Cyndi Spears of Write Moves Graphic Design, Will Moir and Laurie Huckaby at the Rocky Mountain Forest and Range Experiment Station, Dan Seely and Wyndham Hannaway at G.W. Hannaway and Associates, and Alan Honick of Cedar Post, among others.

Our principle beta testers, some of the most patient people I know, deserve much credit for the program's good behavior and none of the blame for the bad (which hopefully there isn't any of since they did such a fine job). They are Chris Hurtt, Mike Gorby, Jamie Krutz and Frank Weed.

Frank Weed also provided us with insights into the VistaPro DEM format. It would have taken us a while to figure it out for ourselves and we appreciate his help.

Jamie Krutz did so much work on the manual and gave us so many good suggestions that he deserves special mention and immediate induction into the World Construction Set Hall of Fame.

Then there are our many users without whom this program would be a lot less functional. Since the first releases of WCS they have diligently documented bugs (it turns out we were making them about as fast as fixing them for a while) and they made copious suggestions for improvement. Not all of their suggestions could be implemented in this release but they won't be forgotten.

To John Sobernheim, owner of The Computer Room in Aurora, Colorado, who graciously extended us the use of equipment for testing and demonstration, we also owe a deep debt of gratitude.

And finally, to Sandi who fed my spirit during the difficult times with love and encouragement, I give thanks from the depths of

my soul. May your wings bear you to your heart's desire, my Guardian Angel.

- Gary Huber, January, 1995

Authors

World Construction Set is the creation of Gary R. Huber and Christopher "Xenon" Hanson.

This manual was written, edited and edited again by Gary R. Huber and Jamie Krutz.

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How To Use This Manual	1
Geography Novice	1
Amiga Novice	2
Amiga Veteran	2
3-D Veteran	2
Manual Organization	2
Introductory Chapters	
Reference Chapters	2 3 4
Tips and Tricks	
How to Find Answers	4
Further Information	5
Problems With Terminology	5
A Note To Explorers	7
Instant Gratification	9
A Sneak Preview	9
Installation	11
System Requirements	11
The Disks	12
Installation	12
Floppy System	12
Hard Drive System	13
Getting Started	17
How WCS Works	
TENERAL CONTRACT STATE STATE STATE	17
Program Organization Database Module	19
Data Operations (Data Ops) Module	19
Data Operations (Data Ops) Woulde	20

Map View Module	21
Parameters Module	21
Render Module	22
Data File Flexibility	22
Project File	23
Database File	24
Object Files	25
Parameter File	26
Color Maps	28
Other File Types	30
Rendering Pictures	31
Saving Files	31
User Interface	33
Amiga Style Guide Compliant	33
MagicUserInterface	34
Non-Modal Operation	34
Freeze and Restore	35
Potential System Font Problems	35
Display Compatibility	36
Choosing A Screen Mode	36
Viewing Pictures	37
Creating and Viewing Animations	37
Testing - Render Tutorial	38
Start World Construction Set	38
Load A Project File	40
Load a Parameter File	40
Use the Settings Editor Window	41
Render A Picture	44
Status Log Messages	45
Tutorials	47
Overview	47
Tutorial One - Image Quality	49
Open the Project	49
Disable Some of the DEM Files	50
Render an Image	53
View the Image	54

Increase the Quality	55
Save the Parameter File	61
Tutorial Two - Image Composition	62
'Scuse Me While I Fix The Sky	63
Fix the Horizon	66
Adjust the (Purple?) Haze	67
Move the Sun	70
Apply your Changes	72
Explore the Ecosystem Editor	73
Change the Ecosystems	75
Advanced Topics	81
Tutorial Three - Motion Paths	82
Terms	82
Key Frames	83
Animate!	84 95
Modify Key Frames Create a Vector Motion Path	97
Ofeate a vector Motion Latin	31
Reference 1 - Data Types	103
Overview	103
Building Blocks	104
Database	105
Parameters	106
Render Settings	110
Digital Elevation Models	111
Relative Elevation Models	115
Technical Explanation	115
Digital Land Grids - Vector Objects	116
Color Maps	118
Z Buffers	
	120
Backgrounds	121
Projects	122
Directory Lists	123
Configuration	124

Reference 2 - Global Menus	125
Overview	125
Project Menu	126
New/Edit	127
Open	129
Save	129
Save As	130
Load Config	130
Save Config	131
Save Screen	132
Info	132
Version	133
Credits	133
Log	134
Quit	135
Modules Menu	137
Database	137
Data Ops	138
Map View	138
Parameters	139
Render	139
Motion Editor	139
Color Editor	140
Ecosys Editor	140
Prefs Menu	141
Preferences	141
Screen Mode	143
Parameters Menu	144
Load All	144
Save All	145
Freeze	145
Restore	146
Extended Parameters Menu	146
Load (Parameter Class)	146
Save (Parameter Class)	147
Load Active	148
Cove Active	140

Reference 3 - Database Module	151
Overview	151
Database Explained	153
Name	154
Enabled Status	154
Vector Points	154
Class	155
Layer Identifiers	156
Label Status	158
Label	158
Maximum DEM Fractal Depth	158
Line Style	159
Line Weight	159
Draw Pen	159
RGB Render Pens	160
Database Pop-Up Menu	160
Load	161
Append	164
Create	165
Edit	166
Save	166
Dir List	167
Database Editor Window	168
Name Button	169
Name Field	170
Enabled Button	171
Points Display	171
Class Cycle Gadget	171
Layer 1 Field	173
Layer 2 Field	173
Sel Button	173
On Button	174
Off Button	174
Label Button	175
Label Field	175 175
DEM Max Fractal Field	176
Line Style Cycle Lagdget	110

Line Weight Field & Buttons	177
Draw Pen Field & Buttons	177
RGB Color Fields & Sliders	178
Object List	178
New Obj Button	179
Add Obj Button	180
Remove Button	181
Search Button	183
Sort Button	184
Save, Load, Append, & Create Buttons	185
Directory List	185
Directory List Editor	187
Directory List	188
Default Directory Button	188
Add Button	190
Swap Button	191
Move Button	192
Remove Button	193
Read Only Button	194
Keep Button	195
Load Button	196
Cancel Button	197
Reference 4 - Data Operations Module	199
Overview	
Digital Elevation Models	199
Where the Data Goes	200
	201
Pop-Up Menu Window	202
Layout Cycle Gadget	203
Extract DEM Button	203
Convert DEM Button	204
Interp DEM Button	204
Import DLG Button	204
Import DXF Button	206
Import WDB Button	207
DEM Extract Window	208
Select Files Button	209

Selected Display Field	210
SE Latitude Field	210
SE Longitude Field	211
Extract Button	211
DEM Converter Window	213
DEM Converter Window Layout	215
DEM Converter Window Gadgets	218
DEM Interpolate Window	236
DEM Interpolate Window Gadgets	237
Reference 5 - Map View Module	239
Overview	240
Map View Control Window	242
Scale Field & Buttons	243
Lat Field & Buttons	243
Lon Field & Buttons	244
Exag Field & Buttons	244
Zoom Button	246
Pan Button	246
Auto Button	247
Center Button	247
Database Button	248
Topo Checkbox Button	249
Vec Checkbox Button	250
Eco Checkbox Button	25
Eco Button	252
Inter Checkbox Button	252
Style Cycle Gadget	253
Dither Checkbox Button	254
Align Button and Check Box	254
Palette Cycle Gadget	255
Clear Button and Check Box	256
Draw Button	256
Refine Button	257
Map Alignment Window	257
NW/SE Lat/Lon Fields	258
Upper Loft/Lower Right Y/V Fields	259

Set Registration Button	259
Eco Legend Window	260
Map View Window	261
Map View Window Mouse-Keyboard Shortcuts	263
Left Mouse Click	263
Mouse Move	264
Shift-Left Mouse Click	264
Alt Key-Left Mouse Click	265
Ctrl Key-Left Mouse Click	266
Enter Key on Numeric Keypad	266
Database Menu	267
Load Objects/All	267
Load Objects/Active	268
Load Topos	268
Save Objects/All	269
Save Objects/Active	269
Database	269
Clear Window	270
Print	270
Close Map	270
View Menu	271
Controls	271
Eco Legend	271
Align Map	272
Center	273
Auto Center	273
Zoom	274
Pan	274
Move/In	275
Move/Out	275
Move/Left	275
Move/Right	275
Move/Up	276
Move/Down	276
Draw Menu	277
Draw Map/Normal	277
Draw Map/Refine	277

Color Map	278
Viewshed	280
Fix Flats	281
Object Menu	283
New Object	283
Find Object/Single	284
Find Object/Multi	284
Highlight	285
Add Points/New	286
Add Points/Append	288
Add Points/Insert	288
Create Stream/New	289
Create Stream/Append	290
Modify Points	290
Input Source	291
Conform Topo/All	291
Conform Topo/Active	292
Match Points	293
Move Origin	294
Duplicate	295
Motion Menu	296
Set Camera	296
Set Focus	297
Path	298
Surface El Submenu	301
Reference 6 - Parameters Module	303
Overview	304
Three Parameter Classes	304
Other Parameters Module Functions	305
Windows	305
Pop-up Menu Window	306
Layout Cycle Gadget	307
Motion Button	308
Color Button	308
Ecosystem	309
Defaulte	309

Motion I/O	31
Active Parameter	31
Interactive Group	31
Animation	
Key Frame System	312
Key Frame Controls	310
Frame Field & Buttons	315
Prev Button	316
Next Button	317
Make Key Button	31′
Group Button	311
Update Button	318
All Keys Button	320
Delete Button	321 321
Delete All Button	322
Time Lines Button	323
Bank Button (Motion Editor Window Only)	324
Scale Button	325
Sun Button (Motion Editor Window Only)	325
Time Line Window Common Features	325
Parameter Cycle Gadget	327
Graph	327
Value Field(s)	328
Pan & Zoom Sliders	329
Frame Slider	329
Prev Button	329
Next Button	330
Add Key Button	330
Del Key Button	331
Keys Exist Field	332
Frame Field & Buttons	332
Linear Button	332
Tension/Continuity/Bias Cycle Gadget	333
Keep Button	334
Grid Button	335
Play Button	335
Cancel Button	336
Cancel Button	330

Scale Keys Window	336
Param Cycle Gadget	337
Frame Field	337
Motion Button	338
Color Button	338
Ecosystem Button	338
All Frames Button	338
This Frame Button	339
Scale Frame Button and Field	339
Scale Value Button and Field	340
Shift Frame Button and Field	340
Shift Value Button and Field	341
Keep Button	341
Operate Button	341
Cancel Button	342
LightWave Motion Window	343
Coordinate System	343
Precautions	345
Scaling and Reference	347
Using The LightWave Motion Window	348
Sun Time Window	352
Ref Lon Field	352
Date Cycle Gadgets	352
Time Field and Cycle Gadget	353
Sun Lon and Sun Lat Fields	353
Reverse Seasons Button	354
Keep Button	354
Cancel Button	354
Reference 6A - Motion Parameters	355
Overview	355
Professional Control Control	355
LightWave Motion Paths	356
Coordinate System	357
Motion Editor Window	4500000
Related Windows and Menu Commands	358
Motion Window Areas	358
Parameter List	359

Key Frame Controls	381
Buttons At the Bottom	383
Camera View Window	386
Using the Camera View Window	386
Interactivity	390
Camera Group	391
Focus Group	392
Center Group	392
Bank	392
Earth Rotation	393
Scale	393
View Arc	393
Flattening Group	393
Vertical Exag	393
Sun Group	394
Horizon Group Haze Group	394
Shade Factor	394
Fog Group	394
Z Minimum	395
Contract to the Contract of th	395
Compass Window	395
Camera View Control Window	396
Draw/Bounds Cycle Gadget	396
Draw Group	397
Bounds Group	405
Grid Group	408
Movement Group	409
Frame Group	410
CentFoc Button	411
Img Aspect Button	411
Close Group	412
Diagnostic Data Window	413
Reference 6B - Color Parameters	421
	421
Overview	421
Palette Registers	421
Animation	441

Choosing Colors	422
Color Editor Window	423
Parameter List	424
Color Register Displays	430
Color Pot Buttons	430
Name Field	431
RGB/HSV Fields, Sliders and Buttons	431
Color Gradient Panel	432
Key Frame Controls	432
Time Lines Button	433
Scale Keys Button	433
Copy Button	434
Swap Button	434
Insert Button	435
Remove Button	435
Keep Button	436
Cancel	436
Color Time Lines	437
Reference 6C - Ecosystem Parai	meters 439
Reference 6C - Ecosystem Parai Overview	
Overview	439
Overview Ecosystem Editor Window	439 441
Overview Ecosystem Editor Window Ecosystem List	439 441 442
Overview Ecosystem Editor Window Ecosystem List Name Field	439 441 442 443
Overview Ecosystem Editor Window Ecosystem List Name Field Class Cycle Gadget	439 441 442 443 443
Overview Ecosystem Editor Window Ecosystem List Name Field Class Cycle Gadget Parameter Fields & Sliders	439 441 442 443 443
Overview Ecosystem Editor Window Ecosystem List Name Field Class Cycle Gadget Parameter Fields & Sliders Custom Ecosystem Model Field	439 441 442 443 443 444 453
Overview Ecosystem Editor Window Ecosystem List Name Field Class Cycle Gadget Parameter Fields & Sliders Custom Ecosystem Model Field Design Button	439 441 442 443 443
Overview Ecosystem Editor Window Ecosystem List Name Field Class Cycle Gadget Parameter Fields & Sliders Custom Ecosystem Model Field Design Button Color Cycle Gadget	439 441 442 443 443 444 453 454
Overview Ecosystem Editor Window Ecosystem List Name Field Class Cycle Gadget Parameter Fields & Sliders Custom Ecosystem Model Field Design Button	439 441 442 443 443 444 453 454
Overview Ecosystem Editor Window Ecosystem List Name Field Class Cycle Gadget Parameter Fields & Sliders Custom Ecosystem Model Field Design Button Color Cycle Gadget Under Eco Cycle Gadget	439 441 442 443 443 453 454 454 455
Overview Ecosystem Editor Window Ecosystem List Name Field Class Cycle Gadget Parameter Fields & Sliders Custom Ecosystem Model Field Design Button Color Cycle Gadget Under Eco Cycle Gadget Density Field & Arrow Buttons	439 441 442 443 443 444 453 454 454 455
Overview Ecosystem Editor Window Ecosystem List Name Field Class Cycle Gadget Parameter Fields & Sliders Custom Ecosystem Model Field Design Button Color Cycle Gadget Under Eco Cycle Gadget Density Field & Arrow Buttons Height Field & Arrow Buttons	439 441 442 443 443 444 453 454 454 455 456
Overview Ecosystem Editor Window Ecosystem List Name Field Class Cycle Gadget Parameter Fields & Sliders Custom Ecosystem Model Field Design Button Color Cycle Gadget Under Eco Cycle Gadget Density Field & Arrow Buttons Height Field & Arrow Buttons Match Red/Grn/Blu Fields	439 441 442 443 443 444 453 454 454 455 456 457
Overview Ecosystem Editor Window Ecosystem List Name Field Class Cycle Gadget Parameter Fields & Sliders Custom Ecosystem Model Field Design Button Color Cycle Gadget Under Eco Cycle Gadget Density Field & Arrow Buttons Height Field & Arrow Buttons Match Red/Grn/Blu Fields Key Frame Controls	439 441 442 443 443 444 453 454 455 456 457 458

Swap Button	46
Insert Button	46
Remove Button	465
Sort List Button	465
Keep Button	463
Cancel Button	463
Ecosystem Time Lines	464
Custom Ecosystem Models	465
Custom Ecosystem Model Editor	465
Name Field	466
Add Button	466
Remove Button	467
Load Button	467
Save Button	467
List	468
Ht Field	468
Items Field	469
Class Cycle Gadget Red, Grn & Blu Fields	469
An Ecological Perspective	469
	470
Resources	472
Reference 7 - Render Module	473
Overview	474
Render Prerequisites	474
How To Render	475
Image Size	475
Multitasking	476
Changing Rendering Task Priority	476
Cancelling the Rendering	477
Progress Windows	477
Stacked Progress Windows	478
Estimated Completion Times	478
Status Log Window	479
How DEM and Vestor Files Dander	404

Image Saving	481
Render Settings Window	482
Overview	482
Render & Size Page	485
Image Save Page	496
Motion Paths & Vectors Page	500
Color Maps Page	505
Surfaces Page	510
Fractals & Ecosystems Page	513
Miscellaneous Page	519
Processing Page	522
Keep Button	526
Render Button	526
Cancel Button	527
Tips and Tricks	529
Customizing Your Screen Layout	529
Setting Up Your Configuration	529
Using MUI Preferences	530
Starting a New Project	532
Creating a Project from an Existing Project	533
Creating a Project from Scratch	534
Building Your Database	536
Extracting, Importing, Creating and Adding Objects	536
The Need For Speed	547
Disabling objects in the Database Window	547
Disable Extra Objects	549
DEM Fractal Depth	551
Rendering Smaller Pictures	552
Turn Off the Screen Saver	553
Lose the Preview Render Window	553
Boost the Render Priority	553
Set Understory Ecosystem to Overstory	553
Color Maps and Custom Ecosystems	554
Quality is Critical	555
Polygon Interpolation	555

Fractal Depth	557
Ecosystem Texturing	558
Setting the Mood	558
Lighting the Scene	558
Sky Options	561
Haze	563
Fog	564
Sunrise Animation	566
Ecosystem Magic	567
Setting Sea Level and Depth	567
Changing Seasons	568
Adding Lakes	569
Get Surreal	572
Custom Ecosystems	575
Realistic Forests	575
Water	580
Scientific Applications	581
Making the Most of Color Maps	581
What is a Color Map?	581
Creating Color Maps	583
Ecosystems Within Set Boundaries	586
Lava Flows, Mirages and Other Cool Effects	590
Animating Color Maps	590
Vector Madness	591
Creating Vector Objects	591
Adding Rivers	594
Political Boundaries and Roads	596
Lighting up the City - Using Point Objects	597
Traffic on the Turnpike - Illuminated Vectors	599
Flying the Camera	601
Motion Paths Made Easy	601
Something You Can Bank On.	608
As the World Turns	609
Spacing Out - Zooms	611
Working With LightWave	612
	612
Landscapes as Texture Maps	613
Matching Motion Paths	010

Z Buffer Simulation	614
Using LightWave for Clouds	615
Changing Image Resolution	615
Pictures for Print	615
Vector Widths	616
Those Zany Z Buffers	617
Saving Z Buffers	617
Converting a Z Buffer to Gray-scale	617
Converting Gray-scale to Z Buffer	619
Merging Images with Z Buffers	621
Release Your Terraforming Urges	621
Appendix A: Troubleshooting	627
Technical Support	627
Appendix B: A Lesson In Geography	629
Geographic Coordinate System	629
Longitude	629
Latitude	633
Animation Considerations	634
Map View Considerations	635
Appendix C: Obtaining Geographic D	ata
	637
Bibliography	639
Glossary	641
Index	651

How To Use This Manual

World Construction Set (WCS) is a powerful and feature packed program. This manual will help you get the most out of it.

How you use this manual will depend on your comfort level with geography, computers, and 3-D modeling. Read on for some advice.

- Geography Novice
- Amiga Novice
- Amiga Veteran
- 3-D Veteran
- Manual Organization
- Problems With Terminology
- A Note To Explorers

Geography Novice

WCS is not just a landscape animation program; it's a Geographic Information System. WCS is based on a spherical planet using latitude and longitude coordinates.

If you haven't studied geography or need to brush up, start by reading Appendix B: A Lesson In Geography.

The Ecosystem Parameters chapter also includes information on basic ecological concepts that you may find helpful for creating realistic landscapes.

There are many good books on geography and ecology that you can find in bookstores and libraries. Some of them are listed in the bibliography toward the end of this manual.

Amiga Novice

If you are just getting started with the Amiga, you'll want to start by reading your Amiga's manuals to learn how your Amiga works. WCS uses standard Amiga mouse, window, button and field operations.

This manual assumes you know how to operate your Amiga.

Amiga Veteran

If you are an Amiga veteran, but new at 3-D animation and landscape generation, you'll want to go through the introductory chapters, work through the tutorials, and then read the reference chapters for a full understanding of the power of WCS.

3-D Veteran

If you are a 3-D animation veteran, you can probably get away with reading just the introductory chapters, doing the tutorials, and then using the reference chapters as needed.

Manual Organization

This manual is organized into Introductory chapters, Reference chapters, Tips & Tricks, and Appendices.

Introductory Chapters

Instant Gratification

Read the Instant Gratification chapter to find out about the cool things WCS can do.

Installation

Read the Installation chapter to learn how to install WCS on your Amiga.

Getting Started

Read the Getting Started chapter to get an introduction to WCS. It includes a short tutorial to make sure you installed WCS correctly and to introduce you to the program.

Tutorials

Go through the Tutorial chapter to get guided hands-on experience with WCS before you begin your own explorations.

Reference Chapters

Data Types Chapter

WCS does not just save one file for each project. Due to the complex nature of the data you'll be using in WCS, the program saves several different kinds of files. Read the Getting Started and Data Types chapters to learn about the different kinds of data.

Global Menus Chapter

The same menu commands are available from almost all of the windows in WCS. Read the Global Menus chapter to learn how to use them.

Module Chapters

WCS is divided into five program modules. Each module has a chapter of its own which describes its purpose and function, as an overview and then in detail. These chapters cover how and why to use every window and gadget in the program.

It's a good idea to read through the reference section at least once. Then use it whenever you need more information about any part of WCS.

Tips and Tricks

Once you are comfortable with the basic operation of World Construction Set, the Tips and Tricks chapter will help you become a power user. Things you'll learn include:

- How to customize your WCS screen layout
- How to make your pictures look better
- How to make your pictures render faster
- How to create new Projects
- How to use WCS with other programs, like LightWave 3D
- How to customize Ecosystems
- How to create motion paths
- How to import and export data
- · How to modify terrain
- How to use Vector Objects
- How to create and use Color Maps

The Tips and Tricks chapter is a must read if you want to get the most out of WCS.

How to Find Answers

This is a big manual. There's a lot of useful information in it. But how do you find the exact information you're looking for?

Table of Contents

If you need more information about a window, button or field, look in the Table of Contents under the reference chapter heading for the WCS module you're using. You'll see the page on which that window, button or field is explained.

Index

In the back of the manual you'll find the Index. The Index is a comprehensive list of terms and phrases and the pages where they are discussed.

Further Information

If you have trouble getting WCS to work on your system, read Appendix A: Troubleshooting. Here you will find answers to technical questions that may help you resolve any problems you might have.

WCS is based on a spherical view of the planet using the standard geographical coordinate system based on latitude, longitude and altitude, rather than the X, Y, Z coordinate system favored by many 3-D animation programs and "flat earth" landscape programs. If you need to brush up on your knowledge of geography, read Appendix B: A Lesson In Geography.

To find other sources for Digital Elevation Map data, read Appendix C: Obtaining Geographic Data.

For a list of books on Geography and Ecology, read the Bibliography. Your local library should also have many books on these subjects.

As you read the manual, if you run across a term that you don't understand look in the Glossary for a definition.

Problems With Terminology

Terminology can be a problem when trying reach across disciplinary lines to communicate complex ideas. Whether you are a graphic designer, video animator, geographer, cartographer, land use planner, natural resource manager or some other kind of 'er', you're familiar with a particular way of describing what you do. Unfortunately, words that mean one thing to you may mean something entirely different to someone else.

One example is the word "mapping." Traditionally this word referred to the spatial arrangement and display of geographic ele-

ments, as in the making of road maps. But computer graphic artists also use this word as a shortened version of "texture mapping;" the application of textures or images to a 3-D surface. WCS uses "mapping" in its original context and uses the phrase "Color Mapping" when applying colors or textures to landscape areas.

When we couldn't find a satisfactory word to capture a particular meaning we became guilty of our own language perversion. An example is the word "ecosystem."

In WCS, an ecosystem is a type of 3-D texture applied to the terrain. In most cases a WCS ecosystem will be designed to mimic a certain type of land cover such as forest, tundra or rock.

Probably the closest thing ecologists have to approaching our meaning is the term "ecological land unit." That simply doesn't fit well in a window title bar or make much sense to anyone other than an ecologist.

Another example is the word "vector." To mathematicians the word means a quantity with magnitude and direction. To graphic artists it is an object in a drawing defined mathematically, To those in the Geographic Information business it is a line that represents something that can be mapped on the ground.

While the meanings overlap to some extent the word will be troublesome to some of our readers. We use an extension of the Geographers' definition which includes points as well as lines. After all a point is a degenerate line, right?

We apologize ahead of time for any misunderstandings or inconvenience our use of the language may cause. Please bear with us as we attempt to bridge the linguistic abyss separating our diverse audience.

A Note To Explorers

Best of luck on your new adventure. The world begins at your doorstep: Explore it all, and don't forget to take pictures!

If all our work has been successful we will be rewarded by your enjoyment of this program. Feel free to contact us at any time regarding organizational improvements that would enhance the usefulness of the software.

If you would like to share your images and animations with us, we'd like to see them. Some of your images may be selected for use on WCS demo tapes (with full credit of course). Send them to:

Questar Productions 1058 Weld County Road 23.5 Brighton, CO 80601

Instant Gratification

A Sneak Preview

We have included some sample images on the distribution diskettes to help get your creative juices flowing and to illustrate some of WCS' powerful features. There is also a text file you can read about the images.

If you have already installed WCS on your system you will find the sample images in the drawer you selected for storing WCS frames. They will be in a separate directory named "InstantGratification." The text file is in the same drawer.

Otherwise you can look at the images directly from the floppy disk. You will find them on Disk 5 in a drawer named "InstantGratification" along with the text file.

In either event the text file is named "InstGrat.txt."

The files are in JPEG format so you will need to use an image viewer program that handles that format.

Keep in mind that JPEG's weakness is highly detailed data and WCS images have a lot of detail. The size of these images has been lowered so that we don't have to use a real low quality factor when compressing them. The originals were rendered at 752 by 480 or larger.

We hope you enjoy your sneak preview.



Installation

- System Requirements
- The Disks
- Installation

System Requirements

WCS requires Workbench 2.04 or higher and at least four megabytes of RAM. For serious work, eight or more megabytes is preferred.

We recommend installation on a hard drive for the most efficient operation. At least 12 megabytes of disk space should be available for project data storage. You should allow another 1 megabyte of disk space to install the sample images referred to in the Instant Gratification chapter.

Rendered images will also require space. A single frame of video in IFF format occupies between 500KB and 1MB. One print resolution image (4K lines) can be over 30MB.

Obviously when working with such large images, more RAM is very desirable although WCS will render images in segments if you need to conserve memory. WCS can render any sized image within 6 megs, if need be.

Rendering and interactive operations are CPU and floating point intensive. We recommend at least a 68020 equipped machine with math co-processor. The faster your machine, the happier you will be with WCS.

The Disks

Included in this software package you will find an envelope with a lot of fine print on the outside. This envelope contains five diskettes but don't open it yet.

Please take time to read the fine print on the envelope before ripping it open. It contains the terms by which you agree to use this program and is a legally binding agreement. We have invested large amounts of time and financial resources to make this program a pleasure to use. We hope you profit from it and expect you to abide by our conditions for its distribution and use.

Once the envelope is opened you will find one program disk and multiple data disks. It is a good idea to make backup copies before proceeding with installation. Refer to your Amiga Operating System manual for instructions if you don't know how to back up your disks.

Installation

Floppy System

While you can run WCS from a floppy, it will be difficult to operate on a floppy-only system unless you have two drives. When it comes time to render images a hard-disk is almost a necessity.

You'll very likely wish you had more storage space for data and faster retrieval without the disk changing inconvenience. The solution is to add a hard drive to your system.

In the mean time, here's how to install WCS in a floppy-only system:

 Place the WCS1 diskette in your floppy drive and double-click the disk icon.

- Double-click the program icon labelled "InstallWCS."
- Answer the questions as they are presented based on your familiarity with the Amiga System, making sure to select a named floppy disk as the destination device.

WCS will be installed automagically.

When done, re-boot your computer.

Hard Drive System

WCS needs at least 1 megabyte of space on any hard drive partition and an additional 12 megabytes for project data storage. Data and the program do not have to be on the same drive. The pictures and animations you create will need additional space as noted above.

You can install it using the automatic Installer program, or do it manually. Unless you have a good reason not to, we recommend you use the Installer program. This will ensure that all the necessary files end up where they need to be for WCS to work on your system.

Automatic Installation

Installation on your hard disk is simple:

- Place the WCS1 diskette in your floppy drive and double-click the disk icon.
- Double-click the program icon labelled "InstallWCS."
- Answer the questions as they are presented based on your familiarity with the Amiga System.

WCS will be installed automagically.

When done, re-boot your computer.

Manual Installation

For those who insist on doing it the hard way, here is the procedure:

- Copy the WCS.lha file to RAM and use the c/Lha program to un-archive it.
- Copy the program and its icon file to the directory you wish them to reside in. Also copy the WCS.Prefs file to the same directory.
- If it doesn't already exist, create a directory named MUI on your hard-drive. Un-archive the file MUI. Iha and copy all the files and directories to the MUI directory. Add the following commands to your user-startup sequence:

assign MUI: drive:path/MUI assign add LIBS: MUI:Libs

where "drive:path" is the device and directory tree leading to the MUI drawer.

- 4. Create a directory anywhere on your system (or use an existing one) for project storage. You may ultimately want more than one, or a hierarchy of directories, for projects but for now one is sufficient. For simplicity's sake you should name the directory WCSProjects.
- Unarchive each data diskette and copy the contents to your "projects drawer" complete with any sub-directories and their contents.
- While it is not absolutely necessary, it is helpful to add the following assignments to your user-startup sequence. Once again, the Amiga manual explains this procedure.



assign WCSProjects: drive:path/project drawer assign WCSFrames: drive:path/rendered image drawer

The WCSProjects assignment should point to the storage area created for projects in step 3. The WCSFrames assignment should point to the device and directory where you would like rendered images to be stored. An actual assignment could look like this if you have a drive named DH0 and WCSProjects is a sub-directory of the 3DModeling directory:

assign WCSProjects: DH0:3Dmodeling/WCSProjects

If you plan to make use of any of the data we provide with the program including any demo tutorials, these assignments should be considered mandatory. If WCS can't find a file it wants, chances are you can fix the problem without a call to Tech Support by adding these assigns.

 If you have added the above assignments to your startup-sequence, reboot your machine before proceeding. Otherwise the installation is complete.

Getting Started

- How WCS Works
- Program Organization
- Data File Flexibility
- User Interface
- Display Compatibility
- Testing Render Tutorial

How WCS Works

Here's how WCS works.

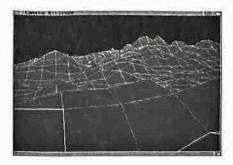
WCS starts with a Digital Elevation Model (DEM). A DEM file is a table of altitudes taken across a landscape at regular intervals, either by satellite, by aerial photography, or by surveyors.

Note: You can even create your own DEM files by importing gray scale pictures or tables of numbers created in a spreadsheet.

The data looks something like this:

2314 2315 2318 2325 2340 2354 2362 2365 2361 2352 2316 2319 2323 2330 2348 2357 2363 2365 2365 2360 2317 2324 2323 2332 2350 2358 2365 2364 2365 2361

WCS takes that DEM and recreates the shape of the original landscape, like this:



Then WCS applies Ecosystems to that landscape using rules of nature.

The Ecosystems can include things like ground, rock, grass, shrubs, deciduous trees, conifer trees, water, and snow. WCS also simulates sun-



light to shade the Ecosystems, and creates a gradient sky. WCS can even apply haze and fog; draw Vector Objects like country boundaries; and use bitmapped pictures called Color Maps to alter the Ecosystems or project pictures onto the landscape.

The final element is you:

Your picture here!

WCS lets you tweak all of its rules of nature in the form of Parameters that you can alter. By altering Parameters you can completely change the look of a landscape. You can also animate Parameters to create landscapes that change over time.

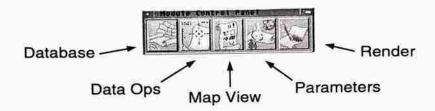
So, in summary, here's how WCS works (pay attention, there will be a test!):

DEMs + Rules of Nature + Your Tweaks = really cool pictures and animations of landscapes.

Program Organization

WCS consists of five interrelated modules. The modules work together in a non-modal way. That means you can work in many windows at the same time. You will usually have windows from several modules open together. When you do something in one window, other windows will update to reflect your changes.

You can open these modules from the Modules menu or the Module Control Panel:



Database Module

Use the Database Module to see the DEM files and Vector Object files in the current Database. You can select which ones you want to render, add or delete them, and change Vector Object colors and line widths.



You can also directly load and save the Database from here, although you'll usually want to let WCS do it automatically when you open and save Projects. Projects keep track of Database files for you, along with other files.

Data Operations (Data Ops) Module

Use the Data Ops Module when you need to import and export landscape or Vector data in a variety of formats or when you need to improve the resolution of DEM data.



WCS can import many different formats of data but during normal operations WCS uses its own formats. Data in another format must be converted to the WCS format before it can be used to render pictures.

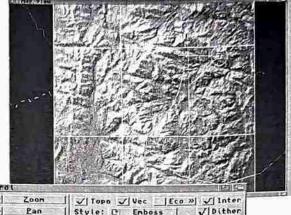
The functions in the Data Ops Module are for converting the supported formats to WCS' own. You can convert from several readily available formats such as the U.S. Geological Survey "one degree" DEM and the U.S.G.S. "optional distribution" DLG (vector) format. Vector data can also be of the World Data Bank format or simply a DXF file (used by many CAD programs) in latitude and longitude.

Additionally, there is a function in the Data Ops Module for converting Vista DEM format or any other kind of array data to WCS format. You can use the function to convert gray-scale images or spreadsheet data to an elevation model. Many other DEM formats exist and many can be imported into WCS using this flexible routine.

You may sometimes find that the DEM data you have is not sufficiently high in resolution to look good in the pictures you want to create. WCS offers an interpolation function to increase the resolution. That function is also found in the Data Ops Module.

Map View Module

Use the Map View Module for two dimensional mapping and GIS functions, creating Color Maps, and to position the Camera, Focus Point, sun and haze with your mouse.



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Lon	105.64	(> A	uto Center	J	Align	I CI	Grey
Fran	74 974	COL	oatabase >	1 1	Clear	Draw	Refine

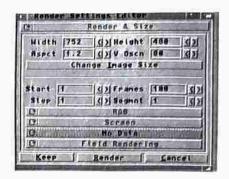
Parameters Module

Use the Parameters Module to adjust and animate Motion, Color and Ecosystem Parameters. This is where you'll probably spend most of your time.



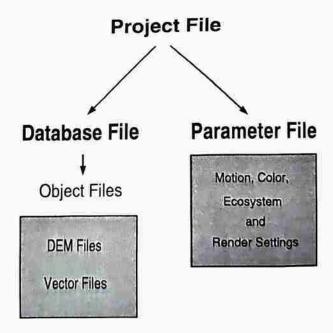
Render Module

Use the Render Module to adjust all the Render settings and create images or image sequences.



Data File Flexibility

WCS uses more than one kind of data file. This may seem confusing at first, but the way it works gives you a lot of power and flexibility. The files relate like this:



A WCS Project file keeps track of a separate Database file and a separate Parameter file.

The Database file keeps track of all the DEM (landscape) files and any Vector Object files used for the Project.

Note: The actual data is stored separately in Object files so it can be used by many projects.

The Parameter file stores all your artistic decisions about how the landscape should look.

Project File

The Project file is an umbrella file that keeps track of one Database file and one Parameter file as well as a number of other file and path names.

When you save a Project, WCS saves a list of where to look for the Database and Parameter files you are using. When you open that Project file, WCS will automatically load that Database and Parameter file.

Before it loads the Parameter file WCS will give you the opportunity to load a different Parameter file by bringing up a file requester. Since the Parameter file contains all your artistic decisions about motion, color, ecosystems and rendering, you can easily apply different looks to the same landscape data by loading different Parameter files.

You don't have to use Project files. You can load and save Database and Parameter files separately. Using Project files makes it more convenient.

While Database and Parameter files are the most essential, there are a number of other names and paths stored in the Project file. In fact for every file that WCS needs to either read or write (with the exception of Object and Color Map names), there is a name and path stored in the Project file.



Project files also contain a list of directories in which to search for Object files. Since WCS uses flexible Object paths, it needs to know where to look for the Objects that create a landscape. The list of directories can be as long as you like, allowing you store Objects anywhere on your system. It lets you reorganize your disks with a minimum of hassle. If you move Objects around you simply update the Directory List.

A Project can be edited or created in the Project Editor window.

The Directory List can be edited from the Directory List Editor window.



Database File

The Database file is a list of the Objects that form the shape of the landscape, and any Objects that define lines and points drawn over the landscape. Objects include the DEM files that form the landscape, and any Vector files you might be using for things like roads and country boundaries.

The Database file also keeps track of which Objects you've enabled for rendering, and the colors and line widths of Vector Objects.

Database files do NOT contain the DEM and Vector data, they just know which files to use. There are two huge advantages to this:

- 1 Because they do not contain the actual Object file data, Database files don't have to be very big, and you won't end up wasting disk space by saving Object files more than once.
- 2 Because the Database consults with the Directory List to know where to look for Object files, WCS can load each Object as needed, rather than having to have them all loaded at once.

This lets you render huge landscapes on an Amiga computer without having to have the very huge amounts of memory it would take to load all the data at once.

Because of the way this works, you can render any number of DEM files, up to and including the entire earth, with just 6 megs

of RAM!

You can interact with the Objects in the Database using the Database Editor window.



Object Files

Object files are the foundation of your images. They are the raw data that WCS uses to create landscape shapes (DEM files) and lines and points (Vector Object files).

WCS uses Vector Object files to add things like roads, rivers and country boundaries.

With the Database you can combine many Object files together to create your images, and different Databases can use the same Object files.

Parameter File

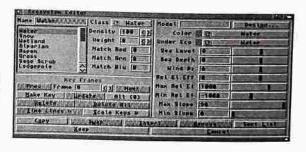
The Parameter File is where you store all your Parameters and Render Settings. Parameters control how your images look and your image sequences animate, and Render Settings control those aspects of your images that can't be animated.

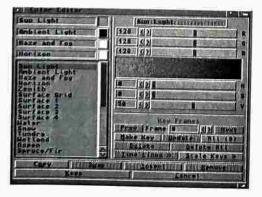
Without the Parameter file, your landscape would have no grass, no rocks, no trees, no snow, no color, no motion, well, you get the picture.

WCS gives you over 75 Parameters that you can animate, divided into three groups:

- Ecosystem Parameters
- Color Parameters
- Motion Parameters

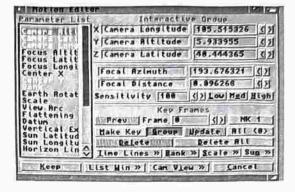
Each kind of Parameter has its own editor window. You can change Ecosystem Parameters using the Ecosystem Editor window.



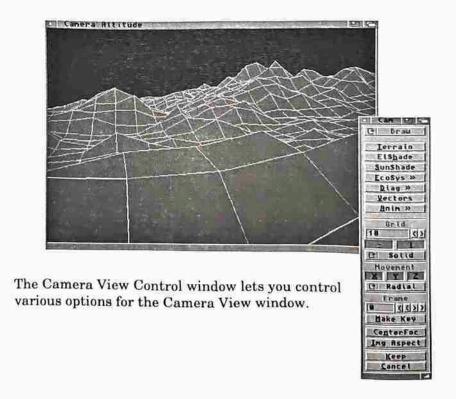


You can change Color Parameters using the Color Editor window.

You can change Motion Parameters using the Motion Editor window.



You can also interactively change Motion Parameters by dragging the mouse in the Camera View window.





The Map View window lets you move some Motion Parameters; the camera, focal point, sun position, and haze distance, by dragging them with the mouse.

The Map View Control window lets you adjust various options for the Map View window:





Finally, you can change Render Settings with the Render Settings window.

Color Maps

After you master the basics of WCS you'll want to learn about the advanced Color Mapping feature. Color Maps are bitmapped pictures you can use three ways:

Overlay pictures onto areas of a landscape

For example, you could superimpose a satellite photograph over the DEM data of the same area. Or you could paint a picture of a fantasy landscape and superimpose it onto the 3D structure of a DEM. You could even superimpose a picture of water onto a lake.

· Tint areas of a landscape

For example you could take a grassy plain and tint the grass in a checkerboard pattern of browns, greens, golds and yellows to simulate fields growing crops. Or you could tint an area to show the boundaries of a national park, a county, or a watershed area. You could even simulate a fire by tinting with a wash of yellows and reds.

Specify exact Ecosystems for specific areas of a landscape

For example you could make a grove of Aspen grow in a specific place, simulate a burned hillside by making it bare ground, or create a ski map by making the ski runs have snow instead of trees.

By using a series of images you can animate Color Maps. This opens up exciting possibilities for simulating fire, lava flows, glaciers, illustrating animal migrations, showing water surfaces, and even showing Ecosystems moving over time.

WCS lets you create Color Maps from the Map View window using the Color Map command in the Draw menu. When you use this command WCS will create a bitmapped image for the currently selected DEM. It can show the landscape as a shaded relief or contoured map for use as a guide in painting the Color Map and it will show the locations of any Vector Objects.

Note: Color Maps correspond to individual DEMs. If you want to use them over multiple DEMs you'll need to create a Color Map for each DEM.

You can import the Color Map image into any paint program that supports 24 bit IFF image files. Some programs, like ImageFX from Nova Design, have a light table feature. Using the light table you can put the image in the background and use it as a guide as you paint your Color Map image in the foreground. Or you can paint directly on the guide image and stencil out the terrain data when you are done.

Once you've created a Color Map, you can use it by enabling Color Maps in the Render Settings window. Color Maps should be stored in one directory or a numbered sequence of directories (for animated Color Maps).

You must tell WCS where to look for Color Maps in the Project Editor or Render Settings window. If Color Maps are enabled, WCS will look for Color Maps with the same names as DEMs. If it finds a Color Map for a DEM, it will use it. If it doesn't, it will complain in the Status Log window but it will go ahead and render the DEM normally.

Other File Types

There are a few other file types that WCS uses internally and you don't have to worry much about them.

WCS will generate a Relative Elevation Model (REM) file for each DEM file the first time you render a picture with it. REM files keep track of the concavity or convexity of slopes, and WCS uses this information to help determine what ecosystems should go on different parts of the slopes. REM files are just as big as DEM files so make sure you allow enough hard drive space for REM files whenever you acquire new DEM data.

Map View saves a preferences file whenever the module is closed. Information concerning your map scale, center and drawing styles is saved in this file. It will always be named Map.Prefs. WCS will look for the Map.Prefs file whenever the Map View Module is opened. If found, map settings will be taken from it. If not found,

WCS will supply default values. The file allows Map View to reopen in exactly the same position it was when closed last.

Map.Prefs are stored in the Default Directory so it is possible to have a different set of preferences for every Project. The Default Directory is designated in the Project Editor window which can be opened from the Project menu.

Rendering Pictures

With a Database file loaded that tells WCS what Object files to use, and with a Parameter file loaded that tells WCS all about Motion, Color and Ecosystems, you're all set to render incredible pictures.

To make it more convenient you can use Project files to keep track of both the Database file and the Parameter file. This makes it easy to load or save both a Database and a Parameter file in one step.

Note: You can also use the Parameter file from one Project with the Database file from another. This gives you a powerful way to take a "look" you created for one landscape and apply it to another landscape.

Saving Files

WCS will not save anything unless you tell it to.

You may freely experiment with the Database and Parameters and WCS won't change any of the data on your hard disk until you actually save your changes.

The other side of the coin is that unless you do save to disk, any changes will be lost the next time you start WCS or load a different Project.

It is a good idea to save any changes to disk immediately if you feel they are worth preserving. That way you won't forget and quit the program without saving them.

You can save the Database and the Parameter files separately, or you can save the Project. When you save the Project, WCS will ask you if you want to save the Database, the Parameters, or both. Generally you can choose "both" to make sure everything is saved.

If you create or import Objects, they will be added only to the Database in memory. You must save the Database to disk if you want to find those Objects the next time you open that Database. When you import an Object, the Object itself is automatically saved to disk in WCS' proprietary format. When you create a new object you will need to save it if it is something you wish to keep. You will be asked if you wish to save any Objects that have been created or modified before WCS frees the memory reserved for those Objects. This could happen upon quitting the program, closing the Map View Module or loading a new Database.

You should also save the Parameter file or Database file before you open a new Project since the new one will overwrite any changes you have made to the old one.

Data Safety

Again the basic files used by WCS are:

- Project files
- Database files
- Parameter files
- Object files (DEM and Vector files)

These files may be read and written many times during a WCS session. It's a good idea to back up copies of critical data so that as you work you don't risk accidently destroying data you need. The best way to copy entire directories of data is from the Amiga Workbench or a Shell. See your Amiga reference manual for instructions if you don't know how to copy files.

It's also a very, very good idea to back up your work periodically so that if your hard drive fails you don't lose your work. You can back up your work to floppy discs, or by using other methods like tape drives, removable hard drives, etc.

User Interface

WCS lets you use resizable windows, menus, buttons, lists, fields and cycle gadgets to create stills and animations.

Amiga Style Guide Compliant

WCS is Amiga Style Guide compliant. It uses standard user interface elements like windows, buttons, fields, and the standard Amiga file requester. All of the user interface elements operate as they would in any Amiga program, with two exceptions.

If you click on the circular arrow on the left edge of a cycle gadget it works like a standard Amiga cycle gadget, letting you step through the available choices one at a time. But if you click anywhere over the name of the currently selected choice in a cycle gadget, it will pop up a list of all the choices available. You can then move the mouse down to select the choice you want and then release the mouse button to choose it.

This is much easier than using the standard Amiga cycle gadget.

Note: You can make cycle gadgets in other Amiga programs work the same way as those in WCS by putting the program Cycle-To-Menu in your Workbench startup drawer. Cycle-To-Menu is available in public domain software collections like the Fred Fish collection and the Aminet collection.

Another exception deals with the handling of mouse input during Map View zoom and pan operations and in selection of preview render windows in Camera View. Each of these operations re-

quires two clicks of the mouse rather than a click and drag. A rubber band style line or box will appear when you click the first point, and the box will move with the mouse until you click the second point. You'll see additional instructions posted in the window title bars.

If you need more information on the operation of standard Amiga gadgets and windows, please refer to your Amiga Operating System documentation.

MagicUserInterface

WCS was developed using the MagicUserInterface (MUI) system developed for the Amiga by Stefan Stuntz. MUI is copyright 1993/94 by Stefan Stuntz and is used by permission.

You can customize the appearance of WCS' windows and gadgets using the MUI Preferences program installed in the MUI directory. It will let you save window positions so they will open where you want them even after the computer has been shut off.

Registering your copy of MUI with its author allows you to save more features like the color of window backgrounds and how gadgets are drawn. Registration instructions can be found in the MUI Preferences program (just named MUI) in the MUI drawer created during World Construction Set installation.

Non-Modal Operation

WCS operates in non-linear fashion. You can have almost every window in the program open simultaneously, each with its particular function available to you as you need it.

In many cases the windows communicate with each other passing information and updating displays to allow an extraordinary degree of user-interaction and feedback.

You can use any window at any time with two exceptions. When you are actually rendering, all the windows will be suspended, except for the progress windows and the Status Log window which will be reporting information about the rendering in progress. When WCS is waiting for specific input such as a mouse click all other input will be suspended. This is most likely to happen in Map View or Camera View. In all such cases, a message will be posted in the appropriate window title bar explaining what WCS is waiting for. If the program appears to "hang," look for such a messages.

Freeze and Restore

WCS has a Freeze command and a Restore command.

You can use the Freeze command to temporarily store the state of WCS' Parameters before you try an experiment. Then if the changes you make don't work out, you can use the Restore command to reset the Parameters to where they were when you used the Freeze command.

Use these commands to experiment freely. Remember: Good judgement comes from experience. Experience comes from bad judgement. Don't sweat it if you don't like everything you do. Learn as you go and have fun!

Potential System Font Problems

World Construction Set uses the System Default Text font that you selected in the Amiga's Preferences. Normally this is acceptable but if you use a large font, some windows may not be able to open in this font and a very tiny font will be substituted.

If this happens, you can change the tiny font if you have a registered version of MUI. Alternatively you could select a smaller system font. Refer to your Amiga manual to find out how.

Using A Proportional System Font

WCS was developed on systems using Topaz 8, a bit-mapped font. Proportional fonts may create some misalignment of gadgets in some windows. Other than being unaesthetic this in itself will not harm operation.

However, due to the different widths of digit characters, you may find that numeric string gadgets do not always display the leftmost character which can lead to confusion. There is no way to tell whether this has happened except to click in the string and scroll the cursor left to the first character. We recommend using a fixed width font to avoid this potential problem. Resizing windows wider may also help solve this problem by making string gadgets wider.

Display Compatibility

Because it uses resizable windows in its interface, WCS lets you take advantage of high resolution displays.

WCS is compatible with third party display cards such as the Spectrum, Retina, Picasso and Merlin.

Choosing A Screen Mode

When you first start WCS it will show you a list of the screen modes available on your system. You can choose any available

screen mode that can provide 16 colors, including very high resolution screens on third party graphics cards like the Spectrum, the Retina, and the Picasso.



WCS uses a 16 color screen for its interface.

Viewing Pictures

When you generate pictures, you can view them with any program that can display standard IFF-ILBM 24 bit pictures.

Creating and Viewing Animations

WCS can generate full color image sequences and 16 color preview image sequences which you can compile into animations and play back using other Amiga programs. For example, both ImageFX and Art Department Professional can create animations from image sequences, and ImageFX comes with a utility to view animations. A program called Magic Lantern can create and play animations on all major display cards. There are also animation compiling and playback programs available in the public domain.

For real time playback of full color image sequences the DPS Personal Animation Recorder works well, especially since you can render directly to its dedicated hard drive. Other real time playback solutions available or coming soon at the writing of this manual include the Toaster Flyer from NewTek, the VLab Motion from MacroSystems Germany (NoahJi's in the USA), and the Broadcaster Elite from Applied Magic.

Lower cost solutions with certain compromises in speed, number of colors and playback speed include the Centaur Development's OpalVision, the Digital Creations' DCTV, and HAM8 animations on AGA equipped Amigas.

For network television work you can use ImageFX or Art Department Professional to save frames to an Exabyte tape drive for real time playback on an Abekus digital disk recorder. For film production you can output high resolution frames to a film recorder.

Questar does not specifically endorse these or other playback products, but we suggest you evaluate them to see if they fit your needs.

Testing - Render Tutorial

Sure we're jumping ahead a bit here but we figured you'd be ready at this point for a little entertainment.

Here is a little pre-cooked project ready for you to render in glorious 24 bit color! This will give you a preview of the joys in store and to check that your WCS installation went OK.

Just to warn you up front, this won't be the best picture you'll ever create nor the fastest to render. The tutorials in the next chapter will let you take the basic image you'll create in this tutorial and fine tune it. As you do so you'll learn more of the capabilities of WCS.

Note: If you manually installed WCS and have not added the startup assignments in your user-startup script as suggested in the installation chapter, please do so now. The following tutorial depends on them extensively! If you used the automatic installation option, the assignments were made automatically so you don't have to worry about them.

Start World Construction Set

Start WCS from Workbench by double clicking its icon.

Alternatively you can start WCS from a shell (type: WCS <return>).

You will see a Screen Mode Requester.



 Set the desired mode and screen size and select "Use" or "Save." You should soon see a gray-blue screen with a bar of icons in the middle and a window with a mountain scene in it.



 Admire the picture (rendered with WCS of course), read the "About" information and then make it go away by clicking on the Okay button.

You can, if you like, leave it there and just drag it to one side, or send it to the back with the depth gadget. But you might as well make it go away since you won't need to use it for anything.

One of WCS' features is its non-modality. Virtually any open window can be accessed at any time. You don't need to close one window to start a new operation in another.

In practice you may want to close windows when you are finished with them to reduce screen congestion and memory overhead. But it's very useful to be able to choose the windows you want to have open as you work on your images.

You now should have the colorful Module Control Panel front and center. This is the trunk of a many-branching tree.

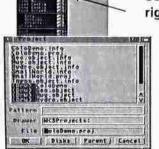
From here you can go anywhere in WCS with just a few clicks of the mouse. Since the Module Control Panel will be open as



long as the program is running you should move it somewhere unobtrusive such as the bottom center of the screen.

Load A Project File

For our test rendering you will need to load a Project.



Select Open from the Project menu with the right mouse button.

A file requester will appear showing the contents of your assigned WCSProjects drawer.

Note: If no assignment was made during installation or made incorrectly you will now have a request to insert a volume called WCSProjects in any drive. If that

happens you should abort this tutorial and go back to step 6 of the Installation section above.

Select the file "ColoDemo.proj."

This is a Project file that contains the names of a Database file and a Parameter file as well as many other names and paths that WCS will use for file access and storage during this test render.

Click the OK button to load that Project file.

Load a Parameter File

You will now see an additional requester to load a Parameter file.

It is presented such that by selecting "OK" in it you will



load the Project as last saved. Alternatively you could select a different Parameter set, should you so desire.

For now, just accept the requester as it appears.

You now have loaded your first WCS Database and Parameter file.

The Status Log window displays messages that WCS feels you should hear about, such as loading and saving certain files. It

should have opened now with messages about the Database, Parameters and Project you loaded.



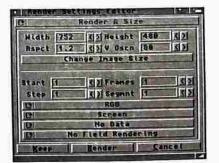
Use the Settings Editor Window

 Select the Render icon in the Module Control Panel - the one on the far right that looks like a quill pen drawing a mountain scene - to open the Render Settings Editor window.



This is the place where all of WCS' Render Settings and file paths are edited.

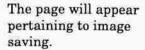
You probably don't need to change anything here but since this demo is supposed to be fun and "fool-proof" we'd better err on the side of caution and check a few things before we begin our rendering.



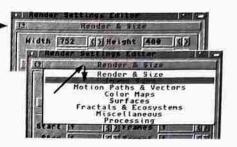
The Settings Editor is composed of seven pages. Near the top of the window is a cycle gadget that says "Render & Size." This is the page selector.

You can move to the next page by clicking on the circular arrow at the left end.

> Scroll through the pages or click on the text part of the gadget and drag the mouse down to the "Image Save" entry then release.



You will need to store the image after it is rendered if you wish to view it in full color. We want to be sure that a valid device and path are specified in advance.





Since this is the first time you are running WCS you should see the frame Save Path string gadget with the contents reading "WCSFrames:."

If all has gone according to plan in installation this should point to a valid path. Let's check it and see.

Click on the disk icon to the right of the string gadget.



A file requester will open and should display the contents of your frame save path.

If it looks correct select "OK" or "Cancel."

Note: Once again, if the system tells you to insert volume "WCSFrames" something has gone wrong and you need to establish that path now. If that happens, just find the frame output directory using the buttons at the bottom of the requester and select "OK."

One more important caveat and that is for users operating on less than eight megs of memory. Rendering takes big bites (or is it bytes) of memory.

To render the test image as we have configured it will consume about five Megs of temporary buffer space. If you don't have this much available or it has become fragmented for some reason (try re-booting) you will need to render the image in segments.

 Go to the Render & Size page of the Settings Editor and increase the number of Segments. In the string gadget next to the label "Segmnt" enter 2. Don't do this until you try rendering and determine that there is not enough memory.



If rendering fails due to memory considerations increase the number of segments one at a time until it works.

True color images take a lot of storage space as well so now is a good time to make sure you have at least one megabyte available on your frame storage device.

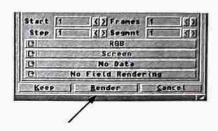
For floppy-based users, if you give your frame storage disk a different name from the data disk and be sure that name is specified

in the Frame Path of the Settings Editor (see above) WCS will prompt you to insert that disk when it is needed.

Render A Picture

 Click the Render button at the bottom of the Render Settings window.

Rendering will begin.



Sit back and watch the show.

A gauge will pop up to show your progress and estimated time of completion.

Since you are using the DEM Objects for the first time some additional computations need to be done. A gauge will pop up that says "Computing." Soon it will close and a new one will open to show the progress for rendering that DEM. This sequence will repeat until all of the visible DEMs have been rendered. In subsequent renderings the "Computing" gauge will not appear as this is only necessary the first time each DEM is used.

Note: To abort the rendering for any reason click "Cancel" in either progress gauge window and control will be returned to any open windows.

 When rendering is complete, load the image into your favorite 24 bit display program to view it in true color or reduce it to a color depth compatible with your display capabilities.

The images WCS renders are saved to the directory that you assigned as WCSFrames. The images are numbered according to the number of the frame that was rendered. Both the frame number and its name can be changed in the Render Settings Editor.

Hopefully all went well up to this point but if it didn't, go back and make sure your installation was correct.

Status Log Messages

You're done with your rendering, but just for fun let's do one more thing:

Take a look at your Status Log window.

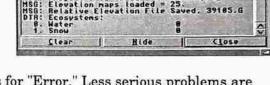
If it's not already open, select the Log command in the Project menu to open the Status Log window.

Messages appear in the Status

Records = 82, Harked = 82

Records = 82, Harked = 82

in the Status
Log while rendering. Serious
problems are
preceded with
the "ERR:" pre-



fix, which stands for "Error." Less serious problems are prefixed with "WNG:" which stands for "Warning." You can use these messages to see if there were any problems in the rendering process.

There will be various "DTA:" (stands for "Data") or "MSG:" (stands for "Message") messages giving statistical information which you can use to help make decisions that improve picture quality and rendering speed. You'll learn more about that in the next chapter.

In the next chapter there are some tutorials that will lead you through techniques for improving the quality of the rendering you just created, and to help you understand some of the Status Log messages.

This tutorial is a rather slow image to render. It was selected to

give you the broadest exposure to the supplied terrain data and to provide a final image of acceptable quality with a minimum of understanding. There are many ways to optimize rendering speed discussed in the Tips & Tricks chapter of this manual.

Tutorials

- Overview
- Tutorial One Image Quality
- Tutorial Two Image Composition
- Tutorial Three Motion Paths

Overview

In this chapter you'll learn some key tips and techniques for getting excellent results with World Construction Set.

It's important that you step through these exercises just as they are written since some later steps depend on the outcome of earlier ones.

When you have finished these tutorials, feel free to go back and experiment to your heart's content. You may well end up with something even better.

But first...

Before you proceed, please take a few minutes and read the first few chapters of this manual. You'll want to be somewhat familiar with the various data types WCS uses.

It would also be a good idea to skim the overview sections of the rest of the chapters to get a passing familiarity with the various program modules.

As you progress through the tutorials, use the rest of the manual to help answer any questions you might have. Use the Index and the Table of Contents to find out where to look for more information on any of WCS' features. Use the Glossary to check the definition of any unfamiliar terms you see.

The Tutorials

This tutorial chapter is broken into three parts.

The first Tutorial shows you valuable ways you can enhance the landscape to achieve higher quality images. You'll learn how to use Polygon Interpolation, Fractal Depth, and Ecosystem Texturing to make your images more realistic.

The second tutorial lets you explore the vast power of Ecosystems, learn how to control what you render using the Database Module, and experiment with the Motion Parameters as you improve image quality even further. You'll learn how to directly control the camera, the sky, the sun and the haze to fine tune the composition of your image.

The third tutorial shows you some of the ways that WCS lets you bring a landscape to life with animation.

Let's jump right in.

Tutorial One - Image Quality

For every combination of Camera and Focus Point there are a million and one different images that you can create. Motion, Color, Ecosystem Parameters, Render Settings and the DEM interpolation level work together to give the final result its character.

We will say right at the outset that you should not be overly disappointed if the first several attempts at creating an image give less than the stunning results you envisioned. There are many variables involved and it takes time to bend them to your will.

In this tutorial we will begin with one of those less than stunning images and see what can be done to correct certain obvious flaws. Then we will work on some of the finer aesthetic points until we obtain a reasonably outstanding image.

Our goal will be to create an image that looks fairly realistic. We may depart from nature's scheme a bit to add interest to the image. Do not shun this exercise just because your only interest is in creating fantasy worlds of pure imagination. The tricks we will show you apply regardless of your aim.

We will assume you have tried the Render Tutorial in the Getting Started chapter so you already know how to load a Project file.

Here we go!

Open the Project

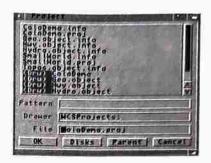
To begin this exercise, load the "ColoDemo.proj" Project file.

 Select Open in the Global Project menu.



 In the file requester select ColoDemo.proj and hit OK.

> ColoDemo.proj will be found in the "WCSProjects:" directory.



 When the Parameter file requester appears select "Tutorial.par."

> This file contains the initial Color, Motion, Ecosystem and Render Settings Parameters for this tutorial.



If you make a mistake and load the wrong one you can load the correct one with the Parameters menu item "Load All." Simply select the correct file, "Tutorial.par," in the requester.

Disable Some of the DEM Files

We always want to minimize rendering times. One good tip for doing that is to disable DEMs that are not going to be visible in your picture. For this tutorial there are several DEM files we can disable:

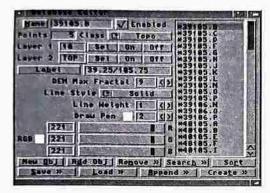
 Open the Database Module pop-up menu by clicking the leftmost icon in the Module Control Panel (the small window with the picture buttons).



Select "Edit" from the pop-up menu.

This will open the Database Editor.





DEMs can be individually enabled or disabled. In the list at the right side of the Editor you will see all the Objects available for mapping and rendering. Those that begin with a number are Digital Elevation Models.

The first two digits of DEM names represent the latitude and the next three represent the longitude of the one degree block that each DEM is a part of. The DEMs then have a letter appended to them to indicate where in the block the DEM is located.

The items in the Editor List that are preceded by an asterisk are enabled.

For this exercise we want to minimize not only rendering times but the amount of memory and time taken for certain interactive functions. We do this by disabling any DEMs that are not immediately essential, those that do not appear in our scene.

There is an interactive way to determine which DEMs you need from the Map View Module but for now, just take our word that you can disable all DEMs except 39105.C and 39105.G.

The easiest way to do that is:

Select any one of the DEMs by clicking it in the List.



You will see that Layer 2 on the left side of the window says "TOP." That is the designation for a topographic DEM.

Click on "SEL" in the Layer 2 row

You will notice all the DEMs become highlighted in the List. They are now selected for group modification.

 Click the checkmark gadget near the top that says "Enabled."



The checkmark should disappear along with all the asterisks. All DEMs are now disabled. You have disabled the "TOP" layer.

To enable the ones we want:

- Scan down the List (use the scroll gadget if the items are not in view) until you come to 39105.C.
- Double-click on this item.

The asterisk should reappear for this item only.



Do the same for 39105.G.

All of the rest of the items in the Database are Vector Objects. They should all already be enabled at this point.

Note: Later we will show you a way to temporarily turn off all Vector Objects when you render.

Now you can close the Database Editor and the pop-up menu.

Use the close gadget or hit the Escape key when the



window is active (active windows have a dark blue frame).

Render an Image

Let's go ahead and render this scene just the way it is so you can see what we are starting from.

You should first set the name of the output file to something descriptive. Do this in the Settings Editor.

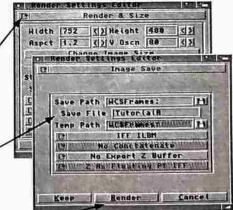
Open the Render Settings Editor by clicking on the Render Module icon (on the far right end of the MCP).



This window is arranged in "pages." On the first page are the image size Settings. On the second are the frame save paths.

You can scroll through the pages by clicking on the circular arrow at the left end of the cycle gadget at the top of the window.

 Change the name of the "Save File" on the second (Image Save) page to "TutorialA"



 To begin rendering, select the Render button at the bottom of the Settings Editor.

If you have at least 6 megs of free memory and it is not too badly fragmented the rendering should go OK. If you get an "out of memory" message, you may have to close other applications or even reboot the machine and start again.

If you still have a problem you will need to render the image in segments which will take just a little longer but will give the same result:

- Open the Settings Editor again.
- Increase the string gadget value labeled "Segmnt" to two and try rendering again.



If it still doesn't render you can increase the segments again to three or four.

View the Image

When the rendering is complete, the image will be saved in whatever directory you chose as your WCSFrames: directory during installation.

If you followed our naming instructions, the image file will be named Tutorial A001. The last three digits correspond to the frame number.

To view the image:

 Load the image into a 24 bit image viewing program or image processor.

Note: Any program that can load and display an IFF-ILBM 24 bit image will work, including OpalPaint, ImageFX, Art Department Professional, Toaster Paint, Spectra Paint, TV Paint, XI Paint, Alpha Paint, True Bril-



liance, etc., as well as 24 bit picture viewers that come with various graphics cards like the Spectrum, the Retina, the Picollo. and the Picasso.

What you should see is a lot of white, green, gray and brown patches, some dark green spiky things in the foreground valley and a blue sky with a white band running through it.

Note: If this is not what you see, go back and repeat the operations above. You may have enabled the wrong DEMs or loaded the wrong Parameter file.

Pretty nice, huh? Don't worry, now we'll learn how to make it look better.

Increase the Quality

Polygons are both the blessing and bane of WCS images. They are the underpinnings of our rendering scheme and give WCS' renderings their unique realism. However when they are too large they can quickly destroy that realism.

Put aside in your mind any other problems of this first rendering and let's consider the resolution issue. WCS gives you several powerful allies to help you fix these obnoxiously large polygons:

- DEM Interpolation
- Fractal Depth
- Ecosystem Texturing

We will use them all in this example.

DEM Interpolation

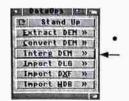
When polygons are as apparent as they are in the first rendering, the first technique to use is DEM Interpolation.

Open the Data Ops Module pop-up menu by selecting

the second icon from the left in the Module Control

Panel.





Select "Interp DEM" and a small window will open.

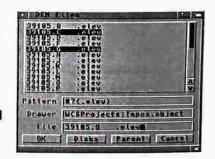


Using the "Select Files" button and the file requester that it invokes, negotiate to the directory that contains your DEM data.

This will be the WCSProjects:Topos.object drawer. You will see a list of all the DEM sets that were supplied with the program.

We only wish to interpolate the two that we need for this project, "39105.C .elev" and "39105.G .elev."

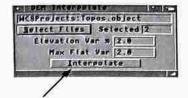
Click on one of these and while holding the shift key click on the other.



Select "OK" to close the requester.



In the DEM Interpolate window there should be a "2" in the text gadget labeled "Selected."



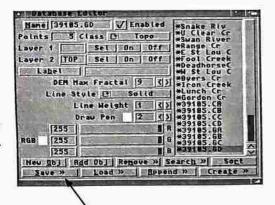
 We will use the default Variation variables so just select "Interpolate" and wait until the process is done.



You'll see progress gauges that tell you how the operation is proceeding.

When it's done, close the DEM Interpolate window.

If you look in the Database Editor you will see that the two original enabled DEMs are disabled and there are eight new DEMs at the bottom of the list. They should all be enabled at this point.



 Save the Database using the Save button in the Database Editor.

You will see a file requester with the name and path of the current Database. Select "OK" to save it again with the same name.

Note: You must save the Database file any time you make modifications to it that you want to keep. This includes adding Objects to it by interpolating DEMs as you just did.

Close the Database Editor and try rendering again.

If you wish to compare images as we proceed, you can first rename the image save file to TutorialB so that the first image does not get overwritten when you render.

You will notice that rendering takes a bit longer this time.

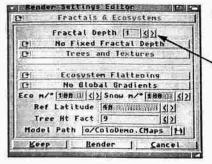
Note: Some of the DEMs render very quickly, in fact they contribute nothing to the image. Later we will learn how to check the Status Log to see which DEMs are unnecessary so we can disable them in the Database List. This will shorten overall rendering time.

When the picture is rendered, view it like you did before.

Fractal Depth

You will still see some polygons in the last rendering but they are now down to a more manageable size.

Rather than interpolate again, It's time to use Fractal Depth. Up till now we have not added any fractals. By increasing the Fractal Depth we increase the amount of apparent detail:



- Open the Settings Editor in the Render Module and go to the Fractals and Ecosystems page.
- Change the number in the topmost gadget, labeled Fractal Depth, to "1."

You can experiment later with increasing this value further still.

 Change the render file save name if you desire on the Image Save page and render again.



This time you will notice a great difference in the look of the image. There is considerably more intricacy to the terrain cover. There are more trees and very few apparent polygons.

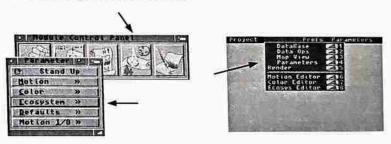
We're making progress.

You could increase the fractal level yet again at this point but that would increase the rendering time.

Ecosystem Texturing

There is another way to be rid of those remaining polygon shapes without sacrificing speed. Using Ecosystem Texturing, we can add textures to the ground, rock and low vegetation Ecosystem Classes.

 Open the Ecosystem Editor by selecting "Ecosystem" from the Parameters Module pop-up menu or from the Modules pull-down menu.



The window will open with "Water" as the Active Ecosystem.

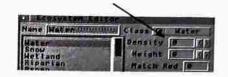
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STOCKED STREET	Density D SM	Cotor	12	Harer
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All the attributes on the right side of the window determine where and how the Active Ecosystem will be rendered.

Our current image doesn't use water, but scroll down the list on the left side of the window using the cursor and notice the varying attributes of the different Ecosystems.

In particular, pay attention to the Density value just to the right of the top of the Parameter List. This is the

value we are going to modify. It controls the percentage of polygons that receive a texture during rendering.



We want to change those Ecosystems which are causing us problems, namely Rock, Bare and Tundra. Actually Rock is the main offender because of the steep slopes on the right edge of the image but let's change the other two just for consistency and so you can see the result.

- Select the Rock Ecosystem by clicking it in the List.
- Increase the Density value to 100 percent.



- Select the Bare ecosystem and increase its Density value to 100 percent.
- Select the Tundra ecosystem and increase its Density value to 100 percent.

We'll come back to this window and do some more editing later. For now, close the window.



- Click the Keep button to close the Ecosystem window and preserve the changes you made.
- Render and view the image to see the effects of these changes.

These three techniques, DEM Interpolation, Fractal Depth and Ecosystem Texturing, can be applied to any scene to achieve the optimal balance between rendering performance and image quality.

When you are very close to the terrain you may need to interpolate yet again and increase the Fractal Depth to 2 or 3.

Save the Parameter File

You may wish to try some other combinations now, but first save your Project with a new Parameter file before you modify the Project further. You'll use this Parameter file in the next tutorial.

The Parameter file will contain all of the Ecosystem, Color, Motion and Render Settings that you have modified up to this point.

 Use the Global menu item "Save All" in the Parameters menu.



You can name the file anything you wish. WCS will append ".par" to the name if you do not.

Tutorial Two - Image Composition

The arrangement of elements in a scene, including Ecosystems and the positioning of Camera and Focus Points, is largely subjective. What we will attempt to do now is show you how typical modifications are made with an eye toward improving the image we began in the last section.

 Begin by loading the same Project file, "ColoDemo.proj" and the Parameters as they were saved at the end of the last tutorial section.

Glaring problems

In looking at the last image we rendered there are nine rather glaring problems and deficiencies.

1 There is just too much sky.

The image is almost half sky. A good rule of thumb is to have about two thirds terrain, one third sky.

2 The white stripe, called the Horizon Line, is too high in the picture.

It should be just behind the horizon. The Horizon Line simulates the lightening of the sky as it nears the earth.

- 9 There isn't enough haze to give a sense of depth to the image.
- 3 The terrain itself has some rather annoying flat spots.
- 4 The lighting is too bland.
- 5 The snow line is too level.
- 6 The snow cover is too even.



- 7 There is too much tundra and not enough forest.
- 8 The trees are too small.

Don't worry, we can fix these problems.

Render at will

We will do much as we did in the last tutorial, describing modifications one at a time, except that we won't tell you when to render a new image. We'll just describe the changes and you can render at any time as we go along.

The more often you render, the better feel you will get for the effects we are creating with each step of the process.

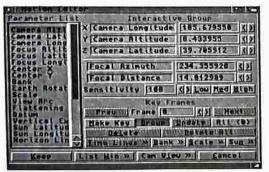
Save Often

Be sure to save your work frequently, especially the Parameter file.

'Scuse Me While I Fix The Sky

Let's do something about the first problem: too much sky. The solution is to tilt the camera down so it's aimed more at the land-scape and less at the sky.

In the Parameters Module pop-up menu select "Motion."



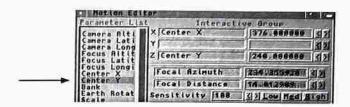
The Motion Editor will open.

Here is where we would edit features such as Camera position, Sun position, Haze distances, etc.

We can adjust the amount of sky in the picture in two ways. We could lower the Focus Point's Altitude or we could decrease the "Center Y" value. Adjusting Center X or Center Y merely re-centers the rendered image. It causes the Focus Point to be placed at a different spot in the picture without altering the geometry of the Camera-Focus relationship.

Let's try changing the Center position:

Select "Center Y" in the Parameter List.



You will see the current value in one of the string gadgets in the Interactive Group on the right side of the window. It should read "240.0." Since we are working with an image height of 480 pixels, 240 is exactly half the height. This is where WCS considers the center of our image to be and places the Focus Point there.

There is also a value for "Center X" which if you check you will see is 376.0 or half the image width.

Let's change the Center Y value to move the image "center" toward the top of the picture. To do this we need to decrease the value since by convention, point (0,0) is at the upper left corner of the image.

 Set the value to 160.0 by clicking in the string gadget and deleting the old value and typing in the



new one. Hit Return on the keyboard to set the value.

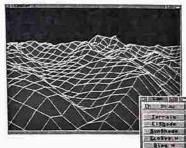
Note: You must hit Return whenever you type a number into one of these value strings or the entry will have no effect.

Now open the Camera View and let's see if we have affected the value sufficiently:

Select "Cam View" at the bottom of the Motion Editor.



The Camera View window will open and the enabled DEMs will be loaded. Soon a wire grid of the terrain will be presented. Feel free to move windows around or re-size them to create a comfortable workspace.



To our eye that Center Y correction looks pretty good. Let's make sure we don't lose that setting while we play around in Camera View.

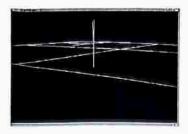
 Click in the Camera View Control window border to activate that window.



Now select "Freeze" from the global Parameters menu.

You can get back to the current settings anytime by selecting "Restore" so long as you don't close any windows with the "Keep" button.

 Try adjusting the center positions interactively by clicking in the Camera View and moving the mouse with the left button held down.



As you move interactively, the terrain grid will be replaced with a group of rectangles which represent the outline of the DEMs. When you wish to see the terrain grid again, select "Terrain"

grid again, select "Terrain" in the Camera View Control window.

You will notice that you are adjusting both X and Y as you move the mouse.

You can disable one or more axes by de-selecting the axis in the Camera View Control window. X is the left to right movement of the mouse with the left button pressed. Z is the up and down movement with the same button. The Y axis is the up and down movement with the right button pressed.

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Make Key
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 Select "Restore" now from the global menu. The terrain grid will be re-drawn at the position it was when we selected "Freeze" before.

Fix the Horizon

Let's tackle the second problem: the white stripe, called the Horizon Line, was too high in the picture.

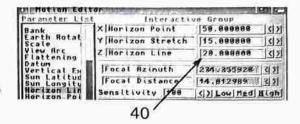
In the Camera View window, you can see the position of the actual horizon. The lowest points on the distant ridge line are about 30 percent of the way down from the top of the window.

It will give us more contrast between snow and sky if we set the horizon line a bit below that, so let's put the Horizon Line 40 percent below the top of the window.





- Bring the Motion Editor to the front and select "Horizon Line" in the Parameter List.
- Enter 40.0 in the string gadget next to the label "Horizon Line" in the Interactive Group at the right.



This number is the percentage of screen above the Horizon Line.

It said 20.0 before and that's why the pale horizon band was in the middle of the sky.

Adjust the (Purple?) Haze

Now to tackle the third problem, there isn't enough haze to give a sense of depth to the image.

 Click in the Camera View window and type the letter "t" to cause it to redraw the terrain.

Note: There are keyboard shortcuts for most commands in WCS. Each window has its own. You can find out what they are for each gadget in each window in the reference chapters of this manual.

The entire terrain grid is drawn in white. If there were visible haze, you'd see part of the distant terrain drawn in blue to indicate where the haze is visible.

Since the entire terrain is drawn in white, haze is having no effect on any part of this image. The Haze Start value is set too high, so let's change it.

 In the Motion Editor select "Haze Start" and note the current value of 25.

In the Haze Start field that appears in the Interactive Group area of the Motion Editor, you'll see that the Haze Start value is 25. This is in kilometers, and means that haze does not begin to have an effect until a distance of 25 kilometers from the Camera.

That is too far for realism's sake. It might be useful for certain aerial views where we want clarity, not realism, but here we should set the value lower.

Use the Diagnostic Preview

You could guess at values and re-draw the terrain grid every time to see when you guess right, or you can determine an appropriate distance the easy way, by doing a Diagnostic Preview Render.

Let's do it the easy way.

In the Camera View Control there are a number of other draw modes below "Terrain."

 We'll try some of the others later but for now, select the one that reads "Diag."



errain

You must now select two corner points for the preview rendering. What we are trying to determine is the distance to the point where we want the haze to begin. Images look best if there is a part of the foreground with no haze. This part of the image should not be too large. Let's preview the end of the ridge that sticks out from the left side of the picture.

Click on the terrain about two thirds of the way down

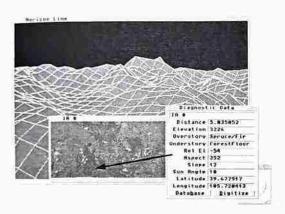


from the top of the window and about a sixth of the way in from the left edge.

Now you will see a "rubber band" box attached to the pointer showing you the area that will be previewed. You can cancel the operation with the right mouse button if you wish to start again.

 Make your second selection near the bottom of the window at the tip of the ridge coming in from the right.

A new window will open and the palette will change to the Render Palette. The preview will be rendered and



then another window will open. This is the Diagnostic Data window.

- Move it to the side but keep it in view.
- Click anywhere inside the Preview window and data about the clicked point will be posted to the text gadgets in the Data window.

Here you can learn about Ecosystems, elevations, sun angles, relative elevations, slopes, slope azimuths, latitudes and longitudes as well as the value we are interested in which is distance.

 Hold the mouse button down and move the pointer around on the preview image.

The diagnostic data will be posted continuously. You will see that the distance value hovers around 5.0 kilometers. We will use this as our Haze Start.

 Set this value in the Motion Editor as you did before for Horizon Line.

Be sure Haze Start is the Active Parameter.

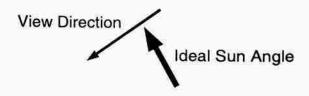
Move the Sun

While we are here, let's do something about that flat lighting. Note the latitude and longitude values in the preview. They are 40° and 106° respectively rounded off to the nearest degree. Back in the Motion Editor if we select Sun Latitude in the Parameter List we see that the Sun Latitude is set to 40° and the Sun Longitude is 100°. These values are both too close to the terrain values. That means the sun is nearly overhead.



We will get more contrast and shading if we position the sun farther to the image's left or right. There is a small window which we haven't mentioned yet. It opened along with the Camera View. It is a Compass and the needle which radiates from its center tells us which way the Camera is pointed.

North is always at the top in the Compass window. The needle is pointed to the lower left which is southwest. The sun should be moved at right angles to this line for maximum contrast. That would mean to the southeast for this image.



To move the sun south you subtract latitude. To move it east you subtract longitude.

Set the Sun Latitude to 35° and Sun Longitude to 80°.



Entirely different moods can be created by manipulating the sun position. We have chosen sort of a late morning feel.

If you wish to experiment, select "Freeze" again from the menu so you can come back to the current settings later.

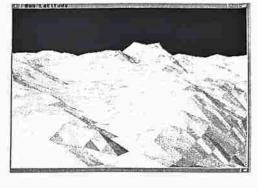
 Close the Render Preview and Data windows by clicking the preview close gadget.

Let's evaluate the sun position with another of the drawing modes.

Select "SunShade" in the Camera View Control.

The grid drawing will be replaced with a solid model of the terrain shaded according to the sun position.

Note the soft shadows created by our current settings. If you want stronger



shadows move the sun farther away.

Beyond a certain point you will no longer increase shadow contrast. Instead the entire scene will start to go dark. WCS works on a global coordinate system and yes, the sun can disappear over the horizon.

Note: There is another way to set the sun position which you might find handy. You can set it with a real-world date and time. The button in the Motion Editor labeled "Sun" will open the window to do that. It is described in the Motion Parameters chapter.

Apply your Changes

We are done in Camera View. If you have made experimental modifications be sure to restore the working set of Parameters and then close with the Keep button in Camera View Control. You might check the values in the Motion Editor just to make sure all the changes are set correctly, and then save the Parameter file from the Parameters menu with the Save All command.

Render your image without Vector Objects

Now is a good time to check your progress by rendering since we are moving on to the esoteric topic of Ecosystems next.

Since we aren't really interested in rendering the Vector Objects in the Database (they don't fall inside the image anyway) there is a way to disable them as a class:

 Open the Settings Editor in the Render Module and go to the "Motion Paths & Vectors" page.

You will see a cycle gadget that says "Rndr to Bitmap."

Change this to "No Vectors" and they will not be rendered.

They will, however, still be enabled in the Map View Module which will



be introduced later in the Motion Path tutorial.

Disable unused DEMs

If you wish to speed up the rendering a little, check in the Status Log after rendering and note any DEMs that have a polygon count of zero. You can disable them without affecting the image.



To disable them open the Database Editor from the Database Module pop-up menu. Find the Objects that you want to disable in the list of names on the right-hand side of the window. Double-click on the names and the asterisk in front will disappear indicating that they are disabled.

WCS does its best to trivially discard any DEMs that do not appear in the image but it errs on the side of caution if there may be a chance of it appearing.

Go ahead and render your image.

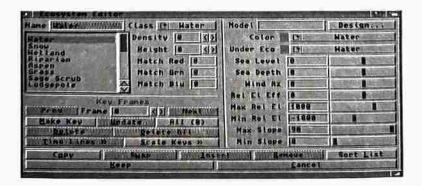
It will be rendered without the Vector Objects, and with all the changes you made in the Motion editor. Take a look!

Explore the Ecosystem Editor

The last thing our tutorial image needs is some more interesting and diverse terrain cover. In WCS we call the basic terrain cover units, "Ecosystems."

Begin by opening the Ecosystem Editor.

 From the Parameters Module pop-up menu select "Ecosystem" and the Ecosystem Editor will open.



Similar to the Motion Editor, there is a Parameter List on the left side of the window. Each name in the list is an Ecosystem that you can modify. They are mostly named after important plants in the Colorado Rocky Mountains.

The other gadgets on the right side of the window control where each Ecosystem is rendered on the terrain and how it will look.

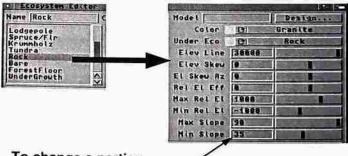
We won't go into too many details here about all of the features available to control Ecosystems, but we will show you a few modifications to prove that they do have a substantial impact and to give you a feel for the possibilities.

More Ecosystem help can be found in the Tips & Tricks chapter as well as complete explanations of all the variables in the Ecosystem Parameters chapter.

In order to change an Ecosystem you must first select it from the Ecosystem list:

Click the name of an Ecosystem in the List.

When you do, all of its Parameters will be placed in the gadgets on the right side of the Editor.



To change a particular value, click in its string gadget and delete the current value then type in the new value.



Note: You can use "Right Amiga X" to delete the contents of a string gadget.

Change the Ecosystems

Let's make some changes to the Ecosystems to improve the image.

In this tutorial the explanations will be brief. You can find more information about how each Parameter works by reading the Ecosystem Parameters chapter.

Note: We have included the finished modifications as a separate Parameter file named "FinalTutorial.par." You can load this with the Load All command in the Parameters menu if you don't want to make the following changes manually.

This tutorial will take you through a lot of settings quickly. Here we go:

1. Set Snow Skew Azimuth from -55° to 45°.

This will bring the snow line down on the side of the mountain facing northeast or towards the Camera. This is also the direction that snow tends to accumulate in this region of the United States.

2. Set Aspen Elevation Line from 3325 to 3500 meters.

This image contains mostly high elevation terrain so we need to raise some of the tree lines to move them up into the picture. We aren't so concerned with scientific validity in this tutorial as appearance.

3. Set Aspen Tree Height to 25 meters.

The aspen look a bit small next to the conifers so we'll boost them a bit.

- 4. Set Lodgepole Elevation Line from 3075 to 3200 meters.
- 5. Set Spruce/Fir Elevation Line from 3225 to 3500 meters.
- Set Krummholz (the stunted trees near timberline) Elevation Line from 3325 to 3550 meters.
- 7. Create a new ArcticWillow Ecosystem.

Now there are big patches of Aspen. We can add more diversity by creating another Ecosystem that has slightly different values.

 Select the Aspen Ecosystem and then select the "Insert" button.

A blank space will appear above Aspen in the List.

- Now select Aspen again and select the "Copy" button.
- · Click on the blank line above Aspen.

All of Aspen's features have been copied to the new Ecosystem. Enter the name "ArcticWillow" in the string gadget above the Ecosystem List.

8. Set ArcticWillow Elevation Line to 3840.

We want this Ecosystem to extend upward through the tundra zone.



9. Set ArcticWillow Maximum Relative Elevation from -30 to -35.

We want willows in the wettest areas. This will assure that they only grow in terrain concavities.

Set ArcticWillow Maximum Slope from 30 to 15 degrees.

We want willows to represent the flatter parts of the concave surfaces.

11. Set ArcticWillow Tree height from 20 to 8 meters.

Willows aren't too tall at this elevation, they are more like big shrubs.

12. Set ArcticWillow Understory Ecosystem from UnderGrowth to Tundra.

 Select the name Tundra with the cycle gadget labeled "Under Eco."

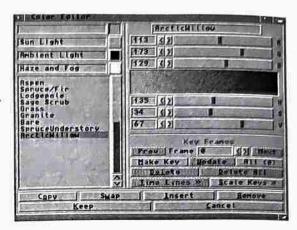
Tundra will be rendered underneath the willow shrubs.

Create a palette color for the new Ecosystem.

- Open the Color Editor from the Parameters Module pop-up menu.
- Select the first blank line in the Color Parameter List.
- Enter the name "ArcticWillow" in the string gadget at

the top right side of the Color Editor.

- Enter the three color components in the string gadgets beneath the name as red=113, green=173, blue=129.
- Close the Color Editor with the Keep button to keep your changes.

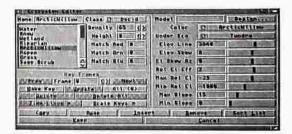


14. Set ArcticWillow Color in the Ecosystem Editor from Aspen to ArcticWillow.

 Select the name "ArcticWillow" in the cycle gadget labeled "Color."

This is the color that will be used to render the willows.

Now the Arctic Willow Ecosystem is complete. The Ecosystem Editor should look like this:



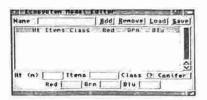


Create an Ecosystem Model for the Tundra Ecosystem.

Although diminished, the tundra is still an important component of the final image. We can add a splash of color to the tundra by using a Model to describe the Ecosystem in detail.

- Select Tundra from the list.
- Click the Design button.

The Ecosystem Model Editor will open. Our Model is going to be a mixture of bare ground, grass and flowers.



 Enter the following data in the string gadgets at the bottom of the window:

Ht=0, Items=10, Class=Bare, Red=188, Grn=187, Blu=140.

Now select "Add" from the top row of buttons.

The bare component, which has a weight of 10 has been added to the list.

Repeat the process for some purple and yellow flowers:

Ht=1, Items=20, Class=LowVg, Red=187, Grn=136, Blu=232,

Ht=1, Items=20, Class=LowVg, Red=219, Grn=215, Blu=122.

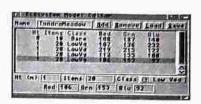
Now add two shades of grass just for variety:

Ht=1, Items=20, Class=LowVg, Red=113, Grn=155, Blu=100,

Ht=1, Items=20, Class=LowVg, Red=106, Grn=153, Blu=92

During rendering each of the Model entries will be rendered a certain fraction of the time according to its number of items. In this case the first entry will be rendered at 10/90 of all Tundra polygons since the total items in the Model is 90.

The finished model should look like this:



 Save the Model with the "Save" button at the top of the window.

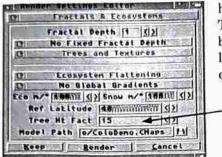
The Model must be in the path designated as the Model Path in the Settings Editor. The requester will open to that directory. Use a descriptive file name that identifies it with the Tundra Ecosystem like "TundraModel."

- Close the Model Editor and you will see that the Model name has been entered into the string gadget in the Ecosystem Editor.
- You can also close the Ecosystem Editor now with the Keep button. Be sure to use "Keep" to preserve the changes.

Increase the global Tree Height Factor from 9 to 15.

The Tree Height Factor is found in the Settings Editor on the Fractals & Ecosystems page. Increasing it will increase the





height of all trees proportionally. The original value may have been more realistic but the larger value will be more interesting.

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 Save the Parameter file again and render to see the changes.

Advanced Topics

The unrealistic flat spots in the terrain, including several of the mountain peaks, can be smoothed and rounded. The tool for doing this is found in the Map View Module, Draw menu. It is called "Fix Flats." See the Map View Module chapter for a complete description of this feature.

That's it for this tutorial. We've just skimmed the surface of a lot of subjects but we covered some important topics that will help you in all your WCS work.

Tutorial Three - Motion Paths

There are several different methods of creating and editing Camera and Focus motion paths interactively in WCS. In this chapter we will demonstrate them all briefly.

Terms

First, we need to define a few terms:

Camera is used in WCS to denote the observation point, if you will, from which a scene is viewed.

Focus is used to denote the target at which the Camera is aimed.

The Focus Point is an arbitrary point in space. It has no fixed physical relationship to any of the image elements.

We do not use the Heading, Pitch and Bank system which you may be familiar with from other applications nor do you have to create a special object to be the target. The Focus Point always exists and is always the target.

The Focus Point will be computed for you if you have the "Look Ahead" feature enabled (more on that later) but otherwise you must designate Focus Point position explicitly. This will automatically establish the heading and pitch.

Bank is available as a separate Parameter. It controls how much the Camera is tilted from side to side. It is used for animation where you wish to create the feeling of leaning into turns or in global modeling to tilt the earth's axis.

The Camera and Focus point positions each have three components: latitude, longitude and altitude.

Latitude and longitude are measured in decimal degrees; for in-



stance 40.25 degrees latitude. The altitude variables are measured in kilometers above or below the earth's surface.

There is one special Focus position: all three Focus Parameters set to 0.0. That position is defined as "Camera pointing at the center of the earth with north pole at the top." It is useful for creating rotating globes about a fixed axis.

As you may remember from the last tutorial, Camera, Focus and Bank are among a lengthy list of modifiable Parameters. They are called Motion Parameters in WCS.

Any Motion Parameter can be animated!

Key Frames

In this tutorial we will show you how to set up and modify animations.

Animation requires that we designate special values for Parameters at certain video frames. These we call key frames and key frame values.

WCS will automatically compute the in-between frame values using a smooth curve function called a spline.

When we spoke of several methods for creating Motion Paths above we were referring to the processes of creating key

frames. Once the key frames and their values are designated, WCS will actually create the animation by drawing the key frames and all the frames between them.



Animate!

Let's jump right in and see how it is done:

 Begin by loading the "ColoDemo.proj" Project file and select "MotionDemo.par" in the Parameter requester.

This file already has key frames created for the Camera Path and several other Parameters. You can use it for a reference as to how things should look in a finished animation.

Enable DEMs

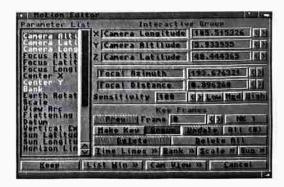
To speed re-draws and save memory you should enable only the DEMs we will use for this demonstration.

- Open the Database Editor and enable 40105.A, 40105.B, 40105.E, 40105.F, 40105.I and 40105.J.
- Disable all other DEMs.

DEMs are the Objects whose Class is "Topo" or "Surface." They are the terrain elevation models.

Explore The Motion Editor Window

 Open the Motion Editor as you did in the last tutorial.





Notice that some of the Parameters in the list are shown in white. This indicates that key frames exist for those Parameters.

Click on any white Parameter in the list.

Notice that the key frame controls below the Interactive Group become un-ghosted and available for use. This hap-

pens whenever you select one of the key framed items as the Active Parameter

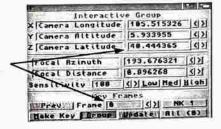
Prev Frame 8	(())	NK 1
Make Key Group	Update	811 (8)
Mul DeLete	Delete	BIL
Time Lines > Bank	e n Scale	m Sun x

You can for instance use the "Next" button (labeled as "NK" with a number after it) to jump to the next key frame for that Parameter.

The Current Frame is displayed in a string gadget at the top of the key frame controls. It lets you select any frame in the animation to view. Use the arrow buttons to advance or retreat one frame at a time through the animation or enter a frame number in the string gadget.

 Select Camera Latitude as the Active Parameter and increment the frame counter.

As you adjust the frame counter you will see the Parameter values in the Interactive Group fields changing. They are showing the splined values for the entire Camera Group at the Current Frame.

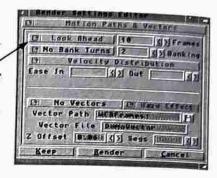


 Select Focus Latitude as the Active Parameter and increment the frame counter.

You should be able to see that its value is splined even though there are no Focus key frames. That is because

"Look Ahead" is enabled and it is getting the Focus values from the Camera Path.

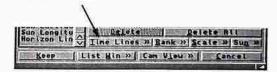
Look Ahead is a Render
Setting that you can enable or disable in the Settings Editor of the Render Module. It causes any
Focus key frames that
exist to be ignored. When
Look Ahead is enabled
the Camera will always
be aligned to the motion
path "looking ahead" a



set number of frames in the direction of travel. It's like seeing the view through the cockpit window of an airplane.

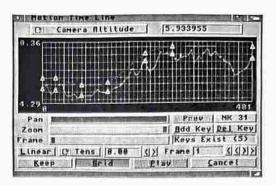
Explore the Time Line Window

- Click "Camera Altitude" in the Motion Parameters List to select it as the Active Parameter.
- Click the "Time Lines" button.



You'll see a progress window as WCS loads DEM data. All of the enabled DEMs will be loaded. They are used to compute a terrain profile along the flight path. All DEM's are loaded so that if you change the motion path the terrain profile can be updated. If you have a lot of DEMs enabled you may run out of memory. You will be advised of the error but it isn't fatal so keep going.

The Motion
Time Line window will open
and you will see a graph of the
Camera Altitude
(in red) plotted
over the terrain
elevation (in
green).



Note: If you ran out of memory during DEM loading the terrain graph may not be accurate depending on whether the data along the path got loaded successfully or not. It will default to zero elevation if there is no data.

In the Time Line graph, wherever there is a key frame for Camera Altitude, you will see a white or yellow triangle.

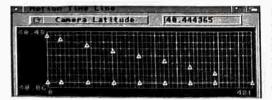
The yellow triangle denotes the Active Point.

Click on any white triangle to make it the Active Point.

You can drag the Active Point with the mouse pointer to change the altitude of the camera at that key frame.

 Now click on the circular arrow at the left end of the cycle gadget at the top of the Time Line window.





A new graph will be drawn, this time for the next item down the Parameter List that has two or more key frames. In this tutorial that will be Camera Latitude.

Once again you will see two graphs. The red one is the latitude of the Camera position, the green one is Camera motion velocity. Latitude and Longitude graphs all show velocity as their auxiliary curve.

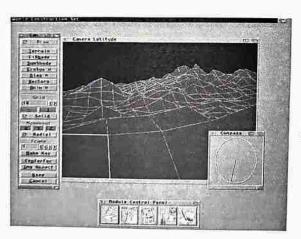
Auxiliary curves are presented on the graphs only for the Camera and Focus Parameters. The red curve is always the graph of the Parameter itself, the green curve is the auxiliary curve showing either the elevation or velocity profile.

 Go ahead and look at the other key framed Parameters, and then close the Time Line window. All Motion Parameters can be key framed and graphed.

Explore the Camera View window

 Now open the Camera View by clicking on the "Cam View" button in the Motion Editor.

The DEMs will be loaded again and a window will appear. Soon a wire-frame representation of the view at the Current Frame will be drawn.



The tall, skinny window that opened last is the Camera View Control. It has tools to modify the drawing parameters and to select frames for viewing or modification.



 If you click on the arrow buttons next to the frame counter in the Camera View Control, the display will change.



You will be seeing a two dimensional bounding box representing each DEM. The bounding boxes won't look like much from this angle since you are on the same plane they are. In fact they will appear as straight lines. There will be a three dimensional cross near the center of the image that is a compass whose red arm always points north. The yellow ray points toward the sun.

You will now also be looking at a different frame depending on which arrow button you selected. The outer frame buttons move you to the next or previous key frame, the inner buttons move you one frame ahead or back.

 You can redraw the terrain grid any time by selecting "Terrain" at the top of the window.

☐ Drau Lerrain EtShade SunShade Ecosys » Diag » Vectors

Explore the Map View Window

- Re-size the Camera View to about a quarter of its opening size and move it up into the top right corner of the screen.
- Leave the Camera View open and open the Map View as well.
- Click on the middle icon in the Module Control Panel.

The Map View and Map View Control windows will open and Vector Objects will load into memory.

Note: Map View operations sometimes require input from the user in the form of mouse clicks or typed commands. Look for instructions in the bottom of the Map View Control window where there is

a text field for this purpose. There will also be messages in the Map View title bar when WCS is waiting for input.



The following description refers to a lot of different buttons and checkboxes. These are all found in the Map View Control window.

- When Map View is done loading the Vector Objects, which will take a few seconds, you should check to see which items will be drawn. The following items should have checkmarks in the boxes next to their labels:
 - Vec (stands for Vectos)
 Inter (stands for Interactive)
- · These items should not have checks:
 - Topo (stands for Topography)
 Eco (stands for Ecosystems)
- Center and draw the map by clicking the Auto button in the Map View Control window.

The map will be drawn at the center of the window. If this is the first time you have used Map View, the scale will be 100 and the map will be rather small.

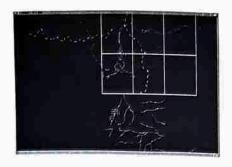
Use the arrows next to scale in Map View
Control to decrease it to about 12.5. Click
the left arrow a number of times. With each
click the scale will be cut in half (enlarging
the map by a factor of two). The map itself
won't change until you redraw it.





 Click the Draw button on the Map View Control window.

WCS will re-draw the map at the new scale.



You can center the map over the area of interest:

- Select the Center button in the Map View Control window and then click in the middle of the white DEM outlines in the map.
- Select the Topo checkbox in Map View Control and draw again.

You will now have a topographic representation of the enabled DEMs. Depending on the terrain drawing style, you may see a shaded relief or contoured presentation.

Select "Multi" in the Style cycle gadget and re-draw.

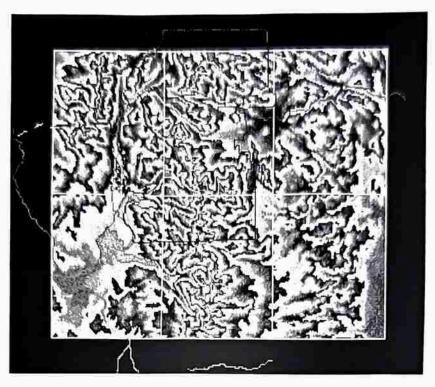
Now you will see the terrain presented as a series of pseudo-contours in shades of gray. The cycle of gray shades repeats itself but in general lighter shades represent higher elevations.





You can control the contour interval with the "Exag" setting. Experiment a bit with different drawing styles and Exag settings.

You can also try the three available palettes in combination with each style to see which is most useful.



Select the checkbox labeled "Inter" (stands for Interactive) and re-draw.

You'll see the positions for the Camera, the Focus point, and Haze rings represented in the Map View window and a curved line that represents the Camera path.

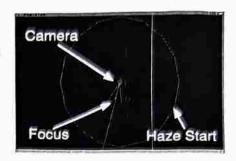
Note: You may need to disable the Topo checkmark and click the Draw button again to see them clearly. The interactive features do not show up well against a terrain background.

You also may need to zoom in closer on the map to separate the features since they are close together. You can do that by holding the control key and clicking in the area you want to zoom on.



The Camera is the small square with two rays coming out of it. The rays represent roughly the area that would appear in a rendered image.

The Focus Point is represented by a cross that points toward the Cam-



era. It may be difficult to discern because it is very close to the Camera.

The inner ring represents the Haze Start and the outer ring, if it is visible, represents where haze reaches full density. These rings are very crude and their radii do not take into account Camera Altitude.

The curved line passing through the Camera and Focus points is the Camera motion path. It is formed by splining a curve through the key frame points you saw in the Motion Editor and Time Line windows.

Camera View and Map View connectivity

Now we can demonstrate the way Camera View and Map View work together:

- Bring the Camera View to the front and position it so that you can see the Camera and Focus Points in Map View.
- Next arrange the Camera View Control window so that you can see the frame controls.

When you adjust the frame counter now you will notice that both the Map View and Camera View respond with the new position.

- If you set the Active Parameter to Camera Latitude and adjust the position interactively in Camera View, the position will be posted to Map View as well.
- To reverse the process click and drag the Camera in Map View.

Other features like Focus and Haze in Map View and the entire Camera View are simultaneously updated. Of course you can re-draw the terrain grid in Camera View whenever you like.

You can make it redraw automatically by selecting AutoDraw in the Bounds page of the Camera View Control window. Use the cycle gadget at the top of the CVC to change pages.

There are two items of note in the Map View Motion menu: "Set Camera" and "Set Focus."

Note: Map View has its own set of menus. The Map View window must be active (have a blue border) in order for you to access its menus.

 Select either "Set Camera" or "Set Focus" from the Map View Motion menu and then click on a point in Map View. The selected item will jump to that spot.



This is handy when one of the items is out of the picture for some reason and can't just be dragged to the desired location.



Modify Key Frames

Now let's try modifying some of the existing key frames. There are two buttons in the Motion Editor that determine which Parameters, if any, besides the Active Parameter are affected by the Make, Update and Delete Key functions.

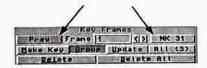
One of these is labeled "Group" and when it is selected (depressed) all other members of the Interactive Group are affected. For instance if Camera Latitude is Active and you select "Make Key", a key frame will be created for Camera Altitude, Lati-

tude and Longitude.

The other button of concern is the one to the right of the "Update" button and is labeled with a number in parentheses. The number is telling you how many Motion Parameters have key frames at the Current Frame.

When it is selected, the Make, Update and Delete functions will affect all the Parameters with keys at the Current Frame.

- For now just select the Group button if it isn't already and activate one of the Camera Parameters, it doesn't matter which one.
- Use the "Previous" and "Next" key buttons (they may be labeled PK and NK with a number) to move to a key frame (the "Delete" button will become un-ghosted).



 Back in the Map View, go into Interactive mode and drag the Camera to a different position. Now select "Make Key" in either the Motion Editor or Camera View Control.

You will be asked at what frame to make the key.

 The default is the Current Frame so accept that.

> We could have used "Update" instead of "Make Key" but since some of the key frames in the supplied animation do not have Keys



for all Camera Parameters, it is safer to use "Make Key." "Update" will only update the values of key frames that already exist.

You will be asked if you also wish to make key frames for the Focus Group. Since this animation uses "Look Ahead" rather than Focus key frames answer "No."

Repeat this process at several other key frames.

You can combine the functionality of Map View and Camera View by setting the Latitude and Longitude in Map View and adjusting Altitude in Camera View. Remember that "Look Ahead" is engaged.

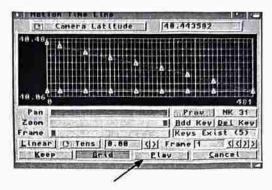
The Focus Point is not re-splined until the new key frame is made so although the Camera Position is where it appears to be, the Focus Point will not be correct until you "Make" the key frame.

- Open the Motion Time Line window again.
- With Camera Altitude as the Active Parameter, you can adjust the vertical component of the Camera Position by clicking on a point once to activate it and again to drag it to a new altitude.



 To see a simplified version of the animation select "Play" in the Time Line window.

> The animation will play in the Camera View at the fastest speed it can given the size



of the window, number of DEMs loaded, type of Bounds active, and your processor and graphics speeds.

Select "Play" again to stop the animation.

Create a Vector Motion Path

There is another way to generate key frames from the Map View window. In this method you create a Vector Object and digitize some points along the desired path and then convert these to key frames. Let's try this method now:

- Bring Map View to the front.
- Hold the shift key and click on one of the Vector Objects

A stream will work well. It will be highlighted in the drawing and you will be asked if it is the right Object.

Answer yes.

This now is the Active Object and when we create a new Object it will have its Database fields cloned from this one.

 If it is not selected, activate the Topo checkbox in Map View Control and re-draw.



 Select "Add Points/New" from the Map View Object menu.

Remember that the Map View has its own special menus and the Map View, not the Map View Control, window must be active to reach them.

You will be asked if the Active Object is the one you want to digitize or if you want to create

a new Object. Select
"New." You will then be
asked to supply a name
for the new Object.





- Give the new vector a name such as "CamPath."
- Now begin digitizing points with the mouse.

There are instructions and keyboard commands in the text at the bottom of Map View Control.

Follow these instructions, first digitizing the



obligatory "Label Point" (for labeling Vector Objects in Map View) then digitizing points along the desired path.

You can use the terrain contours to help envision how the animation will look. You could try to go up a valley, between two peaks and then down the opposite valley for instance.

Do not try to digitize too many points. These are going to be your key frames. Keep the points within the area of the loaded DEMs.



 When you have laid out the path fairly roughly finish the digitization by hitting "Q" and then "Return" on the keyboard.

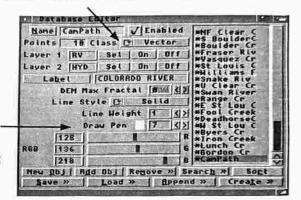
The new Vector will be drawn. You will be asked if you wish to conform the Object to the terrain.

- Answer "OK" to create elevation data for the Vector.
- Now open the Database Editor with the "Database" button in Map View Control.

You will see the new Object down at the bottom of the list. You can change any of its fields but make sure the Class cycle gadget next to the number of points says "Vector."

Since that is the default for new Objects it should already be set correctly.

 You might want to change the Draw Pen to 7 (yellow) so that it stands out in Map View. You will need to re-



draw the map to see the change in color.

Close the Database Editor.

Before we convert the Vector to a Motion Path we can perform an interpolation on the Object to space its points evenly. This will assure that the final motion path has a relatively constant velocity.

 In the Map View Motion menu select "Path/Interpolate."



You will be asked how many points the interpolated Vector should contain. The default is the current number.

Accept the default.

You will then be shown the total length of the path and the length of each seg-

ment. You may re-set the number of points if the segment length is not to your liking but for this ex-

ercise accept it the way it is.

You will be asked to conform the interpolated Object to the terrain. Answer "OK."



Now let's convert the Vector to our Camera Path. There are four functions for converting Vectors to and from either Camera or Focus Paths. You will find them in the Map View Motion menu.



Select "Path/Vect-Camera."

You will be warned that key frames already exist and they will be overwritten by this process.

Tell WCS to proceed.

You will then be asked to specify a frame interval to represent each Vector segment. The value you enter here will affect the velocity of your Camera movement.

• Try 30 for starters as a frame interval. Enter the value in the requester and hit Return.

30

| Input | Inp

You can always repeat the process with a larger or smaller interval if 30 doesn't work well. You have a choice to create Camera Altitude key frames or not and so you will be asked if you wish to use elevation data.

Answer affirmatively when it asks about using elevation data.

The last requester will ask if you want the Camera Altitudes to reflect current Vertical Exaggeration and Flattening Motion Parameter values.



 Answer yes again to use current Motion Parameter values.

This will cause the Camera Altitude scale to be adjusted for these values.

Your Camera Path is complete except that you will probably want to adjust the Altitude values upward since the Camera is now positioned right at ground level. You can use the Time Line graph very effectively here.

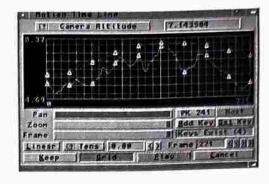
 Open the Motion Time Line window from the Motion Editor and select Camera Altitude as the Active Parameter.



You will see that the red graph lies closely along the green surface elevation graph.

 Click on each white triangle to activate it in turn and drag it to a higher altitude.

> You could also increase the altitudes in the Motion Editor or interactively in



Camera View, jumping from one key frame to the next and adjusting the altitude of each.

Note: If you use this method be sure to hit the Update or Make Key button before advancing to the next frame or the edits will be lost.

That's one way to do animations. You could repeat the process for the Focus path or use the Look Ahead feature found in the Render Settings Editor (Motion Paths & Vectors page).

The reference chapters which comprise most of this manual have abundant tips on using all the animation features, most of which were only vaguely alluded to here. The Tips & Tricks chapter has even more ideas for creating motion paths.

We hope these tutorials have been helpful to you. Watch for our videotape tutorial series which will go into more detail on specific topics.

In the meantime, enjoy the program.

Reference 1 - Data Types

- Overview
- Database
- Parameters
- Render Settings
- Digital Elevation Models (Terrain)
- Relative Elevation Models
- Digital Land Grids Vectors Objects
- Color Maps
- Z Buffers
- Backgrounds
- Projects
- Directory Lists

Overview

WCS lets you make 3D landscape pictures using the data from Digital Elevation Model (DEM) files. DEM files are tables of height measurements taken across a landscape at regular intervals. DEM files are created by satellite mapping of the earth's surface, aerial photography or ground based surveying.

Note: WCS comes with several sets of DEM data and more are available from a variety of sources (see Appendix C: Obtaining Geographic Data).

WCS lets you combine multiple DEM files to create pictures of larger landscapes. It also lets you add other Objects, like roads, streams, and color maps. It keeps track of multiple DEM files and other Object files in another file, called the Database file.

But WCS lets you do more than just render bare 3D landscapes.

You can apply ecosystems to your landscapes to create realistic looking plant cover, rocks and ground. You can animate color, ecosystems and position to fly through changing landscapes. The parameters that describe ecosystems, color and camera position are stored in Parameter files.

To help WCS apply the ecosystems to a landscape, WCS creates Relative Elevation Model (REM) Files. REM files give WCS clues about where different ecosystems would logically exist.

WCS also creates a Map.Prefs file that automatically saves the settings of the Map View window. Another file you don't have to worry about is the WCS.Prefs file, a special Project file that saves your default paths as they were when you last quit the program.

WCS generates or uses several kinds of files, including 16 color images you can use to create preview animations; images from the Map View window; 24 bit rendered images; Color Map images; Background images; temporary images; Z-Buffer files; Vector Objects, and several kinds of landscape data formats. You can control where each of these are saved.

To make it easy to deal with all these file types, there's an "umbrella" file called the Project file. When you open an existing Project file it automatically finds all the files you need for the Project.

Building Blocks

A Database file, Directory List and Parameter file should be thought of as building blocks that together make a Project. Each has its own separate editing window (or windows) and contributes something unique and essential to your pictures.

By storing each separately WCS gives you maximum flexibility with a minimum of required disk space.

It may take some time to get used to WCS' modular approach to

file management. As you begin to create your own Projects and you see how quickly they grow when scenes cover large areas and have thousands of streams and roads, it will begin to make sense.

Database

When you open a Project, it tells WCS which Database file is used by that Project.

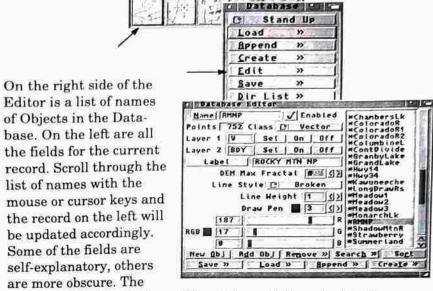
The Database is a list of Object names plus some data that tells WCS which Objects to draw and how they are to be drawn. Since Databases can become quite large, they can be saved one time and referenced by many different Projects. That is why they are stored in their own files.

You may be familiar with the concept of a database from other computer applications. WCS uses a Database to keep track of the Objects in a Project. It is the first thing you will create when beginning a new Project and the first thing you will load into memory when you want to work on an old one (it will be loaded automatically when you open a Project file).

A Database consists of records and fields. There is one record for each Object and within each record a number of fields describing attributes of the Object. In WCS the number of fields is fixed, that is we have pre-defined the attributes of interest and their order of occurrence in each record.

The number of records however will vary depending on the size and complexity of your Project. There is no minimum or maximum number of Objects that a Database may contain.

To see an example Database start WCS and load the "ColoDemo.proj" Project as you did in the render tutorial in the last chapter. Open the Database Module pop-up menu with the leftmost icon (the one that looks like rolls of parchment) in the Module Control Panel. Select "Edit" and the Database Editor will appear.



Database Module chapter will explain each item in detail.

The Database determines which Objects will actually be used to create a rendering and how they will be drawn. Any Object can be enabled or disabled for drawing. You will find this to be a handy feature with complex Projects.

Parameters

When you open a Project you will see a requester that asks for the name of a Parameter file. The default is the one whose name is stored in the Project file. You may however choose any other Parameter file you wish.

WCS uses many user-configurable variables to create its images. Most can be animated, in other words varied over time. These we call Parameters and they come in three classes:

- Motion
- Color
- Ecosystem

Motion Parameters control the movement in an image--camera, focal point, sun, earth rotation, etc. We also include a number of related items in the Motion class--haze, fog, shading, vertical exaggeration, datum flattening, view arc, etc.

Color Parameters control the 24 bit wide palette which in turn controls the color of landscape features such as rock, trees, sky, and water. The Color Parameters are referenced in turn by the Ecosystem Parameters.

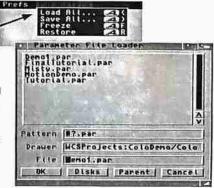
Ecosystem Parameters determine the elements that cover your landscape and how they are distributed. They may be designed to mimic nature or for almost any conceivable special effect. Forests, meadows, tundra, snow, barren rock, grass, shrubs, water--all are possibilities.

Understanding the implementation and design of ecosystems both from WCS' and nature's point of view will be one of your most significant challenges to mastering this software's full potential. For more information about this see the Parameters chapters.

To preview what awaits you in succeeding chapters:

Load a Parameter file now (either from the Parameters menu with the Load All command or by loading a Project file from the Project menu with the Open command).

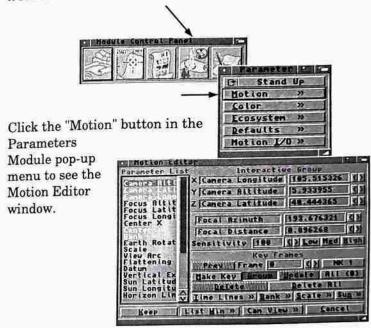
You'll find Parameter files in the ".object" directory associated with a particular Database. Parameter



files always carry a suffix of ".par." As you saw in the preceding render tutorial, Parameters can be loaded when you load a Project or later.

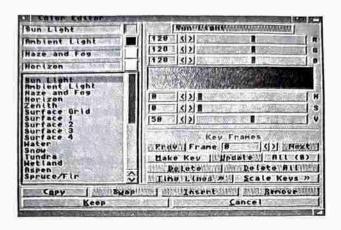
If you have previously loaded a Database or Project WCS will display the contents of the associated default ".object" directory, otherwise you will have to negotiate the directory tree manually to find the ".par" files.

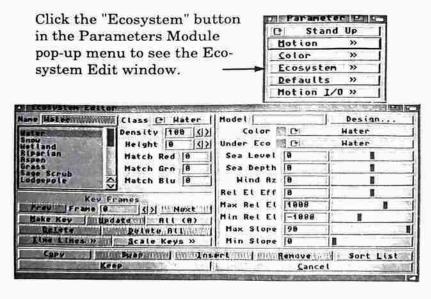
 Open the Parameters Module by clicking the fourth icon from the left in the Main Control Panel.



Click the "Color" Button in the
Parameters Module pop-up menu
to see the Color Editor window.

| Color | Hotion | Motion | Motion





Feel free to play a bit in each Editor. Although the results of selecting some buttons may surprise you, you won't break anything.

Select "Cancel" in each window when you are done.

You can save and load different looks and different animations for the same landscape by using different Parameter files. This lets you use the same landscape data for very different looking images and animations without having to store the landscape data itself more than once.

Render Settings

Similar to Parameters, Settings are the non-time-varying variables. They are set once and remain fixed throughout an animation. They control lots of useful functions associated with rendering an image or animation-image dimensions, save format, frames to render, Color Maps, fractal depth and a host of others.

Settings are saved along with Parameters in the ".par" file. If you already have Parameters loaded take a look at the Settings by going to the clicking on the Render Module icon in the Module Control Panel.

Also included under the Settings category is all the path information WCS needs to access files for input or output while rendering (except Object files). This information is stored in the Project file. The

selves are defined in the Directory List (see below).

paths to the Object files them-

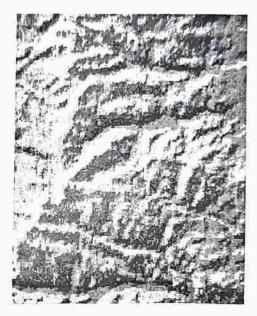
Settings are covered in detail in the Render Module chapter.

Digital Elevation Models

The most basic elements in a WCS scene are the Objects that are rendered and mapped. In WCS, Objects come in two basic flavors: Digital Elevation Models (DEMs) and Vector Objects.

DEMs are the terrain data. They are a regular array of elevation points that define the height of the landscape. Each DEM describes a rectangular area. You can combine multiple DEMs to cover more territory.

Most DEM data in the United States was supplied originally by the U.S. Geological Survey or the Defense Mapping Agency. The data is derived from photogrammetry (aerial photographic interpretation) and is generally quite accurate. WCS uses the three arc-second data set



which is available for the entire United States.

Note: The spacing between data points in a DEM is measured in degrees, minutes and seconds of arc. There are 360 degrees of arc in the circumference of the earth, 60 minutes in each degree, and 60 seconds in each minute. That works out to each second of arc, or arc-second as they are called, being about 30 meters in length.

We have included several DEM sets with the program to get you started. Additional sets are available from us or directly through the U.S.G.S. See Appendix C: Obtaining Geographic Data for information on acquiring additional terrain models.

Elevation models are considered as Objects by WCS and as such each DEM is represented by a record in the Database. They are stored as ".elev" files in one of the ".object" directories. Vector outlines of the DEMs are stored in ".Obj" files, normally in the same directory.

Elevation models can be rendered in either of two forms: as "Landscapes" or as "Surfaces." Landscapes employ model-derived or Color Map indexed ecosystems to create realistic terrain simulations. Surfaces apply instead a set of color gradients based on the elevation model.

Virtually any type of rasterized (two dimensional array) data can be converted to DEM format and rendered as a Landscape or Surface by WCS. Demographic information for instance could show the density of population as a shaded relief image for ease of visualization. Superimpose political boundaries and highways in vector format and you have a very high impact display.

You can also create elevation models in a paint program and import them into WCS.

See the Data Ops Module for more information on importing data.

Every DEM used in WCS must be referenced to the world geographic coordinate system of latitude and longitude. This system allows WCS to arrange pieces of the globe, our DEMs, into a coherent arrangement. That way you can model the whole globe or only a part of it; positioning and lighting will be treated in a consistent fashion.

When importing data, you will need to specify some corner coordinates. This can be difficult if you have no knowledge of geography. A road atlas or world map can be a useful reference. In the Data Ops Module chapter and Appendix B: A Lesson in Geography we'll give you some help in this department.

The DEM data provided with World Construction Set was derived from standard United States Geological Survey DEM data sets.

The original data was one degree of latitude by one degree of longitude coverage at a 1201 x 1201 grid. Each grid point was 3 arc seconds from its neighbors in all directions (1/1200th of a degree). This corresponds roughly to 90 meters on the ground, hence this format is sometimes referred to as 90 meter data.

Other data formats exist and are available from the U.S.G.S. but at the present time this is the only format directly supported by WCS. If you wish to order data directly from the Survey (coverage is available for the entire United States) be sure to specify that you want "One Degree DEM" data. This format is also referred to as "1:250,000" or "Quarter Million Scale" data.

Otherwise, contact Questar Productions at the number in Appendix C: Obtaining Geographic Data and we will provide you with data already in WCS format. Alternatively, you can create your own DEM data and import it to WCS (see the Data Ops Module chapter).

For most of our needs, the data as received, the 1201 x 1201 grid, will either be too much data for our available memory, too little aerial coverage to reach to the horizon, or not high enough resolution for close-up scenes. WCS presents solutions for all these dilemmas.

First, the original DEM is broken apart into 16 smaller units of 301 x 301 grid points. This is the data as you receive it from us. This data can then be further interpolated as many times as necessary, each time doubling the resolution. This will allow you to get as close as you need without sacrificing realism.

A scene may be composed of as many DEMs as necessary to create the illusion of distance. You can map the entire country if you have that much data.

Because of on-demand data loading, you never need more memory than it takes to render one DEM. The data have a one-point overlap at all edges so that each DEM fits seamlessly with the next. No-one will ever guess that the scene was not a single model.

There is another advantage to on-demand loading. Data that does not fall within the visible portion of the image or is obscured behind foreground mountains can be disabled and will not consume rendering time. Every Project's Database can be custom-tailored to only render data that is really needed, saving perhaps days of needless effort in a lengthy animation.

DEM resolution is a critical issue for WCS users. Depending on a host of factors which include view angle, distance to the subject, topographic relief, vertical exaggeration and ecosystems, you may find the resolution of the data we provide to be too coarse: You will see triangular polygons in rendered images. The DEM data provided with the program is of a fairly coarse nature. We provide it that way so as to give you as much primary data as will fit on a reasonable number of diskettes.

There are multiple solutions to the resolution problem which may be used singly or in combination to yield the most pleasing results with optimum rendering time economy. The data may be interpolated to achieve greater actual spatial density (see Interp DEM in the Data Ops Module chapter), you may use a higher level of Fractal Depth for more apparent detail (see Fractals & Ecosystems in the Settings Editor section of the Render Module chapter) or you may implement Ecosystem Textures (see the Ecosystem Parameters chapter) to mask the polygon edges.

For our work we find that a single interpolation (quadrupling the data density) combined with a Fractal Depth of two or three and Ecosystem Texturing solves all of our polygon problems while keeping rendering times within reasonable limits.

These are not hard-and-fast rules or they would have been hard-coded into the system. They are left variable to meet the needs of the moment. Here is where experimentation and experience will pay off when a project deadline looms.

Relative Elevation Models

Relative Elevation Models (REMs) are files that WCS creates automatically. You don't have to worry about them except to make sure you have enough disk space for them. They will take about the same amount of hard drive space as each DEM and WCS will store each one in the same directory as the DEM from which it was derived.

Technical Explanation

REM files are derived from the Digital Elevation Model files as the difference or residual between actual and smoothed elevations. They describe the concavity or convexity of the terrain surface. WCS uses them to more accurately place ecosystems along slopes.

The extension for Relative Elevation files is ".relel" and the files are stored anywhere in the Directory Path (see the discussion of Directory Lists below) but usually in the same directory as the ".elev" DEM files.

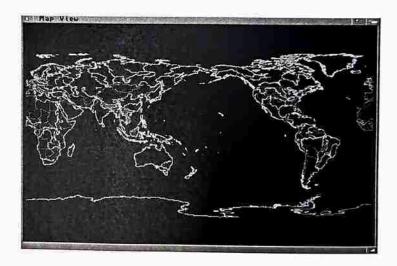
WCS will automatically generate REMs as it needs them. This will only be necessary once for each elevation model. They will be stored on your hard drive in the same directory as the DEMs.

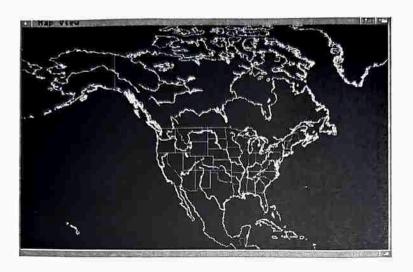
Digital Land Grids - Vector Objects

Digital Land Grid (DLG) is the generic name for vector-based Objects. We will use the term Vector Object throughout this manual. Anything that can be represented on a map as an outline or line can be input to WCS as a Vector Object.

Vector Objects include lines, points, or a series of lines or points. Examples of things that could be represented by Vector Objects include:

- streams
- lakes
- roads
- campgrounds
- park boundaries
- state boundaries
- · country borders
- the outline of a DEM





Vector Object Files

All of the Objects in a Database have a Vector Object file associated with them. These files end in the suffix ".Obj" and are stored in various directories which end in ".object." These files actually contain the coordinates of the Object or, in the case of DEMs, the outline of the elevation model.

You can create (digitize) Vector Objects in the Map View Module or as an overlay to a 3-D rendering in Camera View (Parameters Module) or import from another source in DXF, World Data Bank or U.S.G.S. DLG format (see the Data Ops Module chapter).

Every entity present in the Database should have a Vector file associated with it even if it is a DEM (Topo or Surface) entity. These are the ".Obj" files in the ".object" directories.

In the case of DEMs and Surfaces they will be created for you to represent the outline of the mapped area. These files contain the latitude and longitude coordinates of all the vertices that define the Vector.

The Map View Module is the primary WCS arena for editing Vector data. How Vector data is represented on a map or in renderings (line color, weight, pattern, etc.) is controlled by field information in the Database.

You will learn more about Vector Objects later in the Database and Map View Module chapters.

The latitude/longitude information found in the Object file is all that is necessary to draw Vectors in Map View. However if you wish to see these Objects draped on the terrain in your rendered images you will need to create elevation data for each Object as well. This is done in Map View.

It is easy to overlook this simple step and wonder why your Vector Objects do not show up in renderings. By default they are rendered at sea level elevation (0 meters). You will be asked whenever you modify the vertices of a Vector if you wish to conform it to the terrain. It is a good idea to answer yes so that it is not forgotten.

DLGs are useful in their own right but can also be used to generate Color Maps (see below) which expand WCS' rendering capabilities almost beyond limits. Please see the Database, Data Ops and Parameters Modules for more information on the use of DLGs.

Color Maps

Bitmaps can be applied to a terrain model similar to the application of texture maps in conventional 3D programs. In WCS we call these "Color Maps" and they are much more powerful than simple texture maps.

Of course you could use them to create marbleized or wood-grained landscapes but more often they will be used to delineate features on the landscape of special interest. The area of a park may be tinted pink, a lake blue, a city yellow for example. Additional power lies in the ability to link any ecosystem to a color in the Color Map. This allows precise control over the distribution of terrain cover types.

While we have endeavored to make ecosystem modeling as flexible as possible it cannot hope to fully replicate the actual diversity found in a real landscape. This is partly due to data limitations—no climate data per se—but due even more so to natural and human manipulations of the landscape.

Clearings were made in the primeval forest centuries ago first by fires and beaver, then by hunter-gatherer cultures and finally by our own agriculture and urban-based civilization. In fact the clearings now outsize the forest in most parts of the world. While left alone a forest may re-grow, still, old logging scars, abandoned farmsteads, fires, landslides, insect epidemics and many other disturbances leave their marks on the landscape for centuries.

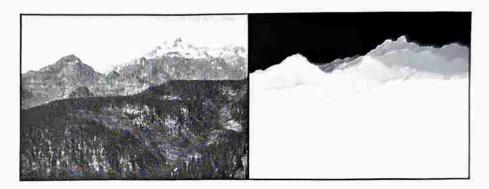
While these intricate disturbance patterns cannot be modeled algorithmically they can be explicitly defined using Color Maps and Ecosystem Indexing.

The principal limitations that apply to Color Maps are that they must be of the same dimensions as the DEMs to which they will be applied and they must be in the correct orientation. Also their names must match the DEM to which they will be applied and reside in a special series of directories.

Creating detailed Color Maps can be a considerable undertaking, especially if they are animated. We have provided some tools to help with this task. You will find them in the Map View and Data Ops Modules. More information on the use of Color Maps can be found in the Ecosystem Parameters chapter and Settings Editor section of the Render Module chapter.

Z Buffers

Another data type employed by WCS is the Z Buffer. It is a two dimensional array of values that correspond to distance from the viewer (camera) in a rendered image. Think of it as a gray-scale image with brighter values (higher numbers) being farther away.

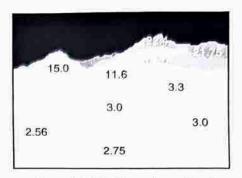


Normal image next to its Z buffer

Z Buffers can be loaded and saved from WCS. They can be created from any gray-scale image or moved to and from any other program that supports Z Buffer import/export and the ZBUF/ZBOD IFF format.

A Z Buffer is created every time WCS renders an image. It allows us to know which elements in the landscape obscure others. For instance if the valley behind a ridge is hidden to our view it will not be drawn because it has a higher Z Buffer value (farther away).

If a Z Buffer is pre-loaded before rendering it is used as a 3D stencil (something like an alpha channel used by video graphic artists) allowing you to render around or through only certain areas of the image. The result will depend on the relationship between the pre-loaded Z Buffer and the Z values computed by WCS for the current terrain.



Sample Z Buffer values (km)

Z Buffers can be created from gray-scale images for the purpose of compositing images "on the fly" as rendering proceeds. One might pre-load an image of clouds and a Z Buffer that grades from black at the top (close) to white at the bottom (distant). When rendered, the clouds near the top will appear in front of any mountains tall enough to reach them while distant clouds will appear behind the mountains.

In WCS the Z values range from a minimum of 0.0 for the foreground up to a very large number for the background. The absolute units are in kilometers from the "camera lens."

Hopefully more 3D programs will support Z Buffer exchange in the future to give you more capabilities in this domain. The Data Ops and Render Module chapters will fill in the details on using Z Buffers to good advantage. Developers, please contact us for specifications of the ZBUF and ZBOD IFF chunks.

Backgrounds

Background Images can be loaded to create a visual backdrop to any rendered scene. With combinations of Z Buffers and Backgrounds many creative effects can be achieved. The Z Buffer will act like a 3D stencil allowing the Background to be revealed

wherever the loaded Z Buffer value is less than the rendered Z Buffer. Background Images may be either IFF-24 or Raw RGB (Sculpt) format but must be the same dimensions as the image currently being rendered.

Sequences of Background images can be used to create moving clouds or star fields or to composite an animation rendered in another program with a WCS animation. The Background sequence images must have frame numbers in their names that correspond to the frames of a WCS animation.

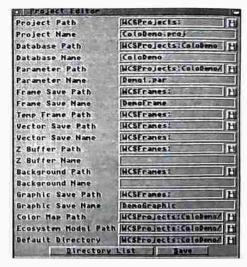
Projects

A Project file is usually the first thing you'll open after you start up WCS. Projects are handy to use because the Project file keeps track of all the other files you need.

The Project file contains the name of a Database file, a Directory List, and a Parameter file. The Directory List is a list of paths where WCS will look for Object files, like DEM files and Vector Object files.

A Project file also includes the names of a frame storage directory, Color Map directory, Z Buffer file and directory, Background Image file and directory, as well as some interface configuration data.

To see what is in a Project file use the Project menu Open command to load a Project file. Projects normally end in the suffix ".proj" and are stored in



the "WCSProjects:" directory. Use the Project menu New/Edit command to view the Project's contents.

Data need not be stored in more than one location to be accessible by multiple Projects. Paths may be changed at will to facilitate data movement between machines. Restoring a complete setup of files and directories becomes an issue of seconds rather than minutes using Projects (see Global Menus for more information).

Directory Lists

A Project file also includes a list of directories. The Directory List is used to find the Objects themselves during rendering and mapping operations.

It is important to note that the Objects themselves are not loaded when the Project file is opened. To conserve memory, since Objects may be very large, they are only loaded as needed. Thus the Directory List. It tells WCS where to search for the Objects when they are needed.

Data Objects may reside across multiple directories or devices, the only stipulation being that the device support random access reads (streaming tape drives would not be useful here, for instance). The Directory List contains the paths to be searched and the appropriate order. You can create or edit a Project's Directory List in the Database Module. They are saved as part of the Project file.



Load the "ColoDemo.proj"
Project again and open the Database Module pop-up menu
(first Module Control Panel
icon). Select "Dir List" to see
what a Directory List looks like.
You will see that all the paths
begin with "WCSProjects:."

Now you can perhaps see the importance of making that assignment in the User-Startup Sequence.

If you wish to move these data directories to a different device or modify their names, feel free to do so. Simply update the Directory List by removing the old paths and adding the new ones and then re-saving the Project from the pull-down menu. This subject will be covered in greater detail in the Database Module chapter.

Configuration

Configuration files contain window information that can be used to restore a particular workspace arrangement. They are used to quickly re-establish a frequently used setup. They complement Project, Database and Parameter files, not replace them.

Save a Configuration file any time you want to be able to return to a particular window arrangement in the future. It will store information about what windows were open and what their sizes and positions were when the file was saved.

Load the Configuration to restore that window arrangement. The Save Config and Load Config commands are found in the Project menu.

WCS uses some custom windows in addition to MUI windows. Since MUI automatically remembers its window positions, these are not stored in the Configuration file. Only custom window positions and sizes are saved here. The custom windows are Map View, Camera View and the Camera View Compass.

Reference 2 - Global Menus

- Overview
- Project Menu
- Modules Menu
- Prefs Menu
- Parameters Menu
- Extended Parameters Menu

Overview

The Global menu commands are available when any window is active except the Camera View window or Map View window.

The Map View window has its own set of menus to save screen space. These are documented in the Map View chapter. Since the Camera View window uses the right mouse button to adjust altitude you can't access any menus when the Camera View window is active. To gain access to the Global menus when Map View or Camera View is active, just click in any other window.

The Global menus are standard Amiga drop down menus. Use the right mouse button to see them.

Note: If you're unfamiliar with Amiga drop down menus, read the AmigaOS manual that came with your Amiga.

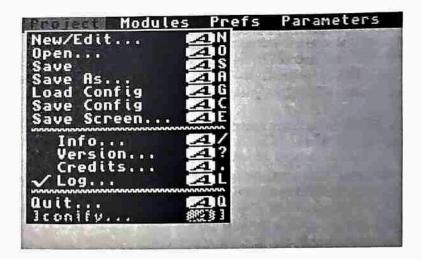
There are four Global menus:

- Project
- Modules
- Prefs
- Parameters

Project Menu

The Project menu gives you access to 12 commands:

- New/Edit...
- Open...
- Save
- Save As...
- Load Config
- Save Config
- Save Screen...
- Info...
- Version...
- Credits...
- Log...
- Quit...



New/Edit

Keyboard shortcut: RightAmiga N

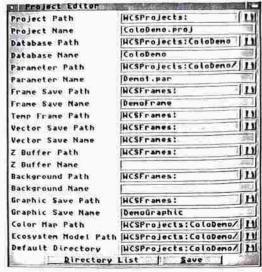
Use the New/Edit command to create a new WCS Project or to edit the paths and file names in an existing Project. A Project consists of a list of paths and files, plus window size and position information.

When you choose the New/Edit command, you'll see the Project Editor. Here you can see and change all the paths and file names WCS uses to find the data related to the Project.

- Project Path
- Project Name
- Database Path
- Database Name
- Parameter Path
- Parameter Name
- Frame Save Path
- Frame Save Name
- Temporary Frame Path
- Vector Save Path
- Vector Save Name
- Z Buffer Path
- Z Buffer Name
- Background Path
- Background Name
- Graphic Save Path
- Graphic Save Name
- Color Map Path
- Ecosystem Model Path
- Default Directory

The Path fields contain the names of drawers where files can be kept. You can type a path or use the Path buttons next to each Path field to bring up a standard file requester from which you can select a path. If you use the file requester, WCS will type the name in the Path field for you.

The Name fields contain names for the files.



The Default Directory is the drawer where WCS will put new Objects you create.

For more information about each of these file types, see the Getting Started and Data Types chapters and especially the Render Settings section of the Render Module chapter.

Buttons

Below the Path and Name fields are several buttons:

- Directory List button
- Save button

Click the Directory List button to open the Directory List window (see The Database Module reference chapter).

Click the Save button to save any changes you made in the Project Editor window.

Creating a new Project is made easier with the use of the Project Editor. You simply open the Editor window and enter the names of all the paths and file names that will be used for the new project. Of course you must still create some of the necessary files such as the Database and the Parameter file. The steps for doing so are covered in the Database and Parameters reference chapters.

Note: Some of the Project entries may also be changed from the Render Settings Editor. This is so that you can change them and render without opening several windows.

Open

Keyboard shortcut: RightAmiga O

Use the Open command to open an existing WCS Project file.

Project files contain directory and file name information. A Project tells WCS where it can find all the other data it needs to map and render. It also tells it where to save rendered images.

Project files also contain some window related information--the size and position of Camera View and Map View for instance. Thus opening a Project can cause these windows to assume new positions the next time they are opened.

Save

Keyboard shortcut: RightAmiga S

Use the Save command to save a WCS Project file under the current Project name.

The file will be saved if the current name is valid. You will be asked if you wish to save the Database and Parameter files as well. This is a good way to make sure everything about your Project has been saved.

You should re-save the Project file any time path information is changed and you want those changes to be permanent.

The Directory List should be updated whenever new Objects are imported or new DEMs extracted. It can be accessed either from this Project Editor or from the Database Module pop-up menu. The Directory List lets WCS find all of the Object files. Without it being current there can be no rendering.

The Project file should be saved any time the Directory List is altered.

Save As

Keyboard shortcut: RightAmiga A

Use the Save As command to Save a WCS Project file under a new name. You should use this option the first time you save a new Project. See notes for "Open" and "Save" Project above.

A standard file requester will appear. Enter the name and path for the new file or select an old file to be overwritten.

When the Project is saved you will be asked if you wish to save the Database and Parameter files as well.

oad Config

Keyboard shortcut: RightAmiga G

Use the Load Config command to load a previously stored workspace configuration. The configuration file keeps track of which windows you want to have open and where some of them were when you last saved a configuration file using the Save Config command (see below).

The last saved configuration file will be loaded from the "ENVARC:WCS" directory if one exists. If there is no Database or Parameter file in memory you will be prompted with file names and paths according to the last ones used. Accept or change them

as desired. WCS will then proceed to open all the windows and position them as they were when you saved the configuration file. You may need to do some depth arrangement.

The Objects loaded into Camera View, if opened, will only be those enabled in the Database (see Database Editor in the Database Module chapter). If you want Objects loaded other than those in the stored Database file you should open the Database first and modify it before selecting "Load Config."

Some MUI windows may not appear in the same positions as you saved them if they have been rearranged since saving the configuration file. Normally this is a positive feature and it cannot be overridden. If you want, you can save window positions from within MUI (see the Tips and Tricks chapter).

Save Config

Keyboard shortcut: RightAmiga C

Use the Save Config command to save a WCS workspace environment for later re-establishment.

All currently open windows will be recorded as well as their present sizes and positions. The information is saved in the system "ENVARC:WCS" directory.

Note: some window positions are remembered by MUI, rather than WCS. For those windows, you can save their positions from MUI (see the Tips and Tricks chapter).

If "ENVARC:" does not already exist the operation will fail. To create the directory make a sub-directory named "env-archive" in the system Prefs drawer and place the following command in your user-startup sequence (see the Amiga System manual for instructions):

assign ENVARC: SYS:Prefs/env-archive

WCS will create the WCS sub-directory in "ENVARC:" the first time you save a configuration.

Save Screen

Keyboard shortcut: RightAmiga N

Use the Save Screen command to save the WCS screen as an IFF 4 bit (16 color) file.

You will be presented with a standard file requester. Set the desired path and file name and click the OK button. Click the Cancel button instead if you want to abort the operation.

Info

Keyboard shortcut: RightAmiga /

Use the Info command to open the Information window.

This window contains information about available memory resources, number of topo maps, the name of the ARexx port, the name of the current Database file, the name of the current Parameter file and the screen mode.



It also has a button to allow you to perform the equivalent of an "Avail Flush" command from the Command Line Interface (CLI). Using this in tight memory situations may free up just enough space to help you out of a bind.

Memory fragmentation is always a potential problem. You will certainly gain more by closing windows (Map View and Camera View in particular) than you will by using the Flush button but it is always worth a try.

Version

Keyboard shortcut: RightAmiga ?

Use the Version command to open the World Construction Set Version window.

This is the window that appears when the program is started. You should have this window in front of you when you call for technical support. It contains the program version and revision numbers as well as your own personalized serial number. Without these we can't give you much help.



Credits

Keyboard shortcut: RightAmiga.

Use the Credits command to open the World Construction Set Credits window. Find out who to blame or praise for this piece of work.

Note: The photos don't do us justice!



Log

Keyboard shortcut: RightAmiga L

Use the Log command to open the Status Log window.



The Status Log window will display any messages that have accumulated even though the window was closed.

Normally the Status Log opens automatically the first time it receives a message for posting. You may "Hide" it with the Hide button and it will open the next time there is a message of Warning severity or greater. You may "Close" it with the Close gadget or button and it will not open automatically until it receives a message of Error severity (most severe).

The Status Log is an invaluable tool for diagnosing operation and image problems. Refer to it whenever you have a question about what WCS has done. Up to 100 messages are stored and then the list purges itself and starts afresh.

There are four classes of messages. Each message is preceded by a three letter abbreviation of the message class:

- Error (ERR)
- Warning (WNG)
- Message (MSG)
- Data (DTA)

Error

Error messages indicate problems where WCS failed to perform a task. If you see an Error message, you'll want to find out what caused it. For example if an Object file cannot be found or a window cannot be opened or memory allocation fails you will receive error messages.

Warning

Warning messages indicate things that might be problems, but might not be. For example, if you have Color Maps turned on in the Render Settings window, you'll see a Warning message for each DEM that doesn't have a Color Map. That may be OK if you meant to create color maps for only some of the DEMs.

Message

Message messages are informational. For example they tell how many Objects were loaded during mapping or what the Ecosystem and Fractal counts were during rendering.

Data

Data messages are headings for various data categories. For example they will tell you that the data which follows are Ecosystem counts or fractal level counts.

Quit

Keyboard shortcut: RightAmiga Q

Use the Quit command to close World Construction Set.

WCS will save a ".Prefs" when it closes and re-load it the next time the program is run. The Prefs file is really a Project file with some additional information about screen modes. All of your current path settings will be saved and default Database and Parameter file names. The files themselves however are not saved unless you request WCS to do so before closing.

When you choose the Quit command you will see a requester with three buttons:

- Close
- Warn
- Cancel

Close

Click the Close button to close WCS no matter what. WCS will close with no warnings about potentially unsaved files. ONLY DO THIS IF YOU'RE SURE YOU DON'T WANT TO KEEP ANY OF THE CHANGES YOU MADE DURING YOUR WCS SESSION!

If you use this option, WCS will not check to see if anything was left unsaved!

Warn

Click the Warn button if you want WCS to check and make sure there are no unsaved changes. If there are unsaved changes WCS will allow you to save items before closing.

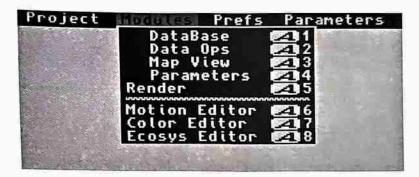
Cancel

Click Cancel if you decide you don't want to quit WCS. You will be returned to the program and you can continue your WCS session.

Modules Menu

The Modules menu gives you access to 8 commands:

- Database
- Data Ops
- Map View
- Parameters
- Render
- Motion Editor
- Color Editor
- Ecosys Editor



The commands in the Modules menu perform the same functions as the icons in the Module Control Panel and the Parameters module pop-up menu. They are here in menu form so that you can quickly open windows when the Module Control Panel is hidden. Hot keys make window access even more efficient.

Database

Keyboard shortcut: RightAmiga 1

Use the Database command to open the Database Module pop-up menu (see the Database Module chapter).



This has the same effect as selecting the Database Module icon (the one on the far left) in the Module Control Panel.

Data Ops

Keyboard shortcut: RightAmiga 2

Use the Data Ops command to open the Data Ops pop-up menu (see the Data Ops Module chapter).

This has the same effect as selecting the Data Ops Module icon (the second from the left) in the Module Control Panel.

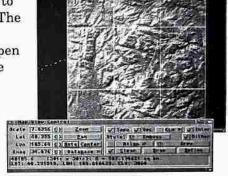


Map View

Keyboard shortcut: RightAmiga 3

Use the Map View command to open the Map View Module. The Map View window and Map View Control windows will open and Vector data will load (see the Map View chapter).

This has the same effect as selecting the Map View Module icon (the one in the center) in the Module Control Panel.



Parameters

Keyboard shortcut: RightAmiga 4

Use the Parameters command to open the Parameters Module pop-up menu (see the Parameters Module, Motion Parameters, Color Parameters and Ecosystem Parameters chapters).



This has the same effect as selecting the Parameters Module icon (the second from the right) in the Module Control Panel.

Render

Keyboard shortcut: RightAmiga 5

Use the Render command to open the Render Settings window (see the Render Module chapter).

This has the same effect as selecting the Render Module icon (the one on the far right) in the Module Control Panel.



Motion Editor

Keyboard shortcut: RightAmiga 6

Use the Motion Editor command to open the Motion Editor window (see the Motion Parameters chapter).

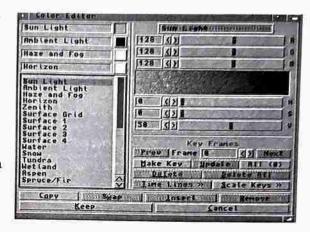
This has the same effect as selecting the Motion button in the Parameters Module pop-up menu.

Color Editor

Keyboard shortcut: RightAmiga 7

Use the Color Editor command to open the Color Editor window (see the Color Parameters chapter).

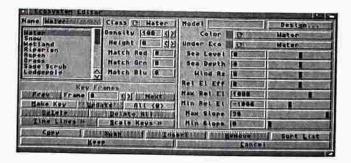
This has the same effect as selecting the Color button in the Parameters Module pop-up menu.



Ecosys Editor

Keyboard shortcut: RightAmiga 8

Use the Ecosys Editor command to open the Ecosystem Editor window (see the Ecosystem Parameters chapter).



This has the same effect as selecting the Ecosystem button in the Parameters Module pop-up menu.

Prefs Menu

The Prefs menu gives you access to 2 commands:

- Preferences...
- Screen Mode...

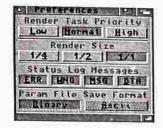


Preferences

Keyboard shortcut: RightAmiga P

Use the Preferences command to open the Preferences window. There are four areas in the window:

- Render Task Priority
- Render Size
- Status Log Messages
- Save Format



Render Task Priority

WCS takes advantage of the Amiga's excellent preemptive multitasking abilities by not only multitasking properly, but also letting you set the priority WCS uses when rendering images.

Choose Low when you want WCS to not interfere with most other Amiga programs during rendering (a priority of -1). This way you can multitask other programs as if WCS wasn't even running, and yet when you aren't using CPU cycles WCS will grab them and use them to calculate images.

Choose Medium to give WCS the same priority as most other programs (a priority of 0). Use this when you're on a deadline and you want WCS to grab it's share of CPU cycles. You can still use other programs, but they may slow down somewhat.

Choose High when you want WCS to have all the CPU cycles it can get (a priority of +1). Most other programs will not get any CPU cycles if you choose High. As a practical matter, this is about the same as choosing Medium and then not using your computer to run other programs.

Render Size

WCS lets you choose between 1/4, 1/2 and 1/1 sized rendering.

Use 1/1 for normal final quality renderings. WCS will use the image resolution you set in the Render Settings requester (see the Render Module chapter).

Use 1/2 when you want to see a half sized preview version of an image. This will render faster than a 1/1 image at the expense of detail, but it's meant for preview images and animations.

Use 1/4 when you want to see a quarter sized preview version of an image. This will render even faster since it's the smallest, but you'll lose even more detail. It's still useful for preview images and animations.

Status Log Messages

Here you can select which message classes WCS will show in the Status Log window (see the Log command above).

Save Format

Here you can choose between binary and ascii formats. Binary files load faster but are not portable from one computer platform to another. A Parameter file saved on an Amiga in Binary format could not be read on a PC and vice versa. Ascii format files on the other hand are completely portable and can be read on any platform.

Ascii files have the added advantage of being readable by literate human beings. That means if you know what you are doing you can go in and edit them without using WCS.

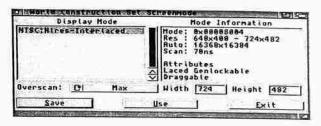
Note: If these gadgets are ghosted the format option is not yet implemented.

Screen Mode

Keyboard shortcut: RightAmiga M

Use the Screen Mode command to choose the kind of screen on which you want WCS to run.

Selecting a new screen mode will require WCS to close its windows and current screen. It will ask you first if it is OK to do that. If



you have unsaved changes you should cancel the requester and save your changes before re-selecting the Screen Mode command.

You'll see a requester showing all the screen modes available in the Amiga's standard display database. Your choices will include any screen modes available on most third party graphics boards if you have one.

Choose a display mode and click the Save button and WCS will reopen using the screen mode you requested. When you quit WCS, your screen mode choice will be saved automatically. The next time you open WCS it will open in the same screen mode.

Parameters Menu

The Parameters menu gives you access to either 4, 6 or 8 commands, depending on which window is active:

- Load All
- Save All
- Freeze
- Restore
- Load (Parameter Class)
- Save (Parameter Class)
- Load Active
- Save Active



Load All

Keyboard shortcut: RightAmiga (

Use the Load All command to open an existing Parameter file. Parameter files include Motion, Color, and Ecosystem Parameters; Render Settings; and all key frames.

A standard file requester will appear with the name of the active Parameter file already selected. Select another file if you wish and click the OK button. If you decide not to open a Parameter file click the Cancel button to abort the operation. Key frames are always loaded with this menu option, replacing any existing motion, color and ecosystem key frames in memory. The newly loaded file becomes the active Parameter file and its name will be saved in the Project file as the default Parameter file the next time you save the Project file.

Save All

Keyboard shortcut: RightAmiga)

Use the Save All command to save a complete Parameter file, including Motion, Color, Ecosystem Parameters; Render Settings; and any key frames that may exist.

A standard file requester will appear with the name of the active Parameter file already selected. You can save it over that file, select another file to save over, or type the name for a new file. Then click the OK button. If you decide you don't want save the Parameter file click the Cancel button to abort the operation.

Freeze

Keyboard shortcut: RightAmiga F

Use the Freeze command to copy the current Parameter set, including key frames, to a special Parameter buffer. You can recall these settings with the Restore command (see below). This is a good way to temporarily save all Motion, Color and Ecosystem Parameters, along with Render Settings and key frames when you want to experiment with other settings. If you don't like the results of your experimentation, simply use the Restore command to get back to where you were.

Note: If a new Parameter file is loaded from disk, some of the data in the Restore buffer will be updated depending on what data is loaded. The same is true for "Save" operations. For instance if you load or save the Ecosystem Parameters only, the Ecosystem Pa-

rameters will be updated in the Restore buffer but the Motion Parameters will not. Key frames will be updated only if the entire file is loaded or saved. Closing windows with the Keep buttons will also cause the Restore buffers to be updated selectively.

Restore

Keyboard shortcut: RightAmiga R

Use the Restore command to restore all Parameters, Render Settings and key frames to the values they had when the Freeze command was last selected or when data was loaded from disk (see Freeze above).

Extended Parameters Menu

Certain windows have an extended version of the Parameters menu. Those windows are the ones that deal directly with Parameters like the Motion, Color, Ecosystem and Render Settings Editors or the Time Line windows. If you do not see the option you are looking for try activating one of the other windows as the options are specific to the Parameter Class represented by a certain window.

For instance, you can load Motion-only partial files when the Motion Editor or one of its subordinate windows is active. For the Settings Editor, you can load only the Render Settings if you desire but there is no way to load individual Settings.

Load (Parameter Class)

Keyboard shortcut: RightAmiga [

Use the Load (Parameter Class) command to load a single Parameter Class from disk. The Parameter Class will appear in the command itself (Motion, Color or Ecosystem). You might want to use

this command if you are editing both Ecosystems and Motion at the same time and then decide that you want to discard the Ecosystem and keep the Motion changes. You would load only the Ecosystem Class from the original Parameter file.

A standard file requester will appear with the name of the active Parameter file already selected. Select the desired file for input and click the OK button. Click the Cancel if you want to abort the operation.

If key frames exist in the selected file you will be asked if you wish to load all key frames in addition to the basic Parameter Class. If you say yes WCS will load all Motion, Color and Ecosystem key frames together and replace any currently held in memory. Make sure this is what you want to do!

Key frames for a single Parameter Class cannot be loaded by themselves.

Save (Parameter Class)

Keyboard shortcut: RightAmiga]

Use the Save (Parameter Class) command to save a single Parameter Class to disk. The Parameter Class will appear in the command itself (Motion, Color or Ecosystem). There are times when you need to update only one Parameter Class in a file. An instance would be if you had several Parameter files for a Project and you changed the color palette in one and wanted to copy that change to the other files without overwriting the Motion or Ecosystems.

A standard file requester will appear with the name of the active Parameter file already selected. Select a file to overwrite or enter the name for a new file and click the OK button. Click the Cancel button if you want to abort the operation.

If the file already exists, only the Parameter Class designated in the menu will be saved. The other Parameters will not be changed.

If key frames exist in memory for any Parameter Class you will be asked if you wish to save all key frames. Doing so will overwrite any key frames currently in the file.

If you save under a new name WCS will create an entire Parameter file and all the current Parameters held in memory will be saved under the new name. This will then become the active Parameter file.

Load Active

Keyboard shortcut: RightAmiga {

Use the Load Active command to load a single Parameter from disk to replace the Active Parameter (the one you have selected in the Parameter List in any of the three Parameter Editor windows - Motion, Ecosystem or Color). You might want to do this if you are editing several Motion Parameters at the same time and then decide that you want to discard only one of the changes but keep the rest. You would load only the Active Parameter from the original file.

A standard file requester will appear with the name of the active Parameter file already selected. Select the file from which you want to load the Active Parameter and click the OK button. Click the Cancel button if you want to abort the operation.

WCS will search the source file for a Parameter with the same name as the Active Parameter and load it if found.

If key frames exist in the file you will be asked if you wish to load all key frames. Be careful, if you do so WCS will replace ALL key frames for ALL Parameter Classes in memory with those from the file.

Save Active

Keyboard shortcut: RightAmiga }

Use the Save Active command to save just the Active Parameter (the one you have selected in the Parameter list in any of the three Parameter Editor windows - Motion, Ecosystem or Color). This is a way of transferring information from one Parameter file to another. Say you wanted to update the Haze Color in a number of files without disturbing the other colors. You could use this option.

A standard file requester will appear with the name of the active Parameter file already selected. You can save the Active Parameter to that file, select a different file to save the Active Parameter into, or enter the name for a new file, and then click the OK button. Click the Cancel button if you decide you don't want to go through with the Save operation.

WCS will search the destination file for a Parameter of the same name as the one in memory and overwrite this regardless of its position in the Parameter List. Key frames will not be saved under this menu option.

Reference 3 - Database Module

- Overview
- Database Explained
- Database Pop-up Menu
- Database Editor
- Directory List
- Directory List Editor

The first of World Construction Set's five main modules is the Database Module. You can access its commands by opening its pop-up menu, which you can do by clicking the first icon in the Module Control Panel:



or by selecting the Database Module command in the pull down menu



Overview

Underlying the spectacular pictures and animations you can create in WCS are a whole lot of numbers. The numbers represent the position and elevation of points on your landscape, the coordi-

nates of Vector Objects like roads and rivers, the path your camera takes as you fly it through the landscape, the position of the sun, and more.

Some of these numbers are stored in Object files. The Database, which is an organized collection of data, or information, contains the names of these Objects as well as information about how they will be drawn or rendered.

WCS gives you direct access to the contents of the Database you're working with. You can see information about each Object, and you can make changes to the Objects to fine tune your images.

You'll need to have a Database in memory to create pictures. The Database contains the information about how every Object should appear.

In this chapter we will explore in detail the nature of WCS Databases and how to manipulate them to achieve your desired results.

It's important to remember as you use WCS that the Database influences all drawing and rendering operations. If something doesn't appear the way you think it should, the first place to look for an explanation is the Database. The Database is a simple construct but when projects get complex it is easy to overlook something simple.

Also explained in this chapter are Directory Lists. WCS uses Directory Lists to find the Objects represented in the Database.

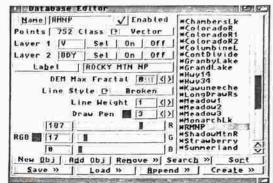
As we said above, the Objects themselves are not a part of the Database. They exist separately. Since Object files can be quite large and you may wish to use the same Objects in multiple Databases, they are normally stored only once and merely referenced from different Databases. Using the Directory List, WCS can easily find any of the Objects in the Database no matter where they may be physically located on your system.

Database Explained

WCS is a Geographic Information System, and the Database is central to its operation. Since WCS is enhanced to provide specialized functions such as 3D rendering, it has specialized information requirements. Many of these are addressed in the Database.

You learned the basic idea of the WCS Database in the Getting Started and Data Types chapters. Now let's take a more complete look at it. You can interact with the Database using the Database Editor window.

You can open this window from the Database Module pop-up menu using the Edit command. It's also conveniently available from the Map View Control window and the Diagnostics Data window.



For every Object that you want to use in an image, be it a Vector Object or DEM, there must be a corresponding entry in the Database.

For every entry there is a record containing 15 fields of information. They are:

- Name
- Enabled Status
- Vector Points (vertices)
- Class
- Layer Identifiers (2)
- Label Status
- Label
- Maximum Fractal Level (for DEMs)

- Line Style
- Line Weight
- Draw Pen
- RGB Render Pens (3)

The information in the fields tells WCS which Objects to render and how to render them.

First we'll look at the purpose of each field. Then, in the Database Editor section, we'll see how you can change your WCS pictures by changing the information in the fields.

Name

You can use up to ten characters to uniquely identify an Object. Files associated with the Object will begin with this name (padded with blanks up to 10 characters). No two Objects may have the same name since that could cause file retrieval errors. Files associated with this Object should be stored in a directory that's referenced in the Directory List. There may be several files depending on the type of Object, whether Vector, DEM or Surface class.

Enabled Status

This field toggles between off and on. When it is in the "on" state the Object is enabled for mapping and rendering or loading into Camera View (see Parameters Module). In the "off" state the Object will be ignored by all WCS functions except Database editing.

Vector Points

Every Vector Object is defined by some vertices, that is latitude/longitude coordinate pairs. The number of vertices currently defining the Object (or in the case of DEMs and Surfaces, the closed outline of the mapped area) are reflected in this field. The user has no direct input to this field. It is maintained by WCS as

points are added or deleted in other modules (see Map View, Data Ops and Parameters Modules).

Class

Every Object in the Database must belong to a "Class." The Class determines how the Object will be treated by the Render, Map View and Parameters (Camera View) Modules. Here is a summary of the Classes:

Topo

A Digital Elevation Model (DEM) that is treated as a Landscape. Ecosystems are mapped to the surface along with textures as defined by the Ecosystem Parameters. The coloring will be determined by which Color Parameters are referenced by individual Ecosystems. Shading will be applied based on sun position and topography.

Surface

A DEM that is colored by elevation (hypsometric shading). Up to three contiguous color gradients can be applied to the surface. Surfaces do not use Ecosystems. They may have a net of grid lines superimposed. See the Color section of the Parameters Module chapter and Render Settings section of the Render Module chapter for more information.

Vector

An Object which will be rendered in line or point form. Vectors may be colored, shaded and even hazed. They are used to represent an unlimited array of Objects from streams and roads to the footprint of an Object that will be rendered in another program and combined with WCS renderings.

Illuminated Vector

A Vector Object that changes its color under dim lighting conditions. At a light level of 30 percent (100% being sun

directly overhead, 0% being sun on the other side of the planet) the Vector's normal color is replaced by a yellow-white color to represent illumination. Since Vectors can be rendered as points, a Vector with many points could represent a city which lights up at night.

Segmented Vector

A Vector Object which has only a limited number of its segments visible at any given frame of an animation. The part visible is keyed to the frame number. At frame 10 the visible portion will begin at the 10th Vector vertex. The number of visible segments is determined by the Settings Parameter "Segs" on the Motion Paths & Vectors page of the Render Settings Editor.

Illuminated Segmented Vector

A Vector Object with the properties of both Illuminated and Segmented Vectors.

Layer Identifiers

Various items in the Database may have affinities with other items. Layers allow the user to perform simultaneous operations on all items with such affinities. Entities are frequently grouped based on common drawing characteristics.

For instance, let's say you want all rivers to be blue and all highways to be one pixel wide. It would make sense to create two layers named RIV and HWY, making it easy to change the color blue for all rivers or the line weight of all highways in one operation.

WCS provides for two layer identifiers to be specified for each Object. Since affinities may overlap a second layer provides greater flexibility. There is no limit to the number of layers that may be employed.

Reference 3 - Database Module

The layers are not necessarily hierarchical but they could be. For example:

Hierarchical						
item	layer 2	layer 1	Description			
1	HWY	2L	2 Lane Highway			
2	HWY	2L	2 Lane Highway			
3	HWY	4L	4 Lane Highway			
4	HWY	4L	4 Lane Highway			
4 5	RIV	NV	Navigable Waterway			
6	RIV	NV	Navigable Waterway			
7	RIV	NN	Non-Navigable			

Non-Hierarchical

item	layer 2	layer 1	Description
1	HWY	SM	2 Lane Highway
2	HWY	SM	2 Lane Highway
3	HWY	LG	4 Lane Highway
4	HWY	LG	4 Lane Highway
5	RIV	LG	Navigable Waterway
6	RIV	LG	Navigable Waterway
7	RIV	SM	Non-Navigable

In the first example 2L and 4L layers are subdivisions of the Highway layer. NV and NN are members of the River layer. This may be convenient if two lane highways share important characteristics such as line weight or line style that are not shared by either rivers or four lane highways.

The second example assumes that small Objects regardless of whether they be rivers or highways have important similarities and large Objects share similarly important characteristics. For instance you might want to make all large items three pixels in width and small ones only two regardless of their major classification.

Layers are frequently used to disable or enable entire groups. In the previous examples you might want to enable only large items

for mapping. In the first example you would have four layers to enable/disable. In the second you only have two.

Layer 1 may contain 0-2 characters, layer 2 may contain 0-3 characters. Any printable characters may be used including blanks.

Label Status

WCS can label entities when drawing a map. Only Objects with labeling enabled are labeled. You can create Labels for each Object using the Label field (see below). You can then turn labels on or off individually.

You can also turn labels on or off as a group (see layers above).

Label

The label field is 15 characters wide. You can use upper and lower case and any printable characters, including spaces. Labels are drawn in the Map View when the Label Status button is selected for an Object.

Maximum DEM Fractal Depth

This field pertains only to DEM Objects. You can use Fractals to add apparent detail to DEMs. This is one way to reduce the polygonal appearance of your landscape images. The more apparent detail you want, the higher the Fractal Depth should be.

Normally Fractal Depth is controlled globally by a variable found in the Render Settings Editor. Since the Fractal Depth is a major factor in determining rendering speeds it may be inefficient to use the same Depth for all DEMs.

When a particular DEM is always at a large distance from the camera you may wish to set this field to some value less than the global value. This DEM will then render much more quickly without sacrificing detail in the foreground.

Reference 3 - Database Module

A DEM will be rendered at the smaller of the global Fractal Depth and the DEM Max Fractal depth.

See Fractal Depth in the Settings Editor section of the Render Module chapter for more information.

Line Style

WCS supports a number of drawing styles for both lines and points in Map View.

Line: Solid, Dotted, Dashed, Broken Point: Point, Circle, Square, Cross

Line styles are those in which all vertices are connected with a patterned line. Point styles draw a symbol at each vertex but no connecting lines.

These styles are effective only in the Map View Module. Rendering any Line style will produce a solid line, any Point style a simple point.

Line Weight

Line Weight is the width in pixels of Vector Objects both in Map View and when rendered. This value will also be effective for Point style Vectors. You may wish to change this for different rendering resolutions increasing it for print resolution.

Draw Pen

The Draw Pen is the pen register (color) to use for drawing Vectors to the screen. The available pens are numbered from 0 to 15.

This affects screen drawing only and has no effect in rendered images. If you want to change the colors of Objects in rendered images, use the RGB Render Pens (see below).

WCS currently supports only 16 color screens.

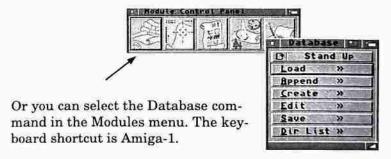
RGB Render Pens

Red, green and blue values are for Vector Objects in rendered images only. These values will be adjusted during rendering for shading, haze and fog effects if Haze Effect is enabled on the Motion Paths & Vectors page in the Render Settings Editor (see the Render Module chapter).

Database Pop-Up Menu

The Database Pop-Up menu gives you access to Database and Directory List commands.

To open it, select the leftmost Module Control Panel icon.



You'll see a small vertical pop-up menu window.

It has standard Amiga gadgets for resizing, zooming, front/back positioning, and dragging. You can resize it by dragging the resize gadget in the lower right corner. If you resize the window, you can click the zoom gadget in the upper right corner, just left of the front/back gadget, to toggle between two sizes. You can move the menu anywhere on the screen by dragging the title bar at the top of the menu.

At the top of the menu is a cycle button that lets you choose to display the menu vertically with the "Stand Up" command, as shown above, or horizontally with the "Lay Down" command like this:



The menu lets you access six Database commands:

- Load
- Append
- Create
- Edit
- Save
- Dir List

Load

Keyboard Shortcut: I

Use the Load command to load an existing Database into memory.

Note: You must have a Database in memory before you can do any drawing, animating or rendering.

There are three ways to get a Database into memory. The Load command is one way. Use this when the Database you want to use is not part of a complete Project, you want to load a different Database to replace the one in the current Project, or to undo temporary changes involving the currently loaded Database.

Another way is to create a Database from scratch using the Create command. Use this when you are starting a new Project and the Database does not yet exist.

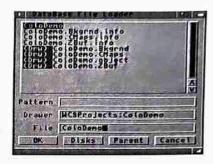
Finally, if you use the Open command in the Project pull-down

menu, WCS will open a complete Project file which includes a Database. This is the way you will most often access a Database.

How to load a Database using the Load command:

 Click the Load button.
 You'll see a standard file requester that looks something like this:

> If you have loaded a Database before in either this or a previous WCS session, WCS will remember the file and path you used before.



 Either click the OK button to load that Database file, or double click the name of a new Database file to load a new Database.

Database files do not have any special naming conventions or suffixes. Usually they are named for a geographic region, a client, or something that identifies it with a certain group of Projects. Frequently a Database file can be recognized because there is a directory with the same root name and ".object" appended.

If WCS finds an ".object" directory associated with the newly loaded Database you will be given the choice to make it the Default Directory.

The Default Directory is where WCS will save any new Objects, Parameter files, or Map.Prefs files you create. It's also the directory you'll see when you open many file requesters.

You can click either the Yes or No button on the requester.

If you Answer "No" to the default question, WCS will leave the default as it is currently set and simply add the directory to the List. WCS maintains a Directory List to search for Object files. Normally you would want the ".object" directory associated with a particular Database to be in this search list. In fact there is no reason that it shouldn't be in the list so WCS adds it automatically when a Database is loaded.

Until you change the Default in the Directory List Editor or Project Editor this will be the place that WCS will store newly imported or created Objects.

You may freely move Objects between directories in the Directory List, re-prioritize the List or add new paths to the List at any time (see Directory List below).

If a Database is loaded you will next see a requester that lets you load a Parameter file.

Since all rendering operations require a Parameter file in memory it is often convenient to load one now (see the Parameters Module and Global Menus chapters for more information). If you do not wish to do so simply cancel the requester.

If you load a new Database and then re-save the Project, the new Database will become the default Project Database. It will be the one loaded the next time you load that Project.

Append

Keyboard Shortcut: a

Use the Append command to concatenate a pre-existing Database to the one currently in memory. This is a convenient way to merge different Databases. One reason for doing so would be that if you purchased several data sets from Questar each would come with its own individual Database. Should you wish to combine them into one, the Append command will do the job.

How To Append A Database

- Click the Append button. You'll see a standard file requester.
- Select the name of the Database to append.

It can reside anywhere in the system, not just in the current directory.

The Database in memory will assume the appended file's name and path. You must be careful when saving Projects after appending. If you re-save the Project file the last appended Database will be the name of the Project Database. You can override this behavior by re-saving the Database first under the desired name.

When Database files are appended duplicate Objects are not eliminated but beware that duplicate names will cause confusion during mapping and rendering and should be avoided.

WCS will match Object names to data files in the order that they are encountered by searching the Directory List.

Duplicate Object names will result in the same Object being mapped multiple times. They can be removed from the Database using the Remove command in the Database Editor.

Create

Keyboard Shortcut: c

Use the Create command to create a new Database. When starting a new Project you may wish to begin by creating a new Database. This would be most appropriate if the new Project will use none of the Objects in any existing WCS Database.

How to create a new Database:

- Click the Create button. You'll see a standard file requester.
- Select the path where you want the new Database to be saved, and enter a name for the new Database.
- Select "OK" to create the Database and associated files or "Cancel" to abort the operation.

Should the Database name already exist in the path you have selected, you will be prompted to overwrite the existing Database files or abort the operation. Any existing data in the files will be lost if you proceed.

In the event that a ".object" directory already exists WCS will see that as a failure to create the directory and report the error. Select "Cancel" in the error message window if you do not want to dispose of the just created Database file. In any event the Object directory will not be affected.

Newly created Databases contain zero Object records. Data can be brought in with any of the Data Ops Module functions or new Objects can be created and digitized in the Map View Module.

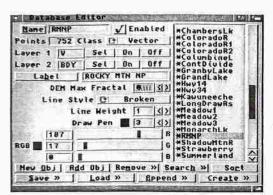
Edit

Keyboard Shortcut: e

Use the Edit command to open the Database Editor. The Database Editor allows you to set the drawing and rendering characteristics of all the Objects in the Database, both DEMs and Vectors.

How to open the Database Editor:

Click the Edit button, You'll see the Database Editor:



Here you can determine how each Vector Object is to be drawn: line weights, colors and styles. For DEM Objects you can set the individual fractal depth, a major determinant in how long it takes to render each DEM. You can enable or disable any Object for drawing in the Database Editor.

For more about the Database editor, see the Database Editor section later in this chapter.

Save

Keyboard shortcut: s

Use the Save command to save the Database file to disk. Do this any time the Database has been changed including after Objects have been imported, created or added, if you want to preserve the changes.

How to save a Database:

- Click the Save button. You'll see a standard file requester with the current Database name and path already filled in.
- Select "OK" to replace the existing file on your hard drive with the Database information in your Amiga's memory.

From time to time you may want to back up the Database with a different name or path. To do so:

- Select the path where you want the new Database to be saved, and enter a name for the new Database.
- Click the "OK" to create the Database and associated files.

If it does not already exist, WCS will attempt to create a ".object" directory to serve as the default Object storage directory (see Directory List below).

Dir List

Keyboard shortcut: d

Use the Directory List command to open the Directory List Editor. The Directory List tells WCS where to find the Object files needed for rendering and drawing.

The list must contain all the directories that should be searched to find the Object files. You should update the list whenever you create or import new Objects.

It is also necessary to update the list if you load a Database independently of a Project since Project files are where the Directory List is stored.

To save the Directory List, save the Project with the Save command in the Project menu.

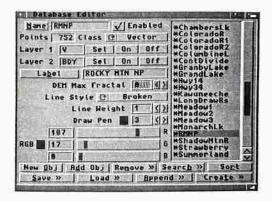
How to open the Directory List Editor:

 Click the Directory List button. You'll see the Directory List Editor:

Here you can add, delete or reprioritize elements of the Directory List. You can also set the Default Directory in which new Objects are saved.



Database Editor Window



The Database Editor window lets you determine how Objects will be mapped and rendered. It lets you enable Objects or disable them so they will or will not be drawn. The Database Fields discussed in the "Database Explained" section above are all available for editing in the Database Editor.

How to open the Database Editor window:

 Select the "Edit" button in the Database Module popup menu.

You'll see the Database Editor (shown above).

You can position the Database Editor window anywhere in the workspace by dragging the title



bar. You can use the Editor window at any time no matter what other windows are open, except during rendering.

Note: You can also open the Database Editor from the Map View Module, or from the Diagnostic Data windows in Camera View. This is only for added convenience and does not affect operation of the Editor.

All operations within the Editor window take effect immediately; you don't have to close the window.

Name Button

Keyboard shortcut: n

Click the Name button to specify a new name for an Object.

A requester will appear asking for the new name. Type a new name or alter the original.

If the new name already exists in the Database, WCS will open a requester that gives you the option of trying a different name. You may try a different name or cancel the operation.



When you create a new name for the Object, WCS will search for files matching the old name and rename them to match the new name.

This is the only way an Object's name should be changed. Don't change Object names from the Workbench, CLI or anywhere else!

Associated files must be found in one of the directories in the Directory List (see Directory List below).

If an Object file name is changed in some other fashion outside WCS' control there will be a discrepancy between file names and Object name which WCS can not resolve. It will treat the Object as disabled regardless of enabled status. You must reconcile the names by modifying the file root names to match the Object name (padded to 10 characters with blanks) or by changing the name in the Database.

Names must not include illegal file name characters such as :*/?'#% (see Amiga reference manual). Names will always contain 10 characters. Shorter names will be padded with blanks.

Note: Due to the 10 character file name limit for DEM files, and the fact that interpolating DEM files adds a character to the end of the name, you can't successfully interpolate a DEM that has a name that's already 10 characters long. If the name of the DEM you want to interpolate is already 10 characters, rename the DEM with a shorter name before interpolating.

Name Field

The Name field shows an Object's name. This is the name someone gave the Object when it was first created (see New Obj below).

You can change the name by clicking the Name button (see above). Normally it's a good idea to not change the name since other Databases may be looking for the same file. You may need to change the name if it's a DEM file you're going to interpolate and the name is already too long (see the note above). But if you just want to give an Object a label to make it easier to keep track of the Object, use the Label field (see below).

Enabled Button

Click the Enable button to enable or disable an Object for mapping and rendering.

A checkmark appears when the Object is enabled. No checkmark means the Active Object is disabled. Click to toggle the checkmark on and off.

In the list you can tell which Objects are enabled by the asterisk next to enabled Objects. When an Object is enabled it will appear in the Map View window, and it will be rendered when you render images. There is one exception: Vector Objects won't be rendered if you turn Vector Object rendering off in the Render Settings Editor window (see the Render Module chapter).

There are several ways to enable or disable Objects (see Layer and List below).

Points Display

The Points display shows the number of Vector vertices for the current Object. This is an informational display.

DEM and surface entities display the number of vertices in the outline, not the number of grid points in the map itself.

Class Cycle Gadget

Use the Class cycle gadget to set an Object's Class.

Click the circular arrow at the left to cycle through the choices, or

click on the text and drag to the choice you want from the drop-down list. There are six classes of Objects:

Topo

Topo Class Objects are DEMs that will be rendered as realistic landscapes with trees, grass, rock, ground and snow.

Surface

Surfaces are DEM Objects that are rendered without Ecosystems but instead are colored based on the elevation of the terrain.

Vector

Vector Objects are rendered as lines or points.

Illuminated Vector

Illuminated Vectors are Vector Objects that are rendered in a yellow-white color when they are shaded from the sun making them appear like lights.

Segment V

Segmented Vectors are Vector Objects that only have a portion of them rendered in each frame of an animation.

Illum Segment

Illuminated Segmented Vectors are Vector Objects that combine the properties of Illuminated and Segmented Vectors.

An item's Class is extremely important. Be sure to set this if you create a new Object. You cannot create a DEM Object in the Database Editor. All Objects created here will be assigned the Vector class. You can change the type of Vector but you must not try to make it into a DEM or it will not render correctly.

For existing Objects, do NOT change the Class from one of the Vector Classes to one of the DEM Classes or it will not render properly. Similarly do NOT change a Topo or Surface Object into a Vector or it will not render properly.

Layer 1 Field

The Layer 1 Field lets you tag the currently selected Database items with a two letter abbreviation. First select a group of entities that you want to group together with the tag. Then enter a two letter abbreviation to define this group of entities.

You can use any arbitrary two letter abbreviation. You can use any printable characters including punctuation and blank spaces, but WCS will change lower case characters to upper case since the code must be in upper case.

Once you have tagged a group of entities with the same two letter abbreviation you can easily use the Select, On and Off buttons (see below) on all members of the group at once.

You can also create different groups using the Layer 2 field (see below). The same Object can be grouped with one set of entities with a Layer 1 tag and another group of entities with a Layer 2 tag.

Layer 2 Field

The Layer 2 field works just like the Layer 1 field (see above) only instead of a 2 letter abbreviation you need to enter a 3 letter abbreviation.

Sel Button

"Sel" stands for "Select." Click the Sel button to simultaneously select all entities in the current layer (see Layer 1 Field above).

To deselect the group, just click a single Object in the list.

Once you've selected all the members of a group, they will all be affected by any changes you make to either Layer field, and you can use the On and Off buttons (see below) to enable or disable them as a group.

Since each Object can belong to two layers be sure to choose the "Sel" button to the right of the desired Layer field (1 or 2).

To activate all entities belonging to two layers, click a member of the first layer you want to select that's tagged in one of the Layer fields. Click the Sel button next to the Layer field. Then hold down the shift key, and click a member of a second group that's tagged in one of the Layer fields. Finally, click the Sel button next to that Layer field. All members of both groups will be selected in the list.

You may scroll through the list with the arrow keys rather than shift-clicking if you prefer.

On Button

Click the On button to enable all members of a layer (see Layer 1 field above) for mapping and rendering. You can tell which Objects are enabled in the list by the asterisk next to them.

Click an Object of the desired layer in the list. Then click the On button to the right of the appropriate Layer field. All members of that Layer's group will be enabled (asterisks visible next to their names in the list).

The On and Off buttons are handy for being able to quickly enable and disable sections of the landscape (DEM Objects) or Vector Objects like rivers, roads and boundaries.

Off Button

Click the Off button to disable all members of a layer for mapping and rendering (see On button above).

Click an Object of the desired layer in the list. Then click the Off button to the right of the appropriate Layer field. All members of that Layer's group will be disabled (no asterisks next to their names).

Label Button

Keyboard shortcut: b

The Label button lets you turn on labeling in the Map View window. When it's on (highlighted in blue and depressed) the text in the Label field (see below) will appear on the Map View window at the Label Coordinates for the Object (see the Map View Module chapter).

Currently only the active screen font is available for labeling.

Note: If the Label button does not remain pressed when you click on it then labeling is not yet implemented.

Label Field

Use the Label field to enter a new label for the current Object. You can use labels to hold descriptions for specific Objects, and you can cause them to appear on the Map View window by clicking the Label button (see above).

Type a new label or modify the old one. Labels may be up to 15 characters in length and include any printable characters including upper and lower case letters, blank spaces and punctuation symbols.

DEM Max Fractal Field

Fractal Depth adds detail, but at the expense of rendering time. The DEM Max Fractal field lets you decide which DEMs need detail and which don't.

Use the DEM Max Fractal field to set the maximum Fractal Depth that will be used in rendering the selected Object. This lets you lower the Fractal Depth for Objects that don't matter, like DEMs that are further away, while allowing more important Objects, like closer DEMs, to have a higher Fractal Depth.

To do so, select a DEM Object from the Object list. If it will be close to the camera, since WCS automatically enters "9" for each DEM as the default you can leave it at that. If it will be farther from the camera, enter a low number, perhaps "0," "1" or "2," into the Max Fractal Field to limit its Fractal Depth.

Nine is the absolute maximum Fractal Depth. You can directly enter any integer from zero to nine or click the buttons next to the field to increment or decrement the number.

Once you've limited the DEM Objects that don't need high Fractal Levels, you can set the overall Fractal Level in the Render Settings Editor window (see the Render Module chapter). Make sure Fixed Fractal Depth is enabled in the Render Settings Editor if you are rendering an animation.

DEMs will be rendered at the smaller of the global Fractal Depth and the DEM Max Fractal depth set here.

Be sure to check the Max Fractal value if you notice a lack of apparent detail for some DEMs. You may have forgotten to re-set it to 9 when you changed camera positions and brought a DEM that has a low Max Fractal value closer to the camera. Don't just set it at something less than 9 and forget about it!

Note: This setting will only apply if the selected Object is of Topo or Surface Class (see Class Cycle Gadget above). This value is ignored for Vector Objects.

Line Style Cycle Gadget

Use the Line Style cycle gadget to select the line or point style for mapping an Object in the Map View Module. You can choose from eight options.

Point Style Objects will be represented by discrete points at the Vector's vertices. Line style Objects will have the vertices connected with straight line segments.

Point Styles

- Point
- Circle
- Square
- Cross

Line Styles

- Solid
- Dotted
- Dashed
- Broken

The current selection will appear in the cycle gadget.

This only affects the Map View window. When you render an image, all Line Styles will be rendered as solid lines and all Point Styles as simple points.

Line Weight Field & Buttons

Use the Line Weight field to set the weight of a Vector Object for drawing and rendering.

Enter the desired weight in pixels in the string gadget or use the arrows to increase or decrease the weight one pixel at a time.

You may wish to vary this to obtain consistent proportions when an image's resolution is changed. Increase it for print resolution images.

Draw Pen Field & Buttons

The Draw Pen field lets you select the screen color for mapping and rendering Vector Objects.

Enter the desired palette number in the string or step through available selections with the arrow buttons. The color will be displayed in the swatch to the left.

Draw Pen affects only screen colors and has no effect on rendered images.

Some palette switching may occur as you activate different WCS windows. Because of this, the color in the swatch may change, and it will not be accurate when other windows are active. Don't be concerned, only the color when the Database Editor is active is important.

Depending on screen mode and available color registers, the color may be different in the onscreen rendering window than as you see it here and in the Map View Module.

RGB Color Fields & Sliders

The RGB Color fields and sliders let you set the red, green and blue color components to specify the color of Vector Objects when you render 24 bit images.

To do so, select a Vector Object from the list. Enter red, green and blue values in the string gadgets or adjust the sliders. Legal values are 0 to 255. You'll see an approximation to the 24 bit color (based on the current screen mode) in the color swatch to the left.

These settings have no effect on screen drawing color as used in the Map View Module and Camera View, or the onscreen color of Vectors during rendering (see Draw Pen fields & buttons above).

Note: These settings apply only to Vector Objects. DEM and Surface entities ignore the RGB values and instead deriving their palette from Color Parameters (see the Color Parameters chapter).

Object List

The Object List lets you select Database Objects, and enable/disable Objects for mapping and rendering.

Selecting

Individual Objects are activated by clicking on them with the mouse or scrolling with the cursor keys.

Multiple Objects may be selected for simultaneous modification. Press the shift key before clicking on the first Object to be selected and then hold it down while selecting as many Objects as desired. You may find it useful to release the shift key and scroll with the cursors to view additional Objects before shift-clicking to select them.

All active and/or selected Objects will have their records modified at the time a change is made in a Database field. This rule does not apply to name changes however.

Enabling

An Object may be enabled or disabled by double-clicking its name in the list view. An Object that is enabled will have an asterisk next to its name.

You can also enable or disable groups of Objects using the buttons next to the Layer 1 and Layer 2 fields (see Layer 1 field above).

New Obj Button

Keyboard shortcut: o

Click the New Obj button to create a new Object and add it to the Database. You'll need to do this before digitizing a new Vector Object. You can create it in the Database first, and then digitize the actual points in the Object.

A requester will appear asking for a name. The new Object will be given all the attributes of the old Object that was active when the button was selected. This can save much typing and button pushing. If the selected name already exists in the Database you will be asked to specify a different name or cancel the Object creation.

New Objects are created with one point (vertex). This is simply a ruse to let WCS know that it is a valid Object. This point will be rewritten with your own coordinates whenever you digitize this Object (see the Map View Module chapter and the Camera View section of the Motion Parameters chapter). We recommend you digitize the points for the Object right away to avoid possible confusion later.

A new Object always has its Database fields cloned from the Object that was active when the new Object was created except that all new Objects are created as plain Vector Class. You can change any of the fields after the object is created.

Be sure to save the Object when WCS requests you do so. This will assure that the number of vertices in the ".Obj" file always corresponds with the number in the Database record.

DEM and DLG entities can be imported as well as created (see the Data Ops Module chapter).

New Objects can also be created in Map View with the "New Object" and "Add Points" menu commands, they don't have to be created here in the Database Editor.

The procedure for digitizing Objects is covered in Tips & Tricks chapter and in the Map View Module reference chapter.

Add Obj Button

Keyboard shortcut: d

Click the Add Obj button to add one or more existing Objects to the Database. This lets you add more DEMs when you want to fly your camera over a larger area. It also allows you to add rivers, roads or other Vector Objects that you may have created for a different Project but want to apply to the current Project. A file requester will appear. Locate the Object you wish to add. It must already exist and end in a ".Obj" suffix. When you have found the desired Object click "OK."

WCS will determine the number of points in the Object and add the Object to the Database. If Map View is open the added Object, or its outline if it is a DEM, will be drawn.

You may multi-select as many files in the requester as you like. They will all be added to the Database when you click "OK."

You may wish to edit the rest of the Object's Database fields before drawing or rendering the Object so that it is drawn the way you wish.

It is entirely possible and sometimes desirable to have DEMs in a Database that overlap in aerial coverage. You should avoid having overlapping DEMs enabled at the same time however as this will probably cause you some confusion when mapping and rendering. Overlapping DEMs can result from DEM interpolation as well as adding Objects to a Database.

Remove Button

Keyboard shortcut: m

Use the Remove button to delete an Object and record from the Database.

It sometimes is desirable to remove unwanted Objects from the Database. This could be because you merged two Database files and there were duplicate entries. Or you might maintain a master Database with all of the Objects you have on your system and then for specific Projects, remove all but those that you really need. Occasionally you might create an Object and then decide that you don't want it. The Remove function lets you perform these housekeeping chores.

Bear in mind that an Object and its record in the Database are two separate things and that you may sometimes wish to remove a record from the Database without destroying the Object itself; for example if the Object is being used in other Databases and should not be disturbed.

You will be asked if you wish to delete all associated files from disk. If you only want to remove the Object from the Database but not delete files, select "Database Only" in the requester.

Note: You should save the Database whenever you remove an Object, and particularly if you delete associated files, so that Database and available files remain in coordination.

Object files will be removed no matter where they are in any of the directories in the Directory List.

Be careful that you don't delete files that are still needed by another Database in a shared Object directory.

How to delete an Object's record from the Database:

- Select the Object to be removed (see "List" above).
- Click the "Remove" button.

You will see a requester asking if you want to remove all associated files from disk.



Reference 3 - Database Module

Click the "From Disk" button in the requester if you
want to delete ".Obj", ".elev" and ".relel" files from disk
(if they exist).

Click the "Database Only" button if you want to remove only the Object's record from the Database. If there are any related ".Obj", ".elev" and ".relel" files, they will not be deleted.

Note: If you click the "Database Only" button in the requester, the Object's associated ".Obj", ".elev" and ".relel" files will be inaccessible to WCS unless you create a new Object of the same name at a later time or they are referenced in a different Database.

Click the Cancel button to abort the operation. Nothing will be deleted.

Search Button

Keyboard shortcut: h

Use the Search button to select one or more Database Objects that match your search criteria.

This is another way to do multiple selection. It's a quick way to select all Objects that have similar names.

For example, if you use the Vector import functions in the Data Operations Module you will likely end up with a lot of objects having at least part of their names in common. You may want to assign those Objects with certain name similarities to a common Layer. To do this you would use the Search function to activate them so you can set the Layer descriptor for all of them at once.

See "Layers" and "List" above for more options.

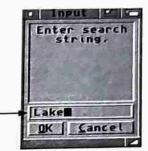
How to use the Search button to quickly select Objects with similar names:

Click the Search button.

A requester will appear asking you for the string to be searched with.

 Enter the text you want WCS to use as the basis for selecting Objects.

> WCS will select each Object that has your search text anywhere in its name.



Sort Button

Keyboard shortcut: r

Use the Sort button to sort the Database entities in alphabetical order by name. This will affect how they are shown in the Object list on the right side of the Database Editor window.

Normally the order of items in the Database is arbitrary. When you add new Objects they are always put at the end of the list. You may want to use the Sort button occasionally to make it easier to find Objects in the list.

This is strictly for your convenience. The order of the list does not matter to WCS and will not affect how WCS operates.

How to sort the Database:

Click the Sort button.

The Database will be sorted alphabetically. The list will show the new order.

Save, Load, Append, & Create Buttons

These buttons work exactly like the identically named commands in the Database pop-up menu. See the Database Pop-up Menu section above for details.

Directory List

Because WCS must deal with so many data types, the number of files generated can quickly become difficult to manage if stored together in one directory. Additionally, more than one Project or Database may share the same Objects yet it would be inefficient to store multiple copies. To provide for flexibility and economy, WCS uses a Directory List to guide its search for data. The list tells it which directories to scan for Object data and in what order.

Directory List entries may be any legitimate paths found on your system. The only restriction is that the device must support random access reads.

Entries may be designated "Read Only" to prevent WCS overwriting certain data files as updates are generated from within the Map View Module.

A Default Directory is also maintained apart from the search list. If a new Object is created, it will be saved to the Default Directory. If an Object's Vector description is modified (as in digitizing new coordinates, etc.) and it is re-saved, WCS will attempt to lo-

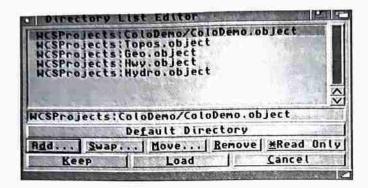
cate the original file by searching the Directory List. If the file is not found or it is in a "Read Only" directory, the Object will be saved to the Default Directory. It is preferable to make the Default Directory one of the directories in the search list.

The Default Directory may be changed at any time to facilitate saving different Database Layers (see Database Editor above) to different locations. The ColoDemo Project included with this software exemplifies this directory architecture. All DEM entities are stored in the Topos.object drawer, all river, stream and lake entities are in the Hydro.object drawer, and so on.

Frequently when a file requester opens, for instance when you invoke the DEM Convert function, it opens with the Default Directory active. This is only for convenience and is not meant to imply that the file must be loaded from or saved to this drawer.

The Default Directory and the Directory List are addressed through the Database Module pop-up menu, "Dir List" button or from the Project Editor window. They are saved as part of any Project file including WCS.Prefs when the program closes.

Directory List Editor



The Directory List window lets you edit the Directory List. Here you can tell WCS the directories where you want it to search for Objects during mapping and rendering operations. You can prioritize the directories in the List to obtain optimal search efficiency.

The Editor also is where you set the Default Directory, which is the directory WCS will automatically save new Object and "Map.Prefs" files.

How to open the Directory List Editor window:

 Click the "Dir List" button in the Database Module menu.

The Directory List will appear. You can move it around in the workspace by dragging the title bar. You can access it during other WCS operations, except when rendering.

All operations within this window take effect immediately. You don't have to close the window for your choices to take effect.

Directory List

The List area of the Directory List window shows you a list of directories in order of search priority. The topmost entry has the highest search priority, the bottom entry, the lowest.

When WCS needs to locate an Object file it begins with the first path in the list. If it doesn't find the Object in that directory it goes on to the second and so on until it either finds the Object or exhausts all the paths in the list. Since it takes time to search through a long list, you should arrange the list such that the Objects needed most often are found in the highest priority paths near the top of the list.

You can click on the directory names in the list and use the commands in the buttons at the bottom of the window to make changes to the Directory List. For instance, the Move command moves the selected item to wherever you want it. Swap will exchange the selected item with another item you select. Remove will delete an item from the list if it is no longer needed.

Note: If you can't read all the directory names, try expanding the window horizontally with the sizing gadget to give the window more room to display the names.

Default Directory Button

Keyboard shortcut: f

Use the Default Directory button to choose which of the directories in the list will be the Default Directory.

The Default Directory is where new Objects are stored. It is where the DEM Extract function and the DLG, DXF and WDB Import functions place the imported Object files. It is also where the Map.Prefs file is saved when you close the Map View Module. You should set the Default Directory before invoking import and

Reference 3 - Database Module

extract functions if you want to control where on disk the files are

The Default Directory is the directory that will appear when you open Object file requesters.

You can change the Default Directory as many times as you like in any WCS session. It is saved when you save the Project file.

For normal operation the Default should be set to the ".object" directory associated with the Database in use. For instance when using the ColoDemo Database you would set the Default to ColoDemo.object except when you are importing Objects as described above. You don't need to change it when you import Objects, it just helps keep directory sizes manageable. Large Projects may have thousands of Objects.

How to choose the Default Directory:

- Select the desired entry in the list by clicking it with the mouse.
- Click the Default Directory button.

The directory name will be displayed in the text gadget above the button.

Note: If you want to make a directory the Default Directory and it's not in the Directory List, you have to first add it to the list (see "Add" below). Then follow the above outlined procedure. You can later remove the name from the list if you desire, but normally you would want it in the list.

Add Button

Keyboard shortcut: d

Use the Add button to add an entry to the Directory List. Whenever a new directory is created to store Objects its name must be added to the Directory List.

If you load a new Database you should check the list to be sure that all the required Object paths are represented in the list. When a Database is loaded as part of a Project Open operation, the Directory List will be loaded from the Project file and additions will seldom be required. You should update the list when you Append a Database to the one in memory or you add an item to the Database using the Add command in the Database Editor.

If you receive messages in the Status Log window during mapping or rendering about WCS not being able to find or open certain Object files, you should check the Directory List to be sure that all Object files are located in directories in the list.

How to add an entry to the Directory List:

Click the Add button.

You'll see a standard Amiga file requester.

- · Use the requester to find the desired directory.
- · Click the OK button in the file requester.

Note: click the Cancel button if you decide to abort the addition.

The new entry will be added to the bottom of the list. You can change its position in the list with the "Move" and "Swap" buttons (see below).

When it looks for Objects, WCS will search the directories in the order they are arranged in the list. It's a good idea to put the directories that have the most Objects toward the top of the list. That way WCS will be more likely to find Objects after looking in fewer directories. The fewer directories WCS has to look through, the faster it will find the Objects.

Swap Button

Keyboard shortcut: s

Use the Swap button to interchange two Directory List entries. This will reverse their search priority.

When it looks for Objects, WCS will search the directories in the order they are arranged in the list. It's a good idea to put the directories that have the most Objects toward the top of the list. That way WCS will be more likely to find Objects after looking in fewer directories. The fewer directories WCS has to look through, the faster it will find the Objects.

How to swap Directory List entries:

- Select one of the list entries you want to swap by clicking it with the mouse.
- Click the Swap button.

The pointer will change to indicate a swap operation is in progress.

Click the other entry and the two will be interchanged.

Note: To cancel a swap operation click on the "Cancel" button at the lower right corner of the window.

Move Button

Keyboard shortcut: m

Use the Move button to move a Directory List entry from one position to another. This will change its relative search priority.

When it looks for Objects, WCS will search the directories in the order they are arranged in the list. It's a good idea to put the directories that have the most Objects toward the top of the list. That way WCS will be more likely to find Objects after looking in fewer directories. The fewer directories WCS has to look through, the faster it will find the Objects.

How to move a Directory List entry:

- Select the list entry you want to move by clicking it with the mouse.
- Click the Move button.

The pointer will change to indicate a copy operation is in progress.

 Click in the list at the point where you want the new entry to go.

The entry will be inserted in the list at the position you chose. All lower priority entries will be moved down one position.

Note: To cancel a move operation click on the "Cancel" button at the lower right corner of the window.

Remove Button

Keyboard shortcut: r

Use the Remove button to remove an entry from the Directory List.

From time to time it is a good idea to check and see if there are unneeded entries in the Directory List. Extra directories may result from creating new Databases. When you create a new Database WCS will add at least one directory to the list but it will not remove any that are already present.

Since a new Database will in many cases not require some or all of the old directory paths, you should remove them manually. Of course removing an item from this list does not in any way affect any of your actual data on disk.

There is little harm in having unneeded entries in the list other than the slight delay entailed every time a directory is scanned for a file.

You might consider building a master list of all Object directories on your system and using that for all Projects rather than having custom lists for each Project. Do whatever seems best to you.

As a compromise you might sort the master list into the most efficient prioritization for each Project.

How to remove entries from the Directory List:

- Activate the entry to remove.
- Click the Remove button.

The entry will disappear from the list and all subsequent entries will move up one position.

Read Only Button

Keyboard shortcut: *

Use the Read Only button to mark a Directory List entry as "Read Only." Files in this path will not be overwritten during re-save operations.

Normally when WCS re-saves an Object file after some operation has been performed on it (like new Vector points digitized or DEM flat spots fixed) it will be re-saved to the same location as the original file, overwriting the original.

If you want to preserve the original you can mark the Object's directory as read-only. This forces WCS to save the new version in the Default Directory instead of overwriting. You can then remove the read-only directory from the Directory List and WCS will use the new version of the Object.

You might want to mark a directory as read-only when you are using data from a CD ROM, since you can't write data to a CD ROM. By making the directory read-only, WCS will not try to write to it. If you don't make a CD ROM directory read only, you will see pesky error requesters generated by the Amiga operating system when you try to save.

If you are not changing your data in any way it wouldn't matter if a directory was marked read-only or not.

Note: The "Read Only" command will not apply for the directory that you have chosen to be the Default Directory for a Project, since that's where new Object files will be stored when you create them.

How to protect a Directory List entry from being overwritten:

Activate the desired list entry and select "Read Only."

An asterisk will appear in front of the entry in the list to denote it as "Read Only." If an entry is already set to Read Only, select the Read Only command again to toggle it off.

Keep Button

Keyboard shortcut: k

The Keep button lets you close the Directory List Editor and preserve the changes.

You don't have to click on the Keep button to apply your changes. Any changes you make in the Directory List Editor take effect immediately and stay in effect unless you click the Cancel Button.

How to close the Directory List and keep your changes:

Click the Keep button.

The Directory List will close with all changes preserved.

Notes: Changes will be saved the next time the Project file is saved. Or, said differently, to save the changes to disk you must re-save the Project file.

Load Button

Keyboard shortcut: I

The Load button lets you load an existing Directory List from disk.

When you create a new Project you may wish to use the same Directory List that is used by a different Project. You can load only the Directory list from the other Project file without loading the rest of the Project using this command.

Using the Directory structure included on the WCS distribution disks as an example, let's say we want to start a new Project that will include all of the Vector data on the distribution disks but none of the DEMs. It would be far simpler to load the Directory List from the ColoDemo.proj file than to re-create it from scratch. The Vectors are stored in three directories: Geo.object, Hwy.object and Hydro.object. Since we aren't going to use the DEMs we can eliminate the Topos.object directory with the remove function (see above), a much simpler process than adding the three Vector directories.

Also a possibility, as we noted above, is to use the same Directory List for all Projects and just modify the search priority for most efficient operation. This is facilitated by the Load function.

Once again, be sure to save the Project file to preserve any changes to the Directory List.

How to load a Directory List

Click the Load button.

You'll see a standard Amiga file requester.

 Select the Project file which contains the Directory list you desire.

Reference 3 - Database Module

The new list will load without affecting other Project-related items. All other paths such as the Frame Save path, Color Map directory, and Background Image directory will remain unchanged.

Cancel Button

Keyboard shortcut: c

The Cancel button lets you close the Directory List Editor without keeping any changes you might have made. Use this button when you want to leave the Directory List Editor without making any changes to the Directory List.

Tip: When you want to import a number of Objects using one of the Data Ops Module commands like Import DLG or Extract DEM and you want them to go in a certain drawer, set the Default Directory in the Directory List Editor to the desired destination but don't close the window. Then import the data. When you are done close the Directory List Editor with the Cancel button. That will restore the Default to what it was before.

How to cancel the Directory List Editor:

Click the Cancel button.

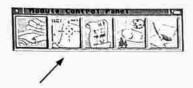
The Directory List Editor will close and all changes will be lost.

All changes are undone including loading new lists, additions and removals, changes in priority or write status, and changes in the Default Directory.

Reference 4 - Data Operations Module

- Overview
- Pop-up Menu
- DEM Extract Window
- DEM Converter Window
- DEM Interp Window

The second of World Construction Set's five main modules is the Data Ops (Operations) Module. You can access its commands by opening its pop-up menu, which you can do by clicking the second icon in the Module Control Panel:



or by selecting the Database Module command in the pull down menu.



Overview

WCS creates landscape images based on DEM files. DEM files are lists of numbers representing the height of an area of land measured at regular intervals.

The Data Operations (Ops) Module lets you bring Digital Elevation Model (DEM) data into WCS. WCS uses DEMs to recreate the shape of landscapes.

Digital Elevation Models

WCS includes several sets of DEM files. Using the Data Ops Module you can import DEM files from other sources, and even import data that's not in a standard DEM format.

WCS has an extremely flexible array of DEM conversion functions in addition to direct support of standard U.S. Geological Survey One Degree files.

Note: for information on obtaining additional elevation data, see Appendix B: Obtaining Geographic Data.

One Degree DEM format

WCS supports the import of DEM terrain data in one of the U.S. Geological Survey standard formats called "One Degree DEM." It's also referred to as "3 arc second," "90 meter," "1:250,000," and "Quarter Million Scale."

This high quality format is available for the entire USA. It offers several advantages over other DEM formats. The main advantage is that sampling was done on a standard latitude/longitude grid with overlapping edge rows and columns.

This makes it possible for WCS to load each DEM file in turn as it renders your images. Without that ability, the memory requirements for executing lengthy animations and aerial perspectives that cover vast amounts of territory would be impossible on most personal computers.

While the One Degree data is not perfect, it avoids some of the problems found in other data sets. For example, "30 meter" DEM data is inconsistent in quality, much more expensive if you want to obtain broad regional coverage, and not currently available for all parts of the USA. The 30 meter data is not supported directly by WCS at this time.

Other data formats

Data available from private sources are generally abstractions of public domain data that have been stripped of too much useful information to be seriously considered for use by WCS. At least two other 3D terrain modeling programs' data falls into this deficiency category. Those programs map the terrain as if the earth were flat and are little concerned with the global position of the data.

Note: In the interest of compatibility, however, WCS can import the proprietary files from the program "VistaPro."

In contrast, the WCS data structure lets you create a seamless rotating earth, move the sun in a realistic arc across the sky and have distant peaks diminish as they roll over the horizon to the far side of the planet.

Non-georeferenced data has its value, however limited, and we have made provisions for importing all sorts of generic array data in the DEM Converter window.

You can even create your own landscapes in a paint program and import them using WCS' flexible DEM Converter function (see the Tips & Tricks chapter).

Where the Data Goes

When you use any of the WCS import functions, the data you import will be stored as Object files in your Default Directory.

Note: You can see which directory is your Default Directory by looking in the Directory List window. From there you also can change which directory is the Default Directory.

WCS will also automatically import them into the current Database. You can enable the new DEM Objects for rendering in the Database Editor window. They'll appear in the list on the right side of the window.

Note: You can read more about the Database Editor window and the Directory List window in the Database Module chapter.

Pop-Up Menu Window

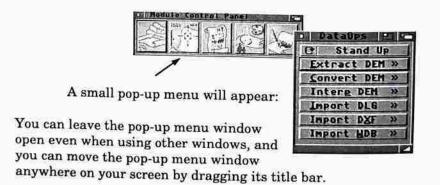
When you click the Data Operations Icon, you'll see the Data Operations pop-up menu window. Here you can select any of six command buttons:

- Extract DEM
- Convert DEM
- Interp DEM
- Import DLG
- Import DXF
- Import WDB

You can also use the Stand Up/Lay Down cycle gadget at the top of the window to make the pop-up menu window orient vertically or horizontally.

How to open the Data Ops pop-up menu window

Click the second Module Control Panel icon:



Layout Cycle Gadget

Use the Stand Up/Lay Down cycle gadget at the top of the window to make the pop-up menu window orient vertically or horizontally.

How to choose window orientation:

- Choose the Stand Up command to orient the window vertically.
- Choose the Lay Down command to orient the window horizontally.



Note: You can also use the window's zoom gadget to toggle between alternate window locations.

Extract DEM Button

Keyboard Shortcut: e

Click the Extract DEM button to open the DEM Extract window (see the DEM Extract window below).

Use the DEM Extract window to import standard one degree U.S. Geological Survey DEM files. To import other kinds of terrain models and to convert other types of data and images to DEMs use the Convert DEM button described below.

Convert DEM Button

Keyboard Shortcut: c

Click the Convert DEM button to open the DEM Converter window for inter-format data conversion (see the DEM Converter window below).

WCS supports the conversion of numerous binary and ascii array formats to and from WCS DEM format. You can use this window to convert bitmapped images to the WCS Color Map format, to convert arrays to Z Buffers, or just as an array conversion utility.

Interp DEM Button

Keyboard Shortcut: p

Click the Interp DEM button to open the DEM Interpolate window, where you can interpolate existing WCS format DEMs to higher resolution (see DEM Interpolate window below).

Import DLG Button

Keyboard Shortcut: i

Click the Import DLG button to import Vector Objects from a United States Geological Survey "optional distribution" format Digital Land Grid file.

A standard file requester will appear. The requester will open in the Default Directory but you may select from any directory on your system. Select a single file by clicking on it.

The selected file must be a United States Geological Survey Level 3 Digital Land Grid file in the "Optional Distribution Format" of Universal Transverse Mercator (UTM) coordinates. If the file is of the correct format, insofar as WCS can determine, each Vector

Reference 4 - Data Operations Module

entity in the file will be converted to a separate Vector Object and added to the active WCS Database. A Database must have been previously loaded or created before using this function.

You should set the Default Directory in the Directory List window (see Database Module chapter) to the path you wish the output Objects to be stored. Some DLG files are quite large and can result in thousands of Objects so be prepared for this process to take some time and storage space. The total size of the output files will be somewhat smaller than the original DLG file due to WCS' more concise structure.

DLG files contain no entity name information but they do have attribute codes for each Object. WCS will attempt to interpret the DLG attribute codes to arrive at Object names and layer descriptors.

In large DLG files there is a certain amount of repetitiveness between one Object's descriptive information and other Objects'. In those cases where a unique name cannot be derived, WCS will append a series of alphabetic characters to the name since in WCS each Object must be named uniquely.

As more and more Objects are added to the Database, it takes longer and longer to determine if a name has been used already. The result can be a slowing of the process as the Database grows.

If you must abort the process for any reason, those Objects already created will remain for your use or disposal.

Note: Be sure to save your Database after importing DLG files. If you don't you won't have access to the newly created Object files the next time you run WCS.

The U.S.G.S. is a good source for extensive Vector data coverage. For most parts of the U.S. they can provide several layers of information including roads, hydrography (streams), railroads and pipelines. Please see Appendix C: Obtaining Geographic Data, for information about acquiring this data.

Import DXF Button

Keyboard Shortcut: x

Click the Import DXF button to import Vector Objects from a DXF file.

A standard file requester will appear. The requester will open in the Default Directory but you may select from any directory on your system. Select a single file by clicking on it.

The selected file must be a DXF format file with Vector coordinates in Latitude/Longitude units (degrees and decimal fractions). To the best of our knowledge, WCS supports all DXF versions as defined in the AutoCAD format specifications. Some codes and fields will be ignored, however.

If the file is of the correct format, insofar as WCS can determine, each Vector entity in the file will be converted to a separate Vector Object and added to the active WCS Database. A Database must have been previously loaded or created before using this function.

You should set the Default Directory in the Directory List window (see Database Module chapter) to the path you wish the output Objects to be stored. Some DXF files are quite large and can result in thousands of Objects so be prepared for this process to take some time and storage space. The total size of the output files will be substantially smaller than the original DXF file due to WCS' more concise structure (that's putting it mildly).

Interpreting DXF data is variable in result. Sometimes layer and/or name information is available. If it is it will be used to determine WCS Object names. Usually there is a large amount of irreconcilable similarity between one Object's descriptive information and other Objects'. In those cases where a unique name cannot be found within the file, WCS will append a series of alphabetic characters to the name since in WCS each Object must

Reference 4 - Data Operations Module

be named uniquely. As more and more Objects are added to the Database, it takes longer and longer to determine if a name has been used already. The result can be a slowing of the process as the Database grows.

If you must abort the process for any reason, those Objects already created will remain for your use or disposal.

Note: Be sure to save your Database after importing DXF files. If you don't you won't have access to the newly created Object files the next time you run WCS.

Import WDB Button

Keyboard Shortcut: w

Click the Import WDB button to input Vector Objects in World Data Bank format.

A standard file requester will appear. The requester will open in the Default Directory but you may select from any directory on your system. Select a single file by clicking on it.

The selected file must be a World Data Bank format file. If the file is of the correct format, insofar as WCS can determine, each Vector entity in the file will be converted to a separate Vector Object and added to the active WCS Database. A Database must have been previously loaded or created before using this function.

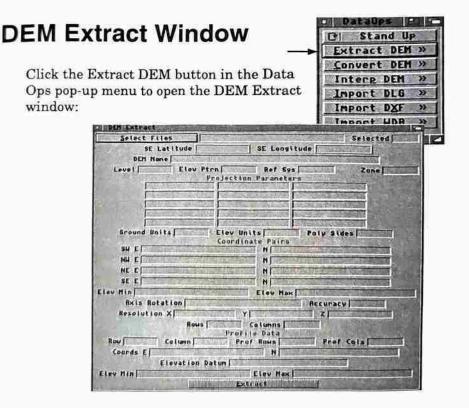
You should set the Default Directory in the Directory List window (see Database Module chapter) to the path you wish the output Objects to be stored. Some WDB files are quite large and can result in thousands of Objects so be prepared for this process to take some time and storage space.

The total size of the output files will be larger than the original WDB file due to expansion of short integer values into double precision floating point.

There are only a few classes of data in WDB files and these are used to give the WCS Objects unique names by appending a series of alphabetic characters to the name. Layer descriptors will match the class. As more and more Objects are added to the Database, it takes longer and longer to determine if a name has been used already. The result can be a slowing of the process as the Database grows.

If you must abort the process for any reason, those Objects already created will remain for your use or disposal.

Note: Be sure to save your Database after importing WDB files. If you don't you won't have access to the newly created Object files the next time you run WCS.



Reference 4 - Data Operations Module

This window lets you import United States Geological Survey (USGS) One Degree Digital Elevation Model terrain data.

You can move the DEM Extract window anywhere on the screen. It is non-modal, which means you can leave it open and use it at any time except during rendering.

Note: This window is very large in order to show the entire USGS header structure when you are extracting a file, which will be useful to those familiar with these kinds of files (and if you don't know what it all means you can safely ignore it). Depending on the font you are using you may need to be working on an overscan screen to see it normally. You will get a substitute font much smaller in size if there is not enough room to open the window in your normal font.

Select Files Button

Keyboard Shortcut: s

Use the Select Files button to select DEM files for extraction.

Click the Select Files Button.

A standard file requester will appear. The file requester will show the Default Directory but you can choose files from anywhere on your system.

You can select a single file by clicking its name in the file requester.

You can select multiple files by holding the shift key while clicking the names of as many files as you wish to extract.

When you extract a file, WCS will take the file name and append a period and one of 16 letters (A through P) to distinguish subdivided DEM entities. If the resulting name is longer than 10 char-

acters, the input file name will be truncated accordingly. If the file name is already 9 or 10 characters long, there will be no room for the dot and added letter. To avoid this problem, change the name of the input files before using the Select Files button. Do this from the Amiga Workbench using the Rename menu command. If you are not familiar with this process, see the manual that came with your computer.

The naming convention adopted for use here at Questar is to name input files for the southeast corner of the one degree block covered by the data. For instance if the block's southeast corner is at latitude 40 degrees and longitude 105 degrees, the resulting name would become 40105. You can use any system you like and do not need to adhere to our convention.

Short names, preferably no more than 5 characters in length, will allow room for additional letters to be appended if you interpolate the data at a later time (see Interp DEM later in this chapter).

Selected Display Field

The Selected Display field shows how many files you've selected for extraction.

SE Latitude Field

The SE Latitude field lets you set the southeast corner reference latitude for each DEM you are extracting. When you extract a file WCS will ask you to enter a latitude number in this field. The number you enter here should be the southeast corner latitude in degrees of the area covered by the input data file.

Note: One Degree DEM files do not contain sufficient information for WCS to know this value automatically. Refer to Appendix A: A Lesson In Geography if you are unsure about using longitude and latitude values.

SE Longitude Field

The SE Longitude field lets you set the southeast corner reference longitude for each DEM you are extracting. When you extract a file WCS will ask you to enter a longitude number in this field. The number you enter here should be the southeast corner longitude in degrees of the area covered by the input data file.

Note: One Degree DEM files do not contain sufficient information for WCS to know this value automatically. Refer to Appendix A: A Lesson In Geography if you are unsure about using longitude and latitude values.

Extract Button

Keyboard Shortcut: e

Use the Extract button to start the extraction process.

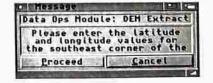
Note: If you haven't selected any files to extract, the Extract button will be ghosted. You can select files using the "Select Files" button, described above.

To extract data files into WCS DEM files:

Click the Extract Button

WCS will look at each selected file in turn until all extractions are complete or until an error occurs such as a full disk drive or incorrect file type.

As WCS extracts the files it will ask you to supply latitude and longitude values for the southeast corner of each DEM (the SE Latitude and SE Longitude fields are described above).



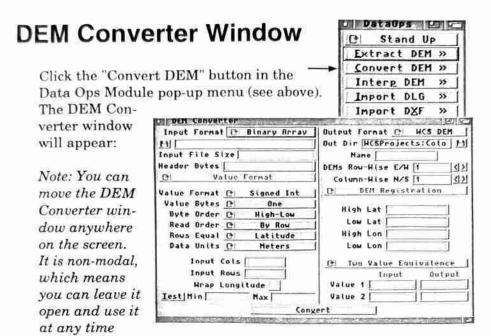
Save the Database

The Database itself must be saved to preserve the additions you have just made. Do this using the Save button in the Database Module pop-up menu or the Save button in the Database Editor.

During the extraction process you'll see each file's header in the upper part of the window with column headers in the lower part.

DEM items will be added to the Database as they are extracted. If you about the extraction process, completed items will remain available for use. You can open the Database Editor window to see the new DEM Objects in the list.

Note: You can watch items being added to the Database Editor window during import operations if you want, but it's much faster if you close the Database Editor when you're importing DEMs into a Database. Closing the Editor first also helps prevent memory fragmentation.



WCS uses two dimensional arrays as its basic data format. A two dimensional array is a fancy term for a bunch of numbers arranged in columns and rows, like those in a spreadsheet.

except during rendering.

WCS supports the conversion of numerous binary and ascii array formats to and from WCS DEM format. You can use this window to convert bitmapped images to the WCS Color Map format, to convert arrays to Z Buffers, or just as an array conversion utility.

WCS uses different formats of two dimensional arrays for various purposes:

Digital Elevation Models (DEMs)
 Survey data that WCS uses to define the shape of the landscape.

Z Buffers

Depth files that store the distance of each pixel from the camera so WCS knows what parts of the landscape are behind other parts of the landscape.

Color Maps

Bitmap images that let you colorize areas of landscapes or force specific Ecosystems to appear in specific places on a landscape.

WCS lets you flexibly change data from one format to another using the DEM Converter window.

Examples

For example, you can export a terrain model as a gray-scale image. You can then load it into a paint program and edit the picture with standard painting tools. Whiter areas represent higher places in the landscape and darker areas represent lower places in the landscape. By adding your own lighter or darker areas you can "terra-form" the landscape to your own desired contours. You can then re-import it into WCS as a DEM to render (see the Tips & Tricks chapter).

As another example, you can import a gray-scale image, perhaps an alpha channel, as a Z Buffer, converting it to a floating point array that would allow you to merge a background image as WCS renders the terrain. The background image would be treated as if it had depth of its own. Objects in the background image could actually obscure parts of the terrain (see the Tips & Tricks chapter).

You can also import more exotic forms of data, including data created in a spreadsheet, and render it as a Landscape or Surface to help visualize the data. WCS lets you convert an ascii spreadsheet or nearly any other kind of array into DEM format (see the Tips & Tricks chapter).

WCS also lets you convert array data from one variable type to another for purposes outside of WCS altogether. You might have

Reference 4 • Data Operations Module

data that was generated on a PC in Intel format and need to use it on the Amiga which, with a Motorola processor, uses a different byte order in its integer representations. The DEM Converter window lets you convert between the two.

Finally, The DEM Converter window lets you import DEM files in the proprietary format used by Virtual Reality Labs' VistaPro. At this time only the "small" VistaPro format is supported but it is one way to obtain higher resolution data for selected geographic areas.

Other DEM formats may be imported using this window if you know something about the file headers. ERDAS format files for instance are regular arrays of data with a standard header size of 128 bytes. Knowing this and how many rows and columns of data there are in the file you can bring the array into WCS as a DEM.

DEM Converter Window Layout

There is an input side and an output side to the window. On the left you will establish the parameters describing the input data and any pre-processing you wish to perform. On the right is the output description along with any processing which needs to be done.

Input Formats

You can choose from these input formats:

- Binary Array
- WCS DEM
- Z Buffer
- Ascii Array
- Vista DEM
- IFF-ILBM Images

Binary Array variable formats may be one, two or four byte integers, either signed or unsigned, and four or eight byte IEEE floating point.

You'll need to know a certain amount of information about the input array, depending on the format you choose. For WCS

DEMs, Z Buffers, Vista DEMs and IFF-ILBM images all of the Variable Format information will be supplied by WCS. For Binary and Ascii Arrays, WCS will determine the overall size of the input file and you must supply the header size (if there is one) and all variable format specifications.

Be sure to select the input array format before selecting the input file. This allows WCS to analyze the data in the file headers if the format is known to WCS.

Output Formats

You can choose from these output formats:

- Binary Array
- WCS DEM
- Z Buffer
- WCS Color Map
- IFF-ILBM 8-bit Gray-Scale Image
- IFF-ILBM 24-bit Image

On the output side, again depending on format, certain data are essential, others optional.

You MUST always specify an output directory and file name.

If the format is WCS DEM you MUST specify the DEM Registration values. WCS must know where in the geographic coordinate system the DEM belongs. See the Lesson In Geography chapter if you do not understand how to set these registration values.

For all but Binary Array output you can ignore the Value Format information. WCS will supply it automatically when it matters. For Binary Arrays, such as when you are exporting a DEM as a raw (not IFF) gray-scale bitmap, you must supply the format information.

With all formats you can use the DEMs Row-Wise and Column-Wise fields to tell WCS to create more than one output file in

Reference 4 - Data Operations Module

either direction. This can be very important if you are converting a large array of data to a WCS DEM.

WCS loads each DEM into memory as it renders. If the DEM is too large WCS will not be able to render it. The solution is to break it down into smaller units. You can specify how many units in both the row-wise (east-west) or column-wise (north-south) dimensions. The DEMs that come with WCS are 301 rows by 301 columns in size. If your input array is 1200 columns by 600 rows you could output it as 4 DEMs row-wise and 2 DEMs column-wise to approximate the standard 301 x 301 dimensions.

Note: There is nothing magical about 301 x 301. It just happens to work well for the normal One Degree DEMs that WCS uses. The number of rows and columns can be anything you wish, memory permitting.

In the Value Format & Sampling section, you can enable resampling to a different number of total data rows or columns if you fill in the appropriate variables. A larger number than the input rows and columns will mean finer density of data points and higher resolution. Reducing the numbers, called downsampling, could be useful for generalizing elevation models. If you leave them blank, no resampling will occur.

The Equivalence variables at the bottom of the output side let you specify any data value scaling operations you want to have performed. This can also be applied to any output format. It could be used to scale Z Buffer values for merging images or to convert elevations to gray-scale and vice versa.

DEM Converter Window Gadgets

Pre-Processing Options

You can choose from two pre-processing options:

Floor and ceiling value substitutions.

Use these to limit the highest and lowest values so that they don't go below a "floor" value or above a "ceiling" value. Numbers below the floor value will be changed to equal the floor value. Numbers above the ceiling value will be changed to equal the ceiling value.

For example you could use the ceiling substitution when converting a Z-Buffer from a floating point array to a gray scale image to limit the upper end of the range. Otherwise the gray scale image would be primarily black (distant). See the Tips and Tricks chapter for more about Z-Buffer conversion.

Array cropping.

Use this to reduce the area of the array by removing data from around one or more edges. You would use this to make a landscape smaller.

Data Processing Options

You can choose from three data processing options when converting:

Resample the array to different overall dimensions. Use this to change the spatial resolution of the data. A data array can be sampled to higher or lower resolution.

The original data is resampled using a bi-linear splining technique (curve-fitting).

Subdivide the array into a number of arrays.

Use this to convert one large array into numerous smaller arrays. This is useful to conserve memory during rendering.

Reference 4 - Data Operations Module

Scale the data.

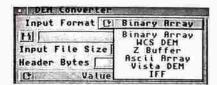
Use this to convert between different units of measure for instance when converting a DEM or Z Buffer to gray-scale image.

Input Format Cycle Gadget

Use the Input Format cycle gadget to determine the array format of the source data set.

You can choose from six options:

- Binary Array
- WCS DEM
- Z Buffer
- Ascii Array
- Vista DEM
- IFF-ILBM image



This gadget should be set before selecting the input file so that WCS can use the format information to fill in other fields below when possible.

Binary Array format is any binary data that can be represented in rows and columns, that has a consistent variable type (such as two byte integer or four byte floating point), that is not compressed in any way, and that is contiguous in the file.

There may be header information if you know the header size and there may be additional data beyond the array in the file but the body of data itself must proceed from the first to last value without interruption.

WCS DEM is the format used for topographic data by World Construction Set. This is the format provided with the program and the format generated with Data Ops functions like Extract DEM and Interpolate DEM. This format is used only for DEM Objects, not Vectors.

Z Buffer format files are generated after rendering if the Settings Parameter "Export Z Buffer" is enabled and the export format is set to "Floating Pt IFF" (see the Settings section of the Render Module chapter).

Ascii Array files have the same restrictions as Binary Array format above. The only difference is that the data is in ascii text characters rather than binary. If you are in doubt which it is, open the file with a text editor and see if you can read it like normal numbers. If so it is ascii. Any non-numeric character may be used as a field delimiter with the exception of "-/." Legal delimiters include commas, blanks, tabs, linefeeds, carriage returns, and alphabet characters.

VistaPro format DEM files are widely available. The DEM Converter can be used to import any "small" VistaPro format file into WCS. At this time the "large" and "huge" files are not supported.

IFF-ILBM (interleaved bitmap files) are the standard on the Amiga platform. The DEM Converter can import and convert any 8 bit (gray scale) or 24 bit IFF files. Please note that an 8 bit gray-scale image, the type WCS supports, is not the same as a palette-mapped 8 bit (256 color) file. Attempting to load a palette-mapped 256 color file will yield strange results.

Name Button & Field

Use the Name field to specify the input file for conversion. You can either type the file path and name directly or use the Disk button to the left of the field. Click the button and a file requester will appear. Choose the appropriate drawer and file and select "OK."

Using the Disk Button to select a file as opposed to entering a name directly in the string will trigger WCS' format analysis routine which attempts to fill in other information about the file in the gadgets below. Select the appropriate Input Format before using this button to gain maximum advantage of the analysis.

File Size Display Field

The File Size Display field shows the file size in bytes.

This field is filled when format analysis is performed in connection with file selection (see "Name" above). The file size may be used to estimate the value format and value size (bytes) when the number of rows and columns is known according to the formula:

File Size = Header + (Rows x Columns) x Value Size

Header Bytes Field

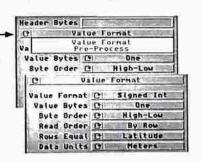
The Header Bytes field Determines the size of data offset, if any, from the beginning of the input file.

This field will be filled in during format analysis (see "Name" above) if the format is WCS DEM, Z Buffer, Vista DEM or IFF-ILBM. It may be left blank if there is no header in Binary Array or Ascii Array files.

Value Format/Pre-Process Cycle Gadget

Use the Value Format/Pre-Process cycle gadget to display either the _____ Value Format settings or the Pre-Process settings. Click the circular arrow to switch between them.

Both the Value Format and Pre-Process settings will be used to process the input file.



Value Format Cycle Gadget

The Value Format cycle gadget determines the type of variable to be input, whether signed or unsigned integer or floating point. This gadget setting is mandatory.

All floating point variables are taken to be signed and they must be in IEEE format.

Value Bytes Cycle Gadget

The Value Bytes cycle gadget determines the value size of individual input data items. This gadget setting is mandatory. Notes: Integers may be one, two or four bytes, floating point values may be four or eight bytes.

Byte Order Cycle Gadget

The Byte Order cycle gadget determines if integers are in Motorola (Amiga, Mac, SGI) format of high byte first, or Intel format of low byte first (PC). This gadget setting is mandatory.

This setting is irrelevant for floating point values. If you are importing data from other platforms be sure to check the processor. If your output looks unrealistic it may be that this setting needs to be changed. You can use the "Test" function below to see if values are realistic.

Read Order Cycle Gadget

The Read Order cycle gadget determines what order the data is presented in the input array.

For WCS' purposes, rows are considered to run left to right or west to east. Columns run top to bottom or north to south. Bitmap array data such as gray scale images are read by row. WCS DEM data is read by column. "By row" means that all of the columns in one row are read then all of the columns in the next row, etc. If you don't really care about the orientation of the output data or don't want it changed leave this at the default setting (by row).



Rows Equal Cycle Gadget

The Rows Equal cycle gadget determines if an input row is to be output as a row of latitude or column of longitude. "Rows equal

Reference 4 - Data Operations Module

latitude" is the normal setting since for standard map presentations, north is at the top of the image.

If you don't really care about the orientation of the output data or don't want it changed leave this at the default setting (latitude).

Data Units Cycle Gadget

The Data Units Cycle Gadget determines the scaling factor stored in WCS DEM files.

WCS DEM files contain header information that tells WCS how to treat the data when rendering. One of the items is a scale factor that converts the stored elevation values to a standard scale (kilometers).

DEM elevations are normally in meters but they do not need to be. If you wish higher resolution you can use either feet, inches or centimeters. Set this cycle gadget to the units you wish to treat the data as

This setting will not cause scaling of the data as DEM Conversion takes place. It is only during rendering that it will have an effect.

The default setting is meters. If you select "Other" as the units, the scale will be set to meters.

Please also be aware that WCS DEMs store only integer values. This means that you will get no higher resolution than this setting. Also note that the maximum DEM value is 32767. Obviously if you use inches as your units you have a smaller elevation range to work with than if you use feet or meters. If you use kilometers, you will have great range but poor resolution. Feet or meters will generally work best.

This setting is ignored if the output format is other than "WCS DEM."



Floor Button & Field

The Floor button and field determine if a floor (minimum) value is to be applied to the input data set.

Set the minimum threshold value in the string and activate the check box to its left.

All input values less than the floor value will be replaced with the floor value. The check box must be selected or the string value will have no effect. This is necessary so that WCS does not mistake "no value" for zero.

You can test the input data range using the "Test" function below to help with this setting. The "Test" results will show the effect of a floor value only if the check box is selected. If the string is blank it will be taken as 0 if the check box is selected.

Ceiling Button & Field

The Ceiling button and field determine if a ceiling (maximum) value is to be applied to the input data set.

Set the minimum threshold value in the string and activate the check box to its left.

All input values greater than the ceiling value will be replaced with the ceiling value. The check box must be selected or the string value will have no effect. This is necessary so that WCS does not mistake "no value" for zero.

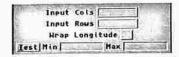
You can test the input data range using the "Test" function below to help with this setting. The "Test" results will show the effect of a ceiling value only if the check box is selected. If the string is blank it will be taken as 0 if the check box is selected.

Crop Left, Right, Top, and Bottom Fields

The Crop fields determine if the input array is to be cropped on any side and by how many rows or columns.

Set only the values that apply. Blank values will be taken as 0 and no cropping will be performed.

The left, right, top and bottom designations refer to the data as it is arrayed in the input file, not as it might be reoriented in output.



Input Cols Field

Use the Input Cols field to set the number of vertical columns present in the input array. This gadget setting is mandatory.

After selecting the input file, if this value has not been completed by the format analysis process, you must supply a value.

Frequently you can determine the array size from the file size and a knowledge of value format and size. For WCS DEM, Z Buffer, Vista DEM and IFF-ILBM formats this value will be supplied.

You will be warned that the file size is incorrect when conversion begins if the header + rows x columns x value size does not equal the file size. It may be that there is additional data present in the file beyond the data array itself in which case you may choose to continue with the conversion. Otherwise you may need to rethink at least one of the size variables.

Input Rows Field

Use the Input Rows field to set the number of horizontal rows present in the input array. This gadget setting is mandatory.

After selecting the input file, if this value has not been completed by the format analysis process, you must supply a value (see Input Cols above).

Wrap Longitude Checkbox

Use Wrap Longitude to tell WCS that an input array wraps completely around the globe.

When a data set is to completely encircle the globe WCS needs to know. The first column of data will be duplicated as the last so that when the globe is rendered it will be seamless.

Select the box so it displays a checkmark if the data is to circle the whole globe. Otherwise the box should not be checked.

Test Min/Max Display Button

The Test Min/Max Display Button lets you tell WCS to scan the input file and determine the minimum and maximum values present. This can be used to determine if the value format settings are correct before actually converting the data and to help adjust floor/ceiling and scaling parameters.

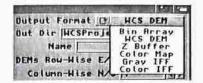
Select an input file and then click the Test button. The file will be opened and scanned. The minimum and maximum values will be inserted in the text gadgets.

Floor, Ceiling and Cropping will be applied prior to the scan operation (see these items above).

Output Format Cycle Gadget

Use the Output Format cycle gadget to select the format of the output file.

The supported formats are: Binary Array, WCS DEM, Z Buffer, WCS Color Map, IFF-ILBM 8 bit gray-scale, and IFF-ILBM 24 bit color image.



Color Map format is a set of three color component files oriented in the same way as a WCS DEM (column-wise data beginning at the southwest corner). A file that already has the correct orientation will have north at the right and west at the top of the image when viewed in a paint program. Color Maps generated from Map View will already be in the correct orientation and should not be converted with this function or the orientation will be rotated an additional 90 degrees.

The gray and color IFF formats are most useful on the Amiga for terraforming DEMs. Both gray and color IFF files will contain the same gray-scale data. The reason for the color format support is that some paint programs won't load 8 bit non-palette-mapped IFF files. The 8 bit (gray-scale) files will be smaller if your paint program can use them.

A Binary Array output could also be used for terraforming. You would convert a DEM to a gray-scale array (one byte, unsigned - Sculpt format). The array output will have north at the top of the image. After processing it can be imported back into WCS as a DEM. It will be converted back to DEM orientation using the default input orientation settings.

Terraforming is explained in the Tips & Tricks chapter of this manual.

Simply the ability to convert array data from one variable format to another including cross-platform format conversions could make WCS valuable far beyond its rendering capabilities.

Out Dir Button & Field

Use the Out Dir (Output Directory) button to set the device and directory for conversion output.

Enter a directory path in the string gadget or select the Disk icon and set a path using the file requester.

You MUST enter an output directory and file name regardless of the output format. The default provided is the Default Directory as set in the Project Editor window or in the Directory List window.

Name Field

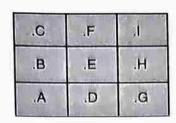
Use the Name field to set a name for the output file.

Enter the desired name in the string gadget or use the Disk Button next to the directory string to select or enter a name. You MUST enter a name.

In the case of Vista DEM input a name will be supplied here based on the name embedded in the Vista file. You can change it if you like.

If the output format is "WCS DEM" the output entity will be added to the Database using this name. If it is longer than 10 characters the name will be truncated. It's a good idea to use names of only five or six characters to leave room for the extra letters WCS adds when interpolating, if you think you'll ever need to interpolate the DEM for greater resolution.

If there is more than one output file, letters will be appended to the name to distinguish them. The letters will begin with 'A' in the lower left (southwest) and increase to the top (north) and then to the right (east) as in the following example which has nine output maps:





DEMs Row-Wise E/W Field & Buttons

Use the DEMs Row-Wise E/W field and buttons to set the number of output maps running east-west or left-right.

A single input array may be broken into as many output arrays as desired to optimize memory during rendering. If the array size is not evenly divisible by the number of output maps you will be so advised.

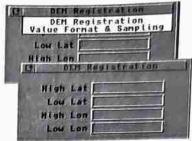
There is no harm in having unequal sized DEMs in WCS so normally you simply acknowledge the warning and instruct WCS to proceed. The value of the warning is that if you see the dimension of one axis is much greater than the other you may wish to abort and select a different number to even them out. This could also be an indication that the output row-wise number is switched with the column-wise number.

Column-Wise N/S Field & Buttons

Use the Column-Wise N/S field and buttons to set the number of output maps running north-south or top-bottom (See "DEMs Row-Wise E/W" above).

DEM Registration/Value Format & Sampling Cycle Gadget

Use the DEM Registration/Value Format & Sampling cycle gadget to select either the DEM Registration settings or the Value Format & Sampling settings. Click on the circular arrow to switch between them.



The DEM Registration settings are only important if the output format is "WCS DEM." The Value Format & Sampling settings apply to all formats.

Latitude & Longitude Fields

Use the High Lat, Low Lat, High Lon, and Low Lon fields to set the maximum and minimum latitudes and longitudes that WCS should consider as the registration coordinates for output DEM files.

These values are only important if the output format is WCS DEM but in this case the values are essential. They are the four corners of the resulting DEM files, and they are what WCS will use to position each DEM onto the globe.

If you have no idea where the data belongs in the world geographic coordinate scheme you should read Appendix A: A Lesson in Geography."

Where the data is placed determines the length of the east-west cell dimension relative to the north-south dimension. Even if this is arbitrary data, a poor choice will result in elongation along one axis.

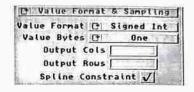
For data that should have equidistant spacing on both axes (say you wanted to render the output of a spreadsheet) you should place the data along the equator (±one degree latitude perhaps).

Reference 4 - Data Operations Module

The distance between high and low latitude and longitude values will determine the steepness of slopes. In arbitrary data cases you may wish to experiment with different ranges to see which comes closest to giving you the amount of terrain relief you wish without applying vertical exaggeration or flattening to achieve the effect.

For input files of Vista DEM format there is a default set of latitude and longitude values which are placed in these gadgets by the program when you select the input file. These values are ones which should work in all cases but they are not the actual geographic coordinates of the DEM. If you know the appropriate coordinates you can fill them in here.

Value Format Cycle Gadget



Use the Value Format cycle gadget to determine the type of variable to be output, whether signed or unsigned integer or floating point. You MUST set this for Binary Array output. For all other formats it will be ignored and set internally.

All floating point variables are taken to be signed and they must be in IEEE format.

Value Bytes Cycle Gadget

Use the Value Bytes cycle gadget to determine the value size of individual output data items. You MUST set this for Binary Array output. For all other formats it will be ignored and set internally.

Integers may be one, two or four bytes, floating point values may be four or eight bytes.

Output Cols Field

Use the Output Cols (Columns) field to set the total number of output columns. This determines if the data will be re-sampled prior to conversion. Re-sampling is used to increase or decrease the data's spatial resolution. Thought of in terms of rendering quality, higher resolution will yield smaller polygons and the appearance of more detail in a terrain model.

The original array may be splined to either a larger or smaller size. If this item is left blank or is 0 there will be no width-wise (east-west) re-sampling.

Output Rows Field

Use the Output Rows field to set the total number of output rows. This determines if the data will be re-sampled prior to conversion. The notes for Output Columns above apply here as well.

The original array may be splined to either a larger or smaller size. If this item is left blank or is 0 there will be no height-wise (north-south) re-sampling.

Spline Constraint Button

Use the Spline Constraint button to limit the excursions of the spline function during re-sampling operations.

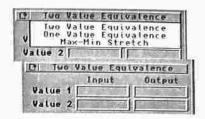
Splining is a method of data interpolation that fits a smooth curve between data points and extracts new values at points between the originals. It generally yields better results than linear interpolation methods. There are cases though where splines can create anomalous high frequency events. These are seen as fringes around regions of high data contrast. Spline Constraint will eliminate such anomalies.

When selected, splined values will always fall within the limits established by the end points of each spline interval. In less contrasty situations the small excursions that result from splining may actually be desirable to add additional depth.

Two/One Value Equivalence/Max-Min stretch Cycle Gadget

Use the Two Value/One Value/Max-Min Stretch cycle gadget to select the type of value scaling to be applied.

Select the type that best suits your knowledge of input/output value equivalence. Special settings for each type will appear below the cycle gadget.



Two Value Equivalence

If you choose Two Value Equivalence you'll see four fields that let you set the scaling and translation parameters for conversion.

Set the equivalent values on both the input and output side of the equation. WCS will compute the scale and translation factors for you.

Use this page if you know at least two equivalent values in the input/output data set.

For example let's say you are converting a Z Buffer with a maximum value of 30.0 (you know this because it is the Ceiling value you designated on the input side of this window) and a minimum of 0.0 (a WCS Z Buffer will never have values less than 0.0). If you wish to output this array as a gray scale array with a maximum of 255 and a minimum of 0 but you want the highest input (farthest) value to be equivalent to 0 and the lowest value to be 255, you would set up the four fields like this:

	Input	Output
Value 1	30.0	0
Value 2	0.0	255



One Value Equivalence

If you choose One Value Equivalence you'll see three fields and one cycle gadget. Use them to set the scaling and translation parameters for conversion.

This equivalence type requires that you specify three values and designate which variable type the third value represents. The third value may be a maximum output value, minimum output value or a scale factor. WCS will compute the scaling and translation factors based on the type of data represented by the third value.

Using the above example, if the minimum input value were 0.0 then the results would be identical. Otherwise whatever the minimum value might be will become 255 in the output file.

	Input	Output
Value 1	30.0	0
Min Out		255

Alternatively a scale could be used to express the same thing:

	Input	Output
Value 1	30.0	0
I/O Scale		1176

where I/O Scale is a ratio of input to output ranges.



Max-Min Stretch

If you choose Max-Min Stretch you'll see two fields. Use them to set the scaling and translation parameters for conversion.

Reference 4 - Data Operations Module

Set the maximum and minimum output values desired. WCS will compute the scaling and translation factors necessary to scale the data to this range.

Use this if you know only the desired output range or if you want the actual input range scaled to a particular output range. Floor and Ceiling values will be applied before scaling factors are calculated.

In the above example, if the minimum value present in the file were 10.0 and the maximum after Ceiling substitution was 30.0, using this equivalence type would create more dynamic range in the output image since the unused 0.0 to 10.0 range is eliminated from the computation.

Convert Button

Keyboard Shortcut: v

Click the Convert button to initiate the conversion process.

The input file will be opened. You will be appraised of the progress in each step of the conversion with a series of progress gauges. The output files will be written if the conversion was a success.

It is a good idea to note from the progress gauges which processes are applied to be sure that all steps were correctly initialized and executed and that no additional processing was done which would indicate that you set something you didn't intend to.

Newly created DEMs are added to the Database automatically. Be sure to save your Database file after converting to WCS DEM format. Otherwise any additions will be lost when you close WCS.

DEM Interpolate Window

Select "Interp DEM" in the Data Ops Module pop-up menu. The DEM Interpolate window will open:

Stand Up

Extract DEM »

Convert DEM »

Interg DEM »

Import DLG »

Import DXF »

DEM Interpolation is used to increase the resolution of terrain data. Whenever renderings show polygons too large and angular to be successfully removed with



increased Fractal Depth (see the Settings section of the Render Module chapter) or Ecosystem Texturing (see the Ecosystem Parameters chapter) you should interpolate the DEM data. Interpolation is the most effective remedy for the polygon problem but it also is the most expensive in terms of rendering time and as such should be used sparingly.

Only those DEMs which appear in the foreground somewhere in an animation should be interpolated. Renderings may encompass DEMs of varying resolution so long as the boundary between two different resolutions is not too near the Camera. Sharp linear Ecosystem changes may be indicative of a resolution boundary.

Note: Due to the 10 character file name limit for DEM files, and the fact that interpolating DEM files adds a character to the end of the name, you can't successfully interpolate a DEM that has a name that's already 10 characters long. If the name of the DEM you want to interpolate is already 10 characters, rename the DEM with a shorter name before interpolating.

DEM Interpolate Window Gadgets

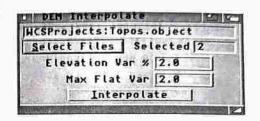
Name Display Field

The Name field displays the path of the selected input files. This field will be blank untione or more files ae selected.

Select Files Button

Keyboard Shortcut: s

Click the Select Files button to select files for interpolation.



A standard file requester will appear showing only ".elev" files which are the only ones that should be interpolated. Select a directory and as many files as desired by clicking on the first file and shift-clicking on the rest. Select "OK" when the process is complete.

Selected Display Field

The Selected field displays the number of DEM files selected for interpolation.

If this number is one or larger the "Interpolate" button will become enabled.

Elevation Var Field

Use the Elevation Var field to set the amount of random variation applied to surfaces as a function of the elevation difference between the two end points on each spline segment.

This value could range from 0 to 100%. The higher the value the more perturbed the resulting surface will be. The default of 2% appears pleasing to our eye in most cases.

Max Flat Var Field

Use the Max Flat Var field to set the maximum amount of elevation variation to be applied where surfaces are flat.

Since the variation as a function of elevation difference will evaluate to 0 if the surface is flat, this setting allows some randomness even on flat portions of the terrain. This is essential to creating realism on valley floors in particular. We have found that a value of 2 meters works well in many cases but feel free to experiment.

Interpolate Button

Keyboard Shortcut: i

Click the Interpolate button to start the interpolation process.

Each selected file will be examined in turn, interpolated and the output files written to the same directory as the source files. For each input file four new DEM Objects will be added to the Database and be automatically enabled for rendering and mapping. The parent DEM will be disabled for mapping and rendering but will remain in the Database for later use.

If the destination device becomes filled, the interpolation process will stop but all files saved successfully will remain available for use.

Relative Elevation Models (REM's) will also be interpolated at the same time as the corresponding DEMs. If no REM exists for a DEM it will be created and then interpolated.

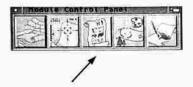
Note: Be sure to save the Database file after interpolating or the interpolated DEMs will not be available the next time you run WCS.

Reference 5 - Map View Module

- Overview
- Map View Control Window
- Map Alignment Window
- Ecosystem Legend Window
- Map View Window
- Mouse-Keyboard Shortcuts
- Map View Menus

The third of World Construction Set's five main modules is the Map View Module. The Map View Module uses two main windows, the Map View window and the Map View Control window.

To open the Map View Module click the third icon in the Module Control Panel:



or select the Map View Module command in the pull down menu:



The Map View and Map View Control windows will open and any enabled Vector Objects will be loaded into memory. The map itself won't be drawn until you click the draw button.

World Construction Set

Note: The size and position of the Map View window are saved in the Project file so that each Project can have a custom configured work space. The last position used when the program closes will be stored in the Prefs file and the window will open at that position next time unless a Project file is loaded and overrides the Prefs setting. If WCS is unable to open the window at the previous position due to a reduction in screen size, it will be repositioned to fit the smaller screen.

Overview

The Map View window lets you see an overhead view of your terrain and Vector Object data. It shows you a flat projection of the data as it would look from directly overhead.

As you might guess from the name "Map View," it's just like looking at a map.

You can choose what Objects are visible on the map. You can use the mouse to position the camera and focus point, and to adjust the view arc and haze distances.

Changes you make in the Map View window will be reflected in other WCS windows. For example, if you drag the Camera with the mouse in the Map View window, the Camera View window (available from the Motion Editor window) will also change.

The companion Map View Control window has buttons and fields that let you determine what is shown on the Map View window.

You can open the Map Alignment window and the Ecosystem Legend window from the Map View Control window. The Map Alignment window lets you specify registration coordinates when digitizing Vector Objects from a tablet.

You can use the Ecosystem Legend window along with the Eco button to shade the Map View with colors representing ecosys-

Reference 5 - Map View Module

tems. This is invaluable when you're adjusting Ecosystem Parameters and want to see how the Parameters are affecting where WCS is placing ecosystems.

Special Map View menus give you access to useful commands that let you do things like digitize new Vector Objects by clicking on the Map View window with the mouse; conduct a Viewshed Analysis to see what areas are visible from any point on the map; and a Fix Flats function that lets you fix the tops of mountains if the data resolution is low enough to make them look more like buttes than peaks.

To the best of our knowledge, WCS' mapping package is the only 2-D or 3-D Geographic Information System available on the Amiga platform. It provides sophisticated features such as Visual Sensitivity Analysis normally found only in expensive work station environments.

Visual Sensitivity Analysis lets you determine what points are visible from a road or from a proposed housing development or for any number of other uses. This sophisticated tool, in combination with Color Mapping and 3-D rendering, could be a significant revenue generator for WCS users.

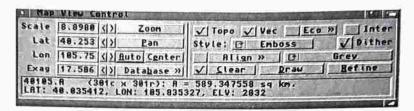
If this portion of the program proves to be valuable to our users, rest assured that it will expand to encompass even more GIS features in the future. While we think we have made a bold start, we realize that we have barely scratched the surface in this department.

Note: Many of Map View's commands are modal. In other words once you invoke these commands you must carry through with certain actions (like mouse clicks or keyboard entries) before normal WCS operation can resume. When WCS expects certain input from the you, what to do both in the Map View Control window and in Map View's title bar. Be sure to keep an eye out for these messages so you don't mistake modal operations for a program lock-up.

Map View Control Window

The Map View Control window gives you handy access to many frequently used map scaling, positioning and drawing controls.

Note: Most of these commands are also available from the Map View menus, the special menus that are only available when the Map View window is active.



The Map View Control window also gives you buttons for selecting which sets of data items to draw. In the case of DEMs there are a number of options to adjust palette, map style and exaggeration.

One of Map View Control's primary functions is to relay messages to the user. Here you will find out if WCS is expecting mouse or keyboard input and what the available options are at any given time during any given operation. When there is no specific anticipated activity you will find other useful information such as Active Object identification, latitude, longitude and elevation data, and so on.

Map View Control window will remain open as long as the Map View window itself is open. Closing the Map View Control window will also close the Map View window and free all Vector and DEM memory.

Scale Field & Buttons

Use the scale field and buttons to set the map drawing scale. This lets you zoom in and out. To redraw the map in the new scale click the Draw button (see Draw button below).

Enter a value in the field, or click the arrow buttons to halve and double the value.

Scale is a ratio of real world units to screen units similar to the kilometers/inch scales often found on printed maps. The larger the number the more area the map covers. To zoom in on the map you must make the value smaller.

A scale of 4000 is large enough to let you see the whole world. A scale of 1 to 10 is most useful for working with the WCS' standard DEMs.

Lat Field & Buttons

Use the Lat (Latitude) field and buttons to set the latitude coordinate for the center of the Map View. This lets you scroll the map up or down in the Map View window.

Enter a value in the field, or click the arrows to move by one half the screen height. Increasing the value moves the view point north and shifts the map downward on the screen.

You will need to click the Draw button (see below) to update the map.

If you are not familiar with the latitude/longitude coordinate system refer to Appendix B: A Lesson in Geography.

Lon Field & Buttons

Use the Lon (Longitude) field and buttons to set the longitude coordinate for the center of the Map View. This lets you scroll the map left or right in the Map View window.

Enter a value in the field, or click the arrows to move by one half the screen width. Increasing the value moves the view point west and shifts the map right on the screen.

You will need to click the Draw button (see below) to update the map.

If you are not familiar with the latitude/longitude coordinate system refer to Appendix B: A Lesson in Geography.

Exag Field & Buttons

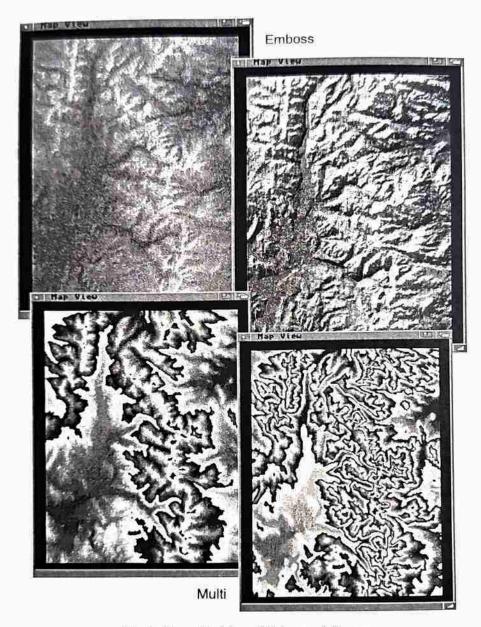
Use the Exag (Exaggeration) field and buttons to set the apparent topographic exaggeration or contour interval.

The function of this value will change depending on which Map Style is active (see below). The value represents the contour interval when the style is "Multi" gradient. For "Emboss" and "Slope" styles the value modifies contrast.

Increasing the value will decrease the contour resolution or contrast. Using a smaller number (higher contrast) with the "Emboss" Map Style can make the Map View look like an aerial photograph.

This gadget is only available when Topo (DEM) Objects are loaded and the Map Style is not "Single" or "Surface."

Reference 5 - Map View Module



Variations in Map Style and Exag

World Construction Set

Note: The Exag setting only affects the appearance of DEMs in Map View. It doesn't change the DEM data files themselves or in any way affect how DEMs will look when rendered. Use the Vertical Exaggeration or Flattening Motion Parameters (see the Motion Parameters chapter) if you want to actually create more or less terrain relief.

Zoom Button

Keyboard shortcut: z

Click the Zoom button to choose a smaller area of the map to fill the Map View window.

You will be asked to select two corner points. Click on the desired northwest corner point then on the desired southeast corner. The scale will be computed to fit all the region into the window and the map will be re-drawn.

If the area you selected has a different aspect ratio than the Map View window itself, additional area may be visible on one axis.

Note: You can also zoom in and out using the "+" and "-" keyboard shortcuts. Map View, not Map View Control, must be the active window to use the shortcuts.

Pan Button

Keyboard shortcut: p

Click the Pan button to shift the Map View drawing in any direction.

You will be asked to set an origin and a destination point with the mouse. Click the first point then move the pointer to the desired location for that point and click again. The map will be re-drawn in the new position.

Note: You can also pan left and right using the left and right arrow keys on your keyboard, with or without holding down the shift key. Map View, not Map View Control, must be the active window to use the shortcuts.

Auto Button

Keyboard shortcut: a

Click the Auto button to center the Map View drawing at the geographic center of all enabled Database Objects.

WCS will compute the geographic center of the enabled Database Objects and re-draw the map.

This is a convenient way to locate yourself if you are lost outside the data area or if you are loading a new Database into Map View for the first time.

Enabling and disabling Objects is accomplished with the Database Editor allowing a selected portion of large Databases to be worked on efficiently.

If the Map Scale (see above) is too small, it is possible that even with Auto Centering, Objects will not appear in the drawing area. Enlarge the scale factor and re-draw.

Center Button

Keyboard shortcut: e

Click the center button to shift the Map View drawing to a new center latitude/longitude.

You will be asked to select the point to center the drawing around. Click at the desired center point in the Map View drawing. The Map View will be re-drawn with the new center.

World Construction Set

Note: An alternative is to control-click at a spot in the Map View window. This will cause the selected spot to become the new map center and to zoom in by a factor of two.

Database Button

Keyboard shortcut: b

Click the Database button to open the Database Editor window.

This has the same effect as clicking the Edit button in the Database Module pop-up menu, but it's handier to open it with this button if you have the Map View Control window open.

The Database Editor lets you enable or disable Objects in the Map View. Enabling an Object causes it or its outline (in the case of a DEM) to be drawn immediately. Disabling it un-draws it. Un-drawing Objects, especially DEMs can have the effect of partially un-drawing surrounding Objects. To restore them you will need to redraw the map.

You also may want to use the Database Editor to change the drawing characteristics, like pen color or line thickness, of Objects in Map View.

You can activate and multi-select Objects using the mouse in Map View for modification in the Database Editor. See the Find Object menu commands later in this chapter.

Activating an object from the Database Editor (assuming it is already enabled and drawn) by single-clicking on its name will cause it to redraw in a highlight color in the map. This makes it easy to identify a Database Object name with an Object in the map.

Topo Checkbox Button

Click the Topo (Topographic) button to enable or disable the drawing of topographic data in the Map View window.

If the button is checked, the next time you click the Draw button DEM elevation data will be drawn according to the Palette and Map Style settings below. De-selecting this gadget will cause DEM data to not be drawn but will not release the DEM memory.



Only those topos enabled in the Database will be loaded into memory. You can cut down on memory requirements by disabling any DEMs you don't actually need.

If you receive an error message while loading DEM data check the Status Log for information. You may be out of memory or there may be a path missing in the Directory List so that certain DEMs can't be found.

If you run out of memory loading DEMs and receive an error message only those DEMs that were loaded will be drawn. Unlike WCS' rendering process, Map View does not load only one DEM at a time. That would make redraws too slow. You should disable enough DEMs in the Database so that they load without any error messages. If you don't disable enough, WCS will try to load all the DEMs again every time you redraw the map.

To free DEM memory without closing the Map View window, disable some or all DEMs in the Database and redraw the Map View. DEMs take considerable memory and you may need to free it for other uses.

Vec Checkbox Button

Click the Vec (Vector) button to enable or disable the drawing of Vector data in the Map View window. When this gadget is selected (checkmark visible) Vector Objects will be drawn every time you click the Draw command.

Vector Objects are things like roads and streams and boundaries of things like parks and lakes. They also can be the outlines of DEM Objects. If you see some white rectangular boxes in Map View when drawing with



this option, chances are you are seeing DEM outlines.

If you want to see only topographic data, de-select this item. The outlines around DEMs will also disappear.

Clicking on any Object (or inside if its a DEM) will tell you what that Object is if you look at the text field in the Map View Control window. This can help you determine what DEMs to disable if you want to speed up rendering times.

Eco Checkbox Button

Click the Eco (Ecosystem) checkbox button to enable or disable the drawing of Ecosystem data in the Map View window.

When this gadget is selected (checkmark visible) Ecosystem data will be drawn every time the Draw command is invoked.

Ecosystem mapping is most useful working in conjunction with the Ecosystem Editor (see the Ecosystem Parameters chapter). You can edit Ecosystems in the Ecosystem



Editor and see the changes immediately in Map View by redrawing the map.

Up to 6 Ecosystems can be shown at a time in Map View. The colors used to represent the Ecosystems are determined by the Ecosystem Legend window described below.

Ecosystems and topography can be shown together if both Eco and Topo Checkboxes are selected in the Map View Control window. This is not only useful but results in some very pretty maps.

Note: The first time WCS needs to compute Ecosystems for a particular DEM (as it does in Eco mapping here and during rendering) a Relative Elevation Model must be computed and saved to disk. It takes some additional time but it need only be done once per DEM for as long as you own the data so it's worth the wait.

Eco Button

Keyboard shortcut: RightAmiga,

Click the Eco button to open the Eco Legend window. This is the same as Selecting the Eco Legend command in the View menu. The Eco Legend window lets you set which Ecosystems can be depicted by which colors for previewing where various Ecosystems exist on the map (see the Eco Legend window below).

Inter Checkbox Button

Click the Inter (Interactive) button to enable or disable the drawing of Camera, Focus, Haze and Sun position information in the Map View window.

When this gadget is selected (checkmark visible), symbols representing the Camera, Focus Point, Haze Rings, Sun and motion paths will be drawn every time the Draw command is invoked. This lets you see where these Motion Parameters are relative to the map.



Note: Depending on the scale of the map and the positions of the Interactive items, they may fall outside of the Map View window. You can increase the scale and redraw to bring them into the picture. To see the sun you may need to increase the scale to around 4000 or so.

You can move these symbols directly with the mouse. Click on them and drag with the left mouse button to change the Camera Longitude/Latitude; Focus Point Longitude/Latitude; Haze Distances; and Sun Longitude/Latitude. If you want to use these interactive symbols to create key framed positions for these Motion Parameters in an animation, first select the desired Motion Parameter in the Motion Editor window. Then move the symbol in the Map View window to its desired location. Finally, create a key frame either in the Motion Editor window (see the Motion Parameters chapter or the Parameters chapter) or by hitting the Enter key in the numeric keypad.

If the Motion Editor isn't open you will only be able to create Camera and Focus key frames with the Enter key.

The motion paths shown in Map View will be updated whenever you make or update key frames. Both Camera and Focus paths are shown.

Style Cycle Gadget

Use the Style Cycle gadget to select the style in which topographic data is drawn in the Map View window.

There are five options:

Emboss

Emboss Style shades the terrain as though the light source was in the northwest (upper left). Use the "Exag" field in the left part of the window to adjust the amount of detail shown.

ALL

Slope With Slope Style darker shades indicate flatter terrain.

Single

Single Style uses a single gradient to represent all elevation data currently in memory. Darker shades are lower elevations.

World Construction Set

Multi

Multi Style uses a repeating gradient to represent elevations. The result is a pseudo-contour map with contour interval specified in the "Exag" field found in the left part of the window. Lighter shades represent higher elevations within a single dark to light gradient band.

Surface

Surface style uses the Surface Elevations from the Render Settings Editor window's Surface page (see the Render Module chapter) to establish three elevation ranges. Each range is represented by a color gradient.

Lighter shades represent higher elevations within a single dark to light gradient band. Elevations below Surface Elevation One are drawn in the darkest shade. Elevations above Surface Elevation Four are drawn in the lightest shade.

Different combinations of Map Style and "Palette" (see below) can be useful.

Dither Checkbox Button

Select the Dither button to enable dithering of DEM surfaces in the Map View window. Dithering gives the effect of more colors to create more precise looking topographic views.

Dithering will be applied whenever you click the Draw button when the Dither button is selected (checkmark visible).

Align Button and Check Box

Keyboard shortcut: g

The Align button opens the Alignment window. There you can force the Map View to be aligned to registration points that you

specify. This lets you adjust reference coordinates when digitizing Vector Objects using a digitizing tablet.



Select the Check Box to enable aligned drawing. Select the

Align Button to open the Map Alignment window (see the Map Alignment window below).

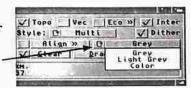
Normally WCS scales the Map View based on the latitude of the center point in the window. Latitude determines the longitudinal (east-west) scale since a degree of longitude is smaller the closer you are to either pole. You may override this automatic scaling by establishing reference coordinates and registration points.

With this done and the Align check box selected all of the other scale and centering features will be disabled. The map will always be drawn at the same position.

Alignment could be used to establish an alternate view position which could be enabled and disabled simply by selecting or de-selecting this check box and re-drawing the map.

Palette Cycle Gadget

Use the Palette cycle gadget to choose the color gradient used for drawing topographic data in the Map View window. There are three choices:



Grey

The grey palette is a standard grey scale gradient.

Light Grey

The light grey palette makes it easier to see Vector Objects against a topographic background.

Color

The color palette is useful for slope analysis and to make certain features more pronounced.

This is a cosmetic effect only and has no bearing on the data presented other than to make it more or less understandable and useful.

Clear Button and Check Box

Keyboard shortcut: c

Click the Clear button to clear the Map View window.

If the Check Box button is selected, the Map View window will be cleared automatically before re-drawing when you click the Draw button (see below).

If the Check Box is not selected, the window will not be cleared when you click the Draw button.

Draw Button

Keyboard shortcut: d

Click the Draw button to draw the Map View window using scale, position and palette settings as currently displayed in the Map View Control window. Topographic, Vector, Ecosystem and Interactive data will be drawn if their respective checkbox buttons are selected (checkmark visible).

Vector Objects are drawn with the attributes defined in the Database. You can enable and disable Objects and change the line color, weight and pattern of Vector Objects from the Database Editor window (see the Database Module chapter).

DEMs can be disabled individually once they are loaded. If you wish to remove certain DEMs from Map View, disable them in the Database Editor window and redraw.

Refine Button

Keyboard shortcut: r

Click the Refine button to draw a selected portion of the Map View window.

You will be asked to set two corner points to define the area. To set, click once on the northwest corner and again on the southeast corner or hit ESC on the keyboard (Map View must be the active window) to cancel. The selected portion of the map will be re-drawn with the current settings.

Draw Refine is useful for seeing a portion of a DEM drawn with a different map style or with a different set of options (for instance with or without Ecosystem data).

Map Alignment Window

Click the Align button in the Map View Control window to open the Map Alignment window:

You can set latitude and longitude reference coordinates in this window to adjust map registration before digitizing Vectors from a tablet source.



Once you've set them, you can add points using the Add Points commands in the Map View window's Object menu.

World Construction Set

Alignment may also be used to change the map aspect. Normally WCS scales the Map View based on the latitude of the center point in the window. Latitude determines the longitudinal (east-west) scale since a degree of longitude is smaller the closer you are to either pole.

You may override this automatic scaling by establishing reference coordinates and registration points. With this done and the Align checkbox selected in the Map View Control window all of the other scale and centering features will be disabled. The map will always be drawn at the same position.

Alignment could be used to establish an alternate view position which could be enabled and disabled simply by selecting or de-selecting this checkbox and re-drawing the map.

NW/SE Lat/Lon Fields

The NW (Northwest) and SE (Southeast) Latitude and Longitude fields let you set the reference coordinates for Map View Alignment and tablet digitizing.

Enter decimal latitude and longitude in degrees. Be sure to enter larger values in the northwest gadget. Positive latitude is considered to be the northern hemisphere and longitude values increase from east to west.

See the "Lesson in Geography" chapter for more information on the global geographic coordinate system.

See the Add Points menu command in the Map View Window section below for information on setting the corresponding source map reference points when digitizing with a tablet.

Upper Left/Lower Right X/Y Fields

The Upper Left and Lower Right X and Y fields let you set the screen registration points that correspond to the reference coordinates above.

Enter values directly into the fields for precise positioning, or set interactively using the Set Registration button below.

The values are in pixels from the upper left corner of the Map View window.

Set Registration Button

Keyboard shortcut: r

Click the Set Registration button to interactively set the screen registration points that correspond to the reference coordinates above.

After you click the Set Registration button, go to the Map View window and click on the desired upper left screen position first and then on the lower right. You may abort the selection by hitting ESC on the keyboard while the Map View window is active.

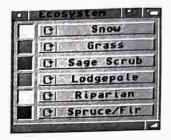
If you want to see the screen coordinates displayed in the Map View Control window as you move the mouse, activate the Map View window by clicking in the window title bar before selecting points.

Eco Legend Window

The Eco Legend window lets you select which colors represent which Ecosystems on the Map View window.

To see these colors on the Map View window, click the Eco Checkbox button so that the checkmark is visible, and then click the Draw button. The colors will be drawn over any visible DEM Objects to indicate where certain Ecosystems are located.

You can open the Eco (Ecosystem) Legend window by clicking the Eco button on the Map View Control window.



The Eco Legend window gives you six cycle gadgets and six color swatches.
Use the cycle gadgets to assign a par-

ticular Ecosystem to the color in the swatch to its left. Then when you draw the Ecosystem colors in the Map View window, wherever you see that color is where the selected Ecosystem exists on your landscape.

Seeing where Ecosystems are placed from the overhead perspective of the Map View window can be a big help when you're setting Ecosystem Parameters (see the Ecosystem Parameters chapter).

Map View Window

The Map View window gives you a 2-D mapping space for displaying and manipulating Vector and DEM Objects and Motion Paths.

To open it click the middle icon in the Module Control Panel or select the Map View command from the Modules menu. The Map View and Map View Control windows will open and any enabled Vector Objects will be loaded into memory.

The Map View gives you an aerial perspective, as if you

were immediately overhead looking down on the earth.



North is always at the top of the map and east is at the right. The size of Objects in the map is controlled by a scale value just like the one used to make printed topographic and highway maps. The larger the scale the more area fits in the map.

The Map View drawing does not try to account for curvature of the earth by using complicated projection schemes. Rather it shows every longitude line as running parallel to the others. Longitude lines run north-south and latitude lines run east-west. In Map view they run top to bottom and left to right respectively.

On the curved earth a degree of longitude gets smaller as it approaches the poles. Map View does try to compensate for the distortion of longitude distances by using a different scaling factor for longitude than for latitude. The scaling factor is computed for the point at the center of the Map View window. This is why DEM outlines often appear rectangular rather than square.

World Construction Set

Visualization is key to creating dynamic images and animations. Using the checkbox buttons in the Map View Control window (see above), both Vector and DEM Objects can be drawn in a variety of ways that will help to visualize the Objects in your Database.

Map View may be the most essential part of the program for certain users involved in land use planning and resource management. Often those users will experience the synergy of having the 3-D rendering capabilities to support the visualization process. This may be especially true when preparing presentations to the public who may be more comfortable with 3D perspectives than with plan style maps.

The functions available from this window will allow you to create new Vector Objects and to edit them. You can create elevation data for them that is used in rendering. You will also find functions for laying out Camera and Focus Motion Paths and converting them to and from Motion key frames.

Color Maps can be generated from Vector outlines that, when completed in a paint program, can be used to texture a terrain model or as an Ecosystem Index Map.

Visual Sensitivity Analysis (sometimes referred to as Viewshed) can be performed on the terrain data to determine what points are visible from a road or from a proposed housing development or for any number of other uses. This sophisticated tool, in combination with Color Mapping and 3-D rendering, could be a significant revenue generator for WCS users.

Map View sports its own set of menus. Each item has a keyboard shortcut noted in the descriptions that follow.

Note: When using Map View's menu functions, be sure to pay heed to any instructions that appear in the bottom portion of the Map View Control window. You may think the program is stuck when it is merely waiting for your input. You will also find much other useful information posted to the Map View Control window so it pays to keep it in sight.

In addition to menus, Map View also supports several keyboard-mouse combinations for such actions as activating Objects, disabling Objects, retrieving Object information, and creating Motion key frames. Mouse movements by themselves with Map View active cause certain useful items of information to be posted to the Map View Control window (see Mouse-Keyboard Shortcuts below).

In Map View we will use the term "Active Object" to denote the one on which operations will be performed. It is the one highlighted in dark blue in the list if you have the Database Editor open.

Closing Map View will also close Map View Control and free all Vector and DEM memory.

Note: The size and position of the Map View are saved in the Project file so that each Project can have a custom configured work space. The last position used when the program closes will be stored in the Prefs file and the window will open at that position next time unless a Project file is loaded and overrides the Prefs setting. If WCS is unable to open the window at the previous position due to a reduction in screen size, it will be repositioned to fit the smaller screen.

Map View Window Mouse-Keyboard Shortcuts

Left Mouse Click

Click with the left mouse button over any Object you wish to identify. The Object's name will be posted to the Map View Control text at the bottom of the window.

The name will be followed by the number of rows and columns in the elevation array if the Object is a DEM and topos are loaded (see above). The area of the Object will be displayed next followed by a warning "Not Closed" if the Object's last point does not close precisely back to the origin.

The number of columns and rows for DEMs represent the east-west and north-south array dimensions which can be useful for generation of one-to-one pixel-data cell map alignments. These might be used for generation of Color Maps from screen shots after Viewshed Analysis, etc.

This function does not activate an Object, only identifies it.

Mouse Move

Moving the Mouse over the Map View window shows latitude, longitude and elevation information in the Map View Control window.

With the Map View window active, move the mouse over the map. Latitude, longitude and, if topos are loaded, surface elevation will be posted to the bottom line of the information text in the map View Control window. Elevations are always shown in meters.

This information might be useful in laying out viewpoints or in determining Ecosystem Elevation Lines.

Shift-Left Mouse Click

Shift-clicking lets you activate a Database Object.

Hold either Shift key and left-click over the Object you wish to activate. You will be presented with a requester and the name of an object. If this is the correct Object select "Yes." If it's not select "No" and WCS will attempt to



Reference 5 - Map View Module

find another Object. Because you might have several overlapping Objects in any one position on the map, WCS may show you the names of several Objects in turn. Select "No" until you see the name of the Object you want; then select "Yes."

When you select "Yes" the Object becomes the active one and can be operated on by any process described in the menu sections below. The Object will also be selected in the Database Editor window's Object List. This is a handy way to select Objects in the Database Editor when you don't know their names.

This action has the same effect as the menu item "Find Object." If no Object is found the Active Object will remain what it was before this operation.

Note: Because "shift-clicking" is a way to multi-select in the Database Editor List, shift-clicking on an Object in the Map View will multi-select items in the Database List if the Database Editor is open. Shift-clicking in Map View can be used to add selected items for batch modification of Database fields.

Alt Key-Left Mouse Click

Alt-Clicking lets you disable a Database Object.

Hold either Alt key and click on the Object you wish to disable. You will be presented with a requester and the name of an Object. If this is the correct Object select "Yes" if not select "No" and WCS will attempt to find another Object.

When you select "Yes" the Object becomes disabled in the Database and will not be mapped or rendered until it is enabled again from the Database Editor.

If no Object is found the Active Object will remain what it was before this operation. Otherwise the disabled Object will be the Active Object and a new Active Object must be designated before using any Object manipulation commands such as "Add Points."

Ctrl Key-Left Mouse Click

Control-Clicking lets you zoom in on a specified portion of the Map View.

Hold the Control (Ctrl) Key and click on the point you wish to be the new map center. The map will be re-drawn at half the scale with the new center point in the middle of the window. The map will be enlarged by a factor of two.

This operation is a combination of Pan and Scale adjustment.

Enter Key on Numeric Keypad

The Enter key in the numeric keypad of your keyboard lets create Motion key frames.

With the Map View as the active window hit the Enter key in the keypad. This has the same effect as selecting "Make Key" in the Motion Editor window.

You will be asked what frame to make a key frame for. The results will depend on whether the Motion Editor is open. If it is then whatever Motion Parameter is active (or group if the Group button is selected) there will be the item or group for which a key frame is made. It could be the Camera, Focus, Sun, Haze or whatever.

If the Motion Editor is not open then the key frame will automatically be made for the Camera position.

If the Group button is selected and the key frame was made for the Camera position you will be asked if you would also like to make key frames for the Focus Group. If the Focus Group is active in the Motion Editor then you will be asked if you would also like to make key frames for the Camera Group. That way you can make both Camera and Focus key frames without having to

Reference 5 - Map View Module

re-select the Active Parameter. This saves doing a lot of window rearranging and the possibility of losing the position of Motion items when Active Parameters are changed.

Database Menu

The Database menu has seven commands:

- Load Objects (All or Active)
- Load Topos
- Save Objects (All or Active)
- Database
- Clear Window
- Print
- Close Map



Load Objects/All

Keyboard shortcut: RightAmiga L

Select the All command in the Load Objects submenu to load Vector Objects into memory. All enabled Vector Objects in the Database will be loaded into memory, overwriting those currently held in memory.

You may want to do this if you have modified but not saved some Objects and want to restore their original coordinates.

If Objects have been modified you will receive warnings as the Objects are reloaded that the number of points in the Object files does not match the number the Database says the Objects have. These warnings should not concern you since you know you are restoring Objects you have modified.

Objects are loaded from any directory that lies in the search path as defined in the Directory List (see the Database Module chapter for more about the Directory List window).

Directory Lists are stored in the Project File and the most recently used one is saved in WCS.Prefs when the program closes. The Database itself is stored separately in its own file so that it may be shared among numerous Projects.

Load Objects/Active

Keyboard shortcut: RightAmiga K



Select the Active command from the Load Objects submenu to load the Active Vector Object from disk. The Object will load, replacing the current Object definition in memory.

Since there is no "Undo" for changes to a Vector, you must re-load the Object from its file to restore it after modification if you decide you don't like the changes you made.

Load Topos

Keyboard shortcut: RightAmiga J

Select the Load Topos command to load or replace existing DEM and Surface data in memory. Only DEMs enabled in the Database will be loaded.

This is a way to force Map View to update the DEM data in memory. Normally whenever the Draw command is issued the Database is checked to see if there are any new DEMs enabled or disabled. Occasionally conditions arise where this fails to catch a change in status. Load Topos will force the update in these situations.

DEM data will also load whenever the "Draw" command is invoked with the "Topo" item enabled in the Map View Control window.

Save Objects/All

Keyboard shortcut: RightAmiga S



Use the All command in the Save Objects submenu to save all enabled Vector Objects' vertex coordinates to disk. This stores the latitude, longitude and elevation data.

Elevation data should be generated first with "Conform Topo" in the Object Map menu. Normally Objects are conformed and saved in one step at the time an Object is digitized or modified.

The Database should also be saved after Vector points have been modified in case the number of points was changed. Otherwise you will get a message informing you that the Database point count does not match the number in the file the next time the Object is loaded.

Click the Cancel button in the progress window if you want to abort the operation.

Save Objects/Active

Keyboard shortcut: RightAmiga W

Use the Active command in the Save Objects submenu to save the Active Vector Object's vertex coordinates to disk (see Save Objects/All above).

Database

Keyboard shortcut: RightAmiga B

Use the Database command to open the Database Editor.

This has the same effect as selecting the Edit button from the Database Module pop-up menu.

Clear Window

Keyboard shortcut: RightAmiga C

Select the Clear Window command to clear the Map View window to black.

Print

Keyboard shortcut: RightAmiga /

Select the Print command to Print the Map View window to the Prefs Printer using the current AmigaOS Graphics Printer Preferences (see your Amiga manual).

There is a delay of five seconds after making this selection to place the Map View window to the front of the Screen.

A small window will appear after the selection is made from which the printing operation can be cancelled. You must send this to the back or move it if it obscures the Map View. Bring it to the front again if you wish to abort the print operation.

For print operations the gray scale used for mapping DEMs is lightened for better print quality. The black background is changed to white, allowing Vectors to show better.

Close Map

Keyboard shortcut: RightAmiga Q

Select the Close Map command to close the Map View and its associated Map View Control window and free Vector Object and DEM memory.

This can free substantial memory resources. It's useful to do this before rendering.

View Menu

The View menu has eight commands:

- Controls
- Eco Legend
- Align Map
- Center
- Auto Center
- Zoom
- Pan
- Move



Controls

Keyboard shortcut: RightAmiga H

Select the Controls command to bring the Map View Control window to the front of all other windows.

Depending on how you set up your screen the Map View window can be rather large and might obscure the Map View Control window. This is a quick way to bring the Map View Control window to the front when you need it.

Eco Legend

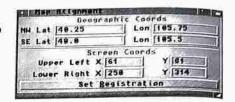
Keyboard shortcut: RightAmiga,

Select the Eco Legend command to open the Eco Legend window. This is the same as clicking the Eco button on the Map View Control window. The Eco Legend window lets you set which ecosystems can be depicted by which colors for previewing where various ecosystems exist on the map (see the Eco Legend window above).

Align Map

Keyboard shortcut: RightAmiga G

Select the Align Map command when you want to align the Map View drawing to a pre-set position and scale. The Map Alignment window will open.



The Map View normally uses an

X:Y ratio based on the Latitude:Longitude scale ratio for the point at the center of the window. Sometimes you may want to modify that ratio.

You can do that by selecting the Align command and inserting a fixed Lat/Lon to X/Y correspondence in the gadgets provided. The first Lat/Lon and X/Y pairs should be the upper left or northwest pair. The other should be the lower right or southeast pair. Failure to order these correctly will result in an inverted map or one that fails to draw at all.

An alternative to setting the X/Y coordinates with the keyboard is to set them interactively with the mouse. Select "Set Registration" at the bottom of the Map Alignment window and set the two corner points, northwest (upper left) corner first. The Lat/Lon coordinates still must be entered via keyboard.

The Lat/Lon pairs set in the Map Alignment window are also used for registration of maps in Tablet Input mode when digitizing Vectors. The coordinates should be set before selecting "Add Points."

Center

Keyboard shortcut: RightAmiga E

Select the Center command when you want to shift the Map View drawing to a new center latitude/longitude.

You will be asked to select the point to center the drawing around. Click at the desired center point in the Map View drawing. The Map View will be re-drawn with that point as the new center.

An alternative is to control-click at a spot in the Map View window. Hold the Control key down while you click with the mouse. This will cause the selected spot to become the new map center and to zoom in by a factor of two.

Auto Center

Keyboard shortcut: RightAmiga A

Select the Auto Center command when you want to center the Map View drawing at the geographic center of all enabled Database Objects.

WCS will compute the geographic center of the enabled Database Objects and re-draw the map.

This is a convenient way to locate yourself if you are lost outside the data area or if you are loading a new Database into Map View for the first time.

You can Enable and disable Objects from the Database Editor window (see the Database Module chapter). By limiting which Objects are enabled and then using the Auto Center command, you can quickly show a selected portion of a larger area.

If the Map Scale (found in the Map View Control) is too small, it is possible that even with Auto Centering, objects will not appear in the drawing area. Enlarge the scale factor (zoom out) and then click the Draw button in the Map View Control window to see more area.

Zoom

Keyboard shortcut: RightAmiga Z

Select the Zoom command to blow up a small section of the Map View drawing to the full width of the Map View window.

You will be asked to select two corner points. Click on the desired northwest corner point then on the desired southeast corner. The scale will be computed to fit all the region into the window and the map will be re-drawn.

If the area you selected has a different aspect ratio than the map View window itself, additional area may be visible on one axis.

Pan

Keyboard shortcut: RightAmiga P

Select the Pan command when you want to shift the Map View drawing in any direction.

You will be asked to set an origin and a destination point with the mouse. Click the first point then move the pointer to the desired location where you'd like that point to end up, and click again. The whole map will shift in that direction and be re-drawn.

Move/In

Keyboard shortcut: +

Select the In command in the Move menu when you want to



zoom in on the map in the Map View window. The Map View window will zoom in at a factor of 2, and redraw.

Move/Out

Keyboard shortcut: -

Select the Out command in the Move menu when you want to zoom out from the map in the Map View window. The Map View window will zoom out at a factor of 2, and redraw.

Move/Left

Keyboard shortcut: Left Arrow & Shift-Left Arrow

Select the Left command in the Move menu when you want to shift your viewpoint in the Map View window to the left. The map will shift by a factor of one half the window width, and redraw. If you hold down the shift key and use the left arrow keyboard shortcut, the map will also shift by a factor of one half the window width. Without the shift key the map will move by a factor of one eighth.

Move/Right

Keyboard shortcut: Right Arrow & Shift-Right Arrow

Select the Right command in the Move menu when you want to shift your viewpoint in the Map View window to the right. The map will shift by a factor of one half the window width, and re-

draw. If you hold down the shift key and use the right arrow keyboard shortcut, the map will also shift by a factor of one half the window width. Without the shift key the map will move by a factor of one eighth.

Move/Up

Keyboard shortcut: Up Arrow & Shift-Up Arrow

Select the Up command in the Move menu when you want to shift your viewpoint in the Map View window toward the top of the window. The map will shift by a factor of one half the window height. If you hold down the shift key and use the up arrow keyboard shortcut, the map will also shift by a factor of one half the window height. Without the shift key the map will move by a factor of one eighth.

Move/Down

Keyboard shortcut: Down Arrow & Shift-Down Arrow

Select the Down command in the Move menu when you want to shift your viewpoint in the Map View window toward the bottom of the window. The map will shift by a factor of one half the window height. If you hold down the shift key and use the down arrow keyboard shortcut, the map will also shift by a factor of one half the window height. Without the shift key the map will move by a factor of one eighth.

Draw Menu

The Draw menu has four commands:

- Draw map
- Color Map
- Viewshed
- Fix Flats



Draw Map/Normal

Keyboard shortcut: RightAmiga D

Select the Normal command in the Draw Map submenu to draw the entire Map View window using the scale, position and palette settings as currently displayed in the Map View Control window.

Objects are drawn with attributes as defined in the Database. You can use the gadgets in the Database Editor window to modify their line color, weight and pattern (see the Database Module chapter).

Only Objects currently enabled are drawn. Objects can be enabled or disabled in the Database Editor.

Draw Map/Refine

Keyboard shortcut: RightAmiga R

Select the Refine command to draw a selected portion of the Map View window.

You will be asked to set two corner points to define the area. To set, click once on the northwest corner and again on the southeast corner or hit ESC on the keyboard (Map View must be the active window) to cancel.

Draw Refine is useful for seeing a portion of the map drawn in a different DEM style, or for drawing a portion of the map with a different set of options (for instance with and without DEMs enabled).

Color Map

Keyboard shortcut: RightAmiga M

Select the Color Map command to create Color Map files for the currently enabled Vector Objects.

Color Map files are IFF-ILBM images that you can edit in a paint program. WCS can use them during rendering for tinting land-scapes, superimposing bitmapped textures onto landscapes and specifying exact placement of ecosystems. One common use for Color Maps is to create lakes.

Color Maps are related to individual DEM files. If you have several DEMs in a landscape and you want to use Color Maps that cross DEM boundaries you'll need to generate a Color Map for each DEM.

To create a Color Map file for a specific DEM, activate the DEM by holding down the Shift key and clicking within the DEM outline in the Map View window.



When the correct Object is activated, select the Color Map command. Any selected Vector Objects will be included using the 24 bit RGB color designated for them in the Da-



tabase Editor window (see the Database Module chapter). Only enabled Objects will be drawn.

DEMs can be drawn into the Color Map as well. You will be asked if you wish to include DEM elevation information in the Color Map.

Reference 5 - Map View Module

If you answer "Yes," the elevations will be rendered with the drawing mode set in the Map View Control window (single, multi, surface, emboss or slope).

You will be asked to specify a file name and path for saving the image. The current Map View drawing will not be affected by this operation.

Color Maps are used as sophisticated texture maps in WCS' Render Module. Vector Object out-



lines can be saved from Map View for use as Color Maps directly or for import and modification in a 24 bit paint program.

Color Maps must correspond in name and size to a DEM in the Database. In order to create a Color Map for a particular DEM, the Object must be enabled and it must be the Active Object.

It is a good idea to shift-click in the center of the desired DEM to activate it immediately prior to performing this operation just to be sure that it is the Active Object. If the DEM itself is not currently loaded you will have an opportunity to load it after making this selection.

Only enabled Vector Objects will be rendered into the Color Map. If you wish to create a Color Map of a lake, for instance, you would disable all other Vector Objects in the Database except the lake outline.

The file requester allows you to name the Color Map file anything you wish, but you should use the name supplied in the file requester. This maintains the correspondence between the Color Map and DEM files which is a necessity for rendering. Otherwise WCS will not find the file when rendering and the Color Map will not be used in your rendered images.

The output file will be in IFF format. Trailing blanks are not necessary to fill out the file name to 10 characters.

See the Render Settings Editor in the Render Module chapter for more information about the use of Color Maps. Also, see the Tips and Tricks chapter.

Viewshed

Keyboard shortcut: RightAmiga V

The Viewshed command lets you construct a Visual Sensitivity Analysis of the active Vector and terrain data.

Viewshed or Visual Sensitivity Analysis is a sophisticated GIS function. WCS will analyze what points on the terrain can be seen from the points along a Vector Object or conversely, what points on the terrain can see the Vector. This type of information is extremely important in these days of environmental and aesthetic awareness any time new building construction is contemplated.

Select the Vector Object that will provide the sample points for analysis (see Find Object below). Select Viewshed from the menu and a requester will appear informing you of the Active Object and asking for confirmation that this is the Object to analyze. Click the Yes button and the Visual Sensitivity window will appear at the same size and position as the Map View window.

The analysis is performed for a single Vector Object and all the terrain data that shows in the Map View window. You may want to interpolate the points of the Vector Object to obtain equidistant analysis point spacing (see Path/Interpolate below). The Vector may have as few as one point or as many as 1999. The more points the finer the resolution of the output but the longer it will take to perform the analysis.

You will be asked if smoothing is to be performed on the terrain data. This is absolutely essential if small map scales (enlarged

Reference 8 - Map View Module

maps) are in use. When the DEM cell size is larger than one pixel, stair-stepping results due to the way WCS is optimized for quick drawing in Map View. Smoothing minimizes this effect.

You will be asked to provide a vertical offset for the analysis. This corresponds to the height above the terrain that the observation will be made from. It is a good idea to position the viewer several meters above at least to simulate eye height.

One analysis pass will be made for every point along the viewpoint Object. With every pass the gray scale visibility value will be updated to represent an arithmetic average of the visibility. You may cancel at any time and the data generated up to that point will be preserved.

When complete, you will have the option to see Vectors drawn onto the map. You may save the screen for image processing from the main WCS Project menu. You may wish to colorize it, scale it, crop it and convert it to Color Maps (see Convert DEM in the Data Ops Module) and apply it as a Color Map during rendering for a striking visual display of otherwise obscure information.

Fix Flats

Keyboard shortcut: RightAmiga_

Select the Fix Flats command to correct flat anomalies in the terrain, like mountain tops that may appear flat due to the low resolution of DEM data.

Terrain data, depending on the technology and algorithms with which it was digitized, may contain unnatural flat spots. These are particularly noticeable when they form the peaks of mountains or the bottom of valley floors and are accentuated when vertical exaggeration is increased. They can be smoothed to some extent with this function.

The best way to tell if there is a need for this process is to render a few scenes from different vantage points and observe whether the flat spots are noticeable. By using the Interactive features of Map View you can see where the camera is relative to the focus and locate the flat spots relative to those. The Emboss and Slope drawing modes in Map View also can be useful in delineating these annoying features.

When you select the Fix Flats command you will be asked to set two corner points to bound the area of interest. The two points must lie within a single DEM.

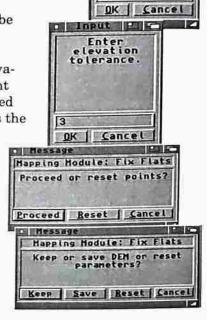
A requester will then ask for the minimum matching points. This determines how many contiguous points are needed to be considered flat. Increasing this (to a maximum of eight) will decrease the number of flat points that will be operated on. The minimum value is 0 for which all points will be operated on.

The next requester asks for an elevation tolerance. Any contiguous point within ±this value will be considered flat. Increasing the value increases the number of points operated on.

You will then be shown in red the points which meet the operation criteria. You may proceed with the operation, re-set the criteria or cancel the operation.

New elevation values will then be computed and the map re-drawn. You may keep the changes, save them to disk (overwriting the origi

them to disk (overwriting the original DEM data), re-set the operation criteria and try again, or cancel the whole operation.



2

Enter

matching

points.

Object Menu

The Object menu has eleven commands:

- New Object
- Find Object
- Highlight
- Add Points
- Create Stream
- Modify Points
- Input Source
- Conform Topo
- Match Points
- Move Origin
- Duplicate



New Object

Keyboard shortcut: RightAmiga N

Select the New Object command to create a new Object in the Database.

You will be asked to supply a name for the Object. If the name already exists in the Database you may choose another name or cancel the operation.



This process clones the Active Object's Database fields except for name, number of points and Class. All new Objects are created with one point. This point is simply a dummy vertex that will be overwritten the first time the Object is digitized in Map View (see Add Points/New below). All new Objects are created as plain Vector Class.

You should select an Object of similar type from the existing Database entries before activating this menu item to save having to

do extensive Database field editing later. You should check the resulting Database entry later to verify that all fields are set to the desired attributes, especially the Object's Class.

Find Object/Single

Keyboard shortcut: RightAmiga F

Select the Single command in the Find Object submenu to activate an Object in the Database.

You will be asked to click on the desired Object. Your selection will be highlighted in a contrasting color and you will be asked if the Object is the correct one.



The Active Object is the one on which operations are performed. An Object must be activated for you to add points to it, modify existing points, etc.

This menu item has a shortcut: You may shift-click (click the left mouse button while holding the shift key) on the Object and accomplish the same result.

Another alternative is to alt-click the Object. This will select it and disable it in the Database. Until it is re-enabled from the Database Editor it will not be drawn or rendered.

Find Object/Multi

Keyboard shortcut: RightAmiga U

Select the Multi (Multiple) command in the Find Object submenu to multi-select Objects in the Database Editor List or de-select Objects in the List. Select an Object within the area of interest as the Active Object (see "Find Object/Single" above). Select "Find Object/Multi." If the Database Editor is not open it will be opened. You may move it to the side or in back of the Map View.

You will then be asked if you wish to "Select" or "De-select." You will be asked to select two corner points to bound your search area. Any Objects with at least one vertex inside the search area will be selected in the Database Editor. These items can now have their attributes modified as a group (see the Database Editor section of the Database Module chapter for more information).

The Active Object will not be changed by the search. Please note that the Active Object's fields will also be changed if you modify any Database fields. You should select an Object within the search area to be the Active Object before doing the search to avoid unforeseen modifications.

You may repeat the Find Object/Multi command as many times as you like to select Objects in complex arrangements on the map. You can also combine selecting and de-selecting with this command.

Highlight

Keyboard shortcut: RightAmiga?

Select the Highlight command to accentuate the Active Object.

The Active Object will be drawn in a contrasting color.

Depending on the Objects normal color, the highlight color will be white or yellow. Use this to visually locate the Active Object on the map.

Note: When you use the Draw command or button to redraw Map View the Active Object will be drawn in its normal color. You can use Highlight to accent it.

Add Points/New

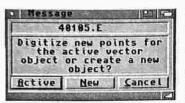
Keyboard shortcut: RightAmiga X



Select the New command in the Add Points submenu to digitize the Active Vector Object from scratch.

You may digitize with the mouse or with a tablet (see "Input Source" below to set the mode).

First you will be asked to confirm that the Active Object is the correct one to digitize. You will also be given the option to create a new Object. If you select Active and it is a DEM you will be



warned and the operation will be aborted: You cannot digitize a DEM Object. If you select New, you will be asked for the new Object's name.



Instructions in the Map View Control window explain what to do from

here. You will be asked to set a "Label Point" first. This point is used to place the label if you later create one for this Object. Then you may digitize as many as 1999 additional points to define the Object.

If you are digitizing with the mouse you may modify the process in several ways. You may click each point individually, you may draw with the left mouse button down or you may hit the RETURN key and additional points will be interpolated between mouse clicks.

When digitization is complete or if you want to stop and start again, hit 'Q' or 'C' on the keyboard. 'Q' will simply terminate the

Reference 5 - Map View Module

process and 'C' will close or complete the Object back to the origin. You must then accept the new points by hitting RETURN or rejecting them and restoring the original points by hitting ESC.

If you are using a tablet for input the process is similar. You will be asked if you would like to digitize new registration points first however. These must be entered for at least the first Object you digitize. It should be done whenever the source map setup changes.

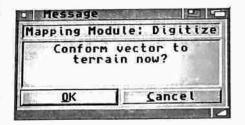
Note: Be sure you have set registration latitude and longitude coordinates in the Map Alignment window before invoking the Add Points command if you are digitizing with a tablet. Failure to do so will result in digitized points falling in the wrong locations.

Digitize with button number one, first the northwest point, then northeast, then southeast. The first and last points should correspond with the alignment Lat/Lon pairs set with the "Align" command in the Draw Map menu. The middle point must represent the same latitude as point one and longitude as point three. It is used to determine source map rotation.

Digitizing then proceeds using button one until complete. Button 2 will close the Object back to the origin, button 4 will signal completion of the process and button 3 will abort the process.

With either digitization method, when you are finished you will be asked if you wish to conform the Vector to the topography. We

suggest you do that now so it is not forgotten. You will need to do it sometime before you render the Vector. Answering yes will cause the Vector and elevations to be saved to disk (see "Conform Topo" below for more information).



The Add Points New command will replace all existing data points with new ones.

Add Points/Append

Keyboard shortcut: RightAmiga Y

Select the Append command in the Add Points submenu to append new Vector points to an existing Object without changing those points that already exist.

See the Add Points New command above for a complete description of the process.

This may be used if an entire Object can not be digitized in one setup (for example if the Object goes off screen or onto another source map (when using a tablet for input).

Add Points/Insert

Keyboard shortcut: RightAmiga I

Select the Insert command in the Add Points submenu to insert new points into an existing Vector Object.

In the Map View Control window you will find instructions. You will be asked to select the point to insert new points after. You may click on the desired point or use the 'u', 'U' 'd' or 'D' keys to step through the points to the desired one. Hit 'Q' on the keyboard after your selection is complete then begin digitizing as for "Add Points New."

This command is not available if you are using tablet input.

Create Stream/New

Keyboard shortcut: RightAmiga ~



Select the New command in the Create Stream submenu to create Vector Object points that follow a low in the terrain to simulate a stream course.

You will be asked to select the stream start point. This should be the point of highest elevation along the desired path. You will then be asked to select the approximate end point. This need only be approximate and gives a preferred trend for the Object to follow should it encounter a spot with no gradient.

When the Object reaches the edge of the current DEM you will be asked if you wish to continue onto the next adjoining map. This is tricky and not always successful. Due to imperfections and the gridded nature of the DEM data, you may have to manually append a few points to bridge the boundary between DEMs using "Add Points Append" and then continue the stream with "Create Stream Append."

When you are finished you will be asked if you wish to save the Object. We suggest you do that now so it is not forgotten. Answering yes will cause the Vector and elevations to be saved to disk. You do not need to conform stream Objects to the terrain, it is done automatically.

This function has difficulties where the terrain is flat or if there is even a slight closed depression along the stream course. You may need to perform substantial editing to the resulting Object using the "Modify Points" menu item to make it usable.

If the result is too blocky looking (this will depend on the DEM data resolution and closeness of the Object to the camera) in your rendered images, you may wish to use "Path/Interpolate" in the Map View Motion menu to smooth it.

Create Stream/Append

Keyboard shortcut: RightAmiga '

Select the Append command in the Create Stream submenu to append points following a low in the terrain to an existing Object.

You will be asked only to supply an approximate end point to establish a stream trend. All other parts of the process are identical to "Create Stream New."

The original points need not have been created with the Create Stream command.

Modify Points

Keyboard shortcut: RightAmiga .

Select the Modify Points command to delete existing Vector Object points.

When you first select this command the first point of the Active Object will be highlighted in yellow on the map.

Select the point to delete by using the 'u', 'U', 'd' or 'D' keys to advance or retreat through the Object points or by clicking on the point. The selected point's number will be displayed in the Map View Control.

To delete the selected point hit the minus (-) key. Holding down the minus key will repeat the operation very quickly letting you delete a whole range of points. To end the modification hit 'Q' on the keyboard. There is no "undo" for this function. You must reload the Object from disk so be sure it is backed up before using this function.

When you are finished modifying the Object you will be asked if you wish to conform the Vector to the topography. This is necessary anytime Vector points are changed. Answering yes will cause the Vector and elevations to be saved to disk (see "Conform Topo" below for more information) so don't answer yes unless you are completely satisfied with the points.

Currently the only modification operation supported is deleting points. This can be useful for eliminating the "bowl of spaghetti" that sometimes results from "Create Stream."

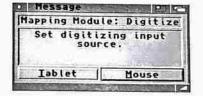
Input Source

Keyboard shortcut: RightAmiga

Select the Input Source command to select the Vector digitization input source.

You will be presented with a requester. Choose between the mouse or a Summagraphics tablet.

Tablets must communicate with the computer via the serial port.



Other tablets may work besides the supported Summagraphics Bitpad tablet if they use the same basic protocol for sending coordinate points and button information.

Conform Topo/All

Keyboard shortcut: RightAmiga!

Select the All command in the Conform Topo submenu to create elevation data for all enabled Vector Objects based on elevations found in the underlying DEMs, and to save the Vectors and elevations to disk.

If DEM data is not currently in memory it is loaded before the operation proceeds. Failure to load DEMs will cause the operation to abort. There is, however no assurance that the entire Vector lies within the loaded DEM area. If points are found outside the DEMs the elevation will be saved as 0 for these points.

It is a good idea to load all DEMs before initiating this operation and to draw them along with the Vectors of interest to be sure the Vectors fall within the DEM bounds. If they do not, enable additional DEMs in the Database and redraw.

As each Object is conformed it will be saved to disk.

Valid elevations must exist in order for a Vector to be rendered in Camera View or in final output images and animations. By default, Vectors are rendered at sea level (0 meters).

Conform Topo/Active

Keyboard shortcut: RightAmiga T

Select the Active command in the Conform Topo submenu to create elevation data for the Active Vector Object based on elevations found in the underlying DEMs, and to save the Vector and elevations to disk.

This works just like the Conform Topo/All command above.

You will be asked if you wish to conform a Vector to the terrain any time its points are modified. Answering yes to these queries will only affect the Active Object.

Note: Conforming an Object will automatically cause the Object to be saved to disk overwriting the existing Object. Make backup copies of your Object data so you can restore it if you need to.

Match Points

Keyboard shortcut: RightAmiga =

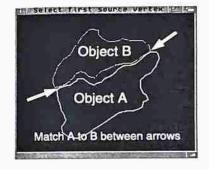
Select the Match Points command to match selected points of the Active Object to selected points of a target Object.

When digitizing adjacent Objects that share a boundary you generally want a precise match between the points of both Objects. Match Points lets you take one Object and use it as the source and another as the target. The target's points will be shifted to precisely match those of the

source Object over a user-specified interval on both the source and target Objects.

First activate the target Object (the one that will be changed). Then select the Match Points command.

You will be asked to select the point to begin the match and



then the point to end the match. Use the same procedure that you would use for selecting a point to delete using the Modify Points command (see above).

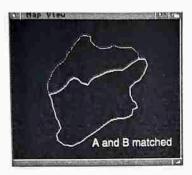
After both end points have been selected for the target you must select an Object to act as the source. Click on the desired Object.

When the correct one is highlighted accept the Object identifier requester. You must now repeat the point selection process for the source Object. Keep in mind that the match process is directional. Be consistent in choosing first and last points unless you really want to reverse them for some reason.

You can match single points to single points if for example you want to tie two roads together at an intersection or have two

streams meet at a point. About the only thing illegal is to match a single point on the target to multiple source points. Due again to the directional nature of the process there must be two target points to stipulate directionality.

You also cannot match points across the first point (origin) of a Closed Object. If the interval you want to match begins at one point, goes to the last point and on around to a point beyond the origin again you will need to move the origin using the Move Origin command below.



When the process is ready to proceed you will be asked if you want to complete it. This is your last chance to bail out. There is no "undo" for this operation so be sure the Object is backed up before using Match Points.

When the matching is finished you will be asked if you wish to conform the Vector to the topography. We suggest you do that now so it is not forgotten.

You will need to do it sometime before you render the Vector. Answering yes will cause the Vector and elevations to be saved to disk (see "Conform Topo" above for more information).

Move Origin

Keyboard shortcut: RightAmiga O

Select the Move Origin command to set the first point of the Active Object to a different vertex.

This may be necessary when matching the points of one Object to those of another. Matching points can not take place over an interval that contains the origin.



You will be asked to select a new origin for the Object. Do so with the same process and commands as "Modify Points." Point one will now be at the selected point. Make sure the new origin is outside the match interval. The origin may be moved as many times as necessary to accommodate all necessary match operations.

After moving the origin you will be asked if you wish to conform the Vector to the topography. We suggest you do that now so it is not forgotten. You will need to do it sometime before you render the Vector. Answering yes will cause the Vector and elevations to be saved to disk (see "Conform Topo" above for more information).

The origin can only be moved on Closed Objects, ones where the first point is at the exact same position as the last point. If that is not the case for the Active Object you will be asked if you wish to close it at this time. If you decline the operation will be aborted.



Duplicate

Keyboard shortcut: RightAmiga &

Select the Duplicate command to make a copy of the Active Object.

You will be asked to choose a name for the new Object. The new object will have all its fields and vector vertices copied from the Active Object. The only exception is that the Object's Database Class field will be set to plain Vector. You can change it if you like later.

Duplicate Objects can be used to create Segmented Vectors for making things like cars on a highway.

Motion Menu

The Motion menu lets you position the Camera and Focus Point using the Map View as a guide. There are also commands for generating motion paths from Vector Objects, Vectors from paths and for splining Vectors. In addition you can set the Render Settings Surface Elevations from this menu. There are four commands:

- Set Camera
- Set Focus
- Path
- Surface Elevation



Set Camera

Keyboard shortcut: RightAmiga >

Select the Set Camera command to set the current Camera Latitude and Longitude Motion Parameters. Use this command to set the Camera position if it is currently out of the Map View or if Interactive items are not shown.

You will be asked to select a point in the map with the mouse. Doing so will place the Camera position at the selected latitude and longitude. The altitude will remain unchanged.

After setting, to preserve the position if there are Camera Key Frames, you should select "Make Key" or "Update" in the Motion Editor with the Camera group active and the Group button depressed. Failure to do so will result in the loss of this position the next time the frame number or active Motion Parameter is changed.

If this is only an experimental Camera position use the "Freeze" and "Restore" features found in the Global Parameters menu to undo temporary changes later.

If Camera View is open you will get immediate feedback on the selected Camera position.

Set Focus

Keyboard shortcut: RightAmiga <

Select the Set Focus command to set the current Focus Latitude and Longitude Motion Parameters. Use this command to set the Focus position if it is currently out of the Map View or if Interactive items are not shown.

You will be asked to select a point in the map with the mouse. Doing so will place the Focus position at the selected latitude and longitude. The altitude will remain unchanged.

After setting, to preserve the position if there are Focus key frames, you should select "Make Key" or "Update" in the Motion Editor with the Focus group active and the Group button depressed. Failure to do so will result in the loss of this position the next time the frame number or active channel is changed.

If this is only an experimental Focus position use the "Freeze" and "Restore" features found in the main Parameters menu to undo temporary changes later.

If Camera View is open you will get immediate feedback on the selected Focus position.

Path

The Path submenu gives you access to five commands:

- Interpolate
- Vect-Camera
- Vect-Focus
- Camera-Vect
- Focus-Vect



Interpolate

Keyboard shortcut: RightAmiga 5

Select the Interpolate command to replace the vertices of the Active Object with a user-defined number of vertices evenly spaced along a splined version of the same path.

This function is useful in combination with Vector to Path conversions (see "Path" in this Map menu) or for creating Segmented Vectors for special rendering purposes (see Database chapter). They would also be useful if you are using the Vector for Visual Sensitivity Analysis (see "Viewshed" in the Draw menu).

A requester will appear asking for the number of points to generate. Interpolate can either reduce the number of points, expand the number or leave the total unchanged, as you desire.

After interpolation you will be asked if you wish to conform the Vector to the topography. Whether you should or not depends on whether you plan to render the Object or just use it as a Camera/Focus Path. Answering yes will cause the Vector and elevations to be saved to disk (see "Conform Topo" above for more information).

Vect-Camera

Keyboard shortcut: RightAmiga 6

Select the Vect-Camera command to convert the currently Active Vector Object to the Camera Motion Path.

You may specify the frame interval that the space between each Vector vertex is to represent. You also may choose to use the elevations of the Vector Object if they exist to create altitude key frames

The Vector Object itself is not changed by this process but the Camera key frames in memory will be overwritten.

Normally you would interpolate the Vector (see the Interpolate command above) with a number of output points 20 to 100 times less than the number of frames desired in the animation. This ratio would then be used here as the frame interval. Interpolating spaces the vertices evenly and gives a smooth velocity curve to the key frame output.

Using the Elevation data to create Camera Altitude key frames would work in special cases but normally altitudes would be created later in Camera View or Motion Time Lines where more visual feedback is available.

Vect-Focus

Keyboard shortcut: RightAmiga 7

Select the Vect-Focus command to convert the currently Active Vector Object to the Focus Motion Path.

The procedure is the same as with the Vect-Camera command above.

The Vector Object itself is not changed by this process but the Focus key frames in memory will be overwritten.

Normally you would interpolate the Vector (see the Interpolate command above) with a number of output points 20 to 100 times less than the number of frames desired in the animation. This ratio would then be used here as the frame interval. Interpolating spaces the vertices evenly and gives a smooth velocity curve to the key frame output.

Using the Elevation data to create Focus Altitude key frames would work in special cases but normally altitudes would be created later in Camera View or Motion Time Lines where more visual feedback is available.

Camera-Vect

Keyboard shortcut: RightAmiga 8

Select the Camera-Vect command to convert the current Camera Motion Path to a Vector Object that can be operated on in the Map View Module.

You have the option to select all frames or key frames only for conversion. Selecting all frames will create a Vector with a coordinate pair at the camera position for every frame. The special Motion Path Setting "Velocity Distribution" will be used if it is enabled (see the Render Settings Editor in the Render Module chapter).

Selecting "key frames only" will create an Object with vertices only where a key frame exists for either camera latitude, longitude or altitude.

Vertical Exaggeration and Flattening as they are currently defined in the Motion Parameters (see the Motion Parameters chapter) may be applied to the altitudes in creating the elevation data for the Vector.

Note: Use of Vertical Exaggeration and Flattening factors should normally be done if you wish to render the Object as a Vector in

Camera View or in final images. It converts the altitudes of the Path to the same scale and reference as the DEMs.

Focus-Vect

Keyboard shortcut: RightAmiga 9

Select the Focus-Vect command to convert the current Focus Motion Path to a Vector Object that can be operated on in the Map View Module.

The procedure is the same as with the Camera-Vect command above.



Surface El Submenu

Keyboard shortcut: RightAmiga 1-4

Select any of the Surface El (Elevation) 1-4 commands to set the elevation of Surface Color Control Lines.

You will be asked to set a point with the mouse. Click on the desired point and the elevation of that point will become the Surface elevation corresponding to the menu sub-item you selected.

Surface Elevations one through four adjust the vertical spacing of Color Control Lines in the scheme used for rendering Surface DEMs. This method of shading by elevation, known as hypsometric shading, applies gradients of color to the Surface based on elevation.

WCS can use up to three such gradients in one rendering. Each range is contiguous with the ones above it and below. Gradient 1 goes from a low elevation of Surface 1 up to a high of Surface 2.

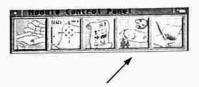
Gradient 2 goes from Surface 2 up to surface 3 and Gradient 3 goes from Surface 3 up to Surface 4. Areas above Surface 4 will be rendered in Surface Color 4, areas below Surface 1 will be rendered in Surface Color 1.

You may view the results of your selection either by re-drawing the Map in "Surface" mode or by opening the Settings Editor and looking at the complete array of Surface Elevations on the Surfaces page. These values may also be set in the Editor and viewed in Map. See the Data Types and Database Module chapters for more information about DEM Surfaces.

Reference 6 - Parameters Module

- Overview
- Pop-up Menu
- Active Parameter and Interactive Group
- Animation
- Key Frame System
- Key Frame Controls
- Time Lines
- Time Line Window Common Features
- Scale Keys Window
- LightWave Motion Window

The fourth of World Construction Set's five main modules is the Parameters Module. You can access its commands by opening its pop-up menu, which you can do by clicking the third icon in the Module Control panel:



or by selecting the Parameters Module command in the pull down menu.



Overview

The Parameters Module lets you take your raw landscape shapes and bring them to life with color, shading, texture and movement. You can control and animate a wide variety of Parameters. Parameters are the values in WCS that let you control the look of your images.

By changing these Parameters you can emulate nature to make anything from realistic looking earth scenes to bizarre alien landscapes that have never before been seen by human eyes.

You can also create sequences of images in which Parameters change over time. You can animate the position of the Camera, the position of the sun, the height of mountains, the color of the haze, and more.

Three Parameter Classes

There are three Classes of Parameters:

- Motion
- Color
- Ecosystem

Motion Parameters include those that let you move the Camera, Focus Point, sun, fog and haze. You can control them using the Motion Editor window.

Color Parameters let you change the colors of trees, haze, ground, rocks, sky, or anything else you can see. You can control them using the Color Editor window.

Ecosystem Parameters let you create combinations of plants, ground, rock surfaces, water and snow and decide where and how WCS should arrange them on your landscape. You can control them using the Ecosystem Editor window.

Each of these Parameter Classes has its own chapter following this one. See those chapters for more on each Parameter Class and how to use the Editor windows.

Other Parameters Module Functions

The Parameters Module also allows you to have WCS automatically create a new default Parameter file as a starting point for all Ecosystem, Color and Motion Parameter values. You might want to do this if you import new data into WCS.

Finally, the Parameters Module lets you import or export Motion Paths in LightWave format. This lets you match the motion of the WCS and LightWave Cameras when combining WCS background animations with LightWave foreground animations.

Windows

The Parameters pop-up menu window lets you open Editor windows for each Parameter Class (see the Motion Parameters, Color Parameters and Ecosystem Parameters chapters).

Each Class also has a Time Line window for animation key frame control which you can open from the Editor windows (see the Time Lines section below).

The Motion Parameters window lets you open a special window called the Camera View window. In the Camera View window you can change Motion Parameters by dragging the mouse interactively. This is similar to the interactive positioning you can do in the Map View window, but in 3-D space.

It's useful to have both the Camera View and Map View windows open for interactive positioning of the Camera and Focal Point. To make this easier, if you move the Camera or Focal Point in one window WCS will also update the other window.

The Camera View window also lets you do several kinds of test renderings.

All windows are non-modal; you can leave them open and still work within other WCS windows.

All the settings in these windows take effect immediately. You don't have to click the Keep button to make your changes take effect.

If you make some changes in a window and don't want to keep them, close the window with the Cancel button and the changes will be undone.

If you want to close the window and keep the changes you made in it, click the Keep button. The window will close and your changes will be kept.

Pop-up Menu Window

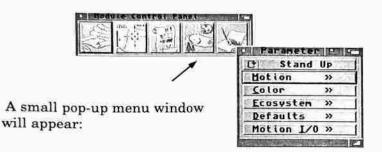
When you click the Parameters Icon, you'll see the Parameters pop-up menu window. Here you can select any of five command buttons:

- Motion
- Color
- Ecosystem
- Defaults
- Motion I/O

You can also use the Stand Up/Lay Down cycle gadget at the top of the window to make the pop-up menu window oriented vertically or horizontally.

How To Open the Parameters Pop-Up menu Window:

Click the fourth Module Control Panel icon:

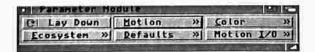


You can leave the pop-up menu open even when using other windows, and you can move the pop-up menu anywhere on your screen by dragging its title bar.

Layout Cycle Gadget

Use the Stand Up/Lay Down cycle gadget at the top of the window to make the pop-up menu window orient vertically or horizontally.

- Choose the Stand Up command to orient the window vertically as seen above.
- Choose the Lay Down command to orient the window horizontally.



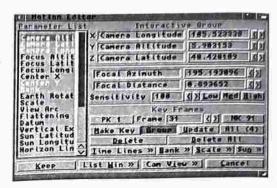
Note: You can also use the window's zoom gadget to toggle between alternate window locations.

Motion Button

Keyboard shortcut: m

Click the Motion button to open the Motion Editor window.

Here you can control all the Motion Parameters. These are covered in the Motion Parameters chapter.

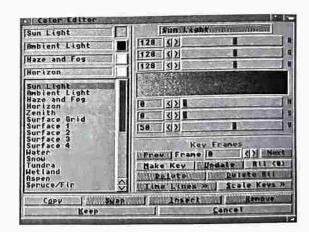


Color Button

Keyboard shortcut: c

Click the Color button to open the Color Editor window.

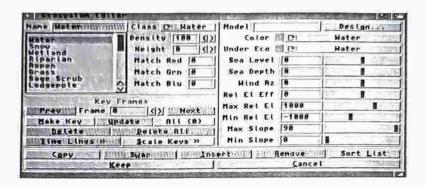
Here you can control all the Color Parameters. These are covered in the Color Parameters chapter.



Ecosystem

Keyboard shortcut: e

Click the Ecosystem button to open the Ecosystem Editor window.



Here you can control all the Ecosystem Parameters. These are covered in the Ecosystem Parameters chapter.

Defaults

Keyboard shortcut: d

Click the Defaults button to have WCS compute and set starting values for all Parameters and Settings. You might want to do this after you've imported new data into WCS using the Data Ops Module.

These won't be the most interesting, most realistic, or most anything set of Parameters that can be applied to your data, but they give you a place to start.

Ecosystem and Color Defaults

WCS will derive certain information about the terrain and from that make "educated guesses" at what Ecosystem and Color Parameters should provide at least a bit of spatial variety and color.

Motion Defaults

If the DEMs are in the northern hemisphere, WCS will point the Camera to the north with the sunlight angling from the southeast. In the southern hemisphere WCS will aim the Camera south, with the sunlight coming from the northeast. The Focal Point will always be at the center of the DEM that's most central of all the enabled DEMs

More often than not you will create new Parameter data by modifying an old data set rather than using this Default function. You would load an existing Parameter file that is similar to the one you want to create, modify it then re-save it with a different name.

The Default function is the only way of creating a new set of Parameters from scratch.

How to have WCS compute default values for all Parameters:

Click the Default button.

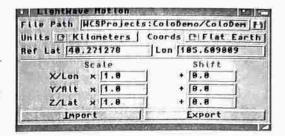
WCS will load all the enabled Digital Elevation Models found in the Database and use them as basis for computing all Color, Ecosystem and Motion Parameters.

Motion I/O

Keyboard shortcut: i

 Click the Motion I/O button to open the LightWave Motion window.

Here you can import and export motion paths for use with LightWave 3D, a modeling and animation program from NewTek (see the LightWave Motion window section later in this chapter).



Active Parameter

At any given time for each of the Editor windows there is only one Active Parameter. The Active Parameter is the one highlighted with a blue bar in the Editor's Parameter List. The current value or values of the Active Parameter are displayed in the editing gadgets of the window.

Interactive Group

For Motion Parameters you can interactively modify more than one Parameter when you drag the mouse in the Camera View window. For example, you can interactively change the Camera's longitude, latitude and altitude if you select any one of these Parameters as the Active Parameter in the Parameter list.

Groups of related Parameters that you can modify together in the Camera view are called Interactive Groups.

When you select the member of an Interactive Group, you'll see fields for each member of the Group shown on the right side of the Motion Editor. You can change their values by typing new numbers in the fields or by clicking the arrow buttons next to each field.

The X, Y and Z designations next to members of the Interactive Group refer to the axes of motion that control that Parameter in the Camera View. This will be explained in the Camera View section in the Motion Parameters chapter.

Some Interactive Groups have three members, others only one or two. There are no Interactive Groups for Color or Ecosystem Parameters.

Animation

World Construction Set lets you animate more than 75 Motion, Color and Ecosystem Parameters. While this may sound overwhelming, in practice you'll probably leave most Parameters constant over the duration of an animation and only change those that create the effect you want.

For example, you can animate the Camera and Focus positions to create a fly-over sequence; animate the colors of the sky and sun position to create a sunrise; or animate the snowline and vegetation colors to simulate the coming of spring.

It's easiest to start with an idea of what you want to see. Then find the Parameters that can accomplish the effect.

The possibilities are virtually unlimited. You may hit upon some unique variations that no-one else (including the authors) have thought of!

Key Frame System

WCS gives you a very flexible key frame system to make it easy to animate the Parameters that control color, ecosystems and motion. Using this system you can fly the Camera though a land-scape, change the angle of the sunlight, change the color and depth of the haze, and much more.

The controls for creating and modifying key frames are duplicated in each Parameter Editor window (see Key Frame Controls below), with additional controls and a graphic display available in the Time Line window (see Time Lines below).

You don't have to figure out and type in values for every Parameter for every frame. All you have to do is specify a few values for just those Parameters you want to animate, and assign those values to a few frames, called "key frames."

Once you do that, WCS will automatically enter the numbers for the "in-between" frames; the frames between the key frames. WCS will smoothly interpolate the in-between values using spline curves you can control.

It's even easier than that because you don't even have to type in numbers for the key frames. You can use the interactive Map View and Camera View windows to visually adjust Motion Parameters, and the buttons and gadgets in the Color Editor window and Ecosystem Editor window to quickly select Color and Ecosystem Parameter settings.

Here's a quick example of key framing: if you made a key frame for a Camera altitude of 10 kilometers at frame 1, and then you made another key frame for a Camera altitude of 50 kilometers at frame 30, WCS would animate the Camera moving between 10 to 50 kilometers in altitude over the thirty frames.

WCS also gives you a lot of control over how it interpolates the in-between values. Each key frame is the knot in a modified

Catmull-Rom spline. By adjusting the tension, continuity and bit as amounts at each key frame, you can change the shape of the curve. Changing the shape of the curve lets you control how the value accelerates or decelerates into and out of each key frame.

You can see a graph of the key frames and interpolated values in the Time Line window. There you can move the key frame values with the mouse, and change any key frame to a different frame number with a pair of arrow buttons.

You can also use Velocity Distribution in the Render Settings Editor window (Motion Path and Vectors page) to smooth out the interpolated values, and then use Ease-in and Ease-out Parameters to adjust the velocity of the beginning and end of the animation.

You don't have to use key frames for a Parameter if you're not going to animate it. If you don't give a Parameter any key frames, it will take its value from the field associated with that Parameter. For example, if you type 6 (kilometers) into the Camera altitude field, as long as you don't create any key frames for the Camera altitude, it will stay at 6 for all the frames in your animation.

The key frames for one Parameter do not have to coincide with key frames for another Parameter. You might have key frames for Camera Altitude, Latitude and Longitude at frames 1, 50 and 100 and key frames for Sun Latitude, Longitude and Horizon Color at frames 20 and 80.

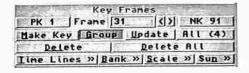
WCS has special Tension, Continuity and Bias controls that let you modify the way the Parameter changes between key frames, as represented by a curve, (called a spline). You can use them to make motions smoother or less smooth. They are described in the Time Lines section below.

WCS' Motion Paths use the same splining technique employed by the 3-D modeling and animation program, LightWave (by NewTek). With certain limitations, WCS Motion Paths can be exported for use in LightWave, and WCS can import paths created or modified by LightWave. See the LightWave Motion window below for more information.

Key Frame Controls

You'll see a standard set of key frame controls in each of the Parameter Editor windows. The controls are:

- Prev (PK #)
- Frame
- Next (NK #)
- Make Key
- Group (Motion only)
- Update
- All Keys
- Delete
- Delete All
- Time Lines
- Bank (Motion only)
- Scale
- Sun (Motion only)



When you use these controls they will only apply to the currently selected Parameter in the current Parameter window. For example you can't create a key frame for the Camera position using the key frame controls in the Ecosystem Editor window. You'd have to use the key frame controls in the Motion Editor window.

There is one important difference in the Motion Editor window's key frame controls. Some of the Motion Parameters can be selected together as a group using the Group button. You can then make a key simultaneously for all members of the Group. For example, this lets you create a key frame for Camera longitude, latitude and altitude in one step.

Color and Ecosystem Parameters can't be grouped, so there's no Group button in their key frame controls.

Frame Field & Buttons

Use the Frame field and arrow buttons to select an animation frame.

The Frame field shows the number of the current frame. The current frame is the frame shown by the Camera View window, and tracked by the interactive Camera, Focus Point, sun position and view angle in the Map View.

You can enter a new number in the Frame field and WCS will make that the current frame. You can also change which frame is the current frame by using the Next and Prev buttons, or by using the Frame Slider in the Time Line window.

If key frames are present, changing the frame counter will cause the splined values to be displayed in the Editor windows' value gadget(s). For Motion Parameters, the Interactive Group will be updated.

Each Editor has its own frame counter which operates independently of the other frame counters in other windows. Update and Delete Key functions (see below) use the frame number displayed here to determine which key frame to operate on. Having separate frame counters for each Parameter Class prevents you from losing modifications to Parameters accidentally when you change the frame number in a completely different window.

The frame number in this gadget is referred to as the "Current Frame."

Prev Button

Keyboard shortcut: v

"Prev" is short for "previous." Click the Prev button to move to the previous key frame. The previous key frame will become the current frame. If there is no previous key frame, the Prev button will be ghosted. If there is a previous key frame, you'll see "PK" (for Previous Key Frame) and that frame's number printed on the Prev button. The Camera View will be updated if it is open.

Numbers or ghosting that appear in the Prev button refer only to the Active Parameter.

Next Button

Keyboard shortcut: x

Click the Next button to move to the next key frame. The next key frame will become the current frame. If there is no next key frame, the Next button will be ghosted. If there is a next key frame, you'll see "NK" (for Next Key Frame) and that frame's number printed on the Next button. The Camera View will be updated if it is open.

Numbers or ghosting that appear in the Next button refer only to the Active Parameter.

Make Key Button

Keyboard shortcut: k

Use the Make Key button to create a key frame for the current Active Parameter. A requester will appear in which you may designate the frame for which a key is to be made. You may accept the frame number in the requester string or enter a different frame number. Accept by selecting "OK" or hitting the Return key.

A key frame will be generated for the Active Parameter. If the "Group" button is selected (depressed) when "Make Key" is selected, a key frame will be created for all Parameters in the Interactive Group. The Group option is only available for Motion Parameters.

When you make a key frame for a Parameter, its name turns white in the Parameter list. This lets you see at a glance which Parameters have key frames.

When you make more than one key frame for a Parameter, the Time Lines button will be enabled when you select that Parameter in the Parameter list. You can then use the Time Lines button to open the Time Lines window.

In the Time Lines window you can graphically edit the Motion spline for that Parameter.

Group Button

The Group button is only available in the Motion editor window.

Click the group button when you want to be able to set a key frame for all members of a group at the same time. When the Group button is on, whenever you make a key frame for one member of a group, you'll automatically make a key frame for all members of the group. This is a useful shortcut. For example, if you want to set a key frame for the Camera latitude, longitude and altitude at the same time, click any one of those Parameters in the Parameter list, and as long as the Group button is selected when you make a key frame for any one of the members of that group you'll make a key frame for all members of that group.

There are eight groups:

Camera

Includes latitude, longitude and altitude.

Focus

Includes latitude, longitude and altitude.

Center

Includes Center X and Center Y.

Flattening

Includes Datum and Flattening.

Sun

Includes latitude and longitude.

Horizon

Includes Horizon Line, Horizon Stretch and Horizon Point.

Haze

Includes Haze Start and Haze Range.

Fog

Includes Fog None and Fog Full.

Each group consists of two or more Parameters. When you click the Group button, you can then use the Make Key button to create a key frame for all the Parameters in the group at once.

In addition, if the Group button is selected when you make key frames for either the Camera or Focus Groups you will be asked if you also wish to make key frames for the other (either Focus or Camera) Group. This lets you set both Camera and Focus positions and make key frames for both at once without switching Active Parameters.

Update Button

Keyboard Shortcut: u

The Update button is something you'll want to get to know if you plan to do a lot of animating. It lets you experiment with changing any of the Parameters after you've already made the current frame a key frame for that Parameter. You can then change the Parameter's value, but the new value won't become married to the key frame until you click the Update button.

For example, you can make a key frame for the View Arc, but then play with other View Arc settings by dragging the mouse in the Camera View window. If you find a setting you like better just click the Update button and that new value will be remembered by the key frame. Otherwise the new value will not be remembered by the key frame.

In other words, use the Update button when the current frame is a key frame for the current Parameter, and you've changed the value of that Parameter. Click the Update button to put your new value into the key frame.

If you don't, the key frame will revert to the old value for that Parameter as soon as you go to another frame or click the name of another Parameter in the Parameter list.

If you are not sure if a key frame exists for the Active Parameter, note whether the Delete button is enabled. If so then there is a key frame.

You could create a new key frame for the same frame which would overwrite the old one, but the Update button saves time. Update allows you to update all Parameters that have key frames as well as the Active Parameter or Group.

The button to the right of "Update" is the "All Keys" button. It tells you how many Parameters have key frames at the Current

Frame. If the All Keys button is selected, the Update button will update the values for all the Parameters that have a key frame at the current frame.

If you're in the Motion Editor window and the Group button is selected, the Update button will update the values for all the Parameters in the Group that have a key frame at the current frame.

All Keys Button

The All Keys button works with the Update and Delete buttons. If the All Keys button is selected, the Update button will update the values for all the Parameters that have a key frame at the current frame, and the Delete button will delete all the key frames at the current frame.

If the All Keys button is not selected, the Update button will only update the key framed value for the currently selected Parameter or Group, and the Delete button will only delete the key frames for the currently selected Parameter or Group.

Note: Groups only apply to the Motion Editor window.

Tip: when moving Camera, Focus Point, Haze and Sun around in the Map View All Keys lets you grab keys for all without having to click a member of each group in the list, which would otherwise lose the new value in the other group. Of course key frames must already exist for all the Parameters for this trick to work.

Delete Button

Keyboard shortcut: Delete Key

If you've made a key frame and you decide you'd rather not have that frame be a key frame after all, use the Delete button. The frame will no longer be a key frame for the Active Parameter. For

example, if you've made a key frame for the View Arc, you can then click the Delete button and that frame will no longer be a key frame for the View Arc.

If you first turn on the All Keys button, the Delete button will Delete the values for all the Parameters that have a key frame at the current frame. After you use the Delete button, no Parameters will have a key frame at the current frame.

If you're in the Motion Editor window and you turn on the Group button, the Delete button will delete the values for all the Parameters in the Group that have a key frame at the current frame. After you use the Delete button, no Parameters will have a key frame at the current frame.

Once you delete a key frame for a Parameter, WCS will automatically calculate a value for that Parameter for that frame based on other key frames if there are any. If there aren't any key frames for a Parameter, its value will be the same for all frames.

If there are no other key frames for the Active Parameter its name will return to the normal color (black) in the Parameter List. If there is only one key frame the Time Lines button will occome disabled.

Note: You can use the Freeze and Restore Global menu commands to experiment with deleting key frames.

Delete All Button

Keyboard shortcut: d

Click the Delete All button when you want the Active Parameter to have no key frames. This is a



quick way to start over if you don't like the way a Parameter is animating, or if you decide you don't want that Parameter to change after all.

Reference 6 - Parameters Module

When you click the Delete All button, you'll see a requester asking if you're sure you want to delete all key frames for the Active Parameter. Click OK to delete all key frames for the Active Parameter. Click cancel if you don't want to use the Delete All command.

The All Keys and Group buttons don't effect the Delete All command. The Delete All command will only affect the Parameter you have selected in the Parameter list.

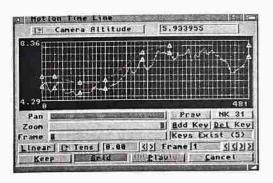
Because the Parameter will have no key frames after you use this command, if the Time lines window is open the graph will be ghosted.

Time Lines Button

Keyboard shortcut: t

Select the "Time Lines" button in the Motion, Color or Ecosystem Editor windows and the appropriate Time Line window will open (see Time Line window Common Features below).

Here you can see a graph of the Active Parameter and interactively adjust key frame value and position. You can also add, delete key frames, and modify Tension, Continuity and Bias.



The Time Line window will only be available when the Active Parameter has two or more key frames.

If this button is selected when one of the Altitude Parameters is active there will be a slight delay while DEMs are loaded for computation of the elevation profile. You may wish to disable any DEMs in the Database that do not affect the profile to save

memory. If topos are already loaded for use in Map View they will be used here as well without additional memory requirements.

Bank Button (Motion Editor Window Only)

Keyboard shortcut: b

Click the Bank button to automate the creation of Bank key frames from the Camera Motion Path.

If Bank Keys already exist you will be asked if you wish to overwrite them. You will then be asked to supply an interval to make Bank key

frames at. The default

is "K" which stands for "existing key frames."

Parameters Module: Bank Key

Key Frames exist for the

Parameter. them?



Accepting the default will create a Bank key frame at every frame where there is already a Camera Latitude or Camera Longitude key frame. Otherwise you can specify a frame interval which can be as small as one (1) which will create a Bank key at every frame. Using every frame would be equivalent to using the Turn

Banking feature in the Render Settings Editor: No smoothing of the Bank angle will sometimes result in choppy animation. We suggest a minimum of 20 frames for the interval.

The rest of the process is automatic. If none exist, or if there is no more than one Key for either Camera Latitude or Longitude, then the operation will fail and no Bank Keys will be created.

The amount of banking will be a function of path curvature and the "Banking" Setting (see the Render Settings section of the Render Module chapter).

Scale Button

Keyboard shortcut: s

Click the Scale button to open the Scale Keys window for key frame scaling and translation.

See the Scale Keys Window section below for more information.

Sun Button (Motion Editor Window Only)

Keyboard shortcut: n

Click the Sun button to open the Sun Time window for setting the sun position using a date and time.

See the Sun Time Window section below for more information.

Time Line Window Common Features

Time Lines are graphs that show Parameter values, whether they be Motion, Color or Ecosystem, plotted against time. They are an essential aid in the animation process. Time Lines can tell you if a motion or color change is smooth. They let you modify Parameters interactively with the mouse. In certain cases they let you see a Parameter superimposed on another variable for additional information. Camera Altitude is plotted along with terrain elevation, for example.

Note: Time Lines may be familiar to you as "Motion Graphs" and "Envelopes" from other applications.

You may open a separate Time Line window for each of the three Parameter Classes. Since most Time Line features are shared we will discuss all the common elements here and discuss those components unique to each Class in the appropriate Parameter chapter.

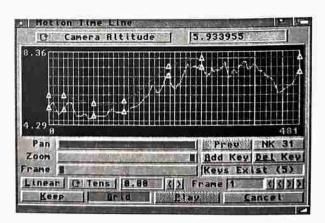
All edits made in a Time Line window are applied immediately. You do not need to use the "Update" button in the Editor window to preserve them. Edits made in the Editor or in Camera View will not be represented in the graph until you click in the Time Line value string and hit "Return" on the keyboard. This will set the value, redraw the graphs and update the key frame.

We have tried to make WCS as non-modal as possible but there are limitations. When Time Lines are open, if you select a Parameter in the Editor window List for which a Time Line graph cannot be drawn because there are less than two key frames, you will not be able to access some of the Time Line window functions. You may not, for instance, add or delete a key frame from the graph window.

Also, when Time Lines are open you will not be able to delete either of the last two key frames for a particular Parameter. If it is necessary to do this you must first close the Time Line window.

in the following generalized discussion, the term Editor window could refer to the Motion, Color or Ecosystem Editors interchangeably.

You can undo any changes made to key frames since the Time Line window was opened by closing it with the "Cancel" button.



Parameter Cycle Gadget

Use the Parameter cycle gadget to choose the Parameter you want to work with in the Time Line.

Only Parameters with two or more key frames can be graphed since a spline cannot be created from a single point. Operating the cycle gadget will only allow you to select from those Parameters.

Graph

The Graph displays a key framed Parameter versus time (measured in frames).

Opening the Time Lines window will automatically cause the graph to be drawn as will selecting a new Active Parameter.

Each key frame is designated on the graph by a white triangle. Selecting on one of these with the mouse will activate it. The active point is drawn in yellow. The Frame associated with the active point will become the Current Frame and all gadgets in the appropriate Editor window and Camera View will be updated.

You may drag the active point to a new value with the mouse. The point must be active before you click to begin dragging. You may not activate and begin dragging in one operation. This is to prevent accidentally changing the value when you only wanted to activate the point.

You may add key frames directly on the graph (see "Add Key" below). The graph will be disabled whenever there are less than two key frames for the Active Parameter.

Motion Time Lines

For certain Motion Parameters there will be an auxiliary curve drawn on the same graph. The actual Parameter graph will be the red curve in any case. For Camera or Focus Altitude the green graph curve is the terrain elevation along the Motion Path. It is drawn to the same scale as the altitude curve.

For Camera and Focus Latitude and Longitude the green curve represents velocity. It is scaled to the graphed Parameter and so it should only be taken in a relative sense. It will show any velocity irregularity as bumps and dips in the graph. If Velocity Distribution is enabled (see the Render Settings section of this chapter), the velocity graph you will see represents the smoothed velocity. This is so you can visually confirm the smoothing action.

The Parameter curve itself is not smoothed in the graph regardless of the Velocity Distribution Setting. If smoothing were applied to it, interactive key frame editing would be confusing since the graph would not be showing the actual key frame values.

You can not edit the auxiliary curves directly. Selecting points on these curves will activate the corresponding points on the primary graph.

Value Field(s)

Use the Value field(s) to display and set a Parameter value.

The field(s) will display the value(s) of the Active Parameter at the Current Frame. To modify a value enter a new value in the string and hit the Return key on your keyboard. The key frame value will be updated only after you hit the Return key.

If you enter a value from the Editor window or drag the mouse in the Camera View window, this field will be only temporarily updated. To actually set the key frame to this value, click in the field and hit the Return key on your keyboard.

There is one Value field for Motion and Ecosystem Classes and three fields for Color (red, green and blue).

Pan & Zoom Sliders

Use the Pan and Zoom sliders to adjust the amount and portion of the Time Line graph visible in the window.

The Zoom slider controls the amount of the graph that is visible. The Pan slider controls the portion that is visible.

Frame Slider

Use the Frame slider to control the Active Frame and the frame displayed in the Camera View (Motion Time Lines only).

For finer animation control using this slider you can enlarge the Time Line window. That will give the slider finer granularity.

Note: The active key frame in the Time Line graph (the one drawn in yellow) won't update along with this slider unless the frame the slider selects happens to be the exact frame number where there is a key frame.

Prev Button

Keyboard shortcut: v

Click the Prev (Previous) button to jump to the next lower key frame, if there is one, for the Active Parameter.

The next lower key frame will become the Current Frame and all values associated with that frame will be set in the appropriate Editor gadgets. The Camera View will be updated if it is open. The new active point will be highlighted in yellow on the graph.

When this button is disabled there is no previous key frame for the Active Parameter. When enabled the button text will change to display "PK" and the frame number of the previous Key.

Next Button

Keyboard shortcut: x

Click the Next button to jump to the next higher key frame, if there is one, for the Active Parameter.

The next key frame will become the Current Frame and all values associated with that frame will be set in the appropriate Editor gadgets. The Camera View will be updated if it is open. The new active point will be highlighted in yellow on the graph.

When this button is disabled there are no key frames for the Active Parameter beyond the Current Frame. When enabled the button text will change to display "NK" and the frame number of the next Key.

Add Key Button

Keyboard shortcut: k

Click the Add Key button to add a key frame at a user designated point on the graph.

After you click the Add Key button, click on the point where you want to add a key frame. A new key frame will be created at the frame selected. The value will be that of the spline at that frame before the new Key was added.

Because of the way splining works, adding a key frame at a point will modify the splined values on either side of the added point slightly even though the value at the point itself remains unchanged.

This button will be disabled if the graphed Parameter is not the same as the Active Parameter in the Editor window. This could result from selecting a Parameter in the Editor Parameter List that has less than two key frames.

Reference 6 - Parameters Module

Note: In order to add a key frame beyond the upper frame limit of the graph you must use the Make Key button in the corresponding Parameter Editor window.

Del Key Button

Keyboard shortcut: Del

Click the Del Key button to delete a key frame, Group of key frames or All key frames at the Current Frame.

The key frame for the Active Parameter at the Current Frame will be deleted.

For Motion Parameters, if the "Group" button next to the "Make Key" button in the Motion Editor is selected (depressed) when Delete is selected then all of the Interactive Group members' key frames at he Current Frame will be deleted.

If the "All Keys" button to the right of the "Update" button in the Editor window is selected (depressed) when Delete is selected then all key frames at the Current Frame will be deleted. Only those Keys of the same Parameter Class (Motion, Color, Ecosystem) will be affected.

If there are only two key frames for the graphed Parameter this button will be disabled. The last two key frames cannot be deleted while Time Lines are open.

Keys Exist Field

The Keys Exist field shows you how many Keys exist at the Current Frame.

The number of Keys is only for the same class of Parameters: Motion, Color or Ecosystem. In other words if it says "Keys Exist (4)" and you are in the Motion Time Line window then there are a total of four Motion Parameters with key frames at this frame. There may also be an unspecified number of Color or Ecosystem Parameter Keys.

Frame Field & Buttons

The Frame field shows the frame position of the active point in the graph. Use the inner arrows to move the frame position of the key frame by one or the outer arrows to move it by ten.

Use this to fine-tune the shape of the graph.

The position of the last key frame can not be changed.

If the Group button is selected (Motion Parameters only) adjusting the frame position of a key frame will cause the corresponding key frame to be adjusted for other members of the Interactive Group.

Linear Button

Use the Linear button to tell WCS not to spline (fit a curve) from the current key frame to the next. A straight linear segment will be interpolated instead of a smooth curve.

Linear can be used to stop a motion in one place for a length of time. Beware of this option though in that it will not ensure that motion decelerates and accelerates into and out of the still segment. For smoother transitions you should use the Tension control described below.

Linear can be enabled or disabled for every key frame and for every key framed Parameter individually.

This feature adds to WCS' compatibility with LightWave 3D. If you plan to export WCS motion paths to LightWave, you should be sure to use the same Linear setting for all Camera and Focus Parameters at any given key frame.

Tension/Continuity/Bias Cycle Gadget

Use the Tension, Continuity and Bias cycle gadget to select one of the spline control variables: Tension, Continuity or Bias.

You can then set a value for the selected variable using the field and arrow buttons to the right of the cycle gadget.

If the Group button is selected (Motion Parameters only) adjusting the tension, continuity or bias will cause the corresponding values to be adjusted for other members of the Interactive Group at the same key frame.

Tens Field & Buttons

Use the Tens (Tension) field and buttons to adjust the Tension or tightness of splined curves and to allow for ease in/out of splined effects.

Set the desired value in the string or adjust with the arrow buttons. Use a value of 1.0 for smooth ease in or ease out of an effect. Values greater than 0 will tighten the spline at the key frame, less than 0 will flatten it.

Use this adjustment sparingly. It can create velocity anomalies and S-shaped splines so always check the results in the Time Lines graph.

Cont Field & Buttons

Use the Cont (Continuity) command to adjust the Continuity of splined curves.

Set the desired value in the string or adjust with the arrow buttons. Values greater or less than 0 will cause discontinuity at the key frame.

Use this adjustment for special effects where sharp breaks in motion are desired and always check the results in the Time Lines graph.

Bias Field & Buttons

Use the Bias command to adjust the Bias or skew of splined curves.

Set the desired value in the string or adjust with the arrows. Values greater than 0 will offset the maximum curvature of a spline to the higher side of the key frame, less than 0 will offset it to the lower side.

Use this adjustment sparingly. Like Tension and Continuity, it can create velocity anomalies so always check the results in the Time Line graph.

Keep Button

Keyboard shortcut: K

Click the Keep button to close the Time line window and keep changes.

The Time Line window will close and all changes made since the window was opened will be preserved.

You do not need to close the Time Line window for changes to take effect, they are effective immediately. If you want to close

the Time Line window and lose any changes you've made, click the Cancel button (see below).

Grid Button

Use the Grid button to turn on and off the grid overlay in the Time Line graph.

Sometimes the grid is useful for seeing subtle changes in a graph. Other times it gets in the way and slows graph redraws. Enable it or disable it as you please. It won't affect the graphed values one way or the other.

Play Button

Keyboard shortcut: p

Click the Play button to view key frame values as an animation.

Depending on the Parameter Class you will see the splined values played in the Color Editor Color Gradient Panel or in the Camera View window.

The Play function is not available in the Ecosystem Time Line window.

Motion splines will be viewable only if the Camera View is open. The animation will be played with whatever Bounds are currently enabled in the Camera View Control window. It will be played as fast as your machine permits which will probably be slower than real-time.

You can adjust the speed by changing the "Step" Render Setting in the Render Settings Editor (see the Render Module chapter). A larger value will increase the animation speed. Don't forget to re-set the Setting's value before you begin final animation rendering.

Cancel Button

Keyboard shortcut: c

Click the Cancel button to close the Time Line window and undo changes.

The Time Line window will close and all changes made since the window was opened will be cancelled. The values will be restored to their original condition.

Only the key frames for the appropriate Parameter Class will be affected by the action. If changes were made from other windows affecting this Parameter Class while this window was open, they too will be lost when you select Cancel here. If you want to close the window and keep all your changes, click the Keep button instead (see Keep above).

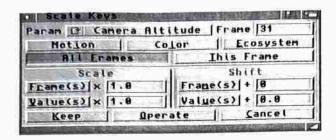
Scale Keys Window

From time to time it may be necessary to change some or all key frames by a scale factor or an added value. The Scale Keys (Key Frames) window provides the tools to do this quickly. The frame numbers may be adjusted or the values of the Keys themselves.

You can scale a single Parameter, all Parameters or a class of Parameters (Motion, Color or Ecosystem). You can scale a single key frame or all key frames.

Use the Scale Keys window to provide an interface to the key frame scaling and translation operators.

To open the Scale Keys window select "Scale" or "Scale Keys" in one of the Parameter Editor windows. The Scale Keys window will open.



Note: Depending on which Editor the window was called from there will be different Parameter selections available in the Scale Keys window.

Param Cycle Gadget

Use the Param cycle gadget to select a single Parameter for adjustment.

The Parameters available here will depend on the Editor from which the Scale Keys window was opened. For instance, if you opened it from the Motion Editor only key framed Motion Parameters can be scaled individually.

Only those Parameters with key frames will be available here.

Frame Field

Use the Frame field to select a single key frame for adjustment.

The window will be opened with the Current Frame in this string. You may enter a different frame if you desire.

This value will have no effect if "All Frames" is selected below.

Motion Button

Keyboard shortcut: i

Use the Motion button to select ALL Motion Parameters for modification.

If this button is selected (depressed) when the "Operate" button is selected, all Motion Parameters will be affected by the operation.

Color Button

Keyboard shortcut: I

Use the Color button to select ALL Color Parameters for modification.

If this button is selected (depressed) when the "Operate" button is selected, all Color Parameters will be affected by the operation.

Ecosystem Button

Keyboard shortcut: e

Use the Ecosystem button to select ALL Ecosystem Parameters for modification.

If this button is selected (depressed) when the "Operate" button is selected, all Ecosystem Parameters will be affected by the operation.

All Frames Button

Keyboard shortcut: f

Use the All Frames button to choose whether the scaling and translation operators are applied to all frames or only a single frame.

Selecting the All Frames button will de-select the This Frame button (see below).

If the All Frames button is de-selected only the frame displayed in the Frame field will be affected by the scaling and translation operators.

This Frame Button

Keyboard shortcut: t

Use the This Frame button to choose whether the scaling and translation operators are applied to only the frame appearing in the Frame string gadget (see above) or all frames.

Selecting the This Frame button will de-select the All Frames button.

Scale Frame Button and Field

Keyboard shortcut: r

Use the Scale Frame field to specify a scale factor to apply to frame numbers.

Select the button and enter a value. The default (null operation) is 1.0.

The entered value will be multiplied with the frame numbers. If the "Scale Frame" value is 10, a key frame at frame 20 will be at frame 200 after the operation.

The frame scale will not be applied unless the Scale Frame button is depressed.

Scale Value Button and Field

Keyboard shortcut: v

Use the Scale Value field to specify a scale factor to apply to Key values.

Select the button and enter a value. The default (null operation) is 1.0.

The entered value will be multiplied with the Parameter value. If the "Scale Value" is 5.0, a Camera Altitude of 2.0 will become 10.0 after the operation.

The value scale will not be applied unless the Scale Value button is depressed.

Shift Frame Button and Field

Keyboard shortcut: m

Use the Shift Frame field to specify a translation or shift to apply to frame numbers.

Select the button and enter a value in the string. The default (null operation) is 0.

The entered value will be added to the frame numbers. If the "Shift Frame" value is 10, a key frame at frame 20 will be at frame 30 after the operation.

The frame shift will not be applied unless the Shift Frame button is depressed.

Shift Value Button and Field

Keyboard shortcut: u

Use the Shift Value field to specify a translation or shift to apply to Parameter values.

Select the button and enter a value. The default (null operation) is 0.0.

The entered value will be added to the Parameter value. If the "Shift Value" is 5.0, a Camera Altitude of 2.0 will become 7.0 after the operation.

The value shift will not be applied unless the Shift Value button is depressed.

Keep Button

Keyboard shortcut: K

Select the Keep button to close the Scale Keys window and preserve changes.

The Scale Keys window will close and all changes will remain.

Scaling and translation operations take effect immediately without closing the window.

Operate Button

Keyboard shortcut: o

Use the Operate button to apply the scaling and translation factors to designated frames and Parameters.

Select the Parameter(s) and Frame(s) to operate on and enter scaling and/or translation values in the strings. Select all scaling and translation key buttons that correspond to the operations you wish to perform. Finally select the "Operate" button.

The operations will be performed scaling first, translation (shift) second.

If the Motion, Color or Ecosystem button is selected (whichever one corresponds to the Parameter Class of the Editor that opened the window) then the "Param" cycle selection at the top of the window will have no effect since all of the keys for that class will be affected anyway.

You can perform as many operations as you like while the Scale Keys window is open.

Cancel Button

Keyboard shortcut: c

Select the Cancel button to close the Scale Keys window and undo changes.

The Scale Keys window will close and all changes will be cancelled. The key frames will be returned to their condition when this window was opened.

If changes were made from other windows while this one was open, they too will be lost when you select Cancel here.

LightWave Motion Window

World Construction Set is primarily a landscape rendering program. In an effort to provide you with as much functionality as possible, we have included support for one of the most popular 3-D motion formats: LightWave. You can create a LightWave scene first and import its motion path to WCS or generate the motion path in WCS, taking account of the terrain features and export it to LightWave for the addition of non-terrain Objects.

Ultimately, when LightWave supports import and export of Z Buffers as WCS does, the two programs will be able to share the most vital components for merging animations. Even without Z Buffer support, there are ways to successfully merge images created in both applications to create amazingly realistic effects.

WCS expects to support a broader range of LightWave file formats in the future including DEM conversion to LW Objects. This will further help the process of coordinating action between the two rendering systems.

Coordinate System

There are actually two sets of import/export functions available in this window. Both yield a LightWave format motion file but the results and the way you will make use of them are very different.

There is a basic problem in converting a WCS scene to the 3-D geometry inherent to all traditional rendering programs. Other programs see the world as flat. Three dimensional space is organized around a set of coordinate axes. Each axis is perpendicular to the other two and all the axes are straight lines. The two horizontal axes define the plane of the "ground."

In WCS we use three axes as well. However, describing a scene in these Cartesian coordinates would be awkward. The intersection of our axes is at the center of the earth. The two horizontal axes

define the plane of the equator. Only at the two poles is the "ground" even parallel to that plane and there it is over 6000 kilometers above or below it.

To move over the ground at a constant altitude requires actually moving in an arc "around" the earth. It turns out that there is another coordinate system designed many centuries ago (probably around the time the earth was discovered not to be flat) virtually custom made to our purposes. It is called variously as "geographic", "polar coordinate" and "the latitude/longitude" system.

There are other reasons for using this system besides simple convenience to the user. Most people are somewhat familiar with the lat/lon system and most state and country maps display these coordinates along the edges. The system is globally accepted and doesn't require expertise in analytical geometry to understand.

Where we run into trouble is in trying to present the same information in the system LightWave understands. We have taken two different approaches. One keeps the geometry simple on the LightWave end but loses some accuracy, the other is more complex for LightWave users but retains all the accuracy of the original. Which one is the best one to use will depend on your knowledge of LightWave tricks and how much motion there is in the animation.

We will refer to the two options as "Flat" and "Spherical." Flat will work when the Motion Path covers a small enough area that the curvature of the earth has little effect. It treats the area around the Camera as if the topographic datum were flat. As you may have found in trying to map a square image to a ball, distortion is inevitable. For that reason there are as many types of map projections for accomplishing the feat as there were 19th century cartographers.

The Spherical option does not try to do anything tricky with the data. It just outputs raw X, Y and Z coordinates based on real distances with no attempt to re-orient the "ground" to be parallel to

any particular axes. Data points will lie somewhere beyond the radius of the earth. The trick then is for the LightWave user to be able to re-orient the entire landscape along with the motion path and shift it to a more convenient position relative to LightWave's axes.

Precautions

There are, as you might expect, a few caveats to using the Light-Wave I/O functions.

 LightWave does not use Focus Points but instead has a Heading/Pitch/Bank system.

WCS will convert its Focus Points to HPB when exporting and create a proxy Focus Point from the HPB values when importing. This seems to work well enough in most cases. However angular measurements like HPB are cyclic, they repeat every 360°. WCS doesn't know and doesn't care what cycle a value falls in, LightWave does. Let's use Heading as an example.

In WCS the Camera is aimed from point A to point B. If you pan in a full circle you will come back to the same Focus Point, B. In LightWave if your original heading was angle C, after the full circle pan the Heading will be C + 360°, it has jumped to the next cycle.

When exporting, we have no way of keeping track of which cycle we are in. The output will then cause big jumps at the ends of cycles in LightWave's motion. Instead of the sequence 358, 359, 360, 361 you will get 358, 359, 0, 1. Actually the break is more likely to occur at -90/270° rather than 0/360° but the effect is the same.

You may encounter this in either Flat or Spherical mode. The solution, at least until we think of a better one, is to manually adjust for the cycling by adding 360° wherever

necessary in the LightWave motion path. You should check Heading, Pitch and Bank for this potential problem It is a problem when exporting only.

- The export file will honor whatever settings WCS would use to render the scene including "Look Ahead", "Auto Banking", "Bank Factor", Bank key frames and Focus key frames. Be sure to have these adjusted before you invoke the exporter.
- WCS will allow you to have separate key frames for each motion axis with independent tension, continuity and bias settings. LightWave does not. For consistent results you should honor LightWave's conventions when creating a WCS path for export.

The exporter will put out a complete LW key at each frame for which one of the critical Motion Parameters exists. The critical Parameters are:

- Camera Altitude
- Camera Latitude
- Camera Longitude
- Focus Altitude
- Focus Latitude
- Focus Longitude
- Bank

For any Parameters that a key does not exist at such a frame, the value will be splined. This is an imperfect solution since it isn't really the same to spline a value and to have a key for that value. The best approach if you are going to swap paths with LightWave is to honor LightWave's conditions even though it means giving up some control.

 Since there can only be one tension, continuity and bias per output key frame, be sure that they are all the same for each Parameter at any given frame in WCS.

Reference 6 - Parameters Module

- WCS supports a movable focal center. These are the "Center X" and "Center Y" Parameters. Since there are no such creatures in LightWave, or at least not represented as such in the motion file, you would be best to leave these set to the image center unless you plan to compensate in some way from within LightWave.
- As we discussed above, when using the Flat coordinate system try to keep your WCS paths limited in latitude scope and the distortion should be minimal.

In large aerial images there is also earth curvature distortion so try to keep your LightWave Objects near center foreground if you are viewing large map areas in WCS. If the distortion becomes too large it will be evident in strange movements of LightWave Objects relative to the terrain. Objects that should be fixed to the ground will seem to drift around. Using the Spherical coordinate system should solve the problem.

All in all, these precautions are not too restrictive given the huge rewards that will come from being able to use both programs hand in hand.

Scaling and Reference

When using Flat coordinates, the Motion Path will be referenced to three values, one for each axis. The X axis is referenced to a longitude coordinate, Y axis to an altitude and Z axis to a latitude coordinate. Ideally these reference values should fall somewhere within the scope of the path. When the I/O window opens, the average latitude and longitude of the current WCS Camera and Focus Paths will be computed.

These are the best values to use as reference although you may enter any values you like. The farther the reference values are from any given portion of the path, the greater the distortion will be due to the projection error discussed above. The altitude refer-

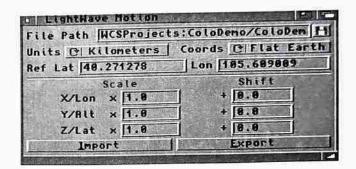
ence is fixed at sea level (0). The reference point will become (0, 0, 0) in LightWave's coordinate system.

Reference coordinates are not needed in the Spherical scheme. The center of the earth is taken as the reference.

You can apply a scale factor to any of the three axes. This allows you to convert to value sizes that are most useful for use in Light-Wave. The default is to use real world measurements where one kilometer in WCS is still a kilometer in LightWave.

Using The LightWave Motion Window

Select the Motion I/O command in the Parameters Module pop-up menu. The LightWave Motion window will open.



The average of Camera and Focus Position will be computed and entered in the Reference Latitude and Longitude strings.

File Path Field & Disk Button

Use the File Path field and disk button to set the file name and directory path for either import or export operations.

Enter a device, path and file name in the string or use the disk button to select.

A valid file name must be present in order to proceed with either import or export operations. A default file name "LWMO" is appended to the Default Directory and placed in the string when the window opens.

Units Cycle Gadget

Use the Units cycle gadget to set the desired measurement unit.

The default units are kilometers. If you wish you may convert the data to any of the following units: meters, centimeters, miles, feet or inches. In any event, this is not a scaling operation, simply a units conversion. The output will be in real world measurements regardless. If you wish to scale the data to larger or smaller numbers for ease of use, that feature is available below.

Coords Cycle Gadget

Use the Coords cycle gadget to choose the coordinate system that will be used for the import or export operation. Choose between Flat and Spherical (see Scaling and Reference above).

Two types of I/O functions are available. Which one is in effect is determined by the coordinate system.

Ref Lat Field

Use the Ref Lat field to set a reference latitude for computing Y values when exporting or to anchor the path when importing.

If you export and later import you must be sure to set this to the same value. Make a note of it when you export.

This value is ignored for Spherical Coordinates.

Ref Lon Field

Use the Ref Lon field to set a reference longitude for computing X values when exporting or to anchor the path when importing.

If you export and later import you must be sure to set this to the same value. Make a note of it when you export.

This value is ignored for Spherical Coordinates.

Scale X/Y/Z Fields

Use the Scale X/Y/Z fields to set additional scaling parameters for each axis.

If you use one value for export you must use the inverse value for import to retain the same proportionality.

In Spherical Coordinates, the first scale factor is used for all three axes so as not to distort the sphericity of the globe. The other two are ignored.

Shift X/Y/Z Fields

Use the Shift X/Y/Z fields to set translation values for each axis.

If you use one value for export you must use the negative value for import to return to the same position.

In Spherical Coordinates, all three translation values are used.

The shifts are applied after the scale factors when exporting and before when importing:

export: $X = ((ref lon - longitude) x scale_e) + shift_e$ import: $longitude = ref lon - ((X + shift_e) x scale_e)$

Import Button

Keyboard shortcut: i

Select the Import button to initiate import of a LightWave Motion file as the WCS Motion Path.

If key frames exist for the Camera, Focus or Bank Parameters you will be asked if you wish to overwrite them. Key frames will be created for each Camera and Focus Group Parameter as well as Bank at every frame for which one exists in the LightWave file.

The single tension, continuity and bias setting in the LW file will be set for all WCS Parameters at the key frame.

Export Button

Keyboard shortcut: e

Select the Export button to initiate export of the WCS Motion Path as a LightWave Motion file.

A LightWave Motion file will be created using any Camera, Focus and Bank key frames as well as any other Render Settings that apply to paths.

See the precautions in the introduction to this window above.

Sun Time Window

The Sun Time window provides a quick and easy way to set the sun's position (both Sun latitude and Sun Longitude) using familiar terms such as the month, day and time you want to simulate.

You can set the time values and create a key frame for the Sun Group, then re-set the time and create another key frame. This will give you an animation of the sun position based on real-world sun positions. You could change the date and animate the seasonal movement of the sun from low in the sky to high overhead.

To open the Sun Time Window click on the Sun button in the Motion Editor window. The Sun Time window will open.



Ref Lon Field

Use the Ref Lon (Reference Longitude) field to enter a longitude from which to reference the time. WCS must know where you want to call "home" when it figures out the sun position. After all if you tell it 1:00 PM, that will be a different sun position for someone in China than for someone in Germany. The longitude of the Focus Point will be placed in this field as the default reference when the Sun Time window opens.

Date Cycle Gadgets

Enter the month and day of the year that you want to simulate. The sun is at a lower latitude during the winter months and higher in summer. The dates of winter and summer solstice are usually around the 21st of December and June in the northern hemisphere and reversed in the southern.

Note: Using the Sun Time window you will never get a sun position higher than +23 degrees latitude or lower than -23 degrees.

Time Field and Cycle Gadget

Enter the time of day in the string gadget and set the cycle gadget to afternoon or morning. In WCS 12:00 noon is considered PM and midnight is AM. You can use either a 12 hour clock scheme or 24 hour but in any event the AM/PM cycle gadget must be set correctly.

Time is used to set the sun's longitude and the Reference Longitude described above determines where the time value relates to.

Sun Lon and Sun Lat Fields

Whenever you change any of the above settings a new Sun Longitude and latitude will be computed and placed in these string fields. They also will be placed in the Motion Editor's Interactive Group if the Active Group is "Sun."

You can type values into these two fields directly and when you hit Return the values will be updated in the Motion Editor.

When the Sun Time window first opens the Latitude and Longitude fields will be filled in with the current Sun position settings. From these the best date and time values will be computed and all the rest of the window's gadgets will be set.

Note: It is possible to create Sun positions that have no real-world counterpart. For instance if you set the Sun Latitude to 40 degrees. This can never happen naturally unless the earth rolls over on its side (frightening prospect) but it might be useful to get certain lighting on a scene. WCS will compute a date and time as best it can under these circumstances.

Reverse Seasons Button

Sun latitude positions are symmetrical to the solstice events. In other words the sun is at the same latitude four days before as well as after the solstice. Therefore WCS can't figure out which season you are in from latitude information alone. This button reverses the seasons if WCS doesn't guess correctly what you intend.

This button only changes the month and day gadgets. It has no effect on the sun position or time of day.

Keep Button

Use the Keep button to close the Sun Time window and keep the changes including any key frames that were created. Use the Cancel button (see below) to cancel changes instead.

Cancel Button

Use the Cancel button to close the Sun Time window and undo any changes, including any key frames that were created, since the Sun Time window was opened. Use the keep button (see above) to close the window and keep the changes instead.

Note: Cancelling will undo changes made to Motion Parameters other than Sun position if they were made since the Sun Time window was opened.

Reference 6A - Motion Parameters

- Overview
- Motion Editor Window
- Motion Time Lines
- Camera View
- Camera View Window
- Compass Window
- Camera View Control Window
- Diagnostic Data Window

Overview

Motion Parameters let you move things like the Camera, the Focus Point, the Sun position, Haze Range, and the View Angle. Use them to get just the right Camera angle, lighting, haze distance, and lens for creating still images. You can also animate Motion Parameters to create spectacular flying animations, with changing light, haze, fog and even landscape height.

You can see and change these Parameters using the Motion Editor window, the Camera View window, the Camera View Control window and the Compass window. If you are creating an Animation you can create key frames for these Parameters using the Motion Editor window.

LightWave Motion Paths

WCS supports both the import and export of Motion Paths in LightWave format. To find out how to do this using the Light-Wave Motion I/O window read the end of the previous chapter.

Coordinate System

Because the earth is a sphere, WCS uses a polar coordinate system rather than the Cartesian system of most 3-D modeling programs. What this means to you is that you will be laying out Camera, Focus and Sun positions in degrees of Latitude and Longitude and using Altitude, instead of using X, Y and Z units of measurement.

This is how ship captains, airline pilots and space agencies navigate around the earth. It lets "up" be "up" no matter where you are on the globe, and it lets you move around the globe with no special effort required to keep from shooting out into space.

If you're used to "flat earth" programs that use X, Y and Z systems, it may take a while to get used to moving the Camera in an orbital path in the Camera View window. But all it takes is a little understanding of what is going on, and a little experimentation, to start getting comfortable with this system. After a few projects it will probably feel like second nature and you'll wonder how you ever got along without it.

Polar coordinates are the simplest system of reference for points on a sphere (such as the earth). They let you move around the globe without concern for the curvature of the earth. They also allow for absolute referencing according to an accepted standard (latitude and longitude).

Polar coordinates allow the surface of the earth to be represented as it really is-curved. After all, Columbus proved it was over 500 years ago, who are we to argue?

Note: For more insight into latitude and longitude, read Appendix B: A Lesson In Geography.

Stand Up

>>

<u>Color</u>

Ecosystem

Motion Editor Window

Use the Motion Editor window to edit Motion Parameters and Motion key frames. You can move the Motion Editor window anywhere on the screen and use it along with other windows. It will remain functional except during rendering.

To open the Motion Editor window, select the Motion command in the Parameters Module pop-up menu:

Or select Motion Editor from the Modules pull-down menu.

The Motion Editor window is one of the main hubs of activity in World Construction Set. From this window you control not just motion but mood.



Note: You must first load a Parameter file, or create one using the "Default" button in the Parameters Module pop-up menu, before you can open the Motion Editor window.

For every given Camera/Focus position there are an unlimited number of different images you can create. The time you invest experimenting with the Motion Parameters, along with the Color and Ecosystem Parameters, will pay off as you gain a full appreciation of the possibilities.

Related Windows and Menu Commands

There are four other windows you can open from the Motion Editor window: the Camera View window, the Camera View Control window, the Compass window (see below), and the Motion Time Line window (see the Parameters chapter).

Also, you can change several Motion Parameters from the Map View window when in its interactive mode (see the Map View chapter).

The Parameters menu offers several functions that apply to Motion Parameters, including loading and saving complete Parameter files, and loading and saving the Active Parameter.



The Freeze/Restore commands are useful for temporarily holding a set of Parameter settings while you experiment with other settings (see the Global Menus chapter for more about these commands).

Motion Window Areas

The Motion Editor window has four areas:

- Parameter List
- Interactive Group
- Key Frame Controls (see the Parameters chapter)
- Bottom Buttons

Parameter List



The Parameter list shows you all the Motion Parameters you can change and animate.

You can click the name of a Parameter in the list to make it the Active Parameter. You can then change this Parameter or any members of its Parameter Group by typing values into the Interactive Group fields or dragging the mouse in the Camera View window. To use these values in an animation you can create key frames by using the Key Frame Controls.

To make a Parameter the Active Parameter, click its name in the Parameter list. Its value and those of its Interactive Group (if it has one) at the Current Frame will be displayed in the Interactive Group fields to the right of the Parameter list. For example if you click the Camera Altitude Parameter in the list, the Interactive Group fields will show the values for Camera Altitude, Camera Latitude and Camera Longitude for the Current Frame.

Note that you'll always see focal azimuth and distance fields under the Interactive Group. They are always visible regardless of the interactive group but can only be edited when the Active Group is Camera or Focus.

By the way, when you create a key frame for a Parameter it's name will be displayed in white in the Parameter list. This lets you know at a glance which Parameters have key frames and which ones don't.

Here are all the Motion Parameters in the Parameter list:

- Camera Altitude
- Camera Latitude
- Camera Longitude
- Focus Altitude
- Focus Latitude
- Focus Longitude
- Center X
- Center Y
- Bank
- Earth Rotation
- Scale
- View Arc
- Flattening
- Datum
- Vertical Exaggeration
- Sun Latitude
- Sun Longitude
- Horizon Line
- Horizon Point
- Horizon Stretch
- Haze Start
- Haze Range
- Shade Factor
- Fog None
- Fog Full
- Z Minimum

Camera Altitude

Maximum: 1,000,000 kilometers

Minimum: -6,362.683195 kilometers (the center of the earth)

Camera Altitude is the height of the Camera. It's measured in kilometers above or below sea level.

Note: The elevations in DEM files are also relative to sea level.

Reference 6A - Motion Parameters

Camera Altitude, Camera Latitude and Camera Longitude together define the Camera's position in 3-D space. They are all members of the Camera Group.

Camera Latitude

Latitude

Maximum: 90.0 degrees (north pole) Minimum: -90.0 degrees (south pole)

Camera Latitude is how far the Camera is north or south of the equator. It's measured in degrees and is compatible with the latitude markings on standard maps and globes.

Longitude

90 45

360 270 180 90 0

Camera Altitude, Camera Latitude and Camera Longitude together define the Camera's position in 3-D space. They are all members of the Camera Group. When you change the Camera Latitude without changing the Camera Altitude, the Camera will naturally move at a fixed orbital distance from the earth rather than shooting out into space.

-45

Camera Longitude

Maximum: 1,000,000 degrees Minimum: -1,000,000 degrees

Camera Longitude is how far the Camera is east or west of the prime meridian, which passes through Greenwich, England. It's measured in degrees and is compatible with the longitude markings on standard maps and globes, with one exception.

Contrary to certain other standards, for WCS a positive longitude is west of the meridian and negative longitude is east. This is due to the fact that much of the high quality DEM data available is for the Western hemisphere.

We hope this will avoid some frustration for anyone not already steeped in the sometimes arcane conventions of the Graphic Information Systems trade.

WCS supports continuous longitudinal motion up to 1,000,000 degrees (approximately 2,777 complete orbits) in both positive and negative directions. For additional rotational control see "Earth Rotation" below. Longitude position may be expressed as either positive or negative (-5° = 355°) based on the 360° full circle.

Camera Altitude, Camera Latitude and Camera Longitude together define the Camera's position in 3-D space. They are all members of the Camera Group. When you change the Camera Longitude without changing the Camera Altitude, the Camera will naturally move at a fixed orbital distance from the earth rather than shooting out into space.

Focus Altitude

Maximum: 1,000,000 Kilometers

Minimum: -6,362.683195 Kilometers (the center of the earth)

The Focus Point is the point at which the Camera is always aimed. Focus Altitude is the height of the Focus Point. It's measured in kilometers above or below sea level.

Reference 6A - Motion Parameters

Note: The elevations in DEM files are also relative to sea level.

Focus Altitude, Focus Latitude and Focus Longitude together define the Focus Point's position in 3-D space. They are all members of the Focus Group.

Focus Latitude

Maximum: 90.0 degrees (north pole) Minimum: -90.0 degrees (south pole)

Focus Latitude is how far the Focus Point is north or south of the equator. It's measured in degrees and it's compatible with the latitude markings on standard maps and globes.

Focus Altitude, Focus Latitude and Focus Longitude together define the Focus Point's position in 3-D space. They are all members of the Focus Group. When you change the Focus Latitude without changing the Focus Altitude, the Focus Point will naturally move at a fixed orbital distance from the earth rather than shooting out into space.

Focus Longitude

Maximum: 1,000,000 degrees Minimum: -1,000,000 degrees

Focus Longitude is how far the Focus Point is east or west of the prime meridian, which passes through Greenwich, England. It's measured in degrees and is compatible with the longitude markings on standard maps and globes, with one exception.

Contrary to certain other standards, for WCS a positive longitude is west of the meridian and negative longitude is east. This is due to the fact that much of the high quality DEM data available is for the Western hemisphere.

WCS supports continuous longitudinal motion up to 1,000,000 degrees (approximately 2,777 complete orbits) in both positive and negative directions. For additional rotational control see

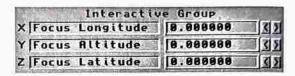
"Earth Rotation" below. Longitude position may be expressed as either positive or negative (-5° = 355°) based on the 360° full circle.

Focus Altitude, Focus Latitude and Focus Longitude together define the Focus Point's position in 3-D space. They are all members of the Focus Group. When you change the Focus Longitude without changing the Focus Altitude, the Focus Point will naturally move at a fixed orbital distance from the earth rather than shooting out into space.

Special Map Making Focus Position

There is one special Focus position for making maps or rotating globes: If Focus Altitude, Focus Latitude and Focus Longitude are all set to 0.0 then the Focus will be placed at the earth's center

and the Camera will point straight down with the top of the Camera to the north.



This special Focus position gives you a

map-like overhead perspective of the terrain. It is also used for rotating or zooming on the whole earth.

Note: If you don't want north to be at the top of the picture you can change the rotation of the Camera with the Bank Parameter.

Center X & Center Y

Maximum: 32,000 pixels Minimum: -32,000 pixels

Center X and Center Y let you step back from the normal three dimensional universe of WCS and scroll around over the potential two dimensional bitmap that WCS will render. This is a unique WCS feature that you may find useful for adjusting the framing of a landscape without changing all the Camera and Focus Point key frames.

Reference 6A - Motion Parameters

WCS can render any section of a landscape at any resolution up to 32,767 pixels square. When you render an image, WCS renders only the part of the landscape that is visible to the Camera. If you think of that image as part of a larger potential image, then you can think about using Center X to scroll left or right and Center Y to scroll up and down by a set number of pixels across the potential image.

This gives you the same kind of control as a photographer who is printing a negative and can control which part of the negative is actually projected onto the photographic paper. It's also similar to the controls available on a microfilm reader to let you scroll around on the microfilm to choose which area to view.

If you use the Change Image Size button in the Render Settings Editor window to select various image sizes WCS will automatically adjust the Center X and Center Y settings for you when you render so that you're image will look the same no matter what size you choose to render. This is useful if you need to create matching images for video and for print.

Advanced users may wish to change image widths and heights directly by entering values in the Settings Editor string gadgets (see the Render Module chapter). If you change an image's width directly, you'll need to modify Center X proportionally to retain the same centering. Let's say in a 640 by 400 image you want the Focus to be at image center. Center X would be set to 320. Now to change the image size to 720 by 460, Center X should become 360 (720/360 = 640/320).

You'll need to do the same for Center Y if you directly change the height of an image and you want the vertical centering to be the same.

Note: when you render 1/2 and 1/4 sized images using the buttons in the Preferences window, WCS changes the Center X and Center Y Parameters automatically. This lets you create quick small sized preview renders without having to worry about Center X and Center Y settings.

Bank

Maximum: 1,000,000 degrees Minimum: -1,000,000 degrees

Bank lets you tilt the Camera around the axis between the Camera and the Focus Point. You can use it for turn banking during Camera motion, or to simulate tipping the axis of a rotating earth. 360° provides one complete roll.

Earth Rotation

Maximum: 1,000,000 degrees Minimum: -1,000,000 degrees

The Earth Rotation Parameter lets you spin the earth around its axis. The axis of the earth is a straight line through the north and south poles.

You can use the Earth Rotation Parameter to quickly create a rotating globe. A setting of 360 will cause the earth to rotate all the way around one time. This is somewhat simpler than orbiting the Camera around the earth.

To determine the rotation speed take your Earth Rotation value at the last key frame and divide it by the number of frames in the animation. Multiply the result by 30 for NTSC video and 25 for PAL video. That will give you the rate in degrees per second.

Tip: Try animating Earth Rotation and Camera Longitude at the same time for a complex motion effect.

Scale

Maximum: 1,000,000 times bigger

Min: .0001 times smaller

The Scale Parameter is an advanced feature that many people may never use. It lets you change the size of objects relative to the size of an image pixel.

Reference 6A - Motion Parameters

As a side effect, this creates the illusion of closeness or distance. Objects appear to be closer at smaller "Scale" settings (think of map scales where large scales mean small objects).

This is similar to what the View Arc Parameter does (see below) in that it has the effect of changing the Camera focal length. But if you want to change or animate a changing lens focal length (zoom lens), use the View Arc Parameter instead of the Scale Parameter. The View Arc Parameter was created for this task and it won't effect the mathematical scale of your Objects.

Advanced users might want to use the Scale Parameter when adjusting between various render image sizes. But it is usually easier to use the Change Image Size button in the Render Settings Editor window to select various image sizes because that way WCS will automatically handle scale changes for you.

Be careful if you use the Scale Parameter. WCS has no way of knowing your intentions when you modify image dimensions. If your intention is to include a larger area in the rendered image then the "Scale" value should remain fixed. If you wish to gain higher resolution for a fixed area of imaged terrain, you would modify the "Scale" value in inverse proportion to the size change.

For instance if you established the composition of an image at an image size of 752 by 480 and a "Scale" of .5 and then decided to double the image size to gain finer detail but keep the same composition, you would change the "Scale" to .25 (1504/752 = .5/.25).

View Arc

Maximum: 179 degrees Minimum: 1 degree

The View Arc Parameter works much like a zoom lens does on a Camera. It provides the illusion of closeness and distance without changing the spatial relationship of objects in the image. You can animate the View Arc to create the effect of a zoom lens changing focal length to zoom in or out.

View Arc has a similar effect to Scale (see above) but its units of measure are easier to understand since they are proportional rather than inversely proportional to the area of terrain covered in an image.

The value of the View Arc Parameter corresponds to actual degrees of arc when the Scale Parameter is set to 1. Normally you should leave the Scale Parameter set to 1. But if you don't, the View Arc's value will be a relative measurement of arc rather than an exact measurement in degrees.

Flattening

Maximum: 100 arbitrary units Minimum: -100 arbitrary units

The Flattening Parameter lets you grow or shrink the landscape.

If you animate the Flattening Parameter, the Ecosystems will not move with the landscape as it grows. For example, if you use it to grow some mountains, snow will not appear until the mountains grow above the snow line. Also, if you make mountains taller, the shading from the Sun will change.

Note: If you want to grow or shrink mountains without these side effects, use the Vertical Exaggeration Parameter instead (see below). If you want the shading enhancement but don't want Ecosystems to be affected enable Ecosystem Flattening in the Render Settings Editor (see the Render Module chapter).

Technically what the Flattening Parameter does is change elevation values relative to the Datum elevation. You can set the Datum elevation with the Datum Parameter (see Datum below).

Flattening of 0.0 has no effect on the elevation data. A value of 1.0 creates a perfectly flat landscape at the Datum elevation. Values higher than 1.0 actually invert the terrain making valleys into ridges and vice versa. Negative values exaggerate the terrain.

Reference 6A - Motion Parameters

Note: The exact formula for Flattening is given under Datum below.

The effects of the Flattening Parameter are similar to those of the Vertical Exaggeration Parameter (see below) except that changes in Flattening will change shading and produce new elevation conditions for Ecosystems, whereas Vertical Exaggeration simply creates vertical distortion of the existing shading and Ecosystems.

Also Vertical Exaggeration is always relative to sea level. Flattening can be relative to sea level if you set the Datum value to zero, but it can also be relative to any other elevation you set with the Datum Parameter.

Flattening can be used to create enhanced shading and vertical exaggeration when low resolution or low relief DEMs are being used. For instance, when using the low resolution global DEM set, a negative Flattening value will enhance the appearance of significant topography. You should enable Ecosystem Flattening as mentioned above so that Ecosystems are adjusted for the added relief.

Datum

Maximum: 1,000,000 meters Minimum: -1,000,000 meters

The Datum Parameter establishes the base elevation upon which Flattening (see above) operates.

Here is the formula:

((Elevation - Datum) x Flattening) + Datum = New Elevation

For example lets assume the elevation of a DEM data point (a place on the landscape) is 4000 meters and the Flattening value is .5. With a Datum value of 2000 meters the formula would look like this:

 $((4000-2000) \times .5) + 2000) = 3000$

The new elevation of the DEM data point after flattening would be 3000 meters.

With a datum of 0 (sea level) the formula would look like this:

$$((4000-0) \times .5) + 0 = 2000$$

The new elevation of the DEM data point after flattening would be 2000 meters.

Vertical Exaggeration

Maximum: 100 arbitrary units Minimum: -100 arbitrary units

The Vertical Exaggeration Parameter lets you grow or shrink the landscape.

If you animate the Vertical Exaggeration Parameter, the Ecosystems will move with the landscape as it grows. For example, if you use it to grow some mountains, if there's any snow it will stay at the same longitude and latitude position no matter how tall or short the mountains appear to be. Also, if you make mountains taller, the shading from the Sun will not change.

Note: If you want to grow or shrink mountains without these side effects, use the Flattening Parameter instead (see above).

Technically speaking, the Vertical Exaggeration Parameter modifies apparent elevation values relative to sea level. Vertical Exaggeration increases apparent relief without affecting shading intensity or Ecosystems.

A value of 1.0 has no effect. Values greater than 1.0 increase relief, less than 1.0 decrease relief. Negative values invert the terrain.

Sun Latitude

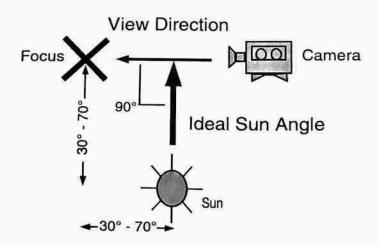
Maximum: 90.0 degrees (directly over the north Pole) Minimum: -90.0 degrees (directly over the south Pole)

Sun Latitude is the north-south position of the point at which the sun is directly overhead. Sun Latitude and Sun Longitude are members of the Sun Group.

Sun Latitude and Sun Longitude are measured in the same geographic coordinate system as the Camera and Focus Point positions.

The key to good lighting is to be aware of the Sun position in relation to the Focal Point. To figure out the north-south position of the Sun in degrees relative to the Focus Point, subtract the Focus Latitude from the Sun Latitude.

If the Sun is 90 degrees or more away from the Focus Point, your image will be dark (no shading). If the Sun is at the same Latitude and Longitude your image will be lit from directly above, which gives you very flat lighting. For a more pleasing look, try an angle of 30 to 40 degrees of both latitude and longitude between the Sun and the Focus Point. For a morning or evening look, try 60 to 70 degrees.



The steepness of terrain and any Flattening (see above) will also affect the lighting.

It's worth taking the time to experiment with the Sun Latitude and Longitude. Small changes in the angle of the light from the Sun can create big changes in the look of your images.

By working with Sun position, horizon attributes (see below) and Colors Parameters (see the Color Parameters chapter) you can create various moods including realistic sunsets and night scenes.

You can see the position of the sun in the Map View window (see the Map View chapter). You can see the angle of the sunlight in the Camera View window (see below).

Sun Latitude can be set using a date and time in the Sun Time window. This is more intuitive but has some restrictions on flexibility. See the Sun Time window description in the Parameters Module chapter.

Sun Longitude

Maximum: 1,000,000 degrees Minimum: -1,000,000 degrees

Sun Longitude is the east-west position of the point at which the sun is directly overhead. Sun Latitude and Sun Longitude are members of the Sun Group.

Sun Latitude and Sun Longitude are measured in the same geographic coordinate system as the Camera and Focus Point positions.

The key to good lighting is to be aware of the Sun position in relation to the Focal Point. To figure out the east-west position of the Sun relative to the Focus Point subtract the Focus Longitude from the Sun Longitude.

For tips on lighting, see Sun Latitude above.

Sun Longitude can be set using a date and time in the Sun Time window. This is more intuitive but has some restrictions on flexibility. See the Sun Time window description in the Parameters Module chapter.

Horizon Line

Maximum: 100 percent Minimum: 0 percent

The Horizon Line Parameter is a member of the Horizon Group, along with the Horizon Point and Horizon Stretch Parameters.

To simulate a sky, WCS draws a background that starts with the Zenith color, gradually changes to the Horizon color, and then gradually changes back to the Zenith color. The area of Horizon color can be a dot you can position with the Horizon Line Parameter and the Horizon Point Parameter (see below). You can stretch the dot into a line using the Horizon Stretch Parameter (see below).

To produce a realistic sky, you'll want to stretch the Horizon color into a line. With a blue Zenith color and a white Horizon color, you'll see a background that goes from blue to white to blue again (see the Color Parameters chapter) giving you a blue image gradiating to a white stripe in the middle.

The white stripe is the horizon. To make the sky look natural behind your landscape, you'll want to position the horizon so that it's just behind the top edge of the landscape. That way it will look like the farthest sky, the sky closest to the ground, is lighter in color, and the nearer sky, the sky closer to the top edge of the image, is bluer in color.

The Horizon Line parameter lets you move the horizon higher or lower in the image. The Horizon Line Parameter is a percent of the height measured from the top of the image. For example a value of 50 will put the line in the vertical center of the image. A value of 25 will put the line one fourth of the way down from the top of the image.

Note: The Horizon Line Parameter setting has no effect if Fixed Horizon is disabled in the Render Settings Editor window. Disabling Fixed Horizon will let the horizon line float with camera motion and turn banking.

Horizon Point

Maximum: 1,000,000 percent Minimum: -1,000,000 percent

The Horizon Point Parameter is a member of the Horizon Group, along with the Horizon Line and Horizon Stretch Parameters.

The Horizon Point is the horizontal position of the horizon color between the left and right edges of the rendered image. You can stretch the horizon color into a line using the Horizon Stretch Parameter (see below).

The Horizon Point Parameter lets you move the horizon left or right. The Horizon Line Parameter is a percent of the width measured from the left edge of the image. For example a value of 50 will put the point in the vertical center of the image. A value of 25 will put the point one fourth of the way from the left side of the image.

The Horizon Point need not fall within the image itself. Sky colors will gradate from the Horizon color to the Zenith color in both directions horizontally away from this point at a rate dependent on Horizon Stretch (see below).

Horizon Stretch

Units: dimensionless

Maximum: 100 arbitrary units Minimum: -100 arbitrary units

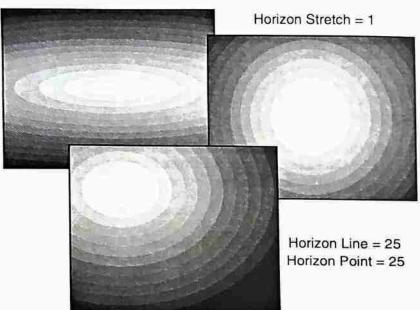
The Horizon Stretch Parameter is a member of the Horizon Group, along with the Horizon Line and Horizon Point Parameters.

The Horizon Stretch Parameter lets you control the width to height ratio of the horizon zone, and the rate of transition between the Horizon color and the Zenith color. Use it to stretch the Horizon Point into a horizontal line.

Higher values will broaden the zone. A value of 1.0 will create a round zone except as modified by pixel aspect (see the Render Module chapter). This can be a useful effect behind a rendering of the entire earth. A value of 15 creates a good horizontal horizon band, useful for creating a realistic looking sky behind a land-scape scene.

Horizon Effects

Horizon Stretch = 4



Haze Start

Maximum: 1,000,000 kilometers Minimum: -1,000,000 kilometers

Haze Start and Haze Range are the members of the Haze Group. Together they define how haze effects the objects in your image.

Haze is a simulation of the dust, smoke and water particles present in the earth's atmosphere. These particles tint objects in the distance. Heavy haze can even totally obscure far away objects.

Haze Start is the distance from the Camera at which haze begins to color objects (see the Color Parameters chapter). Objects closer than this distance will not be effected by haze.

You can change the Haze Start value by clicking Haze Start in the Parameter List. Then you can edit its value in the Interactive Group field, or click the increment decrement buttons next to the field.

You can also interactively change Haze Start within the Camera View window (see below) or in the Map View window (see the Map View chapter).

Beyond the Haze Start distance objects will get more and more colored by the haze color (see the Color Parameters chapter) as they get farther away from the Camera.

Haze Range

Maximum: 1,000,000 kilometers Minimum: -1,000,000 kilometers

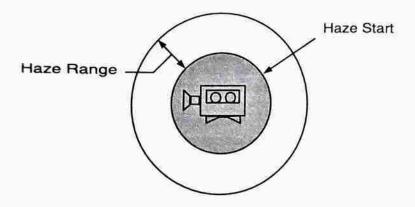
Haze Start and Haze Range are the members of the Haze Group. Together they define how haze effects the objects in your image.

Haze is a simulation of the dust, smoke and water particles present in the earth's atmosphere. These particles tint objects in the distance. Heavy haze can even totally obscure far away objects.

Haze Range is the distance beyond the Haze Start ring at which objects completely disappear into the haze color (see the Color Parameters chapter).

You can change the Haze Range value by clicking Haze Range in the Parameter List. Then you can edit its value in the Interactive Group field, or click the increment decrement buttons next to the field.

You can also interactively change Haze Range within the Camera View window (see below) or in the Map View window (see the Map View chapter).



Shade Factor

Maximum: 2.0 arbitrary units Minimum: 0 arbitrary units

The Shade Factor Parameter lets you set the overall shading depth or contrast between fully shaded and fully lit surfaces. Use it to limit the darkest areas of an image or to brighten dark images.

A value of 0.0 will yield no shading. Values between 0.0 and 1.0 are useful for reducing contrast, with numbers slightly less than 1.0 being the most useful. A value of 1.0 will result in normal

shading. Values in excess of 1.0 are probably of limited value since they will darken your picture in an unnatural way.

When a polygon is fully shaded it will be rendered in the ambient light color (see the Color Parameters chapter).

Fog None

Maximum: 1,000,000 meters Minimum: -1,000,000 meters

Like Haze, Fog will tint elements of an image toward the Haze color (see the Color Parameters chapter). However it works with elevation rather than distance.

Fog None is the elevation above sea level beyond which the fog effect begins. From there to the Fog Full elevation, objects will be increasingly colored by the Haze color. This lets you simulate things like mountain peaks disappearing into fog. If the Camera is looking down from above, you can simulate valleys disappearing into fog.

If the Fog Full Parameter is higher than the Fog None Parameter, objects below the Fog None elevation will not be tinted by the Haze color. This is good for images where mountain peaks disappear into the fog.

If the Fog Full Parameter is lower than the Fog None Parameter, objects above the Fog None elevation will not be tinted by the Haze color. This is good for images where valleys disappear into the fog.

If you don't want to have any fog effect, you must set both the Fog None and Fog Full Parameters above the highest point or below the lowest point present in your landscape. For example you can set them both to zero if you want to insure that there is no fog effect.

Fog Full

Maximum: 1,000,000 meters Minimum: -1,000,000 meters

The Fog Full Parameter lets you set the elevation at which all objects are rendered in the Haze color (see the Color Parameters chapter and Fog None above).

Z Minimum

Maximum: 1,000,000 Kilometers

Minimum: 0 Kilometers

The Z Minimum Parameter lets you set a minimum distance for rendered objects. All objects that lie closer than the Z Minimum distance to the Camera, including parts of DEMs, will not be rendered.

This is useful for creating cutaway views of the terrain model.

Interactive Group Fields & Buttons

When you select a Motion Parameter in the Parameter List, its value and those of any other members of its Interactive Group will appear in the Interactive Group fields to the right of the list. For example, if you select Camera Altitude, you'll see the values

for all the members of the Camera Group in the Interactive Group fields: Camera Altitude, Camera Latitude and Camera Longitude.

Interaction	ve Group	
X Camera Longitude	105.523338	(1)
Y Camera Altitude	5.903153	()
Z Camera Latitude	40.420109	<1>
	195.193096	KE
Focal Distance	STATE OF THE PARTY	< >
Sensitivity 100	KN Low Med I	

The values you see in the Interactive Group fields are those for the

current frame. You can change the current frame using the gadgets in the Key Frame area of the Motion Editor window.

There are several ways to change the values for any Parameter whose value is displayed in an Interactive Group field. You can edit the value directly in the field, or click the arrow buttons to the right of the field to increment or decrement the value. If you use the buttons, the increment of change will depend on the variable itself and the Sensitivity setting (see below).

Note: Parameters can also be set using the interactive capabilities of the Camera View window (see below) and the Map View window (see the Map View chapter) to change their values.

The X, Y and Z designations left of the Group value fields refer to the axis of the mouse movement you can use to interactively modify each value by dragging the mouse within the Camera View window.

Beneath the Interactive Group proper are two additional fields: Focal Azimuth and Focal Distance.

Focal Azimuth is the heading of the Camera lens. Measured in degrees, it's the clockwise angle between due north and the direction that the Camera is pointed.

The Focal Distance value is the distance in kilometers between the Camera and the Focus Point.

These fields and their associated arrow buttons are active when the Camera or Focus position is the interactive group.

Note that you'll always see focal azimuth and distance fields under the Interactive Group. They are always visible regardless of the interactive group.

Sensitivity Field & Buttons

The Sensitivity field shows a number between 1 and 1000. This number affects two things, how far the arrow buttons in the Interactive Group cause values to change in the adjacent fields, and how fast the Interactive Group values change when you drag the mouse in the Camera View window

The lower the Sensitivity value, the smaller the increment of change in Motion Parameters when you click the arrow buttons in the Interactive Group. Also, the lower the value, the less dragging the mouse in the Camera View window changes the Interactive Group values.

If you want to make big changes fast, set the sensitivity to a larger value. If you want to fine tune the values of the Interactive Group with small changes, set the Sensitivity to a lower value.

You can edit the Sensitivity value directly in the Sensitivity field, or you can click on the buttons to the right of the field.

The left arrow button decreases the Sensitivity value by one. The right arrow button increases the Sensitivity value by one. The Low button (keyboard shortcut l) sets the Sensitivity value to 10. The Medium button (keyboard shortcut e) sets the Sensitivity value to 100. The High button (keyboard shortcut h) sets the Sensitivity value to 1000.

Key Frame Controls

All of the Motion Parameters can be animated. You can fly through the terrain, grow mountains, change the haze and even wipe out the terrain using the Z Minimum Parameter.

The Key Frame Controls allow you to do these things and many more. They are described at length in the Parameters chapter.

There are four additional buttons in this section which open special windows or perform special functions. They are also described in the Parameters Module chapter:

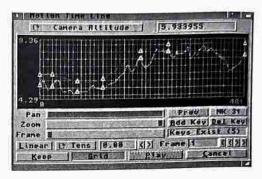
Time Lines Button

Keyboard shortcut: t

Click the Time Lines button to open the Motion Time Line window.

The Motion Time Line window will open and display a graph of the Active Parameter.

This feature will be disabled if there are less than two key frames for the Active Parameter. See the Time Lines section in the Parameters Chapter for more information.



Bank Button

Keyboard shortcut: b

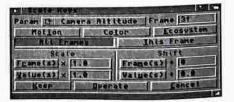
Use the Bank button to automatically compute and create Bank key frames.

See Bank Button in the Parameters Module chapter.

Scale Button

Keyboard shortcut: s

Click the Scale Keys button to open the Scale Keys window, where you can do key frame scaling and translation.



See Scale Keys window in the Parameters Module chapter for more information.

Sun Button

Keyboard shortcut: n

Use the Sun button to open the Sun Time window where you can set the sun position using a date and time.

See Sun Time window in the Parameters Module chapter.



Buttons At the Bottom

Keep Button

Keyboard shortcut: K

Click the Keep button to close the Motion Editor and preserve changes.

The Motion Editor and all associated windows including Motion Time Line and Camera View will close with all changes being retained.

If you wish to cancel the changes made in other windows but keep changes that were made in the Motion Editor before the other windows were opened, close the other windows with their Cancel buttons and then close the Editor with the Keep button.

List Win Button

Keyboard shortcut: w

Click the List Win button to open a resizable Parameter List window. This is exactly the same as the Parameter List in the Motion Editor window.

Depending on the size of the screen on which you are running WCS, you may not have room to see both the Motion Editor window and the Camera View window. If that's the case, you might want to use the List window along with the Camera View window. That way you can easily select different Parameters while working interactively with the Camera View window.

You can stretch the List window out vertically using the size gadget in the lower right corner of the window, and move it off to one side using the drag bar at the top of the window.

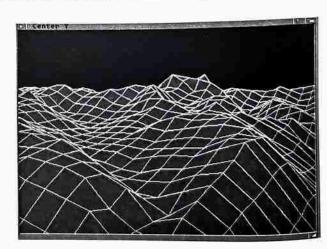


Cam View Button

Keyboard shortcut: i

Click the Cam View button to open the Camera View window. The Camera View shows you what the Camera sees using your choice of preview format. You can click and drag the right and left

mouse buttons directly in the window to interactively change the Active Motion Parameter (see the Camera View window below).



When you click the Cam View button, the Camera View Control and Compass windows will also open.

The size and position of the Camera View and Compass window are saved in the Project file so that each Project can have a custom configured work space.

The last positions used when the program closes will be stored in the Prefs file and the windows will open at these positions next time unless a Project file is loaded and overrides the Prefs settings. If WCS is unable to open the windows at the previous positions due to a reduction in screen size, they will be repositioned to fit the smaller screen.

Draw Ierrain

ElShade

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Diag » Vectors

Cancel Button

Keyboard shortcut: c

Click the Cancel button to close the Motion Editor and undo changes.

The Motion Editor and all associated windows including Motion Time Line and Camera View will close with all changes being cancelled.

All Motion Parameters and their key frames will be returned to their condition prior to opening the Motion Editor regardless if changes were made and later "Kept" from the Camera View or Time Line windows.

Camera View Window

The Camera View window is an integral part of the Motion Parameter editing system. It allows interactive manipulation of all the Motion Parameters with visual feedback on many. Camera View provides numerous preview options.

The Camera View is in reality, three separate windows: the View window itself, The Camera View Control window and the Compass window. All will open when you select "Cam View" from the Motion Editor. The Compass window may be closed at any time but the View Control must remain open as long as Camera View is open. Closing either one will also close the other.

The Camera View window may be re-sized and positioned anywhere on the screen. Its size and position will be remembered the next time it is opened. The information is also stored in the Project file. Of course the Project must be re-saved for this to be true. Camera View drawings are scaled to fit the entire width of the render scene into the window regardless of window size.

Using the Camera View Window

As the name implies, what you will be seeing in the Camera View is the view through WCS' imaginary Camera lens. The window will open with the view at the Current Frame (set in the Motion Editor). The terrain will be down-sampled at a grid size of ten the first time you open it. You can change the grid later for either more speedy drawing (larger grid) or more detail (smaller grid).

If there are too many DEMs enabled for them all to be loaded at the specified grid size you will be asked if you wish to increase the grid size. The question will be repeated until a size is found that will fit in available memory. Alternatively you could cancel the operation and disable some of the DEMs and try opening the Camera View again.

Camera View has a number of other controls that affect how the drawing appears during interactive operation and as a 3-D grid. There are also a number of special render preview functions that can help with setting the sun position and Ecosystem Parameters and with obtaining smooth motion.

You can move around in the 3-D world of WCS terrain and establish Camera and Focus position key frames as you go. You could create an entire Motion Path solely from within Camera View although it may be somewhat tedious to do this way. For the most part we use it to find photogenic views, to fine-tune animation paths and for scientific documentary work where we need one view that covers certain specific terrain features. We use it extensively for previewing sun positions, animation paths and Ecosystem distributions.

Mouse Conventions

There are a few mouse conventions that you should be aware of while using the Camera View. They concern axes of motion and how to select something in the View window.

In the Motion Editor section above we mentioned that each member of every Interactive Group had a motion axis assigned to it for use in Camera View. These axis designations are for convenient reference only. They may or may not have any intuitive connection to the real world or to the same variables as used in other programs.

We define the X axis as the left to right movement of the mouse pointer when the left mouse button is pressed. The Z axis is the top to bottom movement of the pointer when the left button is pressed. The Y axis is the top to bottom movement when the right button is pressed.



For the Camera and Focus Groups you will probably be using "radial" motion most of the time. The X axis controls the rotation of either the Camera about the Focus Point or the Focus Point about the Camera. Both Latitude and Longitude will change since you move in an arc. The Z axis controls the motion toward and away from the Focus Point. The Y axis controls the Camera or Focus altitude.

There is no reason to get sticky about terminology here. Yes, in other programs the Z axis is defined differently. Just remember that these axes really aren't important to WCS in the way that they are to other 3-D modeling programs. Here they simply represent a certain type of mouse movement, nothing more. If they confuse you then ignore them. You will soon learn to move around in Camera View with no thought about X, Y and Z or any other letters of the alphabet.

Preview Rendering

In Camera View you can render various kinds of previews to help you visualize the final rendering product:

Elevation Shaded

Elevation Shading shows you where the three color gradients will be applied if you render DEMs as Surfaces (see the Settings Editor in the Render Module chapter).

Sun Shaded

Sun Shading shows how the sun position affects the shading of terrain models. It is like Solid previews in other 3-D programs.

Ecosystem

Ecosystem Previews show you in 16 colors how a portion of the final image will look complete with trees, rocks and snow.

Diagnostic

Diagnostic Previews are Ecosystem Previews with a window that opens giving you a broad spectrum of data about the preview rendering. Use it to diagnose Ecosystem problems, find out how far away items in the rendering are from the Camera, and to learn lots of other useful information.

Wire-frame Animation Frames

You can render out a wire-frame representation of each animation frame and compile it into an animation using an outside program.

Certain render preview functions available from the Camera View Control window require that you select an area of coverage. That is, you can choose to render any part of the scene that is visible. To do this you first select the rendering function you desire (this applies to both "EcoSys" and "Diag" which stand for Ecosystem and Diagnostic). Then you must click on two points in the Camera View window at opposite corners of the area you wish to cover.

We stress that this is not a click-once-and-drag operation. You will see a "rubber band" box appear attached to your pointer and anchored at the first point you select. If you change your mind about the position of the first point click with the right mouse button and start all over.

When you need to perform some operation like selecting a preview area you will be told to do so in the Camera View title bar.

Shortcuts

All of the function buttons in the Camera View Control window have keyboard shortcuts. You may use these shortcuts regardless of whether Camera View itself or the Control window is active. We will not duplicate the description of these functions. Both will be described under Camera View Control window below.

You can make key frames at any time the Camera View or Camera View Control windows are active by hitting the Enter button in the numeric keypad. This will have the same effect as clicking one of the Make Key buttons.

Faster Drawing

The speed of re-drawing depends on the drawing styles (called Bounds types) that are enabled and their complexity and on the number of DEMs that are loaded. It is generally suggested that in the interest of speed you enable only those DEMs that you really need before opening Camera View.

Once Camera View is open you can disable or enable additional DEMs in the Database Editor. When you next redraw the terrain grid the DEMs in memory will be updated.

Interactivity

The Interactive Group is determined by which is the Active Parameter in the Motion Editor. You set this by clicking on the desired item in the Motion Editor Parameter List or in the Parameter List window. A third method is to scroll through the list using the "Ctrl-Arrow" key combination. Hold down the Control key while using the up or down cursor arrows to move up or down through the list. The Active Parameter's name is displayed in the Camera View title bar.

When Camera Group or Focus Group is active you can modify the other of the two by holding down either Alt key on the keyboard before you click with the mouse in the Camera View window. This will let you set up a complete view, both Camera and Focus without having to switch Active Parameters.

For many Motion Parameters, it makes no sense to set them interactively since there is no visual feedback. Here we will describe those that provide some sort of visualization imagery. They will be described by Interactive Group with tips on gaining the most information from the Camera View display. You should reference the Camera View Control (CVC) window section below for more information about enabling different motion axes and Bounds.

Camera Group

When any of the Camera Parameters are active you can modify all of the Camera Parameters interactively in the Camera View. To initiate movement, click and hold the left mouse button anywhere in the Camera View window.

If there is a grid drawing present it will disappear to be replaced by any Bounds types selected in the Camera View Control window. As you move the mouse the display will be updated. If Grid Bounds is turned on the entire grid will be re-drawn when you let up on the mouse.

You can initiate a full re-draw whenever you like by selecting "Terrain" in the CVC.

If Auto-Draw is on in the Bounds controls you can initiate a full re-draw by clicking in the Camera View window. The window will also redraw automatically if you move any of Interactive representations of the Camera, Focus Point, Sun, Haze rings in the Map View window if Auto-Draw is on.

How mouse movements affect the Camera Group Parameters is determined by a cycle gadget in Movement section of the Camera View Control. You will see it below the "CentFoc" button and it will say either "Radial" or "Rectang." In Radial mode the X mouse axis moves the Camera in an arc around the Focus Point. Z axis movement moves the Camera closer or farther away. In Rectangular mode the X and Z axes directly adjust Longitude and Latitude. The Y axis controls Camera Altitude regardless of the mode.

When using any of the Bounds types it is easy to get lost while moving, especially if the Camera is very close to the terrain. Someday we'll have fast enough machines to draw the entire grid in real time. For now, you may have to pull the Camera back and raise its altitude enough to get your bearings, then try again to find that perfect view.

Keeping your bearings will get easier with practice. Use the Compass window and Compass Bounds to help orient yourself. It pays to get the "lay of the land" from a medium distance before trying to zoom in on a particular terrain feature. You can also use the Map View Module to establish your whereabouts or to set the Camera position. Map View and Camera View provide a powerful combination giving you both 2-D and 3-D views at once.

Focus Group

Most of what was said above for Camera Group applies equally to the Focus Group. One difference is that when moving the Focus Point interactively you may move the entire data set out of the window. Then you are really lost. Go back to Camera Group and do the "pull away" trick to find yourself and if that doesn't work use "CentFoc" in the CVC. That should bring everything back into the picture.

Tip: Try using a lower Sensitivity setting when interacting with the Focus Group. You will have more control over the movement.

Center Group

If you get lost here the best thing to do is to go to the Motion Editor and re-set the values numerically to one half of the render image width and height. Camera View is scaled to fit the entire width of the render scene into the window regardless of window size so this will at least bring the Focus Point to the center of the window.

Bank

Interactive modification works well for this Parameter. You can see the terrain tipping from side to side as you move the mouse along the X axis.

Earth Rotation

Render Sun Shade previews at different frames to see how the earth is rotated during an animation. You may need to work with grid sizes of as low as 2 or 3 before you will see the shading around continents when working with low resolution global DEM data.

Scale

We prefer to save this value for scaling between different resolutions when we are doing both video and print versions of the same image. As such we maintain precise control over it using only numeric input. It will respond very similarly to View Arc when modified interactively.

View Arc

Interactive modification works well for this Parameter. It is just like using a zoom lens on a video Camera.

You can also see View Arc change in the Map View if "Inter" is selected and interactive elements drawn.

Flattening Group

These two are tricky to change interactively. Its probably best to manipulate the Flattening component first (X axis). Then either adjust the Camera and Focus Altitudes or the Datum, whichever gives you the desired effect. Use Box Bounds to get the most feedback on the Flattening component.

Vertical Exag

Interactive modification works well for this Parameter when Box Bounds are on so you can see how much exaggeration you are getting.

Sun Group

Use Sun Shade previews for visual feedback on sun position.

If Compass Bounds is enabled in the CVC you will see a yellow ray pointing toward the sun from the center of the 3-D compass in the Camera View. This will only be seen when there is no terrain grid drawn there.

Setting the sun position from the Sun Time window will update the Camera View Compass Bounds display immediately.

The sun can also be positioned interactively in the Map View window (see the Map View chapter).

Horizon Group

No visual feedback.

Haze Group

The Terrain grid drawing gives haze information in the colors it uses to draw the grid. White is for parts of the image closer than the Haze Start. Dark Blue is for areas that are completely hazed out. The area in between, the Haze Range, is medium blue. These Parameters have no real-time feedback and are perhaps best set numerically for more control or in Map View.

Beware though that the Haze rings seen in Map View are only approximate because they don't take into account Camera Altitude. Only in Camera View do you see the Haze portrayed as it will be in final renderings.

Shade Factor

No visual feedback.

Fog Group

No visual feedback.

Z Minimum

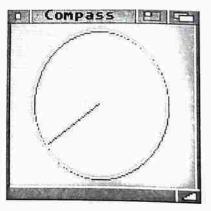
There is no real-time feedback so interactive modification is of limited practicality. The terrain grid drawing function ignores this setting. Use either Sun Shade or El Shade for visual support. They will accurately portray the Z Minimum cutoff.

Compass Window

The Compass window shows the Camera azimuth or bearing.

The window may be re-sized, re-positioned and closed but the window is for display only and has no user-operable gadgets.

In this window, the Camera position is at the center of the circle. The red line points outward in the direction of the Focus Point. North is at the top of the window and



east to the right. In other words if the Camera is pointed due east, the red line will extend from the center horizontally to the right. Do not confuse this type of compass with the one used in Compass Bounds (see below) which always points toward the north.

Camera View Control Window

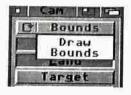
The Camera View Control window gives you the buttons and fields you need to control the features of the Camera View window.

To open it, click the Cam View button in the Motion Editor window. The Camera View Control window will open, along with the Camera View window and Compass window.

The Camera View Control window is divided into six groups of gadgets:

- Draw Group
- Bounds Group
- Grid Group
- Movement Group
- Frame Group
- Close Group

Draw/Bounds Cycle Gadget



The Draw/Bounds cycle gadget lets you show either the Draw Group controls or the Bounds Group controls.



The Draw Group controls let you draw a representation of the data in the Camera View window using a choice of rendering styles.

The Bounds Group controls let you choose how the data is represented as you drag the mouse in the Camera View window. You can select multiple Bounds types at the same time.

Draw Group

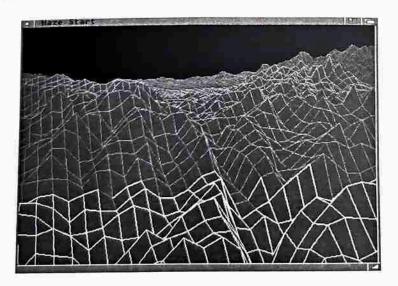
Terrain Button

Keyboard shortcut: t

Click the Terrain button to draw the terrain as a grid of lines.

The grid will be drawn. If you cancel before it is complete only the finished part will appear.

In low memory situations drawing will be slower. Both Solid and Open Wire-frame grids are available (see Grid Group below).



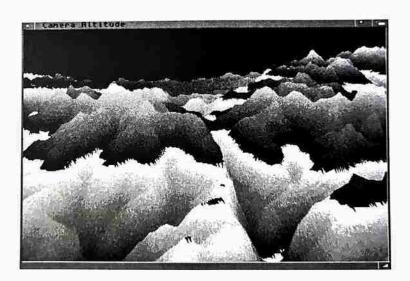
El Shade Button

Keyboard shortcut: h

Click the El (Elevation) Shade button to draw a preview of the terrain as if it were to be rendered as a "Surface" using the Surface Elevations from the Render Settings to determine color gradient boundaries.

Each DEM will be computed and drawn in turn. Darker shades of gray represent lower elevations within any of the three gradients. Enabled Vector Objects will be rendered into the finished image if Vectors are enabled for rendering in the Render Settings Editor window (see the Render Module chapter).

If you see less than three complete gradients you may wish to re-set the Surface Elevations. You may do this interactively from 1 Tap View or in the Settings Editor.



Sun Shade Button

Keyboard shortcut: s

Click the Sun Shade button to draw a solid shaded preview of the terrain.

Each DEM will be computed and drawn in turn. Darker shades of gray represent areas that receive less illumination. Enabled Vector Objects will be rendered into the finished image if Vectors are enabled for rendering in the Render Settings Editor window (see the Render Module chapter).

If the lighting contrast does not include the full range from white to black, you may wish to re-set the Sun Latitude and Sun Longitude Motion Parameters.



EcoSys Button

Keyboard shortcut: e

Click the EcoSys (Ecosystem) button to render a preview with full Ecosystem evaluation and sun shading and to preserve a full set of the Parameters as they were used to create the rendering.

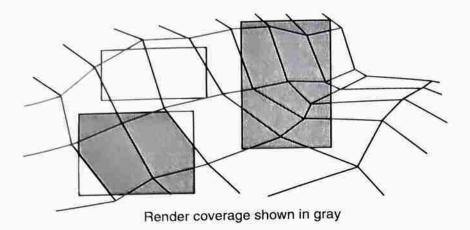
After you click the button, select the diagonal corner points of the area in the Camera View you wish to render. To select click once at the first corner and again at the opposite corner. A new window will open and the onscreen palette will change to the render palette to allow more colors for the onscreen rendering.

You may abort the operation between the first and second corner selections by pressing the right mouse button or any time during rendering by clicking "Cancel" in the small progress window. A copy of the current Motion, Color and Ecosystem Parameters and Render Settings will be held in a buffer associated with this window.

If any Parameters are subsequently modified while this window is open you can restore the Parameters used to create the preview by selecting in the image area of the window. You may create up to ten such preview windows each holding a separate copy of the Parameters specific to that window. Key frames are not copied.

Selecting the area to be rendered requires care to ensure that at least one grid node (the intersection between two grid lines) falls within the area. Without this WCS can not determine where the selected area falls on the ground. It loads just enough of the DEMs involved to fill the preview window.

The following diagram illustrates the areas that will be rendered for different selected preview areas on a typical grid.



Ecosystem previews can be useful in determining how the final rendering will appear, whether the Ecosystem Parameters are set to give you the results you want and whether your sun position is appropriate. You can modify Parameters and test them with new previews.

When you have determined the set you wish to use you can close all the other preview windows and select in the image area of the one you want. This will re-set all the Parameters including Ecosystem and Color, to what they were when this preview was created. Key framed Parameters, however, will not be affected.

Note: To select a window's Parameter set, first activate any other window. Then click somewhere inside the image of the preview window you want to select Parameters from. You will see a requester asking you if you wish to restore this set of parameters.

Diag Button

Keyboard shortcut: d

Click the Diag (Diagnostics) button to render a preview with full Ecosystem evaluation and sun shading and to provide diagnostic data about the rendering.

Operation is the same as for "EcoSys" above with the exception that some additional memory is allocated for diagnostic data buffers.

When rendering is complete or after you select "Cancel" in the progress window the Diagnostic Data window will appear. If you click anywhere inside the render preview the diagnostic information for the point you clicked will be set in the Data window. The Diagnostic Data window may be left open as long as desired. You may close it alone or it will close automatically when the render preview window to which it is attached is closed.



Diagnostic previews will tell you precisely what data was used to create the preview rendering. You can learn about Ecosystems, slopes, sun angles, latitude/longitude, elevation, Z Buffer values and other things to help you diagnose the image. In addition to this function you also can digitize Vector Objects directly from the 3-D rendering. See Diagnostic Data Window below for more information.

Note: There can be only one Diagnostic Data window and it will always be attached to the last preview window rendered. If you start another preview the Diagnostic Data window will first close and all the diagnostics for the preview to which it was attached will be lost.

Vectors Button

Keyboard shortcut: v

Click the Vectors button to render Vector Objects into the Camera View.

All enabled Vector Objects for which there are valid elevations will be rendered. By default if there are no elevations Vectors are mapped at sea level. You can create elevation data in the Map View window (see the Conform to Topo menu command in the Map View Module chapter).

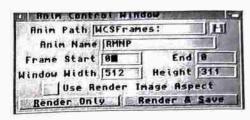
There will be no Z Buffering of the Vectors so spatial relationships may be somewhat obscure. Use Sun Shade (see above) to view Z Buffered Vectors.

Anim Button

Keyboard shortcut: m

Click the Anim button to create a series of 16 color (4 bit) animation frames. The Anim Control window will open.

In the Anim Control window you may choose a file name and path for storing the output frames. You may enter a range of frames to render. You may choose a window size that the animation will



be created in and you may force the window's proportions to match those of final rendered images as set in the Settings Editor (see Render Module chapter). You also may choose to render the animation frames only to the window and not save them to disk.

When you have set the file name and path, frame range and window size (the default is the current Camera View size) You may start rendering wire-frames by selecting either "Render Only" or "Render & Save." You may of course close the window without doing either.

Each frame will be rendered in turn until the end of the selected animation range is reached or until you select "Cancel" in the progress window. You can compile the frames into an animation using the software of your choice.

The image size will be the size you set in the Anim Control window. Larger images generally render and play slower than smaller ones.

You can control the playback rate somewhat by rendering fewer than every frame. Set the "Step" increment in the Render Settings Editor window.

Canera Longitude

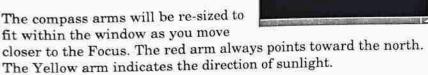
Bounds Group

Compass Button

Keyboard shortcut: o

Activate the Compass button to cause a 3-D compass representation to be drawn at the Focus Point during interactive operations.

The compass arms will be re-sized to fit within the window as you move



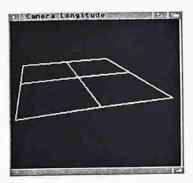


Keyboard shortcut: I

Activate the Land button to cause an outline representation of each DEM to be drawn during interactive operations.

The outline is drawn in white. It represents the average of the high-

est and lowest elevation in the loaded DEM set.



Target Button

Keyboard shortcut: t

Activate the Target button to cause a pair of elevation profiles to be drawn targeted at the Focus Point during interactive operations.

The profiles are along the latitude and longitude grid lines closest to the Focus Point. They are drawn in

yellow. Target Bounds are especially useful for positioning the Focus Point at a specific terrain feature.

Note: Target Bounds will not be drawn if Profile Bounds is enabled (see below).



Box Button

Keyboard shortcut: b

Activate the Box button to cause a bounding box representation of each DEM to be drawn during interactive operations.

The boxes represent both the highest and lowest elevations found in

each DEM. The red lines represent the north end of the box, the yellow lines the south end, The east and west sides are in blue.

Profile and Profile Density Buttons

Profile keyboard shortcut: p

Activate the Profile button to cause a simplified profile representation of the DEM encompassing the Focus Point to be drawn during interactive operations.



If the 1/1 Profile Density button is selected, the profiles are every longitudi-



nal profile. If the 1/2 Profile Density button is selected, the profiles are every second longitudinal profile. If the 1/4 Profile Density button is selected, the grid is every fourth longitudinal profile. They are drawn in green.

When Profile bounds are enabled Target Bounds will not be drawn.

Note: The profile density is downsampled from the terrain grid after it has already been downsampled for loading into Camera View. In other words if the grid size (see below) is set to ten and the density is set to 1/2 then you will be seeing 1/20 of the actual terrain profiles $(1/2 \times 1/10)$.

Auto Draw Button

Activate the Auto Draw button to have the Camera View window redraw the data as a terrain every time you release the mouse in the Camera View window or the Map View window. This saves the trouble of clicking the Terrain button in the Camera View Control window's Draw group.

Grid Group

Size Field & Buttons

Use the Size field and arrow buttons to set the terrain grid size.

To increase the detail of the grid decrease the grid size. To increase the drawing speed increase the size. The next time the terrain grid is re-drawn the DEMs will be re-loaded at the new sampling density.



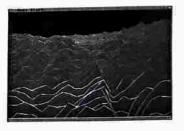
WCS will remember the last grid size you worked with. The grid size is also stored in the Project file. If there are too many DEMs enabled for them all to be loaded at the specified grid size you will be asked if you wish to increase the grid size. The question will be repeated until a size is found that will fit in available memory. Alternatively you could cancel the operation and disable some of the DEMs and try opening the Camera View again.

Note: The terrain grid size set here has no effect whatsoever on the terrain resolution in actual renderings or in Ecosystem and Diagnostic previews.

- (Latitude) & I (Longitude) Buttons

Use the Latitude and Longitude buttons to enable latitude and longitude grid line drawing.

The terrain grid is composed of latitude and longitude grid lines. If the "-" button is selected the latitude lines will be drawn (the ones running east-west). The "I" button enables the north-south running longitude lines. Some interesting effects can be achieved with only one or the other



enabled. You may want to try creating an animation using the "Anim" feature for a "high-tech" look.

Style Cycle Gadget

Use the Style cycle gadget to select between Solid and Open Wire Frame terrain grid presentations.

Open Wire Frame is slightly faster to render and lets you see all the terrain data. It lets you see what is behind a mountain. Solid is usually easier to interpret.

Movement Group

X, Y, & Z Buttons

Movement
X Y Z
Radial

Keyboard shortcuts: x, y, z

Use the X, Y & Z buttons to enable or disable interactive control on the three mouse axes.

Select the axes you wish to interactively control. De-select all others. For instance if you wish to adjust distance to the Focus Point without changing the view azimuth (moving radially), disable the X axis.

See the discussion above regarding the axes and their interpretation. The axes corresponding to different Parameters can be determined from the Interactive Group in the Motion Editor.

Radial/Rectang Cycle Gadget

Determines if Camera and Focus interactive movements are radial to each other or strictly rectilinear along the axes of latitude and longitude.

See the discussion of Camera Group above for more information.

Tip: Use Rectangular movement when you are working with global DEM sets. That will let you move around the earth with the X mouse axis and from north to south with the Z axis.

Frame Group



Frame Field and Buttons

Use the Frame Field and arrow buttons to select the Current Frame.

Enter a value in the string or use the arrows. The inner arrows advance or retreat one frame and the outer arrows jump to the last or next key frame for the Active Parameter.

Within the Motion Parameter windows there is only one Current Frame. The Current Frame in the Motion Editor will always be the same as the frame number shown here.

Make Key Button

Keyboard shortcut: M

Select the Make Key button to create a new key frame or key frame Group.

A requester will appear in which you may designate the frame for which a key is to be made. You may accept the frame number in the requester string or enter a different frame number. Accept by selecting "OK" or hitting the Return key. A key frame will be generated for the Active Parameter.

If the "Group" button is selected (depressed) in the Motion Editor when "Make Key" is selected, a key frame will be created for all Parameters in the Interactive Group.

You can use "Make Key" to update existing key frames if you like. It may be more convenient than bringing the Motion Editor to the front and using the "Update" button. Be aware though that their effect is slightly different when the "Group" button is selected (depressed) in the Motion Editor.

Reference 6A - Motion Parameters

Note: If there are one or more key frames for a particular Parameter then the Parameter Name will be written in white in the Parameter List. If there are two or more key frames then the Time Lines button in the Motion Editor will be enabled.

Note: If either Camera or Focus Group is active you will be asked if you also want to make key frames for the other of the two groups. This will let you set a complete view without having to switch active Parameters which would cause some of the values to be lost before you could make a key frame for them.

CentFoc Button

Keyboard shortcut: n

Select the CentFoc (Center Focus) button to place the Focus Point at the center of the loaded DEMs.

WCS will compute the center of all loaded DEMs in latitude, longitude and elevation and place the Focus Point there. The view will be re-drawn with whatever Bounds styles are currently enabled.

Use this feature if you get lost in WCS space and can't find your data. Also if you have a new data set, try using this to place the set within the window. You may still need to use the Camera controls to move closer to the new data. "CentFoc" does not affect Camera position (also see "Default" in the Parameters Module pop-up menu).

Img Aspect Button

Use the Img (Image) Aspect button to resize the Camera View to match the width/height ratio of final rendered images.

Since Camera View can be re-sized at will often the dimensions will not be of the same proportions as final images. That could lead to confusion about what is going to be in the picture when it renders.

To set the window height of the Camera View to the height that would preserve the same proportions as a final rendering, click the Img Aspect button. The Camera View window will be resized. If necessary the window will be repositioned on the screen. If the height would be too large to fit on WCS' screen you will be warned and given a chance to use the full screen height or cancel the resizing operation.

Close Group

Keep Button



Keyboard shortcut: k

Whenever you make a change in the Camera View window and Camera View Control window your changes take effect immediately. Click the Keep button when you want to close those windows without losing your changes.

If you want to close the windows and not keep your changes, use the Cancel button (see below).

When you click the Keep button, the Camera View, Compass and Camera View Control windows will close and all changes made since the windows were opened will be preserved.

Cancel Button

Keyboard shortcut: c

Whenever you make a change in the Camera View window and Camera View Control window your changes take effect immediately. Click the Cancel button when you want to close those windows and undo all the changes you made in those windows while they were open.

Reference 6A - Motion Parameters

When you click the Cancel button, the Camera View, Compass and Camera View Control windows will close and all changes made since the windows were opened will be cancelled.

Note: All Motion Parameters and their key frames will be returned to their condition prior to opening the Camera View regardless if changes were made and "Applied" from the Scale Keys or Motion Time Line windows while Camera View was open.

Diagnostic Data Window

The Diagnostic Data window lets you do three things:

Display diagnostic data about a rendered image or preview

You can see a lot of useful information about an area of your image. You can use this information to figure out why the image is rendering the way it is.

2) Digitize Vector Objects from the rendered image.

You can digitize Vector Objects from a Diagnostic Preview by clicking the digitize in the associated Diagnostic Data window.

Measure Z Buffer (distance) values.

You can use this information to set haze distances, scale images for import to WCS as Z Buffers (see Render Settings in the Render chapter and the Tips & Tricks chapter).

The information in the Diagnostic Data window is the exact information WCS uses when rendering an image. It includes:

- Name
- Distance
- Elevation
- Overstory
- Understory
- Relative Elevation
- Aspect
- Slope
- Sun Angle
- Latitude
- Longitude

Note: See the Ecosystem Parameters chapter for more information about the effect of some of these Parameters.

To open the Diagnostic Data window, click the Diag button in the Camera View Control window to render a preview of an image. Or enable the "Data" option in the Settings Editor, and then render an image. WCS will create diagnostic data for the entire image while rendering.

The Diagnostic Data window will open when rendering is complete.



Click any point in the rendered image to display diagnostic information for the point. You can hold the left mouse button down and move the pointer around on the image to scan the information.

You can digitize Vector Objects directly from this window as you would do in Map View. See "Digitize" below for more information.

Reference 6A - Motion Parameters

You can position the Diagnostic Data window anywhere in the workspace. It will remain open and functional until it or the image window to which it is attached is closed.

Name Display

At the top of the Diagnostic Data window is the name of the Diagnostics Preview window for which it displays information. This is the same as the name in the title bar of the related Diagnostics window. The Diagnostic Data window will not display information from any other Diagnostics window.

Diagnostics windows are named "IA#" where "#" is a number showing how many diagnostics windows you've rendered so far.

Distance Display

The Distance display shows the distance from the Camera to the diagnostic point in kilometers. This is also the Z Buffer value for that point.

Note: if you want to know how far that is in miles, multiply it by .621. One kilometer is equal to approximately .621 miles.

You can use the Distance Display to measure the distance to any terrain feature. This can be handy when you want to know how far away something is before you set Haze Parameters.

It's also useful for converting gray-scale images to Z Buffers in the DEM Converter window of the Data Ops Module. The Z Buffers can then be used along with a Background image during rendering to insert 3-D objects rendered elsewhere into the scene (see the Tips and Tricks chapter).

Elevation Display

The Elevation display shows the elevation in meters at the selected diagnostic point.

Note: If you want to know the elevation in feet, multiply it by 3.28 One meter is equal to approximately 3.28 feet.

Overstory Display

The Overstory display shows the name of the Ecosystem rendered at the diagnostic point. This will be one of the Ecosystems from the Ecosystem Editor window's Parameter List.

If no data was rendered at this point (because it is sky or for other reasons) the Ecosystem will be listed as "None."

Understory Display

The Understory display shows the name of the Understory Ecosystem rendered at the diagnostic point.

The name will normally correspond to the Understory Ecosystem of the Ecosystem in the item above. However, if there is snow on the ground at the diagnostic point, "Snow" will be listed as the Understory.

Rel El Display

The Rel El display shows the Relative Elevation at the diagnostic point.

Use this to determine Ecosystem Maximum and Minimum Relative Elevations and Relative Elevation Effect. Relative Elevations are used to determine where Ecosystems are placed on the landscape (see the Ecosystem Parameters chapter).

Aspect Display

The Aspect display shows the aspect of the terrain at the Diagnostic point.

Reference 6A - Motion Parameters

Aspect is the azimuth of the terrain slope vector. It is in degrees clockwise from north.

If the terrain slopes due north the aspect is 0°. If it slopes due east the aspect is 90°. Use this to determine Ecosystem Skew Azimuths. Skew Azimuth controls what direction the Ecosystem Skew is maximized (See the Ecosystem Parameters chapter).

Slope Display

The Slope display shows the terrain slope at the diagnostic point.

Slope is the angle the terrain makes measured against the horizontal plane of flat ground. It's in degrees and always positive.

Use this value to help determine Ecosystem Maximum and Minimum Slopes. You may want to limit certain types of vegetation like wetlands to slopes less than 5 degrees or forests to less than 30 degrees. The slope value will tell you if you need to raise or lower the Ecosystem Maximum slope to cover a piece of terrain.

Note: When using a value of Flattening greater or less than zero (0.0) the terrain slopes will be affected. If Flattening is greater than zero the slopes will decrease, less than zero will make them increase. This will affect Ecosystem coverage. This might be exactly the effect you want, increasing the amount of rock as terrain relief and slopes increase. If you want to maintain constant coverage instead, use the diagnostic slope values found here to help determine what the Ecosystem Maximum Slope values should be.

Sun Angle Display

To display the angle between the terrain and the sun at a point.

Notes: The measurement is in degrees. An angle of 0° indicates that the maximum amount of sunlight is received here. An angle of 90° indicates the minimum.

Latitude Display

The Latitude display shows the latitude at the diagnostic point.

Latitude is measured in decimal degrees from the equator.

Longitude Display

The Longitude display shows the longitude at the diagnostic point.

Longitude is measured in decimal degrees from the prime meridian at Greenwich, England. In WCS West longitude is positive.

Database Button

Keyboard shortcut: b

The Database button gives you a handy way to open the Database Editor, where you can select or create a Vector Object to digitize.

Note: You can also open the Database Editor window by clicking the Edit button in the Database Module pop-up menu.

Digitize Button

Keyboard shortcut: d

When you want to digitize a Vector Object, you must first select an existing Object or create a new one in the Database Editor window (see above). Then click the Digitize button to begin Vector digitization.

When you click the Digitize button, it will say "Quit Dig" to signify that you can click it again when you are done digitizing.

Digitize by clicking on points in the image window just like in Map View. You may digitize up to 1999 points per Object. If you want to delete points, click with the right mouse button. When you are finished click the Quit Dig button.

Reference 6A - Motion Parameters

You will be asked if you wish to save the Vector when the process is complete. You must save it if you want it to be rendered or drawn in Map View. If you choose to save the Object you will see a file requester for saving the Database as well. Saving the Object means just saving the Vector's coordinates to a file. The Database must also be saved to tell WCS that the Object exists.

Elevation data will be automatically created as you digitize from information in the diagnostic data buffers created while the preview was rendered. The elevation data is saved if you save the Object.

Digitization in preview windows is non-modal. You can do other operations without stopping the digitization process.

Reference 6B - Color Parameters

- Overview
- Color Editor Window
- Color Time Lines

Overview

From sunrise to sunset, from season to season, nature provides us with an ever changing feast of color. Since our intent in World Construction Set is to come as close as possible to replicating nature's diversity, a flexible palette is essential.

Everything that can be rendered in WCS has a Color assigned to it which can be set to any of over sixteen million possibilities. WCS will take the assigned color and vary its value (darkness) according to the position of the sun. Colors will be blended to create fog and haze, reflected light in shadows and variations in the sun light color itself.

Palette Registers

There are thirty palette registers. Twelve of these are used by WCS for special purposes. Their names can't be changed. Eighteen are available for your use when you design your own Ecosystems (see the Ecosystem Parameters chapter).

Animation

You can animate all thirty Colors using key frame animation. This makes it easy to create effects like sunrises or seasonal color changes. By animating Color Parameters together with Motion Parameters and Ecosystem Parameters you can simulate the

changing face of nature over time or create wild alien effects.

Have fun!

Choosing Colors

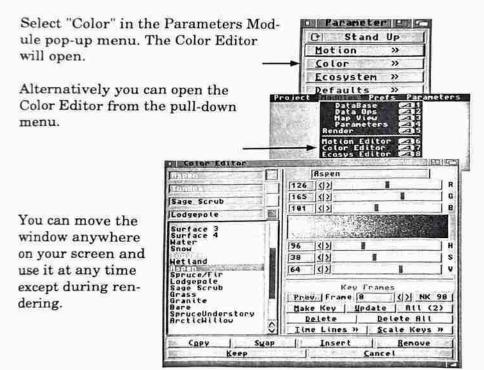
While you can choose from a full range of colors, the more natural colors are those fairly low in saturation. In other words there is a fair amount of gray in natural colors. It is easy to get carried away and create a garish landscape. Of course for fantasy adventures or cartoons that may be just the ticket.

Also make sure you consider your output medium. Certain display devices including television monitors behave very badly with over-saturated colors. For some print media you may wish to add saturation to compensate for absorbent paper or poorly calibrated software and equipment.

There doesn't yet seem to be any universally accepted hard-copy color calibration scheme. We have even found that the same equipment gives different results on different days depending on the humidity, temperature, phase of the moon and probably a few other equally obscure variables. If you are outputting to color copiers be sure to run a few tests before spending weeks rendering dozens of 4K resolution images.

Color Editor Window

Use the Color Editor window to edit the Color Parameters and Color key frames. By changing the Color Parameters for your Ecosystems you can completely change the look of your landscape.



Note: You must have a Parameter file loaded before you can open the Ecosystem Editor window. If you are starting a new Project you can create a Parameter file with the "Default" button in the Parameters Editing Module or you can load an existing Parameter file from another Project and modify it.

Note: several functions applying to Color Parameter Editing are found in the Parameters Global menu. These include loading and saving complete Parameter files as well as individual items. Also

the Freeze/Restore commands can be useful for temporarily holding a set of Parameter settings while you experiment with other settings.



The Color Editor window has these areas:

- Parameter List
- Color Registers
- Color Pot Buttons
- Name Field
- RGB/HSV Fields & Buttons
- Color Gradient Panel
- Key Frame Controls
- Copy/Swap/Insert/Remove buttons
- Keep/Cancel Buttons

Parameter List

The Parameter list lets you select the Active Color Parameter.

Click on an item in the list. It now is the Active Color and its values at the Current Frame are displayed in the string gadgets and sliders on the right side of the window and in the Color Gradient Panel.



List items displayed in white have at least one key frame associated with them. The Active Parameter is the only one that can receive input.

There are thirty palette colors. The first twelve of them are pre-assigned by WCS for special purposes. You will recognize the 12 in the Color Editor by the fact that you may not change their names or positions in the Parameter List. Of course you can

Reference 6B - Color Parameters

change the colors themselves and animate them over time. Eighteen of the colors are available for your own use.

The 12 pre-assigned colors are:

- Sun Light
- Ambient Light
- Haze & Fog
- Horizon
- Zenith
- Surface Grid
- Surface 1
- Surface 2
- Surface 3
- Surface 4
- Water
- Snow

Sun Light

Ask any outdoor photographer what color sunlight is and he or she will tell you that it depends on the time of day among other things. It is true, sunlight varies in color from warm tones in the morning and late afternoon to more neutral in midday. We wish to be able to create the time of day signature on our images without having to modify every color.

In WCS, the default (average) light color is (128,128,128). These values will cause no modification of other colors. All colors will appear as they are designated in the Editor. Changing any component will cause that component of all other colors to be modified according to the formula $RGB = RGB \times (RGB_{sun} / 128)$

So to create that warm morning glow, raise the red component to perhaps 135, the green to 130 and lower the blue to 120. Place the sun low on the horizon to create deeper shadows and voila, you can almost smell the coffee.

Don't overdo it! Too much variation can create weird effects.

Ambient Light

Even the deepest shadows have some reflected light on bright days. On overcast days, that is all there is. The color set here is the darkest color that any shadow will be. All colors will tend toward this color as shade level increases. We have found that pictures are more interesting and natural looking if you add a touch of blue to the ambient light. We use (0,0,10) for most of our images.

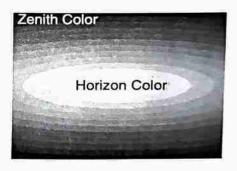
Haze and Fog

The haze and fog color affects both the perception of distance and time of day (in WCS haze is distance-related and fog is elevation-related).

Haze and fog are actually water particles reflecting light so the haze color implies the color of sun light. For our midday pictures we use a haze color of (218,218,251) which works well blending distant mountains with the horizon color.

Horizon

Normally the haze color and the horizon color would be closely related since it is actually haze, distance and sunlight that combine to make the sky near the horizon a different color from the color overhead. We let you adjust these colors individually so you can determine the effect you want.



Horizon Color is applied to the sky portion of images at the Horizon Line and Horizon Point as determined by those Motion Parameters. If you are not using the "Fixed Horizon" feature the horizon line will be computed for you and will be based on Camera Altitude and Bank angle. See Motion Parameters and Render Settings for explanations of these features.

Zenith

The position directly overhead is termed the zenith. In WCS the zenith will be at the top corner of the image most distant from the Horizon Point if "Fixed Horizon" is enabled (see Motion Parameters and Render Settings for explanations of these features). It will be at the Zenith Altitude as defined in the Render Settings otherwise

A gradient of color will be applied between the horizon and zenith using the horizon and zenith colors. The gradient will actually be an ellipse with the Horizon Line and Point at its center and the ellipticity defined by the Horizon Stretch Motion Parameter.

Surface Grid

For DEMs rendered as "Surfaces" rather than as "Landscapes" with Ecosystems, the color of the DEM is determined by four surface colors (applied as gradients) and a grid color. The grid color determines the color of latitude and longitude grid lines drawn across the DEM after rendering. "Grid" must be enabled on the Surfaces page of the Settings Editor for this to happen. The grid spacing is also set there.

Whether the grid is rendered to the bitmap or to a vector file is determined by the "Vectors" cycle gadget on the "Motion Paths and Vectors" page of the Settings Editor.

The grid line width is always one pixel.

Surface 1

This is the color of "Surface" rendered DEMs at and below the first Surface Elevation value. A gradient between this Color and Surface 2 Color will be applied between Surface Elevation 1 and Surface Elevation 2. The Elevations can be set from the Settings Editor or Map View (see the Motion menu in Map View).

Surface 2

This is the color of "Surface" rendered DEMs at the second Surface Elevation value. A gradient between this Color and Surface 3

Color will be applied between Surface Elevation 2 and Surface Elevation 3.

Surface 3

This is the color of "Surface" rendered DEMs at the third Surface Elevation value. A gradient between this Color and Surface 4 Color will be applied between Surface Elevation 3 and Surface Elevation 4.

Surface 4

This is the color of "Surface" rendered DEMs at and above the fourth Surface Elevation value.

Rendering DEMs as Surfaces

You can render elevation-shaded surfaces in two ways. First you can set specific DEMs' Database Class to "Surface." Do this in the Data-

pase Editor (see the Datapase Module chapter).

Second you can enable he "Topos as Surfaces command in the Render Settings Editor (see the Render Module chapter) which will cause all DEMs, regardless of Database Class to render as color-gradient Surfaces.

You can set the four Surface Elevations in

the Settings Editor or do it interactively in Map View (see the Map View module chapter, Motion menu).

You can preview the surface elevation settings in Camera View (see the Motion Parameters chapter) with the ElShade command.

Tip: To create a white shaded relief map set all four Surface colors to white (255, 255, 255) and render



with the Topos as Surfaces option (see the Settings Editor in the Render Module chapter). You can adjust the amount of shading using the Sun position and Shade Factor which are Motion Parameters. This will make an attractive background for the display of Vector information.

Water

The water Color is reserved for rendering all areas that fit the water Ecosystem definition (see the Ecosystem Parameters chapter). This could be considered the color for areas below "sea level".

Water is not shaded the same as other Ecosystems. Bathymetry or depth affects the value of the color in the same way that sun angle affects normal Ecosystems. The depth is figured from the Water Elevation Line down to the elevation of the polygon being rendered. The polygon is not rendered at its true elevation but at the water surface. The greater the depth the darker the shade. The dark end of this depth gradient is determined by the "Sea Depth" value in the Ecosystem Editor (only visible when Water is the Active Parameter).

There will also be a gradient near the water's edge where it shoals. Here the gradient will be towards a sand color. Depending on the "Wind Azimuth" (also in the Ecosystem Editor) there will be some whitecaps formed along the windward shores.

Snow

Snow gets a pre-assigned register because it is treated somewhat differently than a normal Ecosystem Color. To simulate the reflective property of snow surfaces, the shading gradient is

non-linear. The fall-off is faster for red than for green and faster for green than blue. This seems to give a slight bluish tinge to the snow in shadows to simulate reflected sky.

We prefer a color of around (229,229,229) or 90% of the full value so that the white is not too overpowering, especially for video work. If you notice too much blue seeping into the snow shadows, you should decrease the blue component slightly. How the color spectrum is balanced on your chosen output device will be most noticeable in the snow. We have found that people have a wide acceptance range of other Ecosystem Colors but strange looking snow bothers them every time.

User-Definable Colors

The other 18 Color Parameters may be named anything you like, placed in whatever order pleases you and assigned to any and as many Ecosystems as you wish.

Color Register Displays

The Color Register Displays show the names of the last four Colors selected for editing.

Selecting an item from the Parameter List causes the item to be added in the top register here. You can make any of the four register Colors active by selecting on the Color Pot to the right of the name.

To edit the name itself you must use the string gadget above the RGB sliders on the right side of the Editor.



Color Pot Buttons

The Color Pots buttons display the last four Colors selected for editing and to let you choose one of them for further modification.

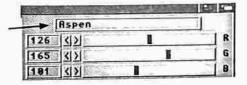
Reference 6B - Color Parameters

Selecting an item from the Parameter List causes the item to be added in the top register. The former top three items are moved down one register. You can make any of the four register colors active by selecting on the Color Pot.

The purpose of having four registers here is to be able to see four colors next to each other for comparison. Remember the color resolution is only 4096 out of a possible 16+ million.

Name Field

The Name field shows the name of the Active Color's name. You can edit the name.



Enter a name in the field. Up to 23 characters are allowed.

The name really isn't terribly important. Name a Color whatever helps you remember what it is supposed to represent.

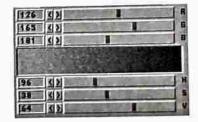
The name will appear in the Ecosystem Editor as an Ecosystem's Color.

The name of the first 12 Colors in the list may not be changed. They have special purposes and are in a fixed sequence.

RGB/HSV Fields, Sliders and Buttons

Use the RGB/HSV fields, sliders and buttons to edit the Active Color's red, green and blue components.

You may enter values in the strings, adjust with the arrows or use the sliders. You will see imme-



diate updates of the other gadgets. Of particular note are the two systems of adjustment. You may modify the components directly with the top three sets of gadgets or you may modify hue, saturation and value with the bottom three sets.

Natural colors are not highly saturated. For the most part we have found color saturations of 15 to 55 percent work well. Of course you are perfectly welcome to have hot pink trees if you like.

Color Gradient Panel

The Color Gradient panel shows the color range for the Active Color. This is for information only.

The left end of the gradient is the color as it will appear in full sunlight. The right end is as it will appear in near total shade.



Due to the limited palette available the gradient is rather crude. In an actual rendering many more shades are available and the hue will be much more consistent.

Key Frame Controls

Key Frame controls let you animate any of the colors WCS uses to render pictures.

Key Frame Controls are discussed at length in the Parameters Module chapter.

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Prev Fram	e 0	() NK 98	
Make Key	Update	R11 (2)	
Delete	De	Delete All	
Line Lines	>> Sca	le Keys »	

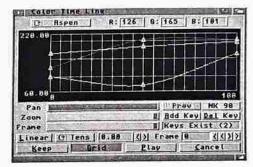
Time Lines Button

Keyboard shortcut: t

Click the Time Lines button to open the Color Time Line window.

The Color Time Line window will open and display a graph of the Active Parameter.

This feature will be disabled if there are less than two key frames for the Active Parameter. See the Time Lines section in the Parameters Module Chapter and the Color



Time Lines section below for more information.

Scale Keys Button

Keyboard shortcut: s

Click the Scale Keys button to open the Scale Keys window, where you can do key frame scaling and translation.



See Scale Keys window in the Parameters Module chapter for more information.



Copy Button

Keyboard shortcut: o

Use the Copy button to copy the components of the Active Color to those of another palette item.

Select the Color you wish to copy. Then select "Copy". The pointer will change to let you know a copy operation is in progress.

Select the destination item from the Parameter List. The destination item will now be the same color as the former Active Color and the destination item will become the Active Color. Click on "Cancel" or any other gadget to abort the copy operation.

The name is not copied, only the color components.

Swap Button

Keyboard shortcut: w

Use the Swap button to swap one Color item for another. Do this if you wish to rearrange the order of the colors in the list. The first twelve color items can not be swapped, their order is fixed.

To change the order of colors in the list, select the first item. Then click the Swap button and the pointer will change to indicate that a swap operation is in progress. Finally, select the second item from the Color Parameter List. The two items will be reversed.

Click on "Cancel" or any other gadget to abort the swap operation if you change your mind.

Insert Button

Keyboard shortcut: i

Use the Insert button to insert a blank Color entry above the Active Color. Do this when you want to create a new color entry in the list.

Select the Color that you want to insert a new item above. Select "Insert". All items in the list from the Active Color down will be moved down one position in the list and a blank item inserted. The last item in the list will be lost. You may now set a name and color for the new item or copy another item to it.

The order of user-defined colors in the list is not really important. You are free to arrange it any way you like with the exception of the first twelve entries.

Remove Button

Keyboard shortcut: r

Use the Remove button to remove a Color item from the Parameter List.

Select the item to remove, and then click the Remove button. The item will be deleted from the list and all items below the removed item will be moved up one position.

The order of items in the list is not really important except that the Ecosystem Parameters refer to colors by list position. So if you remove an item in the Color List make sure you reassign the color of any Ecosystems that used that color. Do this in the Ecosystem Editor (see the Ecosystem Parameters chapter).

Keep Button

Keyboard shortcut: K

Click the Keep button to close the Color Editor and preserve changes.

The Color Editor and Color Time Line window will close with all changes being retained.

If you wish to cancel the changes made in the Time Line window but keep changes that were made in the Color Editor before the other window was opened, close the Time Line window with its Cancel button and then close the Editor with the Apply button.

Cancel

Keyboard shortcut: c

Click the Close button to close the Color Editor and undo changes.

The Color Editor and Color Time Line window will close with all changes being cancelled.

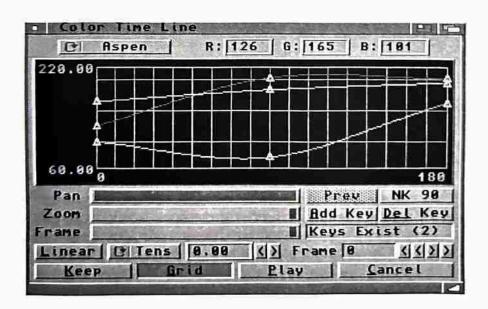
All Color Parameters and their key frames will be returned to their condition prior to opening the Color Editor regardless if changes were made and later "Applied" from the Time Line window.

Color Time Lines

Each Color Time Line graph will display all three color components in their respective colors. If you only see the blue line then all three lines are coincident. The Time Line window must be the active window for the graph colors to show correctly in red, green and blue. Only one color component is active for modification at a time by dragging points. Click on the point to activate it. Then click again to begin dragging.

For Colors, integer values are of sufficient precision and require less memory and storage space. For that reason, the Time Line graphs for Colors may appear a bit ragged. When changes are very gradual they may appear to be stepped. This will not be evident in the finished animation.

For more information about the Time Line window, see the Time Line section in the Parameters chapter.



Reference 6C - Ecosystem Parameters

- Overview
- Ecosystem Editor Window
- Ecosystem Time Lines
- Custom Ecosystem Models
- Custom Ecosystem Model Editor
- An Ecological Perspective
- Resources

Overview

WCS lets you use "Ecosystems" to give 3-D texture to the landscape. You can choose from textures like snow, water, deciduous and conifer trees, grass, rocks and ground. When you render a picture, WCS automatically puts different Ecosystems in different places using rules based on nature.

For example, WCS can put snow above the snow line, forests below the tree line but not on steep slopes, and grasslands on the plains.

You can change the rules. The Ecosystem Editor window lets you control the Ecosystem Parameters to alter the rules that WCS uses to apply the Ecosystems to the landscape.

You can define Ecosystems in the Ecosystem Editor window. You can combine an Overstory and an Understory to create many kinds of landscape surfaces in a simple way. Typical Ecosystems could be wetlands, spruce forest, alpine tundra or grassland. The names you choose for your ecosystems should probably be drawn from real life to minimize confusion.

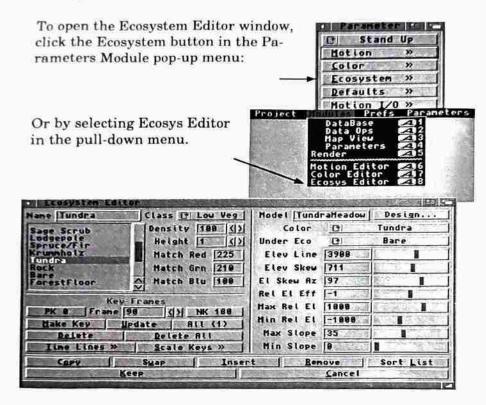
You can also create Custom Ecosystems with more variations using the Custom Ecosystem Model Editor window.

In order for WCS to apply realistic surfaces to a landscape, there must be some Ecosystems defined in the Ecosystem Editor window. WCS comes with some Parameter files that already have Ecosystems defined.

If you want to create a new Project the easiest way to create Ecosystems for it is to load an existing Parameter file and modify it. It would take much longer to create all the Ecosystems from scratch.

You must supply a list of Ecosystems from which the program will pick the most appropriate one to map at any given point on the landscape.

Ecosystem Editor Window



You can move the window anywhere on your screen and use it at any time except during rendering.

Note: You must have a Parameter file loaded before you can open the Ecosystem Editor window. If you are starting a new Project you can create a Parameter file with the "Default" button in the Parameters Module pop-up window or you can load an existing Parameter file from another Project.

The Ecosystem Editor window has these areas:

- Name
- Class
- List
- Height
- Density
- Design Button
- RGB Matching
- Parameters
- Key Frame Controls
- Copy/Swap/Insert/Remove/Sort List buttons
- Keep/Cancel Buttons

Note: several functions applying to Ecosystem Editing are found in the Parameters Global menu. These include loading and saving complete Parameter files as well as individual items. Also the Freeze/Restore com-



mands can be useful for temporarily holding a set of Parameter settings while you experiment with other settings.

Ecosystem List

The Ecosystem List shows you all the Ecosystems. You can click any Ecosystem to edit its Parameters.

Click an Ecosystem in the list. It now is the Active Ecosystem



and you'll see its Parameter values at the Current Frame displayed in the fields on the right side of the window.

Note: List items displayed in white have at least one key frame associated with them. The Active Parameter is the only one that you can change.

Reference 6C - Ecosystem Parameters

Name Field

Name Tundra

The Name field shows the name of the Active Ecosystem.

The name is a convenience for you, it doesn't matter to WCS. Name an Ecosystem in a way that helps you remember what it is supposed to represent. For example, if you have an Ecosystem that is designed to simulate a pine forest, you might want to call it "Pine Forest."

You can't change the name of the first 2 Ecosystems in the list, Snow and Water, but you can change the name of any other Ecosystem. Click in the field and use the Amiga keyboard to directly edit the name. You can use up to 23 characters.

Class Cycle Gadget

Class 🕑 Low Veg

Use the Class cycle gadget to select the type of Ecosystem represented by the Active Ecosystem Parameter and the texture to be applied there.

Select from the following options: Water, Snow, Rock, Ground, Conifer, Deciduous or Low Vegetation.

Textures are affected also by the Tree Height and Density values (see below). The Density is particularly important. Water, snow, rock and ground all currently use the same texture.

Textures are one of the strongest defenses available in WCS to combat the polygon problem. They render very quickly and should be used for all surfaces if you are close enough to the landscape to see polygon shapes. Also consider increasing the Fractal Depth (see the Render Settings section of the Render Module chapter and Interpolate DEM window in the Data Ops Module chapter).

Parameter Fields & Sliders

The Parameter fields and sliders let you change the Ecosystem Parameters. By changing these Parameters you can control where WCS puts each Ecosystem on the landscape. You can type numbers directly into the fields or use the sliders to change the values.

Color	13	Tundra
Under Eco	0	Bare
Elev Line	3908	
Elev Skew	711	
El Skew Az	97	
Ret Et Eff	-1	
Max Rel Et	1000	
Min Rel Et	-1980	
Max Slope		
Min Stope	9	

The Ecosystem Parameters include:

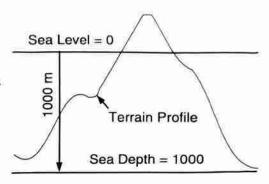
- Sea Level (Water Ecosystem only)
- Sea Depth (Water Ecosystem only)
- . Wind Azimuth (Water Ecosystem only)
- Elevation Line
- Elevation Skew
- Elevation Skew Azimuth
- Relative Elevation Effect
- Maximum Relative Elevation
- Minimum Relative Elevation
- Maximum Slope
- Minimum Slope

Sea Level Field

Sea Level is only available when you select the Water Ecosystem in the Ecosystem List. Use the Sea Level field to specify the level of the ocean surfaces in meters. Any land below the level you set will be covered by water.

Sea Depth Field

The Sea Depth field is only available when you select the Water Ecosystem in the Ecosystem List. Sea Depth determines if you see shades of blue in the oceans that vary by ocean depth. The optimum depth for the ocean is the actual depth in meters. This will give the fullest range of ocean color variation. If you want the ocean to all be darker, decrease the value. Increasing the value will cause the ocean to all be closer to the Water color you set in the Color Editor.



Wind Azimuth

The Wind Azimuth field is only available when you select the Water Ecosystem in the Ecosystem List. It controls the direction of waves breaking on ocean shorelines. Zero (0) azimuth is considered to be north. An azimuth of 90 will cause waves to appear on the east-facing shorelines. An azimuth of 180 will cause waves along south-facing shorelines, and so on.

Elevation Line

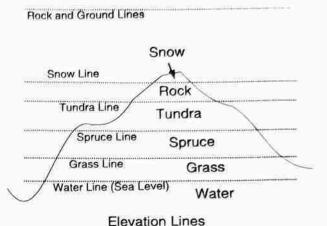
You can set the upper limit for an Ecosystem in the Elevation Line field.

For all Ecosystems except snow, the Elevation Line is the average upper limit for the Ecosystem in meters. For the snow Ecosystem the Elevation Line is the lower limit of the Ecosystem in meters. In Nature, the snow melts below the snow line.

For rock and ground ecosystems elevation is not a factor, so you will probably want to set the value to the maximum setting of 32,000 meters. That way WCS can use those Ecosystems at any elevation.

If the Elevation Line were the only Parameter, Ecosystems would be distributed like the layers of a cake on the hillside with each one occupying a well-defined elevation range. But the Elevation Line only represents the average upper limit.

The limit at any given site will vary depending on local factors which you can alter using the rest of the Parameter variables (see below). They are designed to break up this even-layered distribution and to create a natural patchy appearance that embod-



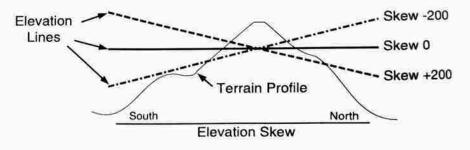
ies valid ecological principles.

Ecological Explanation

As elevation increases conditions become more harsh. Temperature drops, growing season shortens, desiccating wind exposure increases, solar radiation becomes more intense and soils tend to become poorer. Every plant species has an upper limit to its range beyond which it cannot survive or reproduce.

Elevation Skew

You can use the Elevation Skew field to add irregularity to the land cover. You can use values from -1000 to 1000. Most Ecosystems look best with numbers from -500 to +500.



Technical Explanation

Elevation Skew is a measure of the effect of slope azimuth on the upper limit of an Ecosystem. In other words, it changes the Elevation Line of an Ecosystem based on the direction of the slope.

The Elevation Line will be lowered in the direction of the Skew Azimuth (see below) by an amount proportional to the slope and Elevation Skew. The value is in units of meters and referenced to a 45° slope. In other words, on a 45 degree slope, if the Elevation skew value is 200 then the Elevation Line will be raised or lowered 200 meters. On lesser slopes the change will be proportionately less.

Ecological Explanation

One of the factors that breaks up the layered arrangement of Ecosystems is the azimuth or direction of the terrain slope. In the northern hemisphere, southern slopes receive more hours of sunlight especially in the winter. This makes them somewhat warmer on average than north-facing slopes. They also tend to be drier and have more months free of snow.

These are important factors to plants which can not sprout until the snow has cleared. The drier conditions on the other hand mean more months of drought and certain moisture-loving species cannot thrive here.

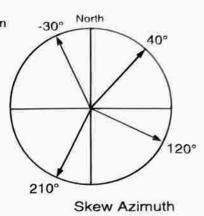
Elevation Skew Azimuth

You can use the Elevation Skew Azimuth amount to add irregularity to the land cover. You can use values from -360 to +360. In nature values of -90 to +90 are typical.

The value for a given species of plant depends on the complex interaction of a host of factors such as prevailing wind direction, wind strength, latitude, solar intensity at different times of the day and the specific temperature and moisture requirements of the plant species. For non-living Ecosystems such as snow, the controlling variables are prevailing wind direction, wind strength, and sun intensity.

Technical Explanation

The direction in which the Elevation Skew has the greatest effect is the Elevation Skew Azimuth. If the Elevation Skew is positive the Elevation Line is lowered, if negative, it is raised in the Skew Azimuth direction. At 180° from the Skew Azimuth the effect will be of the same magnitude, only reversed. This value is measured in degrees clockwise from north so north is 0°, east is 90°, etc.



Ecological Explanation

In the Rocky Mountains our winter winds prevail from the west. Snow is blown off ridges and accumulates in basins on the east side. Sun melts more snow on southern slopes, where its force is more intense, than northern so the cumulative effect is to deepen snow on the northeast sides of mountains. Here snow frequently lays until late summer when it is long gone from other slopes. We can simulate that effect by setting the Skew Azimuth to 45° (northeast) and the Elevation Skew to 200 (a moderate value).

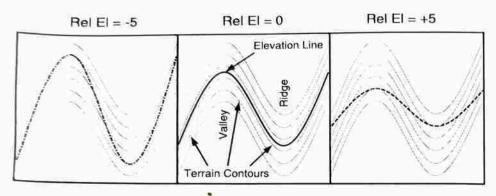
Relative Elevation Effect

One of the most powerful tools available to us in the quest for realism is the Relative Elevation Model. Derived from the DEM it tells us if slopes are convex or concave.

The greater this value (in absolute terms), the stronger the effect. Values from +10 to -10 generally work well. A value of +5 works well for snow, causing it to fill in the valleys on a mountain side.

Technical Explanation

WCS creates REM files automatically from your DEM files in order to find areas that are concave or convex. It can then assign Ecosystems to such areas taking the shape of the surface into account and using the values you set in the Relative Elevation Effect field.



Relative Elevation Effect

Ecological Explanation

In nature concave areas collect water, convex areas shed it. Concave areas have deeper soils with higher water tables even to the point of being saturated or hydric. These extremely wet areas have been termed wetlands and are of vital importance to flood control, water quality preservation and wildlife (not just mosquitos).

Convex terrain drains quickly and soils tend to be droughty. They are often coarser in texture which aids in the rapid removal of soil moisture. Wind exposure is higher which desiccates the site and any plants that grow on it. Convex sites are favored by some species of plants and shunned by others.

Complicating things are the temperature effects. Valleys are like pipelines that transport air masses up and down mountains. At night cold air from the surrounding peaks drains down into the valleys. They are often ten or more degrees cooler at night than surrounding slopes. During the day they trap hot air which flows up from lower elevations.

The end result is that some Elevation Lines are lowered in valleys and others are raised. We can take advantage of this diver-

gent behavior by creating some Ecosystems that exhibit each. It will add realistic complication and diversity to our images whether or not we truly understand the principles behind it. Small dips and bumps in the terrain model will produce isolated clumps of one Ecosystem or another. These are equivalent to micro-climate zones found on real hillsides. They are the main reason that timber line is seldom truly a line.

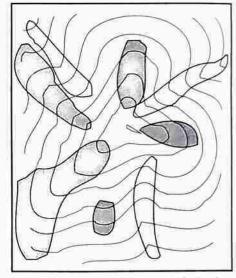
Maximum & Minimum Relative Elevation

Some Ecosystems may be limited exclusively to concave or convex terrain. You can set those values to limit their occurrence with the Maximum and Minimum Relative Elevation Parameters.

Relative Elevations assume a statistically normal distribution

about the mean value of zero. That is to say most values are near zero and very few values are at the extremes of the range. For DEMs we have encountered, values ange from -250 to +250.

We have found upper limits of -20 or -30 for a deciduous consisted consisted and interesting and realistic patches of color among the darker greens of a conifer forest. In the Rockies those patches might represent aspen or shrub willows at middle and higher elevations.



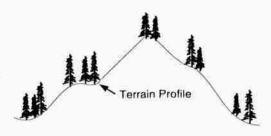
Different Ecosystems Limited To Max and Min Relative Elevations

The last Ecosystem in the list that isn't meant to be a special understory-only Ecosystem (see below) should have a wide open relative elevation range (-1000 to +1000). Usually this is the Bare (ground) Ecosystem.

Reference 6C - Ecosystem Parameters

Maximum Slope

This is probably the easiest Parameter to visualize. Everyone knows that trees do not grow on the face of a cliff. Setting the Maximum Slope for vegetation Ecosystems to 30 or 35 degrees will work well.



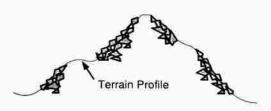
Maximum Slope Limited Ecosystem

Rock should have a maximum slope of 90°.

The last Ecosystem in the list that isn't meant to be a special understory-only Ecosystem (see below) should have a wide open slope range (0 to 90 degrees). Usually this is the Bare (ground) Ecosystem.

Minimum Slope

We have used Minimum Slope on occasion where we wish to have some way to discriminate between two Ecosystems that otherwise have identical or similar Sub-Parameters. We also use it to limit rock to slopes greater than 35°.



Minimum Slope Limited Ecosystem

The last Ecosystem in the list that isn't meant to be a special understory-only Ecosystem (see below) should have a wide open slope range (0 to 90 degrees). We normally use bare ground as our last Ecosystem. It will be the default in case the terrain conditions do not match any other Ecosystem.

Special Ecosystems

There are two pre-assigned Ecosystems, water and snow. Each of these is treated slightly differently from other Ecosystems and so WCS must know where in the list to find them.

Water is different in that any elevation below the water line will be rendered as if the elevation of the point were at the water line. The shading applied will be based on the depth below this line. See the Color Parameters chapter for more information about water coloring. If you wish to actually render the ocean bathymetry (elevation data) you will need to move the water Elevation Line down below the sea floor. You can create a normal Ecosystem with a line at sea level to give the sub-sea area a unique color.

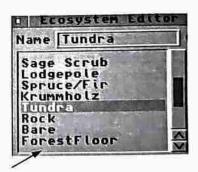
Place this Ecosystem right below the Snow Ecosystem in the Ecosystem List with the Insert command (see below) and copy the Water Ecosystem to it.

You could even create a whole sub-sea world populated with a variety of Ecosystems. Using haze and fog appropriately would let you come close to simulating an underwater environment. Snow is different in that the Elevation Line represents the average lower elevation limit rather than the upper limit. Snow is also shaded slightly differently to simulate its reflective property.

You can create up to 18 additional Ecosystems to meet a variety of needs. Some may be referenced only by Color Maps, some only as Understories to other Ecosystems.

Any such special Ecosystems that you do not wish to be scanned and tested for normal rendering as described above should be placed lower in the list than the Ecosystem with the broadest range of attributes.

Normally we use bare ground for our broad range default. Special Understory or Color Map Ecosystems come



after bare ground in our lists. They will never be rendered except as understories to another Ecosystem and when referenced by a Color Map.

Render Priority

During rendering, the Ecosystem List will be scanned from top to bottom. The first Ecosystem found that matches the terrain characteristics at a given spot will be the one rendered there. Since the evaluation process proceeds in top to bottom order you should arrange Ecosystems in order of most restrictive to least.

Lower Elevation Lines are more restrictive than higher ones.

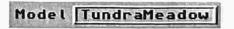
Narrow Slope or Relative Elevation ranges are more restrictive than wide ones. In some cases there may be no clear-cut order. You should then decide which Ecosystem you wish to have precedence. This is like the natural phenomenon of some plant species being more aggressive or prolific.

You can check to see what will be rendered using the Ecosystem preview in the Motion Parameters' Camera View or with the Ecosystem Mapping option in Map View (see the Map View Module chapter).

If you want WCS to sort your Ecosystem List according to what it thinks is a logical order use the Sort List button described below.

Custom Ecosystem Model Field

To specify a Custom Ecosystem Model to be used for the Active Ecosystem Parameter.



Enter a file name in the string or use the "Design" button to the right to enter a new Custom Ecosystem Model file name or load an old one. Enter the file name only. The path will be designated in the Settings Editor (see Render Settings in the Render Module chapter).

Custom Ecosystem Models are only used when you want to create a more complex Ecosystem, say with several kinds and colors of trees, than can be generated using the standard features found in the Ecosystem Editor window.

Note: For a complete description of the use and creation of Custom Ecosystem Models see the section below devoted to that subject.

Design Button



Keyboard shortcut: g

Click the Design button to open the Custom Ecosystem Model Editor window.

The Custom Ecosystem Model Editor window will open.

For a complete description of the use and creation of Custom Ecosystem Models see the section below devoted to that subject.

Color Cycle Gadget

Use the Color cycle gadget to select the principal color for the Active Eco-



system Parameter. The color swatch to the left of the name shows the approximate color.

The color swatch is limited to 4096 colors so it does not display the full range of potential values. Colors themselves and their animation are controlled from the Color Editor (see the Color Parameters chapter).

Ecosystem Colors reference the Color Parameters by number, not name. Whenever the Color List is changed by removing an item you should check and if necessary re-assign any Ecosystem Colors that used the removed color.

Tip: You can quickly change the look of a scene, say from summer to fall, by setting up both summer and fall foliage colors in the Color Editor. Then you can switch seasons by selecting the right set of colors here in the Ecosystem Editor.

Under Eco Cycle Gadget

Use the Under Eco cycle gadget to choose the Under-



story Ecosystem from the list of available Ecosystems. The Understory Ecosystem texture and color will be rendered in combination with the Active Ecosystem. This will add realism and complexity to the image.

The color swatch to the left of the Understory name shows the approximate color of the selected Understory. This will help you visualize what the combination of Overstory and Understory will look like and to give you a visual guide in selecting the desired Understory.

Ecological Explanation

Ecologists frequently describe areas by their plant associations. There is a dominant plant species and a second species that occurs frequently in association with the first. Often the first species forms an overstory or canopy layer and the second forms the ground cover or understory. WCS lets you combine two Ecosystems on the same site to mimic this natural phenomenon.

The normal way this is used is to set the Active Ecosystem's Class (see above), Tree Height and Density (see below) to the taller of the two desired items. Then set the Understory Ecosystem to a smaller plant type (grass or shrubs) or to bare ground.

The Understory may be any of the Ecosystems in the list including bare ground, water or ones you make up specially for the purpose. You should put such specially designed Ecosystems at the bottom of the list and make their Parameters such that they will never be rendered except as Understory to another Ecosystem (for instance set their Line values to -32000). The reason for putting them at the bottom of the list is so that WCS will not have to examine them for every polygon it renders which would increase rendering time.

In some cases you will want to make the Understory the same as the Ecosystem itself. This is normally the case for rock and bare ground and often for low vegetation like grass or tundra.

WCS will let you make the Understory Ecosystem taller than the Overstory if you desire. You can experiment with different Density values too. There are really no limits to the way you can combine Ecosystems to create interesting effects. This is just another tool for creating the diverse appearance of a natural landscape.

Technical Explanation

The way this works is that first a simple polygon is drawn in the color of the Understory's Understory. Then if the Understory has a Density greater than a random number, the Understory texture is rendered in the Understory Ecosystem's Color. Finally, if the Active Parameter's Density is greater than a random number, its texture is rendered in its own Color. Textures are controlled by the Class cycle gadget (see above).

Density Field & Arrow Buttons

The Density field lets you specify the percentage of polygons of the Active Ecosystem that will be covered with



he texture set by the Class cycle gadget (see above).

Enter an integer value between 0 and 100.

A value of zero will cause no trees or textures to be rendered for the given Ecosystem. A value of 100 will cause a tree or texture to be applied at all polygon sites. Tree Densities will have to be determined from an examination of a rendered image.

Increase this value if you want to see more trees of a given type. Lower values will leave more bare spots where the Understory Ecosystem will show through. Fractal Depth and DEM Interpolation level will also affect the spacing of trees.

Reference &C - Ecosystem Parameters

For rock and bare ground a Density of 100 percent is normally used when you are trying to obscure polygon shapes. If polygons are not a problem, you can use smaller values or even zero to get the appearance of greater roughness and to increase rendering speed.

Height Field & Arrow Buttons

Use the Height field to adjust the height of individual treed Ecosystems.



Set the value (in meters) by entering an integer number in the string or adjusting with the arrows.

This is the maximum height for an Ecosystem. Trees will be a random mix of heights from zero up to this value.

For non-vegetation Ecosystems where the Class (see above) is water, snow, rock or ground, the value should probably be zero. Non-zero values will make the ground appear bumpy.

Any Ecosystems where the Tree Height is one or zero can be covered by snow. If the snowline is low enough that a polygon may have snow, WCS will check to see if the height is greater than one meter. If so snow will be drawn as the understory and the tree will be rendered on top of it. Otherwise the texture, if there is one, will be drawn in the snow Color. Usually low vegetation Class items are given a height of one to allow snow to cover them.

Tree heights can be adjusted globally in the Settings Editor as well as by individual Ecosystem here.

Match Red/Grn/Blu Fields

Use the Match Red, Green and Blue fields to set values for use as Ecosystem Indices in Color Mapping.



Set the red, green and blue color component values that will indicate in a Color Map where this Ecosystem is to be rendered. The valid range is 0 to 255. Note that pure black (0,0,0) is reserved and should not be used here.

You may draw maps that depict where certain Ecosystems exist and use these as Color Maps when rendering.

When WCS finds a match between the three color components in the Color Map and the components set for one of the Ecosystems the Ecosystem will be rendered at that spot. The match must be precise. There is no range matching.

Color Maps may include a combination of Ecosystem index colors and tint colors. When an Ecosystem match is not found, the terrain will be tinted the Color Map color. The color (0,0,0) is the cue to ignore the Color Map at that spot and compute the Ecosystem as normal.

In order for Color Matching to occur you must enable both "Color Maps" themselves and "CMap Color Match" on the Color Maps page of the Settings Editor (see the Render Module chapter). Additional information about Color Maps can be found in the Data Types and Map View chapters.

Key Frame Controls

You can animate any of the Ecosystem Parameters found on the right side of the Ecosystem Editor window. They use

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the same key framing technique as Motion and Color animation in WCS.

For instance you could animate the snow line to simulate the coming of winter or an ice age. You could animate the vegetation Elevation Lines to simulate global warming or cooling.

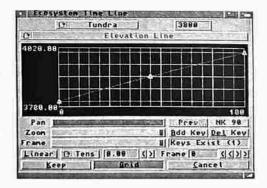
The Key Frame Controls are discussed at length in the Parameters Module chapter.

Time Lines Button

Keyboard shortcut: t

Click the Time Lines button to open the Ecosystem Time Line window.

The Ecosystem Time Line window will open and display a graph of the Active Parameter



This feature will be disabled if there are less than two key frames for the Active Parameter. See the Time Lines section in the Parameters Module chapter for more information.

Scale Keys Button

Keyboard shortcut: s

Click the Scale button to open the Scale Keys window for key frame scaling and translation.



The Scale Keys window will open.

See the Scale Keys window in the Parameters Module chapter for more information.



Copy Button

Keyboard shortcut: o

Use the Copy button to copy the values of the Active Ecosystem to those of another Parameter List item.

Select the Ecosystem you wish to copy. Then select "Copy." The pointer will change to let you know a copy operation is in progress. Select the destination item from the Parameter List.

The destination item will now have all the same attributes as the former Active Ecosystem and the destination item will become the Active Ecosystem. Click on "Cancel" or any other gadget to abort the copy operation.

The order of items in the list is very important. See "Ecosystem Priority" above for more information.

Swap Button

Keyboard shortcut: w

Use the Swap button to swap one Ecosystem item for another. If for some reason you wish to rearrange the list order.

Select the first item. Select "Swap" and the pointer will change to indicate that a swap operation is in progress. Select the second item from the Ecosystem Parameter List. The two items will be reversed including names. Click on "Cancel" or any other gadget to abort the swap operation.

The order of items in the list is very important. See "Ecosystem Priority" above for more information.

Insert Button

Keyboard shortcut: i

Use the Insert button to insert an Ecosystem entry above of the Active Ecosystem.

Select the Ecosystem that you want to insert a new item above. Select "Insert." All items in the list from the Active Ecosystem down will be moved down one position in the list and a blank item inserted. The last item in the list will be lost. You may now set a name and Sub-Parameters for the new item or copy another item to it.

The order of items in the list is very important. See "Ecosystem Priority" above for more information.

Remove Button

Keyboard shortcut: r

Use the Remove button to remove an Ecosystem from the Parameter List.

Select the item to remove. Select "Remove." The item will be deleted from the list and all items below the removed item will be moved up one position.

The order of items in the list is very important. See "Ecosystem Priority" above for more information.

Sort List Button

Since rendering priority depends on the arrangement of items in the Ecosystem List, the order of items in the list is very important. Unfortunately, there is no one right way to order the list. The right order depends on how you want Ecosystems to behave.

We have provided the Sort List button as a fall-back in case you have no idea how Ecosystems should be sorted. It will provide a list order that to WCS seems logical.

Remember, all of the Parameters on the right side of the Ecosystem Editor help determine where Ecosystems will be drawn. The list determines what order WCS will consider each Ecosystem for drawing. As soon as it finds an Ecosystem that meets the requirements of a little piece of terrain it renders it without considering those items (perhaps better suited) farther down the list.

Always use either the Camera View previews or the Map View Ecosystem option to check and see if you are getting what you expected. In many cases you can fix problems by rearranging items in the list.

See Render Priority above for more information.

Keep Button

Keyboard shortcut: K

Click the Keep button to close the Ecosystem Editor and preserve changes.

The Ecosystem Editor and Ecosystem Time Line window will close with all changes being retained.

If you wish to cancel the changes made in the Time Line window but keep changes that were made in the Ecosystem Editor before the other window was opened, close the Time Line window with its Cancel button and then close the Editor with the Keep button.

Cancel Button

Keyboard shortcut: c

Click the Cancel button to close the Ecosystem Editor and undo changes.

The Ecosystem Editor and Ecosystem Time Line window will close with all changes being cancelled.

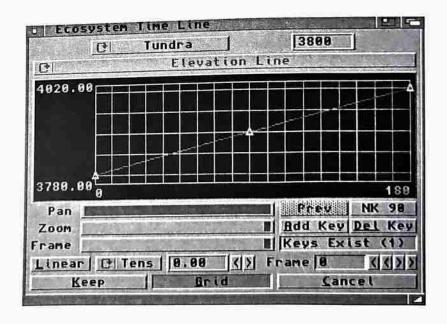
All Ecosystem Parameters and their key frames will be returned to their condition prior to opening the Ecosystem Editor regardless if changes were made and later "Kept" from the Time Line window.

Ecosystem Time Lines

Each Parameter has its own graph on a separate "page" of the Time Line display. To view them in sequence click on the circular arrow at the left end of the page cycle gadget above the graph.

Only one set of Tension, Continuity and Bias values exist for any given frame and apply to all Parameters for a given Ecosystem.

Note: the Time Line graphs for Ecosystems may appear jagged or stepped when changes are gradual. Don't worry, they will still animate smoothly. They may look ragged in the Time Line because Ecosystems use integer values. Integer values are of sufficient precision for this application, and they have the advantage of requiring less memory and storage space than floating point values.



Custom Ecosystem Models

There will be occasions when you need to create an Ecosystem that has more than two types of vegetation or you wish to have more control over tree height or tree colors. The solution is to create a detailed model of the Ecosystem in which you specify the class, frequency, height and color of each item.

Using Custom Ecosystem Models you could create a multi-hued fall forest, a tree plantation of even aged trees, or texture models to apply to water or rock that provides more color variation than would normally be available.

Custom Ecosystem Models are stored in a directory or series of directories that can be animated just like Color Maps. They are created and edited in the Custom Ecosystem Model Editor.

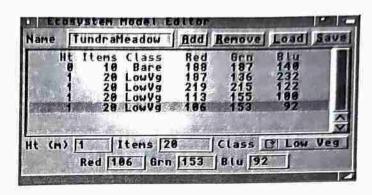
Custom Ecosystem Models are invoked for any Ecosystem with a Model name specified in the Ecosystem Editor (see above).

Custom Ecosystem Models override the Tree Height, Color and Understory settings but not the Density setting. The Model data will only be used for those sites where the Density exceeds a random number between 0 and 100, wherever a tree or texture would normally be rendered.

Custom Ecosystem Model Editor

Use the Custom Ecosystem Model Editor to create or edit a Custom Ecosystem Model.

Select "Design" in the Ecosystem Editor. The Ecosystem Model Editor will open. It may remain open even if the Ecosystem Editor is closed and will remain functional during all processes except rendering. It may be positioned anywhere in the workspace.



Entries in the Model List are referred to as entities. The string gadgets below the List in this window and their contents are referred to as the Edit Entity.

Name Field

Use the Name field to enter a name for the current Custom Ecosystem Model.

Type a name in the string that will be used as the file name for the Model. You should not enter a path as you will be asked to supply that when you save the Model.

This field will be filled in with the name of the Active Parameter's Ecosystem Model if there is one when the window opens. The name may be up to 31 characters in length.

Add Button

Keyboard shortcut: a

Click the Add button to add a new entry to the Model List

The information at the bottom of the window will be entered as a new item in the list. It will be placed in position according to the height Parameter.

Remove Button

Keyboard shortcut: r

Use the Remove button to remove an existing entity from the Model List.

Select the list entity to be removed by clicking on it with the mouse. Click the Remove button and the entity will be stricken from the list.

Load Button

Keyboard Shortcut: I

Click the Load button to load an existing Ecosystem Model for editing.

You will be presented with a standard file requester. The requester will open in the Model Path as currently defined in the Project File. Enter the file name and path and select "OK" to load the file.

If the current Model has been modified you will be asked if you wish to save it before proceeding (see "Save" below).

You can edit the Model Path from the Fractals & Ecosystems page of the Settings Editor (see the Render Module chapter) or from the Project Editor.

Save Button

Keyboard shortcut: s

Click the Save button to save the current Ecosystem Model to disk. It must be saved to disk before you can render with it.

You will be presented with a standard file requester. The requester will open in the Model Path as currently defined in the Project File. Enter the file name and path and select "OK" to save the file.

The Model must be saved to disk prior to using it for rendering.

You can edit the Model Path from the Fractals & Ecosystems page of the Settings Editor (see the Render Module chapter) or from the Project Editor.

List

Use the List to display all the entities in the current Ecosystem Model. You can then select entities to edit or remove.

To select an entity click it with the mouse.

The list is maintained in ascending order of the Height Parameter. Only entities in the list are considered part of the model. The information in the string gadgets at the bottom of the window does not enter the Model until you select "Add" (see above).

Ht Field

Use the Ht (Height) field to set a height for the Edit Entity.

Enter an integer value in the string. The value is in meters and should be relative to other entities' Heights in the Model as well as other Ecosystems in the Ecosystem Editor.

Model Heights will be affected by the global Tree Height Factor (as defined in the Settings Editor, Fractals & Ecosystems page).

Note: This height value will not be altered randomly to create a range of heights as is done for Ecosystems without Custom Models. You must create an entity in the model for every height class you want represented. This is actually easy to do: Simply change

Reference 6C - Ecosystem Parameters

the height value and click the Add button for each height you want. The purpose of Custom Ecosystem Models is to allow you to tailor Ecosystems very specifically. It would make more sense to create a model of an actual tree height distribution which in all likelihood would not be random. Tree height data is often available from government agencies like the U.S. Forest Service.

Items Field

Use the Items field to set a relative object count for the Edit Entity.

Enter an integer value in the string. The value is in units relative to the other entities of the current Model.

This value has meaning only in relationship to other entities in the list's Item counts. The reason it is not expressed directly as a percent is to save you the trouble of doing the arithmetic to see that the Items add up to 100%. If you have two entities in the list and each of those has two Items, then each entity will be drawn 50% of the time.

Class Cycle Gadget

Use the Class cycle gadget to specify the type of texture to use when rendering the Edit Entity.

The Classes are the same as for the Ecosystem Parameters: Water, Snow, Rock, Ground, Conifer, Deciduous and Low Vegetation. See their descriptions under "Class" in the Ecosystem Editor section above.

Red, Grn & Blu Fields

The Red, Green and Blue fields let you specify a unique color for any entity in the Ecosystem Model. For example, by choosing different colors for different trees you can create a forest that simulates fall, or the natural variations of verdant foliage.

To specify a color, enter a number from 0 to 255 in each field for the amount of red, green and blue. You can create any of over 16 million colors by mixing different amounts of red, green and blue.

Here are some colors you can try:

55, 124, 72	Green pine trees
81, 155, 100	Deciduous trees in summer
138, 170, 109	Aspen trees in spring
212, 198, 91	Aspen trees in fall
206, 104, 97	Reddish oak trees in the fall

You can use Custom Ecosystem Models to add color variety to lakes or rock and ground. The Tips & Tricks chapter has some suggestions along these lines.

An Ecological Perspective

In the four and a half billion years that the planet earth has circled the sun, this precious blue sphere has evolved from a buboling, seething mass of molten rock to a fairly hospitable home for as many as 30 million plant and animal species.

The kingdoms of life began colonizing the planet three and a half sillion years ago and were cast forth upon the land from their oceanic incubator a mere 400 or so million years ago. By 350 million years ago the spread of land plants was so extensive that their remains in the form of coal powered the Industrial Revolution. Almost from the very beginning there is evidence of competition among species. In the fossil record we can see one plant group succeeding another in the never ending quest to monopolize the resources of sunlight, minerals and water.

Plant groups that were once widespread have fallen back to occupy very narrow ecological ranges as other more competitive groups came along. Wave after evolutionary wave has washed

Reference 6C - Ecosystem Parameters

across the landscape since the late Silurian geologic period, each wave leaving both casualties and legacies, each wave bring with it a series of new recruits in nature's relentless effort to colonize every last nook and cranny with life.

While paleontologists, those who study life of the prehistoric past, tell us that life for most of history has been on the rise, there also have been periods of decline. At the end of the Cretaceous, the time when dinosaurs went extinct, was one such period. We are living in the midst of another. No one knows for sure who or what wreaked the dinosaur catastrophe but we do know the modern culprit. He or she lives in our homes, even sleeps in our beds and yes, stares out of the mirror at us each morning as we shave or pluck our eyebrows.

We are in essence the most recent wave of evolution to sweep the landscape in our quest for resources. We have indeed come close to fulfilling nature's mandate to occupy every nook and cranny of this abundant planet.

Whatever the future bodes for the other 29,999,999 (give or take ten or twenty million) species, one thing is sure: It is beyond comprehension, how intricate is the design on the fabric of life. The diversity of nature is astounding.

Indeed it is presumptuous to attempt modeling anything so complex with silicon chips and electrons, yet that is our task. It should not surprise anyone that to have any hope of success we must summon nature's own principles to the effort.

WCS includes a system in which the important plant habitat variables, derived from digital elevation models, are embedded in a series of algorithms that predict what will grow at certain locations. All you need do is supply a list of plant communities and some data about their habitat preferences.

For lack of a better term, the word Ecosystem is used to denote the members of this user-supplied list. As you have seen, there are more than just plant communities represented on the list.

Some of them might better be called "land cover types" or "ecological land units" but who wants to say that a thousand times. We will persist in using the term "Ecosystem" and to those ecologists among our users we apologize.

Resources

At the end of this manual is a short list of references to the Rocky Mountain region's natural history. Publications such as these exist for most parts of the world. They provide the general sorts of data you will need to construct your own lists of Ecosystems should you become tired of working with the ones we supply. You can create entirely new lists of Ecosystems or add new items to the lists we provide.

Another source of information and inspiration that we rely on heavily are the works of nature photographers. John Fielder's artistic studies of Colorado grace our office walls and coffee tables. More than one WCS effect can trace its roots to a Fielder photograph.

Equally valuable can be your own photographic forays to the area ou are modeling. Suddenly those shots of the wife and kids at ome long forgotten scenic overlook take on new meaning and value.

Of course your own eye is probably the best instrument for judging whether your modeling results look and feel right. Even if you don't know the first thing about ecology you will quickly notice if things look awry.

Keep tinkering and re-read this chapter from time to time as you gain additional insight. Your renderings will show in quality the time you invest.

Reference 7 - Render Module

- Overview
- Render Prerequisites
- How To Render
- Image Size
- Multitasking
- Cancelling the Rendering
- Progress Windows
- Status Log
- How DEM and Vector Files Render
- Image Saving
- Render Settings Window

The last of World Construction Set's five main modules is the Render Module. You can access its commands by opening the Render Settings window, which you can do by clicking the fifth icon in the Module Control Panel:



Or by selecting the Render Module command in the pull down menu.



Overview

The Render Module is the last step in creating a picture or series of pictures. It takes the DEM data enabled in your Database, adds any Vector Objects you enabled, and applies all of your Motion, Ecosystem and Color Parameters to create your image or sequence.

Render Prerequisites

In order to render, you must have a valid Database and Parameter file loaded into your computer's memory. You can load them separately or load a Project. If you load a Project file, WCS will automatically load the Database and prompt you for a Parameter file.

You will also need enough free RAM for WCS to create various buffers. The buffer space needed for standard size WCS DEMs (301 x 301) is approximately:

Buffer = 8 x (Image Width x (Image Height + V Oscn) / Segments) + (18 x 301 x 301)

The buffer memory does not all need to be contiguous, but several large blocks must be for the Z Buffer and image bitmaps.

If you wish to render Diagnostic Data you will need an additional five times the size of the Z Buffer to store the data. This is not very practical except for small image sizes. It's more practical to do a Diagnostic Render in the Camera View window.

How To Render

To begin rendering, select the Render command in the Modules menu, or click the rightmost icon in the Module Control Panel:



You'll see the Render Settings window. There are many settings you can adjust within the Render Settings window. When you're ready to render, click the Render button at the bottom of the window.

If you are creating an image sequence, WCS will start with the first frame you selected in the Settings window's Render & Size page.

Image Size

WCS will use the image size you set in the Render Settings window's Render & Size page. But you can render half and quarter sized preview images by selecting the "1/2" or "1/4" buttons in the Preferences window.



You can open the preferences window by using the Preferences command in the Prefs menu.

Multitasking

The Amiga's advanced multitasking operating system lets you run multiple programs simultaneously. It doles out your computers calculation power based on some simple rules of priority.

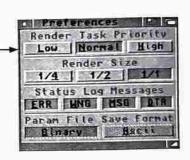
Higher priority programs will always get all the calculation time they need, and lower priority programs will only get calculation time if there are no higher priority programs in line. Any programs that are set at the same priority will get an equal amount of the calculation time currently available at that level.

Most programs run at a priority of zero. Critical system tasks like disk access and keyboard input run much higher. Non-critical tasks run lower.

Many programs, like word processors or spreadsheets, only use calculation time in short intervals when you type a letter or enter a number. Most of the time your computer is sitting idle and a lot of calculation time is unused. But WCS will take all the calculation time it can get when it's rendering.

Changing Rendering Task Priority

You can set the Render Task Priority for WCS before you render by using the Render Task Priority buttons in the Preferences window.



Low

Select "Low" when you want WCS to render in the background without slowing down most other programs. WCS will render at a priority of minus one. This may slow down your renderings when you use other programs, but it will give most other programs full use of the computer when they need it.

Use this setting when you want to do something else, like download files or write a letter, while rendering. You should get complete use of your computer for most programs without even noticing that WCS is there. WCS will use any calculation time your other programs don't use.

Normal

Select "Normal" when you want WCS to get an equal share of CPU time for rendering. WCS will render at a priority of zero. This is the default setting.

You will still be able to use most other programs but they will be slowed down as WCS eats up its share of processor time.

High

Select "High" when you want WCS to get most of the CPU time for rendering. WCS will render at a priority of one.

This will lock out many other programs. You probably will not need to use this setting but it's there if you absolutely want WCS to have every available CPU cycle.

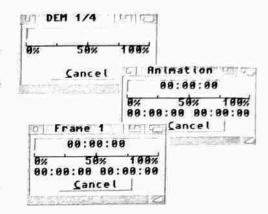
Cancelling the Rendering

You can cancel the rendering process at any time by selecting "Cancel" in any of the progress windows. There are progress windows for each DEM, for the image, and for the animation (see below).

Progress Windows

You will always see a progress window for each DEM. The title bar shows which DEM is rendering and how many total DEM files are enabled for rendering: If you are rendering more than one frame you'll see a progress window for the animation.

You will also see an "image" progress window.



The Image progress window will show the number of the currently rendering frame in its title bar.

Stacked Progress Windows

When you first use WCS, the progress windows will all be centered, causing them to be stacked on top of each other. You can move them by dragging the title bar of each window.

Note: You can save these and other WCS window positions and sizes by saving MUI preferences for WCS from within the MUI program. The MUI program is in the MUI drawer on your hard drive. See the Tips & Tricks chapter for more information.

Estimated Completion Times

Some progress windows will give estimated times of completion. For the Animation Progress window that is the time to complete the number of frames set to be rendered in the Settings Editor. For the Image window it is the time that the current image will be completed.

There are actually three numbers in these progress windows. The one in the gauge gadget tells the time of completion based on your computer's 24 hour clock. The number below and to the left is the time rendering has taken thus far. The number to the right is the estimated time remaining until completion.

The method of computing completion times is not terribly sophisticated. We don't want to spend exorbitant amounts of time predicting completion time. Please don't rely on their accuracy to the second.

Status Log Window



The Status Log is an invaluable tool for diagnosing operation and image problems. Refer to it whenever you have a question about what WCS has done. Up to 100 messages are stored and then the list purges itself and starts afresh.

There are four classes of messages. Each message is preceded by a three letter abbreviation of the message class:

- Error (ERR)
- Warning (WNG)
- Message (MSG)
- Data (DTA)

Error

Error messages indicate problems where WCS failed to perform a task. If you see an Error message, you'll want to find out what caused it. For example if an Object file cannot be found or a window cannot be opened or memory allocation fails you will receive error messages.

Warning

Warning messages indicate things that might be problems, but might not be. For example, if you have Color Maps turned on in the Render Settings window, you'll see a Warning message for each DEM that doesn't have a Color Map. That may be OK if you meant to create Color Maps for only some of the DEMs.

Message

Message messages are informational. For example they tell how many Objects were loaded during mapping or what the Ecosystem and Fractal counts were during rendering.

You can use the messages to determine if there are problems in rendering. The fractal count messages tell you how many polygons have been rendered at each fractal depth up to the value you have set in the Settings Editor.

The Ecosystem count messages tell you how many polygons have been rendered in each Ecosystem. You can find out how many polygons were rendered in the whole image by adding these numbers. You'll probably be amazed. Terrain models are much more complex than the 3-D models you may be used to from other applications.

Note: Snow will never be seen in the Ecosystem count messages. That is because snow is actually rendered as an understory and the snow-covered polygons are counted in the tally for their Overstory Ecosystem.

Data

Data messages are headings for various data categories. For example they will tell you that the data which follows are Ecosystem counts or fractal level counts.

After each frame or field is rendered a message will be posted to the Status Log telling how long the last frame or field took to render and how much time has elapsed since animation rendering began. These messages are posted in red for easier visibility. You can use the times to compare rendering speeds with different options (a change in Fractal Depth, for instance).

How DEM and Vector Files Render

WCS renders each enabled DEM in turn from nearest to farthest from the Camera.

Note: You can enable or disable DEMs in the Database Editor window.

If the "Vectors" option in the Settings Editor is enabled, WCS will also render any Vector Objects enabled in the Database Editor window.

Image Saving

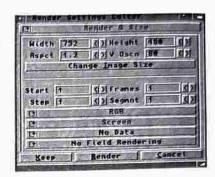
When rendering is completed, WCS will save the image to the path you specified in the Render Setting window's Image Save page. The next image, if this is a sequence, will then begin rendering.

If you are rendering a sequence of images, WCS will automatically append a number to the file name of each picture.

Render Settings Window

To open the Render Settings window, select the Render command in the Modules menu or click the Render Module button, the far right button on the Module Control panel.

The Render Settings window lets you change Render Settings, choose file paths, and initiate rendering. Render Settings control the rendering of images and animations.



Overview

Settings are all the functions used by WCS to create rendered images and animations that remain constant over the animation. They include things like image size, whether a preview image is displayed during rendering, whether Vector Objects are rendered, and the maximum level of fractal detail.

They can't be animated except for path settings which may point to a series of directories or files to load multiple images for Color Map or background image sequences.

Settings control some of the most significant features of WCS such as the use of Color Maps to tint the landscape or as ecosystem indices. The use of background images and Z buffers to composite previous renderings with the current one are features that can extend WCS' range in a wide variety of applications.

We recommend that until you are familiar with all the functions available, you modify and test one Setting at a time. This will let you back up a step and try a different tack if things go awry.

Note: several functions applying to Render Settings are found in the Parameters Global menu. These include loading and saving complete Parameter files as well as individual items. Also the Freeze/Restore commands can be useful for temporarily holding a set of Render settings while you experiment with other settings.

Saving Render Settings and Paths

Render Settings are stored in the Parameters file along with Motion, Color and Ecosystem Parameters.

The best way to save them is to save the Project, which lets you save the Project file, Database file and Parameters file in one step. When you save the Project, WCS will ask you if you want to save the Parameters file.

All of the path information from the Render Settings window, including paths to save rendered images, find Color Maps, and load background images, is saved in the Project file itself when you save it the Project file.

You can also save the Parameters file by itself using the Save-All button in the Parameters menu but this won't save any paths you may have modified since they are part of the Project not the Parameter file.

Note: path information is also saved in a file called WCS.Prefs which WCS automatically saves when you close the program. This lets WCS restore the last used paths when you next open the program.

Pages

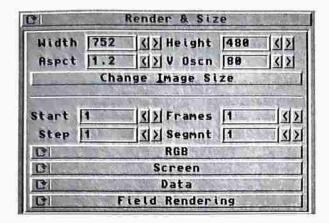
The Render Settings window is arranged into a series of eight "pages," each dealing with a related group of items. The pages are:

- Render & Size
- Image Save
- Motion Paths & Vectors
- Color Maps
- Surfaces
- Fractals & Ecosystems
- Miscellaneous
- Processing

To move between pages, use the cycle gadget at the top of the window. The label on the cycle gadget is the current page name.

Some of the functions in the Render Settings window will be ghosted unless a related function is enabled, usually on the same page. There are a very few items that depend on a setting on a different page or on the value set in a string gadget.

Render & Size Page



Width Field & Buttons

The Width Field lets you set the width of the rendered image in pixels. To change it, type a new number. You can also click the arrow buttons next to the field to increment the existing number up (right arrow) or down (left arrow) by one pixel per click.

Keep in mind that larger images take longer to render. If you're rendering for output on the NewTek Video Toaster or DPS Personal Animation Recorder, set the width to 752. For the Applied Magic Broadcaster Elite set the width to 720. For print output typical widths range from 2048-8192 depending on the size of the print. A good width for slides is 2048. You can type in any number up to 32,767.

Note: The best way to change rendering resolutions is with the Change Image Size button described below.

Height Field & Buttons

The Height Field lets you set the height of the rendered image in pixels. To change it, type a new number. You can also click the arrow buttons next to the field to increment the existing number up (right arrow) or down (left arrow) by one pixel per click.

Keep in mind that larger images take longer to render. If you're rendering for output on the NewTek Video Toaster or DPS Personal Animation Recorder, set the height to 480. For print output typical heights range from 1536-8192 depending on the size of the print. A good Height for slides is 2/3 of the width. You can type in any number up to 32,767.

Note: The best way to change rendering resolutions is with the Change Image Size button described below.

Large image sizes require large amounts of RAM. You can economize on memory and still render high resolution images by rendering in horizontal segments as described below.

Aspct Field & Buttons

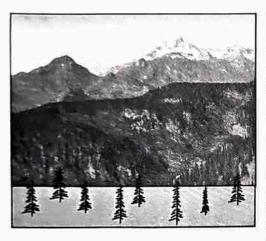
The Aspect field lets you set the pixel aspect of the rendered image. This number is the ratio of pixel height to pixel width, with pixel width always set to 1. It refers to the actual size of a single pixel, not the image as a whole. To change it, type a new number. You can also click the arrow buttons next to the field to increment the existing number up (right arrow) or down (left arrow) by one tenth per click.

The Aspect field lets you compensate for various output media that may require square or non-square pixels. A value of 1.0 gives you square pixels (1:1) which are usually suitable for print media including color copiers and slides. A value of 1.2 (1.2:1) gives you the correct aspect ratio for the NewTek Video Toaster and the DPS Personal Animation Recorder.

You can use any pixel aspect ratio. To create more vertical stretch in the output pixels enter a larger number in the Aspect field.

V Oscn Field & Buttons

The Vertical Overscan field lets you add temporary pixel rows to the bottom of an image while rendering. To change it, type a new number. You can also click the arrow buttons next to the field to increment the existing number up (right arrow) or down (left arrow) by one pixel per click. When WCS renders trees it starts from the base of the tree. When you get so close to a tree that its base falls below the bottom of the image, the whole tree will disappear. To correct that problem WCS lets you add overscan pixels below the bottom of the image. It will render those pixels just to catch the base of any such trees. That way the tops of those trees will still be seen within the final image dimensions. The overscan pixels are then thrown out since they aren't within the final image dimensions.



Try increasing Vertical Overscan as foreground trees become larger. Use a minimum value of 20, and as much as 200 for very close trees in very high resolution images. You should never have to make this number larger than the pixel height of your image.

This value is even more important if you're rendering images in segments using a "Segmnt" setting greater than one (see below). Trees don't have to be

very close for some of their bases to fall below the edge of each segment. It is safer, albeit slower, to err on the generous side so you don't get horizontal lines across your images where segments join.

Making the Vertical Overscan larger will cost some memory and processing time, but it's better to have it too large than too small. If this number is too small you'll see trees disappearing when their bases fall below the edge of the picture, or below the edge of each segment if you're rendering in segments.

Change Image Size Button

Use the Change Image Size button when you want to change image resolutions with the least amount of trouble. It will open the Image Scale window.

Changing image sizes requires some special consideration. There are a number of Motion Parameters related to the size of an image: Center X, Center Y and Scale.

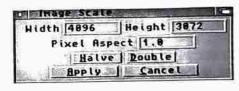
Using the Image Scale window to alter an image's dimensions will get WCS to do the work of computing new scales and center values.

Using the Image Scale Window

To open the Image Scale window click on the Change Image Size button on the Render & Size page of the Settings Editor in the

Render Module. The Image Scale window will open.

When the window first opens the current image dimensions will be set in two fields labeled "Width" and "Height." You will



also see the pixel aspect displayed in a field of its own.

To change an image's dimensions you can directly enter new values in the Width, Height and Pixel Aspect gadgets or use one of the pre-set scaling buttons below.

There are pre-set buttons to halve or double the image size. You can click on them more than once if you need to reduce an image by a quarter or an eighth or enlarge it by 4, 8 or 16 times. You can combine using the pre-set buttons and entering values directly.

Often when you want to change from video to print resolution you will want to change the pixel aspect. Normally for print work the correct ratio os 1.0. For video it is 1.2.

When you have set the size as you want it close the window with the Apply button and the new size will be displayed in the Settings Editor. If you decide not to keep the changes close the window with the Cancel button.

Note: If you change the image size while the Motion Editor is open do not close the Motion Editor with the Cancel button or the Scale and Center values will be lost. This will put these values out of sync with the image size. Also if you cancel the Settings Editor after you make a size change you will put the size out of sync with the Motion Parameters. If you need to change an image size back to what it was before, use the Image Scale window again to perform the operation.

Start Field & Buttons

Use the Start field to specify the frame you want WCS to start with when you click the Render button. WCS will then start with that frame and render the number of frames specified in the Frames field with the frame interval specified in the Step field.

To change the Start field, type a new number. You can also click the arrow buttons next to the field to increment the existing number up (right arrow) or down (left arrow) by one frame per click.

This lets you start with any frame when you begin rendering. You don't have to start with the first frame of your animation. For example, you can render a long animation in pieces over several nights. You can also render any segment of an animation without having to render the whole animation from the beginning.

Frames Field & Buttons

Use the Frames field to set the number of frames to render in a single rendering session. When you click the Render button, WCS will start with the frame specified in the Start field, render the number of frames specified in the Frames field, and use the frame interval specified in the Step field.

To change the Frames field, type a new number. You can also click the arrow buttons next to the field to increment the existing number up (right arrow) or down (left arrow) by one frame per click. Set the Frames field to 1 if you want to render a still image. Set it to a higher number to render a series of images to create an animation.

Step Field

Use the Step field to set the frame increment for rendering sequences of frames for animations. This is only important if you're rendering more than one frame.

To change the Step field, type a new number. You can also click the arrow buttons next to the field to increment the existing number up (right arrow) or down (left arrow) by one frame per click. Set the Step field to 1 if you want to render every frame. WCS will then render every frame starting with the frame in the Start field and rendering the number of frames in the Frames field when you click the Render button at the bottom of the Render Settings window.

Set the Step field to a higher number when you want to render fewer frames. This can save a lot of time when you're rendering an animation test. You can then play back that test at a lower frame rate corresponding to the frame step to get a rough idea of the animation.

For example, you could set the frame step to 3 and render directly to the DPS Personal Animation Recorder. The rendering would be three times faster than if you rendered every frame. Then you could play it back in the PAR at 1/3 the speed, or 10 frames per second.

You'd see the same timing as if you'd rendered all the frames and played it back at 30 frames per second. It would look a little jerky at 10 frames per second, but it would be good enough for a preview render to get a quicker idea of the look and feel of your animation.

You can also use a greater-than-one frame step amount to simulate faster motion by playing the resulting animation at a normal frame rate. For example, if you render every third frame and play it back at 30 frames per second, the animation would play three times faster than if you rendered every frame.

Note: Another way to speed up preview renderings is to use the 1/2 or 1/4 frame size buttons in the Preferences window to render smaller preview images. You can open the Preferences window using the Preferences command in the Prefs global menu. If all you want to test is motion, you can save a lot of time by rendering in wire-frame using the Anim button in the Camera View Control Panel.

Tip: Set the Step field to -1 if you want to render an animation backwards. This would be useful if you are rendering an animation on two computers and want them to both finish at the same time and in the least amount of time. Start one rendering forward from the first frame and the other backward from the last frame. When they reach the same frame the animation is done. This also works on field-rendered animations.

Segmnt Field & Buttons

WCS can render the whole image at once or do it in horizontal segments. Use the Segment field to set the number of segments for rendering. Normally you should use a segment of 1, since this will give you the fastest rendering. If you don't have enough memory to render in 1 segment, use more segments.

Large print resolution images need more memory to render than video sized images. If you find you are out of memory when you begin to render (you will be warned with a requester) try using multiple segments for rendering. Start with 2 and work your way up until you're able to successfully render the image.

You can specify any number of segments. It's best if the height of the image is evenly divisible by the number of segments. Otherwise a few pixel rows may be lost at the bottom. In general, the larger the number of segments the longer the rendering time be-

cause some DEMs will need to be computed more than once per image.

If you choose to render in segments you might want to increase the number in the Vertical Overscan field (see above) to minimize the possibility of disappearing trees.

RGB Cycle Gadget

Use the RGB cycle gadget to choose whether or not to save 24 bit IFF-ILBM images to disk when you render.

Choose RGB when you want to render images to your disk drive. Choose No RGB when you don't want to save any images to your disk drive. You might choose No RGB if you are just rendering a single preview image to the screen (see Screen Cycle Gadget below).

When you select RGB and use the Render button at the bottom of the Render Settings window, WCS will create the number of IFF-ILBM 24 bit images you specified in the Frames field, starting on the frame you specified in the Start field.

WCS will save your images to the disk drive you specified in the Save Path field on the Image Save page of the Render Settings window.

Screen Cycle Gadget

Use the Screen cycle gadget to choose whether or not WCS will draw a 16 color preview on the WCS screen when you render.

There are three reasons to use this:

- As a visual progress indicator during rendering when you're also saving IFF-ILBM 24 bit images to your hard disk using the RGB cycle gadget (see above).
- When you want to get a rough idea of what a camera angle looks like without saving an IFF-ILBM 24 bit im-

age to your hard disk (set the RGB cycle gadget to No RGB).

 When you want to use the diagnostic features of WCS on a full frame (see the Data cycle gadget below).

Note: WCS will not save 16 color on-screen preview images to your hard disk. If you should need a 16 color version of a frame, render a normal 24 bit IFF-ILBM and then use a program like ImageFX or Art Department Professional to reduce it to 16 colors.

Data Cycle Gadget

Use the Data cycle gadget to choose whether to enable diagnostic information when you render an image.

This feature can only work if you are rendering a single frame in one segment. The Data cycle gadget will be ghosted if the Segment field is set to greater than one, or if the Frames field is set to more than one. If you want to use the Data cycle gadget, make sure you first set both the Segment and Frames fields to "1."

This feature also requires an onscreen preview image. Make sure the Screen cycle gadget is set to "Screen." You don't need to save an RGB file to use the diagnostics feature, so you might also want to turn the RGB Cycle gadget to "No RGB."

To see the diagnostic information, select the Data option in the cycle gadget and then render an image. After the image is rendered, the Render Data window will open.

Now comes the fun part. Click anywhere inside the preview image and the Render Data window will show you the exact numbers behind the pixels in

The second second second	re para
Render Wir	
Distance	23.763468
Elevation	6837
Overstory	Aspen
Understory	UnderGrowth
Rel El	J-35
Aspect	[89
Slope	25
Sun Angle	3
Latitude	39.647499
Longitude	185.646667
	Digitize

the image. Seeing the numbers behind the image can be helpful when you're trying to figure out why different areas are being rendered the way they are. You can see information about Ecosystems, slopes, sun angles, latitude, longitude, elevation and Z Buffer. This is especially useful for determining Z buffer distance values of specific topographic features.

You can also digitize Vector Objects directly over the 3-D rendering.

Note: This works just like the Diag button in the Camera View Control Panel, except that instead of rendering the preview image in the Camera View window you'll be working with the full image rendered on the screen (see the Motion Parameter chapter).

You can leave the Render Data window open as long as you want. You can close it at any time. It will close automatically when you close the onscreen preview image window to which it is attached or if you render another preview image.

Note: For detailed information about the Render Data window see the end of the Motion Parameters chapter.

Field Rendering Cycle Gadget

Use the Field Rendering cycle gadget to choose whether or not to enable field rendering. This is only important if you're rendering animations for video.

Field Rendering makes smoother looking motion. It improves the appearance of even very slow moving animations. If you see "ghosting" at high-contrast edges in your images when the camera moves, Field Rendering will give you a significant improvement in your animation quality.

Unfortunately Field Rendering takes twice as long to render since WCS must interpolate every other field and render it separately. This is a feature for the discriminating professional!

Note: When you select Field rendering, WCS will need to save the first field of each frame temporarily until it is combined into the final frame. These are stored with special names in the directory designated as the Temp Path. Set this directory on the Image Save page of the Settings Editor. These temporary files will automatically be deleted after the second field is rendered and the images combined.

Technical Explanation

Every frame of video consists of two fields interlaced together. Each field is half the vertical resolution of the frame.

Your television draws its picture one dot at a time scanning rapidly from left to right to create a line. It draws all the odd numbered lines first, then it starts at the top again and draws all the even numbered lines. The first set of lines is field one, and the second set of lines is field two. Together all the odd numbered lines in field one and all the even numbered lines in field two make up one frame.

This all happens very fast to give you the illusion of watching smooth motion.

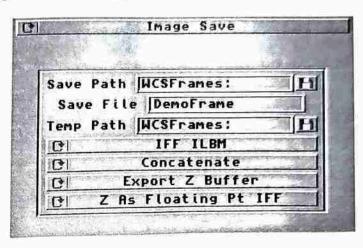
If you select field rendering, WCS will create a separate image for each field of video. This gives you 60 images per second if you're rendering images for NTSC video, or 50 images per second for PAL video.

If you don't select field rendering, WCS will create a separate image for each frame of video. This gives you 30 images per second for NTSC video or 25 for PAL video.

NTSC video is the video standard used in North America and Japan, among other countries. PAL is the video standard used in much of Europe and in Australia, among other countries.

Note: For output to film do not use Field Rendering! Film is projected in a very different way than video. Field Rendering would create a ghosting effect if used in film work.

Image Save Page



Save Path Field & Disk Button

Use the Save Path field to choose the drawer where you want WCS to save 24 bit RGB images. You can type a path directly, or just click the Disk button to bring up a requester to use to find the drawer where you want images saved.

Note: If you're about to render frames from a new Project, you might want to first go to the Workbench screen and create a new drawer for the frames. See your Amiga manual for information on creating drawers and using the Workbench screen.

If "RGB" is selected in the RGB cycle gadget on the Render & Size Page (see above) WCS will save any images it renders to the drawer you specified in the Save Path field. Images will be named with the name you specify in the Save File field (see below).

Note: To begin rendering, click the Render button at the bottom of the Render Settings window.

If you fill up a hard drive during a rendering session WCS will pop up a requester to ask you where you want to save the rest of the frames.

Save File Field

Use the Save File field to specify a file name for rendered 24 bit RGB images.

If "RGB" is selected in the RGB cycle gadget on the Render & Size Page (see above), WCS will save images with this file name in the drawer you specified in the Save Path field (see above).

WCS will save images in the file format you selected using the Save Format cycle gadget (see below).

Note: To begin rendering, click the Render button at the bottom of the Render Settings window.

Animation Frames

If you are rendering more than one frame to create an animation, WCS will take the file name you specified in the Save File field and add a frame number to the end of it. For example, if you enter the name "Flight" into the Save File field, enter "1" into the Start field, and enter "150" into the Frames field, WCS will save 150 frames named "Flight001," "Flight002," and so on up to "Flight150."

This way your frame sequence can be easily handled by other programs like LightWave, which recognize such numbered frame sequences.

Temp Path Field & Disk Button

Use the Temp Path field to choose the drawer where you want WCS to save temporary files during field rendering. You can type a path directly, or just click the Disk button to bring up a requester to use to find the drawer where you want temporary files saved.

The temporary files contain the first field of each frame and only exist until the second field is finished rendering. At that time the two fields are combined and the temporary files are removed from the hard disk.

Save Format Cycle Gadget

Use the Save Format cycle gadget to choose how WCS should save rendered RGB images.

Note: WCS will save RGB images when you select "RGB" in the RGB cycle gadget on the Render & Size page and you then click the Render button at the bottom of the Render Settings window.

You can choose from three formats:

- IFF-ILBM 24 bit
 Use this when you want to save images that other Amiga programs can load.
- Raw Component RGB (Sculpt)
 Since some programs on other platforms do not support
 Amiga IFF file format this provides an interchange op tion. Three separate files will be written: one each for red,
 green and blue pixels. They will have suffixes ".red,"
 ".grn" and ".blu."
- Interleaved Component RGB.
 Since some programs on other platforms do not support Amiga IFF file format this provides an interchange option. One file will be written with a red, green and blue value for each pixel.

Concatenate Cycle Gadget

Use the Concatenate cycle gadget to specify whether multi-segment images will be joined together (concatenated) into a single output file.

Multi-segment images can either be concatenated into one final output file or left as separate horizontal segments.

The benefit of not concatenating is the ability on small systems to work with rather large images in paint or image processing programs. RGB files (see Save Format above) can later be concat-

enated with the AmigaDOS "Join" command (don't try this with IFF files).

Save Z Buffer Cycle Gadget

Use the Save Z Buffer cycle gadget to specify whether Z Buffers will be saved to disk after rendering.

Set this if you wish to save the rendered Z Buffer for later use (see the Z Buffer cycle gadget on the Processing page for more information).

Save Z Buffer Format Cycle Gadget

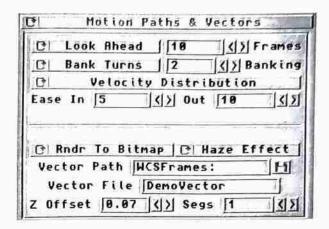
Use the Save Z Buffer format cycle gadget to specify the format of Z Buffer output files.

Z buffers can be saved as 4 byte floating point arrays or as an 8 bit gray scale (suitable for viewing or manipulating in an image processing or paint program). The floating point format is necessary if you want to import them for future WCS renderings. You can convert between formats in the Data Ops Module DEM Converter.

You can choose WCS' ZBUF IFF format for the floating point variety or a simple 2-D array. In gray scale we support standard 8 bit IFF and 2-D arrays.

Format specifications for the IFF ZBUF and ZBOD chunks are available by contacting Questar Productions.

Motion Paths & Vectors Page



Look Ahead Cycle Gadget

Use the Look Ahead cycle gadget to specify whether the Camera axis will be aligned to the Camera Motion Path.

For animations the Camera can be made to point along the Camera Motion Path. Set the frame string to the right of this gadget for the number of frames in advance of the Camera to look. The Look Ahead Frames number must always be one or more.

Look Ahead will override Focus Path key frames.

Look Ahead Frames Field & Buttons

Use the Look Ahead Frames field to set the number of frames ahead of the current position the Camera "Looks" if "Look Ahead" is enabled (see above).

Normally this would vary depending on the velocity of motion, smoothness of motion and the degree of motion anticipation you desire. The value must be one or larger. Larger numbers will tend to smooth jittery motion and lead the viewer into turn sequences.

Bank Turns Cycle Gadget

Use the Bank Turns cycle gadget to specify whether banking will be automatically computed for Camera Motion Paths.

This will allow automatic banking of turns for key framed paths. You must have a defined path for this to work.

Set the amount of banking in the string gadget to the right.

Automatic Banking is added to the Bank Motion Parameter value. If this item is enabled you should have the Bank Motion Parameter set to 0.0 except for special effects or to tilt the Earth's axis.

Normally if you have created Bank key frames you would disable Bank Turns here. Seldom would you use both together.

Banking Field & Buttons

Use the Banking field to set the multiplier factor for automatic "Bank Turns" (see above).

This value controls the steepness of banking as well as the direction.

Normal values would range from 0.0 to 5.0.

Optionally, banking can be controlled using key frames (see Motion Editor window). Key frames will produce more stable results if the Camera Path is less than smooth.

The Banking Factor is used for "Create Bank Keys" in the Motion Editor and in LightWave Motion Path Export as well.

Velocity Distribution Cycle Gadget

Use the Velocity Distribution cycle gadget to specify whether Motion Paths will have velocity smoothing applied.

When using key framed Motion Paths it is sometimes impossible to obtain perfectly smooth velocity. This feature causes all frames to be adjusted by a small amount along the path to even out the velocity over the entire animation. You may specify an "Ease In" or "Ease Out" value to ramp the velocity at either end. The Velocity Distribution feature operates on both Camera and Focus Paths.

When enabled, Velocity Distribution will be applied to the construction of Camera View and the values of Motion Path Parameters in the Motion Editor. Time Lines will not be affected so that you may view the graphs without distortion. The velocity graph in the Time Line window will show the corrected (distributed) values.

It may be most constructive to disable Velocity Distribution until such time as your Motion Paths are as smooth as you can make them and you are ready for an animation preview.

Ease In Field & Buttons

Use the Ease In field to set the length of the velocity ramp at the beginning of an animation if "Velocity Distribution" is enabled (see above).

The value is a number of frames. The sum of Ease In and Ease Out must not exceed the length of the complete animation from frame 1 to the final key frame.

Note: When Velocity Distribution is enabled you can not use the key frame Tension control to ease into or out of a motion.

Ease Out Field & Buttons

Use the Ease Out field to set the length of the velocity ramp at the end of an animation if "Velocity Distribution" is enabled (see above).

The value is a number of frames. The sum of Ease In and Ease Out must not exceed the length of the complete animation from frame 1 to the final key frame.

Note: When Velocity Distribution is enabled you can not use the key frame Tension control to ease into or out of a motion.

Vectors Cycle Gadget

The Vectors cycle gadget determines how Vector Objects are treated during rendering.

Vector Objects can be treated in several ways during rendering. They may be output to the bitmap, output to a file or disabled completely.

If you see no Vectors rendered either in Camera View previews or in final renderings, this is the place to fix the problem.

Haze Effect Cycle Gadget

The Haze Effect cycle gadget determines if haze, fog and shading are applied to Vector Objects.

Illuminated Vectors will not be shaded but will have haze and fog applied if Haze Effect is enabled.

For information on setting the Haze, Fog and Shade attributes see the Motion Parameters chapter.

Vector Path Field & Disk Button

Use the Vector Path field to set the device and directory path to which rendered Vectors will be saved (see Render Vectors cycle gadget) if the Vectors cycle gadget above is set to "Rndr to File."

Vector File Field

Use the Vector File field to set the file base name for rendered Vectors (see Render Vectors cycle gadget) if the Vectors cycle gadget above is set to "Rndr to File."

Frame numbers will be appended.

Z Offset Field & Buttons

Use the Z Offset field to set the distance offset for Vector Objects during rendering.

Vector Objects are Z Buffered into a rendered image. Since trees and topographic irregularities may partially or fully obscure Vectors this offset value is provided to trick WCS into thinking that the Vectors are closer than they really are. This increases their rendering priority.

The units are in kilometers. Positive values increase priority (move Objects closer) A value of 0.06 has worked well for the developers in most situations. If you are using Vectors with large segment lengths relative to the size of DEM polygons you might need to increase this value.

If you are rendering Vectors onto one of WCS' global DEM sets you might need to raise this value to 10 or 20 so the Vectors aren't obscured part of the time.

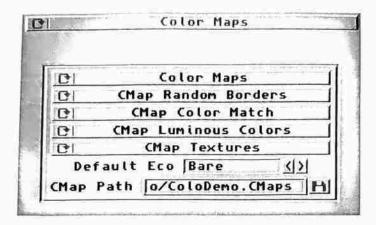
This value does not affect the actual rendered position of Vectors.

Segs Field & Buttons

Use the Segs field to set the number of Vector line segments that will be rendered for a Vector Object (beginning at the vertex corresponding to the frame count) if the "Class" field of the Object is set to "Segment V" or "Illum Seg" (see Database Editor window).

If this value is greater than one there will be an overlap of the rendered portion of Segmented Vectors from one frame to the next. This can create the effect of a slow shutter speed or a long object like a train, etc.

Color Maps Page



Color Maps Cycle Gadget

Use the Color Maps cycle gadget to specify whether Color Maps will be used during rendering.

Color Maps are used for a great many purposes in WCS. Before you can use them they must be enabled here.

The gadgets below determine how Color Maps will be used. Their functions are basically to pass information to the renderer about how you want certain areas to be drawn. Any DEM for which no Color Map exists or the color components of the Color Map are 0,0,0 will be rendered with Ecosystems as normal. When a color is present it can be used directly to tint the Landscape or as an Ecosystem Index.

When used as an Ecosystem Index, the color components at a terrain point are compared to the Match Colors of each Ecosystem. When a match is found, that Ecosystem is rendered at the terrain point. Any of the normal Ecosystem attributes will apply including class (trees and textures), tree height, density, color, understory Ecosystem and Custom Ecosystem Model (see Ecosystem Editor in the Ecosystem Parameters chapter).

With creative use of Ecosystem Models and the color/texture information they provide, you can get the effect of a procedural texture. An Ecosystem Model does not necessarily mean trees. You could use a Model to simulate the rippled surface of water for example.

Color Maps must be of the same size and orientation as the DEM to which they will be applied. They may be in 24 Bit Color IFF or Sculpt Raw format. The "Convert DEM" function in the Data Ops Module and "Draw/Color Map" in the Map View Module will help you achieve correct Color Map images. A 24 bit paint program is very helpful when preparing Color Maps. Their final format can be either Raw RGB or IFF-24.

Color Map names must correspond with the DEM they are to be applied on. In the case of Raw RGB formatted files, the name must include all the blank spaces found in the Object name (names are padded out to 10 characters) before the suffix. The suffixes must be ".red", ".grn" and ".blu" for WCS to recognize them. IFF files are a bit less particular. They must match the Object name but the blanks are optional. There may be no suffix for IFF Color Maps.

Color Maps must be stored in the CMap Path directory. You may change the designated Color Map Path directory at any time. You may want to create several sets of Color Maps for different effects and store them in different directories. Then by changing the path you can change from one effect to the other.

Color Maps can also be animated (see "CMap Path" for more information).

Color Maps are applied only to "Landscape" DEMs, not to "Surfaces" (see Database Editor, Class field).

The "Default Ecosystem" is used to determine the screen rendering color of Color Mapped areas if there is no Ecosystem match.

CMap Random Borders Cycle Gadget

Use the CMap (Color Map) Random Borders cycle gadget to specify whether color boundaries in Color Maps are softened.

Points along a color border are chosen to fall into the color on one side or the other based on a random number. This is particularly effective at fractal levels of two or more.

CMap Color Match Cycle Gadget

Use the CMap (Color Map) Color Match cycle gadget to specify whether Color Map values will be used as Ecosystem Indices.

Color component values are set for specific Ecosystems in the Ecosystem Editor. When these components are found to match identically the components of the Color Map at a point, the referenced Ecosystem will be drawn at that point. It can be used to maintain precise placement of trees, water, snow or to map out entire environments.

If no color match is found for the Color Map components, then the color is used to tint the Landscape.

Maximum slope constraints designated for a color-matched Ecosystem will still apply. Other Ecosystem constraints such as Elevation Line, Maximum and Minimum Relative Elevation, Elevation Skew and Elevation Skew Azimuth will be ignored when a color match is found.

CMap Luminous Colors Cycle Gadget

Use the CMap (Color Map) Luminous Colors cycle gadget to make Color Map colors render without shading by sun position.

Normally colors are shaded according to where the sun is and how it illuminates the scene. Using this option, colors from a Color Map are applied directly to the terrain without shading. This may be useful for creating bodies of molten lava, a glowing forest fire, a watery mirage in the desert or other effects where

you want to specify a precise color pattern for the terrain and not have the sun's position affect it.

Note: Haze and fog will still be applied when this feature is enabled. Also, if colors match a particular Ecosystem using the Color Matching feature described above, they will still be rendered as sun-shaded Ecosystems.

CMap Textures Cycle Gadget

Use the CMap (Color Map) Textures cycle gadget to specify whether trees or other textures will be drawn in the tint color for Color Map areas that do not match a specific Ecosystem.

The texture used to draw the terrain will be that which would normally be drawn on the polygon if there were no Color Map.

When disabled there will be no trees or textures drawn in Color Mapped areas except where there is an Ecosystem match (and then only if "Color Match" is enabled). Color Map areas of pure black (0, 0, 0) will never be affected by this or any other Color Map Setting.

Note: The CMap Luminous Colors feature described above will apply to these textures if it is enabled.

Default Eco Field & Buttons

Use the Default Eco (Ecosystem) field to specify the Default Ecosystem.

The "Default Ecosystem" is used to determine the screen rendering color of Color Mapped areas if there is no Ecosystem match.

It is also the Ecosystem rendered if there is no match between terrain characteristics (site conditions of slope, aspect, elevation) and an Ecosystem in the Ecosystem List. You will receive a warn ing in the Status Log window if this happens. You should redesign your Ecosystems to catch all possible site conditions so that this situation is eliminated. See the Ecosystem Parameters section of the Parameters chapter for information on how to do this.

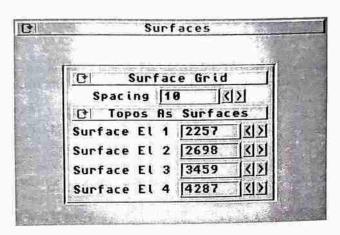
CMap Path Field & Disk Button

Use the CMap (Color Map) Path field to set the device and directory path from which Color Maps will be loaded during rendering (see Color Maps cycle gadget).

Color Maps can be animated. To do so you must create a directory for every frame. The name must include the frame number to which it corresponds. Frame numbers must be at the end of the directory name. Select one of the numbered directories and place its name complete with number in this string gadget. You may use the Disk Button and file requester to select.

If a number is included in the directory name it will be assumed that Color Maps are animated and a directory must exist for every frame you wish to render or rendering will stop when it encounters a frame with no directory. If there is no number the same set of Color Maps will be used for all frames.

Surfaces Page



Surface Grid Cycle Gadget

Use the Surface Grid cycle gadget to specify whether a grid of latitude/longitude lines will be rendered on Surface DEMs.

For "Surfaces", a grid of latitude/longitude lines may be rendered either into the bitmap or a vector file. Which one will depend on the Render Vectors cycle gadget setting (on the Motion Paths & Vectors page).

Spacing Field & Arrows

Use the Spacing field to set the number of data cells between rendered grid lines (see "Surface Grid" above).

Notes: To maintain even grid spacing near DEM edges, this value should be evenly divisible into the DEM size minus one. For normal DEMs as we supply them with a 301 x 301 array size, you should use a grid spacing that divides evenly into 300: 2, 3, 4, 5, 6, 10, 15, 20, etc.

Topos As Surfaces Cycle Gadget

Use the Topos As Surfaces cycle gadget to specify whether all topo DEMs will be rendered as hypsometrically (by elevation) shaded "Surfaces" with color gradients as defined in the Color Editor.

Individual DEMs may be designated as "Surfaces" in the Class field of the Database. Use this Setting only if you want to render all DEMs as Surfaces without modifying the Class field of each DEM Object.

Surface El 1 Field & Buttons

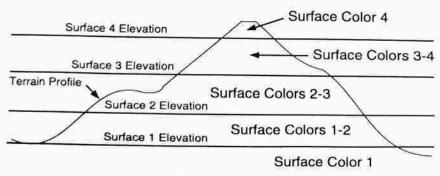
Use the Surface El (Elevation) 1 field to set the elevation at which the first "Surface Color" (see Color Editor window) is applied to Surface DEMs in a hypsometric shading scheme involving four elevations and three color gradients (four colors).

The elevation value is in meters.

This value is also the lower limit of shading gradation in Map View for drawing DEM entities when the Map Style cycle gadget is set to "Surface."

Surface Elevation 1 should be the lowest of the four elevations.

Elevations lower than Surface Elevation 1 will be rendered in the first "Surface Color."



Surface DEM Elevation/Color Scheme

Surface El 2 Field & Buttons

Use the Surface El 2 field to set the elevation at which the second "Surface Color" (see Color Editor window) is applied to Surface DEMs in a hypsometric shading scheme involving four elevations and three color gradients (four colors).

Also the second lowest elevation used in Map View for drawing topos and "Surfaces" when the Map Style cycle gadget is set to "Surface."

Surface Elevation 2 should be the second lowest of the four elevations.

Surface El 3 Field & Buttons

Use the Surface El 3 field to set the elevation at which the third "Surface Color" (see Color Editor window) is applied to Surface DEMs in a hypsometric shading scheme involving four elevations and three color gradients (four colors).

Also the third highest elevation used in Map View for drawing topos and "Surfaces" when the Map Style cycle gadget is set to "Surface."

Surface Elevation 3 should be the third highest of the four elevations.

Surface El 4 Field & Buttons

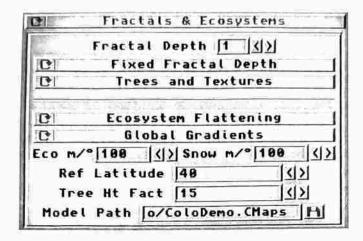
Use the Surface El 4 field to set the elevation at which the fourth "Surface Color" (see Color Editor window) is applied to Surface DEMs in a hypsometric shading scheme involving four elevations and three color gradients (four colors).

Also the upper limit of shading gradation in Map View for drawing topos and "Surfaces" when the Map Style cycle gadget is set to "Surface."

Surface Elevation 4 should be the highest of the four elevations.

Elevations higher than Surface Elevation 4 will be rendered in the fourth "Surface Color."

Fractals & Ecosystems Page



Fractal Depth Field & Buttons

Use the Fractal Depth field to set the level of polygon subdivision to add apparent detail to images.

Increasing this increases detail (and rendering time). Fractal Depth is the second line of defense against visible polygons. If your renderings show sharp angularities and color contrasts in triangular shape, you have moved close enough to the terrain to require some remedial action. There are four possible recourses you can take. They are listed here in order of increasing rendering time and usually our preference.

First, implement textures for every Ecosystem including rocks and ground (snow will inherit from whatever ecosystem it covers). Set the density to 100% and the tree height to 0 (unless you really want trees). This will usually go a long way toward alleviating the polygon problem at very little rendering speed cost. Set these in the Ecosystem Editor.

Second, increase the Fractal Depth. This will cause smaller polygons to be drawn which usually helps obscure their characteristic

shape. It will also increase the number of trees which you may or may not want. The tree density (see Ecosystem Editor) can be used to compensate. You can set a global Fractal Depth here and then for DEMs that don't need the extra detail set their individual depths lower in the Database Editor.

Third, interpolate the DEM once or twice (or as many times as you like). This is much more effective than simply increasing the Fractal Level because it actually generates splined intermediate terrain points. However there is a substantial rendering speed penalty when you do this so in the interest of time and profits, don't go to greater interpolation levels than you need and only interpolate the DEMs that you really need to. Do this in the Data Ops Module's DEM Interpolate window.

The fourth remedy is simply to move a bit further away. Frequently we want the effect of being very near to the ground but this increases the nearest polygons to unacceptable dimensions. Raising the Camera viewpoint just a little can help enormously yet retain the same visual effect. Also try playing with the View Arc. A wider view will shrink polygons proportionally.

The maximum level Fractal Depth supported is 9.

Fixed Fractal Depth Cycle Gadget

The Fixed Fractal Depth cycle gadget determines whether Fractal Depth (see above) is constrained to a fixed value.

Fractal Depth controls the maximum fractal level in an image. Fixed Fractals enabled ensures that all polygons are drawn at the maximum level. Disabled, fractal depth will vary with polygon size which in turn varies with view angle and distance.

For animations you will almost always want this enabled to keep trees and other formations rooted in place. Of course there is a price: It is somewhat slower to render. Usually for still images you will turn this off to gain the speed advantage. Also for very slow moving animations where you are moving perpendicular to the Camera lens axis you may be able to disable "Fixed Fractals."

You may want to set individual DEM Maximum Fractal Depth in cases where a certain DEM is always in the distance and nothing is gained resolution-wise by rendering it at a higher level. See the Database chapter for more information.

Trees and Textures Cycle Gadget

The Trees and Textures cycle gadget determines if trees and textures are used in a landscape rendering.

If Trees and Textures are disabled there will be no trees and no rock, ground or grass textures, only bare polygons in your rendered images.

Sometimes you need to render a preview of an animation and you want to do at the fastest possible speed. When speed, not quality, is the issue you should disable Trees and Textures. At all other times they should be enabled.

Individual Ecosystems can have their textures turned off in the Ecosystem Editor by setting their Density value to zero (0).

Ecosystem Flattening Cycle Gadget

The Ecosystem Flattening cycle gadget determines whether the Motion Parameters, Flattening and Datum, are applied to Ecosystem Lines.

When flattening is applied to the terrain through the Motion Parameters, Flattening and Datum, Ecosystem Elevation Lines can be adjusted automatically to compensate. With this enabled you can modify Flattening and Datum and not have to adjust the Ecosystem Elevation Lines every time.

Slopes also change with changes in these same Parameters. Maximum and Minimum Ecosystem Slope are not adjusted to compensate even when this is enabled. They can be adjusted manually if you desire.

The reason this is a variable is that interesting effects can be gained when it is disabled. For instance you could have an island rising out of the sea and as it gains height it becomes first forest-clad then eventually snow-capped. You can do this without animating the Ecosystem Lines simply by "growing" the island if Ecosystem Flattening is disabled.

Global Gradients Cycle Gadget

The Global Gradients cycle gadget determines whether an elevation gradient is applied to Ecosystem and snow line values based on DEM latitude relative to a reference latitude.

This is generally used to represent cooler temperatures toward the poles. The gradients are applied symmetrically to the equator. The effect on for instance, the snow line, would be that the farther north you go the lower the snow line elevation becomes until at some latitude, the snow line reaches all the way down to sea level. The "Eco" and "Snow" gradient values below determine the severity of this effect.

Eco Field & Buttons

Use the Eco field to set the equivalence of latitude degrees to elevation (in meters) for all Ecosystems other than snow and water.

A gradient can be applied to Ecosystems based on latitude to simulate cooler environments toward the poles (see Global Gradients cycle gadget). Typical values are close to 100.0 meters/degree. Increasing it lowers all Ecosystem Lines more dramatically toward the poles.

The Water Ecosystem is not affected by either Global Gradient. Sea level is, after all, sea level.

Snow Field & Buttons

Use the Snow field to set the equivalence of latitude degrees to elevation (in meters) for the snow line.

A gradient can be applied to the Snow Ecosystem based on latitude to simulate cooler environments toward the poles (see "Global Gradients" above). Typical values are close to 100.0 meters/degree. Increasing it lowers the snow line more dramatically toward the poles.

This value applies to only the snow Ecosystem (see the Eco field above).

Ref Latitude Field & Buttons

Use the Ref Latitude field to set the Global Ecosystem Reference Latitude (see "Global Gradients" above).

A gradient can be applied to Ecosystems based on latitude to simulate cooler environments toward the poles (see the Eco and Snow fields above). The gradients are applied relative to the latitude of the Ecosystems defined in the Ecosystem Editor.

Since gradients are applied symmetrical to the equator the value here should be positive although in practice WCS will take the absolute value of it anyway.

Tree Ht Fact Field & Buttons

Use the Tree Ht Fact field to set the global Tree Height Factor.

All trees, regardless of Ecosystem, can be adjusted in height by this value. A doubling of this value will double the height of all rendered trees and Ecosystem Textures.

Typical working values are from 3.0 to 25.0.

You may want to move toward the upper part of this range if you are using large amounts of vertical exaggeration. For some reason that appears more correct to the eye than small trees on very steep slopes.

Ecosystem tree heights may be adjusted individually in the Ecosystem Editor but will always be scaled by this global value.

Note: The Tree Height Factor is just an arbitrary, dimensionless number. It is not in meters, feet, cubits or any other unit of measure.

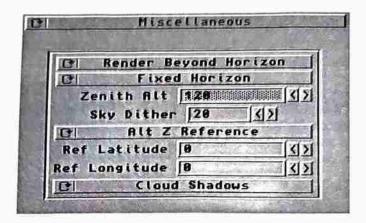
Model Path Field & Disk Button

Use the Model Path field to set the device and directory path from which Ecosystem Models will be loaded during rendering (see Ecosystem Editor and Custom Ecosystem Models in the Ecosystem Parameters chapter).

Custom Ecosystem Models can be animated. If a number is included in this directory name it must match the frame number. If there is no number the same Ecosystem Models will be used for all frames. Frame numbers must be at the end of the directory name. Also see notes for "CMap Path" on the Color Map Page of this window.

There may be a different Model for each Ecosystem in the Ecosystem List (see the Ecosystem Parameters chapter).

Miscellaneous Page



Fixed Horizon Cycle Gadget

The Fixed Horizon cycle gadget determines if the horizon line and point are determined by the Motion Parameters (Horizon Line, Point and Stretch) and associated key frames, or if they are allowed to float along with Camera Motion including Banking.

For animations involving motion, this feature should probably always be disabled. The advantage for stills is that "Fixed Horizon" allows more precise user control of the horizon position. Horizon and Zenith Colors as defined in the Color Parameters will apply regardless.

Zenith Altitude Field & Buttons

Use the Zenith Altitude field to set the steepness of the color gradient between horizon and zenith if the "Fixed Horizon" cycle gadget above is disabled.

The value is in kilometers. Larger values distribute the gradient "higher" into the sky. We have found that values of between 10.0 and 100.0 work well in different situations. Too large a value will give the sky a flat look. Too small a value will place the upper

edge of the gradient in the visible part of the image and should be avoided for greater realism.

Sky Dither Field & Buttons

Use the Sky Dither field to set the number of color points variation allowed when dithering sky colors.

Dithering is often necessary to produce a smooth sky gradient. If you can see banding in the sky, increase this value. Here's how it works: If the computed red, green and blue values are 200, 210, 240, and the Sky Dither range value is 20 (a good default value), the final color values could range from 180-220, 190-230, 220-255.

WCS will ensure that color values never fall outside the legal 0-255 limits.

Alt Z Reference Cycle Gadget

The Alt Z Reference cycle gadget determines if the Z Buffer used for distance discrimination between objects of an image and between the current image and a Background image is referenced to the Camera or to some arbitrary user-defined point.

If for some reason you should wish to reference the Z Buffer to some point other than the Camera, enable this and set the Reference Latitude and Longitude in the strings below.

This could be used to generate some interesting effects when compositing a Background image with the current rendering (see "Background" cycle below). It could also have some strange consequences with regard to what parts of the image obscures other parts since anti-aliasing counts on "closer" objects being rendered first. Use this with discretion.

Ref Latitude Field & Buttons

Use the Ref Latitude field to set the alternate Z Buffer Reference Latitude.

See "Alt Z Reference" cycle above.

Ref Longitude Field & Buttons

Use the Ref Longitude field to set the alternate Z Buffer Reference Longitude.

See "Alt Z Reference" cycle above.

Cloud Shadows Cycle Gadget

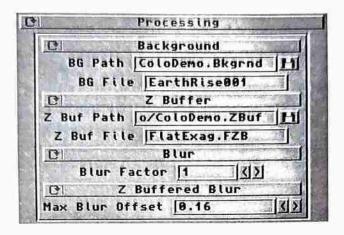
The Cloud Shadows cycle gadget determines if Cloud Shadow Maps will be applied to Landscape DEMs.

WCS regrettably does not yet support cloudy skies but we can give you cloud shadows on the ground. To use this first create some Cloud Maps. Like Color Maps, there should be one for every DEM that will have shadows. They should be the same resolution (normally 301 x 301) as the DEM. They should be gray scale images (8 bit) saved in either IFF or Raw RGB (Sculpt) component format. The files should have the same name as the corresponding DEM Object with ".cloud" appended. The files should be stored in the same directory as normal Color Maps.

For the Cloud Shadows, a gray value of 128 is neutral. Darker values darken the landscape proportionally, brighter values lighten it.

Even with no clouds in the sky this can be used to add interesting highlights and mood to your images. Of course they can be animated (see Color Map Directory string above for more information).

Processing Page



Background Cycle Gadget

The Background cycle gadget determines if a Background image will be pre-loaded during rendering.

You may pre-load an image or series of images (for animations) over which WCS will render. Background images might be used to provide some clouds or in combination with Z Buffers to provide foreground details or animated objects.

Images must be IFF or Raw component format of the same dimensions as the WCS render image size.

The Background image will be antialiased into WCS' rendering.

BG Path Field & Disk Button

Use the BG Path field to set the device and directory path from which Background images (see Background cycle gadget) will be pre-loaded.

BG File Field

Use the BG File field to set the file name for Background images (see Background cycle gadget).



Using a Background Image

If a number is included in the file name it must match the frame number. If there is no number the same image will be used for all frames. Frame numbers may be anywhere in the name, not necessarily at the end. If there is more than one number in the name the last one must be the frame.

Z Buffer Cycle Gadget

The Z Buffer cycle gadget determines if a Z Buffer file is pre-loaded.

A Z Buffer may be pre-loaded against which all WCS render values will be compared. Areas in the rendering farther away than the value in the pre-loaded Z Buffer will not be rendered. They will contain sky or a background image.

Z Buffer files may be in IFF format (we can supply the details) or as a Width x Height four byte, floating point array. The size must match your WCS render image size.

Z Buffers may be animated and used in combination with Background images. Z Buffer arrays can be manipulated in the DEM Converter in the Data Ops Module if you wish to scale Z values.

For more information about Z Buffers see the Data Types chapter.

Z Buf Path Field & Disk Button

Use the Z Buf Path field to set the device and directory path from which Z Buffer files will be pre-loaded (see Z Buffer cycle gadget).

Z Buf File field

Use the Z Buf File field to set the file name for Z buffer files (see Z Buffer cycle gadget).

If a number is included in the file name it must match the frame number. If there is no number the same Z buffer will be used for all frames. Frame numbers may be anywhere in the name, not necessarily at the end. If there is more than one number in the name the last one must be the frame.

Blur Cycle Gadget

The Blur cycle gadget determines if blurring will be applied to the final output image.

Final rendered images may have a blur applied to soften them although they are automatically antialiased during rendering. Blur may reduce flickering if it is a problem on NTSC or interlaced displays but generally it is used for special effects.

Blur may be modulated with a Z buffer offset which limits the distance between pixels that are to be blurred.

Blur Factor Field and Buttons

To set the strength of the "Blur" operator (see Blur cycle gadget).

Blur can be applied to images and frames after final rendering (including Vectors). This could be used to create a focusing or dif-

fusion effect although the blur factor will have to be adjusted manually for each frame.

Increasing this value will increase blurring.

Z Buffered Blur Cycle Gadget

The Z Buffered Blur Cycle Gadget determines whether the blur operator considers the Z differential between adjacent pixels before operating at a point.

Blurring may be limited to a distance offset between adjacent pixels. This might be used for keeping ridges in focus while the details of the terrain are softened. You must also set the "Max Blur Offset" to control the strength of this effect.

Max Blur Offset Field and Buttons

Use the Max Blur Offset field to set the maximum Z offset distance for adjacent pixels to be blurred together if "Z Buffered Blur" and "Blur" are enabled.

Post-rendering blur can be limited to pixels representing proximal areas. For instance if you want to blur a "Surface" to simulate Gouraud shading but still want distinct ridge lines, this is the technique to use. The value is in kilometers of Z offset between one pixel and the next. Typically the value would be between 1 and 3 kilometers.

Pixels less than this distance apart will be blurred together, those farther apart will not be affected (see Blur cycle gadget).

Keep Button

Keyboard Shortcut: k

Click the Keep button at the bottom of the Render Settings window to close the Settings Editor while keeping any changes you made in the Settings Editor window.

Any changes you make in the Settings Editor take effect immediately even if the window stays open. The Keep button lets you close the window while keeping all your changes. If you want to close the Render Settings window without keeping your changes, click the Cancel button instead.

Render Button

Keyboard Shortcut: r

Click the Render button at the bottom of the Render Settings window to begin rendering.

During rendering the only windows that will be active are the render preview window, if you have enabled it; the progress windows; and the Status Log window. The Render Preview window shows a 16 color preview of the image as it renders.

The Progress windows show the estimated time of completion as well as what frame and which DEM in each image is being rendered. The Status Log window shows errors, warnings, messages and data about the rendering in progress.

Cancel Button

Keyboard Shortcut: c

Click the Cancel button at the bottom of the Render Settings window to close the Render Settings window and discard any changes you might have made.

You can use this as a rather massive undo feature since it will throw out all your changes and restore almost all the Render Settings, (everything but changes to paths and file names), to the values they held before you opened the window. Changes to paths and file names will not be discarded even if you click the Cancel button.

If you want to close the window without losing your changes, click the Keep button instead.

Note: Cancelling will not undo changes to file names and paths since they are really part of the Project, not of the Render Settings.

Tips and Tricks

This chapter contains valuable tips and tricks for getting more, better, faster stuff out of WCS.

In preparing this chapter we have tried to cover an enormous amount of ground. To do so we have had to be a bit sparse with detail in our descriptions. We must assume that by the time you read this you already have a fair amount of familiarity with WCS' organization, modules, windows and general operation.

If you find yourself over your head at any point, please refer to the reference chapters for more information. The glossary contains definitions of obscure terms and the index is there to help you locate the information you need.

To become a power user, read on...

Customizing Your Screen Layout

WCS lets you arrange windows to suit your screen size and work preferences. Once you have found a comfortable arrangement you will want to preserve the setup by saving it to disk so you can load it the next time you run WCS.

Some layout options are part of the MUI (MagicUserInterface) system and other parts are strictly WCS. There are ways to preserve each.

Setting Up Your Configuration

A WCS configuration consists of windows you use most often and their arrangement on the screen.

Open the windows you use most.

These might include the Motion Editor, Database Editor, Camera View and Map View windows but can be any of WCS' over 30 different windows.

Arrange the windows for ease of access.

Depending on how you prefer to use WCS and what size screen you run it on there is a special window arrangement that works best for you. It will take some experimentation to find a good arrangement.

Saving and Loading a Configuration File

Select Save Config from the Project Menu.

This will save the names of open windows and the positions of WCS' custom windows to a file on the hard drive where it can be loaded the next time you run WCS.

Select Load Config from the Project Menu.

You can load the Config file after you load a Project in a new WCS operating session and windows will be restored to the positions they were in when you saved the Configuration file. You just might need to do a little depth arranging and you're back in business.

Using MUI Preferences

Most of the windows used by WCS are managed by a shareware program called MagicUserInterface. MUI stores the positions and sizes of windows every time one is closed. When they are reopened they will open the same size and position.

Unfortunately these positions are lost when you shut down the Amiga. However they can be remembered if you save an MUI preferences file.

Start the program, MUI, in the MUI Drawer.

The MUI Preferences window will open.

The MUI drawer was created during installation of WCS on your hard drive. You should find a program named MUI in it.

- At the top of the MUI Preferences window you will see a text field that says "Global" in it. At the right end is a pop-up menu symbol of a downward-pointing arrow. Click on it and a list of available MUI programs will appear.
- Select World Construction Set from the program list by double-clicking on the name.

Removing the Iconify Gadget

Iconification is a feature of some programs that lets you close the application's screen and windows without closing the program or losing the window contents and positions. An icon is placed in the Workbench to show that the program is iconified. Double-clicking on the icon will restore the program to operation.

The default MUI window gadget configuration includes an "iconify" gadget next to the "zoom" and "depth" gadgets in the upper right corner of each window. This gadget is somewhat less than useful since WCS uses some custom windows and a custom screen which do not iconify. In addition the gadget obscures part of the window title.

You can eliminate the iconify gadget and we suggest you do so.

- Use the page cycle gadget to go to the "System" page.
- De-select the checkbox labeled "Iconify Gadget."

Saving Window Positions and Iconify Gadget

Select Save in the MUI Preferences window.

If you do not have a registered version of MUI you will receive a message to that effect. When the message window is "cancelled" the current WCS window arrangement will be saved along with the status of the iconify gadget.

Registered Versions of MUI

MagicUserInterface (MUI) is a shareware program used by WCS to create much of its flexible interface. Registration of MUI with its author, Stefan Stuntz, is a separate operation from registering WCS.

If you have registered your copy of MUI you will be able to save many other interface preferences such as the fonts WCS uses, the color of gadgets and window backgrounds, the way certain gadgets are drawn, and so on.

You can register MUI by completing and sending in the registration form provided in the MUI preferences program. Run the MUI program in the MUI drawer for full details.

Starting a New Project

Creating a new Project is not really a big job but there are a number of steps involved. You will need a Database, a Parameter file and some objects to fill the Database.

Sometimes a new Project can be built from an old one. This is often the case if the new Project is in the same geographic region as an existing Project and will share many of the same Object files.

Creating a Project from an Existing Project

Load an existing Project.

This will be a pattern from which a new Project will be created.

Remove unneeded objects from the Database.

Clean up the Database by removing any objects that won't be needed in the new Project.

Import or create new objects.

Use the Data Ops Module commands to import new data. Use the Map View Module to digitize any new Vector data you want.

Update the Directory List.

The Directory List must contain the path names where WCS can find all of the new objects. The Directory List can be found from the Database Module pop-up menu (Dir List command).

You also should remove any Directory List paths that are no longer needed.

Save the Database with a new name.

To save the Database with all the new Object names, select the Save button in the Database Module pop-up menu. Give the file a new name before accepting the file requester.

. Modify the Parameter file.

Modify the Parameter file you loaded along with the Project to suit the new DEM locations, elevations and type of terrain cover (Ecosystems) you want. You can use the Default button in the Parameters Module pop-up menu to create parameters from scratch if you prefer.

Save the Parameter file in the new ".object" directory.

When you saved the Database with a new name WCS created a new ".object" directory. That is a good place to store Parameter files related to that Database.

· Modify any Project path/file data.

Open the Project Editor using the New/Edit command in the Project pull-down menu.

Set any paths and file names that you want to change. At this point the Database, Parameter, and Default Directory items will already have been updated. Be sure to give the Frame Save Name a name that identifies it with this Project.

Save the Project.

Select Save As from the Project Editor or from the Project pull-down menu. Give the Project a new name and save it in the "WCSProjects:" directory.

Creating a Project from Scratch

Create a Database.

Use the Create command in the Database Module pop-up menu to create a new Database. Give it a new name and save it in a new directory in the "WCSProjects:" drawer.

Set Project paths and file names.



Open the Project Editor with the New/Edit command in the Project pull-down menu.

Enter the names of any paths and file names you would like to change. This should include a Frame Save Name.

Import or create objects.

Use the Data Ops Module commands to import or create DEM and Vector Objects.

Complete the Directory List, delete unnecessary entries.

Open the Directory List Editor from the Database Module pop-up menu and add all paths to the Objects you just created or imported. Delete unneeded ones paths.

Save the Database.

Save the Database file with the Save command in the Database Module pop-up menu. Don't change the file name, just save it with the same name you used when you created it.

Create or modify a Parameter file.

Create a new Parameter file with the Default button in the Parameters Module pop-up menu or load an existing Parameter file from a different project. Use the Parameters menu command Load All.

Change the parameter file as needed for the new Project.

Save the Parameter file.

Save the Parameter file using the Save All menu command. Save it in the Default Directory (the one with the same name as the Database you just created and ".object" added). The Default Directory will be in the same drawer as the Database file.

Save the Project.

Use the Save As command in the Project menu to save the Project. Since you already saved the Database and Parameter file you don't need to do so again now.

Building Your Database

Extracting, Importing, Creating and Adding Objects

Load a Project or Database file or create a Database.

Extracting a DEM

Here we will build the Database Object list by extracting a series of DEMs from a U.S. Geological Survey One Degree DEM file.

Open the Data Ops Module.

Click the second icon in the Module Control Panel to open the Data Ops pop-up menu.

- Select Extract DEM to open the DEM Extract window.
- From Workbench or a shell rename the file you wish to extract.

The DEM file you are going to extract should be named something with 5 characters or less. The Database Object names will be derived from this file name. A short name will leave room in the Object names to add suffixes if you interpolate the DEMs later.

Select the Select Files button in the DEM Extract window.



A file requester will appear. Find the DEM file you wish to extract.

- Select the file or files to be extracted.
- Select the Extract button.

The file header will be read and you will be asked to supply some reference coordinates.

Set the reference coordinates for each file.

The reference coordinates are the southeast latitude and longitude of the input DEM file.

After you enter these, click "OK" in the requester and DEM extraction will proceed.

Save the Database.

DEM Extraction has added 16 objects to your Database. Save the Database file to preserve the changes using the Database Module pop-up menu command, Save.

Converting a VistaPro DEM to WCS DEM

- Open the Data Ops Module.
- Select Convert DEM to open the DEM Convert window.
- Select Vista DEM from the input format cycle.

The Input Format cycle gadget is at the top left of the DEM Converter window. Set it to Vista DEM.

 Select the disk icon on the left side of the window to select an input file.

A file requester will appear.

Select the VistaPro format input file.

The VistaPro file must be of the "small" size.

All the relevant values on the left side of the DEM Converter will be filled in automatically.

Select WCS DEM in the output format cycle.

· Verify or set the output directory and file/object name.

A file name will be set in the output side of the window based on the name of the DEM in the VistaPro file. You can change it or use it as is. You can output to the Default Directory or select a different output directory. If you select a different directory be sure to add the path to the Directory List.

Set latitude/longitude range if desired.

A latitude and longitude range has been set in the registration coordinate gadgets on the right side of the Converter window. You can use these or enter others if you know the coordinates of the input file. The default values are arbitrary but will scale the data correctly even if it isn't at the correct place on the globe.

· Select the Convert button.

Progress windows will show the conversion taking place.

Save the Database.

The Database has been modified so its file should be saved using the Save command in the Database Module pop-up menu.

Converting a gray-scale IFF picture to a DEM

You can create your own digital elevation models by using a paint program and the DEM Converter in WCS.

Create a gray-scale picture in a paint program.

The picture should be painted all in shades of gray. You will need a 24 bit paint program to do this since you will need as much color resolution as you can get.

Using only shades of gray you can get up to 256 different elevation values in your picture. That doesn't mean that your elevations will be limited to only 256 meters in variation. They can be scaled when the image is converted to a DEM.

Use white to represent the highest elevation and black to represent the lowest.

When you are satisfied with your image save it as either an 8 or 24 bit IFF file.

- Open the Data Ops Module.
- Open the DEM Converter window by clicking the Convert DEM button.
- Select IFF from the Input Format cycle gadget.
- Select the disk icon on the left side of the window.

A file requester will appear.

Select the IFF image input file in the file requester.

WCS will automatically detect if it is 8 or 24 bit. All of the gadgets on the left side of the DEM Converter window will be set automatically.

Select WCS DEM in the Output Format cycle gadget.

You will find the Output Format cycle gadget at the top of the right side of the window.

Verify or set the output directory and file/object name.

You must supply an output file name. It will be the name of the object created in the Database. It is a good idea to keep the name short (5 characters or less) so there is room to append letters if it must be interpolated later.

Leave the output directory where it is: the Default Directory.

Set number of DEMs to output.

If the IFF picture you created is fairly large you should have WCS break it into smaller DEMs to save memory when it is rendered. If the width or height is larger than 400 pixels you should output more than one DEM.

To figure how many DEMs to divide it into take the width and divide it by 400. Round the answer up to the next integer. Set that value in the DEMs Row-wise gadget.

Take the height and do the same division, round it up and put the answer in the Column-wise string gadget.

If you don't know what the image size was you can figure it out from the rows and columns on the input side of the window.

The gadget labeled rows tells you what the original image height was and the columns tells you what the width was.

Set the latitude/longitude reference coordinates.

WCS must know where on earth to put the DEMs you are

creating. You must tell it what the latitude and longitude range are that the DEMs cover.

As an example, the DEMs that come with WCS are 301 by 301 in size and cover .25 degree in both directions. You can use these numbers to come up with a reasonable set of lat/lon values to enter.

If your image was 640 by 400 you could make the latitude range .25 x 400/301 or .33 degrees. The longitude range would be .25 x 640/301 or .53 degrees. So you could set the maximum latitude to .33 and the maximum longitude to .53 and set both minimums to 0.

· Set any elevation scaling values desired.

The values in the IFF file will only be from 0 to 255. Probably you will want to scale these to a different range.

Lets say you want your maximum DEM elevation to be 2000 and the minimum to be -200 (below sea level).

In the equivalence cycle gadget at the bottom of the window select Two Value Equivalence. Now below the cycle gadget you will see an input column and an output column. We are going to tell the Converter what input values equal what output values. Put 0 and 255 in the input column and in the output column put -200 and 2000.

Select the Convert button.

You will see a progress window and gauge to tell you what is happening.

Save the Database.

Since the Database will have been modified by adding the converted DEMs you need to save it. Use the Save button in the Database module pop-up menu.

View the new DEMs in Map View.

Open the Map View Module with the middle icon in the Module Control Panel.

- Be sure the checkbox next to the label "Topo" has a checkmark in it. If it doesn't click in the box.
- . Select the Auto button in the Map View Control window.

This will center the map and draw the DEMs you just made. Adjust the scale larger to shrink the map or smaller to zoom in and redraw. Repeat until the DEMs nearly just fill the window. How do they look?

You can try different drawing styles and exaggeration settings. If you can't find any that look good maybe you need to try converting the image again with different equivalence values or a different latitude/longitude range. There are a lot of variables involved and it may take several tries to get the look you want.

Importing Objects - A Wealth of Data

There is a tremendous quantity of vector data available from government agencies like the USGS. You can take advantage of it by importing files in several vector formats. WCS will create Objects out of the data in the files. Supported formats are DLG, DXF and WDB. Importing any of these formats involves essentially the same procedure.

Close the Database Editor if it is open.

Importing Vector objects will create a lot of new Objects and having the Database Editor open will slow things down.

Open the Data Ops Module.

Determine the input file format.

You should know what the file format is ahead of time since there usually isn't anything definitive in the files to let WCS determine that on its own.

Select the right import function.

In the Data Ops pop-up menu select the button that corresponds to the format of the file: either Import DLG, Import DXF or ImportWDB.

Note: DXF files can either include elevation (Z) information or not.

Select the file or files with the file requester.

You will see a file requester. Select the right file to import. When you accept the file name the import process will begin. It could take some time if it is a large file. There will be a progress gauge to tell you how much of the input file has been read.

Save the Database.

The Database has been modified so save it with the Save button in the Database module pop-up menu.

Creating a Vector Object

- Open Map View by clicking the middle icon in the Module Control Panel.
- Draw the map with DEMs.

You will need to have the Topo checkbox in the Map View Control window checked.

Open the Database Editor.

You can use the Database button in the Map View Control window.

 Enable any DEMs necessary so that the new object will have DEM coverage along its entire length.

Use the Database Editor to enable any DEMs that will underlay the Vector Object and redraw the map.

- Activate an object of similar type to the one you wish to create either from the Database Editor or holding the shift key down while you click on the Object in the map.
- Set the digitizing input source using the Map View Object menu command "Input Source."

You can use either the mouse or a digitizing tablet to digitize your object. We will use the mouse in this demonstration so set the source to "Mouse."

 Begin digitizing the object by selecting Add Points/New from the Map View Object menu.

You will be asked if the current Active Object is the one to digitize or if you would like to create a new object. Select "New."

You will then be asked for a name for the new object. Enter a unique name that doesn't already exist in the Database. If it already exists you will be prompted for a different name.

Set the Label Point with the mouse or puck.

First you must set a Label Point by clicking on a spot in the Map View window. You should click on a spot near where the new Object is to begin.



This will be where the Object's label will begin if labeling is enabled for this Object.

Digitize as many points as desired.

Now click on as many points as you like to define the coordinates of the Vector Object. Place the points fairly close together, say every ten pixels or so. The closer you place them the closer you can zoom in on the Object and still see detail. The limit is 1999 points per Object.

Interpolate straight line segments.

If you want to have straight line segments in the Object but don't want to digitize all the points along the line hit the Return key. Now when you next click, WCS will interpolate points in the intervening space. Hit Return again to exit Interpolate mode.

Close the object back to its origin.

To loop the Object back to its point of origin finish the digitization by hitting the "C" key. If you don't want to return to the origin finish by hitting "Q."

Conform the new vector to topo (saves the object to disk).

You will be asked in the Map View Control window text area to either accept the digitized points by hitting Return or cancel by hitting Escape on the keyboard.

If you accept you will be asked if you wish to conform the Object to the topography. Answer "OK" and WCS will match elevation values to the points in the Object and save the Object file.

Save the Database.

Since you have added an Object to the Database you should save it at this time.

Redraw the map to see the Object in its correct color.

Adding an Existing Object

Sometimes you will want to add an Object to one Database that already was imported into another Database. In this case you don't need to repeat the import operation. Simply add the Object or Objects to the second Database.

- Open the Database Module with the first button in the Module Control Panel.
- Open the Database Editor by clicking the Edit button.
- Select Add Obj by clicking the button in the lower part of the Database Editor.

A file requester will appear.

Select the object(s) to add in the file requester.

You can navigate to any part of your computer system where the Objects are stored. Objects have the suffix ".Obj" and these are the only file names you will see.

You can multi-select as many objects as you want to add. When you are done selecting click "OK."

All the Objects you selected will be added to your Database unless there are Objects with the same names already in the Database. In that case those duplicate Objects will be skipped.

Update the Directory List.

Select Dir List in the Database Module pop-up menu. The Directory List Editor will open.

Use the Add button to add the directory where the new Objects are stored to the Directory List. This is so WCS can find the Objects when it is mapping and rendering. If the directory is already in the list then skip this step.

· Save the Database.

You have changed the Database by adding Objects to it. You should save the Database using the Save button in either the Database Editor or the Database Module pop-up menu.

The Need For Speed

There is no such thing as a modeling program that renders too fast. WCS renders so many polygons (millions and millions) that you will need lots of tricks to coax as much rendering performance as you can out of your system.

This section includes the most useful tricks and some that are of only minimal help but worth including anyway so you can learn more about how WCS operates.

Disabling objects in the Database Window

Often times, a number of the objects being rendered in a scene are completely unnecessary. They may be so far away from the Camera that they aren't visible because there are mountains in the way. They add to the rendering time in a big way. By eliminating these distant objects rendering times can be greatly reduced.

Most of this extra time is spent rendering DEMs rather than Vector Objects, which render very quickly by comparison, so we will concentrate on eliminating the unnecessary DEMs.

Open the Map View

- If it isn't already, open the Map View Module by clicking on the middle icon in the Module Control Panel.
- Use the Scale and/or Pan functions to negotiate to a view in which the entire landscape can be seen.

Disable extra DEMs (one by one)

A nearly endless supply of landscapes can be found in one or two DEMs, depending upon what angle you view them from and how their Ecosystems are applied. Don't be shy about disabling those DEMs you don't need. They won't be removed from the Database so you can bring them back to life any time you want to explore them.

Note: This process works for any object in the Database Editor, not just DEMs.

- Open the Database Editor by clicking on the Database button in the Map View Control window.
- Click on any one of the DEM names in the list on the right side of the Editor or hold down the shift key to select multiple DEMs.

DEM Objects are the ones that have names like 40105.A or 39106.P. They also can be recognized by the fact that their Class (shown in a cycle gadget near the top of the Editor window) is "Topo."

The DEM's name in the Database Editor should be selected, as should it's rectangular outline in the Map View.

 Click the checkbox labeled "Enabled," or just double click on the name of the DEM in the Database List.

The asterisk next to the name of the DEM should disappear, and that DEM's yellow outline in the map view should turn black. That DEM is now disabled.

Click on the Draw button in the Map View Control window. The map will redraw, but this time the DEM you disabled will be gone.

Repeat this process until you have disabled all the DEMs you don't want. The disabled DEMs will not appear in the camera view, nor will they be rendered.

Note: If you have already laid out a Camera path you will see it in the Map View as well if the "Inter" checkbox is checked. You can then decide which DEMs to disable based on their distance from the motion path.

You may need to do a few test renderings to determine if the DEMs you disabled were essential or not.

Disable Extra Objects (in user-definable and user-re-selectable chunks)

It is often convenient to be able to re-select a group of objects automatically without going through the pains of selecting each Database name individually. In the Database Editor you can classify any group of Objects as a user-defined "layer." A layer name is input in either one of two given fields marked Layer 1 and Layer 2.

 Open the Database Module by clicking on the first icon in the Module Control Panel.

- Open the Database Editor by clicking on the Edit button.
- Click and drag over any number of Object names in the list on the right side of the Database Editor, or select desired objects one by one in the process described above.

Note: You may want to select all the DEMs that you just disabled so you can later enable them as a group.

The Objects' names in the Database Editor should now be selected (highlighted in light blue).

 Click in the field beside either Layer 1 or Layer 2 to make a cursor appear, and then type in a name for the group of objects you selected.

This specific user-defined layer of objects can be selected again at any time (assuming that the Database file is saved) by the following procedure.

 In the Database Editor, click on one of the objects in the list that was contained within the layer of objects that you had previously selected and named.

You will see the layer name in the field where you typed it before, either Layer 1 or Layer 2.

 Click on the button marked "Sel" to the right of the layer name to select all the Objects in the previously defined layer.

That layer of objects is now selected and can be edited or given a new name. You can use the "Off" and "On" buttons to enable or disable all members of that layer.

DEM Fractal Depth

Fractals are one of the main weapons against the polygon problem. They help add complex texturing to the landscape. Used excessively they add greatly to rendering times.

Global Fractal Depth

- Click on the Render Module icon (the last one in the Module Control Panel) to open the Settings Editor.
- Go to the Fractals & Ecosystems page.
- Decrease the Fractal Depth.

Let's assume that the Fractal Depth was 3. Try a value of 2 and see if your image quality has suffered. If not try 1 or 0. Keep reducing the number until you see polygons too large in the foreground then increase the value by one.

Individual DEM Fractal Depth

Objects in the distance do not need to be rendered with as much fractal detail as those in the foreground.

- Open the Map View Module.
- Turn off Topos and turn on Interactive items.

The checkbox labeled Topo should be off and the one labeled Inter should be on.

- · Draw the Map View.
- Scale and pan the map so all enabled DEMs are visible.
- Select Database in the Map View Control to open the Database Editor.

 For each DEM visible in the Map that does not have a portion of the Camera Path within it, select the DEM object by holding down the shift key and clicking in the DEM outline.

Be sure not to click too close to another vector object. You want to select only DEM objects.

The object's name will be highlighted in blue in the Database Editor's object list. You are actually multi-selecting in the list using Map View as a guide for which objects to select.

- Once all the DEMs that are not close to the Camera
 Path have been selected, go to the Database Editor and
 reduce the DEM Max Fractal field to zero.
- Save the Database.
- Render the image and fine tune the individual fractal depth as necessary.

You might find that you have reduced some of the DEMs too far. You can now raise those back up by one until they render with sufficient detail.

Rendering Smaller Pictures

- Open the Preferences Editor using the Prefs/Preferences menu command.
- Set the Render Size to 1/4 or 1/2.

This is good for rendering previews of animations where the critical thing is the motion path and you don't need full sized images.

Turn Off the Screen Saver

If you are running a screen saver it may be eating up precious CPU cycles to draw pretty pictures on the screen.

Find a screen saver that is smart enough to just turn the screen black when there is intensive computing going on.

Lose the Preview Render Window

- Open the Render Settings window.
- Disable Screen rendering.

Select No Screen with the cycle gadget in the middle of the Image & Size page.

You will still have the progress gauges and Status Log window to tell you how rendering is going.

Boost the Render Priority

This probably won't help much but is worth a try. It will probably lock out some programs so don't do it unless rendering is all you want your Amiga to do for a while.

- Open the Preferences Editor using the Prefs/Preferences menu command.
- Set Render Task Priority to High.

Set Understory Ecosystem to Overstory

This is not a major time saver but worth mentioning especially for global renderings that do not benefit in quality from the extra detail that Understory Ecosystems provide.

- Open the Parameters Module.
- Open the Ecosystem Editor by selecting Ecosystem in the Parameters Module Pop-up Menu.
- For each Ecosystem set the Understory to itself.

One item at a time, select a name in the Ecosystem List. For each, using the cycle gadget labeled "Under Eco," select the same Understory Ecosystem as the selected name in the list. In other words for Tundra select Tundra as the Understory, for Rock, select Rock, and so on.

Color Maps and Custom Ecosystems

Here again, not big time consumers but in the interest of explaining everything that increases rendering time we will mention these two items.

Using Color Maps requires extra calculations for each polygon rendered to determine what color is present in the Color Map and then to determine what should be done with that color. You can gain a slight rendering advantage if you do not use Color Mapping.

Then again if you are using Color Maps, there is probably a reason and you won't want to disable them for the final renderings, only for preliminary tests.

- Select the Render icon to open the Settings Editor.
- Go to the Color Maps page.
- Select "No Color Maps" with the cycle gadget.

Custom Ecosystem Models also consume small additional amounts of rendering time and for preview renderings you may wish to disable them. This must be done on an individual basis. There is no global setting to enable or disable them as a group.

- Open the Parameters Module.
- Select Ecosystem to open the Ecosystem Editor.
- One by one, select each item in the Ecosystem List and if there is a name found in the string gadget labeled "Model," click in the string gadget and delete the name completely.
- Leave the Ecosystem Editor open and render the image.
- If the results are satisfactory close the Editor with the Keep button. If you would prefer to cancel the changes close the Editor with the Cancel button. This will restore the custom Ecosystem Model names.

Quality is Critical

As in all of life there are trade-offs. In WCS the main trade-off is between rendering speed and quality. You can have as much of either one alone as you want but you can never have all of both.

This section talks about ways to increase quality at the expense of rendering speed. You will need to find the critical balance between these opposing principles for yourself. All we can offer are guidelines for optimizing the two.

Polygon Interpolation

- Open the Map View Module with the middle icon in the Module Control Panel.
- Turn off Topos and turn on Interactive items.

The checkbox labeled Topo should be off and the one labeled Inter should be on

- Draw the Map View.
- Scale and pan Map View so all enabled DEMs are visible.
- For each DEM visible in the Map that has a portion of the Camera Path within it, identify the DEM object by clicking in the DEM outline. The name of the DEM will appear in the text gadget at the bottom of the Camera View Control window.

Be sure not to click too close to another vector object. You want to only DEM objects.

Make a note of these DEMs. They are the ones you will later interpolate.

- Open the Data Ops Module with the second icon in the Module Control Panel.
- Select Interp DEM to open the DEM Interpolate window.
- Choose the Select Files button.

A file requester will appear. Navigate through your directories to the one that contains the DEM files. They will have suffixes of ".elev."

- Multi-select the files that you wish to interpolate.
- Adjust the Elevation Variation Percent and Maximum Flat Variation.

The default values of two and two work well in most cases. You can experiment to find values you like. Higher values will add roughness to the terrain but may not always look natural.

Select the Interpolate button.



There will be some gauges to tell you how the interpolation is progressing. It isn't a real fast process. Relative Elevation Models will be interpolated as well as DEMs automatically.

Redraw the Map View.

You will now see that the DEMs around the Camera Path have been subdivided into smaller DEMs. The original DEMs still exist and are in the Database but they are disabled. At any time you can switch back to the original DEMs to gain an increase in rendering speed. You may wish to do that for animation motion tests where quality isn't critical.

Save the Database.

It has been modified so the Database should be saved using the Save button in the Database Module pop-up menu.

Fractal Depth

These instructions are just the opposite of those given to increase rendering speed. Here is where the real trading-off begins.

- Click on the Render Module icon to open the Settings Editor.
- Go to the Fractals & Ecosystems page.
- Increase the Fractal Depth.

Render an image. If you like the results you are done. If you need more detail still, either interpolate the DEMs or increase the Fractal Depth again.

Ecosystem Texturing

- Open the Parameters Module with the fourth icon in the Module Control Panel.
- Select Ecosystem to open the Ecosystem Editor.
- Select each item in the Ecosystem List in turn and if its Class is Water, Rock, Ground or Low Veg (Low Vegetation) set its Density to 100.

Notice that we aren't changing the density value for either conifer or deciduous class Ecosystems. You can increase those if you wish as well but the others are usually the ones that cause offensive polygons to show.

Setting the Mood

Lighting the Scene

Positioning the sun in WCS' universe is one of the most important and fundamental operations. There are three ways of doing it. If you can tell time and read the calendar you will have no trouble using the first method. The second and third are a little less intuitive but much more flexible.

The Quick and Easy Method

- Open the Parameters Module.
- Select Motion to open the Motion Editor.
- Select the Sun button to open the Sun Time window.
- Using the cycle gadgets set the month, date and AM or PM. Use the Time string to enter a time of day.



You can use either 12 or 24 hour clock time but the AM/PM cycle gadget must be set appropriately in either case.

The Reference Longitude string lets you set the longitude that the time is computed from. Normally this would be wherever the camera is pointed. WCS sets the Focus Point longitude as the default value but you can change it.

Since changes made in this window take effect immediately you can close the window with the Keep button or leave it open while you test render in the Camera View. You can create sun position key frames while this window is open as well.

For More Control...

- Select Camera View to open the Camera View window.
- Bring the Bounds page to the front using the cycle gadget at the top of the Camera View Control window.
- Enable Compass Bounds by selecting on the Compass button (it should be blue and depressed).

This will cause a three dimensional compass to appear at the focus point in the Camera View. The yellow ray emanating from the center of the compass is a vector pointing toward the sun.

- Open the Map View Module.
- Set the Map Scale to 4000.
- Enable Interactive drawing by selecting the check box labeled "Inter" in the Camera View Control window so that the box has a check mark in it.

Draw the Map View.

The elements of your model will probably be very small near the center of the window. You should see a circular symbol somewhere that has four short rays coming out of it. That is a symbol for the sun, World Construction Set's light source.

Click and drag the sun symbol in the Map View.

Notice as you move the sun that the yellow sun "ray" in the Camera View moves in response. It may be difficult to determine when the sun is in a good position from the Camera View alone but in combination with the Map View and Compass window you should be able to orient the sun to create the lighting you want.

- Bring the Draw page to the front using the cycle gadget at the top of the Camera View Control window.
- Select Sun Shade to draw a solid shaded model in the Camera View.

You can adjust the resolution of the Camera View model with the grid size in the Camera View Control window. By decreasing the grid to a smaller value, say 5 or 3, you will get a more accurate depiction of the sun's effect.

Moving the sun closer to the model elements in Map View will cause the scene to become more evenly lit. Moving it farther away will cause increased shadowing. At some point you will find the maximum amount of contrast.

For "normal" lighting you should try to place the sun at 90 degrees to the view azimuth. This will give a balance between shaded and sunny surfaces.

You can determine the view azimuth from the Compass window that opens along with the Camera View. It has a



red line that radiates out from the center. Think of the camera as being at the center of the compass and the red line pointing in the direction that the camera points. That is the view azimuth. North is at the top of the compass as it is in Map View.

Sky Options

Gradients

- Open the Parameters Module with the fourth icon in the Module Control Panel.
- Select Color to open the Color Editor.
- Select Horizon in the Color List.
- Use the sliders to select a color for the sky at the horizon.
- Select Zenith in the Color List.
- Use the sliders to select a color for the sky at the zenith.
- Open the Motion Editor by selecting Motion in the Parameters Module Pop-up Menu.
- Select Horizon Line in the Parameter List.

You will now see that in the Interactive Group on the right side of the Motion Editor you have three Horizon Group parameters to work with: Horizon Line, Horizon Stretch and Horizon Point.

Horizon Line controls the vertical position of the horizon color in the rendered image. Horizon Point controls the horizontal position where the most intense Horizon Color is applied along the Horizon Line. Horizon Stretch controls the ellipticity of the Horizon-Zenith color gradient.

 Set the Horizon Stretch by clicking in the string gadget and deleting the contents and typing a new value.

A value of 1 creates a circular gradient. A value of $15~\rm or$ 20 makes the gradient almost flat parallel to the horizon.

- Open the Settings Editor by selecting the Render icon in the Module Control Panel.
- Go to the Miscellaneous page using the cycle gadget at the top of the window.
- There is a cycle gadget in the upper half of the window that either says "Fixed Horizon" or "No Fixed Horizon."
 Set it to the desired condition.

Fixed Horizon can be used for still images to gain precise placement of the horizon line and point. Disabling it allows the horizon line to move as it should in an animated sequence.

Background Images

- Select the Render Module icon in the Module Control Panel to open the Settings Editor window.
- Go to the Processing page using the cycle gadget at the top of the Settings Editor.
- Select "Background" (as opposed to "No Background") in the cycle gadget near the top of the window.

The two string gadgets below the Background cycle gadget will become unghosted.

 Select the image you would like to use as a background by clicking on the disk icon next to the string gadget labeled "BG Path."



A file requester will appear. You can enter any valid device and path name. The background image can exist anywhere on your computer system.

If you want to use a sequence of background images you can select any one of them in this procedure.

Sequences of images must have frame numbers somewhere in their names and the numbers must correspond to the frames they will be used as backgrounds for. In the case of field rendered sequences the background images could also be field rendered or not as you choose. If they are field rendered they should already be interleaved.

Haze

- Open the Parameters Module with the fourth icon in the Module Control Panel.
- Select Motion to open the Motion Editor window.
- Select Haze Start in the Parameter List.

The Interactive Group members will be Haze Start and Haze Range. The values of these parameters will appear in the string gadgets in the upper right of the Editor window.

Haze Start is measured from the camera and Haze Range is the distance between the Haze Start and the point where haze is at full density. The values are in units of kilometers.

- Select the Camera View button to open the Camera View windows.
- Note the colors used to draw the terrain grid.

The colors tell you about the current haze settings and how they interact with the terrain model. White grid lines indicate that there is no haze effect present in that part of the picture. Light blue indicates that haze is in effect but not at full strength. Dark blue is where the image is completely hazed out.

- In the Motion Editor, Interactive Group string gadgets enter different numbers for the Haze Start and Haze Range Parameters.
- Redraw the terrain grid by selecting the Terrain button in the Camera View Control window.

Note how the proportion of white, light blue and dark blue changed. Normally you would want a little white in the foreground of the picture. Whether or not you want any of the dark blue depends on the effect you are trying to achieve - a very hazy day or a clear day.

The best way to determine what effects you like are to experiment. This is the realm of art, not science.

 Render the scene to determine if the settings are the way you want them and make adjustments if they aren't.

Remember that you can also adjust the haze color, sun color sun position and fog effect. These parameters all work together to create a mood.

Fog

- Open the Parameters Module.
- · Select Motion to open the Motion Editor window.
- Select Fog Full in the Parameter List.

The Interactive Group members will be Fog Full and Fog None. The values of these parameters will appear in the string gadgets in the upper right of the Editor window.

Fog Full and Fog None are measured from Sea Level. The values are in units of meters. Fog None is the elevation where there is no fog effect and Fog Full is where the effect is at maximum strength.

Fog Full can be either above or below Fog None. If it is above then all elevations above Fog Full will be at full effect. If Fog Full is below Fog None then all elevations below Fog Full will be at full effect. This way you can create fog that fills valleys or fog that caps mountain peaks.

A Foggy Valley

To create a scene where the valleys are filled with fog, follow this sequence:

- Open the Map View Module.
- Enable Topo mapping in the Map View Control window and draw the Map View.
- Click anywhere in the Map View window to activate the window and move the pointer around over the map to determine the range of elevations.

In the bottom of the Map View Control window there is a text field that will show a readout of various interesting features. One of those features is the elevation of the terrain under the pointer. The elevation value is in meters, the same as the values you need for the Fog elevation parameters.

 Find the lowest and highest elevations in the map (you don't need to be absolutely precise here).

 Set the Fog Full value to a number lower than the lowest elevation and the Fog None value to a number between the highest and lowest elevations.

The effectiveness of the fog feature is often in its subtlety. You can make the effect more subtle by lowering the Fog Full value quite a bit below the lowest map elevation. It often works well to have the Fog None value about half way between the highest and lowest map elevations.

 Render the image and take a look at it. If the effect is too strong, change one or both of the Fog parameters until it looks right to your eye. There are no "correct" values, only ones that look good to you.

The color of the fog is taken from the Color Parameters, Haze & Fog Color. You can change this to create a totally different look.

Remember that you can also adjust the haze effect, sun color and sun position. These parameters all work together to create a mood.

Sunrise Animation

Convincing sunrise and sunset sequences can be generated with WCS. In order to do it convincingly you will need to animate a number of different parameters. The ones most commonly involved are Horizon Stretch, Haze Start and Haze Range, Sun Latitude and Sun Longitude, Fog Full and Fog None, and the Horizon, Zenith and Sun colors.

Ecosystem Magic

Setting Sea Level and Depth

Not only can you set sea level to any elevation you desire, you can control the amount of color variation caused by shallow and deeper bodies of water.

- Open the Parameters Module.
- Click on the Ecosystem button to open the Ecosystem Editor window.

The Water Ecosystem will be the active ecosystem when the window opens. If it is not because the window was already open, activate it by selecting the name "Water" in the Ecosystem List.

On the right hand side of the Ecosystem Editor there are a series of eight string gadgets and associated sliders. With these you control where an Ecosystem appears on the terrain model.

- Enter the elevation (in meters) for your sea level in the string gadget labeled "Sea Level."
- Enter a value for water depth in the string gadget labeled "Water Depth."

Larger values for Water Depth will cause the water to all become more nearly the same shade of color. Smaller values will cause more shade variation from the assigned Water color to black.

Shading is related to the elevation of the terrain model. The farther the elevation is below your sea level value the darker the shade will become until a depth equal to the

"Water Depth" is reached. At terrain elevations below this the water will be black.

Note: Data from some sources do not contain subsea elevations. For instance the U.S.G.S. One Degree data shows all ocean elevations as zero. If your model includes coastal areas using this kind of data do not expect the Water Depth feature to do much. In fact you should set Sea Level to one meter just so that all ocean areas are inundated with water.

The global DEM sets available from Questar, while lower in resolution, do contain bathymetry (subsea elevations) and the Water Depth feature provides interesting variations over the vast oceanic reaches of the planet.

Changing Seasons

While we usually think of animation as involving camera motion, in WCS it can be much more. You can animate any of the Ecosystem Parameters which control where vegetation grows and where snow line is. By combining ecosystem animation with animated colors you can create the effect of changing seasons or even long-term climate change.

Here we will describe the process of animating the snowline. The same technique would apply to any of WCS' other Ecosystems.

- Open the Parameters Module.
- Select the Ecosystem button to open the Ecosystem Editor window.
- Activate the Snow Ecosystem by selecting it in the Ecosystem List.

- Set the snow line elevation for the first frame of the animation by entering a value in the string gadget on the right side of the window labeled "Elev Line."
- Create a key frame at frame 0 by selecting the Make Key button.
- Create a key frame for the last frame in the animation.
- Select the Time Lines button to open the Ecosystem Time Lines window.
- Select the Add Key button to add a key frame. Click in the graph window half way between the start of the graph and the end.

This will add a key frame mid-way through the animation.

 Click on the yellow triangle just added in the middle of the graph and drag the point to a different value.

Depending whether the point in the middle is higher or lower than the end points, you have created an animation that either has a snow line rising and then falling or falling and then rising.

Adding Lakes

There are three ways of creating lakes in WCS. First you can set Sea Level at the desired lake elevation (see above). Of course that means that all elevations lower than that will become water.

Second you can use Color Maps to define exactly what areas are covered by lakes. This is the most accurate and specific way to position lakes. It is described in the Color Map section later in this chapter. And third you can use the method described here. It offers an intermediate amount of positioning control which may be satisfactory in certain circumstances. It generally creates more lakes

than actually exist but they are often arranged in a realistic fashion across the landscape. It has its limits, however.

In parts of the world where the terrain is generally flat or nearly so this procedure will create too much water and sometimes not only in valleys. Where the relief is low it can create lakes on the flat tops of hills: probably not where you want them. In these areas try one of the other methods.

For areas of rugged terrain this method has proven satisfactory and expedient.

- Open the Parameters Module.
- Select Ecosystem to open the Ecosystem Editor window.
- In the Ecosystem List select the item below the Snow ecosystem, whatever it is.

Depending on what other ecosystems exist in the Parameter file you are modifying, the ecosystem list will vary. We want to create a high priority ecosystem so we will put it as high on the list as we can. The positions of the top two ecosystems, "Water" and "Snow" cannot be changed.

Select the Insert button near the bottom of the Editor.

A new Ecosystem will be created where the selected item was. All other Ecosystems will be moved down one in the list to make room.

 Type the name "Lake" in the blank string gadget at the top left of the window.

When a new Ecosystem is created its values will be set to default values and the name field will be blank. You can name it anything you like but somehow the name "lake" seems appropriate.

 Set both the Max and Min Slope values to zero (0) degrees in the editing controls on the right side of the window.

We are setting strict limits on what parts of the terrain are covered with lakes, specifically, areas with no slope.

Set the Max Rel El value to 10.

This will ensure that only flat areas in relative lows will be covered with lakes.

- Set the color to "Water" using the cycle gadget labelled "Color" near the top of the right side of the window.
- Set the Class to "Water" using the cycle gadget to the right of the name string.

The Class of an Ecosystem determines what type of texture will be applied to its polygons.

Set the Density to 100. The Height should be zero (0).

Density determines what percent of Lake polygons receive texturing. Normally for non-vegetation class Ecosystems this is set to 100.

Note: In order for this trick to work properly you must be sure that if you interpolate the DEMs that you set the "Max Flat Var" variable to zero (0) before interpolating. This will preserve all flat areas as truly flat.

Get Surreal

Creating surrealistic landscapes in many ways is easier than realistic ones. You don't have to worry about those pesky laws of nature. But as with realistic landscapes, understanding how to define Ecosystems will let you create the look you want rather than simply random patterns on the terrain.

One of the techniques you will most certainly want to use in creating "other-worldly" domains is the control of color.

In this tip we will create a world of multi-hued rock layers. Depending on the colors chosen the result could be reminiscent of relatively barren areas of our planet like the Painted Desert or something never before seen by human eyes.

- Open the Parameters Module.
- Select Color to open the Color Editor window.
- Select the color in the list below "Snow" by clicking on it.
- Select the Remove button near the bottom of the color Editor.
- Repeat the removal process for every color in the list below Snow.
- Select the blank line below snow in the Color List.
- Enter a name for a new color in the string gadget above the color editing tools on the right side of the window.
- Mix a new color using the sliders.
- Select the next blank line in the Color List and repeat the naming and mixing process. Create a series of perhaps ten new Color Parameters in this way. Give them all different names and colors.



- Close the Color Editor using the "Keep" button.
- Open the Map View Module.
- Enable the Topo option in the Map View Control window and draw the map.

Center the map and scale it so you can see the entire area. Use the "Auto" button in the Map View Control to center the map in the window. Use the arrows next to the Scale string gadget to increase or decrease the scale and shrink or enlarge the map. Remember that scale is the denominator of a ratio and that to enlarge the map you must decrease the scale.

- Activate the Map View window by clicking anywhere in it.
- Move the mouse around over the map and note the elevations of the terrain. Keep track of the maximum and minimum elevation values.

Elevations are noted in the text field at the bottom of the Map View Control window as you move the mouse pointer. The elevations are always shown in meters the same as the units required in the Ecosystem Editor.

This technique of scouting out the terrain elevations is useful whenever you are creating new Ecosystems which is our next step.

- In the Parameters Module Pop-up Menu, select Ecosystem to open the Ecosystem Editor window.
- · Select the item below "Snow" in the Ecosystem List.
- Select the Remove button near the bottom of the window.

 Repeat the removal process for all Ecosystem below Snow in the list.

You should end up with a list containing only two items, Water and Snow. These two are fixed components of every Parameter file and cannot be removed or renamed.

- Select the blank line beneath Snow in the Ecosystem List.
- Enter a name for a new Ecosystem in the string gadget at the upper left corner of the window.

This is the first of a series of Ecosystems we are going to create. The name isn't really important to WCS but is just for you to be able to identify it so make it descriptive like "Rock-1."

- Repeat the naming process for another nine items, placing them in sequence in the List.
- Beginning with the first Ecosystem you created (the one directly beneath "Snow"), select each name in the list and modify its Elevation Line. Use the slider or string gadget on the right side of the window labelled "Elev Line" to do this.

Elevation Line is the upper elevation limit for each Ecosystem. WCS will scan the list from top to bottom when rendering. If a polygon's elevation is below the Elevation Line of an Ecosystem as the list is scanned, the scanning stops and the polygon is rendered in that Ecosystem. If the elevation is higher than the Elevation Line then the scanning proceeds to the next Ecosystem in the list and the comparison repeats.

Our top Ecosystem (not counting Water and Snow) should have its Elevation Line set to the lowest elevation found in the map reconnaissance step above plus a little bit. If you make it exactly the lowest elevation the Ecosystem will never be rendered.



- Set each subsequent Ecosystem in the list to a higher elevation that is within the range of elevations found in the map.
- Set the last elevation in the list to 32,000.

The last Ecosystem in the list is a catch-all. Any polygons that do not fit the description of any other Ecosystem should be rendered in this last one. Therefore its limits should be as broad as possible.

- For each of the Ecosystems you created set its Class to "Rock" using the cycle gadget next to the name string at the top of the Editor window. Set its Density to 100 and its Height to 0.
- For each of the Ecosystems you created select a color using the cycle gadget labeled "Color." The colors do not have to be used in any particular order. Some colors can be used more than once if you wish or not used at all.

By adjusting the Elevation Lines and the colors you can create a nearly infinite number of patterns on the landscape. You can further modify the patterns by adjusting the other Ecosystem Parameters such as Skew, Skew Azimuth, Relative Elevation Effect, maximum Slope, and so on.

Custom Ecosystems

Realistic Forests

There are some places where forests of only one type of tree exists but in many cases a forest looks more natural if there are many species present, each with its own characteristic shape, color and range of heights.

You can create diverse forests in WCS using a Custom Ecosystem Model. In this exercise we will create a fairly simple model composed of both coniferous and deciduous trees of varying heights and colors. You can expand on this model to any level of sophistication you like.

- Open the Parameters Module.
- Select Ecosystem to open the Ecosystem Editor window.
- Select one of the forest ecosystems in the Ecosystem List, for instance Lodgepole.
- Select the Design button at the top right corner of the window to open the Ecosystem Model Editor.
- Enter the following values in the string and cycle gadgets at the bottom of the window:

Ht 5 Items 10 Class Decid Red 145 Grn 173 Blu 113

Select the Add button at the top of the window.

The values you just entered will be transferred to a single line in the list. You have created some deciduous trees 5 meters in height.

Change the string values to the following:

Ht 10 Items 10 Class Decid Red 138



Grn 165 Blu 108

Again select the Add button.

You have now created some slightly darker deciduous trees 10 meters in height. These represent older trees of the same species as the first group.

Now let's add a different species.

Change the values to the following and add them to the list:

Ht 10 Items 20 Class Decid Red 92 Grn 170 Blu 111

Changing the number of items to 20 means that there are as many of these trees as the other two groups combined.

Now let's add some tall conifers to the model.

Change the values to the following and add them to the list:

Ht 20 Items 10 Class Conifer Red 62 Grn 137 Blu 89

These conifers are not only taller they are darker, more blue-green and will stand out against the canopy of leafy deciduous trees.

Let's create some space between the trees by adding some low vegetation and bare ground.

Change the values to the following and add them to the list:

```
Ht 0
Items 30
Class Low Veg
Red 164
Grn 171
Blu 114
```

Change the values to the following and add them to the list:

Ht	0
Items	20
Class	Ground
Red	175
Grn	167
Blu	137

Feel free to add more items to the list. Make it as complicated as you want. The more diversity, the better. It would be especially good to add more height variation since unless it is a managed forest heights tend to spread out over a wide range. Remember that the heights are in meters and a meter is about 3.3 times larger than a foot. Trees seldom reach heights in excess of 30 meters (100 feet).

- Enter a name for the Ecosystem Model in the string gadget at the top of the window. Perhaps "ForestModel" would be appropriate.
- Save the Model by selecting the Save button in the Model Editor.

You will be presented with a file requester that has your model name pre-set along with the Model path as defined in the Project file.

Select "OK" to save the model.

Note: WCS must know where to find the models you are using. There is a directory designated in the Project Editor as the Model Path. You can set this to any directory you like and place your model files in this directory. Access the Project Editor using the global menu command New | Edit.

Close the Model Editor.

Notice that the Model name has been placed in the string gadget labeled Model in the Ecosystem Editor. This Ecosystem will now be rendered using the model information. To cancel the use of the model at any time you can delete the name of the model from this string.

Ecosystems with no name in the Model string gadget do not use models for rendering, they use the height and color information displayed in the Ecosystem Editor. For those Ecosystems that do have custom models, the height and color information in the Ecosystem Editor is ignored.

The Density value found in the Ecosystem Editor for those Ecosystems that have custom models is still important. It determines what percentage of polygons use the model and what percent are drawn as simple polygons with no texturing whatsoever. Be sure to set the Density value, usually to 100. You can quickly reduce the number of trees in a modeled Ecosystem by lowering the Density value if you want a sparser forest without going back and re-editing the model.

Note: Be sure to save your Parameter file after adding a model to one of the Ecosystems. Do this from the Global Parameters menu (Save All).

Water

If you want to add some sparkle to your water you can use a Custom Ecosystem Model. You can add more color shades and hues than would be possible with normal Ecosystem rendering.

Creating a model for water is done the same as for the forest model described above. For that reason we won't repeat all the steps here.

There is a sample model for water on the WCS distribution diskettes. It is found in the ColoDemo/ColoDemo.CMaps directory. To see how this file is used load the ColoDemo project (ColoDemo.proj) and the MtnLakes.par Parameter file.

Open the Ecosystem Editor and you will see that the third Ecosystem in the list is called "Lake." It was created using the technique described above (Adding Lakes). Notice that it uses an Ecosystem Model. You can tell because the model's name is in the string gadget labeled "Model."

Select the Design button to open the Ecosystem Model Editor. Then select the Load button to load a model. The model used is named "FogWaterModel." Load this now.

You can see from the model list that it is really quite simple. All entries have a height of zero (0) and a Class of "Water." The colors and number of items varies.

In this example file the model is applied to the Lake Ecosystem. You could just as easily apply it to the whole ocean by setting this same model name in the "Water" Ecosystem's Model string.

This simple technique can be used to add variety and color to any ecosystem, not just water. Try it on bare ground and rock. Nature adds such variations to the landscape all the time. Rocks weather to colors very different from their originals and often get crusted with colorful lichens. Ground forms crusts of alkali or moss.



For another example of adding color using Custom Ecosystem Models see the Ecosystem Tutorial in the Tutorials chapter. There we add some wildflowers to the alpine tundra.

Scientific Applications

Custom Ecosystem Models can be used to simulate very specific forest stand structures. In fact the models can even be animated over time to show growth and forest succession. For more information about animating Ecosystem Models see the Ecosystem Reference chapter of this manual.

Combining Ecosystem Models with Color Maps offers complete control over the distribution of land covers. The following section tells how use Color Maps to place Ecosystems and Ecosystem Models precisely on the terrain.

Making the Most of Color Maps

Color Maps are among WCS' most versatile and powerful tools. In this section we have put together a few typical examples of their uses. Your imagination will suggest many more as you read through them.

What is a Color Map?

A Color Map is a bitmapped image that is used by WCS to determine certain things about how to render the terrain. You can paint a Color Map in any 24 bit paint program by following the guidelines set out below.

Color Maps can be used to colorize the terrain much like a texture map in other 3-D rendering programs. They can also be used to place Ecosystems at specific spots on the terrain.

There are a few things about Color Maps that are peculiar to WCS. First they must correspond to a DEM object of the same name as the Color Map file. A DEM named 40105.C can only have a Color Map named 40105.C. Color Maps are assigned to their own directory whose name is stored in the Project file.

Second, Color Maps must be of the same dimensions as the DEM to which they correspond. The standard DEM size for the data on the distribution diskettes is 301 rows by 301 columns. If you want to create a Color Map from scratch for one of these DEMs you will need to create a 301 x 301 image. By matching sizes Color Mapping can proceed almost as fast as normal terrain rendering. The drawback is the limited resolution available in Color Maps.

Third, Color Maps are oriented strangely. When you look at them in a paint program they will be rotated 90 degrees clockwise from the Map View orientation. North will be at the right side of the image and west will be at the top. This is to align them with the DEM data which is stored according to U.S. Geological Survey convention and to allow the Color Maps to be loaded very quickly into memory as needed.

Note: You do not need a Color Map for every DEM, only those that have features on them that are to be Color Mapped. For instance if you are using a Color Map to depict a clearing in the forest you only need a Color Map for the DEM that contains the clearing. Any other DEMs in the scene do not need them.

You will receive a warning during rendering if a DEM is found that does not have a Color Map. You can disable all warnings from the Global Prefs menu before rendering if you don't want to see them. On the other hand they may be useful for trouble-shooting if Color Maps don't seem to be working.

If you need more detail in a Color Map you can interpolate the DEM data. Color Maps will then cover one fourth the area of the original and have twice the resolution in any direction. You can find out more about interpolating DEMs in the "Quality is Critical" section of this chapter.

Creating Color Maps

There are several ways to create Color Maps: using WCS data in the Map View Module or using an image file that begins life in another program or is derived from another source (such as satellite data).

From Map View

From Map View you can create a Color Map that contains both terrain and vector data supplied by the Database. All objects that are enabled and that fall within the area of a DEM will be drawn into the Color Map. This is used when the vector objects or the terrain model are to be used as guides in painting the Color Map.

As an example let's say you wanted to colorize Rocky Mountain National Park which is part of the ColoDemo Database included with this program. You would enable the RMNP object in the Database which represents the outline of the park and disable all other vector (not DEM) objects. Following the procedure below for every DEM that the boundary crosses will result in a series of Color Maps showing the boundary. In a paint program you would fill in the area of the park using the boundary as a guide.

- Open the Map View Module.
- · Activate the DEM file you wish to make a Color Map for.

Do this by holding down the shift key and clicking inside the DEM outline that contains the features you want to include in the Color Map.

Select Draw/Color Map from the Map View Menu.

If the active object is not a DEM you will be warned and the operation aborted. Otherwise you will be asked to confirm that the active DEM object is the one to make a Color Map for.

Then you will be asked if you wish to include DEM elevation information in the Color Map. Answering "yes" will cause the output Color Map image file to include the elevation data as seen in the Map View drawing. The same drawing mode (emboss, single or multi-gradient scheme) will be used.

Including the DEM information may be helpful in guiding your painting of the final Color Map.

 Select a path and file name for the output Color Map image.

You will be presented with a file requester that has the current Color Map Path as defined in your Project file and the name of the DEM object as the file name. You may modify either the path or file name before saving the image.

Note: In order for WCS to use Color Maps when rendering an image, each Color Map must be named the same as the DEM object to which it corresponds. Color Maps must be located in the Color Map directory specified in the Project. You can change the Color Map directory from the Project Editor or the Settings Editor.

From an Image File

Color Maps can be created from a picture such as an aerial photograph or satellite image. It may be that you have a DEM file and an image that cover the same area. That is the ideal relationship since they need to be of the same dimensions (rows and columns) and covering the same area for WCS to use them together. The following describes how you import the image part of the pair so that they can be used together in WCS.

Convert the image to raw RGB (Sculpt) format.

This will have to be done in another program such as Art Department Professional or ImageFX. The conversion is necessary so that WCS can read in only one color component at a time to save memory when working with very large images.

The three output files should have suffixes ending in .red, .grn and .blu. Be sure to note the width and height of the image, you will need this information later.

- Open the Data Ops Module.
- Select Convert DEM to open the DEM Converter window.
- Set the Input Format cycle gadget to Binary Array.
- Select the input file using the disk icon at the left side of the window.

A file requester will appear. Find the image file that ends in the ".red" suffix and accept the requester.

- Set the Value Format cycle gadget to "Unsigned Int."
- Set the Value Bytes to "One."
- Enter the image width in the string gadget labeled "Input Cols" and the image height in the string labeled "Input Rows."
- Set the Output Format cycle gadget to "Color Map."
- Select an output file name and path using the disk icon on the right side of the window.

You should set the path to the Color Map directory for the current Project. The file name should be the same as that of the DEM to which the Color Map corresponds.

Note: In order for WCS to use Color Maps when rendering an image, each Color Map must be named the same as the DEM object to which it corresponds. Color Maps must be located in the Color Map directory specified in the Project. You can change the Color Map directory from the Project Editor or the Settings Editor.

 Select the Convert button to convert the image files into a Color Map.

Each component of the image - red, green and blue - will be loaded in turn and output in Color Map format. This version of the Color Map format is nothing more than the image rotated 90 degrees so that West is at the top of the image and north is to the right if viewed in a paint program.

Note: Be sure to enable Color Mapping in the Settings Editor in the Render Module so WCS knows that you want to use the Color Maps.

Ecosystems Within Set Boundaries

WCS uses a sophisticated algorithm to determine where various ecosystems should be placed on the landscape. For most purposes, the realism and accuracy that results is completely adequate. There are bound to be instances though where the user would like more control over where certain ecological features exist.

For instance it might be important to have a clearing in the forest to place a house or to have a lake in a certain valley. The algorithmic approach has its limits but there is another way to precisely control ecosystem placement: by use of Color Maps.

Using Color Maps you can precisely determine what grows where. You can create Ecosystem Models to precisely spell out the characteristics of and Ecosystem for even greater control.



Perhaps most exciting of all is the ability to animate Color Maps to create a time-lapse effect for simulating long-term ecological change. Lakes can dry up or expand, glaciers can advance and retreat.

We will create a Color Map controlled lake as an example of what you can do but keep in mind that any Ecosystem can be controlled by Color Maps in exactly the same manner.

Placing a Lake

- Open the Map View Module.
- Activate the DEM object that will contain the lake by holding down the shift key and clicking inside the DEM outline.

You will be asked to confirm that the highlighted object is the one you desire.

Select Draw/Color Map from the Map View menu.

You will be asked if you wish to include DEM elevation information in the Color Map. Answer "Yes."

There will be a few seconds pause while the elevation information is converted to Color Map format. You will then be presented with a file requester displaying the Color Map Path directory as defined in the Project file and the name of the DEM as the file name.

 Accept the data as it appears in the file requester by clicking "OK."

The Color Map will be saved as an IFF image file.

 Open your favorite 24 bit paint program and load the just-saved image file.

It will look a little different than the terrain model for two reasons. It is rotated 90 degrees clockwise from the map View orientation placing north to the right side and west at the top. Also it includes all 256 shades of gray instead of the paltry 8 that are used to draw DEMs in Map View.

- Select a shade of blue to paint with and make a note of the exact red, green and blue values for the chosen color.
- Paint the lake as a solid blue area in the image. Wherever you paint will become lake in WCS' rendered images.
- Create a stencil of the blue color and paint the rest of the image solid black (red, green and blue = 0).

In other words you want only the blue area preserved. All the rest of the image must be black.

- Save the Color Map image again but do not change its name or directory. You will overwrite the original.
- Close the paint program if you like, we won't be needing it again for this exercise.
- Open the Parameters Module.
- Select Ecosystem to open the Ecosystem Editor window.
- Select "Water," the first item in the Ecosystem List.
- Enter the three components of the color you painted the lake with in the string gadgets labeled "Match Red,"
 "Match Grn" and "Match Blu."
- Close the Ecosystem Editor using the Keep button.



- Select the Render icon in the Module Control Panel to open the Settings Editor.
- Go to the Color Maps page.
- Enable Color Maps with the cycle gadget near the top.
- Enable color matching by setting the third cycle gadget to CMap Color Match.

Note: Be sure to save the Parameter file from the Global Parameters menu to preserve the changes.

You can now render the image and wherever you painted lake in the Color Map the Water Ecosystem will be drawn. You can change the color of water in the Color Editor or create a Custom Ecosystem Model for water as in the example earlier in this chapter.

Ski Trails

One possible application for Color Maps is in the generation of ski trail maps. The technique is the same as for the lake in the last example except that you paint ski trails. You then set the color match values for the Snow Ecosystem instead of Water.

A sophisticated approach would be to use an aerial photograph as a basis for the Color Map, stenciling dark areas to black and lighter areas to white. This will give very accurate results but beware that the Color Map should be scaled to the size of the DEM before it is stenciled since scaling will result in anti-aliasing and the colors must remain pure.

Note: You can determine the size of the DEM for scaling purposes from the Map View window. Click in the outline of a DEM and its size will be displayed in the text field at the bottom of the Map View Control.

Lava Flows, Mirages and Other Cool Effects

For a dramatic effect there is another Color Map option that causes the colors in a Color Map to be rendered without shading.

Normally colors from a Color Map are applied to the terrain model and shaded based on the terrain slope and position of the sun. You can override the shading by selecting Luminous Colors in the Settings Editor.

The effect is to make the color-mapped area stand out sharply from the background terrain. It works great for creating molten lava or shimmering mirages.

- Open the Settings Editor by clicking on the Render Module icon in the Module Control Panel.
- Go to the Color Map page.
- Enable Luminous Colors with the cycle gadget in the middle of the page.

Note: Luminous colors will only apply to those areas of a Color Map that are not matched to an Ecosystem. See the examples earlier in this section if you do not understand Color Matching.

Animating Color Maps

While Color Maps in themselves are among WCS' most powerful tools, their power can be extended into the fourth dimension by animating them.

You can create time-lapse sequences of momentous ecological change or create stunning lava flow sequences with WCS and a little bit of patience.

Animating Color Maps is very simple in theory but it will involve some planning and time for execution. You must create a Color Map drawer for every frame in the animation. In each drawer you will place the Color Maps that correspond to a single frame.

When you select the Color Map Path in the Project Editor you select one of the drawers and WCS will automatically find the correct drawer for every frame of the animation.

Animated Color Map drawers must have numbers as part of the name that correspond to frame numbers. A typical sequence would look like this:

CMaps001, CMaps002, CMaps003...

Note: If the selected Color Map Path includes a number (such as CMaps124) WCS will assume that Color Maps are to be animated and rendering will be halted if there is no drawer corresponding to a specific frame.

Vector Madness

Creating Vector Objects

- Open the Map View Module.
- Draw the map.
- Select Object/Input Source from the map View menu.

You will be asked to set the digitizing input source to either tablet or mouse. For this exercise, select mouse.

If you own one of the supported Digitizing tablets you can digitize points using it if you prefer. See the Map View Module chapter for details.

Select Object/Add Points/New from the Map View menu.

You will be asked if the current active object is the one to digitize or if you want to create a new object. Select "New."

Notice that now there are instructions in the Map View Control window telling you what to do next. Right now it says "Set Label Point."

The Label Point is where a text label will appear in the Map View for the object you are creating.

 Set the Label Point with the mouse by clicking at that point on the map.

The instructions now say:

Set Point: 1. RETURN=Interpolate, C=Close, Q=Quit

 Digitize a few points by clicking on the map with the left mouse button.

You are adding a vertex to the vector object with each click. Now let's try another option.

Hit the RETURN key on the keyboard.

This places you in Interpolate mode. Now whenever you click on the map a number of new vertices will be added to the object connecting the last point to the current mouse position.

 Digitize a few more points and notice how the number of vertices adds up quickly.

Now you can quit digitizing by hitting either the C or Q keys. C will close the object back to the origin making the first and last points of the object the same. Q will stop the digitizing without closing the object.

Hit C to close the object and stop digitizing.

The instructions now tell you to either hit RETURN to accept or ESC to cancel the operation. If you are satisfied with the object's definition hit RETURN. If you want to leave the object unchanged hit the Escape key.

Hit Return to accept the object.

You will be asked if you wish to conform the object to the terrain now. Answering yes will extract elevation data from the terrain model and save it along with the vector coordinates to a file. It will overwrite any existing file for that object so do not say "OK" unless you are sure you want to do that.

Conform the object to the terrain by selecting "OK" in the requester.

The object will be drawn and saved to disk.

Notes: The object will be drawn according to the characteristics of the object in the Database Editor. When a new object is created its characteristics are cloned from the active Database Object. You can edit the drawing characteristics in the Database Editor at any time.

New objects are saved to disk in the Default Directory. You can set the Default Directory from the Project Editor or from the Directory List Editor. Access the Project Editor from the Global Menu command "New/Edit." Access the Directory List Editor from the Database Module Pop-up menu.

You can re-digitize an object any time you wish by repeating the process described here. The only differences are that you will not need to set the Input Source a second time and when you are asked if you wish to digitize the Active Object or create a new one you will select "Active."

Adding Rivers

Rivers and streams are special vector objects in that they follow valleys. This characteristic allows WCS to estimate where a stream would flow if you tell it where to start.

There is a special function available in the Map View Module for creating stream objects.

- Open the Map View Module.
- Enable Topos for drawing in the Map View Control window.
- Draw the map.
- Select Object/Create Stream/New from the Map View menu.

In the Map View Control you will receive instructions on how to proceed. Right now it is telling you to "Select stream start point."

Set first point of the stream.

The point to start the stream is at the stream's highest elevation. From the terrain map you should be able to select an appropriate place.

The instructions will change to read "Select approximate stream end point."

 Set the approximate place where the stream should end.

The purpose of the end point is to give a little direction when the stream hits flat areas where the stream could flow any direction. It will tend to flow in the direction of the stream end point. It may never actually get to the end point or might go right by it but it will always try to flow in the direction established between the start and end points.

· Continue on to next map.

If the edge of a DEM is hit by the stream you will be asked if mapping should continue on to the next DEM. Answering "OK" will let WCS attempt to map the stream further. There are sometimes difficulties in doing this successfully.

The nature of DEM data is imperfect. Sampling density is not always high enough to follow the lowest point of a stream course. Elevation reversals along the path can occur and when they do at the edges of DEMs the vector will bounce back and forth from one DEM to the other indefinitely without making any forward progress. If that happens you will see no growth of the vector on the map and you will be repeatedly asked if you wish to continue. Just say "Cancel."

In these cases you might have to append a few points to the stream manually using the Object/Add Points/Append menu command. You can then proceed with Object/Create Stream Append.

When you are done you will be asked if you wish to save the object.

· Save the object by selecting "OK" in the requester.

New objects are saved to disk in the Default Directory. You can set the Default Directory from the Project Editor or from the Directory List Editor. Access the Project Editor from the Global Menu command "New/Edit." Access the Directory List Editor from the Database Module Pop-up menu.

You can re-digitize a stream any time you wish by repeating the process described here or by using the Object/Add Points menu command.

Note: Stream objects are treated no differently from other vectors during drawing and rendering. Like all vector objects they are controlled by the Database fields. Variables such as line width and color are set in the Database Editor.

Political Boundaries and Roads

Vector objects can be used to show anything that can be represented by a line on the ground. If you look at any road atlas you will see thousands of such features. They include roads, trails, county and state boundaries, city outlines, parks, railroads, pipelines and power lines.

WCS lets you include all these objects in your renderings because it is a Geographic Information System.

Use the techniques above to create vector objects of any kind. Then set their drawing characteristics in the Database Editor to distinguish between different types of vectors. Make the roads one color and the boundaries another.

Database layers let you quickly enable or disable different types of objects. With very little setup time you can create a series of maps showing different features. These are very powerful visualization tools. Since the vectors are draped on terrain models in the renderings it is easy to see how they relate to the familiar contours of the landscape. Suddenly people don't need to be cartographers to understand maps!

Lighting up the City - Using Point Objects

Vector objects may be a series of disconnected points. They don't have to be lines. You can create a vector that simulates the cities on a map. In fact the cities can even light up at night in renderings and animations providing a unique and dramatic effect.

Following are the steps to create a series of illuminated points. Such an object will be rendered in its normal color when the sun lights the terrain around the points. When sunlight falls to 70 percent of full illumination the object points will change to a yellow-white color appearing like lights on the scene.

- · Open the Map View Module.
- Draw the Map View.
- Select Object/Add Points/New from the Map View menu.

You will be asked if you wish to digitize the active object or a new object. Select "New."

You will be asked to enter a name for the new object. You can name it anything you like up to 10 characters.

 Digitize points where city lights are to appear on your rendered images.

You digitize points by clicking in the Map View window. Instructions are provided in the Map View Control window in the text field at the bottom. When you are done digitizing, hit the "Q" key followed by return to accept the points as digitized. For a more complete description of digitizing see the instructions above.

 Open the Database Editor by selecting the Database button in the Map View Control window.

· Find the object name in the list on the right of the Editor.

The name should be highlighted with a blue line. That means it is the active object. Information about how to draw the object appears in the Database Field gadgets on the left side of the window. If it is not the active object click on the name in the list to activate it. Be sure not to double-click the name which will disable it.

Set the object's Class to "Illum Vec."

Near the top of the Database Editor there is a cycle gadget labeled "Class." Click on the circular arrow at the left end until it reads "Illum Vec." You are telling WCS to treat this object as an Illuminated Vector which will glow in the dark.

Set the object's Line Style to "Point."

In the middle of the Database Editor there is a cycle gadget labeled "Line Style." Set it to read "Point." This tells WCS not to connect the object's vertices with straight lines when drawing and rendering.

Set the object's render color to 128, 128, 128.

Using the sliders near the bottom of the window or by typing the numbers in the string gadgets set the red, green and blue color components to 128. This will make the points of the object gray when illuminated by the sun.

You can also change other fields either now or later as you like. You can make the width of the object points 2, 3 or more pixels using the Line Weight field. You can change the color that the object is drawn in Map View using the Draw Pen field.

Traffic on the Turnpike - Illuminated Vectors

We can create an interesting and unusual effect using vectors to simulate moving lights on the landscape.

In this example we will take an existing vector object that represents a highway and transform it into a moving streak of light that looks like a car's headlight beam.

- Open the ColoDemo.proj Project file.
- Open the Map View Module.
- Draw the map and position it so you can see the dark blue line near the top of the mapped area.
- Select Hwy34 as the active object.

Hold the shift key while clicking on the dark blue line. You will be asked if Hwy34 is the correct object. Answer "Yes." If Hwy34 was not the object it asked you about either you clicked on the wrong object or didn't click close enough to the right object. Try again until you find it or read on for another method of activating it.

 Open the Database Editor by selecting the Database button in the Map View Control window.

Hwy34 should be the active object. If it is not then find it in the list on the right side of the Editor and click on it to activate it. Information about it will be displayed in the Database Field gadgets on the left side of the window.

Set the object's Class to "Illum Seg."

Using the cycle gadget labeled "Class" you determine how WCS will treat the object. Set it to "Illum Seg." This tells WCS that the object is an Illuminated Segmented vector. Only certain portions of the object will be rendered in each frame of an animation and it will glow in the dark.

- Close the Database Editor and open the Settings Editor by clicking on the Render Module icon in the Module Control Panel.
- Go to the Motion Paths & Vectors page.
- Enable vector rendering to the bitmap.

In the lower half of the Settings Editor page there is a cycle gadget that determines if vectors are to be rendered. Set it to "Rndr to Bitmap." Other options are to render it to a file or not to render vectors at all.

Set the number of visible segments to 3.

At the lower right corner of the Settings Editor page there is a string gadget labeled "Segs." This determines how many segments of the vector object are visible in any given frame of the animation. You can set this value to any number greater than zero but between 2 and 5 should work well for this exercise.

- Create a viewpoint that looks at the area where this
 highway starts using the Camera and Focus position
 controls in Map View and the Altitude controls in Camera View (these are explained in the Motion Path tutorial). The first points on the highway are at the southwest end of the object.
- Set the sun position at a great distance from the scene, say Latitude -20° and Longitude 180°.

This will create night-time illumination.



Render frames 1 through 20 and you should see the effect.

You could duplicate the highway object and delete various numbers of points from the beginning of the object then set each up with the same Database Field parameters to create more cars on the highway. By reversing the point direction of some objects you can create a bi-directional traffic flow. The Database Module chapter tells how to duplicate objects.

Flying the Camera Motion Paths Made Easy

There are a lot of ways to lay out camera positions and motion paths in WCS. Here we'll show you how it's done. You might also want to go through the Motion tutorial in the Tutorials chapter if you haven't already to familiarize yourself with the different options available.

Before starting this exercise there are two Render Settings you need to disable.

- Open the Settings Editor by clicking on the Render icon in the Module Control Panel.
- Go to the Motion Paths & Vectors page.
- Set the Look Ahead cycle gadget to "No Look Ahead."
- Set the Velocity Distribution cycle gadget to "No Velocity Distribution." This feature will be discussed later in this section.
- Select the Keep button to close the Settings Editor.

Making Motion Paths in Map View

- Open the Map View Module.
- Enable topographic maps by selecting in the check box next to the word Topo and draw the map using the Draw button.

If there are too many DEMs enabled for all to be loaded, only those which fit in memory will be drawn. You can determine which are to be drawn by enabling and disabling DEM objects in the Database Editor. See the "Need for Speed" section above for an explanation of how to do this.

If the map doesn't show the area you are interested in, use the Pan, Scale, Center and Auto buttons in the Map View Control window to position yourself so you see the area of interest. These buttons are described in complete detail in the Map View Module chapter. In the interest of space they won't be covered here.

 Enable Camera and Focus points to be shown in the Map View by selecting the check box next to the word Inter. Inter stands for Interactive. Redraw the map.

Now you should see your camera and focus positions drawn in the map. Sometimes they are hard to see because they do not contrast well with all background shades of the terrain. The camera is represented by a box with two view arc rays coming out of it. The focus is a cross that lies halfway between the view arc rays.

If you can't find these items you should disable topos in the Map View Control window and redraw the map. If you still don't see them then they may be out of the picture. Continue on and we'll show you how to fix that problem.

- Select Motion/Set Camera from the Map View menu.
 Then click on a spot in the map where you want to place the camera.
- Repeat the process for the focus point by selecting Motion/Set Focus from the Map View menu and clicking on the point you wish to look at.

You have now established camera and target positions.

Click on the Camera icon and drag it with the mouse.

The camera position is moved as you move the mouse. You can drag it to any location on the screen (including out of the window so be careful or you will lose it). You can do the same with the focus.

In order to see what the view looks like from the points you have selected you will need to open the Camera View.

- Open the Parameters Module and select Motion to open the Motion Editor. Select the Cam View button to open the Camera View windows.
- Resize the Camera View so it fits on the screen and so you can also see the Map View.
- Now repeat the camera dragging operation in the Map View.

Notice that the DEM outlines in Camera View update as you drag the camera around. You can get the full wire frame view by selecting the Terrain button in the Camera View Control window whenever you like.

 In the Camera View window you can adjust altitude with the right mouse button. Go ahead and adjust it so that you can see over the terrain.

If the camera position doesn't appear to be changing go to the Motion Editor and select Camera Altitude or one of the other Camera Parameters in the Parameter List. Only the active group of Parameters can be modified interactively.

Now you have created a single view. It could be used as is to render a still scene or used as a key frame in an animation. Next we'll show you how to create a motion path from a series of still views such as this one.

Creating Key Frames in the Camera View

- If it isn't already, open the Motion Editor from the Parameters Module pop-up window.
- Set the Group button to its selected state (depressed).

This will ensure that when you create a key frame for any Camera Parameter a key frame will be generated for all Camera Parameters, latitude, longitude and altitude.

- Select Camera Altitude in the Parameter List to activate the Camera Interactive Group.
- If it isn't already, open the Camera View window by selecting the Cam View button in the Motion Editor.
- Set the desired view using both Map View and Camera View as described above.
- Select the Make Key button in the tall Camera View Control window.

You will be asked which frame the key frame should be made for. Enter zero (0) to make the first key frame. You will then be asked if you wish to make key frames also for the Focus Parameters. Answer "Yes."



You have now created a key frame at frame 0. You will need to add at least one additional key frame to create an animation. There is no limit to the number of key frames you can generate in a single animation.

 Repeat the process of setting views using both Map View and Camera View and creating key frames until you are satisfied that you have the motion path you want.

You can see the path as you create it in the Map View. If you want to see where the Camera and Focus are at any given frame you can set the frame number in the Motion Editor. Both Camera View and Map View will reflect that frame's settings.

You can revise the values for any given key frame by selecting a new position and invoking the Make Key command. Enter the frame number that you wish to overwrite.

There is a useful keyboard command for "Make Key." Just hit the Enter key in the numeric keypad while either the Motion Editor, Camera View, Camera View Control or Map View windows are active. It will have the same effect as hitting any of the Make Key buttons.

Another useful keyboard option is used in the Camera View to move the Camera when the Focus Group is active or the Focus when the Camera Group is active. Hold either of the Alt keys while you click and move the mouse in the Camera View. This lets you fine-tune the Camera and Focus positions without switching back and forth between active groups. Switching active Parameter groups has the side effect of undoing any changes if there are key frames present.

Tweaking Key Frames in the Time Line

Time Lines, or motion graphs, let you fine-tune your animation paths interactively. They are especially useful for adjusting altitudes since they also show the profile of the terrain along your path. They also have controls that let you ease in a motion.

 Open the Motion Time Line window by selecting the Time Lines button in the Motion Editor.

You will need to have at least two key frames for the active Parameter in order to do this. If the Time Lines button is ghosted it means that there are less than two key frames for the active Parameter. Either switch to a different Parameter or create some key frames for the active one.

The following instructions assume that you have more than one key frame for all the Camera and Focus Parameters.

 Use the cycle gadget at the top of the window to switch between Parameters. Those that have two or more key frames will be available for Time Line display.

You will see each Parameter graphed over the range of key frames that you have created. The vertical scales will vary depending on the range of values for each Parameter.

Select Camera Altitude with the cycle gadget.

You will see a red line and a green line in the graph. The red line is your Camera Altitude. The green line indicates the terrain profile elevations.

· Click on one of the white triangles in the graph.

The triangle will turn yellow indicating that it is the active point.

Click on the yellow triangle and drag the point up or down.

You are moving the Camera closer or further from the terrain. The graph will be redrawn and you will see the new view in the Camera View window.

 Click in the Camera View window and change the altitude with the right mouse button.

Notice that the value in the string at the top of the Time Line window changes but the graph itself doesn't change.

 Click in the value string at the top right of the Motion Time Line window and hit the Return key.

Now the graph changes. You must do this if you want to keep changes you make in the Camera View. Alternatively you could use the Update button in the Motion Editor to accomplish the same thing.

 Select Camera Latitude with the cycle gadget in the Time Line window.

Again there are two lines, one red and one green. As before, the red line is the Parameter graph but this time the green line is the velocity curve. It shows how fast the Camera is moving.

If the green line is straight then the velocity is constant over the animation. If the green line goes up and down then the Camera will move at different speeds throughout the animation. That may be what you want but if it isn't there are two ways to fix the problem.

The first method is to revise the path to even out the distance the Camera must travel between frames. The second, and easier method, is to use Velocity Distribution.

- Open the Settings Editor by clicking on the Render Module icon in the Module Control Panel.
- Go to the Motion Paths & Vectors page.
- Activate Velocity Distribution by setting the cycle gadget provided for this purpose.
- Check the graph again and notice the difference in the green line.

Velocity Distribution has smoothed out the velocity. The path remains the same but the distance the Camera travels between each frame is averaged over the length of the animation.

You can even increase or decrease the velocity over a number of frames with some of the other settings on this page of the Settings Editor. See the Render Module Reference chapter for more information.

Something You Can Bank On.

You can create exciting fly-through animations very easily in WCS. Start by laying out a motion path using Map View and Camera View as described above but don't worry too much about Focus key frames, they won't be needed once the basic path is laid out.

- Open the Settings Editor by clicking on the Render Module icon in the Module Control Panel.
- Go to the Motion Paths & Vectors page.
- Enable Look Ahead by setting the cycle gadget on this page.
- Set the Look Ahead Frames to 10 for starters.



Look Ahead causes the Camera to align with the motion path. It is like looking out of the cockpit window of an airplane. You will always be looking in the direction of flight.

The frame value is the number of frames ahead of the Camera that the Camera looks. The larger this number the smoother the motion will seem but the more turns will be anticipated. You will need to experiment to find the best value for your animation. It will depend partly on the speed of motion so there is no "correct" value for all cases.

 Set the Banking factor to 1.0 in the string gadget labeled Banking.

The Banking factor determines how much banking is applied to turns in the following steps.

Now we can create Bank key frames automatically.

In the Motion Editor, select the Bank button.

You will be asked what frame interval you wish to create Bank keys at. The default is for only those frames at which there are Camera key frames. Accept the default.

You can now render out the animation in wire-frame preview from the Camera View Control window (Anim button) to see if the amount of banking is what you expected. If it isn't enough set the Banking factor to 2.0 or more and repeat the process of creating Bank keys.

As the World Turns

Here is a trick you can use to create rotating globes. There are special Focus Point settings for when you want to look at the center of the earth.

- Open the Motion Editor from the Parameters Module Pop-up menu.
- Select Focus Altitude in the Parameter list.

The Focus coordinates will be displayed in the Interactive Group string gadgets on the right side of the Editor window.

Set the Focus Altitude, latitude and Longitude all to 0.0.
 Be sure to hit return after setting each value.

Now wherever the Camera is it will be pointed toward the center of the earth. In other words it will be looking straight down at the earth.

North will be oriented toward the top of the view by default but this can be changed with the Bank Parameter. Use Bank to rotate the earth's axis from vertical.

Another application of these special Focus values would be to create plan views for maps. You can use Bank to rotate the map to any orientation.

You can rotate the earth using the Earth Rotation Parameter.

- Select Earth Rotation in the Parameter List.
- Set its value to 0.0 and create a key frame at frame zero
 (0) by selecting the Make Key button and entering 0 in the requester that pops up.
- Set the value to 360 and create a key frame at frame 90.

This will create a full 360 degree rotation of the earth in 3 seconds. If you look closely you will probably see houses, trees and elephants flying off the earth as it spins at this extraordinary speed. Such are the joys of computer animation.



Spacing Out - Zooms

Because WCS sees the earth as a sphere you can zoom in or out from a rotating earth.

Begin by setting up the Focus Parameters for a rotating earth as above.

- Select Camera Altitude in the Parameter List.
- Set the altitude to 10000.
- Create a key frame for Camera Altitude by selecting the Make Key button.

You will be asked what frame to make a key at. Enter zero (0) and hit Return.

- Set the altitude to 10.
- Create a key frame at frame 90.

You have now created a 3 second zoom-in on the planet. To zoom out reverse the positions of the key frames.

If you have several different data sets for the globe you may want to use them each for a portion of the animation to maintain decent resolution throughout the zoom. You can dissolve between animation segments over half a dozen frames to keep the illusion seamless.

Several different global DEM sets are available. Please see Appendix C for more information.

Working With LightWave Landscapes as Texture Maps

Suppose you want to have a landscape shape in LightWave. Currently the best way to do that is to export the DEM data as an 8 bit gray-scale.

- Open the Data Ops Module and select Convert DEM to open the DEM Converter window.
- Select WCS DEM as the input format.

All the necessary data on the left side of the window will be filled in for you when you select a file to import.

- Select Gray IFF as the output format with the cycle gadget at the top right side of the window.
- Enter a name for the output file.

You can change the output directory too if you wish.

- Select Max-Min Stretch in the cycle gadget near the bottom right side of the Converter window.
- Enter 255 as the Max Out Value and 0 as the Min Out Value.
- Begin the conversion by clicking the Convert button.

An file will be written with all the elevation data in the selected input DEM shown as shades of gray.

Then you can import this into LightWave as an image and use it as a bump map or as a displacement map on a flat plane object.

If you use it as a bump map it will give the illusion of a 3-D surface through shading, but it won't actually change the height of the plane at any point. The advantage of this is you can use a single polygon rectangle.

If you use it as a displacement map it will actually create a 3-D object with varying altitudes. This requires building a flat plane object with lots and lots of polygons! To make a flat plane with many polygons in LightWave: Make a rectangle. Use the Triple command to turn it into triangular polygons and then use the Subdivide command multiple times to make more and more polygons.

Matching Motion Paths

WCS can both import and export LightWave's motion files. You can combine animations matching motions between LightWave scenes and WCS terrain. The process is actually fairly simple although there are many options for tuning the results.

We will concentrate here on exporting a motion path.

First you must create a motion path in WCS. There are instructions for doing it in this chapter and other parts of this manual. The Parameters Module chapter has tips on creating the optimum motion path for exporting to LightWave.

- Open the Parameters Module with the fourth icon in the Module Control Panel.
- Select Motion I/O to open the LightWave motion window.
- Enter a file name for output of the WCS motion path.

You can use the disk icon to the right if you prefer a file requester over typing.

All the other fields will be set automatically. You can change the scaling values to suit the size of objects in your

LightWave scene. You can change the shift values to offset the motion path along one or more axes from the origin in LightWave's universe.

If you want the motion path to be mapped around a large sphere (the size of the earth) use Spherical coordinates. Otherwise use the default Flat coordinates. If you want to change any of the units or scaling commands please read about them in the Parameters Module chapter first.

· Select the Export button when you are ready.

A LightWave motion file will be created that you can load directly into LightWave.

Note: You may find after experimenting a bit that you need to change either the View Arc in WCS or the Camera Lens in LightWave to get a perfect motion match.

Z Buffer Simulation

You can simulate the ability to have LightWave objects fly behind WCS mountains by using Projection Mapping in LightWave. Create a LightWave object that covers up the mountain then using Projection Mapping that object will display a piece of the same landscape image that you are using in the background. The object will then be invisible but if you fly an airplane object behind it the airplane will look like it just flew behind the mountain.

According to the esteemed authors of LightWave, future versions of LightWave will have actual Z Buffer support which will make all of this much easier. WCS already supports Z Buffers. Z Buffers are files that contain distance information.

Using LightWave for Clouds

You can create clouds in LightWave by creating a giant rectangle and using the Cloud surface. You can animate clouds to create moving clouds.

Render the cloud animation in LightWave and use it as a background image sequence for the WCS rendering. In WCS:

- · Open the Settings Editor in the Render Module.
- Go to the Processing page.
- Set the Background cycle gadget to "Background"
- Use the disk icon next to the field labeled "BG Path" to select the first image in the background cloud sequence.

Changing Image Resolution

Pictures for Print

- Open the Settings Editor by clicking the Render Module icon in the Module Control Panel.
- Select the Change Image Size button.

This will open the Image Scale window.

 Set the size of the desired image in the width and height gadgets.

You can use the double and halve buttons to increase or decrease the dimensions by a factor of 2 or enter the values directly in the string fields.

Print resolutions are typically 2048 x 1536 or 4096 x 3072.

Set the Pixel Aspect to 1.0.

Pixel aspects are usually 1.0 for print media and 1.2 for video.

Close the Image Scale window with the Apply button.

When you render the image you may run out of memory since large images have large memory requirements. To remedy the problem increase the number of segments that the image is rendered in.

In the Settings Editor increase the value labeled "Segmnt."

Try increasing it to 2 then 3 and so on until you find a number that doesn't give you an error message.

It is best to use segment numbers that divide evenly into the image height. That way there won't be any pixel rows lost at the bottom of the final image.

Vector Widths

If you increase the resolution of an image you may want to increase the line weight of Vector Objects since the values are in pixels. The following assumes that all Vectors have the same line weight initially. If they don't you should adjust each weight group individually.

- Open the Database Editor from the Database Module pop-up menu.
- Multi-select all Vector Objects by clicking on each Vector name while holding down the shift key or by using layer selection.



 Increase the Line Weight field depending on how much the image size was increased.

If the image size was doubled, double the line weights. If it was quadrupled, quadruple the line weights, and so on.

Those Zany Z Buffers Saving Z Buffers

In order to use Z Buffers in the following demonstrations you will first need to save them when you render images.

- Open the Settings Editor by clicking the Render Module icon in the Module Control Panel.
- Go to the Image Save page.
- Enable Export Z Buffer with the cycle gadget.
- Set the Z Buffer export format to "Z As Floating Pt IFF" with the bottom-most cycle gadget on the same page.

Z Buffer files will be saved in the same directory as your rendered frames. They will be larger than the image files themselves by as much as a factor of two. Be sure there is storage space for them.

Converting a Z Buffer to Gray-scale

Gray-scale Z buffer images can be used in programs like Light-Wave 3D to help in creating objects for Projection Mapping. For instance a gray-scale Z Buffer would be easier to trace the outline of a near ridge than would the actual 24 bit rendered image. See the description above of how to simulate Z Buffers in LightWave.

- Open the Data Ops Module with the second icon in the Module Control Panel.
- Open the DEM Converter window.
- Select Z Buffer as the input format with the cycle gadget at the top left side of the window.
- Select the Z Buffer file to convert using the disk icon on the left side of the window.
- Select Gray IFF as the output format in the cycle gadget at the top right side of the window.
- Enter a file name.

Enter a file name for the output IFF image. You can change the output directory too if you like. You can use the disk icon which will bring up a file requester or just type in the names.

- Go to the Pre-processing page using the cycle gadget directly beneath the Header Bytes field on the input side of the window.
- Enter a Ceiling value of 100000 and select the checkbox next to the word Ceiling.

This will eliminate those parts of the image that never had anything rendered in them (very high Z values) from skewing the color distribution towards bright shades.

 Select the Test button on the left side of the window near the bottom.

The input file will be opened and scanned for maximum and minimum values.



 Under Two Value Equivalence, enter the minimum test value in the Input column as Value 1. Enter the maximum test value as Input Value 2. Enter 255 and 0 in the Output column as Values 1 and 2.

This will cause distant objects to be dark (0) and near objects to be bright (255).

Click the Convert button to start the conversion.

Progress gauges will show the different operations as they take place.

Load the image into a 24 bit paint program for viewing.
 Closer parts of the scene will be in light colors. Distant parts will be dark.

Converting Gray-scale to Z Buffer

You can simulate a Z Buffer for use when compositing background images as WCS renders by creating a gray-scale picture and converting it to a Z Buffer. The picture could be an abstraction of the image that is going to be composited.

For instance say you wanted to have an airplane rendered in the foreground of a WCS scene. You would render the airplane elsewhere and in a paint program stencil all the airplane to white and all the rest of the image to black. Save the file as an IFF image. Then:

- Open the Data Ops Module with the second icon in the Module Control Panel.
- Open the DEM Converter window.
- Select IFF as the input format with the cycle gadget at the top left side of the window.

- Select the stenciled IFF file to convert using the disk icon on the left side of the window.
- Select Z Buffer as the output format in the cycle gadget at the top right side of the window.
- Enter a file name.

Enter a file name for the output Z Buffer file. You can change the output directory too if you like. You can use the disk icon which will bring up a file requester or just type in the names.

 Select the Test button on the left side of the window near the bottom.

The input file will be opened and scanned for maximum and minimum values.

 Under Two Value Equivalence, enter the minimum test value in the Input column as Value 1. Enter the maximum test value as Input Value 2. Enter 100000 and 0 in the Output column as Values 1 and 2.

This will cause the white airplane to be a Z Buffer distance of 0 and the background to be very far away (100000 kilometers).

Click the Convert button to start the conversion.

Gauges will show the progress.

Now you can follow the procedure below for compositing the image as you render in WCS.

Merging Images with Z Buffers

If you want part of a background image to appear in front of the terrain in a rendered image you will need to use a Z Buffer to create a mask. See the instructions above on how to create such a mask out of another image. Then set up the WCS Render Settings as follows:

- Open the Settings Editor by clicking the Render Module icon in the Module Control Panel.
- Go to the Processing page.
- Enable Background with the cycle gadget.
- Select the background image using the disk icon next to the field labeled "BG Path."
- Enable Z Buffer with the cycle gadget.
- Select the Z Buffer file using the disk icon next to the field labeled "Z Buf Path."

You are now set to render your image.

Note: If you are using a sequence of images and Z Buffers you do exactly the same procedure. You can select any of the sequence files and WCS will figure out which one goes with which frame by the numbers in the sequence file names.

Release Your Terraforming Urges

WCS has import and export capabilities that let you modify DEM objects in a paint program. You can add mountains in the shape of a logo or transform the earth into a cratered moonscape.

Begin by selecting a DEM to modify.

- Open the Map View Module.
- Enable Topo drawing by selecting the check box labeled Topo in the Map View Control window. Then draw the map.
- Decide which DEM you want to operate on and click inside its outline.

In the bottom of the Map View Control window there is text field that tells what object you just clicked on. Make a note of the name.

- Open the Data Operations Module with the second icon in the Module Control Panel.
- Select Convert DEM to open the DEM Converter window.
- Select WCS DEM with the cycle gadget labeled Input Format.
- Select the disk icon at the left side of the window and select the DEM file to export.

A file requester will appear. You may need to search to find the DEM objects. Those included on the WCS distribution diskettes are in a drawer called WCSProjects:Topos.object.

When you find the file and accept it with the OK button in the file requester WCS will fill in some values on the left side of the window. You don't need to change anything else on this side of the window.

 On the right side of the window select Color IFF as the Output Format. Enter a file name in the Name string. This will be the name the IFF image version of the DEM is saved under.

You might just append .IFF to the DEM name so you remember what the file is later.

Hit the Test button on the bottom left side of the window.

In a few seconds you will see the maximum and minimum elevation values present in the DEM file appear in two text fields next to the Test button. Make a note of these values, you will need them again later.

- Enter the smaller of the two values on the bottom right side of the window on the line labeled "Value 1" under the word "Input." Under "Output" on the same line enter zero (0). Now place the higher value under "Input" on the line labeled "Value 2" and place 255 in the string to the right.
- Select the Convert button to begin processing the DEM file.

In a few seconds when the progress window disappears you can go to your favorite 24 bit paint program and load the image.

Doctor the image to your heart's content. Remember that you are painting in elevation. 255 (white) is the highest elevation and 0 (black) is the lowest.

Often the best approach is to use transparency while painting so you only lighten or darken the image a little with each stroke. This will prevent unlikely cliffs and chasms from being created. A text brush can be stamped on the terrain to create a raised logo. A doughnut-shaped brush, white on the rim and black in the middle, can be used to generate craters.

Anti-aliasing is also useful to ease the transitions from original DEM to terraformed landscape.

When your artwork is done save the image. It is time to import the image back into WCS as a DEM.

- In the DEM Converter window select IFF as the input format.
- Select the image file you doctored using the same procedure as above.

All of the information you need should be filled in on the left side of the window automatically.

- On the output side, select WCS DEM as the format.
- Enter a new name for the object. You can't use the same name as the original since that would cause a Database name conflict.

You will need to set the DEM Registration coordinates so WCS knows where on the globe to map the imported DEM. You can obtain these from the Map View window.

• Move the mouse pointer over the Map View to the upper left corner of the DEM object that you just operated on. In the Map View Control window it will tell you what the latitude and longitude of the mouse is. Read the position and enter the values in the High Lat and High Lon strings in the DEM Converter.

You may want to enlarge the Map View so you can get an accurate read on the coordinates. For DEMs supplied on the distribution diskettes, all values will end in .0, .25, .5, or .75. If the DEM has been interpolated the coordinates will also have been interpolated.



- Move the mouse pointer over the Map View to the lower right corner of the DEM object that you just operated on. Read the position and enter the values in the Low Lat and Low Lon strings in the DEM Converter.
- In the strings under "Two Value Equivalence" enter 0 and 255 for Input. Under Output enter the minimum and maximum values determined in the Test operation above.

In other words, just exchange the values that you had in these columns during export.

Select the Convert button to import the image as a DEM.

A new object will be added to the Database.

- Open the Database Editor from the Database Module Pop-up menu.
- Disable the original object by double-clicking its name in the List on the right side of the Editor window. There should not be an asterisk in front of the name. If there is, double-click it again.

The new object will be found at the bottom of the list. It should be enabled (have an asterisk in front).

- Save the Database with the Save button.
- Redraw the Map View.

The new object should appear where the old one was. If it appears somewhere else then the coordinates were incorrect during the import operation.

Appendix A: Troubleshooting

Technical Support

If you have exhausted all the resources in this manual and are still having trouble with a feature of the program, contact us for technical support:

voice: (303) 659-4028

fax: (303) 659-4028 (call voice first) net: wcsinfo@arcticus.burner.com

We will make every attempt to be here to take calls from 10:00 AM to 12:00 noon and from 1:00 to 4:00 PM. If you don't reach us please don't be upset. We don't want to just have a "warm body" managing tech support. We want to give you real answers and listen to your complaints (well at least the serious ones).

Handling tech calls personally will help us improve future versions of the program and manual. Running a business, however, often means being out of the office on errands and occasionally even taking a vacation. Please just leave your name, phone number, WCS serial number and a brief message describing the problem you are experiencing and we will call you back as soon as we can.

In order for our technical support staff to verify that you are a registered user, please have your serial number handy when you call. This protects your investment in the software as well as our future as a company.

You can find your own personalized serial number in the Version window that opens when the program starts. The window can be

accessed at any time from the Project menu.

Be ready to describe in detail the problem you are having, and the exact steps you are going through to experience the problem.

It's best if you can call from a phone that is near your computer, and that you have WCS running when you call.

Of course you needn't wait until you have a problem to call. Feel free to let us know how you like WCS and any features you would like to see added or enhanced in future versions.

Appendix B: A Lesson In Geography

Geographic Coordinate System

- Latitude
- Longitude
- World Map
- Animation Considerations
- Map View Considerations

When early explorers set out to discover new lands in their wooden sailing ships they needed some way to keep track of where they were in relation to their home port. They needed a global coordinate system that worked well on a spherical planet.

The system they and their cartographers devised is now known as the Geographic coordinate System. It divides the globe into degrees of arc around the planet's circumference.

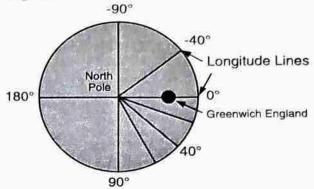
Longitude is the term for the measurement in the east-west direction parallel to the equator and latitude is the measurement north and south from the equator to the poles.

Longitude

Think of the globe in cross-section, sliced along the equator and looking down on it from the north pole. The earth would appear as a circle.

If you draw a line outward from the center of the circle to the rim you would be drawing a line of longitude.

Now if you measure off and draw 359 more such lines, each one equally spaced around the rim of the circle, you would have laid out 360 degrees of longitude. In geometry and geography arcs are measured in degrees.



There are 360 degrees of longitude around the whole earth.

Each of the lines of longitude in reality is a plane, not a line, that slices the earth from the north pole to the south.

It is only when viewed from either pole that they appear as lines. They are called prime meridians.

Longitude planes do form a line at their intersection with the earth's surface. It is a line that arcs from pole to pole in a due north-south direction. These are called longitude lines and can be seen on many globes and maps.

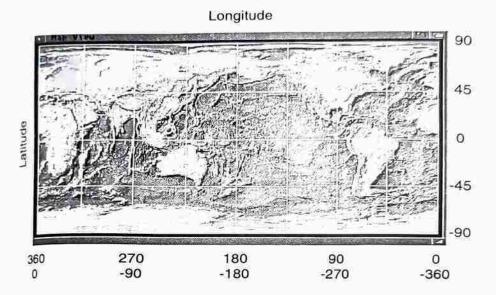
There is one special longitude line, designated arbitrarily as "zero degrees longitude." It runs right through Greenwich, England on its north-south course.

From this line all other lines of longitude are referenced as either east or west longitude depending on whether they lie to the east or west of this special line. Thus most of Europe and Asia are east longitude and North and South America are west longitude.

The longitude lines are numbered according to their degrees of

Appendix B - Lesson in Geography

arc from the Greenwich meridian. Contrary to some conventions, WCS considers positive to be west and negative to the east of Greenwich.



Since most of us seldom venture out on the high seas in small boats these days, we have little need to consider our longitude position from moment to moment. If we wanted to though we could. At any given moment we are positioned at some longitude coordinate. Right now as I write this from my home north of Denver I am almost on the one hundred and fifth degree of longitude west of Greenwich. Actually I am a little bit east of that line which brings up the next question: How do we achieve more accuracy in our geographic coordinate system?

Since there are only 360 degrees spread around the entire circumference of the planet each degree covers quite a wide piece of terrain. In fact a degree is about 69 miles or 111 kilometers wide at the equator. For the purposes of navigating in WCS we need much finer measurements than that.

In traditional navigation each degree is sub-divided into 60 units called arc-minutes. Each arc-minute is one sixtieth of a degree in width. They in turn are sub-divided into 60 arc-seconds. Thus there are $60 \times 60 (3600)$ arc-seconds in a degree.

The terrain data supplied with WCS is sampled at intervals of 3 arc-seconds or 1/1200th of a degree. Using the 111 km width per degree we see that the sample interval is roughly 92.5 meters at the equator. The data is frequently referred to as 90 meter data although it is technically a misnomer for reasons that will be discussed soon.

Rather than use the degrees/minutes/seconds system WCS uses a more easily negotiated system of degrees and decimal fractions. For instance my real longitude here in Brighton, Colorado is 104.088 degrees. To convert degrees, minutes and seconds to decimal degrees use this formula:

decimal degrees = degrees + arc-minutes/60 + arc-seconds/3600

There is one other significant item to note about lines of longitude before we move on to discuss latitude. Notice that lines of longitude converge toward the poles. They become closer together and actually intersect at either pole. A degree of longitude is not the same width everywhere. In fact it is continuously diminishing from the equator to the poles where it becomes zero.

This fact has given cartographers, people who make maps, fits for hundreds of years. There is no way to accurately represent a sphere on a flat piece of paper. Various projection systems have been devised to accomplish the task but inevitably, no matter what projection system is used, distortions occur. Most maps are precisely accurate only in a very small area for this reason.

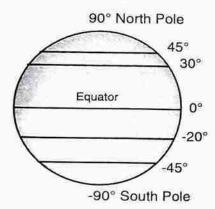
Likewise it is problematic to convert WCS' longitude/latitude coordinates to those of other 3-D modeling programs. Such conversions are only valid when working in a limited area of the globe.

Latitude

In some ways, latitude is simpler to understand than longitude. Instead of 360 degrees, the earth is divided into 180 degrees of latitude. There are 90 between the equator and each pole. North is considered positive and south negative probably because most early cartographers lived in the northern hemisphere.

Once again envision the earth in cross-section but this time cut from pole to pole along a plane of longitude. The equator will be represented by a horizontal line through the middle.

Now divide the circumference in 90 equal steps from each pole to the equator. A line drawn through each step parallel to the equator will represent a line of latitude.



As before, in reality we are only seeing one dimension of a two dimensional plane that runs parallel to the equatorial plane. Notice that the lines become closer together as they approach the poles even though the distance along the circumference of the planet is the same between each plane.

Lines of latitude are the lines formed by the intersection of latitude planes with the surface of the earth. If you were to view the same drawing from the north pole instead of in cross-section you would see the latitude lines as concentric circles

Because latitude lines are parallel to the equator they are called parallels of latitude. The distance between two latitude degree lines is always the same anywhere on the planet, approximately 69 miles or 111 kilometers.

The same sub-division rules apply for latitude as for longitude. Again we use decimal degrees of latitude in WCS instead of the minute/second system for ease of computation.

To illustrate, here at our office our latitude position is 40.015 degrees.

WCS uses the latitude/longitude system for setting camera, focus and sun positions. To set up a scene that shows the mountain view I enjoy, place your camera at 40.015 latitude and 104.088 longitude. Our altitude is about 1.61 kilometers above sea level. The mountains to the west run north-south and begin at around 105.25 degrees longitude so set that as your focus longitude with the same latitude and altitude as the camera.

In WCS, the coordinates of the sun represent the point on the earth at which it is directly overhead. That of course varies with the time of day and season of the year.

Animation Considerations

When setting up a single still scene in WCS you may use either the plus and minus 180 degree longitude notation or the full 360 degree notation. The results will be the same view.

When animating it makes a difference, however which system you use. If you wish to move the camera from one side of the planet to the other, WCS must determine which way around the earth to go. By convention we have decided to make increasing longitude the east to west movement (the way the sun moves). So if you want to go from 100 degrees west to 80 degrees east (a movement of 180°) and move in a sun-wise direction you would

Appendix B - Lesson in Geography

need to set your destination longitude as 280 degrees (100 + 180). To move contrary to the sun you would set the destination as -80 degrees (100 - 180).

You may go around the earth as many times as you like in either direction. Just keep adding or subtracting 360 degrees for each full rotation. This same injunction applies for the focus position and the sun.

Map View Considerations

Always bear in mind when using WCS' Map View that distances and sizes of objects may be deceiving. This is especially true when the map covers a large portion of the world.

Remember that the map scale is accurate only over a very small area. WCS computes the appropriate scale using the coordinates at the center of the Map View window. Areas above and below the center may be distorted. When the equator is at the center, Greenland and Antarctica will appear too large.

When Greenland is at the center, Europe and the United States will appear too small.

In fact if the map is centered on the far north or south all the DEM's will be reduced to thin lines running north-south.

This is an attempt to represent the area at the center in the correct X/Y ratio.

Appendix C: Obtaining Geographic Data

WCS uses landscape data files as the basis for its pictures. It can read U.S. Geological Survey "one degree" format DEM data. WCS comes with some data for Colorado at fairly high resolution. It was derived from this U.S.G.S. data set. The entire earth is also provided with the program (or when you send in your registration card) at a low resolution suitable for viewing the entire earth.

Much DEM (Digital Elevation Map) and DLG (Vector Object) data is available free on the Internet at various ftp sites. Since these sites are subject to change or discontinuation, call us and we will provide you with current information.

In the United States most widely available coverage is provided by the U.S. Geological Survey. Their offices in Denver and Reston, Virginia can provide you with coverage maps and the data itself. As of this manual's publication date they only provide DEM data on 9-track tape which is a bit inconvenient for most small computer users. Vector data is available also on CD-ROM.

There are local services across the country which can transfer the data (usually to MS-DOS formatted) floppy disks or SyQuest cartridges. One such service is located in Boulder, Colorado and they would welcome your call for a price quote: Computer Terrain Mapping, Inc. (303) 444-1670. CTM also can provide global and full U.S. coverage at resolutions suitable for regional work.

You might also try contacting Micro Map & CAD at (303) 988-4940. They have a full line of data and transfer services.

There is a BBS devoted exclusively to GIS issues in Boulder, Colorado. You may find additional data online there. It is also a good place to read the latest GIS news. The phone number is (303) 447-0927. The cost is \$48 per year with a free 45 day trial period.

Much DEM data can be obtained through Virtual Realities Labs in their own proprietary format on CD-ROM. With some limitations this data can be imported into WCS. VRL has offices in San Luis Obispo, California.

Questar Productions plans to produce a CD-ROM of one degree DEM data for the United States. Please call for current information.

We have two global data sets at 5 and 30 arc minute coverage, the entire United States at 30 arc second coverage, the entire United States at 3 arc second coverage (the type of data included in the program package) and we can obtain for you higher resolution data (30 meter) upon request. We also can obtain DLG data at 1:100,000 scale for virtually the entire U.S. and a global vector data set as well.

In addition Questar would be happy to provide WCS contract services and technical consultation (beyond the operation of WCS) at reasonable rates. Call us or write for a quote at:

(303) 659-4028 Questar Productions 1058 Weld County Road 23.5 Brighton, Colorado 80601 USA

By the way, if you locate any sources of data that may be useful to other WCS users we would appreciate hearing about them. These things change constantly and our current information may not be the most complete or up-to-date. With your help we can do a better job of serving all of our esteemed users (yourself included) in the future.

Bibliography

This is a bibliography of a few ecology and GIS data references that we have found useful. Most of them are good general works in layman's English.

If you want to use World Construction Set to create realistic renderings of a particular geographic area, it helps to know more about the geology and plant life of that area.

Some of these sources are especially useful as background reading for the Colorado geographic area included as a sample data set with the program. You can find information for other geographic areas at a well-stocked bookstore or your local library.

Also look for publications from governmental agencies. Virtually every country and state has natural resource departments that publish maps and guidebooks.

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Glossary

24 Bit

Computer images are stored at varying color resolutions. The more resolution the more different colors that the image can contain. A bit is the smallest unit of memory available on a computer. It can have a value of 1 or 0. By combining multiple bits more different combinations of 1 and 0 can be stored allowing a wider range of numbers to be represented. 24 bit images contain 24 bits of information for every pixel, eight each for red, green and blue color components. This allows a total number of colors equal to 2 to the 24th power or 16,777,216 different colors. This is near the limit that the human eye can discern. 24 bit imagery is the standard for professional computer artwork.

Animation

WCS renders single images but they can be compiled into a moving sequence using professional video recording equipment or special computer hardware and software. Animation refers both to the final moving imagery and the effort required to make it. WCS provides all the tools you need to create animated image sequences.

Background Image

WCS can composite an image behind the terrain it renders. It could be an image of clouds, a star field, another planet or anything else. This is called a background image. Background images can also be composited in front of the terrain or embedded in the terrain with the simultaneous use of Z Buffers.

Bitmap

When WCS renders an image it stores the color information as it renders in three computer memory arrays. These are called bitmaps or together, the bitmap.

Camera

In 3-D computer graphics the point of observation, the viewpoint is referred to as the Camera or Camera Point. It is the point in space from which you look at a scene. It can be animated along with the Focus Point to create the sensation of motion.

Color Map

Special bitmaps that are used to control the placement of color and texture on a landscape are called Color Maps. There is a pixel in the Color Map for every elevation point in the terrain model.

Conifer

Trees that have bear their seeds in cones and have needles rather than leaves are called conifer trees. Usually they do not shed all their needles seasonally so they look much the same in winter as in summer. Their shape tends to be conical.

Contour

Elevation data can be expressed on a map as a series of lines, each line being at a constant elevation. The lines are called contours and an area with contoured elevations is called a contour map.

Custom Ecosystem Model

Some vegetation and terrain covers are too complex to model with a single plant species, or a single color. For these WCS lets you create models of the ecosystem and make them as complex as you like. You can have many tree species, all different colors and heights, combinations of deciduous and conifer trees, and textures such as ground and rock all in the same area on the terrain. These complex models are called Custom Ecosystem Models or just Ecosystem Models.

Database

WCS keeps track of the names and drawing characteristics of all the Objects in a scene by use of a database. The Database does



not contain the Objects themselves only their names and characteristics.

Deciduous

Trees which shed their leaves once a year are called deciduous. They tend to have crown shapes that are ovoid or spherical and branch patterns that are more irregular than conifer trees.

Digital Elevation Model (DEM)

For computer terrain modeling the basic unit of data is the digital elevation model or DEM. It consists of a grid of regularly spaced points with an elevation value for the terrain at each grid point.

Directory List

WCS can retrieve Object data from anywhere on your computer system when it needs it for drawing and rendering. To help it find the data there is a list of directories that tells WCS where to look. This is called the Directory List and is an essential part of WCS' operation.

Ecology

The study of relationships between organisms and their environment is called ecology. Interestingly it is derived from the Greek word, oikos, which means house.

Ecosystem

An ecosystem to biologists is an interrelated group of organisms, both animal and plant, and their environment. An ecosystem includes the rocks, minerals, soil, bacteria, fungi, vertebrates, worms, grass, trees, shrubs, water, wind and sunlight and the interactions between all the organisms and their environment.

In WCS we use the word Ecosystem loosely to mean the land cover, whether it be trees of various kinds, tundra, rock, water or whatever

Ecosystem Model

See Custom Ecosystem Model.

Editor

There are many windows in WCS. Those that let you edit or modify Parameters, Render Settings, Projects, Databases, Directory Lists and Custom Ecosystem Models are called Editor windows.

Focus Point

In World Construction Set an image is created by focusing the imaginary Camera (the viewpoint) at a point in space. That point is called the Focus or Focus point. It can be anywhere on, above or below the terrain, at the center of the earth or out in space. It can be animated along with the Camera to create the sensation of motion.

Fractal

Anything which is similar to itself at all different scales is said to contain fractal properties. A landscape is to some extent a fractal surface in that at different scales of resolution you can see the same shapes. For instance a coastline seen from space has a scalloped appearance. From an airplane you see the same shapes although you are seeing the scallops within the scallops that you saw from space. When you stand on the beach and look down at your feet you see the same shapes left behind in the sand by the last wave.

Since digital elevation models are not perfect representations of the terrain down to the last grain of sand, we make use of their fractal properties to generate data at finer and finer granularities to fill in the missing detail. This is called fractalizing the terrain model.

Frame

Animations, like movies, are composed of a series of individual images flashed on the screen so fast that they blur into a moving



picture. Every image in the animation or movie is called a frame. The speed at which the animation is displayed is called the frame rate.

Geographic Information System (GIS)

A new branch of computer science is emerging. It is the science and technology for representing data of all kinds in the form of two and three dimensional maps for spatial analysis. The data can be anything from the layout of transportation systems to demographics. The computer and software that displays and analyzes spatially-referenced data is called a Geographic Information System.

Geography

Geography is science that studies the spatial arrangement of features on the earth. The features include topography, landforms, climate, soil, vegetation, population, culture, industry, agriculture, and anything else that has a spatial distribution over the earth. Sometimes the arrangement of the features themselves is referred to as the geography of an area.

Global Menu

In WCS many commands are issued by clicking with the mouse pointer on a button on the screen. There are also commands available in pull-down menus found at the top of the screen. There are two sets of menu commands, those available when the Map View window is active and those that are available when any other window except Camera View is active. Those latter menus are called global menus in this manual.

IFF-ILBM

IFF stands for Interchange File Format and is the standard for many types of files on the Amiga computer. ILBM stands for Interleaved Bitmap and is a special kind of IFF file designed for pictures. The IFF-ILBM standard was designed by Electronic Arts, Inc., the makers of Deluxe Paint and pioneers in the computer graphics industry.

Image

A picture rendered by WCS using all of the Motion, Color and Ecosystem Parameters, Render Settings, DEM and Vector objects is called an image or a rendered image.

Interactive

Adjusting Parameters such as the Camera position, sun location and haze distances by dragging an icon across the screen with the mouse is called interactivity or interactive modification of the Parameter.

Key Frame

Special frames of an animation that are used as control points or knots on a splined motion curve are called key frames. You set the values you want honored at the key frames and all values at frames in-between key frames are automatically generated by WCS.

Latitude

The distance north or south of the equator measured as an angle or arc is called the latitude. It is measured in degrees with 0 being at the equator, 90 being at the north pole and -90 being at the south pole.

Landscape

In WCS a digital elevation model that is covered by Ecosystems is called a Landscape.

Longitude

The distance east or west of Greenwich England measured as an angle or arc is called the longitude. Longitude is referred to as east or west depending on which way around the globe it is measured from Greenwich. The United States is west longitude, Asia is east.



Map

A map is a two dimensional projection of geographic information. It can be thought of as a view looking down on the earth. North is generally at the top of a map. Objects like roads, streams and boundaries are represented by lines on a map. Terrain elevation information can be shown as contours, shaded relief or a gray-scale.

Motion Path

The movement of either the Camera or Focus Point in WCS is considered to be along a motion path and is defined in terms of key positions through which a smooth curve is interpolated.

Object

In WCS the word Object has a specific meaning. It is anything represented in the Database which will be seen in rendered images or maps. Objects include two categories, Vectors and DEMs. Vector objects represent such things as roads, streams, boundaries and the outlines of DEMs. DEMs are the terrain elevation data.

Parameters

Motion, Color and Ecosystem variables in WCS are called Parameters. They can all be animated. They are stored in a Parameter file.

Project

A project consists of the names of all the other files and directories that WCS uses to create a scene, image or animation. A project is stored in a Project file, frequently with the suffix ".proj."

Relative Elevation Model (REM)

Relative Elevation Models contain information about the concavity (valleys) and convexity (ridges) of a terrain model. REMs are derived from the digital elevation models before any rendering is done in WCS. They are generated automatically the first time

they are needed. They help determine where Ecosystems will be placed on the landscape according to rules of nature.

Render

Render means to create an image using the Objects, Parameters and Render Settings in WCS. Actually WCS creates the image, all you need to do is hit the Render button. An image file will be saved to your hard drive when rendering is complete. To render an animation you tell WCS to render a sequence of images. You lay out the Parameters in advance using WCS' many windows and interactive features.

Render Settings

WCS uses variables that can be animated, that is changed over the course of an animation, and variables that remain constant. Those that remain constant are called Render Settings or just plain Settings. They include such things as whether or not to render Vector Objects, what frame to start rendering, and how many frames to render. Render Settings are stored in the Parameter file.

Settings

See Render Settings above.

Shaded Relief

Shaded relief is a way of showing a three dimensional terrain model in a map or image. The shading simulates shadows that would be cast by the sun in the real world making the map appear 3-D. Usually the light source is from the top left, or top right of the map so shadows fall on the lower sides of ridges.

Spline

Curve fitting is important in the creation of motion paths and other animated effects in WCS. Splines are smooth curves connecting the control points (key frames) constructed out of segments of cubic curves.



Surface

In WCS a Surface is a DEM that is covered with a series of color gradients rather than Ecosystems. The color gradients represent different elevations.

Texture

To create trees, rocks and grass WCS uses textures which are really two dimensional bitmapped images that project upward from the terrain making them appear three dimensional.

Topography

Topography is a general word used when talking about terrain elevations in an area. It means the elevation values of an area rather than a single point.

True Color

Sometimes 24 bit graphics are referred to as true color. It means that they are nearly as high in resolution as the human eye can distinguish. In actuality the real color spectrum is continuous but for computer use we sample the spectrum only often enough to fool the eye.

U.S. Geological Survey (USGS)

The branch of the United States government responsible for assembling and disseminating maps and map data is the Geological Survey. They are a branch of the Department of the Interior. Most governments have something similar and they are a good place to start when looking for digital terrain data.

Vector

Mathematicians define a vector as something with magnitude and direction. We use a more tangible take-off on that: a line, a point, a series of connected lines, or a series of disconnected points that represent some feature of interest on the landscape. Vectors are used in WCS to represent roads, trails, streams, boundaries, buildings, cities and the outlines of DEMs.

Viewshed Analysis

See Visual Sensitivity Analysis below.

Visual Sensitivity Analysis

A frequently asked question whenever there is new building construction or activity of dubious aesthetic appeal proposed for somewhere on the landscape is, "Will it be seen from (my house, the park, the highway...)?" To answer the question landscape architects and planners use Visual Sensitivity Analysis. A viewshed is the area that can be seen or can see a certain point on the terrain.

For instance a visual sensitivity analysis might show that a building site can only be seen from one spot on a certain highway. Or it might determine that a logging area can be seen from an adjacent National Park. Such analyses are used every day to help make decisions about what kinds of development activity may take place in what locations.

Z Buffer

Distance information is generated by many 3-D modeling programs including World Construction Set. The information is used to determine which Objects are rendered in front of which others and which are obscured. The distance information can be stored and written out to a hard disk when rendering is complete. The array of distance information is called a Z Buffer. Z is the distance axis when rendering, hence the name.

Z Buffers can be used to merge two separate images together in WCS. While one image is rendering, the Z information it is generating is compared to the Z Buffer of the second image. Wherever the second image has lower Z values the second image is placed in front of the image currently being rendered and vice versa.



Index

A

```
Animation 1-2, 5, 37, 48, 82-85, 96-98, 102, 110, 114, 122, 156, 172, 176, 236, 253, 299-300, 303, 305, 311-312, 314, 316, 324-325, 329, 335, 344, 352, 355, 359, 366, 387, 389, 393, 404, 408, 421, 437, 454, 459, 477-478, 481-482, 485-486, 489-491, 494, 497, 502, 515, 557, 566, 568-569, 591, 600, 604-611, 615, 629, 634, 641, 645-648 Automatic Installation 13, 38

B
Background Image 122, 197, 214, 415, 482, 520, 522-523, 563, 615, 621, 641

C
Camera 21, 27-28, 33, 35, 48-49, 62-68, 70-72, 75, 82-89, 92-97, 100-102, 104, 117, 124-125, 129, 131-132, 152, 154, 158, 169, 176,
```

100-102, 104, 117, 124-125, 129, 131-132, 152, 154, 158, 169, 176, 178, 180, 214, 236, 240, 252-253, 262, 266, 282, 289, 292, 296-301, 304-306, 310-321, 324-330, 333, 335, 340-341, 344-348, 351, 355-362, 364-367, 371-372, 374, 376-381, 383-397, 400, 403-404, 407-409, 411-415, 426, 429, 453, 462, 474, 481, 491-492, 494, 500-503, 514, 519-520, 530, 547, 549, 552, 556-557, 559-561, 563-564, 568, 600-611, 614, 634, 642, 644-647

Camera Position 63, 88, 96, 104, 266, 296-297, 300, 315, 392, 395, 411, 603-604, 646

Camera View Control Window 27, 65-66, 93-94, 335, 355, 358, 386, 389, 391, 396, 407, 412, 414, 556, 559-560, 564, 603-604, 609

Camera View Window 27, 65-67, 88, 125, 240, 305-306, 311, 316, 320, 328, 335, 355-356, 358-359, 372, 376-377, 380-381, 384, 386, 389-391, 396-397, 407, 412, 474, 494, 559, 603-604, 607

Class 72, 79-80, 84, 99, 107, 134, 144, 146-148, 153-155, 171-172, 176, 180, 208, 283-284, 295, 305, 316, 325, 331-332, 335-336, 342, 428, 442-443, 455-457, 465, 468-469, 479, 505-506, 511, 548, 558, 571, 575-578, 580, 598-599

Color Editor Window 26, 108, 140, 304, 308, 313, 421, 423-424, 511-512, 572

```
Color Map 23, 29-30, 104, 112, 119, 122, 127, 135, 197, 204, 213, 216, 227, 277-279, 281, 452, 458, 480, 482, 505-508, 518, 521, 554, 569, 581-591, 642
```

Color Parameters 26, 107, 139-140, 155, 178, 304-305, 308, 310, 338, 372-373, 376-379, 421, 423, 430, 436, 452, 454, 474, 519, 566, 572

Color Time Lines 421, 433, 437

Configuration File 124, 130-131, 530

Contour 91, 244, 254, 642

Convert 20, 97, 99-100, 186, 202-204, 213-215, 217-220, 227, 235, 281, 299-301, 345, 348-349, 499, 537-539, 541, 584-586, 612, 618-620, 622-623, 625, 632

Coordinate System 5, 71, 112, 216, 243-244, 258, 343-344, 347-349, 356, 371-372, 629, 631

Custom Ecosystem Model 439-440, 453-454, 465-466, 505, 555, 576, 580, 589, 642, 644

D

Data Disks 12

Data Operations Module 183, 199, 622

Data Ops Module 20, 55, 112-114, 117, 138, 165, 180, 197, 200, 213, 236, 281, 309, 415, 443, 499, 506, 514, 524, 533, 535-537, 539, 542, 556, 585, 612, 618-619

Data Safety 32

Database Éditor Window 25, 153, 168-169, 184, 201-202, 212, 248, 256-257, 265, 273, 277-278, 418, 481, 504

Database Explained 151, 153

Database Field 179, 284, 598-599, 601

Database Module 19, 48, 50, 73, 105-106, 123-124, 128, 130-131, 137-138, 151, 153, 169, 186-187, 199, 202, 205-207, 212, 248, 256, 267, 269, 273, 277-278, 285, 302, 418, 428, 533-535, 537-538, 541, 543, 546-547, 549, 557, 593, 595, 601, 616, 625

Datum 107, 319, 344, 360, 368-370, 393, 515

DEM Format 20, 112, 200, 204, 213-214, 231, 235

Diagnostic Data Window 69, 355, 402-403, 413-415

Digital Elevation Model 17, 103, 115, 155, 199, 209, 643, 646

Digital Land Grid 116, 204

```
Directory List 24-25, 104, 110, 122-124, 128, 130, 151-152, 154,
   160, 163-164, 167-168, 170, 182, 185-197, 201-202, 205-207, 228,
   249, 267, 533, 535, 538, 546-547, 593, 595, 643
 Directory List Editor 24, 151, 163, 167-168, 187, 195, 197, 535, 547,
   593, 595
 Disk Space
              11, 25, 104, 115
 DLG Format 117
            99, 154, 159, 177-178, 598
 Draw Pen
 DXF Format 206
F
 Earth Rotation 107, 360, 366, 393, 610
 Eco Legend Window 252, 260, 271
 Ecology 1, 5, 472, 639, 643
 Ecosystem 1, 6, 21, 26, 48-50, 55, 59-61, 73-80, 107, 109, 114, 119,
   127, 135, 139-140, 144-149, 155, 236, 239-241, 251, 256-257, 260,
   262, 264, 304-306, 309-310, 312-313, 315-316, 323, 325-326, 328,
   331-332, 335-336, 338, 342, 357, 368-369, 387-389, 400-402, 408,
  414, 416-417, 421, 423, 429-431, 435, 439-445, 447, 450-471, 474,
   480-483, 505-508, 513-518, 553-555, 558, 567-571, 573-576,
   578-581, 586-590, 642-644, 646-647
 Ecosystem Class
 Ecosystem Editor Window 26, 140, 304, 309, 313, 315, 416, 423,
   439-442, 453, 459, 567-568, 570, 573, 576, 588
 Ecosystem Legend Window 239-240, 251
 Ecosystem Model 79, 127, 439-440, 453-454, 465-469, 505-506,
   555, 576, 578, 580, 589, 642, 644
 Ecosystem Model Editor 79, 439-440, 454, 465, 576, 580
 Ecosystem Parameters 1, 21, 26, 49, 74-75, 107, 114, 119, 139-140,
   144-145, 155, 236, 241, 251, 260, 304-305, 309, 312, 316, 338,
   357, 387, 400-401, 414, 416-417, 421, 429, 435, 439, 444, 459,
  463, 469, 483, 505, 508, 518, 568, 575, 646
 Ecosystem Texture 455
 Ecosystem Time Lines 439, 464, 569
 Enabled Status 153-154, 170
        188-189, 197, 199, 202-203, 208-211, 219, 536-537, 593
 Extract
```

```
F
 Fine Print
             12
 Flattening 101, 107, 231, 246, 300, 319, 360, 368-370, 372, 393,
   417, 515-516
 Floppy System
                  12
 Focus Point 21, 49, 64, 82, 92-93, 96, 240, 252, 296, 304, 316, 321,
    345, 352, 355, 362-364, 366, 371-372, 380, 388, 391-392, 395,
   405-407, 409, 411, 559, 603, 609, 642, 644, 647
 Fractal Depth 48, 55, 58, 61, 110, 114, 158-159, 166, 175-176, 236,
    443, 456, 480-481, 513-515, 551-552, 557
 Freeze 35, 144-146, 322, 358, 424, 442, 483
G
  Geographic Data 5, 103, 111, 113, 200, 205, 637
  Geographic Information System 1, 153, 241, 596, 645
  Geography 1, 5, 112, 210-211, 216, 230, 243-244, 258, 356,
    629-630, 645
  Geological Survey 20, 111-112, 200, 203-204, 209, 536, 582, 637,
    640, 649
  Global Menus 3, 123, 125, 163, 358, 645
Н
  Hard Drive 11-13, 30, 33, 37, 115, 167, 478, 496, 530-531, 648
         18, 21, 28, 48, 62-63, 67-70, 92-94, 149, 160, 240, 252, 266,
    304, 313, 319, 321, 355, 360, 376-379, 381, 391, 394, 413, 415,
    421, 425-426, 452, 503, 508, 563-564, 566, 646
 Horizon Line 62, 66-67, 70, 319, 360, 373-374, 426-427, 519,
    561-562
  Horizon Point 319, 360, 373-375, 426-427, 561
 Horizon Stretch 319, 360, 373-375, 427, 561-562, 566
 Illuminated Segmented Vector 156, 600
 Illuminated Vector 155, 172, 598
```



```
Import 4, 20, 30, 32, 112-113, 117, 120, 167, 183, 188-189, 197,
   200-204, 206-207, 209, 212, 214-215, 220, 279, 305, 311, 315, 343,
   348-351, 355, 413, 499, 533, 535, 543, 546, 584, 612-613, 621,
  624-625
             3, 11-15, 34, 38, 40, 42, 45, 54, 531
 Installation
 Interactive 11, 51, 64, 67-68, 85, 90, 92, 95, 252-253, 256, 282,
  296-297, 303, 305, 311-313, 316, 318, 328, 331-333, 353, 358-359,
  376-377, 379-381, 386-387, 390-393, 395, 405-407, 409-410, 551,
  555, 559, 561, 563-565, 602, 604, 610, 646, 648
 Interpolate 56-58, 61, 170-171, 204, 210, 219, 228, 236-238, 280,
   298-300, 313, 443, 494, 514, 536, 545, 556-557, 571, 582, 592
 Interpolate DEM Window 443
K
 Key Frame 83, 85, 87, 89, 93, 95-96, 102, 253, 266, 299-300, 303.
   305, 313-337, 339-340, 346, 351-352, 358-359, 366, 379, 381-382,
  410-411, 421, 424, 432-433, 442, 459-460, 502-503, 569, 604-606.
   610-611, 646
 Label 43, 67, 153, 158, 171, 175, 286, 484, 542, 544-545, 592
 Label Status 153, 158
 Landscape 1-2, 5-6, 17-18, 20, 23-26, 29, 31, 48, 63, 103-104, 107,
  110-112, 118-120, 151-152, 155, 158, 174, 199, 213-214, 218, 260,
  278, 304, 313, 343, 345, 355, 364-365, 368-370, 373, 375, 378,
  416, 422-423, 439-440, 443-444, 456, 471, 482, 505, 507, 515, 521,
  548, 551, 570, 575, 580, 586, 596, 599, 612, 614, 624, 637, 642,
  644, 646, 648-650
 Latitude 1, 5, 20, 51, 70, 82-83, 85, 87-88, 94-96, 112-113, 117-118,
  154, 200, 206, 210-211, 222-223, 230-231, 242-244, 247, 255,
  257-258, 261, 264, 269, 272-273, 287, 296-297, 300, 311, 314-315,
  318-319, 324, 328, 344, 346-349, 352-354, 356, 359-364, 370-372,
  379, 388, 391, 399, 403, 406, 408-409, 411, 414, 418, 427, 447,
  494, 510, 516-517, 520-521, 537-538, 540-542, 566, 600, 604, 607,
  610, 624, 629, 632-634, 646
Layer Identifiers 153, 156
LightWave 4, 303, 305, 311, 314-315, 333, 343-348, 351, 355, 497,
  501, 612-615, 617
```

```
LightWave Motion Window 303, 311, 315, 343, 348, 613
 Line Style 154, 157, 159, 176, 598
 Line Weight 154, 156-157, 159, 177, 598, 616-617
 Longitude 1, 5, 20, 51, 70, 82, 88, 95-96, 112-113, 117, 210-211,
   222, 226, 230-231, 242, 244, 252, 255, 257-258, 261, 264, 269,
   287, 296-297, 300, 311, 314-315, 318-319, 324, 328, 346-350,
   352-353, 356, 359-364, 366, 370-373, 379, 388, 391, 399, 406,
   408-409, 411, 414, 418, 427, 494, 520-521, 537-538, 541, 559, 566,
   600, 604, 610, 624, 629-635, 646
M
 MagicUserInterface 34, 530, 532
 Manual Installation 14
 Map View Module 21, 30, 32, 51, 72, 81, 117-118, 138, 159, 165,
    169, 175-176, 178, 180, 185, 188, 239, 300-301, 392, 403, 428,
   453, 506, 533, 542, 548, 551, 555, 559, 565, 573, 583, 587, 591,
    594, 597, 599, 602, 622
  Maximum DEM Fractal Depth 158
  Motion Editor Window 27, 84, 108, 139, 240, 253, 266, 304, 308,
    315, 318, 321-322, 352, 355, 357-358, 379, 383-384, 396, 501,
    563-564
  Motion I/O Window
                      355
  Motion Parameters
                      26-28, 48, 71, 83, 86, 88, 95, 107, 139, 146, 148,
    180, 246, 252-253, 296-297, 300, 304-305, 308, 310-313, 315-316,
    318, 328, 331-332, 337-338, 346, 354-355, 357-360, 381, 385-386,
    390, 399, 413, 421, 426-427, 429, 453, 488-489, 494, 503, 515, 519
  Motion Path 72, 86, 93, 97, 99, 299-301, 324, 328, 343-347, 351,
    387, 500-502, 549, 552, 600, 604-605, 608-609, 613-614, 647
  Motion Time Lines 299-300, 328, 355
  MUI 14, 34-35, 124, 131, 478, 529-532
```

Ν

Non-Modal Operation 34

Р

Pan 33, 246-247, 266, 271, 274, 329, 345, 548, 551, 556, 602



```
Parameter List 60, 64, 67, 70, 74, 77, 87, 148-149, 311, 318, 320,
 322-323, 330, 358-360, 376-377, 379, 383, 390, 411, 416, 424,
 430-431, 434-435, 460-462, 561, 563-564, 604, 610-611
Parameters Module. 303, 554-555, 558, 564, 567-568, 570, 572,
 576, 588
Pop-Up Menu 50-52, 55, 59, 63, 73, 77, 105, 108-109, 123, 130,
 137-140, 151, 153, 160, 185-186, 199, 202-203, 208, 212-213, 236,
 248, 269, 303, 305-307, 348, 357, 411, 418, 423, 441, 531,
 533-538, 541, 543, 547, 554, 557, 561, 573, 593, 595, 610, 616, 625
             30-31, 34-35, 141, 270, 365, 471, 475-476, 478, 491,
Preferences
 529-532, 552-553
Preview Window
                 69, 400-403, 415, 526
Program Disk
Program Modules
                   3, 47
Program Organization 17, 19
Progress Window
                  86, 269, 400, 402, 404, 477-478, 541, 623
Project Editor Window 24, 31, 128, 186, 228
Project File 23, 40, 49, 62, 84, 104-107, 110, 122-123, 129-130, 135,
  145, 162, 164, 186, 189-190, 195-196, 240, 263, 268, 385-386, 408,
  467-468, 474, 483, 578, 582, 584, 587, 599, 647
```

R

Relative Elevation Models 103, 115, 238, 557, 647

Render Settings 22, 26, 28, 30, 41, 44, 49-50, 53, 61, 102-103, 110, 128-129, 135, 139, 142, 144-146, 155-156, 158, 160, 171, 176, 254, 280, 296, 300, 314, 324, 328, 335, 351, 365, 367-368, 374, 398-400, 404, 413, 426-428, 443, 453, 473, 475, 480, 482-484, 490, 492, 496-498, 526-527, 553, 601, 621, 644, 646, 648

Render Tutorial 17, 38, 49, 105, 108

Restore 35, 72, 124, 144-146, 197, 248, 267-268, 292, 322, 400-401, 483, 527, 531, 555

RGB Render Pens 154, 159-160

S

Saving Files 31

658

```
Scale 17, 30, 90-91, 101, 113, 200, 217-220, 222-223, 233-235, 243.
   246-247, 252, 255-256, 258, 261, 266, 270, 272, 274, 277, 281,
   301, 303, 315, 325, 328, 336-337, 339-342, 348-350, 360, 366-368,
   382, 393, 413, 433, 460, 488-489, 499, 521, 524, 538, 541-542,
   548, 551, 556, 559, 573, 602, 615-616, 635, 638
  Scale Keys Window 303, 325, 336-337, 341-342, 382, 433, 460
  Segmented Vector 156, 600
 Settings Editor 41-44, 53-54, 58, 72, 80, 86, 102, 114, 119, 129, 146,
   156, 158-160, 171, 176, 254, 280, 300, 302, 314, 324, 335, 365,
   367-368, 374, 388, 398-399, 404, 414, 427-429, 453, 457-458,
   467-468, 478, 480-481, 488-489, 495, 526, 551, 554, 557, 562, 584.
   586, 589-590, 600-601, 608, 615-617, 621
  Shaded Relief 29, 91, 112, 429, 647-648
  Style Guide Compliant 33
       21, 28, 48, 63, 69-71, 89, 107, 152, 155-156, 172, 201, 252,
   266, 304, 312, 314-316, 319, 321, 325, 352-356, 360, 368, 370-373,
   383, 387-388, 391, 393-395, 399-403, 414, 417, 421, 425-426, 429.
   447-448, 470, 494, 507-508, 558-560, 564, 566, 590, 597-598, 600,
   634-635, 646, 648
  Sun Time Window 325, 352-354, 372-373, 383, 394, 558
          6, 81, 83, 102-103, 112, 115, 117, 154-155, 171-172, 176,
    178, 214, 237-238, 241, 254, 264, 268, 279, 296, 301-302, 356,
    398, 425, 427-429, 448, 506, 510-512, 613, 615, 630, 633, 644, 649
  System Default Text Font 35
  System Requirements 11
T
  Texture 6, 60, 118, 262, 279, 304, 439, 443, 449, 455-457, 465, 469,
   506, 508, 571, 581, 612, 642, 649
 Topo 90-92, 97, 132, 155, 172, 176, 244, 249, 251, 269, 283, 287,
   291-292, 294-295, 298, 403, 511, 543, 545, 551, 555, 565, 573,
   602, 622
 Topography 90, 155, 251, 287, 291, 294-295, 298, 369, 545, 645,
   649
 True Color 43-44, 649
 User Interface 17, 33
```

V

Vector Class 172, 180, 283

Vector Object 19, 23, 25, 97, 116-117, 122, 153-156, 166, 171, 177-179, 205-207, 240, 268-270, 279-280, 286, 288-290, 292, 299-301, 418, 504, 543-545, 552, 556, 592, 599-600

Vector Points 153-154, 194, 269, 288, 291

Vertical Exaggeration 101, 107, 114, 231, 246, 281, 300, 360, 368-370, 517

View Arc 107, 240, 320, 322, 360, 367-368, 393, 514, 602, 614

Viewshed 241, 262, 264, 277, 280, 650

Visual Sensitivity Analysis 241, 262, 280, 298, 650

Z

Z Buffer 120-122, 127, 214-217, 219-221, 225, 227, 233, 343, 403, 413, 415, 474, 494, 499, 520-521, 523-524, 614, 617-621, 650 Z Minimum 360, 379, 381, 395 Zoom 33, 92, 160, 203, 243, 246, 248, 266, 271, 273-275, 307, 329, 367, 392-393, 542, 545, 611



