ER Mapper Professional

Level One
Training Workbook
for
Seismic Geophysics Applications

ER Mapper
Geospatial Imagery Solutions

www.ermapper.com

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Summary Contents

Part Two - Enterprise Wide Imagery 305

Table of Contents

Part Two - Enterprise Wide Imagery

About this workbook

This workbook is intended to get you started learning and using ER Mapper 6 for oil and gas exploration applications using interpreted seismic data. It provides simple step-by-step lessons that give you hands-on practice using the basic features of the software, and using more advanced features as well. Please read the following important information before beginning.

- Chapter contents
- Setting up practice datasets
- Typographical conventions used in this document

This manual is not intended to cover all ER Mapper functionality in depth. Please refer to the *ER Mapper User Guide* and other manuals for more detailed information as needed.

Note: The hands-on exercises in this workbook require that the sample datasets and algorithms supplied on the ER Mapper CD-ROM be installed and accessible. Please refer to Appendix A “System setup” in this manual for more information.

Chapter contents

The chapters in this manual give you extensive hands-on experience using the ER Mapper software through a series of specially designed lessons. Most lessons have two basic sections:

- an overview of key concepts
- a series of step-by-step hands-on exercises

It is recommended that you start at the beginning and proceed through the chapters in order because the later chapters build on concepts learned in earlier ones. However, each chapter is independent of the others, so you can refer to a specific chapter at any time for a quick procedural overview or refresher course.

The emphasis of this manual is on learning and using the ER Mapper software, not on teaching image processing, interpretation of seismic data, and other concepts. For more detailed information on the concepts or specific applications, please refer to the *ER Mapper Applications Manual*, any of the text books available, or journal articles listed in Appendix B “References.”

Setting up practice datasets

The exercises in this manual assume that ER Mapper is installed and licensed, and that you will use the default ER Mapper ‘tutorial’ directory to save sample processing algorithms and other files during the lessons. In addition, some chapters require that copies of the ER Mapper sample datasets be placed into the ‘tutorial’ directory for use by individual students. For information on configuring your system for these exercises, please refer to Appendix A “System setup” in this workbook.

Typographical conventions

The following typographical conventions are used throughout this document:

- ER Mapper menus, button names and dialog box names are printed in boldface Helvetica type, for example:

  “Select **Print** from the **File** menu to open the **Print** dialog box.”

- Where you are asked to click the mouse on an icon button in the user interface, both the button and its formal name are indicated in the text. For example:

  “Click the **Print**  button.”

- Text to be typed in a dialog box text field is shown in boldface Courier typeface, for example:

  “Type **`seismic horizon`** in the text field.”

Part One - Seismic Geophysics

1

Introduction to ER Mapper

This chapter briefly describes the role ER Mapper plays as an important tool for the enhancement, integration and analysis of interpreted 3-D seismic survey data for the oil and gas exploration industry. It also contains a brief overview of general image processing concepts and terminology, and information about how ER Mapper works compared to traditional image processing software.

Image processing of interpreted seismic

With the ever increasing number of 3-D seismic surveys being acquired, it is essential that interpretation of the data be both effective and efficient to ensure that maximum information is derived. Image processing, traditionally applied to datasets such as satellite images, has now become an important tool for exploration geophysicists to analyze interpreted seismic horizon datasets and their associated attributes. ER Mapper provides unique capabilities for enhancing and visualizing surface interpretations, and integrating data from a variety of sources to create top quality map products. ER Mapper can lower exploration costs by aiding detection of subtle structural features and lineations not readily discernible by other means. This type of information can, for example, be used to improve the positioning and accuracy of target wells.

ER Mapper provides many features to visualize and integrate interpreted seismic and attribute data, including abilities to:

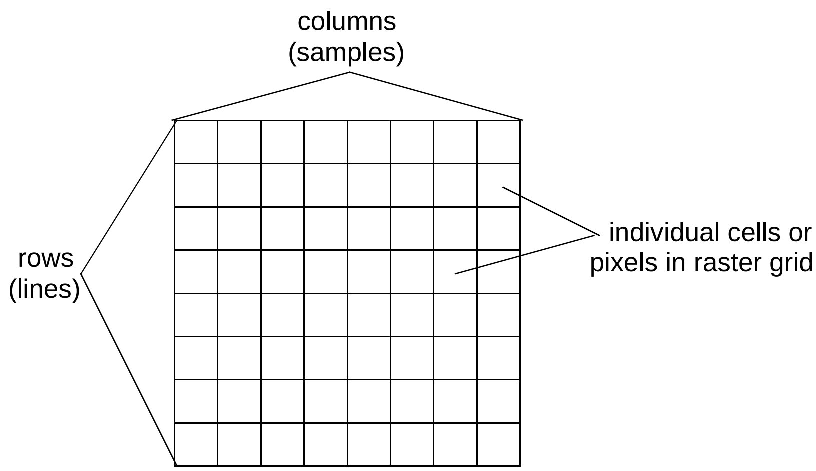
- import data in common geophysical formats, including SEG-Y, Landmark Graphics products, Schlumberger-GeoQuest products, and more;
- apply sophisticated illumination and shading effects to rapidly identify small scale faulting, subtle stratigraphic features, and acquisition/processing artifacts;
- combine structure and attribute images into a single display by showing data as both color and brightness (“colordraping”);
- use math functions to generate dip, azimuth, isochron, and other derivative images of complex time surfaces;
- register satellite images to actual locations of seismic shots;
- tie subsurface images to surface geology;
- combine different types of raster, vector, and tabular data into a single visualization;
- render top quality, cartographic maps to over 230 hardcopy devices and standard graphics file formats.

ER Mapper is also very easy to learn and use, so you can be performing useful work within hours rather than the days or weeks required for learning conventional image processing software.

Image processing concepts

The term *digital image processing* refers to the use of a computer to manipulate image data stored in a digital format. The goal of image processing for earth science applications is to enhance geographic data to make it more meaningful to the user, extract quantitative information, and solve problems.

A digital image is stored as a two-dimensional array (or grid) of small areas called *pixels* (picture elements), and each pixel corresponds spatially to an area on the earth’s surface. This array or grid structure is also called a *raster*, so image data is often referred to as raster or gridded data. The raster data is arranged in horizontal rows called *lines*, and vertical columns called *samples*. Each pixel in the image raster is represented by a *digital number* (or DN).

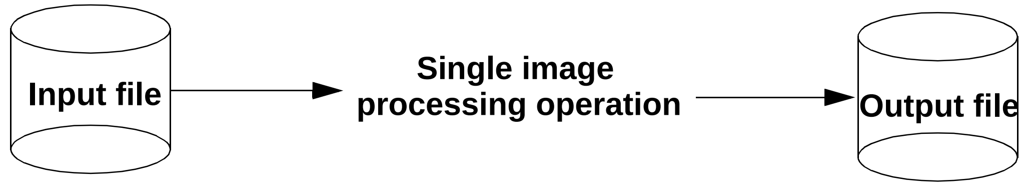


For interpreted seismic data, the DNs represent two-way travel time, event amplitudes, or other seismic attributes. By applying mathematical transformations to the digital numbers, ER Mapper can enhance image data to highlight and extract very subtle information that would be impossible using traditional manual interpretation techniques. *This is why image processing has become such a powerful tool for all types of earth science applications.* The exercises in this workbook provide many examples that illustrate how image processing is typically used to enhance and visualize interpreted seismic datasets.

Image datasets can also have multiple *bands* (or layers) of data covering the same geographic area, each containing a different type of information. For example, an interpreted seismic dataset might have one band containing two-way time data, and another band containing the corresponding event amplitudes.

Traditional image processing

Image processing was first developed on large mainframe computers in the 1960's to process images from planetary satellites. To process an image, you specified the name of the file to process, the type of operation you wanted to perform, then waited for the system to process the data and write the results to a new image file on disk (shown in the diagram below). You then used a separate display program to view the output file and evaluate your results.

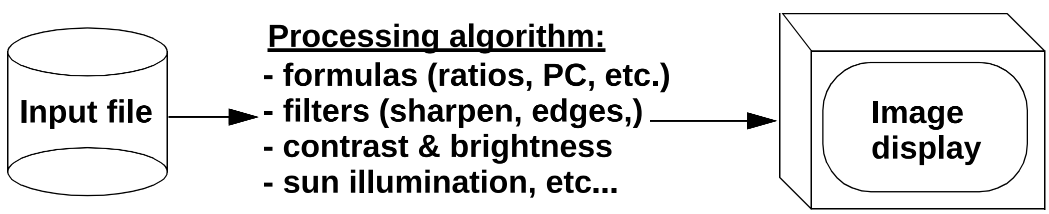


With traditional systems, the changes resulting from the image processing operation are saved in a *separate output raster file*.

With the introduction of powerful workstations in the 1980's, processing of large images could now be performed on the desktop. Surprisingly, nearly all image processing products on the market today are still designed around this "disk-to-disk" approach from the 1960's. This means that to perform a processing operation that requires several steps, you need to write an intermediate file to disk for each step. Only when the final file is created can you view your desired results. This approach can consume tremendous amounts of time and disk space, and if the result is not what you intended, you must often start all over again.

ER Mapper image processing

Recognizing the restrictions inherent in traditional software and the capabilities of new computers, the creators of ER Mapper developed an entirely new approach. Instead of writing a file to disk for each processing step, ER Mapper lets you combine many processing operations into a single step, and render the results directly to your screen display in near real-time. (In most cases, no processed copies of your original data are written to disk unless you request to do so.) The set of processing steps you apply to your data is called an "algorithm data view" in ER Mapper because it lets you define a view into your data.

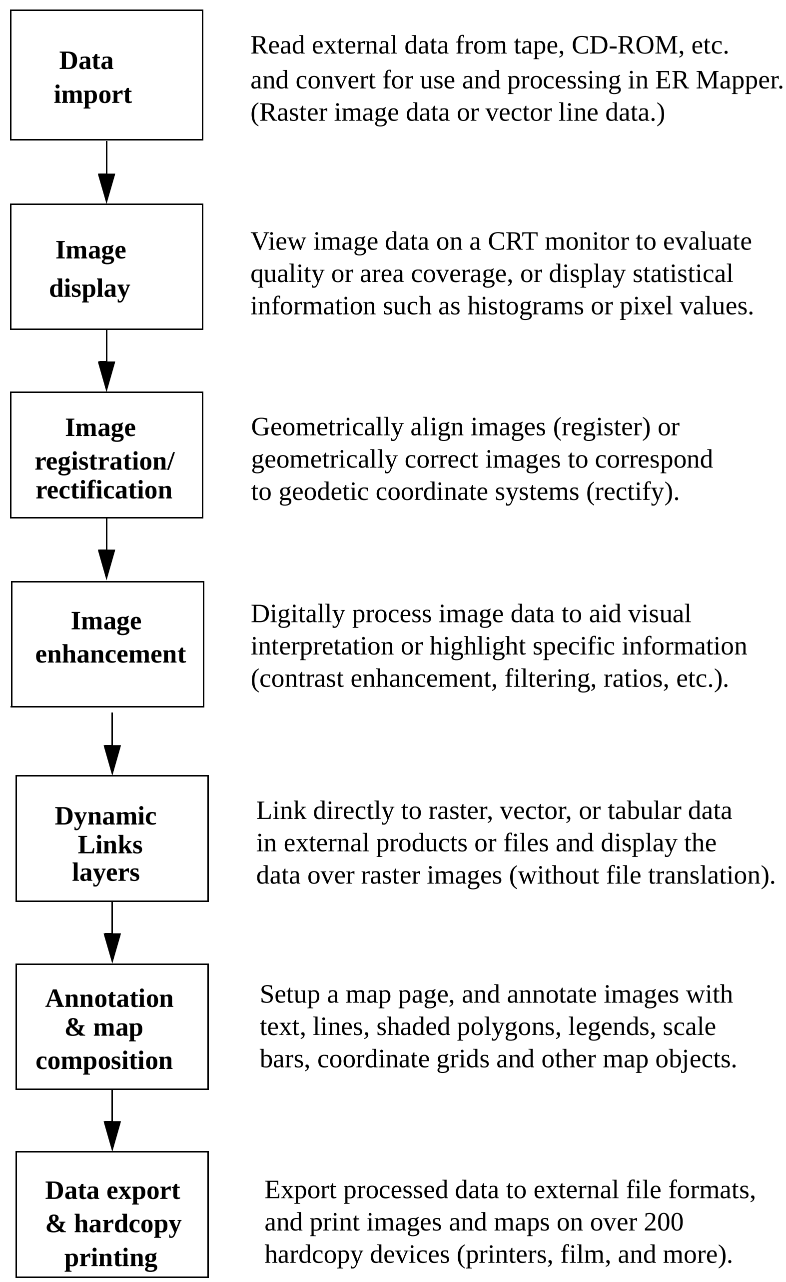


With ER Mapper, you save only a *description of the processing steps* you wish to apply to the data (the algorithm), *not* separate processed copies of the original raster data file. By storing the algorithm data views separately from the actual data, image processing becomes much faster, easier to learn, and more interactive.

In ER Mapper, algorithms can be used for simple viewing of data, or for very complex processing and modelling operations involving many images, transformations of the data, and overlays of other types of data.

Image processing tasks

A flowchart of typical image processing tasks is summarized in the following diagram, from data import through processing to final output. You may or may not need to perform some of these tasks for your application, but it is helpful to have a general idea of a typical procedure:



Data import

The first step in image processing is importing the data you want to use into ER Mapper. For exploration geophysics applications, raster datasets are usually preprocessed and gridded using seismic interpretation software packages. The resulting interpreted horizon datasets and attributes are then opened in ER Mapper for further enhancement, analysis and map production. Typically the data might be stored on magnetic tape, CD-ROM, or other media. There are two primary types of data you may want to import into ER Mapper: raster and vector.

Note: ER Mapper can directly read image data in a number of formats without the need to import it as an ER Mapper Raster Dataset.

Raster image data (such as an interpreted time grid) is the type used as input to image processing operations. When you import a raster image file (using ER Mapper's import utility programs), ER Mapper converts the data and creates two files:

- a binary data file containing the raster data, in band interleaved by line (BIL) format
- a corresponding ASCII header file with an ".ers" file extension

Vector data is stored as lines, points, and polygons. Many geographic information system (GIS) and mapping products use vector data structures because it is more efficient for representing discrete spatial objects like faults (lines), wells (points), or lease block boundaries (polygons). In an image processing product, it is often helpful to overlay vector data on top of a raster image backdrop, for example to overlay interpreted faults or lease boundaries on a seismic horizon. When you import a vector file (using ER Mapper's import utility programs), ER Mapper converts the data and creates two files:

- an ASCII data file containing the vector data
- a corresponding ASCII header file with an ".erv" file extension

Image display

After importing the data, the next step is usually to display the image on your CRT monitor to evaluate the data quality and geographic area of coverage. There are several ways in which data can be viewed, including simple black and white or pseudocolor displays, and red-green-blue (RGB) or hue-saturation-intensity (HSI) color composite displays. The way in which you choose to display your raster data is called the "Color Mode" in ER Mapper.

In addition to displaying the data, you may want to view statistical information about it. Statistics are often good indicators of image quality and anomalies. You can calculate statistics for the dataset, such as the mean value in each band, and view them in a tabular format. Or you may want to view statistical information in a graphical format using tools like histograms, scattergrams, and traverse profiles.

Gridding

The ER Mapper Gridding Wizard can extract regularly gridded raster files from a combination of any or all of the following types of data.

- Random line data
- Contour data, with faults, streamlines, ridgelines, and breaklines
- Random point data
- Regular line data
- Regularly gridded raster file

The output data is a raster (.ers) file with single or multiple bands containing regularly spaced grids.

This is useful where data is required to be in a regularly spaced grid, but is only available as samples taken at irregularly spaced locations.

Image rectification

Raster image data is sometimes supplied in a “raw” state, although this is usually not the case with interpreted seismic datasets. Whenever accurate area, direction, and distance measurements are required, raw image data must usually be processed to remove geometric errors and/or rectify the image to a real world coordinate system.

- *Registration* is the process of geometrically aligning two or more images to allow them to be superimposed or overlaid.
- *Rectification* is the process of geometrically correcting raster images so they correspond to real world map projections and coordinate systems (such as Latitude/Longitude or Eastings/Northings).

If your application requires that your images be registered to one another or rectified to a map projection, you can use ER Mapper’s Geocoding Wizard utilities. You can also use the wizard to rotate a dataset, or to transform a dataset from one coordinate system to another (for example to match other data).

Image enhancement

Image enhancement refers to any one of many types of image processing operations used to digitally process image data to aid visual interpretation or extract quantitative information meaningful to the user. Image enhancement is what many people commonly think of as “image processing.”

In ER Mapper, image enhancement operations are greatly simplified by the “algorithms” processing concept. Nearly all types of image enhancement operations can be applied and displayed in real time to provide truly interactive control without writing temporary files to disk.

Typical image enhancement operations include:

- *Colordraping*–Drape one type of data over another to create a combined display allowing analysis of two or three variables. For example, drape seismic amplitude in color over a shaded two-way time image that highlights structural features.
- *Contrast enhancements*–Improve image presentation by maximizing the contrast between light and dark portions (or high and low data values) in an image. Or, highlight a specific data range or spatial area in an image.
- *Filtering*–Enhance edges, smooth noise, or highlight or suppress specific linear or spatial features in images. For example, apply a gradient directional filter to highlight structural features tending north-south in an image. ER Mapper also includes Fourier transformations for processing in frequency domain space.
- *Formula processing*–Apply mathematical operations to combine multiple horizon datasets or attributes to derive specific thematic information. In ER Mapper, formulas are used for thresholding, differencing, and for creating derivative images such as dip, azimuth, isochrons and others.
- *Real-time 3D visualization*–View and manipulate time surfaces and attributes in 3D perspective or 3D flythrough modes. ER Mapper lets you stack multiple surfaces such as time horizons with color attribute overlays, and manipulate the viewpoint, transparency, and other parameters of the surfaces in real-time.

Dynamic Link layers

Dynamic Links are a special ER Mapper feature that let you link to data in external products or file formats, and display the data on top of raster images without the need for importing the files. Dynamic Links can link to raster, vector, or tabular (point) datasets, so you can access and integrate *all* your geographic information. ER Mapper provides Dynamic Links to several popular products and file formats, and the procedure is fully documented so you can also create your own links to any other product or format you desire.

Types of Dynamic Links include:

- *Links to mapping and GIS products*–Extract and display vector data from GIS products such as ARC/INFO, and mapping products such as Microstation. GIS links are often used to overlay vector data such as geology or lease boundaries.

Tip: You can display, edit, and save ARC/INFO coverage files directly in ER Mapper. See the *ER Mapper User Guide* for details.

- *Links to database products*–Extract and display tabular (point location) data from database products such Oracle. Tabular links are often used to overlay georeferenced point location symbols such as well locations.
- *Links to external file formats*–Display specialized annotation, vector data, or other data stored in PostScript, DXF, DGN, or other standard vector file formats.

Note: ER Mapper can also import vector data in Z-MAP Plus (.zgf), simple ASCII, and other vector formats.

Map composition

You can use ER Mapper's built-in annotation and map composition tools to create top quality image maps combining raster, vector, and tabular data. Annotation lets you draw directly on-screen using text, line, polygon, and other annotation tools, and specify fill color, shading, line styles, and group, resize and move objects. Vector annotation files can also be exported to external file formats for use in other products (for example exporting faults interpreted in ER Mapper to other seismic processing products).

ER Mapper's map composition tools let you create top quality image maps by adding titles, coordinate grids, map collars, scale bars, legends, north arrows, and many other map objects. You can layout and compose simple maps of any desired size or map scale, and more complex maps comprised of multiple images and external data sources. All ER Mapper map objects are defined as full color PostScript, and you can easily add custom map objects such as company logos or special north arrows.

Data export and hardcopy

Once you have completed processing your data, ER Mapper lets you translate raster and vector data to external standard file formats or print to over 230 different hardcopy devices.

ER Mapper's EVW compression allows you to save large images as small files without any noticeable degradation in quality. This is particularly useful if you want to distribute the images over the Internet.

Data export is used to export the processed version of your raster images for use in another product that handles gridded raster data. Or, you may want export vector annotation or vectorized thematic data to another product.

Note: ER Mapper allows you to save your image data in a number of formats for use in external applications.

Hardcopy printing is often the final goal of processing and annotating images, and ER Mapper provides unsurpassed hardcopy support and output to standard graphics file formats. ER Mapper also includes a built-in PostScript-compatible rendering engine, so you get PostScript-quality output (such as beautiful, smooth text) on any supported device, whether the device supports PostScript or not.

You can also easily print at exact sizes and map scales, and automatically print images in strips for mosaicking large image displays. Supported hardcopy devices include film recorders, dye sublimation printers, electrostatic plotters, and inkjet, thermal and laser printers. Graphics file formats include PostScript, TIFF, CGM, Targa, and CMYK and RGB color separations.

2

User interface basics

This chapter introduces the basic use of the ER Mapper graphical user interface. It gives you practice using menus, toolbars, dialog boxes, and image windows, and loading and displaying datasets using sample algorithm data views.

Note: In order to complete the exercises in this manual, you will need to access the sample datasets and algorithms supplied with ER Mapper. If needed, ask your system manager for the location of the ER Mapper software directory at your site.

User interface components

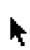
This section provides a brief introduction to the main components of ER Mapper's graphical user interface (GUI). You can perform nearly all operations by pointing and clicking with the mouse, and very little typing on the keyboard is required. The GUI is part of ER Mapper's original design, so it is well integrated and easy to learn and use.

Using mouse buttons

When using ER Mapper, use the left button on your mouse to perform operations like selecting items from menus, manipulating image windows, and drawing annotation. In this manual, all actions are performed with the left mouse button unless otherwise indicated. The following table explains terms used in this manual to describe actions you perform with the mouse.

Term	Meaning
Point	Position the mouse pointer on an item.
Click	Point to an item, then quickly push and release the left mouse button.
Right-click	Point to an item, then quickly push and release the right mouse button.
Double-click	Point to an item, then quickly click the left mouse button twice.
Drag	Point to an item. Then press and hold down the left mouse button as you move the pointer to a new location, then release the button.
Shift-click or Ctrl-click	Hold down the Shift key or Ctrl key on your keyboard, then click.
Shift-drag or Ctrl-drag	Hold down the Shift key or Ctrl key on your keyboard, then drag the mouse.

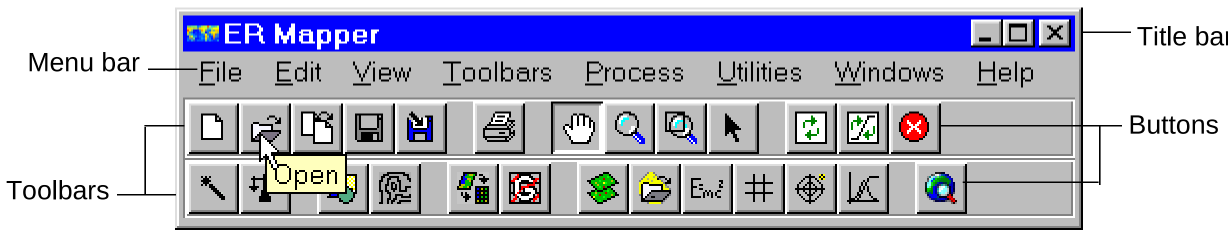
The symbol representing the mouse pointer on the screen changes shape depending on what you are pointing to and the task you are performing.

Pointer	Location on the screen	Function
	Menu bars and buttons; or inside image window	Choose menu commands and click buttons; point to the image to see data values or coordinates.
	Text fields	Type or select text, or reposition the insertion point.
	Inside the current image window	Zoom the image within the image window.
	Inside the current image window	Drag a box over an area to fill image window.

	Inside the current image window	Pan the image within the image window.
	Inside inactive image windows	Select an inactive window to become the current window.
	In image windows when annotation tools are selected	Draw annotation and map composition objects.

The ER Mapper main menu

When you start ER Mapper, the main menu appears. The main menu has two primary components–the menu bar and rows of toolbar buttons.



Menu bar	Lets you select commands used to carry out actions in ER Mapper. To select a command from the menu bar, click on the name of the menu to open it, then click the desired command name.
Toolbar buttons	Shows groups of buttons to let you carry out common tasks quickly. To choose a function from a toolbar, click on the desired button.
Tool tips	Place the cursor on any toolbar button and within a couple of seconds the function of that toolbar button is displayed in a small text window just below the cursor

Using ER Mapper toolbars

Toolbars give you quick access to many common functions, such as saving an image processing algorithm or printing a hardcopy. ER Mapper also provides optional toolbars for specific tasks and image processing applications. To hide or display various toolbars, use the **Toolbar** menu. To get short help for any toolbar function, point to the button and read the tool tips.

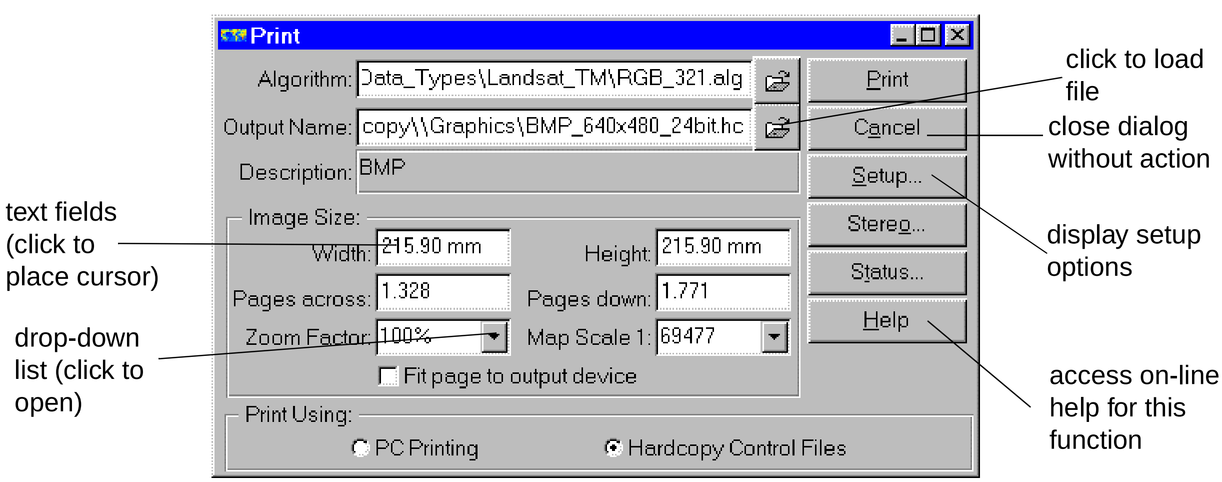
ER Mapper provides toolbars for many common tasks, and also toolbars for building processing algorithms commonly used in remote sensing applications such as forestry, geophysics, and map generation. The functions of the Standard, and Common Functions toolbars are summarized below.

Standard	Provides quick access to standard commands for opening and saving algorithms, printing, starting and stopping algorithm processing, and changing the mouse pointer. Most functions are also available from the menu bar.
Common Functions	Provides quick access to commonly used functions, such as creating general types of algorithms, viewing and editing components of an algorithm.

Using ER Mapper's scripting language, you can also create your own customized toolbars for specific tasks and functions. For more information on creating custom toolbars, see the *ER Mapper User Guide*.

Using dialog boxes

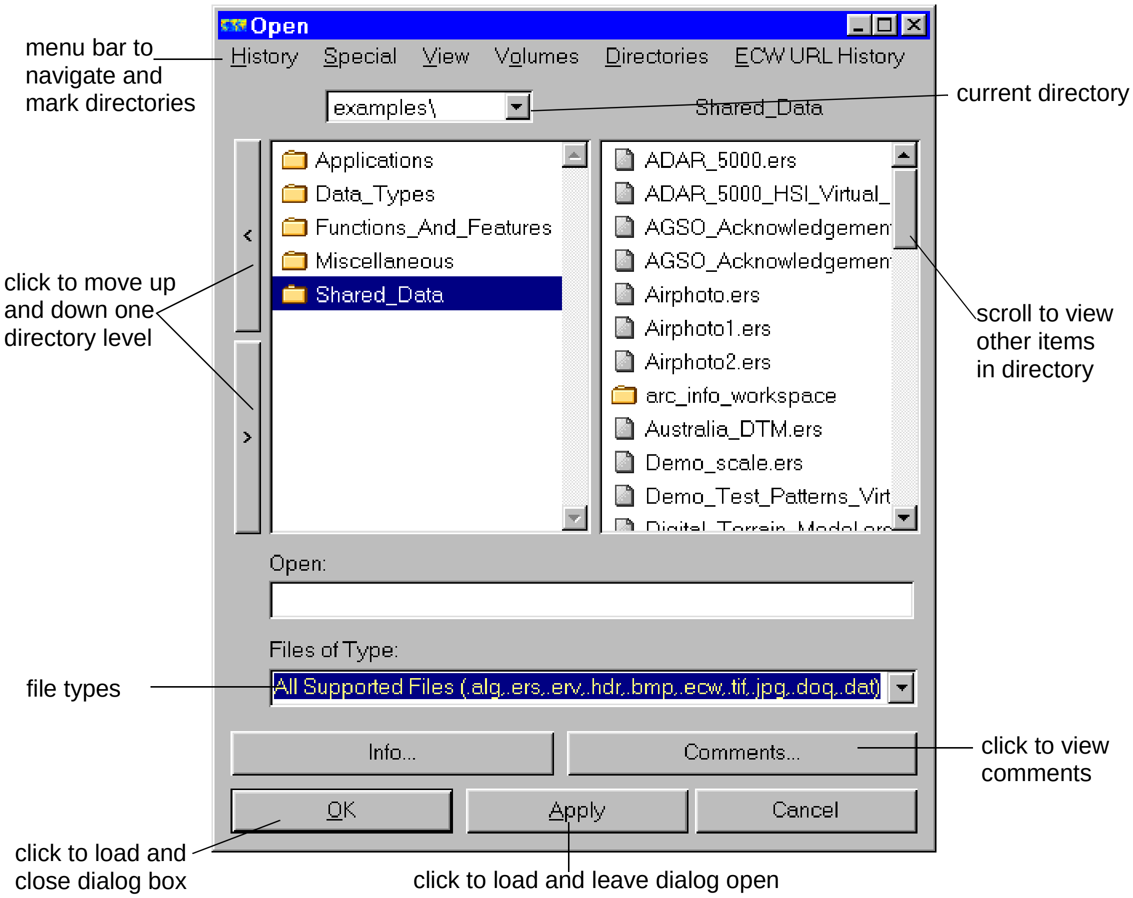
When you select menu commands or click toolbar buttons, dialog boxes often appear for you to choose options to control your image processing tasks. Some dialog boxes, such as the File Chooser, can disappear when you make your selection. Other dialogs can remain open for setting options for as long as you want to use them.



To resize a dialog box, drag one of its corners or edges to the desired size. ER Mapper automatically resizes the dialog box intelligently, so that any central display areas are enlarged, and the layout of buttons remains the same. After resizing, the dialog retains your new size for the current ER Mapper session.

Using the File Chooser dialog boxes

When you choose to open or save a dataset, algorithm, or other file, ER Mapper displays a File Chooser dialog box. The central window contains a list of directories, or files in the current directory.



To open a file or directory displayed in the scroll list window, either double-click on it, or click once to select it and click the **OK** or **Apply** button to open it.

Tip: You can see two levels of directories and/or files by widening the file chooser dialog box (drag one of the sides).

The File Chooser menus at the top have the following functions:

History menu	Use to change the File Chooser's current directory. The menu has two parts: the upper portion lists most recently visited directories, and the lower portion lists marked directories.
Special menu	Use to change to your home directory, or to mark or unmark a directory (any directory may be marked for fast access using the History menu).
View menu	Use to sort the contents of the current directory by name, date modified, or date created.
Volumes menu	Use to access volumes or disk drives on your network.
Directories menu	Use to change to any directory defined by your preferences settings.
ECW URL History	List of the URLs of the most recently accessed image files from an Image Web Server.

Using the on-line help system

ER Mapper provides an extensive on-line help system with both simple overviews and detailed descriptions of all features and functions. There are two ways to access help:

Help menu	Lets you browse all the standard ER Mapper manuals on-line, and go between manuals and topics using hypertext links.
Help buttons	The **Help** button inside dialog boxes gives you context-sensitive help. If needed, you can navigate to view more detailed information using the hypertext links.

Typing text in text fields

To enter text for naming files or changing values in dialog boxes, ER Mapper provides text fields. When you point to a text field, the pointer shape changes to an I-beam. To enter text, click anywhere inside the text field to place the text cursor.

To select existing text, you can drag through the desired portion, or double-click on a word or numeric value to select it. Text that is selected become reverse highlighted, and any subsequent typing replaces it.

Hands-on exercises

The following hands-on exercises introduce you to the basic concepts of using menus and dialog boxes and managing image windows.

What you will learn...

After completing these exercises, you will know how to perform the following tasks in ER Mapper:

- Choose options from menus and toolbar buttons
- Access on-line help
- Display and hide toolbars
- Open an new image window
- Open an existing algorithm data view into a window
- Move and resize an image window
- Zoom and pan the image within the window
- Manipulate multiple image windows on the screen
- Close image windows

1: Using menus and toolbars

Objectives

Learn to open and make selections from menus, use toolbars, and access on-line help.

Move the ER Mapper main menu around the screen

1. Position the mouse pointer on the ER Mapper main menu title bar, then drag it to the lower-left part of the screen.

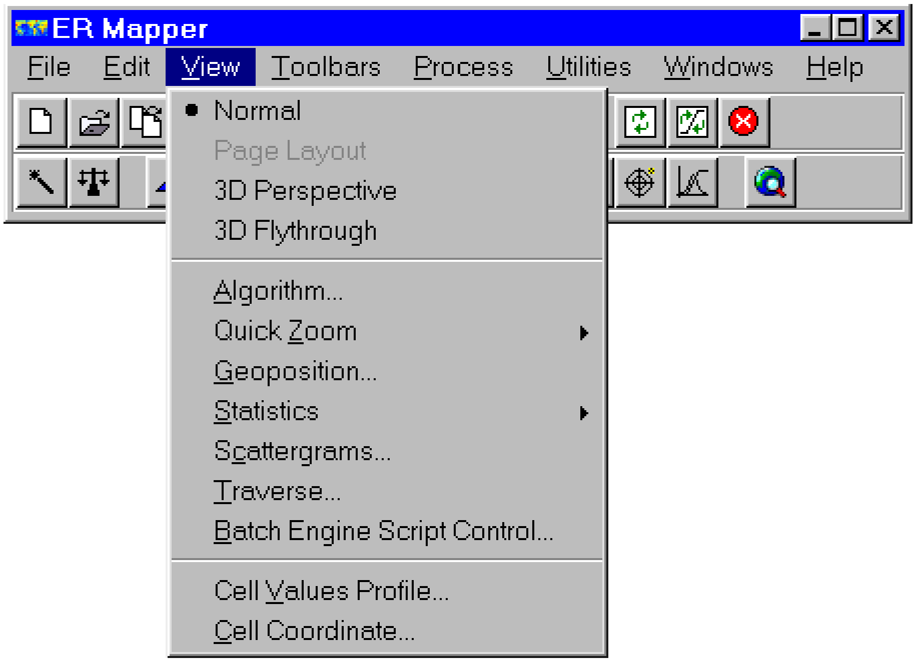
   Pointing to the title bar and dragging is how you move dialog boxes and image windows around the screen.

2. Drag the main menu to the upper-right corner of the screen.

   This is the recommended position for the main menu for the exercises in this tutorial.

Open a menu to display its commands, then close the menu

1 Click on the **View** menu button; a list of commands under the menu displays.



The small arrows next to **Quick Zoom** and **Statistics** indicate that they have additional commands under them.

2 Click on the **Statistics** command to display its submenu.

3 Click anywhere outside the main menu to close the open menus without making a selection.

Note: In the rest of this manual, selecting commands from menus is indicated as follows: "From the **Edit** menu, select **Preferences...**" (which means click on Edit in the menu bar, then click on the Preferences command).

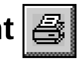
Select the Print command from the menu bar

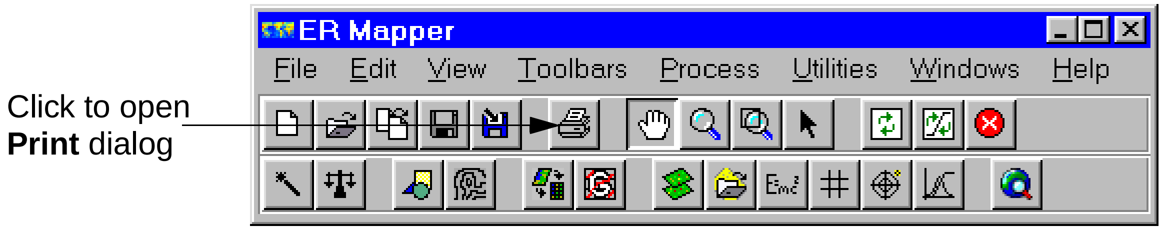
1 From the **File** menu, select **Print**.

The **Print** dialog box appears with options for printing hardcopy.

2 Click the **Cancel** button to close the dialog box.

Select the Print command from the Standard toolbar

1 On the Standard toolbar, click the **Print**  button.



The same **Print** dialog box appears again. Using toolbar buttons is often a faster way to access many commands in ER Mapper.

Tip: Many common commands on the menu bar, such as Print, are also available on the Standard toolbar. Use whichever is fastest or most comfortable.

Display context sensitive help for the Print function

1 On the **Print** dialog box, click the **Help** button.

The **ER Mapper Help** dialog opens to show help for the current dialog box function (printing in this case). Accessing help from a dialog box takes you to the appropriate section in the *ER Mapper User Guide* manual. Hypertext links to other on-line manuals appear as underlined text.

2 In the **ER Mapper Help** dialog, click on the scroll buttons to move to the next page.

ER Mapper moves directly to the next on-line help page.

3 In the **ER Mapper Help** dialog, click the **Back** button at the top of the dialog.

You return to the previous help screen.

Note: The complete ER Mapper manual set is accessible from the on-line help system. These are exactly the same as the printed manuals you receive when you purchase the software.

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4 From the **File** menu (on the **ER Mapper Help** dialog), select **Exit**.

The on-line help system closes.

5 Click the **Cancel** button on the **Print** the dialog box to close it.

Tip: You can also access the complete ER Mapper manual set using the **Help** menu on the main menu.

Display and hide a toolbar

1 From the **Toolbars** menu, select **Oil and Gas**.

A third row of toolbar buttons appears on the main menu below the Standard and Common Functions toolbars. This toolbar has buttons for common image processing techniques used in oil and gas applications.

Oil and Gas toolbar

2 Point to any button on the OIl and Gas toolbar.

A description of the button function displays directly below it (the *tool tip*). The first part of the tool tip indicates the toolbar name and the second part indicates the specific name and function of that button (for example, “Oil and Gas: Create Pseudocolor/TWT Algorithm”).

3 From the **Toolbars** menu, select **Oil and Gas** again.

The Oil and Gas toolbar buttons disappear from the main menu. Use the **Toolbars** menu to display or hide any toolbar. (It is recommended that you always display the Standard and Common Functions toolbars.)

2: Opening windows and algorithms

To display an image in ER Mapper, you first open an image window, then open an algorithm file that processes and displays a specific dataset. You can have as many different image windows open on the screen as you need. (ER Mapper can also create many type of algorithms for you automatically–you will learn about this later.)

Objectives Learn to open image windows on your computer display, and open and run an existing algorithm data view stored on disk.

Open a new empty image window

1 From the **File** menu, select **New**.

An empty image window opens in the upper left corner of the screen. The window title bar reads “Algorithm Not Yet Saved” because no processing algorithm is associated with this image window yet.

Open and display an image processing algorithm

1 From the **File** menu, select **Open...**.

The **Open** file chooser dialog box opens.

2 From the **Directories** menu (on the **Open** dialog), select the path ending with the text **\examples**. (The portion of the path name preceding it is specific to your site.)

The scrolling list in the center changes to show a list of directories beginning with the text ‘application.’

3 Double-click on the directory named ‘applications’ and then ‘Oil_And_Gas_Exploration’ to open it. (Scroll if needed to view it first.)

The list of example algorithms for processing seismic horizon datasets displays.

Note: If you do not see files ending with the extension “.alg,” select “Algorithm Data View” from the **File Type** list menu on the **Open** dialog.

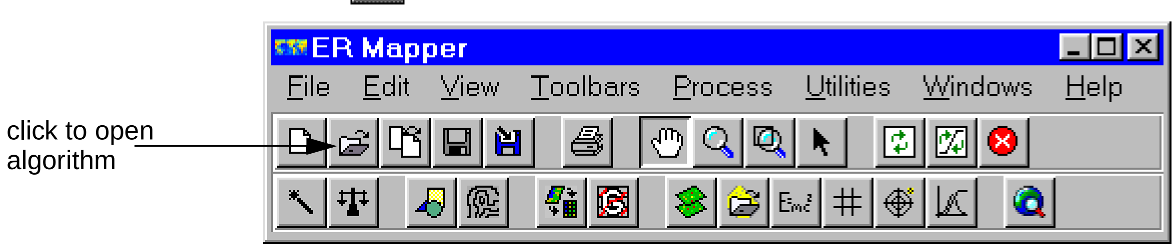
---

4 Double-click on the algorithm named ‘Seismic_Horizon.alg.’

ER Mapper runs the algorithm and displays an enhanced color image of an interpreted seismic horizon. Blues correspond to structural lows transitioning into reds for structural highs. Notice also that the algorithm filename ‘Seismic_Horizon’ now appears in the title bar of the image window.

Use the toolbar to open a different processing algorithm

1 Click the **Open**  button on the Standard toolbar.

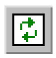


The **Open** file chooser dialog box appears. (This toolbar button has the same function as selecting **Open...** from the **File** menu.)

The algorithm named ‘Seismic_Horizon’ in the ‘Oil_And_Gas_Exploration’ directory is already highlighted since it is currently loaded into the image window.

2 Double-click on the algorithm named ‘Seismic_Horizon_Dip.alg.’

ER Mapper runs the algorithm and displays a greyscale image of seismic dip calculated from the same horizon dataset (a different “view” into the same data). Notice that the title bar also changes to show the filename of the new algorithm.

Note: By default, ER Mapper runs the algorithm automatically for you when you open it from disk. You can also reprocess the data at any time by clicking the **Refresh**  button.

3: Resizing windows and zooming/panning

Objectives Learn to move and resize image windows, zoom (magnify) part of an image, and pan (scroll) to other parts of an image.

Move the image window on the screen

1 Point the mouse at the image window title bar, then drag it to another part of the screen.

2 Drag the image back to the upper-left part of the screen.

Like dialog boxes, dragging images by the title bar is how you move them around the screen.

Resize the image window

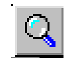
1 Move the mouse pointer directly over the lower-right corner of the image window–the pointer shape changes to a window resize cursor.

2 Drag the lower-right corner to make the window about twice its original size, then release.

Dragging any side or corner of an image window lets you change the default window size as you desire.

Note: When you resize a window, ER Mapper maintains the size of the image inside the window. Empty areas on the sides are filled with a cross-hatch pattern to indicate that no data is displayed there.

Set the mouse pointer to Zoom mode

1 On the Common Functions toolbar, click the **Zoom Tool**  button.

This tells ER Mapper to use the mouse pointer for zooming when it is positioned inside an image window. Also notice that the **Zoom Tool** button becomes depressed to indicate that it is the active pointer mode.

2 Move the pointer inside the image window.

The mouse pointer displays as a magnifying glass icon.

Zoom in and out of the image with the mouse

1 Position the pointer in the center of the image, and click the left mouse button.

The image zooms in by 50%.

2 Position the pointer in the center of the image, hold down the Ctrl. key while clicking the left mouse button.

The image zooms out by 50%.

3 Position the pointer in the image, and then drag it up and down.

As you drag the pointer down the image is magnified, i.e you zoom into it. When you drag the pointer upwards, the image gets smaller, i.e you zoom out.

Set the mouse pointer to ZoomBox mode

1 On the Common Functions toolbar, click the **ZoomBox Tool**  button.

This tells ER Mapper to use the mouse pointer for creating a zoom box when it is positioned inside an image window. Also notice that the **ZoomBox Tool** button becomes depressed to indicate that it is the active pointer mode.

2 Move the pointer inside the image window.

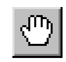
The mouse pointer displays as a magnifying glass and box icon.

Zoom in (magnify) an area of the image with the mouse

1 Position the pointer near the upper-left center of the image, then drag to the lower-right to define a box.

When you release the mouse, ER Mapper runs the algorithm again and magnifies (or “zooms in”) on the area of the image you defined with the box. Dragging a zoom box is a fast way to magnify an area of interest. (There are other zooming functions you will learn about later.

Set the mouse pointer to Hand mode

1 On the Common Functions toolbar, click the **Hand Tool**  button.

This tells ER Mapper to use the mouse pointer for panning when it is positioned inside an image window. Also notice that the **Hand Tool** button becomes depressed to indicate that it is the active pointer mode.

2 Move the pointer inside the image window.

The mouse pointer displays as a hand icon.

Pan (scroll) the image within the window with the mouse

1 Click on the image. and drag it to a new position in the image window.

The hand pointer will grab the image and move it (pan) to the new location.

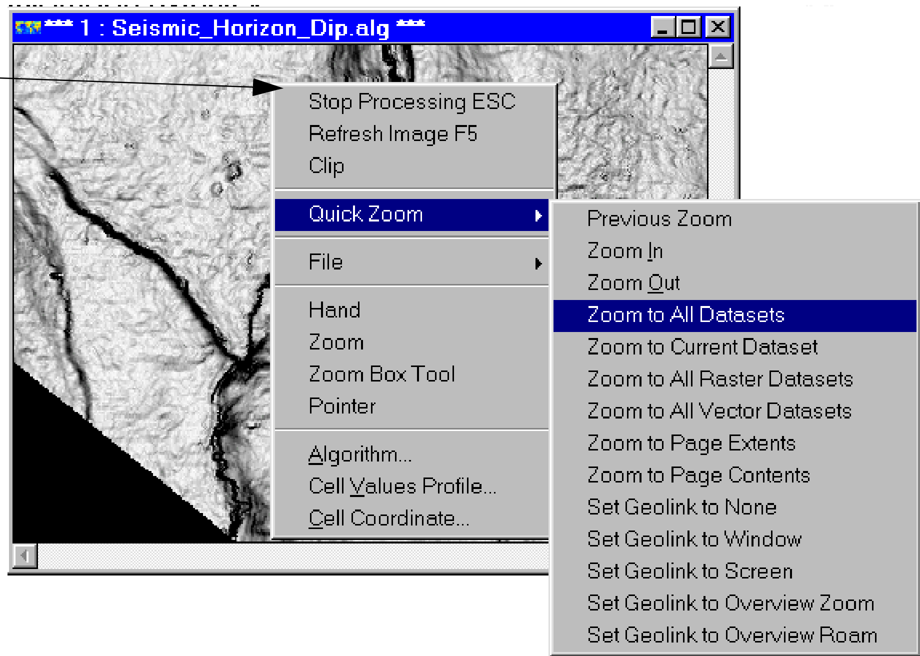
Zoom back out to view the full image extents

1 From the **View** menu, select **Quick Zoom** and then select **Zoom to All Datasets**.

ER Mapper runs the algorithm again and zooms back out to display the full extents of the Seismic_Horizon image data. The **Quick Zoom** submenu provides many options for zooming in or out to specific datasets, setting window geolinking, and other options you will learn more about later.

2 Right-click inside the image window to open the shortcut menu, then select **Quick Zoom** and then **Zoom to All Datasets**.

Right-click inside image window to open shortcut menu

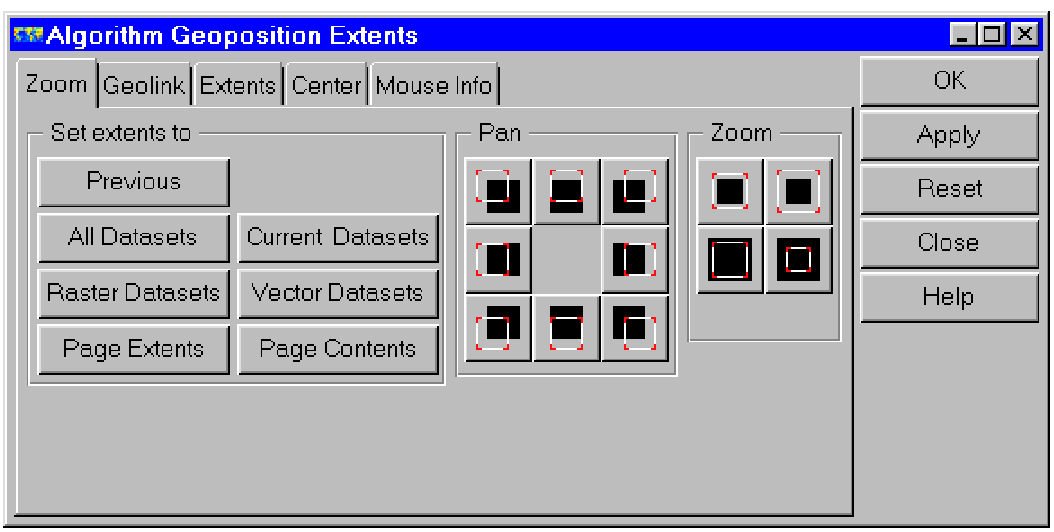


Zoom and pan using buttons for predefined options

In addition to using the mouse, ER Mapper also lets you zoom and pan using buttons to invoke predefined zoom and pan functions.

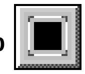
1 From the **View** menu, select **Geoposition...**.

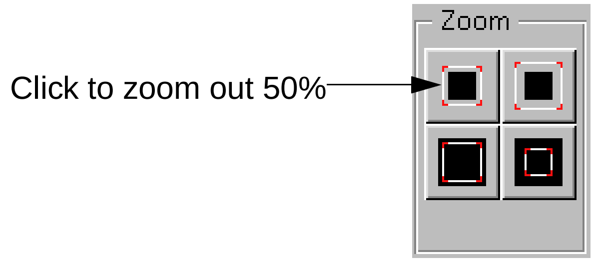
The **Algorithm Geoposition Extents** dialog box appears.



2 Click on the **Zoom** tab at the top to display zoom and pan options.

The **Zoom** tab options show sets of buttons for zooming and panning the image within the window.

3 In the buttons labelled 'Zoom,' click the **Zoom out 50%**  button.



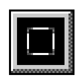
ER Mapper runs the algorithm and zooms out to 50% of the previous display resolution.

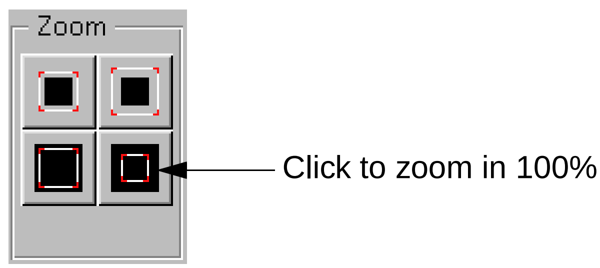
Tip: For all icons on buttons under 'Zoom' and 'Pan,' the black square represents the current image, and the white box represents how the size or position of the image will change after the button is clicked.

---

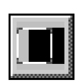
4 In the buttons labelled 'Set Extents To,' click **Previous**.

ER Mapper zooms out to the previous image display extents.

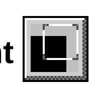
5 Under 'Zoom,' click on the **Zoom in 100%**  button.



ER Mapper magnifies the images to two times (100%) of the previous display resolution (and keeps the image center point constant).

6 Under 'Pan,' click on the **Pan left**  button.

ER Mapper pans or scrolls the image 50% to the left (the previous center point is now on the far right side of the image).

7 Under 'Pan,' click on the **Pan upper-right**  button.

ER Mapper pans the image 50% to the upper-right (the previous center point is now on the lower-left corner of the image).

8 Experiment with other buttons under Zoom and Pan to see their effect.

9 Under ‘Set Extents To,’ click the **All Datasets** button.

ER Mapper resets the image extents to fit the entire dataset in the image window.

10 Click **Close** on the **Algorithm Geoposition Extents** dialog to close it.

4: Managing multiple image windows

Objectives Learn to open a second image window, specify overlap priority between windows, activate an image window, and close image windows.

Open a second image window

1 From the **File** menu, select **New**.

ER Mapper opens a new image window. As with all new image windows, it has no algorithm data view loaded yet.

Open and display a processing algorithm in the new window

1 From the **File** menu, select **Open...**.

The **Open** file chooser dialog box appears.

2 From the **Directories** menu, select the path ending with the text **\examples**.

3 Double-click on the directory named ‘Applications’ and then ‘Oil_And_Gas_Exploration’ to open it

The list of example algorithms for processing seismic datasets displays.

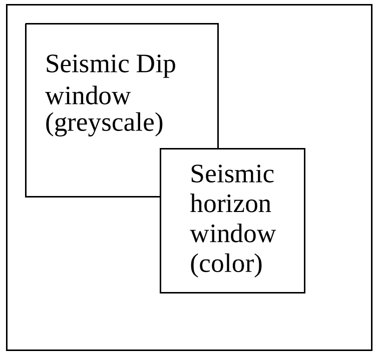
4 Double-click on the algorithm named ‘Seismic_Horizon.alg.’

ER Mapper runs the algorithm and displays the same color view of the horizon dataset you opened earlier. You now have two views of the same dataset displayed in different image windows.

Move the greyscale window to overlap with the color window

1 Drag the image window titled ‘Seismic_Horizon’ to the center of the screen until it partially overlaps with the ‘Seismic_Horizon_Dip’ image window.

Your windows should be similar to the following diagram:



Select a window to be the “active” image window

The “active” image window is the one you want to currently work with, such as zooming, opening a different algorithm, or editing the current algorithm. (You can have many image windows open on the screen, but only one can be active.)

1 Click on the title bar of the window with the algorithm name ‘Seismic_Horizon_Dip.’

The greyscale window moves in front of the color window where there is overlap.

Notice also that the window title has three asterisks (***) on either side of the title–this indicates that it is the “active” of the two image windows.

2 Click on the title bar of the window with the algorithm name ‘Seismic_Horizon.’

The color window is now the active window and it moves in front of the greyscale window. Clicking on the title bar of a window both activates it and moves it in front of any other overlapping image windows.

3 Move the pointer inside the image area of the inactive window (titled ‘Seismic_Horizon_Dip’).

The pointer shape changes to a pointing hand  . This indicates that the window you are pointing to is inactive, and clicking in the window or on the title bar will activate it. (You can activate a window by clicking on the title bar or inside the image area of the window.).

Close both image windows

1 On the ER Mapper main menu, select **Close** from the **File** menu.

The active window closes and disappears from the screen.

2 Close the other image window using the controls on the window itself:

- For Windows, click the  **Close** button in the upper-right window corner.

Tip: To close one of several image windows, it is easier to use the operating system controls on the window itself (step 2 above). You can also close the active window using **Close** from ER Mapper's **File** menu.

The window closes and disappears from the screen. Only the ER Mapper main menu is now open.

What you learned

After completing these exercises, you know how to perform the following tasks in ER Mapper:

- Choose options from menus and toolbar buttons

- Access on-line help
- Display and hide toolbars
- Open an empty image window
- Open an image processing algorithm into a window
- Move and resize an image window
- Zoom and pan the image within the window
- Manipulate multiple image windows on the screen

3

Pseudocolor algorithms

This chapter introduces the basic concepts involved in creating a simple algorithm data view that displays a seismic horizon dataset in greyscale or color. You learn about the interface ER Mapper provides for creating and editing algorithms (the **Algorithm** dialog), and how to control the color mapping and contrast enhancements used to display the image. You also learn to modify the algorithm to view the image in 3D perspective.

About the algorithms concept

The goal of all image processing is to enhance your data to make it more meaningful and help you extract the type of information that interests you. To make this procedure faster and easier, Earth Resource Mapping developed a new image processing technique called “algorithm data views.” Understanding how to use algorithms is the key to understanding how to use ER Mapper effectively.

What is an algorithm data view?

An algorithm is a list of processing steps or instructions ER Mapper uses to transform raw datasets on disk into a final, enhanced image on your screen display. In this sense, algorithms let you define a “view” into your data that you can save, reload, and modify at any time.

You use ER Mapper's graphical user interface to define your list of processing steps, and you can save the steps in an algorithm file on disk. An algorithm file can store any of the following information about your processing:

- Names of dataset(s) to be processed and displayed
- Subsets of the dataset(s) to be processed (zoomed areas)
- Bands (layers of data) in the dataset(s) to be processed
- Color mapping and contrast enhancements (Transforms)
- Filtering to be applied to the data (Filters)
- Equations and combinations of bands or datasets used to create the image (Formulae)
- Color mode used to display the data (Pseudocolor, Red Green Blue, or Hue Saturation Intensity)
- Any vector datasets, thematic color, or map composition layers to be displayed over the raster image data
- Definition of a page size and margins (used for positioning the image on a page for creating maps and printing)
- Viewpoint and other parameters when viewing the image in 3D perspective

By being able to apply a set of processing steps as a single entity, the complexity often associated with image processing is greatly simplified. In addition, you gain tremendous savings in disk space, since you do not need to store intermediate processed copies of your original data on disk.

Building Algorithms in ER Mapper

There are three primary ways to build a processing algorithm in ER Mapper:

- Open a dataset directly (**File Open**) and have ER Mapper automatically display the dataset using a simple default algorithm
- Use the **Algorithm** dialog options to build an algorithm by adding the desired types of layers, loading datasets, and specify processing steps for each layer.
- Use image wizards to have ER Mapper automatically create any of several types of specialized algorithms for you. In this case, ER Mapper adds the appropriate layers to the **Algorithm** dialog, prompts you to load a dataset, and possibly other options as well.

The majority of exercises in this workbook ask you to build algorithms from scratch so you become familiar with and thoroughly understand the basic concepts. However, you will also use the automatic algorithm creation wizards from time to time to understand how they can save time.

Using Algorithms as Templates

Once you have saved your processing instructions as an algorithm file, you can use the algorithm as a “template” to easily apply the same processing to other datasets. To use an algorithm as a template, simply load the desired dataset(s) to replace the default dataset(s) saved with the algorithm to apply the same processing to the new dataset(s). You may also need to adjust the transforms (color mapping) for the new datasets.

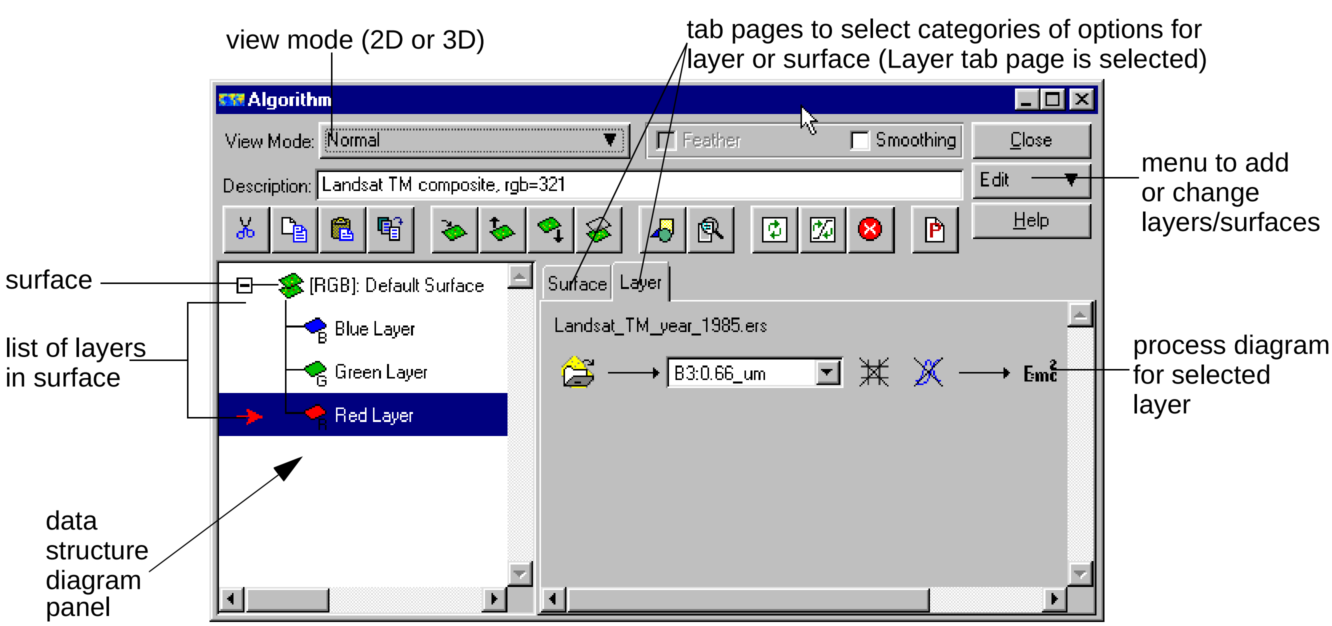
Any algorithm can be used as a template, and ER Mapper also provides many template algorithms for common tasks. These include common display techniques (pseudocolor, colordrape, etc.), writing processed image files to disk, and saving algorithms as “Virtual Datasets.”

The Algorithm dialog

algorithms as “Virtual Datasets.”

The Algorithm dialog

The **Algorithm** dialog is a special dialog box that serves as your “command center” for creating and editing algorithms in ER Mapper. To open the **Algorithm** dialog, you can select **Algorithm...** from the **View** menu or click the **Edit Algorithm** toolbar button. The key components of the **Algorithm** dialog are labelled in the diagram below and described in the table that follows.



Data structure diagram Shows a list of surfaces and layers contained in the current algorithm using a hierarchy or "tree" structure. Select (click on) a surface or layer to change its options using the Tab pages.

Surface A group of raster and/or vector data layers that combine to create a view or image. Algorithms can have multiple surfaces that become independent entities when viewed in 3D mode.

Layers Components of a surface that contain data used to construct an image. Different layer types can contain raster or vector data, and processing for each overlay is controlled independently from the others.

View Mode Sets the manner in which data is displayed as two dimensions (2D) or three dimensions (3D).

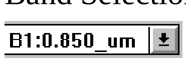
Tab pages Display categories of options for controlling the image display and processing techniques, such as Layer for options for current layer, or Surface for options that apply to an entire surface.

Process diagram Used to control the processing operations applied to dataset(s) in the currently selected layer (displayed when Layer tab is selected).

The Process Diagram

When the Layer tab is selected, the horizontal row of buttons in the right-hand panel of the **Algorithm** dialog are called the *process diagram*. They are used to define your image processing operations for the currently selected data layer. Each button in the diagram controls a specific image processing function.

As the arrows indicate, the processing stream flows from left to right. Typically, you may specify an image to be used, the bands within the image to be processed, then apply processing using formulae, filters, transforms or other options to create your desired image. ER Mapper compiles all the processing steps you specified and renders the resulting image to the screen display. The name and function of the main processing stream buttons are as follows.

Button	Function
Dataset 	Use to load an image from disk, or edit or view information or comments about an image.
Band Selection 	Use to select one or more bands in the image for use in generating an image (a drop-down list).

Button	Function
Formula	Use to enter, load, or save a formula to perform image algebra and other arithmetic operations.
Filter	Use to add or delete one or more spatial filters. (There are both pre- and post-formula Filter buttons.)
Transform	Use to adjust image contrast and brightness. (There are both pre- and post-formula Transform buttons.)
Sunshade	Use to specify artificial illumination of the image to create shaded relief effects.

Note: A cross or “X” through the button indicates that the function is not active in the current data layer. In addition, there are other buttons for some layer types that you will learn about later in this manual.

Hands-on exercises

These exercises show you how to initially display an dataset, use formulas and color mapping, and save and reload a simple image processing algorithm.

Note: These exercises briefly introduce concepts and procedures that are explained in more detail later in this manual.

What you will learn...

After completing these exercises, you will know how to perform the following tasks in ER Mapper:

- Load a new dataset for display and processing
- Use the **Algorithm** dialog to define a processing algorithm
- Add a formula to an algorithm
- Change the color lookup table used to display the image
- Use transforms to adjust the image contrast and color mapping
- Add text labels and comments to an algorithm
- Save the processing algorithm to disk
- Reload and view the saved algorithm

- View the algorithm in 3D perspective

Before you begin... Before beginning these exercises, make sure all ER Mapper image windows are closed. Only the ER Mapper main menu should be open on the screen.

1: Loading and displaying images

Objectives Learn to open an image window and the **Algorithm** dialog, load a raster dataset, and display the dataset on-screen. You will also learn to change the contrast (color mapping) of the image, and use a formula to invert the data range if needed.

(Part 1 shows you how to load a dataset from disk and display it on-screen for an initial look at the data. The dataset was previously imported from a magnetic tape or other media and now resides on the computer's hard disk. Available import formats and details on importing data are discussed briefly in Appendix C and in more detail in the ER Mapper manual set.)

Open an image window and the Algorithm dialog

1 From the **View** menu, select **Algorithm...**.

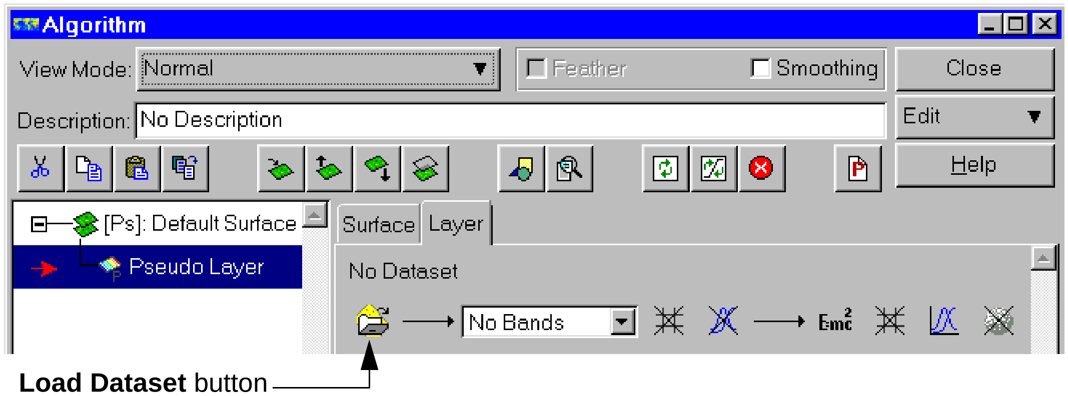
A new empty image window opens in the upper-left corner of the screen, and the **Algorithm** dialog opens.

Note that the **Algorithm** dialog shows a default surface with one Pseudocolor layer in the left-hand panel (labelled “Pseudo Layer”), and a process diagram for that layer in the right-hand panel. The words “No Dataset” above the process diagram indicate that no dataset is currently loaded into the layer.

Note: If you open the **Algorithm** dialog when no image windows are currently open (as in this case), ER Mapper opens an empty image window for you automatically. This shortcut saves you the step of opening a window.

Load a raster dataset into the Pseudocolor layer

1 In the **Algorithm** dialog, click the **Load Dataset**  button.



Load Dataset button

The **Raster Dataset** file chooser dialog box appears.

2 From the **Directories** menu (on the **Raster Dataset** dialog), select the path ending with **\examples**.

The scrolling list in the center now shows a list of directories containing example datasets supplied with ER Mapper (such as 'application...' and others).

3 Double-click on the directory named 'Shared_Data'.

A list of raster datasets with the file extension ".ers" are displayed. (If you do not see files with an .ers extension, open the **Files of Type** menu and select 'ER Mapper Raster Dataset (.ers)'.)

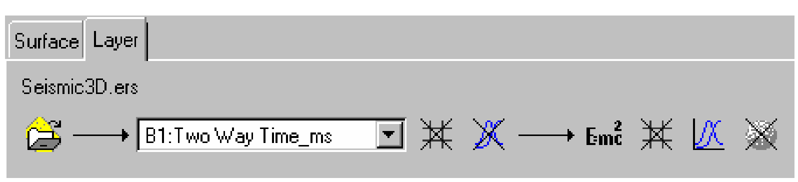
4 Double-click on the dataset named 'Seismic3D.ers' to load it.

The file chooser dialog closes, and the dataset is loaded into the Pseudocolor layer. Note that the dataset name ('Seismic3D.ers') now appears above the process diagram.

The image initially displays as white in the image window–*this is expected* since the range of data values in this horizon dataset is different to the default range ER Mapper initially uses for display. (All data is mapped to the color white.) You will adjust this next.

Resize the Algorithm dialog to view all process option icons

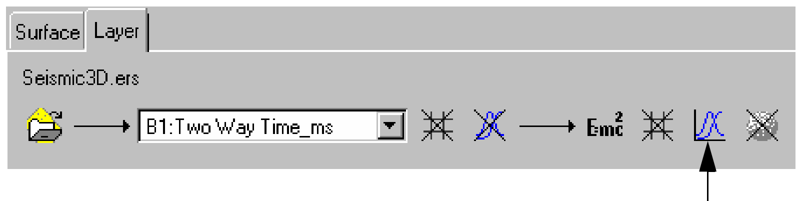
1 Drag one side of the **Algorithm** dialog to widen it until you can see all the option icons below:



Tip: When you resize or reposition a dialog box, ER Mapper automatically remembers this the next time you open it. This lets you setup your work environment as you like.

Adjust the contrast to use the entire range of shades

1. In the **Algorithm** dialog, click on the right-hand **Edit Transform Limits**  button (blue) in the process diagram.



Edit Transform Limits button

The **Transform** dialog box opens. Note that the field “Actual Input Limits” values at the bottom show a data range of about 1920 to 2230 (in exponential notation). This is the actual range of two-way time values in the seismic horizon. You need to tell ER Mapper to map the colors (grayscale) in the lookup table to this range instead of the 0 to 255 range currently shown as the default on the X-axis below.

2. From the **Limits** menu (on the **Transform** dialog), select **Limits to Actual**.

The X axis data range changes to match the Actual Input Limits.

ER Mapper renders the image again, this time using the full range of shades to display the image. This dataset shows two-way travel time values, so structural lows (larger two-way time values) are shown as white transitioning into structural highs shown as black.

In addition, a histogram showing the relative frequency of data values for the horizon dataset appears in the center of the **Transform** dialog. Histograms often provides clues about features in a dataset.

Note: After loading and displaying a new seismic or other geophysical dataset, you should always perform step 2 to match the input data range used for the transform to the actual range of values in the dataset. (There are automated toolbar functions that make this easier, and you will learn about them later.)

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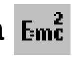
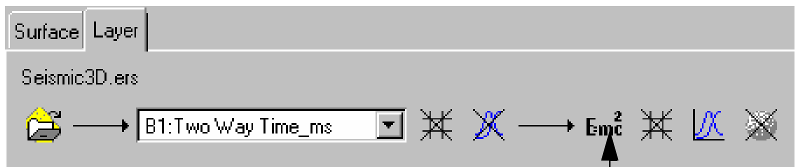
3. Click the **Close** button on the **Transform** dialog to close it.

Use a formula to invert the dataset values

In seismic horizon datasets that contain all positive data values (such as this one), it is often helpful to invert the data values to make the structure easier to interpret (so lower two-way time values correspond to structural highs, and higher values to structural lows). You can do this easily by adding a simple formula to your processing algorithm.

1 In the **Algorithm** dialog, click on the **Edit Formula**  button in the process stream diagram.



Edit Formula button

The **Formula Editor** dialog box opens to let you use standard image processing formulas or create your own formulas. The menu bar at the top gives you fast access to many formulas. Note that the current formula simply reads 'INPUT1,' meaning that the data values are not altered in any way.

2 In the **Formula Editor** dialog, click to place the text cursor before the "I" in "INPUT1," then type a minus sign (-) on your keyboard. Your formula should now look like this:

```
-INPUT1
```

This formula tells ER Mapper to negate (invert) all values in the dataset.

3 On the **Formula Editor** dialog, click the **Apply changes** button.

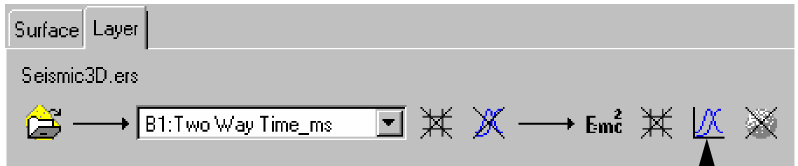
This tells ER Mapper to apply the changes and verify the formula syntax.

4 Click the **Close** button to close the **Formula Editor** dialog.

The image appears as black this time because you have inverted the data range and need to adjust the transform to account for the new range of negative values produced by the formula.

Adjust the contrast again to use the entire range of shades

1 In the **Algorithm** dialog, click the right-hand **Edit Transform Limits**  button.



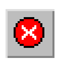
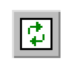
Edit Transform Limits button

The **Transform** dialog box opens. Note that the field Actual Input Limits now show a negative data range (produced by the formula), while the current X axis display limits are still set to positive values (from the previous image).

2 From the **Limits** menu (on the **Transform** dialog), select **Limits to Actual**.

The X axis data range changes to match the Actual Input Limits.

ER Mapper renders the image again using the full range of colors to display the image. Since you inverted the data values with a formula, structural lows (larger two-way time values) are shown as black transitioning into structural highs shown as white.

Tip: Use the **STOP**  button to halt all processing. This can be useful when you make a mistake, or when you want to take a quick look at the results without waiting for processing of the entire image to finish. Clicking **Refresh**  restarts processing from the beginning.

---

3 Move the **Transform** dialog box to the lower left area so it does not overlap with the image window or **Algorithm** dialog.

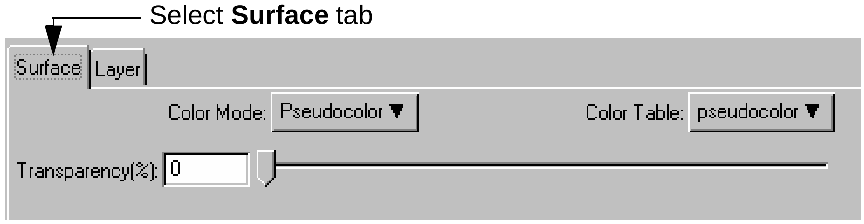
2: Changing image colors and contrast

Objectives Learn to display an image in color, change the color lookup table (LUT) used to display the image, and modify the image contrast/color mapping.

Change the color table to view the image in color

When you are using the Color Mode named Pseudocolor (as you are in this example), the color lookup table controls the set of colors ER Mapper uses to display the image. Each lookup table contains a set of 255 colors that ER Mapper uses to display the image on-screen.

1 In the **Algorithm** dialog, select the **Surface** tab.



Options for Color Mode, Color Table, and Transparency now appear in the panel.

Color Mode is set to "Pseudocolor" meaning that a color lookup table (LUT) is used to control the image colors. The current color table is named "greyscale" (because it is the default color set), and it's set of colors is shown in the color bar on the left side of the **Transform** dialog.

2 Click on the **Color Table** drop-down list button.

A menu listing available color lookup tables appears.

3 From the **Color Table** drop-down list, select **rainbow1**.

This color table has colors similar to 'pseudocolor,' but also adds magenta at the low end and white at the high end.

4 From the **Color Table** list, select **contour**.

ER Mapper renders the image using a lookup table that contains blocks of solid colors (a contouring effect) rather than gradual transitioning between colors.

5 From the **Lookup Table** list, select **pseudocolor**.

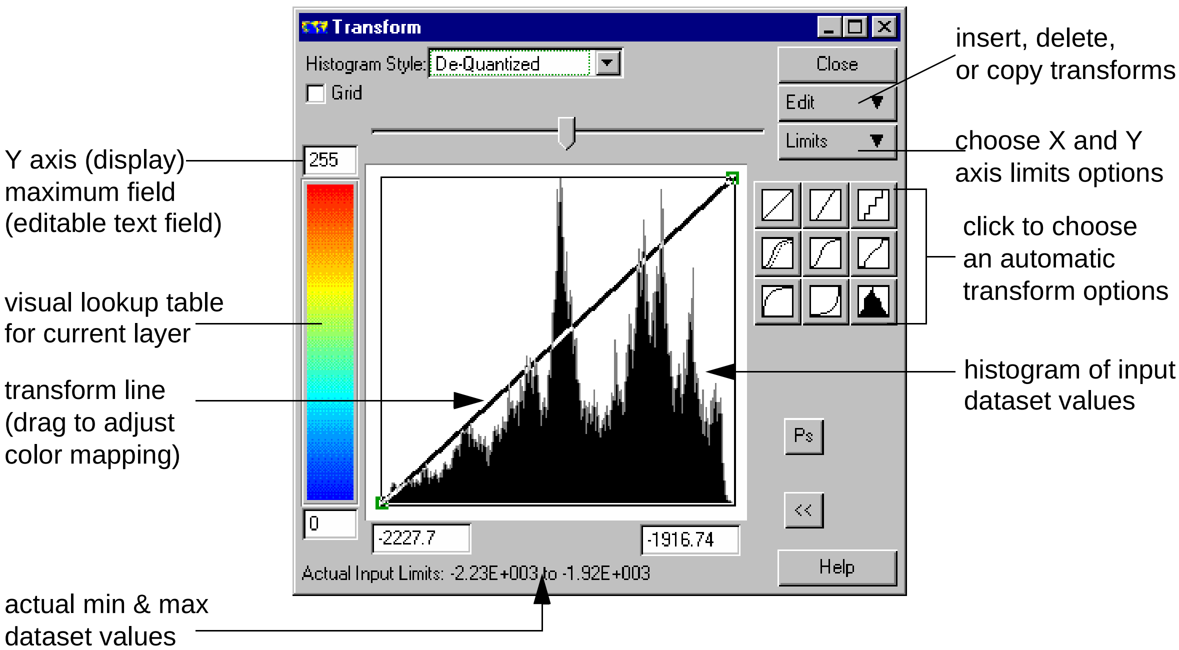
6 In the **Algorithm** dialog, select the **Layer** tab again.

The process diagram is now displayed in the right-hand panel.

Manually adjust the image contrast (color mapping)

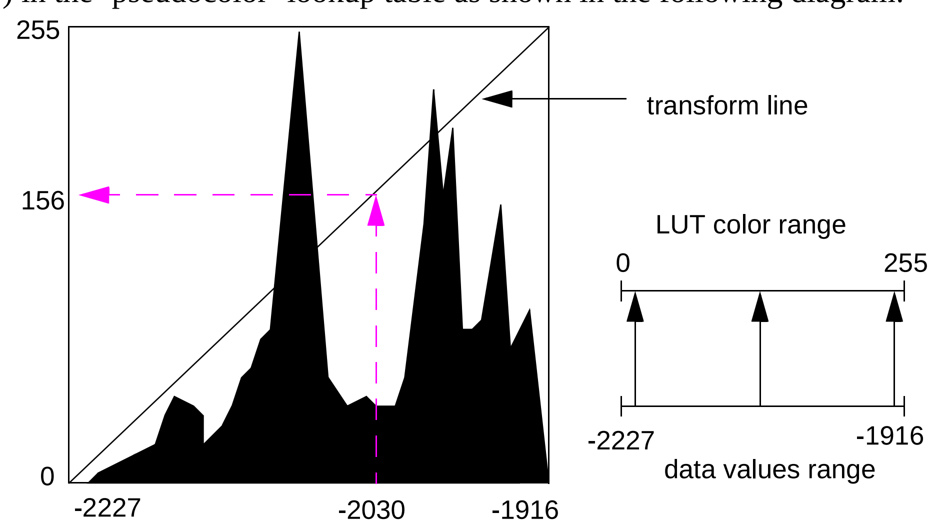
1 Examine the contents of the **Transform** dialog box.

This dialog box lets you control how ranges of data values are mapped to display colors on the screen. The transform line controls how data values are mapped to display colors, and the color bar along the Y axis shows the colors contained in the current lookup table (‘pseudocolor’ in this case).



Up until now, you have displayed the dataset using a default linear transform (shown above), where a straight 45 degree line defines the mapping between input data values and output display colors.

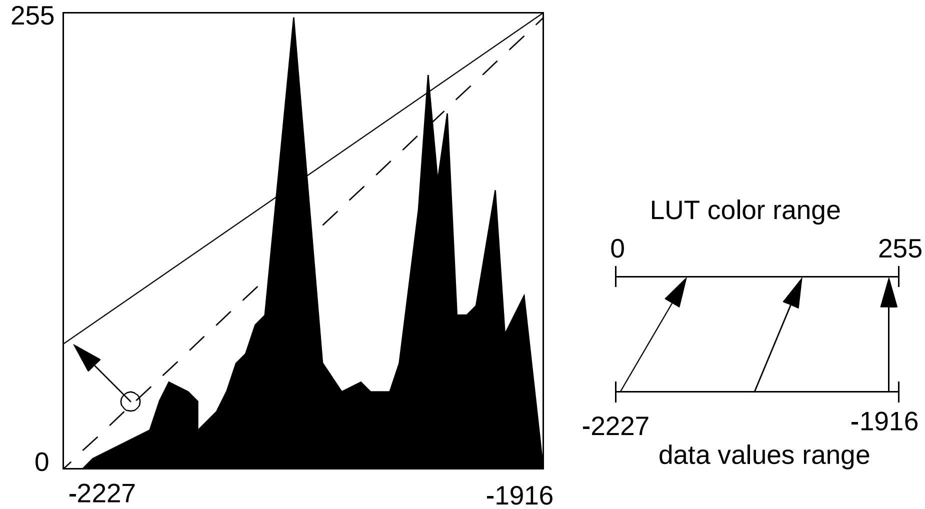
For example, the data value -2030 on the X axis is mapped to color number 156 (yellow) in the ‘pseudocolor’ lookup table as shown in the following diagram:



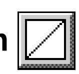
2 Move the mouse pointer around in the window containing the histogram.

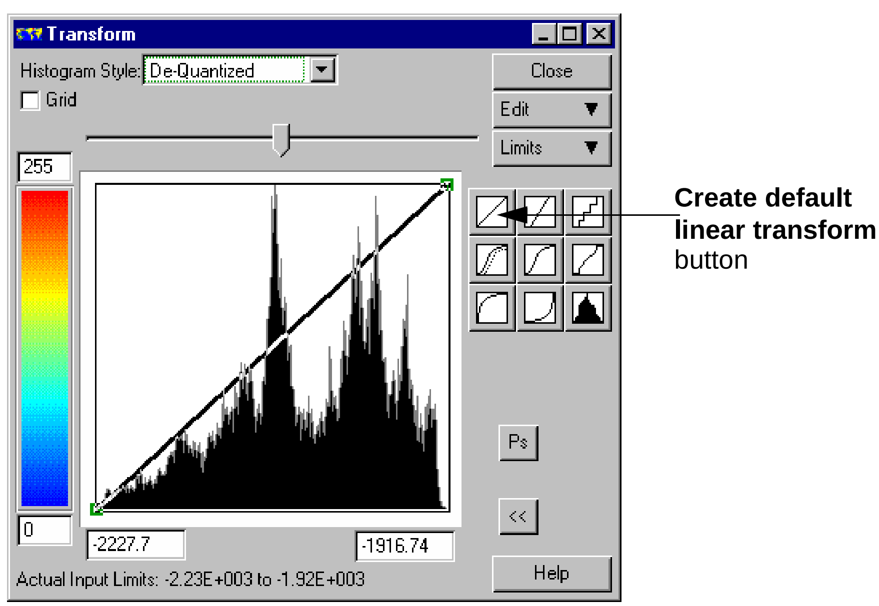
The X-Y location of the current pointer position is shown in the upper-left part of the **Transform** dialog (below “Histogram Style”). The X value is the data value from the seismic horizon dataset (negated two-way time in this case), and the Y value is the position in the set of lookup table colors (ranging from 0-255).

3 Point to the circle on the dotted transform line below, and drag the line up along the Y axis to exclude the blues from the image display.



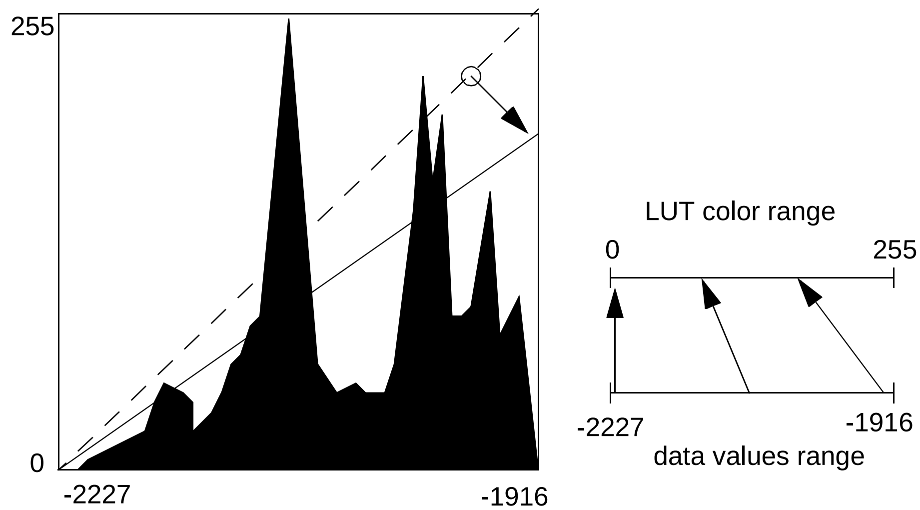
ER Mapper updates the color mapping interactively, so the lower colors in the lookup table (blues) are no longer used to display the image. (Only colors about 80-255 are used to display the image, or cyan-green-yellow-red in this case).

4 On the **Transform** dialog, click the **Create default linear transform**  button (upper-left of the nine buttons together).

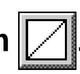


ER Mapper resets the transform line back to a straight linear default and the image colors update interactively.

5 Drag the transform line from the circled area down along the right-hand Y axis to exclude the reds from the image display.



Now higher colors in the lookup table (reds) are no longer used to display the image. (Only colors about 0-200 are used to display the image, or blue-cyan-green-yellow in this case).

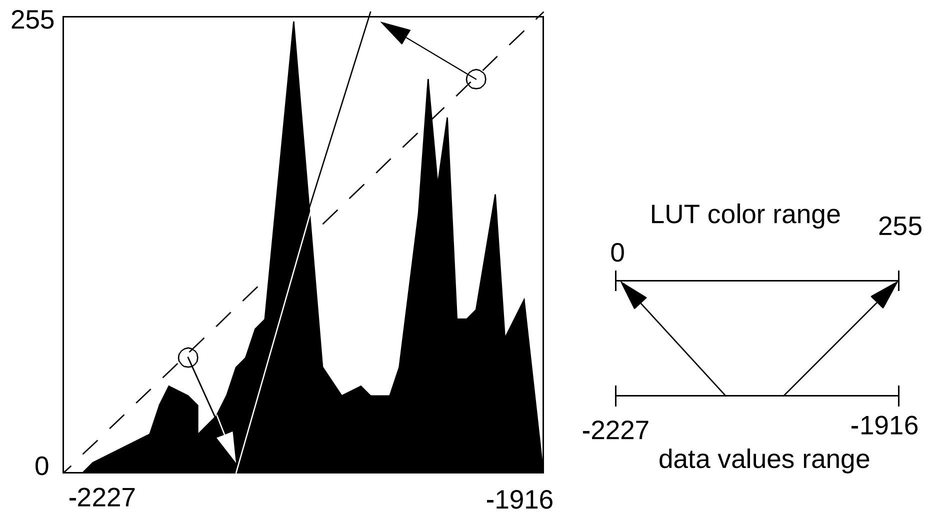
6 On the **Transform** dialog, click **Create default linear transform** .

ER Mapper resets the transform line back to a straight linear default.

Highlight a time slice in the image

By adjusting the transform line, you can map any range of data values to any desired range of colors, for example to highlight particular features visible in your histogram.

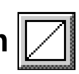
1 Drag the transform line at two points to map the central peak of data values in the histogram to all the display colors (see diagram below).



Now all colors are used to display only the time slice from about -2090 to -2030 milliseconds. Time values greater than -2090 are all mapped to blue, and time values less than -2030 are all mapped to red.

Note: This technique is called *histogram clipping*, because it clips off the tails of the histogram and saturates those values to a single color. It can be effective for highlighting detail in specific features such as a narrow time slice.

---

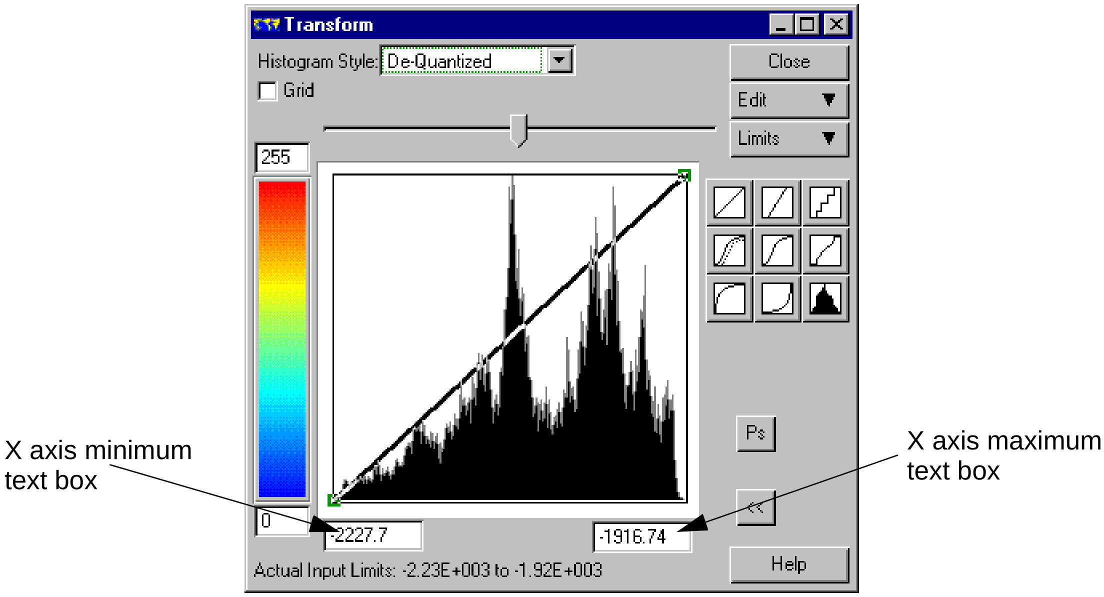
2 On the **Transform** dialog, click the **Create default linear transform**  button again.

Set exact input limits to highlight a time slice

The text boxes next to the X and Y axes of the histogram window let you change the minimum and maximum values. This offers another way to display exact ranges of data or use only specific colors for the image display.

1 Select the text in the X axis minimum text box (currently about -2227), and enter a value of **-2090** (see diagram below).

2 Select the text in the X axis maximum text box (currently about -1916), and enter a value of **-2030**.



Again, all colors are used to display only the time slice from about -2090 to -2030 milliseconds. Time values greater than -2090 are all mapped to blue, and values less than -2030 are all mapped to red.

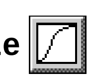
This is another method to map a specific range of data to the entire display range. In this case, you are choosing to display only a specific data range, rather than moving the transform line to accomplish the task.

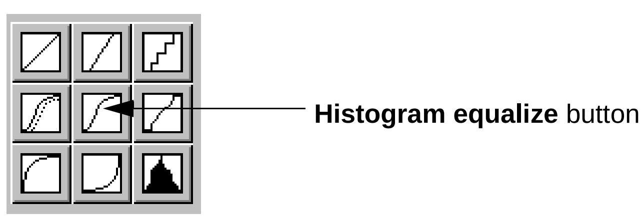
3 From the **Limits** menu (on the **Transform** dialog), select **Limits to Actual**.

The X axis data range changes back to match the Actual Input Limits (so all data values will again be displayed).

ER Mapper renders the full image again with the default linear color mapping.

Apply a Histogram equalize transform to the data

1 On the **Transform** dialog, click the **Histogram equalize**  button (the center button in the set of nine buttons).



Tip: Pass the mouse over the button to see the button name (tooltip).

ER Mapper creates a complex piecewise linear transform line and updates the image. Notice that is this case contrast is maximized in the steepest slopes of the time surface, and detail is obscured in the structural highs and lows.

Histogram equalization (also called uniform distribution stretching) automatically adjusts the transform line so that image values are assigned to display levels based on their frequency of occurrence. More display values are assigned to the most frequently occurring portion of the histogram, so the greatest contrast enhancement occurs in the data range with the most values (peaks in the histogram). Histogram equalization usually creates an image with very strong contrast. In some cases, it can also saturate areas which can obscure detail.

Apply a Gaussian equalize transform to the data

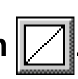
1 On the **Transform** dialog, click the **Gaussian equalize**  button.

ER Mapper creates a complex piecewise linear transform line (sometimes with slight stair steps) and updates the image.

Gaussian equalization automatically adjusts the transform line so that image values are assigned as needed to make the output (display) values occur with a Gaussian distribution. A Gaussian, or “normal” distribution, is characterized as producing a bell-shaped histogram (shown in the output histogram.)

Gaussian equalization is useful when data is skewed in such a way that features could be abnormally saturated if stretched linearly. This technique tends to bring out more detail in areas with less frequently occurring data values so it is good for emphasizing subtle features. (In this case it emphasizes the detail in the structural highs and lows of the horizon, and suppresses detail in the mid-range).

Tip: You can set the number of standard deviations used for the Gaussian equalize function by double-clicking on the button. Smaller values produce more contrast and higher values less contrast. The default is 3 standard deviations.

2 On the **Transform** dialog, click **Create default linear transform** .

Zoom in to view the data range within a specific area

It is sometimes helpful to view the range of time values in a specific area of the image. You can do this by zooming in on the area.

1 If needed, click the **Zoom Box Tool** button on the main menu.

This tells ER Mapper to use the mouse pointer for zooming and panning functions.

2 Inside the image window, drag a box to zoom in on an area of interest.

3 Examine the ‘Actual Input Limits’ fields on the **Transform** dialog.

The ‘Actual Input Limits’ fields have changed to show the range of two-way time values *only within the zoomed area* currently displayed in the image window.

4 Click in the image window to pan the image to an adjacent area.

The ‘Actual Input Limits’ fields update again to show the new range. Zooming into areas of interest and examining the Actual Input Limits is a fast way to view the range of values in different parts of an image.

5 Click **Close** on the **Transform** dialog to close it.

Zoom back out to view the full image extents

1 From the **View** menu, select **Quick Zoom** and then select **Zoom to All Datasets**.

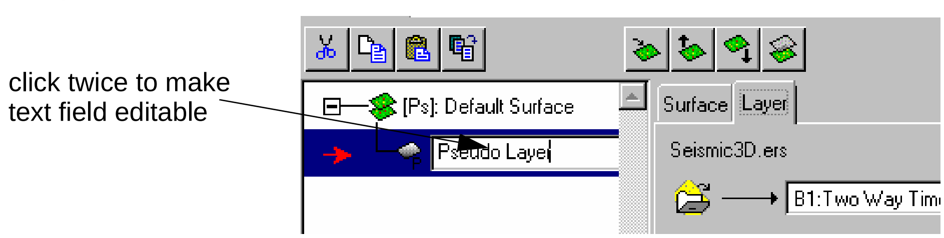
ER Mapper zooms out to display the full extents of the time horizon dataset.

3: Labelling and saving the algorithm

Objectives Learn to specify description labels, titles, and comments for an algorithm, and save the algorithm processing steps to a file on disk for later use.

Enter a description for the Pseudocolor layer

1 In the **Algorithm** dialog, click twice on the text “Pseudo Layer” in the left-hand panel.



The text become reverse highlighted (shown above) indicating the text is editable.

2 Backspace over or drag select the existing text, then type **`Inverted TWT`** in the field. Then press the Enter or Return key on your keyboard.

This text now becomes a visual description for the layer.

Enter a description for the entire algorithm

1 In the **Algorithm** dialog, select the text in the **Description** text field (it currently reads ‘No Description’).

(To select the text, either drag through it, or triple-click to select the entire line.)

2 Type the following text, then press Enter or Return on your keyboard:

```
Horizon KA Pseudocolor
```

This text now becomes a brief description for the entire algorithm.

Save the processing steps to an algorithm file on disk

1 From the **File** menu (on the main menu), select **Save As...**.

The **Save Algorithm** file chooser dialog opens.

2 From the **Directories** menu, select the path ending with the text **\examples**. (The portion of the path name preceding it is specific to your site.)

3 Double-click on the directory named ‘miscellaneous’ and then ‘tutorial’ to open it.

4 In the **Save As:** text field, click to place the cursor, then type in a name for the algorithm file. Use your initials at the beginning, followed by the text ‘Horizon_KA_pseudocolor,’ and separate each word with an underscore (_). For example, if your initials are “JC,” type in the name:

```
JC_Horizon_KA_pseudocolor
```

(You will be asked to add your initials to all practice algorithm names to keep them separate from other students.)

5 Click the **Apply** button to save the algorithm and leave the dialog open.

Your pseudocolor algorithm is now saved to an algorithm file on disk.

Add comments to the algorithm

1 On the **Save As...** dialog, click the **Comments...** button.

A dialog box appears titled with the algorithm path and file name, and a text area to type comments about your algorithm. The cursor is already active in the upper-left corner.

2 In the comments dialog, type the following information to describe your algorithm:

```
This algorithm displays seismic horizon KA using the
'pseudocolor' lookup table. A negation formula is used
to invert the two-way time data for display, so structural
highs are shown as reds, and lows are shown as blues.
```

3 Click **OK** on the comments dialog to save your comments.

4 Click **Cancel** on the **Save As...** dialog close it.

4: Reloading and viewing the algorithm

Objectives Learn to reload and display the algorithm you just created, and to view the text file on disk that defines the algorithm processing steps.

Open a second image window

1 On the Standard toolbar (on the main menu), click on the **New** button.

ER Mapper opens a new image window (this is a shortcut for selecting **New** from the **File** menu). Drag the new window to the lower left part of the screen (so you can see all or part of the other image window).

Open the processing algorithm you created earlier

1 On the Standard toolbar, click on the **Open** button.

The **Open** file chooser appears. (This is a shortcut for selecting **Open...** from the **File** menu.)

2 From the **Directories** menu, select the path ending with the text **\examples**.

3 Double-click on the directory 'miscellaneous\tutorial' to open it.

Your 'Horizon_KA_pseudocolor' algorithm name should appear in the list.

4 Click once on your algorithm name to highlight it (do not double-click).

5 Click the **Apply** button to load and process the algorithm without closing the **Open Algorithm** dialog box.

ER Mapper runs the algorithm and displays the processed horizon dataset in the image window. It looks identical to the other image since they both use the same algorithm and dataset.

View the algorithm comments

1 On the **Open Algorithm** dialog, click the **Comments...** button.

The dialog box opens showing the comments you entered for your algorithm. These comments can be very helpful to others who use or display your algorithm, and they are a good way to document the procedures you used to create it.

2 Click **Cancel** to on the comments dialog box to close it.

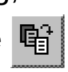
5: Viewing the image in 3D perspective

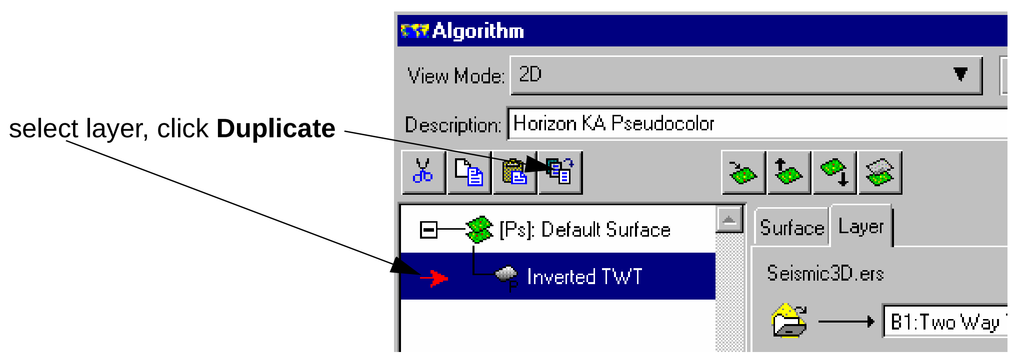
Objectives Learn to modify the algorithm you just created to view the image in 3D perspective.

About 3D perspective viewing

Up until now you have viewed your images using conventional 2D planimetric views. ER Mapper makes it very easy to view images in 3D perspective by simply adding a height (or elevation) component to your algorithm. The following is a very simple introduction to the 3D viewing features, and you will learn more about them in later chapters.

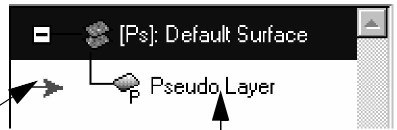
Duplicate (copy) the Pseudo layer of the algorithm

1 On the **Algorithm** dialog, click once on the layer ‘Inverted TWT’ to select it, then click the **Duplicate**  button.



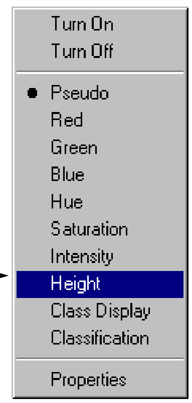
ER Mapper makes an exact copy of the layer below the original. (For example, this layer contains the same dataset, formula and transform as the original.)

Tip: To *select* a layer, click once on the left side. To change the layer's text label, select it first (if needed), then click once on the text label to make it editable.



Change the copied layer to a Height layer

1 Point to the copied (lower) layer, click the right mouse button, and select **Height** from the short-cut menu:



The Pseudo layer changes to a Height layer and ER Mapper sets the layer description to "Height layer." Your algorithm now contains two layers (Pseudo and Height), shown in the layer list on the left panel of the **Algorithm** dialog.

You have now duplicated the inverted two-way time layer and changed the layer type to create a elevation component for your algorithm. (Note that the layer is currently crossed out–this indicates that it is not active until you switch to 3D perspective View Mode.)

Select 3D perspective View Mode to view the image in 3D

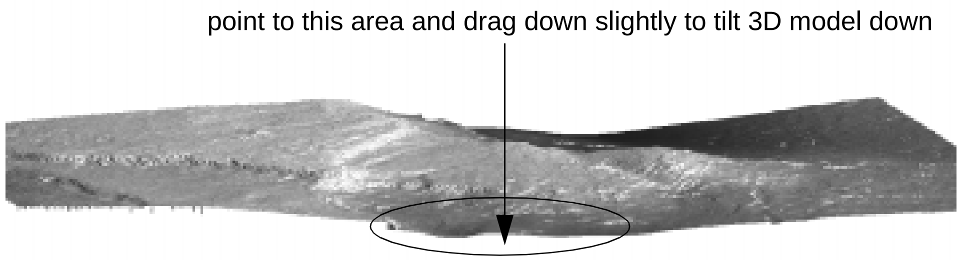
1 From the **View Mode** menu (on the **Algorithm** dialog), select **3D perspective**.

ER Mapper displays a message that the image is being processed, then displays a 3D perspective view of the image in color. The message "Regenerating Terrain" appears in the image window as ER Mapper performs iterations to increase the resolution (detail) in the 3D image.

This 3D image uses color to denote absolute values of two-way time, and also shows the structure of the horizon using a perspective view. The right-hand panel in the **Algorithm** dialog now has two additional tabs–**3D View** and **3D Properties**. These contain controls specifically for 3D viewing of images.

Change the perspective viewing angle

1 Point to the lower part of the 3D image (the cursor changes to a hand), and drag down slightly to tilt the 3D view (see following diagram).



The 3D image tilts downward, so you are now looking more from an overhead viewpoint. You can use the mouse to manipulate the viewpoint, zoom in and out, rotate the image, and other controls (to be discussed later).

This a simple 3D algorithm that contains only one surface (a time horizon in this case). You can also build algorithms that let you view and manipulate multiple surfaces simultaneously (for example multiple time horizons).

Select 2D View Mode to view the image in 2D again

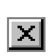
1 From the **View Mode** menu, select **Normal**.

ER Mapper redisplays the image in a two-dimensional planimetric view again.

Note: This 3D exercise was a simple introduction to show how easy it can be to view data in 3D perspective in ER Mapper. You will learn more about the 3D capabilities and controls later.

Close both image windows and the Algorithm dialog

1 Close the image window with the 3D view:

- For Windows, click the  **Close** button in the upper-right window corner.

2 Close the other image window by repeating Step 1.

3 On the **Algorithm** dialog, click the **Close** button to it.

Only the ER Mapper main menu is now open on the screen.

What you learned...

After completing these exercises, you know how to perform the following tasks in ER Mapper:

- Load a new dataset for display and processing
- Use the **Algorithm** dialog to define a processing algorithm
- Add a formula to an algorithm
- Change the color lookup table used to display the image
- Use transforms to adjust the image contrast and color mapping
- Add text labels and comments to an algorithm
- Save the processing algorithm to disk
- Reload and view the saved algorithm
- View the algorithm in 3D perspective

4

Colordrape algorithms

This chapter explains how to apply shaded relief effects to a dataset and create "colordrape" algorithms that drape color information over intensity (brightness) information. Shading and colordraping are two of the most powerful techniques for presentation and analysis of interpreted seismic datasets.

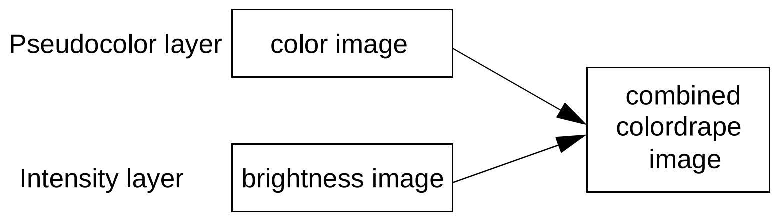
About colordraping

The term *colordraping* refers to the technique of draping one set of image data in color over another set of data that controls the color brightness or intensity. This allows you to effectively view two (or more) different types of data or methods of processing simultaneously in a *combined display.* Colordraping is usually difficult and time consuming using traditional image processing products, but ER Mapper makes it very fast and interactive by providing the special Intensity layer type.

The colordraping technique has become a very popular and powerful tool for visualization of interpreted surfaces. For example, combining two-way time images shown as both color and as structure lets you create a shaded relief image that enhances subtle faults and color-codes their placement relative to depth. From these types of images, far more useful information can be derived than from conventional visualization techniques.

The Intensity Layer Type

ER Mapper provides a special type of layer named Intensity that is the key to the colordraping technique. When you add an Intensity layer to an algorithm, the *brightness* (or intensity) of the image colors are automatically controlled by the data loaded into the Intensity layer. Low data values in the Intensity layer produce dark colors in the image, and high data values produce bright colors.



The diagram above shows how algorithm Pseudocolor and Intensity layers are combined to create a single colordrape image. You will see for yourself how these techniques work in the following exercises.

Hands-on exercises

These exercises give you practice creating colordrape algorithms to display time surfaces as both shaded relief and color. You will also learn to drape data such a seismic amplitude over a shaded time surface to aid analysis.

What you will learn...

After completing these exercises, you will know how to perform the following tasks in ER Mapper:

- Use Intensity layers to create shaded relief images that highlight structure
- Combine Pseudocolor and Intensity layers to create colordrape images
- Turn layers on (to process them) and off (to ignore them)
- Add new layers and move existing layers
- Control the color and intensity components to modify image displays

Before you begin...

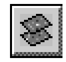
Before beginning these exercises, make sure all ER Mapper image windows are closed. Only the ER Mapper main menu should be open on the screen.

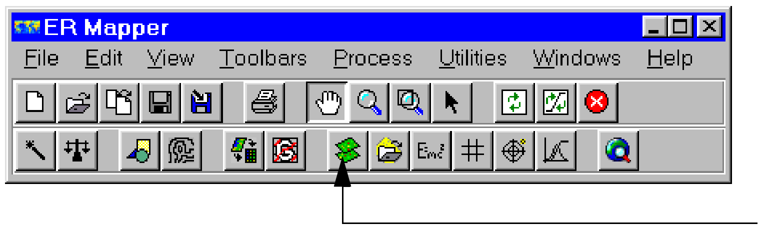
Note: Some of the following exercises repeat steps from the previous exercise to emphasize understanding of the fundamental concepts.

1: Using shading to highlight structure

Objectives Learn how to display a time dataset in an Intensity layer and apply sun angle shading to create shaded relief effects that highlight structure.

Open an image window and the Algorithm dialog

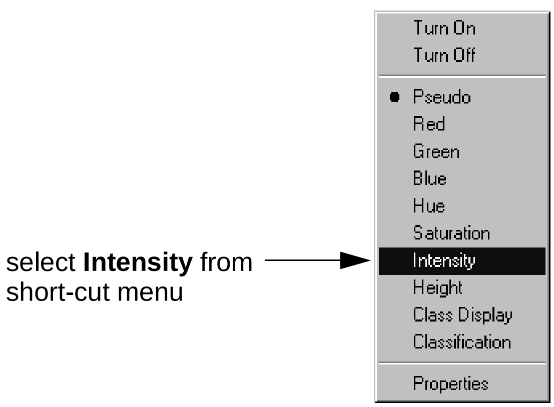
1 On the main menu, click the **Edit Algorithm**  button.



An image window and the **Algorithm** dialog open. (This is a shortcut for selecting **Algorithm** from the **View** menu.)

Change the Pseudocolor layer to an Intensity layer

1 Point to the layer labelled “Pseudo Layer”, click the right mouse button, and select **Intensity** from the short-cut menu:

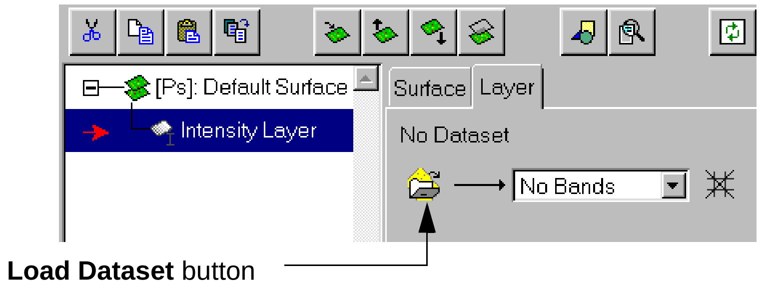


The Pseudo layer changes to an Intensity layer and ER Mapper sets the layer description to “Intensity Layer.”

Tip: Right-clicking any layer opens the short-cut menu that lets you quickly change the layer’s type, and turn it on or off.

Load the sample seismic dataset into the Intensity layer

1 In the **Algorithm** dialog, click the **Load Dataset** button in the process diagram (be sure the **Layer** tab is selected first).



The **Raster Dataset** file chooser dialog box appears.

2 From the **Directories** menu, select the path ending with **\examples**.

3 Double-click on the directory named ‘Shared_Data’

A list of raster datasets and algorithms is displayed.

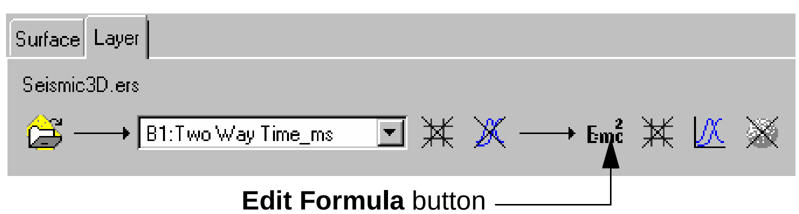
4 Double-click on the dataset named ‘Seismic3D.ers’ to load it.

The dataset is loaded into the Intensity layer.

Use a formula to invert the dataset values

As in the previous chapter, you will invert the time horizon data values to make the structure easier to interpret (so lower two-way time values correspond to structural highs, and higher values to structural lows).

1 In the **Algorithm** dialog, click on the **Edit Formula** button in the process diagram.



The **Formula Editor** dialog box appears.

2 In the **Formula Editor** dialog, click to place the text cursor before the “I” in “INPUT1,” then type a minus sign (-) on your keyboard. Your formula should now look like this:

```
-INPUT1
```

This formula tells ER Mapper to negate (invert) all values in the dataset.)

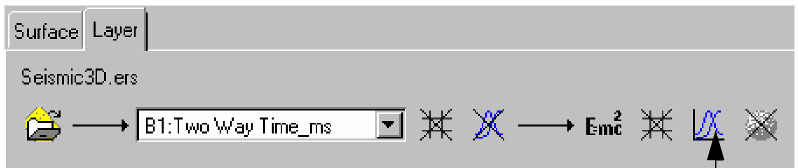
3 On the **Formula Editor** dialog, click the **Apply changes** button.

4 Click the **Close** button to close the **Formula Editor** dialog.

The image appears as black initially because you need to adjust the transform to account for the new range of negative data values produced by the formula.

Adjust the color mapping (contrast) of the image

1 In the **Algorithm** dialog, click the right-hand **Edit Transform Limits**  button in the process diagram.



Edit Transform Limits button

The **Transform** dialog box opens showing the negative data range produced by the formula in the Actual Input Limits fields.

Note: If needed, make the **Algorithm** dialog wider until you can see all the process stream icons shown above.

---

2 From the **Limits** menu (on the **Transform** dialog), select **Limits to Actual**.

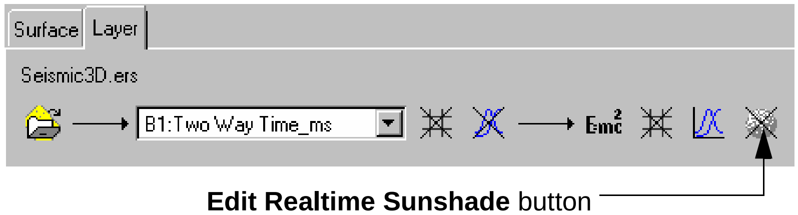
The X axis data range changes to match the Actual Input Limits.

ER Mapper renders the image again, this time using the full range of grey shades to display the image. Since you inverted the data values with a formula, structural lows (larger two-way time values) are shown as dark greys transitioning into structural highs shown as lighter shades. (Intensity layers always render images in greyscale.)

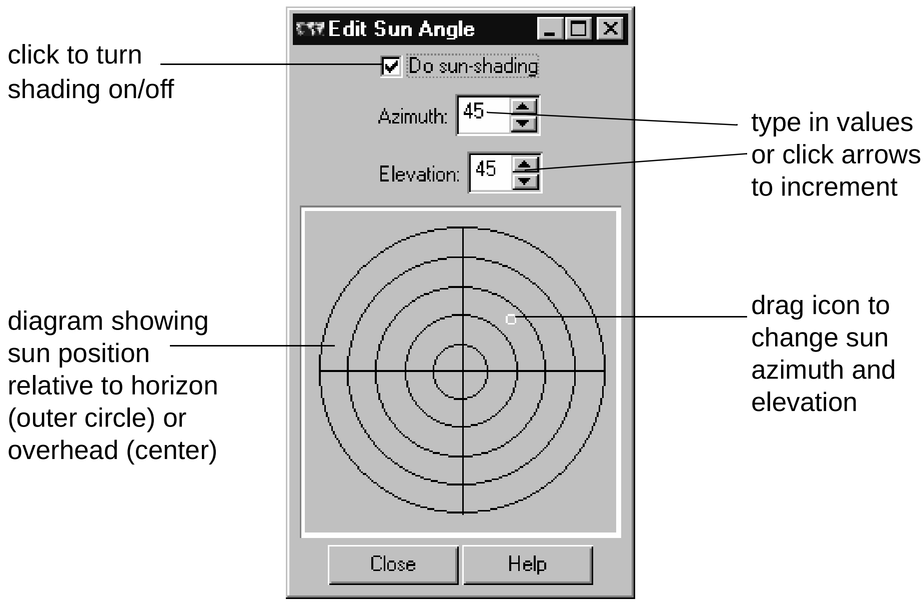
3 Click **Close** on the **Transform** dialog to close it.

Turn on sun shading and display the shaded relief image

1 On the **Algorithm** dialog, click the **Edit Realtime Sunshade**  button in the process diagram.

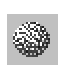


The **Edit Sun Angle** dialog box opens to let you specify shaded relief effects for the Intensity layer.



2 Turn on the **Do sun-shading** option.

ER Mapper applies an artificial illumination effect to clearly define structural features of the time surface.

Also notice that the **Edit Realtime Sunshade** icon in the process diagram is now a yellow sun  to indicate that shading is active for the Intensity layer.

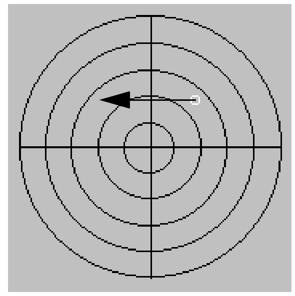
3 Make the image window about 50% larger by dragging lower-right corner of the window border.

4 Right-click on the image and select **Zoom to All Datasets** from the **Quick Zoom** menu.

ER Mapper redisplays the image to show more detail.

Change the sun azimuth

1 In the **Edit Sun Angle** dialog, drag the small sun icon (the circle) to the upper-left quadrant of the circular grid.



The shading angle of the image changes in real time to show the shading effect as if the sun were shining from the northwest.

The *azimuth* (compass direction) from which the sun shines highlights structural features normal to the sun angle. In this case, features trending in a northeast to southwest direction are now highlighted (since they are normal to the northwest sun angle).

2 Drag the sun icon to shade from different compass directions (azimuths).

Structural features normal to your new sun azimuths are highlighted.

Change the sun elevation

1 In the **Edit Sun Angle** dialog, drag the sun icon near the outer rim of the circular grid.

The image becomes darker overall and with larger areas of shadows.

The *elevation* from which the sun shines determines the length of shadows in the shaded relief image. In this case, the sun is shining from a very low sun angle (near the horizon), so you get longer shadows just as you would see right after sunrise or before sunset.

2 Drag the sun icon to the center of the circular grid.

Now the entire image has very little shadow, as if the sun is shining directly overhead during midday. This allows you to see terrain features without directional shadowing introduced by shading from a specific azimuth. (For example, you can see both sides of a fault.)

3 Experiment by dragging the sun icon until you create an image that highlights structural features of interest. (Setting the sun elevation at 45 degrees or greater is usually recommended to reduce shadowing.)

Tip: You can also adjust the sun azimuth and elevation to exact values using the adjustment arrows next to the Azimuth and Elevation fields.

4 Click **Close** on the **Edit Sun Angle** dialog to close it.

Applications of sun angle shading

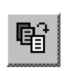
ER Mapper's sun angle shading feature is a very powerful tool for rapid identification of subtle features in time surfaces. It is commonly used for many applications, including:

- identify small scale faulting, and relative through across faults
- identify subtle stratigraphic features (pinchouts, truncations, etc.)
- highlight data acquisition and/or processing artifacts
- highlight quality issues related to interpretation (in both time surface and attribute data)

2: Draping color on the image

Objectives Learn how to duplicate and modify the Intensity layer to create a Pseudocolor layer, and how to combine the two layers to create a colordrape image.

Duplicate the Intensity layer and change it to Pseudocolor

1 On the **Algorithm** dialog, select the Intensity layer (if needed), then click the **Duplicate**  button.

ER Mapper creates a copy of the Intensity layer below the original.

2 Right-click on the new duplicate layer, and select **Pseudo**.

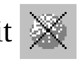
The Intensity layer changes to a Pseudocolor layer. You will use this layer to display the time surface data in color over the shaded relief image.

Turn off sun shading for the Pseudocolor layer

1 With the Pseudo layer selected, click the yellow **Edit Realtime Sunshade**  button in the process diagram.

The **Edit Sun Angle** dialog box opens. Since the layer was duplicated from the Intensity layer, sun angle shading is still turned on.

2 On the **Edit Sun Angle** dialog, turn off the **Do sun-shading** option.

Sun angle shading is now turned off, and the **Edit Realtime Sunshade** icon in the process diagram shows a cross through it  to indicate this.

Note: Sun angle shading is usually applied only to time surface datasets displayed in Intensity layers because two-way time describes structural features well. Sun shading is not normally applied to amplitude or other attribute datasets which are generally displayed in color.

---

3 Click **Close** on the **Edit Sun Angle** dialog to close it.

4 Click on the Algorithm window **Surface** tab, and select ‘pseudocolor’ from the **Color Table** list.

5 Click on the Algorithm window **Layer** tab.

Note that by combining the two processing techniques into one image, you can simultaneously see structural features as brightness and relative depth as color. In this case blues represents structural lows, and reds structural highs.

Tip: The colordrape technique you used here is one of the most important ER Mapper processing techniques used to visualize interpreted time surfaces.

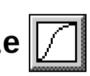
Try different color mapping transforms for the color layer

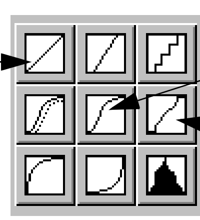
1 In the **Algorithm** dialog, select the Pseudo layer.

By selecting the Pseudo layer, you can now use the process diagram options in the right-hand panel to control it separately from the Intensity layer.

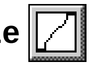
2 Click on the right-hand **Edit Transform Limits**  button in the process diagram.

The **Transform** dialog opens showing the current color table and color mapping.

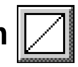
3 On the **Transform** dialog, click the **Histogram equalize**  button.



ER Mapper applies a histogram equalization transform to the data. Notice that the color mapping changes without affecting the shaded relief image in the Intensity layer. This shows how layers in an algorithm are independent of each other, and can be modified individually to affect to overall image they combine to create.

4 On the **Transform** dialog, click the **Gaussian equalize**  button.

ER Mapper applies a gaussian equalization contrast stretch to the data. This maximizes color contrast in the structural highs and lows, but tends to flatten out contrast in other parts of the image.

5 On the **Transform** dialog, click the **Create default linear transform**  button.

ER Mapper resets the color mapping back to a straight linear default.

6 Click **Close** on the **Transform** dialog to close it.

Display the shaded relief and color images separately

1 Turn off the Pseudocolor layer by right-clicking the the layer and selecting the **Turn Off** option from the short-cut menu.

Only the structural component of the image displays since the color component of the algorithm (the Pseudocolor layer) is turned off.

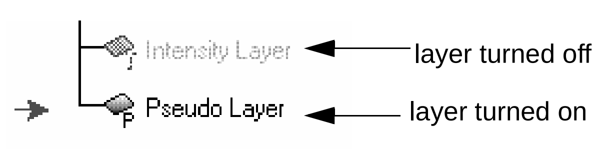
2 Turn the Pseudocolor layer on again (right-click and select **Turn On**).

3 Turn the Intensity layer off (right-click and select **Turn Off**).

By turning layers on and off, you can see them independently of each other to fine tune adjustments before adding them together again.

4 Turn the Intensity layer on again (right-click and select **Turn On**).

Note: When a layer is turned off, the the layer label becomes dim and the icon next to it changes to a question mark (?). If the layer is on, the icon displays a letter corresponding to the layer type, such as "P" for a Pseudocolor layer.



3: Draping amplitude data in color

Objectives Learn how to add a second Pseudocolor layer to drape amplitude (or other data) as color over the shaded time, and how to use multiple Pseudocolor (or other layer types) in the same algorithm.

Add a second Pseudocolor layer to the algorithm

1 Select the Pseudo layer in the layer list.

2 From the **Edit** menu (on the **Algorithm** dialog), select **Add Raster Layer**, then select **Pseudo**.

ER Mapper adds a second Pseudocolor layer to the layer list. New added layers contain no dataset (shown by “No Dataset” above the process diagram).

Load the sample seismic dataset into the new layer

1 In the **Algorithm** dialog, click the **Load Dataset**  button on the left side of the process diagram.

The **Raster Dataset** file chooser dialog box appears.

2 From the **Directories** menu, select the path ending with **\examples**.

3 Double-click on the directory named ‘Shared_Data’.

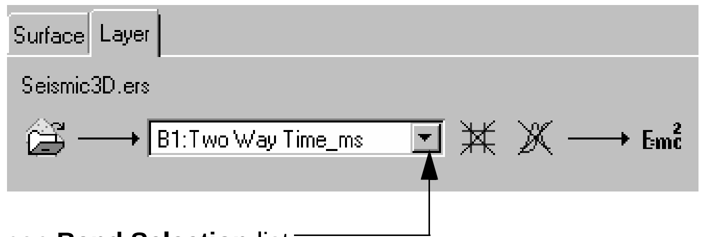
4 Double-click on the dataset named ‘Seismic3D.ers’ to load it.

The dataset is loaded into the new Pseudocolor layer, so all layers contain the same dataset.

Tip: The **OK this layer only** or **Apply this layer only** button on the **Raster Dataset** dialog are designed to let you load a dataset into *only* the currently selected layer. This is useful when you want several layers of the same type with different datasets in them. Double-clicking on the dataset name is the same as clicking the **OK** button.

Change the dataset band for the new Pseudo layer

1 With the new (lower) Pseudo layer selected, click on the **Band Selection** drop-down list in the process diagram (it currently reads ‘B1:Two Way Time_ms’).



A list of two bands displays. This dataset has two layers of data (called “bands”) covering the same geographic area–a two-way time band and a seismic amplitude band.

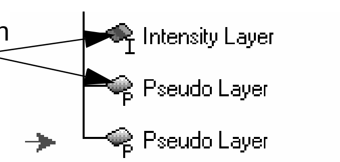
2 Click on the option labelled **B2:Amplitude** to select it as the band to be processed in that layer.

Note: Some datasets can have multiple layers of data, and each layer is called a “band” in ER Mapper. For example, if the dataset contained four time horizons, you would select the one you want to view using the **Band Selection** list.

Turn off the upper Pseudocolor layer and the Intensity layer

1 Turn off the upper Pseudo layer (right-click and select **Turn Off**).

2 Turn off the Intensity layer (right-click and select **Turn off**).



The two layers are now turned off and will be ignored during processing.

3 Click once on the lower Pseudo layer to select it.

The data initially appears as red over the shaded time image–you need to adjust the transform (color mapping) to account for the data in the new layer.

Adjust the transform for the Amplitude color layer

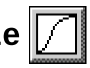
1 Click on the right-hand **Edit Transform Limits**  button in the process diagram.

The **Transform** dialog box opens. Notice that the actual input limits range from about -17000 to +30000.

2 From the **Limits** menu, select **Limits to Actual**.

The amplitude data now displays using the full range of colors.

Note that the histogram for the amplitude data shows that most of the data values are clustered in the center (a normal distribution). This is why the data are displayed primarily in greens and yellows since these are the middle colors in the lookup table.

3 On the **Transform** dialog, click the **Histogram equalize**  button.

Histogram equalization increases the overall color contrast in the amplitude data. Areas of high amplitudes are shown as reds, and low amplitude in blues.

4 Click **Close** on the **Transform** dialog to close it.

Label the three algorithm layers to distinguish them

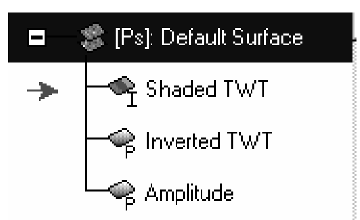
Since you now have three layers in your algorithm (and two Pseudo layers), it is helpful to labels to each so you can quickly distinguish between them.

1 Change the lower Pseudo layer's label to **`Amplitude`** (click on the existing label text, then select and replace it.)

2 Change the upper Pseudo layer's label to **`Inverted TWT`**.

3 Change the Intensity layer's label to **`Shaded TWT`**.

Your algorithm layer list labels should now look like this:



Display the amplitude and shaded time as a colordrape

1 Turn on the 'Shaded TWT' Intensity layer (right-click and select **Turn On**).

This colordrape image lets you easily associate variations in amplitude with structural features shown by the shaded two-way time surface in the Intensity layer. Using this technique, you can drape virtually any type of data in color over the shaded time surface to aid interpretation of subtle relationships.

Display the two-way time data again

1 Turn on the Pseudo layer labelled ‘Inverted TWT.’

2 Turn off the Pseudo layer labelled ‘Amplitude.’

The two-way time data again displays in color over the shaded relief data. You can now easily display either the time or amplitude data simply by turning on the desired layer.

Note: If you have more than one layer of the same type turned on, the layer on top layer has display priority over layers below it. In this case, for example, you would see the two-way time data if both the ‘Inverted TWT and ‘Amplitude’ Pseudo layers were turned on. (Data in lower priority layers is only displayed where they do not spatially overlap with layers of the same type above them.)

---

3 Click once on the layer labelled ‘Inverted TWT’ to select it.

The Layer tab page in the right-hand panel changes to show only the process diagram for the selected layer.

4: Saving the colordrape algorithm

Objectives Learn to save and add comments to the colordrape algorithm.

Enter a description for the algorithm

1 In the **Algorithm** dialog, select the text in the **Description** field, then type the following:

```
Horizon KA time and amplitude colordrape
```

This text now becomes a brief description for the entire algorithm.

Save the processing steps to an algorithm file on disk

1 From the **File** menu (on the main menu), select **Save As...**.

The **Save As...** file chooser dialog box appears.

2 From the **Directories** menu, select the path ending with the text **\examples**.

3 Double-click on the ‘miscellaneous\tutorial’ directory to open it.

4 In the **Save As:** text field, type in a name for the algorithm file using your initials at the beginning followed by the text ‘Horizon_KA_colordrape.’

Separate each word with an underscore (_). For example, if your initials are "DH," type in the name:

`DH_Horizon_KA_colordrape`

5 Click the **Apply** button to save the algorithm and leave the dialog open.

Your pseudocolor algorithm is now saved to an algorithm file on disk.

Add comments to the algorithm

1 Click the **Comments...** button.

A dialog box opens allowing you to type comments about your algorithm.

2 In the comments dialog, type the following description information:

```
This algorithm drapes time or amplitude data in color over
a shaded time surface. Sun angle shading is applied to the
time data in the Intensity layer to highlight structural
features. Two Pseudocolor layers are added to display either
time or amplitude to create a combined color/shaded relief image.
```

3 Click the **OK** button to save your comments with the algorithm and close the dialog.

4 Click **Cancel** on the **Save As...** dialog to close it.

Your algorithm is now commented for future users.

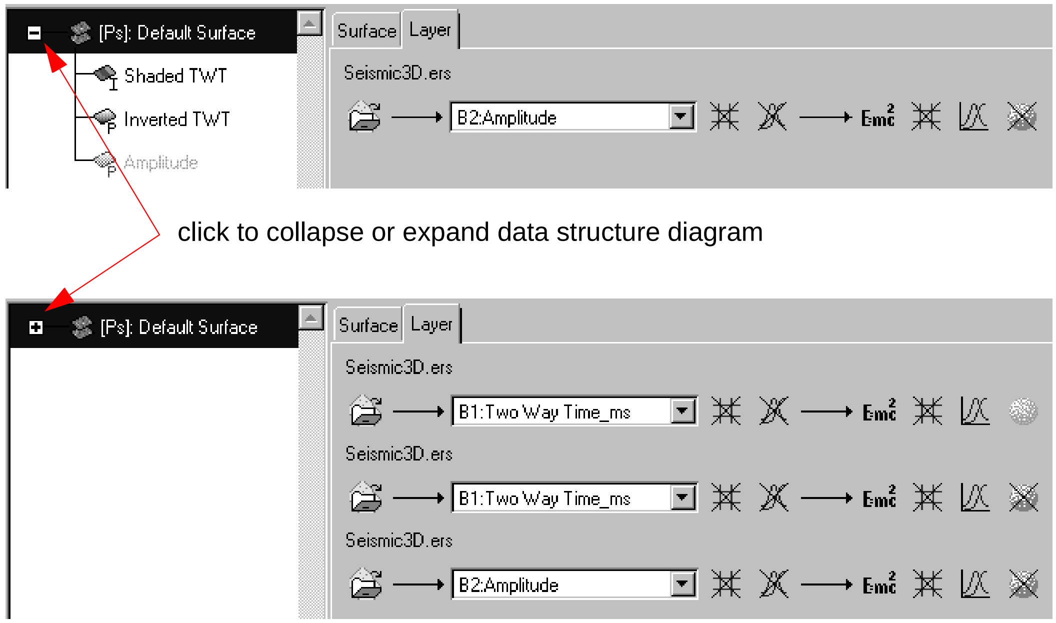
5: Working with layers

Objectives Learn how to collapse and expand the tree structure view of the algorithm. Also learn to view the process diagram for any desired layers, and change layer priority by moving layers up or down in the layer list.

Collapse the data structure view of the surface

This algorithm data view is composed of a single surface that has three layers. Currently this surface is displayed in expanded mode so all the layers are listed in the data structure diagram in the left-hand panel.

1 In the data structure (left-hand) panel, click once on the small “-” button left of the surface name.



The tree structure diagram collapses to show only the surface, and process diagrams for the three layers in the surface are now displayed in the Layer page on the right. Collapsing surfaces can be helpful for navigating around in algorithms that contain several surfaces.

2 Click once on the small “+” button left of the surface name.

The data structure diagram expands again to show all three layers.

3 Click once on the layer labelled ‘Inverted TWT’ to select it.

The Layer tab page in the right-hand panel changes to show only the process diagram for the selected layer.

Choose to show process diagrams for two layers

If you have more than one layer in your surface, you can choose to display the process diagram for any combination of them.

1 Ctrl-click once on the layer ‘Shaded TWT’ to select it. (Hold down the Ctrl key and click on the layer icon, not the label text field.)

Notice that the ‘Inverted TWT’ layer is still highlighted, and process diagrams for both layers are now displayed.

2 Ctrl-click once on icon for the ‘Inverted TWT’ layer to de-select it.

Use Ctrl-click also to remove process diagrams for highlighted layers.

Note: Notice that the ‘Shaded TWT’ layer has a red arrow pointing to it–this indicates that it is the *selected* layer. You may highlight several layers, but only one layer is selected at a time. If you have a number of layers highlighted and open the **Transform** dialog, its contents would apply only to the selected layer.

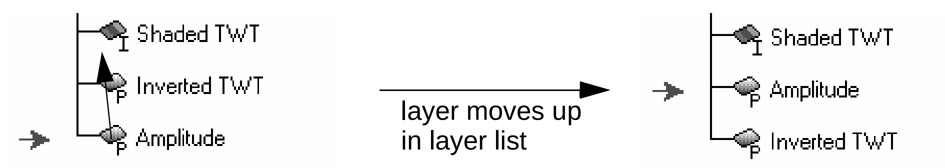
Move the Amplitude layer up change its priority

Right now, if both Pseudo layers were turned on, you would see the inverted two-way time data because it has a higher priority than the amplitude data layer (it is above it in the layer list).

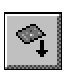
1 Right-click the ‘Amplitude’ layer and select **Turn On**.

You see the two-way time data draped over the shaded time because the ‘Inverted TWT’ layer is higher than the “Amplitude’ layer in the layer list.

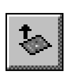
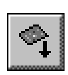
2 Point to the icon for the ‘Amplitude’ layer and drag it above the ‘Inverted TWT’ layer.



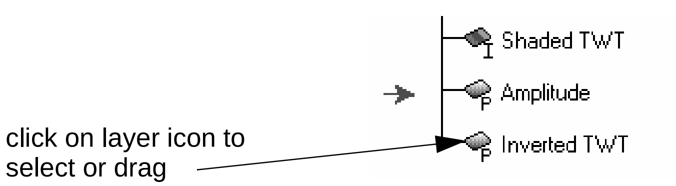
Now the amplitude data displays in color over the shaded time because its layer now has display priority over the color time layer below it.

3 Click once on the ‘Amplitude’ layer to highlight it, then click the **Move Down**  button (in the row of buttons above the tabs).

The selected layer moves down below the ‘Inverted TWT’ layer.

You can move layers either by dragging them or selecting the layer and using using the  or  buttons.

Tip: When selecting or dragging layers, always click on the layer’s icon, *not* on the label text field.



Close all image windows and dialog boxes

1 Close all image windows using the window system controls:

- For Windows, click the ☒ **Close** button in the upper-right window corner.

2 Click **Close** on the **Algorithm** dialog to close it.

Only the ER Mapper main menu should be open on the screen.

What you learned...

After completing these exercises, you know how to perform the following tasks in ER Mapper:

- Use Intensity layers to create shaded relief images that highlight structure
- Combine Pseudocolor and Intensity layers to create colordrape images
- Turn layers on (to process them) and off (to ignore them)
- Add new layers and move existing layers
- Control the color and intensity components to modify image displays

Tips for colordrape algorithms

Generally the Intensity layer of a colordrape algorithm is used to show structural features derived from two-way time data, and the color layers are used to show amplitude, azimuth, isochrons, or any other derivative or attribute images you feel are useful. To use an existing algorithm as a “template” algorithm to apply the same processing to different datasets, simply load new datasets into the Intensity and Pseudocolor layers and adjust the transforms to account for the data ranges.

One colordrape variation some researchers use is to display a dip image in Intensity instead of shading from a specific compass direction. A dip image may delineate both sides of a fault more clearly, for example. (Generation of dip images is explained in the chapter on formulas.)

Using algorithms with multiple layers

As you have seen in this exercise, a single algorithm can contain several layers that can be used to view the data in different ways. In this example, you had two Pseudocolor layers–one to display the two-way time in color and another to display the amplitude data in color. The ability to have access to many different views of the data in a single algorithm is a very powerful feature that lets you quickly visualize a wide variety of processing and enhancements.

As you learn to use ER Mapper, you may build algorithms that contain many layers that process or integrate several different datasets. For example, you might have several color layers that display different seismic attributes. Or, you might have several different time horizons, and simply turn on the layers that give you the horizon and attributes you desire. (Using formulas, a single layer can also show the result of calculations using more than one dataset, for example an isochron).

5

HSI algorithms

This chapter explains how to create algorithms that allow you to display and manipulate data in Hue Saturation Intensity (HSI) color space. The HSI enhancement is an innovative analysis technique that goes one step beyond a colordrape display, so you can visualize three variables simultaneously. (HSI is also referred to as IHS, or Intensity Hue Saturation, in some circles.)

About the HSI Color System

In the Hue Saturation Intensity (HSI) color system, different colors are characterized by three measurable characteristics of a color:

- **Hue**–The main attribute of a color that distinguishes it from other colors in the spectrum. Hues are what you see in a rainbow, and are what we commonly think of as “color” (red, yellow, green, and so on).
- **Saturation**–The amount of grey in a color or color “purity.” Colors with high saturation (little grey) are said to be pure or vivid. Colors with low saturation (much grey) are pastel or dull colors. Completely desaturated colors are grey, no matter what the hue.
- **Intensity**–The relative brightness of a color. Colors with high intensity are bright, and colors with low intensity are dark.

The HSI color system is characterized as an “perceptual” color system because it provides a more intuitive means of manipulating color than the RGB (electronic) color system. ER Mapper implements the HSI color system by means of the Color Mode named Hue Saturation Intensity, and separate algorithm layer types for Hue, Saturation, and Intensity.

HSI Color Mode

To display data in HSI, you set the algorithm Color Mode to Hue Saturation Intensity, then load data into Hue, Saturation, and Intensity layers. In order to produce color, all three layers types must be included in the same surface and turned on. ER Mapper provides HSI template algorithms that let you quickly load and display data using the HSI color system.

Note: Computer monitors use the RGB color system to actually display data, so ER Mapper automatically performs an internal translation of colors specified in HSI back to colors specified in RGB for the monitor.

The Hue Layer

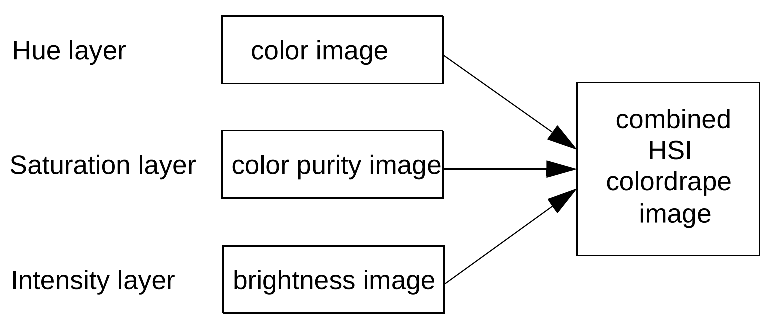
In an HSI image display, the Hue layer type controls the mapping of data values to colors in the spectrum. In a typical display, the range of data values from low to high is mapped through the progression of hues: red-yellow-green-cyan-blue-magenta.

The Saturation Layer

In an HSI image display, the Saturation layer type controls the mapping of data to the purity of colors in the image display (that is, the amount of grey in the colors). Low data values produce pastel or dull colors (much grey), and high data values produce pure or vivid colors (little grey).

The Intensity Layer

In an HSI image display, the Intensity layer type controls the mapping of data to the brightness of colors in the image display. Low data values produce dark colors, and high data values produce bright colors.



The diagram above shows how algorithm Hue, Saturation and Intensity layers are combined to create a single HSI colordrape image. You will see for yourself how these techniques work in the following exercises.

Hands-on exercises

These exercises give you practice creating HSI colordrape algorithms and manipulating image display in HSI color space.

What you will learn...

After completing these exercises, you will know how to perform the following tasks in ER Mapper:

- Use the algorithm Color Mode named Hue Saturation Intensity
- Combine Hue, Saturation and Intensity layers to create HSI images
- Understand the basics for interpreting data displayed in HSI
- Control the hue, saturation and intensity components to modify image displays
- Create a special effect HSI “wet look” algorithm

Before you begin...

Before beginning these exercises, make sure all ER Mapper image windows are closed. Only the ER Mapper main menu should be open on the screen.

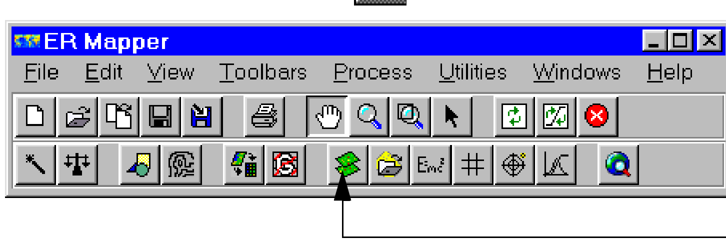
1: Creating the shaded relief image

Objectives

Learn how create an HSI algorithm by opening a new image window, creating Hue, Saturation, and Intensity layers, and loading data into the H, S, and I layers. (The sample algorithm you will create displays two-way time as hues, amplitude as saturation, and shaded two-way time as intensity.)

Open an image window and the Algorithm dialog

1 Click the **Edit Algorithm**  button.



Edit Algorithm button

An image window and the **Algorithm** dialog appear.

Change the Pseudocolor layer to an Intensity layer

1 Right-click the Pseudo layer and select **Intensity** from the short-cut menu:

The Pseudo layer changes to an Intensity layer and ER Mapper sets the layer description to “Intensity layer.”

Load the sample seismic dataset into the Intensity layer

1 In the process diagram, click the **Load Dataset** button.

The **Raster Dataset** file chooser dialog box appears.

2 From the **Directories** menu, select the path ending with **\examples**.

3 Double-click on the ‘Shared_Data’ directory to open it.

4 Double-click on the dataset named ‘Seismic3D.ers’ to load it.

The dataset is loaded into the Intensity layer.

Use a formula to invert the dataset values

As before, it is often desirable to invert two-way time values, so larger time values are displayed as structural lows and smaller values as highs.

1 In the **Algorithm** dialog, click the **Edit Formula** button in the process diagram.

2 In the **Formula Editor** dialog, edit the text string “INPUT1” to add a minus sign (-) in front. Your formula should now look like this:

```
-INPUT1
```

This formula tells ER Mapper to negate (invert) all values in the dataset.

3 On the **Formula Editor** dialog, click the **Apply changes** button.

4 Click **Close** on the **Formula Editor** dialog to close it.

The image appears as black initially because you need to adjust the transform to account for the range of negative data values produced by the formula.

Adjust the color mapping (contrast) of the image

1 In the **Algorithm** dialog, click the right-hand **Edit Transform Limits** button in the process diagram.

The **Transform** dialog box opens, and shows the negative data range produced by the formula in the Actual Input Limits fields.

2 From the **Limits** menu (on the **Transform** dialog), select **Limits to Actual**.

The X axis data range changes to match the Actual Input Limits.

ER Mapper renders the image again, this time using the full range of grey shades to display the image.

3 Click **Close** on the **Transform** dialog to close it.

Turn on sun shading and display the shaded relief image

1 On the **Algorithm** dialog, click the **Edit Realtime Sunshade**  button in the process stream.

The **Edit Sun Angle** dialog box opens to let you specify shaded relief effects for the Intensity layer.

2 Turn on the **Do sun-shading** option.

Sun angle shading is applied to the dataset to enhance the structural features of the time surface.

3 Drag the small sun icon (the circle) around the circular grid until you find a shade angle that highlights structural features of interest. (Keep the sun elevation above 45 degrees to reduce shadowing.)

4 Click **Close** on the **Edit Sun Angle** dialog to close it.

Label the Intensity layer to identify it

1 Change the Intensity layer's text label to **Shaded TWT**.

(If desired, you could also add the shading angle, for example "NE shaded TWT".)

2 Make the image window about 50% larger by dragging lower-right corner of the window border.

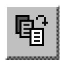
3 Right-click on the image and select **Zoom to All Datasets** from the **Quick Zoom** menu.

You have now created the shaded relief image to highlight structure. Next you will add Hue and Saturation layers to drape other data in color.

2: Adding data in Hue and Saturation layers

Objectives Learn how to build on your shaded relief Intensity image to create an HSI algorithm by adding Hue and Saturation layers. (The sample algorithm you will create displays two-way time as hues, amplitude as saturation, and shaded two-way time as intensity.)

Duplicate the Intensity layer and change it to Hue

1 On the **Algorithm** dialog, select the Intensity layer (if needed), then click the **Duplicate**  button.

ER Mapper creates a copy of the Intensity layer below the original.

2 Right-click on the new duplicate layer, and select **Hue**.

The Intensity layer changes to a Hue layer. You will use this layer to display the time surface data in color over the shaded relief image.

Note: Notice that the Hue layer has a red “X” through it. This indicates that the Hue layer type in *not valid* with the current algorithm Color Mode (which is Pseudocolor by default). In order to use Hue layers in an algorithm, you must also set the Color Mode named Hue Saturation Intensity.

Change the Color Mode to Hue Saturation Intensity

1 Click the **Surface** tab in the **Algorithm** dialog.

Options for Color Mode, Color Table and Transparency display.

2 From the **Color Mode** drop-down menu, select **Hue Saturation Intensity**.

The Hue layer now becomes active, and the HSI color mode is also shown in brackets next to surface name ([HSI]:Default Surface). Also notice that the Color Table option disappears from the Surface tab (because a color lookup table is not used to control image colors with HSI color mode).

Tip: You can also change the Color Mode for a surface by right-clicking the surface name and selecting from the short-cut menu.

Turn off sun shading for the Hue layer

1 With the Hue layer selected, click the **Edit Realtime Sunshade**  button in the process stream.

The **Edit Sun Angle** dialog box opens. Since the layer was duplicated from the Intensity layer, sun angle shading is still turned on.

2 On the **Edit Sun Angle** dialog, turn off the **Do sun-shading** option.

Sun angle shading is now turned off for the Hue layer (shading is not normally used on color layers).

3 Click **Close** on the **Edit Sun Angle** dialog to close it.

4 Change the label for the Hue layer to **`Inverted TWT`**.

Add a Saturation layer and load the sample dataset

1 From the **Edit** menu (on the **Algorithm** dialog), select **Add Raster Layer**, then select **Saturation**.

ER Mapper adds a new Saturation to the layer list. New added layers contain no dataset (shown by “No Dataset” above the process diagram). You will use this layer to display the seismic amplitude data.

2 In the **Algorithm** dialog, click the **Layer** tab to see the process diagram.

3 Click the **Load Dataset**  button in the process diagram.

The **Raster Dataset** file chooser dialog box opens.

4 From the **Directories** menu, select the path ending with **\examples**.

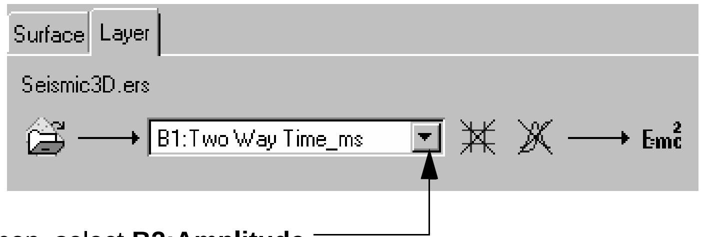
5 Double-click on the directory named ‘Shared_Data’, then double-click on the ‘Seismic3D.ers’ to load it.

The dataset is loaded into the Saturation layer (all layers contain the same dataset).

Tip: You can create new layers in an algorithm surface either by duplicating an existing layer or by adding a new layer. Duplicating the Intensity layer and changing to a Hue layer earlier was easier because the Intensity layer already had the correct dataset, invert formula, and transform input limits (since both layers display two-way time). Sometimes it it easier to add a new layer (as you did above) than it is to duplicate one and remove elements you don’t want (such as the invert formula).

Select the amplitude band and label the Saturation layer

1 With the Saturation layer selected, click the **Band Selection** drop-down list in the process diagram, and select **B2:Amplitude**.

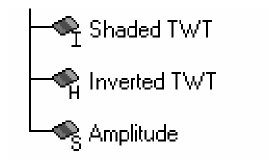


click to open, select **B2:Amplitude**

You have now chosen to display the amplitude data in the Saturation layer.

2 Change the text label for the Saturation layer to **`Amplitude`**.

You should now have Intensity, Hue and Saturation layers with these labels:



Note that the layer icons have a small letter (I, H, or S) next to them to help distinguish them from layers of other types.

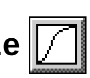
You now have an image similar to the colordrape that shows structure (shaded two-way time) and depth (color-coded two-way time). Now you need to adjust the transform of the amplitude data to make it clearly stand out against the color and shading.

Apply a Histogram equalization to the amplitude data

1 With the 'Amplitude' Saturation layer selected, click the right-hand **Edit Transform Limits**  button in the process diagram.

2 On the **Transform** dialog, select **Limits to Actual** from the **Limits** menu.

The complete histogram for the amplitude data appears.

3 On the **Transform** dialog, click the **Histogram equalize**  button.

The overall contrast in the amplitude data is increased, which appears as variations in color saturation throughout the image. Notice, for example, that the V-shaped uplifted fault block in the upper-left shows high amplitudes as vivid colors and low amplitudes as greyish colors.

You now have an image that shows three variables at once:

- Structure is shown as intensity (brightness) by applying sun angle shading to the two-way time data.
- Relative depth is shown as color (hues), where red indicates structural lows progressing through yellow, green, cyan, and blue to magenta for the structural highs in the time surface.
- The event amplitude is shown by variations in the *saturation* or purity of colors, where greyish or pastel colors indicate low amplitudes and vivid or rich colors indicating high amplitudes.

  This type of display has become a popular ER Mapper processing technique for combined analysis of two-way time and amplitude data, as well as other combinations of time and seismic attribute data.

4 Click **Close** on the **Transform** dialog to close it.

Zoom in on upper-left portion of the image

1 On the Main Menu, click the **Zoom Box Tool**  button.

You can now use the mouse for zooming and panning functions.

2 Inside the image window, drag a zoom box around the V-shaped structure in the upper-left portion of the image (the uplifted fault block in red and magenta).

ER Mapper zooms in on the defined area. Notice that the image takes on a slightly jagged or blocky look when you zoom in closely. (You can begin to see the limits of the seismic data resolution, or the actual pixels that comprise the dataset.)

3 On the **Algorithm** dialog, turn on the **Smoothing** 

option, then Notice that the image becomes noticeably smoother. The Smoothing option applies a bilinear interpolation to the image display. This is often useful for reducing the jagged look and helps make overall features easier to interpret.

Also notice that you can now clearly see the pattern of low and high amplitudes in the uplifted block and surrounding areas. High amplitude areas have very rich colors, and low amplitudes occur along the faults (shown by the low saturation greyish colors in those areas).

4 From the **View** menu (on the main menu), select **Quick Zoom**, then select **Zoom to All Datasets**.

ER Mapper zooms back out to the full image extents.

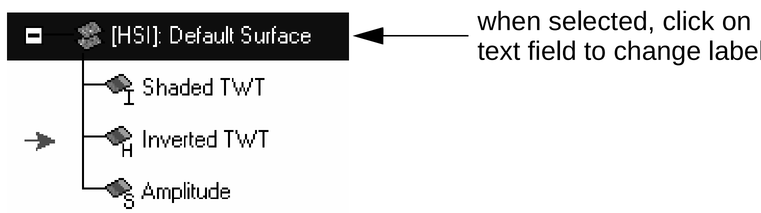
Tip: The **Smoothing** option is most useful when you zoom in very closely on an area of interest, and can be turned on or off as desired. It usually has little noticeable effect until you zoom in close to the pixel resolution.

3: Saving the HSI colordrape algorithm

Objectives Learn to save and add comments to the HSI colordrape algorithm.

Enter a description for the surface

1 Change the surface description text to **`TWT & amplitude`** (it currently reads 'Default Surface').



It is often helpful to label each surface in an algorithm, as well as the individual layers that comprise the surface. (This is especially true for multi-surface algorithms.)

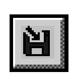
Enter a description for the algorithm

1 In the **Algorithm** dialog, select the text in the **Description** field, then type the following:

`TWT and amplitude HSI enhancement`

This text now becomes a brief description for the entire algorithm.

Save the algorithm to disk

1 On the main menu, click the blue **Save As...**  button.

The **Save As...** file chooser dialog box appears. (This toolbar button is a short-cut for selecting **Save As...** from the **File** menu.)

2 From the **Directories** menu, select the path ending with the text **\examples**.

3 Double-click on the ‘miscellaneous\tutorial’ directory to open it.

4 In the **Save As:** text field, type in a name for the algorithm file using your initials at the beginning followed by the text ‘Seismic_HSI_enhancement.’ Separate each word with an underscore (_). For example, if your initials are “TL,” type in the name:

`TL_Seismic_HSI_enhancement`

5 Click the **Apply** button to save the algorithm and leave the dialog open.

Your HSI algorithm is now saved to an algorithm file on disk.

Add comments to the algorithm

1 Click the **Comments...** button to add comments.

2 In the comments dialog, type the following description information:

```
This algorithm displays time and amplitude data in hue
saturation intensity (HSI) color space. Sun angle shading is
applied to the time data in the Intensity layer to highlight
structure. Time is displayed as color in the Hue layer, and
event amplitude is displayed as variations in color saturation
in the Saturation layer.
```

3 Click the **OK** button to save your comments with the algorithm and close the dialog.

4 Click **Cancel** on the **Save As...** dialog to close it.

Your algorithm is now commented for future users.

4: (Optional) Creating a “wet look” image

Objectives Learn to create an HSI algorithm that creates a special shiny look similar to a plastic raised relief map. This type of image is very popular for presentations and hardcopy map prints.

Note: The following technique uses a fast method to build the “wet look” algorithm using already existing algorithms. You will use existing algorithms as templates more as you become familiar with ER Mapper.

Open an existing colordrape algorithm

1 On the main menu, click the **Open** button.

2 From the **Directories** menu (on the **Open** dialog), select the path ending with the text **\examples**.

3 Double-click on the ‘Applications\Oil_And_Gas_Exploration’ directory to open it.

4 Double-click on the algorithm ‘Seismic_Horizon_Colordrape.alg’ to open it.

ER Mapper displays a horizon colordrape image similar to the one you created in a previous lesson. (Two-way time is draped in color over shaded two-way time.)

Open a second image window

1 On the main menu, click the **New** button.

A second image window appears. Drag it down below the ‘Seismic_Horizon_Colordrape’ image window.

Open an existing “wet look” algorithm

1 On the main menu, click the **Open** button.

2 From the **Directories** menu, select the path ending with the text **\examples**.

3 Double-click on the ‘Applications\Oil_And_Gas_Exploration’ directory to open it.

4 Double-click on the algorithm ‘Seismic_Horizon_Colordrape_HSI.alg’ to open it.

This colordrape shows the same data as the other image window (two-way time in color over shaded two-way time), but with a special enhancement that creates the illusion of a reflected light source. (The shiny surface is created by removing all saturation from the color in the brightest sun-shaded areas so they look bright white.) This specialized enhancement technique is not normally used for interpretation, but is sometimes used to make “glossy” images for presentations.

A short-cut way to create a “wet look” image with your own data (a complete explanation is beyond the scope of this workbook):

- Create and save a colordrape algorithm with one Intensity and one Pseudocolor layer (use the ‘Seismic_Horizon_Colordrape’ algorithm as an example).
- Open the existing wet look algorithm ‘Seismic_Horizon_Colordrape_HSI.’ You will use this algorithm as a template to apply the same processing to your data.

- Load your colordrape algorithm into the ‘Seismic_Horizon_Colordrape_HSI’ algorithm. (Load the algorithm just like a dataset using the **Load a Dataset** button in the process diagram on the **Algorithm** dialog.)

Close all image windows and dialog boxes

1 Close all image windows using the window system controls:

- For Windows, click the **Close** button in the upper-right window corner.

2 Click **Close** on the **Algorithm** dialog to close it.

Only the ER Mapper main menu should be open on the screen.

What you learned...

After completing these exercises, you know how to perform the following tasks in ER Mapper:

- Use Intensity layers to create shaded relief images that highlight structure
- Combine Pseudocolor and Intensity layers to create colordrape images
- Turn layers on (to process them) and off (to ignore them)
- Control the color and intensity components to modify image displays
- Create a special effect HSI “wet look” algorithm

Tips for HSI Algorithms

Displaying data in Hue Saturation Intensity color space is one of the newer techniques in the analysis of interpreted time surfaces. It is helpful to have basic understanding of the way the HSI color system works to help you interpret data presented in this way.

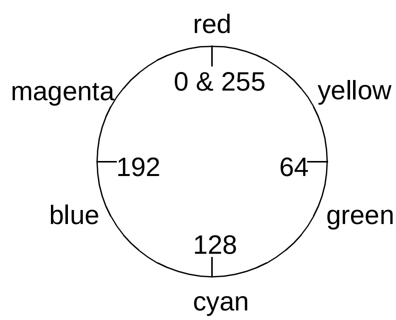
Using the previous HSI image as an example, color is used to indicate absolute depth, or the structural highs and lows in the time surface. The event amplitude is not related to any specific color or hue (red, blue, etc.), but only to the *saturation* of the color. For example, areas of the time surface with similar amplitudes may have completely different colors, but will have the same degree of color saturation or purity.

This example used time in the hue layer and amplitude in the saturation layer, but you could just as easily switch them or substitute any other types of data instead. Shaded two-way time data is generally always used in the intensity layer. (To switch them, you would simply right-click the Hue layer and then select Saturation and vice versa. Then structural lows would be shown by weak colors and highs by vivid colors. The actual colors would show variations in amplitude.)

The steps you followed in this exercise showed how to create an HSI algorithm from scratch, in part to illustrate the use of certain features in ER Mapper. When you learn to use ER Mapper, you can create these types of algorithms more quickly by using an existing algorithm as a template, or using a toolbar button to automatically create certain types of commonly used algorithms.

Modifying color mapping in HSI mode

The set of hues used to display data in HSI can be envisioned as color wheel, where the output data range 0-255 is mapped to the cycle of hues as shown in the following diagram. (The normal 0-360 azimuth range is compressed to 0-255 to simplify mapping to computer displays.):



For example, input data values that are mapped to the output value 128 (by the transform) are displayed using a cyan hue in the image. This is a fixed set of colors, but you can exclude colors either at the bottom or top of the range to modify the colors in the displayed image.

Since the color wheel wraps around on itself, both the very lowest values and very highest values are assigned the color red in the image by default. (You can see this in the sample HSI algorithm you created in this chapter.) You can avoid this by opening the **Transform** dialog and changing the output maximum field to 240. This tells ER Mapper not to use the red hues (240-255) for high data values, and instead map the highest values to the hue magenta. (As another example, the HSI “wet look” algorithm also excludes some hues using this method.)

Tip: To see the progression of colors used in HSI mode, display a dataset in Pseudocolor mode and select the color table named “hue.” Then open the **Transform** dialog and view the color progression of hues on the Y axis color bar.

6

Viewing dataset values

This chapter shows you the options ER Mapper provides for viewing dataset values and coordinate locations. These include cell (pixel) values, neighborhoods, signatures, traverse extraction, and scattergrams. You also learn how to measure distances between two points on an image.

About viewing data values

Viewing image data values is one of the fundamental ways to assess data quality and the particular characteristics of features in an image. Options for viewing data values and geographic locations in ER Mapper include:

Cell values	The data value associated with each cell or pixel in the dataset, or the data values of that cell in each band of a multi-band dataset.
Neighborhoods	An array of data values surrounding a pixel.
Signatures	The data values of a pixel in all bands shown in a line graph format.
Traverse extraction	A profile of data values occurring along a line or polygon drawn on the image.

Scattergrams An X-Y plot showing the relationship between data values in two bands of an image.

Histograms A plot showing the range of data values on the X axis and their relative frequency on the Y axis

Hands-on exercises

These exercises show you various ways of viewing data values, coordinate locations, and geographic distances between two points on an image.

What you will learn... After completing these exercises, you will know how to perform the following tasks in ER Mapper:

- View image data values in text format
- View distances between any two points on an image
- View image data values along a transect profile line
- View two bands of image data values as an X-Y scattergram
- Highlight image areas that correspond to scattergram point clusters

Before you begin... Before beginning these exercises, make sure all ER Mapper image windows are closed. Only the ER Mapper main menu should be open on the screen.

1: Viewing cell values and locations

Objectives Learn to view image data values in a text format, neighborhood format, and signature (line graph) format. Also learn to view the geographic locations and distances in both 2D and 3D images.

Open and display the sample colordrape algorithm

1 On the main menu, click the **Open**  button.

An empty image window and the **Open** dialog box appear.

2 From the **Directories** menu, select the path ending with the text **\examples**.

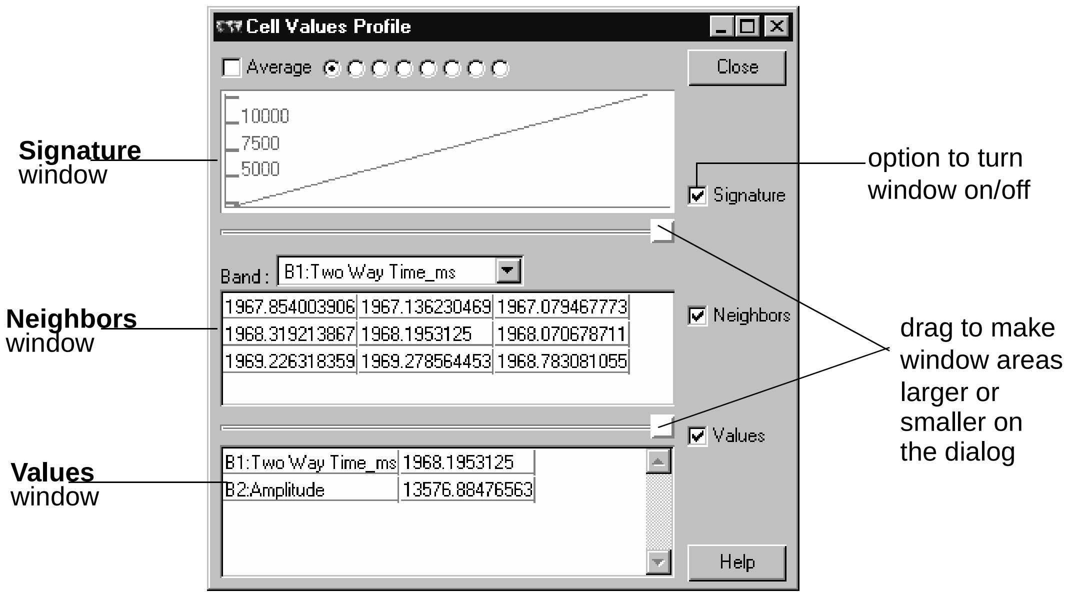
3 In the 'Applications\Oil_And_Gas_Exploration' directory, double-click on the algorithm 'Seismic_Horizon_Colordrape.alg' to open and display it.

This algorithm drapes two-way time in color over shaded two-way time to provide structural relief (similar to one you created in an earlier chapter).

View cell values for the time and amplitude dataset bands

1 From the **View** menu, select **Cell Values Profile...**.

The **Cell Values Profile** dialog box appears. Drag it by its title bar next to the image window. This dialog has three display windows, any of which can be turned on or off at any time.

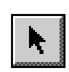


By default, all three options are turned on (**Values**, **Signature** and **Neighbors**.)

2 If needed, resize the dialog until all fields are visible as shown above.

3 Turn off the **Signature** and **Neighbors** options (deselect their option buttons).

Those windows disappear from the **Cell Values Profile** dialog.

4 On the main menu, click the **Pointer Tool**  button.

The Pointer Tool is used to view data values.

5 Point inside the image window, and press and drag the mouse pointer through the image (or just click on any pixel).

The **Cell Values Profile** dialog displays the data values in both the time and amplitude bands in the seismic dataset for the current cell (pixel) location in the image. The data values are updated as you drag the mouse to new locations.

View a neighborhood of cell values

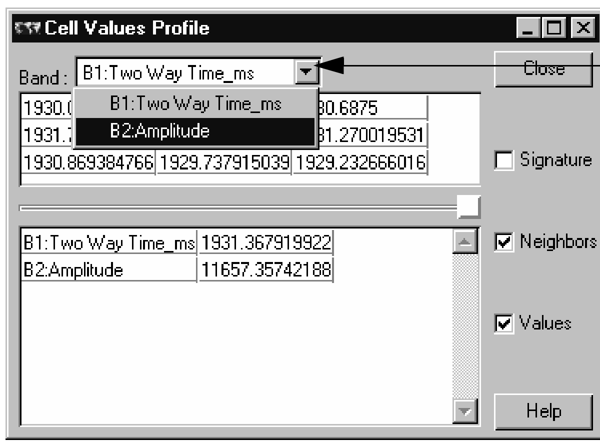
1 In the **Cell Values Profile** dialog, turn on the **Neighbors** option.

The Neighbors window is again added to the dialog, with a drop-down menu to select a dataset band.

2 Point inside the image window, and drag the mouse pointer through the image (or just click on any pixel).

A three-by-three neighborhood of cell values displays as you drag the mouse. The center pixel in the three-by-three array is the current pixel, and the surrounding eight pixels are its neighbors. This feature is useful to viewing the local variance or texture in various parts of an image.

3 From the **Band** drop-down list, select **B2:Amplitude**.



4 Drag again through the image.

The data values for band 2 of the seismic dataset (amplitude in this case) display in the three-by-three neighborhood. (The 3 by 3 neighborhood can only be shown for one band at a time.)

View a signature of cell values

Note: The Signature option is not useful with this sample dataset–the following section describes how you might use it with your datasets.

1 In the **Cell Values Profile** dialog, turn on the **Signature** option.

A third window is added to the **Cell Values Profile** dialog, with a row of buttons on top. This option shows the same data as displayed in the Values window, but in line graph format.

Notes about using signatures with geophysical data

The Signature option is designed for use with datasets that contain multiple bands, and would not normally be used with datasets that contain one or two bands (as this sample one does). It can be very useful, for example, with datasets that contain multiple horizons or multiple attributes to see graphically how the data values in various bands relate to each other. Following are general procedures for using the Signature feature:

- To view a signature, click on one of the option buttons above the Signature window, and drag through the image or click on a feature. The data values for all bands in the dataset will appear as a line graph (a "signature") in the Signature window.
- The buttons above the Signature window set a color for the graph line(s). To see a second signature in a different color, click on another button above the Signature window and drag or click on a feature in the image. A second graph line in a different color will appear. (Each of the buttons starts a new color graph line.)
- To view a signature showing the *accumulated average* of all the data values over the area where you dragged, click on the Average option before dragging. A thickened graph line will appear to indicate that this signature is an average, and you can add to the average signature by continuing to drag. (This allows you to view the average signature over a broad feature area instead of a single pixel at a time.)

2 Click the **Close** button on the **Cell Values Profile** dialog box to close it.

Note: The data values shown in the **Cell Values Profile** dialog are taken directly from the dataset on disk. Therefore, any processing you apply in your display algorithm (such as a formula or filter) *do not affect* the data values you see here. (For example, the two-way time data used here is shown with its original positive data range, even though a formula is used to negate it for display.)

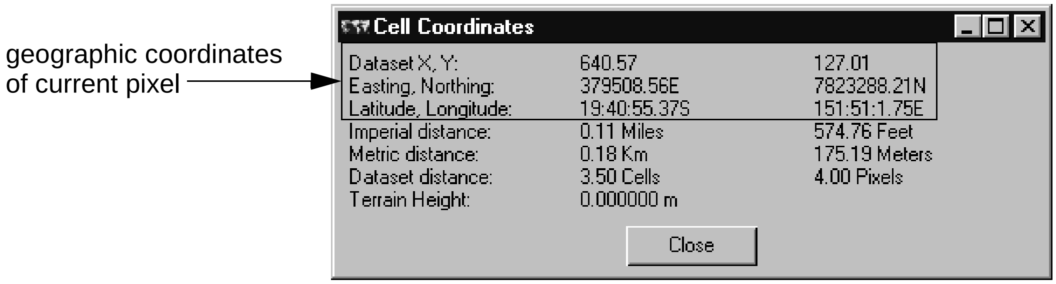
View geographic coordinates in the image

1 From the **View** menu, select **Cell Coordinate...**.

The **Cell Coordinates** dialog appears. Drag it next to the image window.

2 Point to the image window, and drag the pointer through the image.

The dataset and geographic location of the current cell appear, and are updated as you drag the mouse.



The upper three fields of this dialog show the location of the current pixel in dataset column (X) and row (Y) coordinates, and the Eastings/Northings and Latitude/Longitude coordinate systems.

Note: The Easting Northing and Latitude Longitude fields only display valid values if the dataset is registered to a map projection. Unregistered (raw) datasets display zero values in these fields.

View distances between points in the image

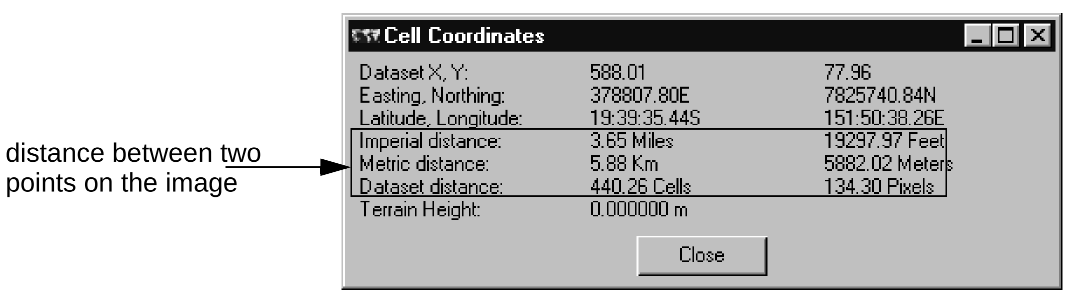
The lower three fields of the **Cell Coordinate** dialog show distance between the point where you first depress the mouse button and the point where you release it. Distances are shown as Imperial distance (feet and miles), Metric distance (meters and kilometers), and Dataset distance (number of cells in the X and Y directions).

1 Point to the image window, and click on any point in the image.

The Imperial, Metric, and Dataset distance fields are cleared to zero values.

2 Pick out two features in the image, then drag the mouse between them.

The distance between those two points is displayed when you release the mouse button. Measuring the distance between two points is called *mensuration*.



(The Terrain Height field is active when the image is viewed in 3D.)

Open and display the sample 3D horizon algorithm

1. On the main menu, click the **Open** button.
2. From the **Directories** menu (on the **Open** dialog), select the path ending with the text **\examples**.
3. In the ‘Applications\Oil_And_Gas_Exploration’ directory, double-click on the algorithm ‘Seismic_Horizon_3D.alg’ to open it.
4. On the main menu, click the **Edit Algorithm** button to open the **Algorithm** dialog.
5. From the **View Mode** menu (on the **Algorithm** dialog), select **3D Perspective**.

   ER Mapper renders the two-way time horizon in 3D perspective.

Query cell values and coordinates on the 3D image

1. From the **View** menu, select **Cell Values Profile...**.

   Both the **Cell Values Profile** and **Cell Coordinates** dialog should be open.
2. Drag inside the image window, and view the cell values and coordinates.

   Notice that the mouse cursor becomes a cross that conforms to the 3D surface as you drag on the image. The arrow on the cursor points north. Querying cell values and coordinates works essentially the same in 3D view mode as it does in 2D.
3. Click **Close** on the **Cell Values Profile** and **Cell Coordinates** dialogs to close them.
4. Click **Close** on the **Algorithm** dialog.

2: Viewing traverse profiles

Objectives Learn to view image data values for multiple bands as a profile or transect along a line or polygon drawn on the image (called *traverse extraction*).

Open the sample colordrape algorithm again

1. On the main menu, click the **Open** button.
2. From the **Directories** menu (on the **Open** dialog), select the path ending with the text **\examples**.

3 In the ‘Applications\Oil_And_Gas_Exploration’ directory, double-click on the algorithm ‘Seismic_Horizon_Colordrape.alg’ to open and display it.

Set up to draw traverse profile lines

1 From the **View** menu, select **Traverse...**.

The **New Map Composition** and **Traverse** dialogs open.

2 On the **New Map Composition** dialog, be sure the **Vector File** option is selected, then click **OK**.

The annotation **Tools** dialog appears, along with an **ER Mapper** warning dialog box.

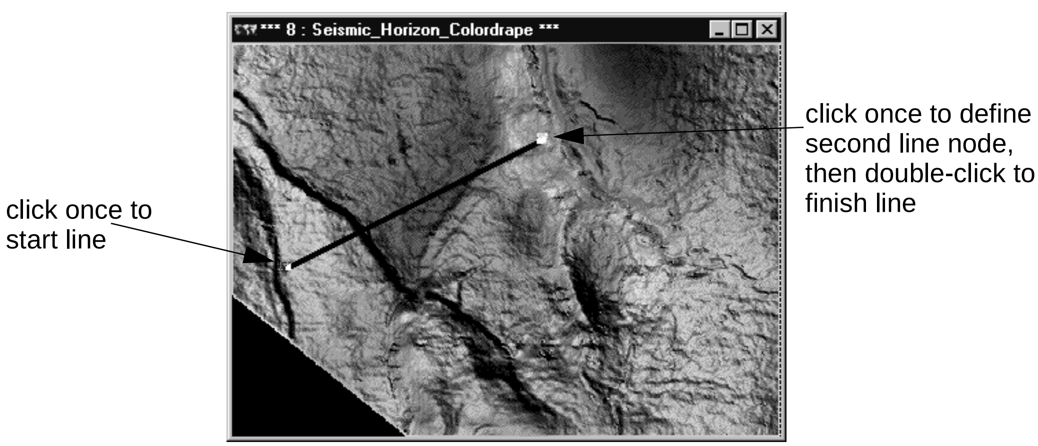
3 Click **Close** on the **ER Mapper** warning dialog to close it. (When using annotation tools for other purposes Page Setup is recommended, but it is not important for this exercise.)

You will use the vector annotation tools in the **Tools** dialog to draw traverse lines on the image.

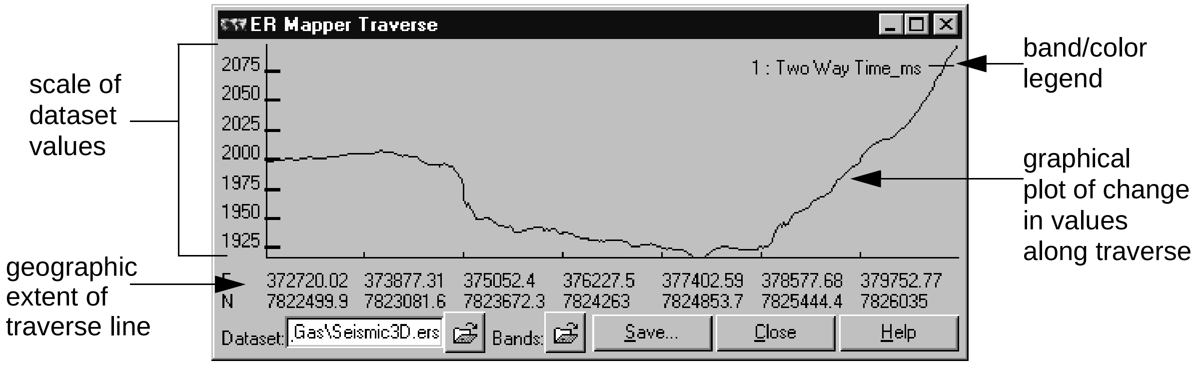
Draw a traverse line on the image

1 On the **Tools** dialog, click the **Poly Line**  button (use the tooltips for buttons if needed).

2 Inside the image window, define a straight line across the red uplifted block in the image. Click once at the start point, once at the end point, then double-click to end the line definition.



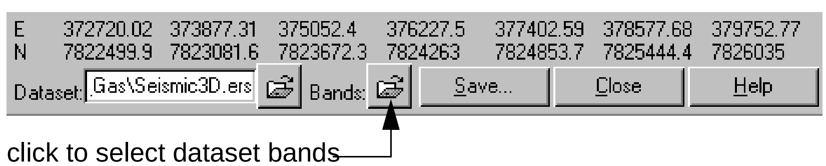
A profile line appears inside the **Traverse** dialog. This line displays the change in the values of pixels underneath the traverse line you drew. By default, values for dataset band 1 (two-way time) are shown as a black profile line.



Note: As with the Cell Profiles, traverse profiles show the data values actually stored in the dataset on disk. Therefore algorithm formulas, transforms, and so on do not affect the data values shown in traverse profiles. (For example, structural highs (smaller time values) are shown as the dip in the profile above.)

View the amplitude data along the same traverse line

1 On the lower part of the **Traverse** dialog, click the **Bands:**  button.

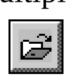


The **Traverse Band Selection** dialog opens.

2 Click on **B2:Amplitude** in the list to select it.

3 Click **OK** on the **Traverse Band Selection** dialog.

A profile of the amplitude data along the same line appears in the **Traverse** dialog.

You can also view profiles for multiple dataset bands at one time by selecting the desired bands using the **Bands:**  button. The profile line for each band appears in a different color with corresponding legend labels in the upper left corner of the **Traverse** dialog.

Draw a second traverse line on the image

1 Inside the image window, define a second line across a different area. (Click once at the start point, once at the end point, double-click to end.)

The new amplitude profile lines appear inside the **Traverse** dialog. You can draw as many different traverse lines on the image as you desire.

Tip: You can also drawn polylines (lines with multiple nodes) that, for example, zig-zag back and forth across a feature like a fault. (Just click once at each node, then double-click to end the line.)

Alternate between the two traverse lines

1 On the **Tools** dialog, click the **Select and Edit Points Mode**  button.

2 Inside the image window, click on the first traverse line you drew.

The line becomes selected (it shows nodes at the end points) and its corresponding profile again appears in the **Traverse** dialog. You can view the profile for any traverse line you've drawn by simply selecting it as shown here.

Revise the location of a traverse line

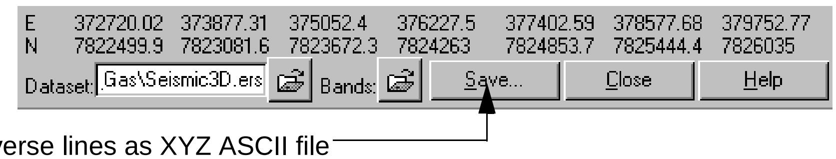
1 Drag one of the nodes (endpoints) of the selected line to a new location on the image.

When you release the mouse button, the profile is automatically updated in the **Traverse** dialog. You can modify the location and length of any traverse line by following these steps.

2 If needed, revise one of your lines so it traverses across one of the major faults in the V-shaped uplifted block in the upper-left part of the image.

Notice that you can easily see the strong dip in amplitude where the line crosses the fault. Traverse extraction can be very useful for clearly associating visual features on an image with patterns or anomalies in data values.

Tip: If desired, you could save the current annotation layer and reload it later, and you can also save the traverse profiles to an XYZ format text file on disk for export to other analysis software if desired..



click to save traverse lines as XYZ ASCII file

Close Traverse Extraction

1. Click **Close** on the **Traverse** dialog to close it.
2. Click **Close** on the **Tools** dialog. When asked to save the current annotation, click **No**.

Notes on viewing multiple profile lines

As described earlier, you can view profiles lines for multiple attributes or horizons by selecting them using the **Bands** button on the **Traverse** dialog. Following are some helpful tips on this:

- All attributes or horizons to be viewed simultaneously must be stored as bands in a single ER Mapper dataset.
- Since the data ranges of various seismic attributes can vary greatly, you may find it helpful to normalize the attributes into a common range. Otherwise, the attribute with the greatest range dominates the range of graph lines on the **Traverse** dialog, and other attributes with smaller ranges may appear as nearly flat lines in comparison. One simple way to do this is to create a new dataset that uses the transforms to rescale the data into a 0-255 range in the output dataset. (The procedure is similar to that shown in Chapter 12 except that you do not delete the transforms.) There are also other more sophisticated ways to resale the data using formulas.

3: Viewing image scattergrams

Objectives Learn to view the relationship between image data values in two bands as a two-dimensional plot called a scattergram (or scatter diagram). Also learn to define areas the scattergram and view the corresponding pixels on the image, and define areas on the image view their data value locations on the scattergram.

A *scattergram* allows you to graphically see the correlation between the data values in two dataset bands. Values for one band are plotted on the Y axis and the other on the X axis. These two numbers locate each pixel in the two-dimensional measurement space of the X-Y graph.

Open a Scattergram dialog box

1 From the **View** menu, select **Scattergrams...**.

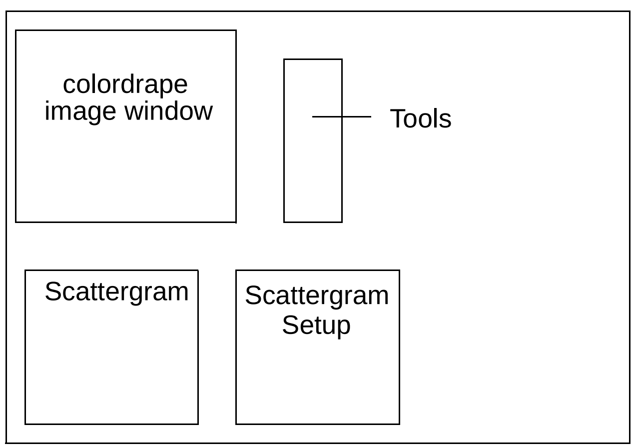
The **Scattergram** dialog and **New Map Composition** dialog boxes open.

2 Be sure the **Raster Region** option is selected on the **New Map Composition** dialog, then click **OK**.

The **Tools** dialog opens.

3 On the **Scattergram** dialog, click the **Setup** button.

The **Scattergram Setup** dialog opens. Arrange the dialogs and image window on the screen as shown below:

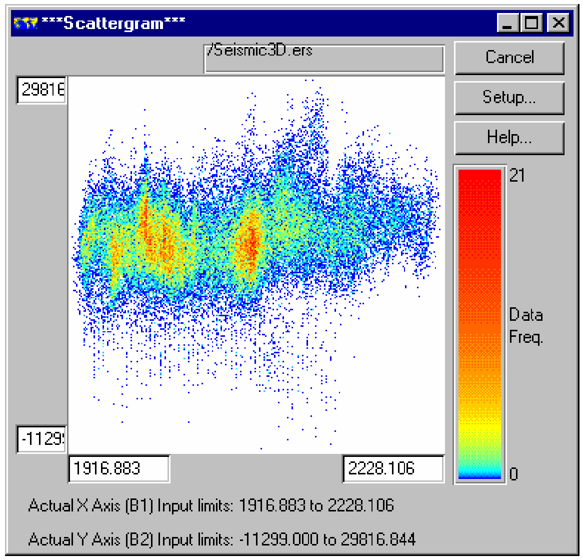


Set the X and Y axis limits to display the scattergram

The **Scattergram** dialog automatically references the dataset in the active image window (‘Seismic3D.ers’). A scattergram does not initially appear because the values for band 1 in this dataset fall outside the default data range of 0-255.

1 In the **Scattergram Setup** dialog, click the **Limits to Actual** button.

The X and Y axis limits are reset, and a scattergram appears in the **Scattergram** dialog window. This plot shows the relationship between the two-way time values (plotted on the horizontal X axis) and the amplitude values plotted on the Y axis.



By default, a new scattergram plots band 1 of the dataset on the X (horizontal) axis and band 2 on the Y (vertical) axis, and the cluster of points is shown using various colors inside the scattergram window. The colors represent the *accumulated frequency* (or “density”) of data values in both bands. Areas of the scattergram with the highest densities of points are shown in colors in the upper part of the color bar (red and yellow), and low density areas in the lower colors (blue and magenta). Typically, high density areas will be a feature comprising a large number of pixels in both bands.

2 Without depressing the mouse, move the cursor around inside the scattergram.

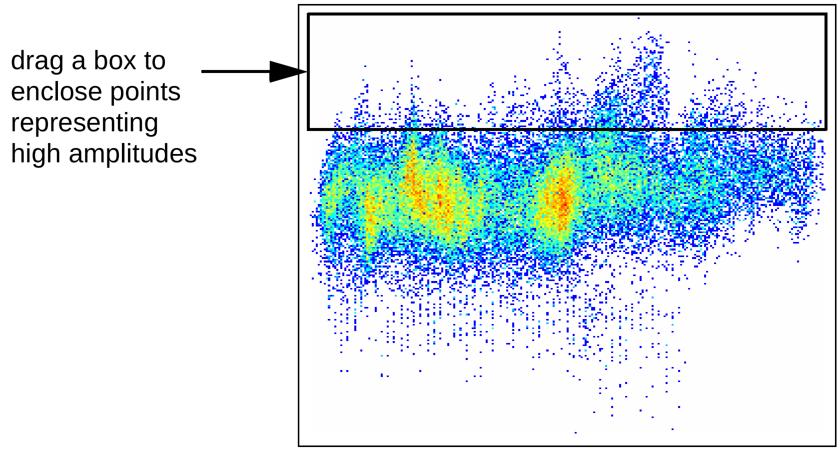
The current X-Y location of the cursor is shown in the upper-left corner of the **Scattergram** dialog.

The wide dispersion of points indicates that there is a weak correlation between the time and amplitude values. The frequency of points and shape of the scattergram can reveal anomalies in the dataset that may not be apparent when looking at the data in other ways.

Draw a box on the scattergram to highlight amplitude ranges

By defining a region box on the scattergram, you can highlight the corresponding pixels in the image window. For example, suppose you want to highlight all the area that exceed a certain threshold of amplitude.

1 In the **Scattergram** dialog, drag to define a large box around the uppermost spread of points (see the diagram below).



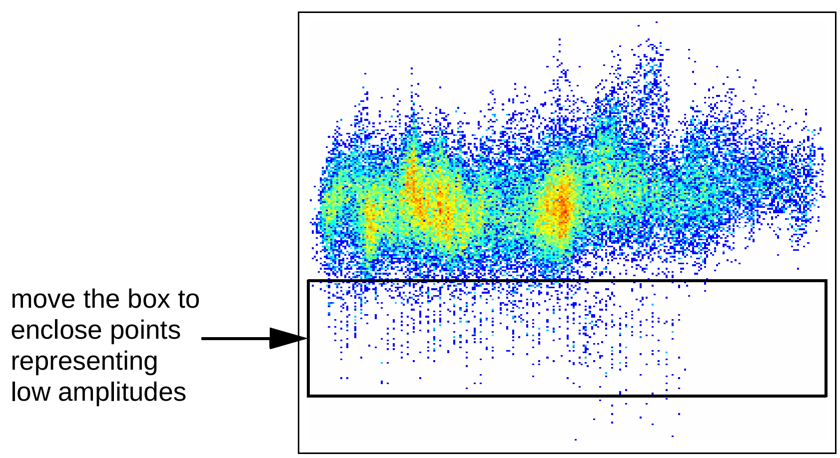
When you release the mouse, ER Mapper runs the algorithm again and then draws a solid color over pixels in the image window whose data values fall within the box limits you defined on the scattergram (in this case event amplitudes exceeding about 20000). By default, the overlay is drawn in red.

Move the region box to highlight low amplitudes

1 In the **Scattergram Setup** dialog, turn on the **Defer Display** option.

This tells ER Mapper to delay updating the scattergram or region overlay until you finish changing the desired options (moving the region box in this case).

2 In the **Scattergram** dialog, point inside the box you drew and drag it down to cover the points for the lowest amplitudes (see the diagram below).



3 After moving the box, click the **Display** button in the **Scattergram Setup** dialog.

ER Mapper runs the algorithm again to color the pixels falling within the box's new data limits (areas with lowest event amplitudes this time).

Change the color of the image overlay

1 In the **Scattergram Setup** dialog, click the **Set color...** button next to **Region Display Color**.

The **Color Chooser** dialog opens.

2 Choose magenta (purple) as your region overlay color, then click **OK** to close the **Color Chooser** dialog.

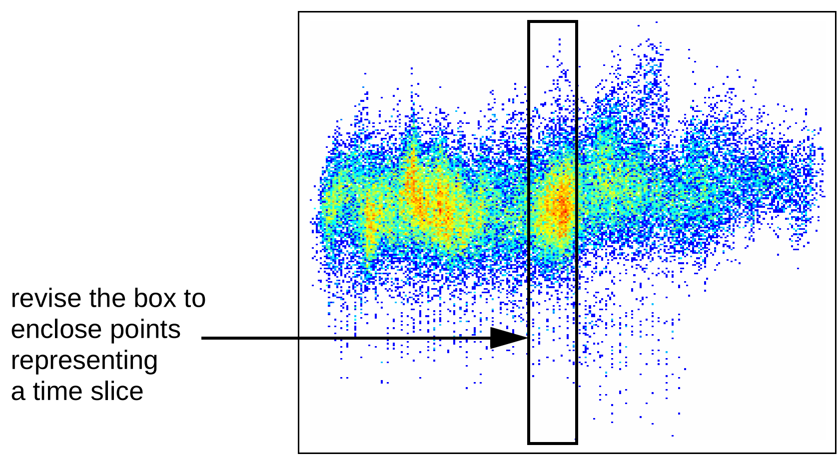
3 Click **Display** in the **Scattergram Setup** dialog.

ER Mapper redraws the image overlay in magenta, so you can more easily see that low amplitude areas are generally associated with faults.

Revise the region box to highlight a time slice

Notice that the region box on the **Scattergram** dialog is selected (it has "handles" at the four corners). You can move or resize the box by dragging the handles.

1 On the **Scattergram** dialog, resize and shape your region box by dragging any of the four handles to enclose a specific range of time values (see the diagram below).



2 After revising the box, click **Display** in the **Scattergram Setup** dialog.

ER Mapper updates the color overlay to highlight the range of time values falling within the box's data limits (in this case about 2050 to 2075 milliseconds).

Tip: The scattergram overlays feature described above also works when viewing images in 3D perspective mode. However, you cannot view an image in 3D when using the annotation **Tools** dialog (as you will next).

Delete the scattergram region

1 On the **Scattergram Setup** dialog, click **Delete Region**, then click **Display**.

ER Mapper deletes the region box from the scattergram, then redraws the image without the color overlay.

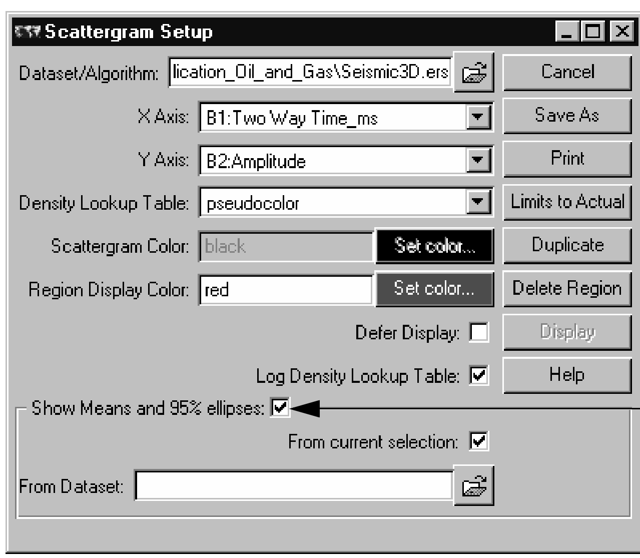
Note: The scattergram region box must be selected before you can move, resize or delete it (click on any box border until selection handles appear).

2 Turn off the **Defer Display** option on the **Scattergram Setup** dialog.

Draw a region on the image

ER Mapper also lets you define a region on the image, and view the mean value and standard deviation ellipse on the scattergram for data values that fall inside the region on the image.

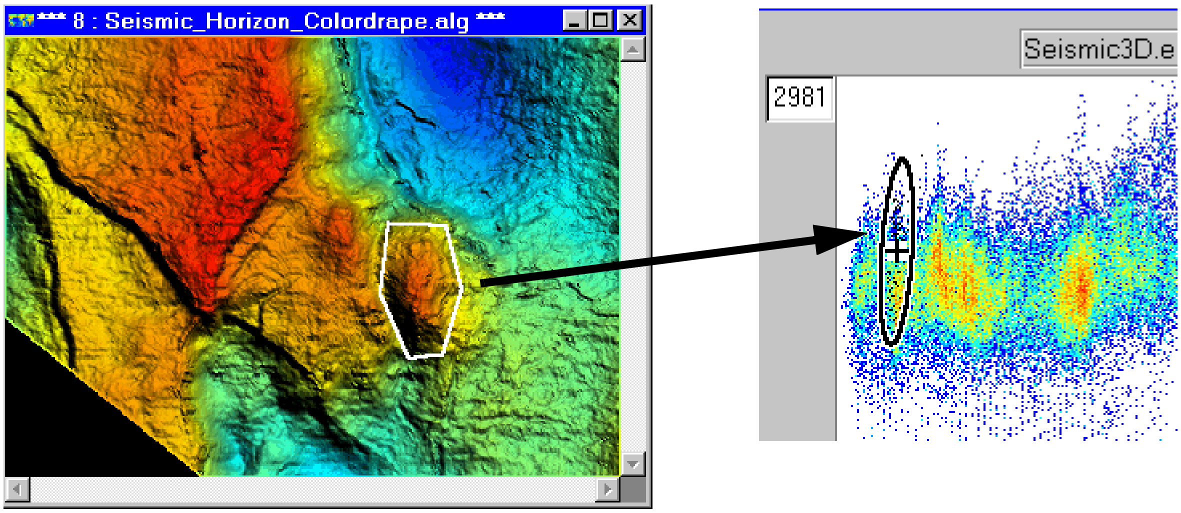
1 On the **Scattergram Setup** dialog, turn on the **Show Means and 95% ellipses** option.



2 On the **Tools** dialog, click the **Polygon**  button.

3 Inside the image window, define a polygon around a feature of interest. Click once at the start point, once at each node, then double-click to end the polygon definition

ER Mapper displays a mean and 95% confidence ellipse for the data values that fall inside the region you drew. This is a easy way to see where the region occurs in the range of possible dataset values shown on the scattergram.



Close the scattergram dialogs

1 Click **Close** on the annotation **Tools** dialog to close it.

2 Click **Cancel** on the **Scattergram Setup** dialog to close it, then click **Cancel** to close the **Scattergram** dialog.

Close all image windows and dialog boxes

1 Close all image windows using the window system controls:

- For Windows, click the **Close** button in the upper-right window corner.

2 Click **Close** on the **Algorithm** window to close it.

Only the ER Mapper main menu should be open on the screen.

What you learned

After completing these exercises, you know how to perform the following tasks in ER Mapper:

- View image data values in text format
- View image data values in multiple bands as a signature
- View image data values in multiple bands along a profile line
- View two bands of image data values as a scattergram
- Highlight image areas that correspond to scattergram point clusters

7

Using spatial filters

This chapter explains how to modify raster image data using spatial filtering to highlight structural features, suppress gridding artifacts or noise, and perform other enhancements to improve visual interpretation. It introduces concepts associated with spatial filtering and gives you practice using ER Mapper's Filter options.

Note: For information on frequency domain filtering (Fourier Transforms), see the *ER Mapper User Guide*.

About spatial filtering

Spatial filtering is a common operation applied to raster image data to enhance or suppress spatial detail to improve visual interpretation. Common examples include applying filters to enhance edge detail in images, or to remove or decrease noise patterns or gridding artifacts in an image. Spatial filtering is called a "local operation" in image processing because it modifies the value of each pixel in the dataset according to the values of the pixels surrounding it. Filters work by removing certain spectral or spatial frequencies to enhance features in the remaining image.

Spatial frequency

A characteristic common to all types of raster data is *spatial frequency*, which defines the magnitude of changes in data values per unit distance for any particular part of an image. Areas of an image with small changes or gradual transitions in data values over a given area are termed *low frequency* areas (such as a smooth lake surface). Areas with large changes or rapid transitions are termed *high frequency* areas (such as an urban area with dense road networks). Spatial filters can be divided into three broad categories:

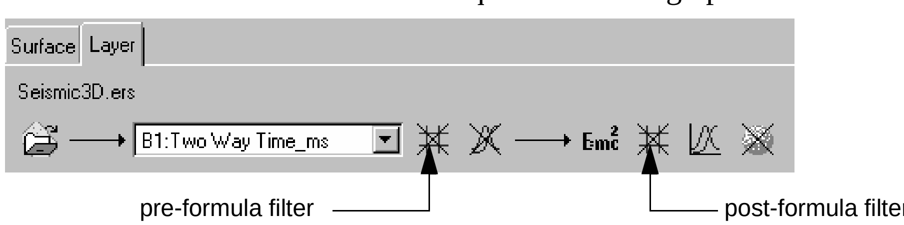
- **Low pass filters** emphasize low frequency detail to smooth out image noise or reduce spikes or gridding artifacts in the data. Since they de-emphasize detail in an image, low pass filters are sometimes called smoothing or averaging filters.
- **High pass filters** emphasize high frequency detail to enhance or sharpen linear features like faults. High pass filters are sometimes called sharpening filters because they are generally used to enhance detail without affecting low frequency portions of the image.
- **Edge detection filters** emphasize edges surrounding objects or features in an image to make them easier to analyze, for example faults. Edge detection filters usually create an image with a grey background and black and white lines surrounding the edges of objects and features in the image.

How convolution filters work

Spatial filtering is accomplished by passing a two-dimensional rectangular array (or window) containing weighting values over the image data at each pixel location. The pixel in the center of the window is evaluated according to the surrounding pixels and weighting values defined for each cell in the array, then a new output pixel value is calculated. The window then shifts over to the next pixel and performs the same operation. This process of evaluating the weighted neighboring pixel values is called two-dimensional convolution, and the filter array is often called a *convolution kernel*.

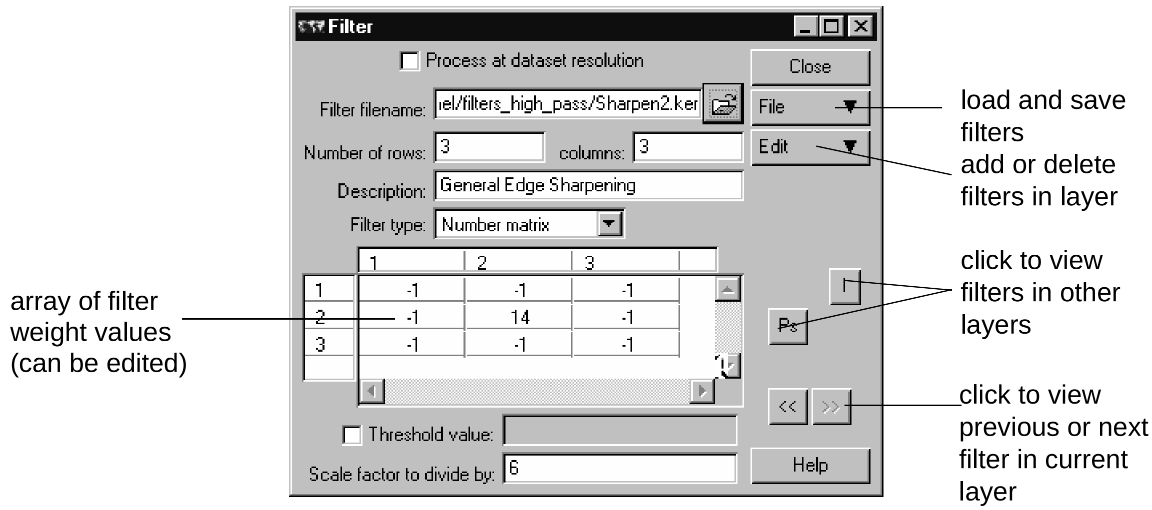
The Edit Filter buttons

By default, each raster layer in ER Mapper has two **Edit Filter (Kernel)** buttons in the algorithm process diagram. One lets you apply a filter *before* a formula (pre-formula), and the other *after* a formula (post-formula). You can also insert additional filters in either location to create sequential filtering operations.



The Filter editor dialog box

To add a filter into the process stream, or create a new filter, click on the desired **Edit Filter (Kernel)** button to open the **Filter** dialog box. ER Mapper provides a wide variety of standard spatial filters, including low and high pass filters, directional edge enhancement filters, and special filters for classification smoothing and for geophysical and seismic data.



ER Mapper also lets you use filters that are written in C code, and provides several C filters as examples. Using C allows you implement more complex or specialized filtering techniques that are not possible with simple convolution kernels. There is no limit to the dimensions of filters that can be defined and used in ER Mapper.

Hands-on exercises

These exercises give you practice applying filters in ER Mapper, and explain how to insert and delete filters in the process stream using the Filter buttons. You will try various types of filters to evaluate their results.

What you will learn...

After completing these exercises, you will know how to perform the following tasks in ER Mapper:

- Insert and delete filters in the algorithm process diagram
- Apply different types of common filters interactively to see their results
- Edit the transform to enhance the contrast of filtered images

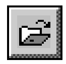
Before you begin...

Make sure all image ER Mapper image windows and dialog boxes are closed. Only the main ER Mapper menu should be open.

1: Applying low pass (smoothing) filters

Objectives Learn to how to insert and delete a filter in the algorithm process stream.

Open and display the seismic dip algorithm

1 Click the **Open**  button on the main menu.

An image window and the **Open** file chooser open.

2 From the **Directories** menu, select the path ending with the text **\examples**.

3 In the 'Applications\Oil_And_Gas_Exploration' directory open the algorithm 'Seismic_Horizon_Realtime_Sun_Shade.alg.'

ER Mapper displays the sample seismic horizon dataset processed to show the seismic two-way time surface illuminated from the northwest.

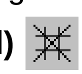
4 Drag the image window by its lower-right corner to make it about 50% larger.

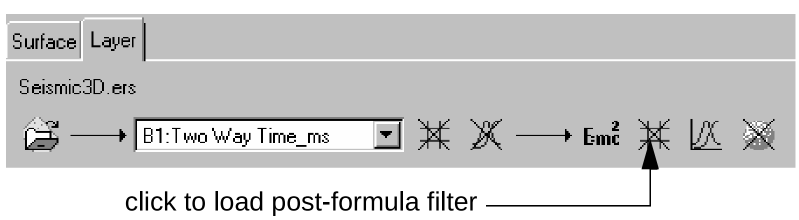
5 Right_click over the image and select **Zoom to All Datasets** from the **Quick Zoom** menu.

Apply a 3x3 low pass (smoothing) filter to the image

1 On the main menu, click the **Edit Algorithm**  button.

The **Algorithm** dialog opens.

2 In the algorithm process diagram, click the post-formula **Edit Filter (Kernel)**  button.



The **Filter** dialog box appears. This dialog allows you to load standard filters supplied with ER Mapper, and create and save your own filters.

3 From the **File** menu (on the **Filter** dialog), select **Load...**.

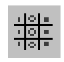
The **Load filter** file chooser dialog box opens.

4 From the **Directories** menu, select the path ending with the text **\kernel**.

5 Double-click on the ‘filters_lowpass’ directory to open it.

6 Double-click on the filter ’avg3.ker’ to load it.

The filter settings are displayed in the dialog box fields. The array (or matrix) of nine weighting values defining the 3 by 3 filter appear in the central scroll window (the “filter matrix window”).

Note: After you load a filter, notice that the icon for the **Edit Filter (Kernel)** button in the process diagram changes to  . This indicates that a filter is currently being used in that part of the algorithm.

The low pass filter creates a blurring or averaging effect. In general, low pass filters work by taking the average value of all pixels in the matrix and assigning it to the center pixel, thus smoothing out jumps or spikes in the data. Low pass filters can be useful for reducing periodic noise or gridding artifacts to make it easier to interpret the major features in the image.

Replace the 3x3 filter with a 5x5 smoothing filter

You can easily experiment with new filters simply by loading a different filter to replace the current one.

1 On the **Filter** dialog, click the  button next to **Filter filename**.

The **Load filter** file chooser dialog box appears. (This is the same as selecting **Load** from the **File** menu.)

2 Double-click on the filter ’avg5.ker’ to load it.

The new filter settings are displayed in the dialog box fields. This filter has a matrix of 15 weighting values shown in the filter matrix window. (You use the scroll bars to view the matrix cells currently not displayed.)

The smoothing effect is stronger this time. In general, the larger the filter matrix, the stronger the effect of the filter.

Replace the 5x5 with a horizontal smoothing filter

1 Click the  button next to **Filter filename**.

2 Double-click on the filter ’avg_hor.ker’ to load it.

The filter settings are displayed in the dialog box fields. This is a 3x3 filter with even weighting values, so it only averages pixels in the horizontal direction.

Features occurring in the horizontal direction are smoothed, while vertical features remain unchanged for the most part. Horizontal, vertical, and diagonal smoothing filters can be useful for reducing gridding artifacts occurring in specific directions.

Tip: The filter array fields are editable, so you can easily experiment and create your own filters with custom weighting coefficients and parameters and save them for later use.

Replace the horizontal filter with a 3x3 median filter

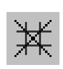
1. Click the  button next to **Filter filename**.
2. From the **Directories** menu, select the **\kernel** path.
3. Double-click on the 'usercode' directory to open it.
4. Double-click on the filter 'median.ker' to load it.

   Notice that this filter is coded as a C program, so an array of weighting values does not appear. Filters that work in more complex ways are usually coded in C, and you can add your own filters in this way too.

   High frequency or noisy features are again suppressed in the image. Median filters work by assigning the center pixel the median value of all pixels within the array (3x3 in this case). They are often used on seismic data because they are very effective for reducing noise without the "blurring" effects of simpler averaging filters you applied earlier.

Delete the median filter from the process stream

1. From the **Edit** menu (on the **Filter** dialog), select **Delete this filter**.

   The contents of the **Filter** dialog clear and the filter is deleted from the process diagram (shown by the  icon).

   The image is rendered without the averaging filter, so it appears as it did originally. As you can see, experimenting with various filtering techniques is simply a matter of loading or deleting filters from the process diagram.

2. Click **Close** on the **Filter** dialog to close it.

Tip: You can also load filters before a formula (using the pre-formula filter button in the process diagram), and apply a sequence of filters in a row.

2: Applying edge detection filters

Objectives Learn to apply filters to detect edge features in an image, and to adjust the transform to account for the effects of the filter.

Open and display the pseudocolor horizon algorithm

1. Click the **Open** button on the main menu.
2. From the **Directories** menu, select the **\examples** path.
3. In the directory ‘Applications\Oil_And_Gas_Exploration’ load the algorithm ’Seismic_Horizon.alg.’

   ER Mapper displays the sample seismic horizon dataset (the two-way time data) as a simple pseudocolor image. (This is similar to the algorithm you made earlier.)
4. Click on the Intensity layer in the data structure diagram to select it, then click the **Cut** button above it. (You do not need it for this exercise).

Change the color table to greyscale

1. On the **Algorithm** dialog, click the **Surface** tab.
2. Select **greyscale** from the **Color Table** drop-down menu.

   ER Mapper displays the image in greyscale. (This is recommended when applying edge detection filters.)

Apply a northerly dip edge detection filter

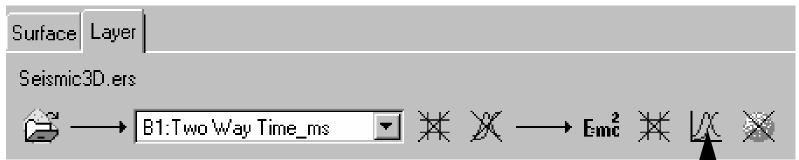
1. On the **Algorithm** dialog, click the **Layer** tab.
2. Click the post-formula **Edit Filter (Kernel)** button in the process diagram.

   The **Filter** dialog box opens.
3. Click the button next to **Filter filename**.
4. From the **Directories** menu, select the **\kernel** path.
5. Double-click on the ‘filters_seismic’ directory to open it.
6. Double-click on the filter ’Northerly_dip.ker’ to load it.

The image initially appears white–this is expected because the effects of the filter have changed the data range, so you need to adjust the transform (color mapping) to restore the contrast. (This was not needed for the low pass filters you applied previously because they only slightly altered the original data range.)

Adjust the contrast of the filtered image

1 On the **Algorithm** dialog, click the post-formula **Edit Transform Limits**  button in the process diagram.



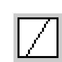
click to open post-formula **Transform**

Note the Actual Input Limits are about -56 to +26. This is the new data range created by applying the edge detection filter to the original seismic two-way time data.

2 On the **Transform** dialog, select **Limits to Actual** from the **Limits** menu.

The X axis limits change to match the Actual Input Limits.

The image contrast is enhanced and most pixels are assigned a mid-grey color in the greyscale lookup table. Notice that the histogram shows that most data values are grouped in the center (so they are mapped to a mid-gray shade), with a few outlying data values (representing the edge features or faults) mapped to black or white.

3 On the **Transform** dialog, click the **Create autoclip transform**  button.

ER Mapper redisplays the image with enhanced contrast. This filter highlights northerly dipping surfaces, where strong northerly dip is shown as dark greys and strong southerly dip as light greys. Surfaces with no strong dip are shown as mid-level greys. Edge detection filters are often used in geophysical applications to highlight faults and lineaments occurring in a specific compass direction.

4 Click **Close** on the **Transform** dialog to close it.

Note: As shown here, applying filters to your data often produces a different data range which initially creates a low contrast image. For many filters, you will commonly need to adjust the transforms for each layer after applying a filter.

Apply an easterly dip edge detection filter

1 On the **Filter** dialog, click the button next to **Filter filename**.

2 Double-click on the filter 'Easterly_dip.ker' to load it.

This time easterly dipping surfaces are highlighted in dark grey, and westerly dipping surfaces in light greys. This filter provides a better enhancement of faults in this time surface than the northerly dip filter because most of the faults occur in a north-south direction.

Note: Since the data range produced by applying the Easterly_dip filter is similar to that produced by Northerly_dip, you do not need to adjust the transform.

3: Applying filters in sequence

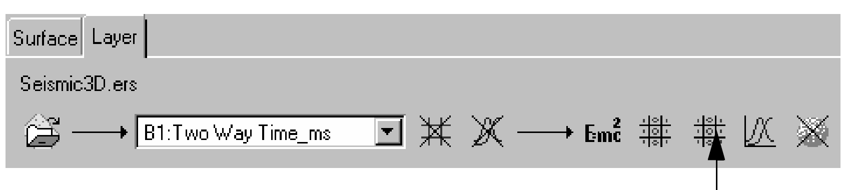
Objectives Learn to append and insert filters to apply a sequence of filtering operations to a dataset, and to move between filters in the process diagram.

Notice that the easterly dip filtering operation has created some minor "salt and pepper" noise in the image. You can add a second filter to help smooth the noise.

Append a second filter to follow the first one

1 From the **Edit** menu (on the **Filter** dialog), select **Append new filter**.

Notice that a second filter button has been added to process diagram. (This is like adding a placeholder for a new filter.) When you append a new filter, a "default kernel" is loaded which has no filtering effect (shown in the **Filter** dialog).



appended filter icon in process diagram

Load a median filter to follow the easterly dip filter

1 Click the button next to **Filter filename**.

2 From the **Directories** menu, select the **\kernel** path.

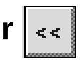
3 Double-click on the 'usercode' directory to open it.

4 Double-click on the filter 'median.ker' to load it.

A noise reduction effect is applied to the image produced by the easterly dip filter. The median filter suppresses "salt and pepper" noise patterns without blurring subtle structural details.

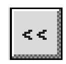
Move between filters in the process diagram

On the **Filters** dialog, note the two arrow buttons near the lower-right corner. These buttons let you easily move to view or edit the contents of any filter in the current algorithm layer.

1 On the **Filters** dialog, click the **Move to previous Filter in layer** 

button.

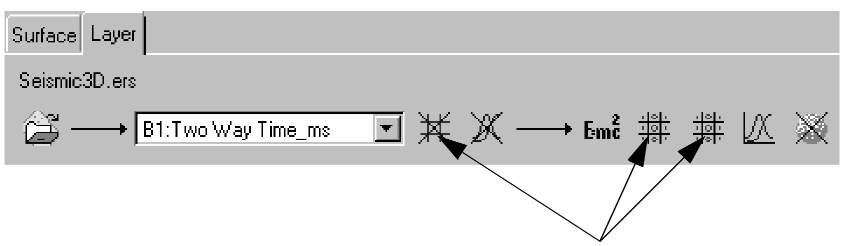
ER Mapper moves one filter to the left in the process diagram, so the **Filter** dialog contents show the easterly dip filter.

2 Click the **Move to previous Filter in layer** 

button again.

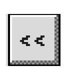
ER Mapper again moves one filter to the left, so it now displays the contents of the per-formula filter (empty since no filter is loaded in that position).

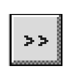
3 Click on the three **Edit Filter (Kernel)** icons in the process diagram one by one.



click on any filter icon in process
diagram to see contents in **Filter** dialog

The contents of the **Filter** dialog update each time to show the filter loaded in that position in the diagram.

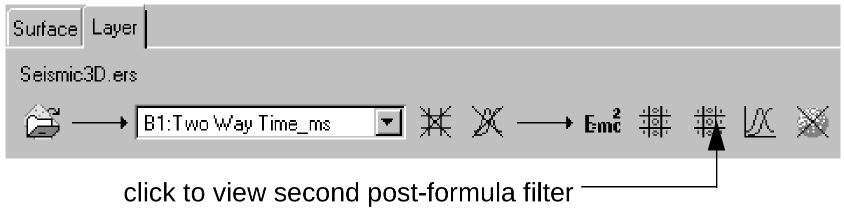
Tip: As shown, you can move between filters either by clicking icons in the process diagram, or by using the **Previous** 

and **Next** 

buttons in the **Filter** dialog.

Delete the median filter from the process diagram

1 Click on the second post-formula filter icon again.



The contents of the median filter are displayed in the **Filter** dialog.

2 From the **Edit** menu (on the **Filter** dialog), select **Delete this filter**.

The median filter is deleted from the process diagram, and its button is removed from the process diagram. ER Mapper automatically moves to the previous filter in the diagram (the easterly dip filter).

3 Click **Close** on the **Filter** dialog to close it.

Close all image windows and dialog boxes

1 Close all image windows using the window system controls:

- For Windows, click the **Close** button in the upper-right window corner.

2 Click **Close** on the **Algorithm** window to close it.

Only the ER Mapper main menu should be open on the screen.

What you learned

After completing these exercises, you know how to perform the following tasks in ER Mapper:

- Insert and delete filters in the process stream diagram
- Apply different types of filters interactively to see their results
- Edit the transform to enhance the contrast of filtered images

8

Using formulas

This chapter explains how to use formula processing in ER Mapper to perform mathematical operations on raster datasets. You learn how to create and edit formulas, and use the standard formulas and functions provided in ER Mapper.

About formula processing

Formulas are commonly used in image processing of seismic data to highlight certain ranges of data, create derivative images such as azimuth or isochrons, and other tasks. Formula processing can range from simple subtraction or thresholding of data to complex spatial modelling and “if-then-else” condition testing.

Formula processing is a “point operation” in image processing because it applies a mathematical function to each pixel in the dataset. Common uses of formulas in seismic image processing include:

- data corrections, such as for polarity of data as shown in earlier chapters;
- transforming and/or combining raw datasets to create derivative images such as dip, azimuth, isochrons, isopachs, and so on;
- overlaying thematic data, such as highlighting a specific data range or attribute in color over a backdrop image;
- isolating specific data ranges or geographic areas of interest using thresholding, region (polygon) masking, and other functions;

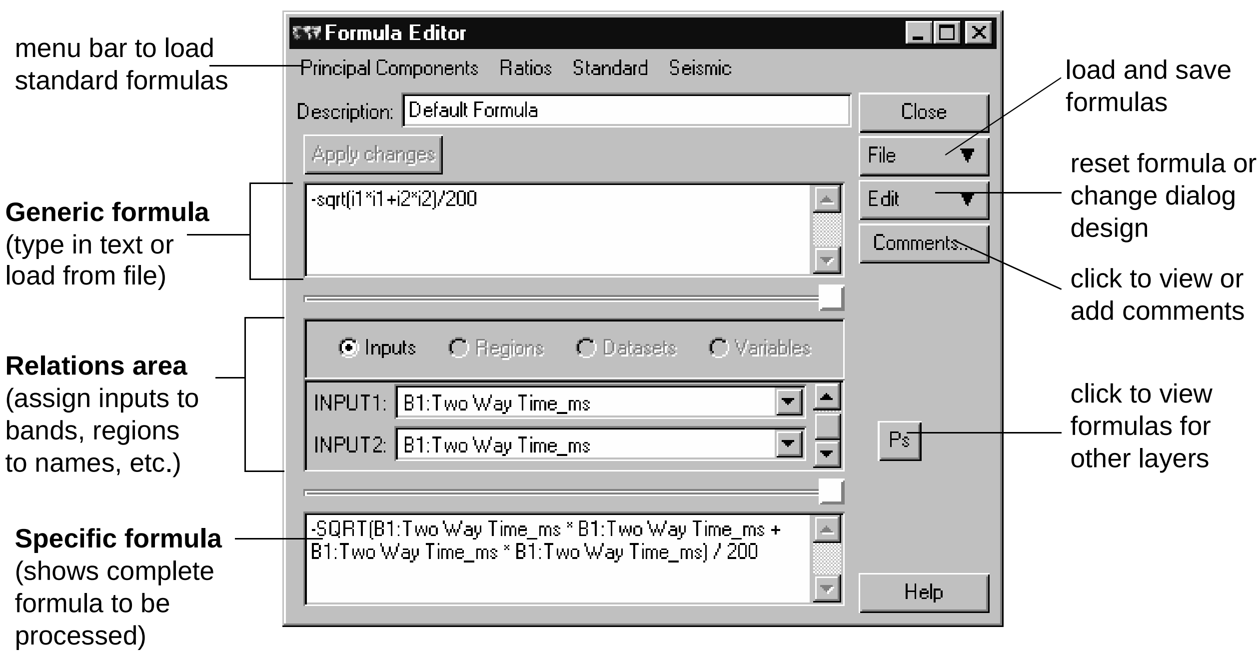
Formula processing in ER Mapper

Many common types of data transformations can be implemented in ER Mapper using formula processing. Since formulas are part of the algorithm processing stream, you can see the results in real time, and interactively modify the formula to quickly fine tune it.

ER Mapper provides a complete set of standard operators and functions you can reference in formula processing. You can also use dataset statistics, special functions, and functions defined with your own C or Fortran user code. See the relevant sections and chapters in the *ER Mapper User Guide* for complete information.

The Formula Editor dialog box

When you click on the **Edit Formula** button in the process stream diagram, ER Mapper opens the **Formula Editor** dialog box. This dialog lets you create, edit, load, and save formulas, and it has the following components:



Tip: For any algorithm, you can open the **Formula Editor** dialog box from two places: using the **Formula** buttons in the process diagram on the **Algorithm** dialog, or using the **Edit Formula** toolbar button on the main menu.

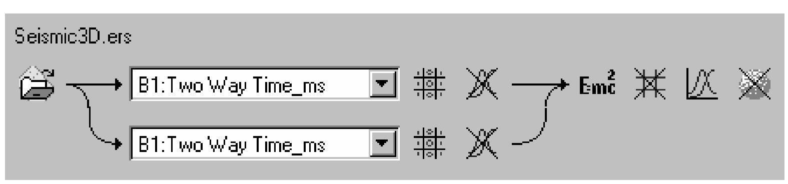
The formula relations concept

The key concept of *relations* is a very powerful feature that makes ER Mapper's formula processing very flexible and interactive. When you enter or load a generic formula, you may include one or more generic specifications that refer to any arbitrary dataset band, region polygon, dataset filename, or variable. You then use the Relations window to choose relations between actual dataset band numbers, region names, etc. and the generic specifications in the formula. The actual assignment of references to dataset bands, region names, and so on is then shown in the Specific formula window.

There are four types of generic specifications (where "n" is an integer value):

Reference	Notation in generic formula	Function
Input specifications	INPUTn, In (or lowercase)	References any band in a dataset.
Region specifications	REGIONn, Rn (or lowercase)	References any region polygon defined for a raster dataset.
Dataset specifications	DATASETn, Dn (or lowercase)	References any raster dataset (an actual disk file with ".ers" extension).
Variable specifications	VARIABLEn, or any text not reserved for ER Mapper functions (for example "density" or "threshold")	References any real number or value to be used as an equation variable.

Formula inputs are also shown graphically in the algorithm process diagram. For example, the following process stream shows that two inputs are being used in the formula, and that they are both assigned to dataset band 1. As indicated, each band can be modified using filters and transforms before being piped through the formula processing.



To select the specific bands to be used in a formula, you can either use the **Band Selection** drop-down list in the process diagram, or select bands inside the Relations window of the **Formula Editor** dialog box.

Hands-on exercises

These exercises introduce you to the basic features of the **Formula Editor** dialog box and procedures for creating and implementing simple formulas.

What you will learn...

After completing these exercises, you will know how to perform the following tasks in ER Mapper:

- Type and edit a formula, and test formula syntax
- Use generic references for inputs, variables, and regions in a formula
- Assign dataset bands, variables, and region names to generic references
- Create a thematic color overlay and specify transparency between surfaces
- Draw polygons to define regions of interest in an image
- Use formulas to process areas of interest (regions) in a dataset
- View formulas to generate dip and azimuth images

Before you begin...

Before beginning these exercises, make sure all ER Mapper image windows are closed. Only the ER Mapper main menu should be open on the screen.

1: Entering and testing a formula

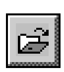
Objectives

Learn how to enter simple formulas and test formula syntax.

Load a Pseudocolor algorithm with the default formula

1. Click the **Edit Algorithm**  button on the main menu.

   An image window and the **Algorithm** dialog box appear.

2. Click the **Open**  button on the main menu.
3. From the **Directories** menu, select the **\examples** path.
4. Double-click on the directory ‘Data_Types’ to open it.
5. Double-click on the directory ‘Magnetics_And_Radiometrics’ to open it.
6. Double-click on the algorithm named ‘Magnetics_Pseudocolor.alg.’

The algorithm displays an image of airborne magnetics data acquired over northeastern Australia. The data represents the strength of the magnetic field on this area of the earth's surface, and is scaled to a data range of 0-255. Using the Pseudocolor lookup table, blues correspond to lower field strengths and yellows and reds to higher field strengths.

Enter a simple formula and test for syntax errors

1 On the **Algorithm** dialog, click the **Edit Formula**  button in the process diagram.

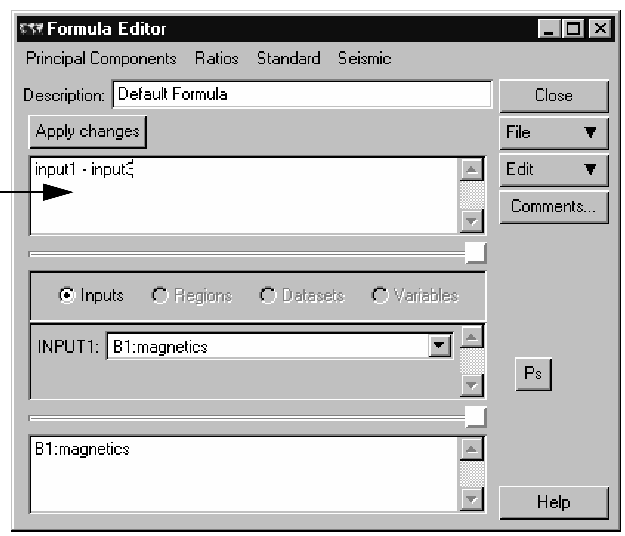
click to open **Formula Editor** dialog

The **Formula Editor** dialog box opens. Note that the generic formula window contains the text “I1,” and that I1 (Input 1) is assigned to dataset band 1 in the Relations window.

2 Edit the formula text to read as follows (*this purposely has an error*):

```
input1 - input3
```

edit formula in Generic formula window



3 Click the **Apply changes** button to test the formula.

ER Mapper issues an error message warning that the formula has a syntax error. (In this case you tried to subtract an input number that was out of sequence; you must also have an “input2” before using an “input3.”

Note: The **Apply changes** button automatically tests for syntax errors in the Generic formula. You must make any corrections before continuing.

Revise the formula to subtract a value

1 In the Generic formula window, edit the formula text to read:

```
input1 - 100
```

(This subtracts 100 from each pixel in the dataset band assigned to input1.)

2 Click the **Apply changes** button to test the formula.

The formula syntax is approved, and ER Mapper translates the generic formula into a specific formula (displayed in the lower window).

Delete the formula and test the syntax

1 In the Generic formula window, edit the formula to remove all text (select the existing text and press the Backspace or Delete key on your keyboard).

2 Click the **Apply changes** button to test the formula.

ER Mapper issues an error message regarding the formula syntax.

Caution: ER Mapper considers no formula at all an error in syntax. At a minimum, the Generic formula window must always contain the text “I1” or “input1” to specify at least one input dataset band to be processed.

3 In the Generic formula window, edit the formula text to read:

```
input1
```

4 Click the **Apply changes** button to test the formula.

ER Mapper accepts the formula.

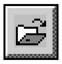
Tip: Under the **Formula Editor** dialog’s **Edit** menu, you can select **Clear** to clear all text from the Generic formula window, or select **Default** the restore the default formula ‘INPUT1.’

5 Click **Close** on the **Formula Editor** dialog to close it.

2: Creating a threshold formula

Objectives Learn how to enter a simple threshold formula and use boolean “if-then-else” logic in a formula. Also learn about null dataset values, and how to use a variable in a formula.

Open the sample sun shade algorithm

1 On the main menu, click the **Open**  button.

The **Open** dialog box appears.

2 From the **Directories** menu, select the **\examples** path.

3 In the ‘Applications\Oil_And_Gas_Exploration’ directory, double-click on the algorithm ‘Seismic_Horizon_Realtime_Sun_Shade.alg’ to open and display it.

This algorithm displays the sun shaded two-way time data to enhance structural features.

Enter a simple threshold formula

1 On the **Algorithm** dialog, click the **Edit Formula**  button in the process diagram.

The **Formula Editor** dialog box opens.

2 In the **Generic** formula window, edit the formula text to read:

```
if -input1 > -2030 then -input1 else null
```

This formula ER Mapper “if the (inverted) two-way time value is greater than negative 2030, then process it, else assign it a value of null.” (Any dataset pixel assigned a value of null is excluded from further processing and does not appear in the final image.)

3 Click the **Apply changes** button to verify the formula syntax and process the algorithm.

Only areas of the image with data values greater than -2030 (structural highs) are displayed, while data values less than -2030 display with no color (they appear black).

4 Click the post-formula **Edit Transform Limits**  button in the process diagram.

In the **Transform** dialog, the Actual Input Limits range is -2030 to -1916. This is expected since data values greater than -2030 are set to null (no value) by the formula and are thus excluded from further processing. The shape of the histogram also reflects the clipping of the data at the -2030 level.

5 Click **Close** on the **Transform** dialog to close it.

Substitute a variable for the value -2030

1 In the Generic formula window, edit the formula text to substitute the word "variable1" for the value -2030. Your formula should read:

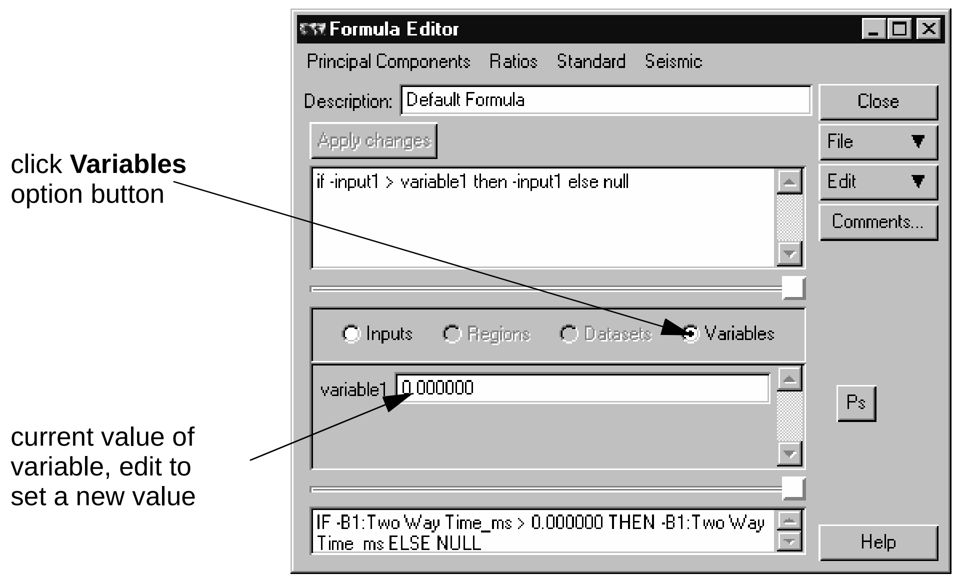
```
if -input1 > variable1 then -input1 else null
```

Your formula now includes a variable that you can set in the **Relations** window.

2 Click the **Apply changes** button.

Two things change: the **Variables** button above the Relations window becomes active, and the value of "variable1" becomes zero in the Specific formula window.

3 Click the **Variables** option button in the Relations window.



The **Relations** window shows that the value of "variable1" is set to zero.

4 Edit the value of "variable1" text field to read **`-1970`** then press the Return or Enter key on your keyboard to validate your text.

This time only areas with time values greater than -1970 are displayed.

5 Change the value of "variable1" to **`-2050`**, then press Return or Enter again to view the new threshold image.

As you can see, using references to variables in your formula (instead of actual values) can speed experimentation. (This becomes more apparent when you use the same variable several times in a formula.)

Tip: You can have several different variables in a formula, and name them nearly any word without spaces (for example *threshold* or *my_value*). Be sure the names do not conflict with text strings ER Mapper uses for standard functions (such as "input1" or "region1").

Load a standard formula from the ER Mapper library

1 From the **File** menu (on the **Formula Editor** dialog), select **Open...**.

The **Open Formula** dialog box appears listing directories of standard formulas supplied with ER Mapper.

2 From the **Directories** menu, select the **\formula** path.

3 Double-click on the formula directory named 'standard' to open it.

A list of standard formulas for many different image processing functions displays.

4 Double-click on the formula 'invert.frm' to load it.

The invert formula (-INPUT1) replaces your threshold formula. (You could just as easily have edited the threshold formula text, but this shows you how to load a formula from ER Mapper's formula library.)

Tip: You can also load many standard formulas using the menu bar at the top of the **Formula Editor** dialog. To create your own formula, type it in, then use **File/ Save As** to save it to one of the ER Mapper formula directories.

---

5 Click **Close** on the **Formula Editor** dialog to close it

3: Creating a thematic color overlay

Objectives Learn how to add a Classification layer to an algorithm, and use a formula to highlight a specific range of values in a dataset as a color overlay. Also learn to put the layer into it’s own surface in the algorithm, so you can change the transparency of the overlay color.

Note: The following technique shows you how to manually define an overlay similar to the one you created earlier using scattergrams.

Add a Classification layer and load the sample dataset

1. Open the **Algorithm** dialog’s **Edit** menu, choose **Add Raster Layer**, then choose **Classification**.

   A Classification layer is added to the algorithm layer list on the left.

2. Click the **Load a dataset** button in the process diagram for the new layer to open the file chooser dialog.
3. From the **Directories** menu, select the **\examples** path.
4. In the directory named ‘Applications\Oil_And_Gas_Exploration’ load the dataset named ‘Seismic3D.ers’ .

   This is the same dataset loaded in the Pseudocolor layer of the algorithm. You will use a formula to define a threshold of amplitude values and display the result as a color overlay.

Define a formula to highlight a specific amplitude range

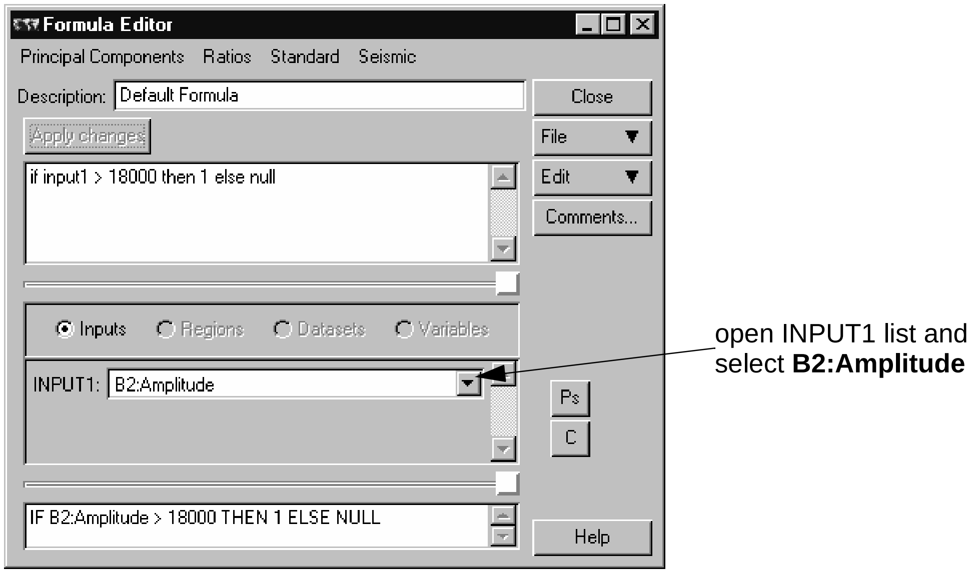
1. With the Classification layer selected, click the **Edit Formula** button in the process diagram to open the **Formula Editor** dialog box.
2. In the **Generic** formula window, edit the formula text to read:

   ```
   if input1 > 18000 then 1 else null
   ```

   This formula tells ER Mapper “if the image data values in the selected band are greater than 18000, then set the value to 1, else set it to null.”

3. Click the **Apply changes** button to validate the formula.

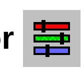
4 In the Relations window, select **B2:Amplitude** from the INPUT1 drop-down list.

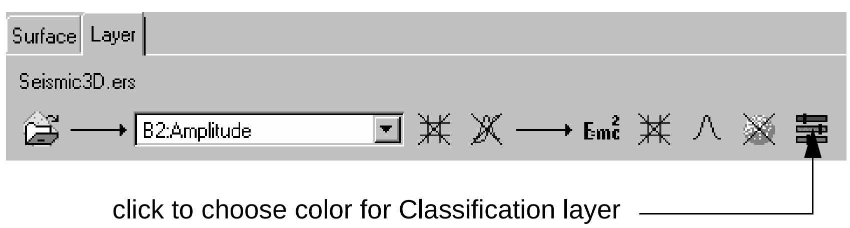


The threshold formula now references band 2 of the seismic dataset (which contains the event amplitude data). This tells ER Mapper to apply the formula to the values in the Amplitude band.

5 Click **Close** on the **Formula Editor** dialog to close it.

Choose a layer color and name and display the image

1 In the process diagram, click the **Edit Layer Color**  button.



2 Choose a red color, then click **OK** to close the **Color** chooser dialog.

3 In the data structure diagram on the left, change the Classification layer's text label to **`high amplitudes`**.

The areas exceeding amplitude values of 18000 are highlighted in a red mask (areas where band 2 values meet the criteria of being greater than 18000). Other areas that do not meet that criteria are assigned the value null by the formula, so the shaded greyscale image created by the Pseudocolor layer "shows through" the red mask in those areas.

4 If desired, edit the formula to try other values between **`12000`** and **`18000`**, then click **Apply changes** to see the results.

5 Edit the formula value to **`11000`**, then click **Apply changes**.

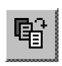
```
if input1 > 11000 then 1 else null
```

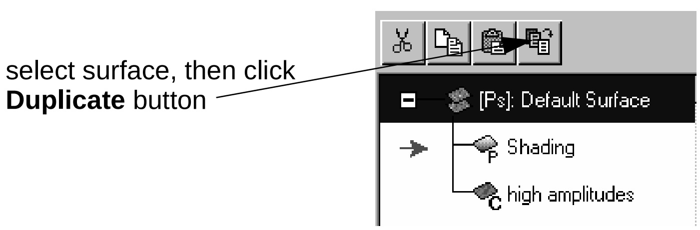
Amplitudes above 11000 cover much of the image. Making the color translucent would aid interpretation by showing structures underneath. The following is one of several ways to do this.

6 Click **Close** on the **Formula Editor** dialog to close it.

Split the two layers into separate surfaces

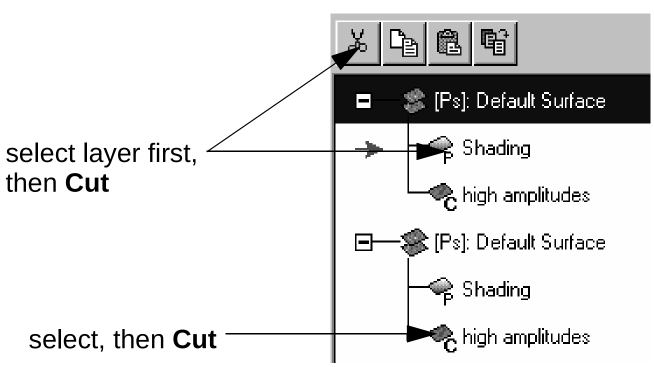
By splitting the two layers into separate surfaces, you can set transparency between the grayscale image and the color overlay image. The following is one way to accomplish this.

1 Select the surface icon in the data structure diagram, then click the **Duplicate**  button.

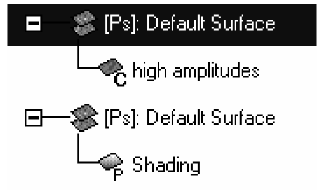


A copy of the surface is added to data structure diagram. The idea here is to create two separate surfaces–one to contain only the color overlay (Classification layer) and another to contain only the shaded greyscale image (Pseudo layer).

2 Select the ‘Shading’ layer in top surface and click the **Cut**  button, then select the ‘high amplitudes’ layer in the bottom surface and cut it also.



Your data structure diagram should now look like this:



3 Click **GO** —the image should not change if your layers are set up correctly.

Set transparency for the color overlay

1 Select the ‘high amplitudes’ layer in the data structure diagram.

2 Select the **Surfaces** tab on the **Algorithm** dialog.

3 Move the **Transparency** slide bar right to its mid-point.

The red color over becomes partially transparent, so the underlying structure of the shaded time horizon shows through.

4 Try other **Transparency** settings to see their effect. A zero setting makes the red color opaque, and a 100 setting makes it invisible.

Note: If you use this technique, it is best that the surface containing the Classification layer be above the surface containing the shaded Pseudocolor layer in the data structure diagram. If you moved the lower surface up, you would be setting transparency of the greyscale image to see the color underneath. The transparency feature is also very useful when viewing multiple surface in 3D (as you will see later). The “colordrape” techniques you used earlier are another way to combine color and structure images.

Notes about Classification layers

The previous example was very simple example of using Classification layers, and you may find it easier to use a scattergram to accomplish thresholding tasks like this. You may add additional Classification layers to display overlays in other colors. You can use more complex conditional tests involving many data layers, attributes, or other tests for a wide range of modelling tasks.

If you have more than one Classification layer in a surface, the layer on top has display priority over others below them. For example, if two Classification layers would cover overlapping areas, the color of the layer on top covers the color in the layer below it where the two overlap. The color of the lower layer is only visible where there is no overlap. Classification layers always have a solid, opaque color unless you use the technique described previously to divide the image into separate surfaces so you can change the transparency.

4: Creating a polygon mask

Objectives Learn how to create a polygon defining an area of interest in a dataset (a “region”), and to use ER Mapper’s “inregion” function in a formula to reference a region for masking purposes.

Note: To complete this exercise, you must use a practice copy of the “Seismic3D.ers” dataset to which you have read/write access. This practice file is assumed to be named “Seismic_practice.ers” residing in the ‘tutorial’ directory. See Appendix A in this workbook for information on setting up the practice dataset.

Re-open the sample sun shade algorithm

1 On the main menu, click the **Open**  button.

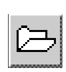
2 From the **Directories** menu (on the **Open** dialog), select the **\examples** path.

3 In the ‘Applications\Oil_And_Gas_Exploration’ directory, double-click on the algorithm ‘Seismic_Horizon_Realtime_Sun_Shade.alg’ to open and display it.

This is the same sun shading algorithm you started with previously.

Load the practice dataset into the current algorithm

1 In the **Algorithm** dialog, click the **Layers** tab.

2 Click the **Load a Dataset**  button in the process diagram.

3 From the **Directories** menu, select the path ending with **\examples**.

4 Double-click on the ‘miscellaneous\tutorial’ directory to open it.

5 Double-click on the dataset named ‘Seismic_practice.ers’ to load it.

The practice dataset is loaded into the Pseudocolor layer.

The image appears unchanged because the dataset you loaded is an exact copy of the previous one. (You need to use you own copy of the dataset for the next step so you don’t conflict with other users.)

6 Drag the image window by the lower-right corner to make it about 50% larger.

7 Right-click on the image and select **Zoom to All Datasets** from the **Quick Zoom** menu.

Next you will draw a polygon on the image to define a region of interest.

Add a vector layer for region definition to your algorithm

1 From the **Edit** menu, select **Edit/Create Regions...**.

The **New Map Composition** dialog box opens.

2 In the **New Map Composition** dialog, make sure the **Raster Region** option is selected.

The **Raster Region** option tells ER Mapper that the annotation tools will be used to create regions for a raster dataset (to define an area of interest in this case).

3 Click **OK** on the **New Map Composition** dialog.

ER Mapper opens the **Tools** palette dialog box. Also notice that a vector layer titled 'Region Layer' has been added to the layer list in the **Algorithm** dialog.

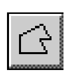
Draw and name a polygon to define a region of interest

1 On the **Tools** palette dialog, click the **Polygon**  button.

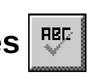
Find a large feature of interest in the image, such as the V-shaped fault block.

2 Point to the area of interest and draw a polygon around it by clicking once at each point, then double-clicking to close the polygon. (Make your polygon fairly large.)

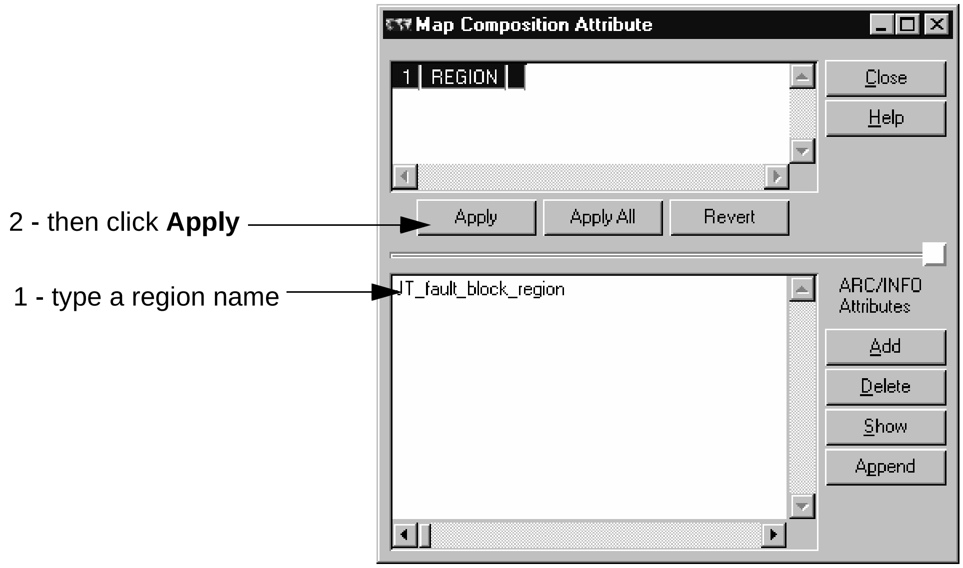
The polygon is selected by default when you close it (it has selection handles at each node).

3 Double-click the **Polygon**  button, choose a red color in the **Line Style** dialog, then click **Close**.

The polygon now displays in red on the image.

4 On the **Tools** dialog, click the **Display/Edit Object Attributes**  button to open the **Map Composition Attribute** dialog box.

5 In the **Object Attribute** dialog, enter a name for the region in the text field at the bottom. Use your initials at the beginning and separate each word with an underscore (_).



6 Click **Apply** to apply the name to the region polygon.

Your name is assigned to the region in the upper part of the dialog.

Define a second region of interest

1 On the **Tools** palette dialog, click on the **Polygon**  button.

2 Draw a polygon around the second feature in the image by clicking once at each point, then double-clicking to close the polygon.

The second polygon is selected by default when you close it.

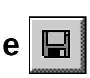
3 In the **Map Composition Attribute** dialog, enter a name for the second region in the lower part of the dialog.

4 Click **Apply** to apply the name to the region polygon.

5 Click **Close** on the **Map Composition Attribute** dialog to close it.

The two region polygons you drew now have a text attribute assigned so you can refer to them by name.

Save the two regions in the practice dataset

1 On the **Tools** palette dialog, click the **Save file**  button.

A dialog asks if you wish to proceed with the overwrite of the practice dataset.

2 Click **OK** to overwrite the practice dataset.

ER Mapper displays a message dialog showing that the regions you defined have been added to the practice dataset.

Note: The definition of a region (its polygon and name) is saved in the header file of the dataset. When you save it, the header file is overwritten to add the new region information. (The raster data file itself is not changed.)

---

3 Click **Close** on the ER Mapper Message dialog to close it.

4 Click **Close** on the **Tools** palette dialog to close it.

You have now defined two named regions of interest, and can use a formula to display or process them separately from other portions of the dataset.

Turn off the Region Layer

Notice that when you closed the **Tools** dialog, the regions you drew are redisplayed along with the names next to them. The Region layer type can be used to display and edit the regions and region names defined in a dataset.

1 Right-click the layer labelled ‘Region Layer (Outline)’ and select **Turn Off**.

Enter a formula using the “inregion” function

1 Select the Pseudo layer labelled ‘Shading’ in the layer list.

2 In the process diagram, click the **Edit Formula**  button.

3 In the Generic formula window, edit the formula text to read:

```
if inregion(region1) then -input1 else null
```

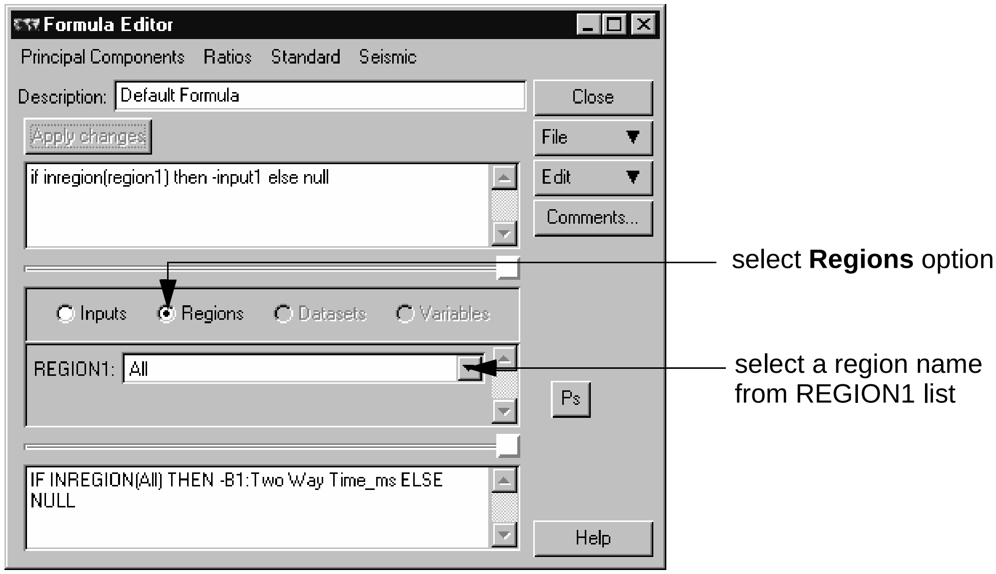
This formula tells ER Mapper “if the area of the image is within the boundaries defined by region1, then process it, else assign it null.”

4 Click the **Apply changes** button to verify the formula syntax.

The generic formula is converted to a specific formula. Also notice that the **Regions** button above the Relations window is now active.

Assign the “region1” argument to a region name

1 Above the Relations window, select the **Regions** option, then select one of your region names from the REGION1 list.



You have now selected your region name to be assigned to the “region1” argument in the generic formula.

Note: Every dataset has a default region named All which is simply the extents of the entire image.

Only the area inside the region name you selected is processed, and all other areas of the image are assigned null values (so they appear black). By using the inregion function in your formula, you have created a “mask” to process only data within a certain geographic part of the image.

Display the second region you defined

1 From the REGION1 drop-down list, select your second region name.

Only the area inside your second region is processed, and all other areas of the image are assigned null values (so they appear black). By using the drop-down list, you can easily change this formula to reference any region defined in a dataset.

Modify the formula to display areas outside your region

1 In the Generic formula window, edit the formula text to read as follows (add “not” before “inregion”):

```
if not inregion(region1) then -input1 else null
```

This formula tells ER Mapper “if the area of the image is *not* within the boundaries defined by region1, then process it, else assign it null.”

2 Click the **Apply changes** button to verify the formula syntax and process the image.

Only the area outside the region you defined is processed and displayed. You have inverted the region mask to process only data *outside* the region.

Revise the formula to display areas inside both regions

1 In the Generic formula window, edit the formula text to read as follows:

```
if inregion(r1) or inregion(r2) then -input1 else null
```

This formula uses two separate inregion statements that refer to two different generic regions. (Note that you can use “r2” as shorthand for “region2” as shown.)

2 Click the **Apply changes** button to verify the formula syntax.

The Relations window now shows drop-down lists for two regions–REGION1 and REGION2.

3 Select one of your regions from the REGION1 list, and select the other from the REGION2 list.

Only the areas inside the two regions you defined appear in the image.

4 Click **Close** on the **Formula Editor** dialog to close it.

5: Using more complex formulas

Objectives View algorithms used to create dip and azimuth images, to see how filters and formulas can be combined to create more complex derivative images.

Load the sample algorithm that generates a dip image

1 Click **Open**  on the main menu.

2 From the **Directories** menu, select the path ending with the text **\examples**.

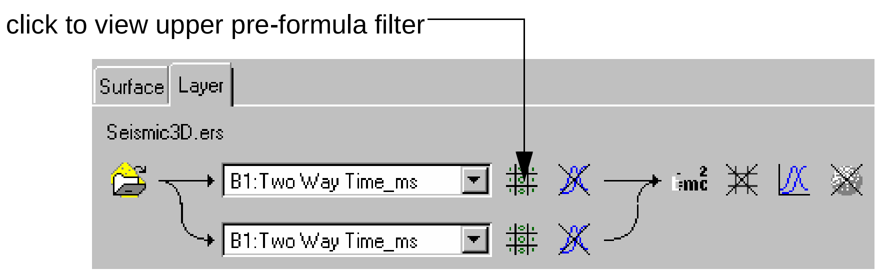
3 Open the ‘Applications\Oil_And_Gas_Exploration’ directory then double-click on the algorithm named ‘Seismic_Horizon_Dip.alg’ to open it.

Dip images (or dip attributes) highlight the major structural trends in a two-way time surface. The dip is the amount of inclination in the horizon surface. This algorithm uses a greyscale color table, so areas with strong dips (steep slopes) appear in darker greys. (Shaded time images with the sun positioned directly overhead create images with similar characteristics in ER Mapper, such as in the sample 'Seismic_Horizon_Realtime_Sun_Shade' algorithm.)

Examine the filters used to generate the dip image

Notice that this algorithm has two inputs in the process stream diagram leading into the formula. Both process the two-way time data (band 1) and each input stream has a pre-formula filter applied.

1 Click on the uppermost of the two pre-formula **Edit Filter (Kernel)** buttons.



The **Filter** dialog shows that the first input has an Easterly dip filter applied to it.

2 Click on the lower of the two pre-formula **Edit Filter (Kernel)** buttons.

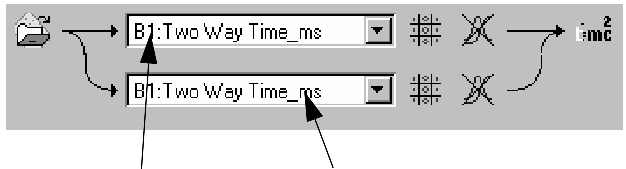
The **Filter** dialog changes to show the contents of that filter, a Northerly dip filter.

3 Click **Close** on the **Filter** dialog to close it.

Examine the formula used to process the two inputs

1 In the process diagram, click the **Edit Formula** button.

This formula operates on two inputs–values produced by the easterly dip filter (INPUT1) and northerly dip filter (INPUT2). It then combines them to create a true dip image. For each “input” number statement in your formula, you create a pre-formula input stream in the process diagram



-sqrt(I1 * I1 + I2 * I2) / 200

Dip images are useful for highlighting features such as the strike of faults, and let you view both sides of a fault. Dip images are sometimes used in an Intensity layer in colordrape algorithms in place of sun shaded two-way time.

Load the sample algorithm that generates an azimuth image

1 Click the **Open** main menu button.

2 Double-click on the algorithm ‘Seismic_Horizon_Azimuth.alg.’ to open it.

This image is displayed with the special ‘azimuth’ color table that has four colors (blue, yellow, white and black). Each color highlights a direction of inclination in the time surface from a local reference direction (north in this case). Azimuth images (or azimuth attributes) highlight the major structural relationships in a two-way time surface.

Notice that this algorithm also has two inputs in the process stream diagram leading into the formula. Both process the two-way time data (band 1) and apply the same Easterly and Northerly dip filters used to create the dip image.

3 Examine the formula used to process the two inputs.

Like dip, the azimuth formula operates on two inputs (values produced by the easterly and northerly dip filters), and combines them to create an image with four colors representing the four primary directions of inclination. White shows westerly inclination, black easterly, blue northerly, and yellow southerly. In particular the interrelationships of faults and direction of throw can be determined.

4 Click **Close** on the **Formula Editor** dialog.

Tip: To generate dip or azimuth images from your own two-way time datasets, simply load your dataset into the existing algorithm and choose the appropriate two-way time band.

Close all image windows and dialog boxes

1 Close all image windows using the window system controls:

- For Windows, click the  **Close** button in the upper-right window corner.

2 Click **Close** on the **Algorithm** window to close it.

Only the ER Mapper main menu should be open on the screen.

What you learned...

After completing these exercises, you know how to perform the following tasks in ER Mapper:

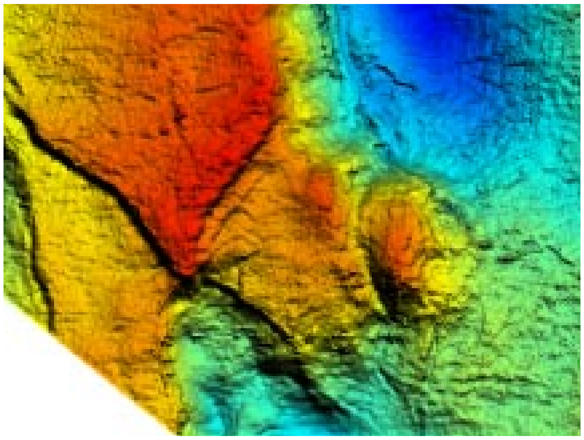
- Type and edit a formula, and test formula syntax
- Use generic references for inputs, variables, and regions in a formula
- Assign dataset bands, variables, and region names to generic references
- Create a thematic color overlay and specify transparency between surfaces
- Draw polygons to define regions of interest in an image
- Use formulas to process areas of interest (regions) in a dataset
- View formulas used to generate dip and azimuth images

9

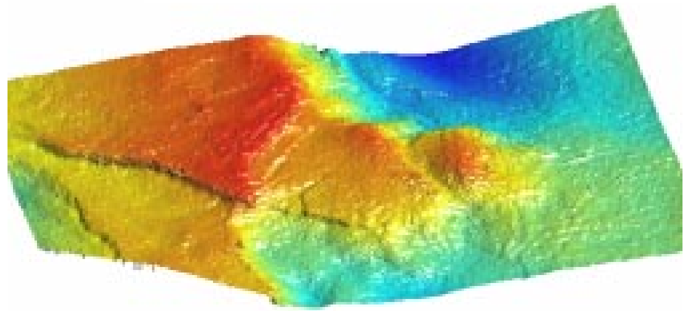
3-D perspective viewing

This chapter explains how to view and manipulate images in 3D perspective to gain a better understanding of terrain features, relationships, and other aspects of your data. ER Mapper lets you quickly change between 2D and 3D views of your data, stack multiple surfaces in a single view, set transparency between surfaces, and many other features.

About perspective viewing



Two-dimensional (planimetric) view



Three-dimensional perspective view

Viewing images in three-dimensional perspective is a valuable tool that helps increase understanding of features and relationships in datasets. Many types of earth science datasets can be integrated to create 3D scenes that show features and anomalies much more clearly than traditional two dimensional views. To create a 3D view, you simply add a Height layer to your 2D algorithm (such as two-way time), then change the View Mode to 3D perspective or 3D flythrough.

ER Mapper’s 3D viewing capabilities are extensive and easy to use, including:

- view any dataset in 3D, and quickly switch between 2D and 3D views
- use static 3D perspective or real-time “flythrough” modes
- stack multiple surfaces (for example, several time horizons) in a single view
- set transparency between surfaces to view underlying features
- incorporate vector data in 3D, such as interpreted faults or lease boundaries
- generate top quality, high resolution 3D hardcopy prints

Hands-on exercises

These exercises give you practice setting up algorithms for 3D viewing, and manipulating the images using the viewing and display controls in ER Mapper’s 3-D perspective viewer.

What you will learn...

After completing these exercises, you will know how to perform these tasks in ER Mapper:

- Prepare an algorithm for 3D viewing by adding a Height layer
- Change the viewpoint, zoom level, and other 3D view parameters

- Use the 3D Flythrough viewing mode
- Stack multiple surfaces in a 3D view and set surface offset and transparency
- Merge separate algorithms into surfaces in a single algorithm

Before you begin... Before beginning these exercises, make sure all ER Mapper image windows are closed. Only the ER Mapper main menu should be open on the screen.

1: 3D viewing basics

Objective Learn to prepare an algorithm for 3D viewing by adding a Height layer that contains the desired elevation data. Also learn to use 3D perspective view mode, and control the viewpoint and display parameters of the 3D scene.

Open a color two-way time algorithm

1 On the main menu, click the **Open** button.

An empty image window and the **Open** dialog box appear.

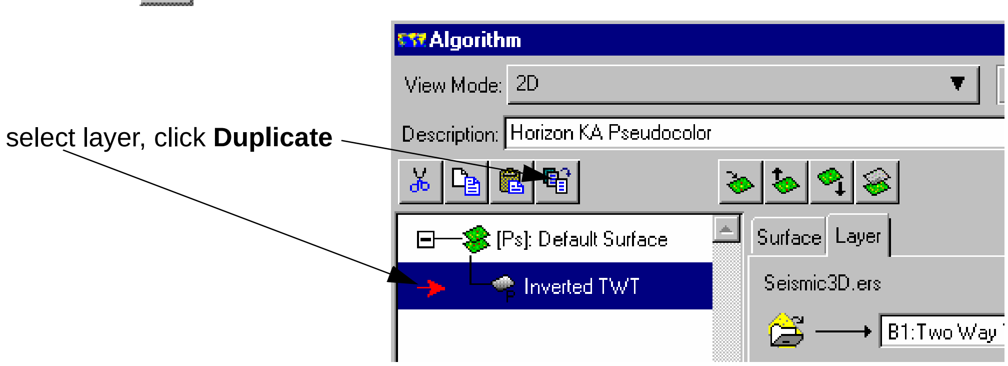
2 From the **Directories** menu, select the path ending with the text **\examples**.

3 In the ‘miscellaneous\tutorial’ directory, double-click on the algorithm ‘Horizon_KA_Pseudocolor.alg’ preceded by your initials to open it. (You created this algorithm in Chapter 3.)

This algorithm is a simple color display of the inverted time data. Reds correspond to structural highs, and blues to structural lows.

Duplicate the Pseudo layer to create a Height layer

1 On the **Algorithm** dialog, select the layer ‘Inverted TWT,’ then click the **Duplicate** button.



ER Mapper makes an exact copy of the layer below the original.

2 Right-click on the duplicate layer, and select **Height** from the short-cut menu.

The Pseudo layer changes to a Height layer. Your algorithm now contains two layers (Pseudo and Height), shown in the layer list on the left panel of the **Algorithm** dialog.

3 If necessary, change the label of the new layer to “Height”.

You have now duplicated the inverted two-way time layer and changed the layer type to create a elevation component for your algorithm. The layer is currently crossed out–this indicates that it is not active until you switch to 3D perspective View Mode.

Note: You could also use the **Edit** menu to add a new Height layer and load the dataset, but duplicating and changing is easier because the layer already contains the desired dataset, band, and invert formula.

Select 3D Perspective mode to view the image in 3D

1 From the ‘View Mode’ menu (on the **Algorithm** dialog), select **3D Perspective**.

ER Mapper displays a message that the image is being processed, then displays a 3D perspective view of the image in color. The message “Regenerating Terrain” appears in the image window as ER Mapper performs iterations to increase the resolution (detail) in the 3D image.

Tilt the image forward or backward

1 On the main menu, click the **Hand (Roam) Tool** button.

2 Point to lower edge of the time surface image and drag slightly downward.

The image moves into a more overhead view perspective, and regenerates detail when you release the mouse button.

3 Point to lower edge of the image and drag slightly upward.

The image moves into a flatter, side view perspective. Dragging the image up or down tilts the 3D model forward or backward (rotate it around its X axis).

Note: If you accidently change the 3D view too much, click the **3D View** tab in the **Algorithm** dialog, then click the **Reset View** button. This resets the the image to a standard default view.

Rotate the image around its center point

1 Point to lower edge of the image and drag slightly right.

The image rotates to the right around its center point.

2 Point to lower edge of the image and drag slightly left.

The image rotates to the left around its center point. Dragging the image left or right lets you view it from a side angle (rotate around the Z axis).

Zoom the image in and out

1 Point to the center of the image. Then press right mouse button and drag slightly upward.

As you drag, ER Mapper zooms out so the image redraws at a smaller size.

2 Point to the image center again, press right mouse button and drag slightly downward.

ER Mapper zooms in so the image redraws at a larger size.

Pressing the right mouse button and dragging up or left zooms the image out; dragging down or right zoom the image in.

3 Set the zoom extents for the image so it fills as much of the window as possible.

Rotate the image side to side

1 Point to the center of the image. First depress the left mouse button, then the right button (hold down both), then drag slightly to the right.

ER Mapper rotates the image to the right.

2 Point to the image center again, depress the left then the right mouse buttons, and drag slightly to the left.

The image rotates left. Pressing the left *then* the right mouse buttons and dragging left or right is how you rotate the image side to side (around its Y axis).

Pan (scroll) the image within the window

1 Point to the center of the image. First depress the right mouse button, then the left button (hold down both), then drag slightly upward.

ER Mapper pans (or scrolls) the image upward without changing the perspective.

2 Point to the image center again, depress the right then the left mouse buttons, and drag around inside the window.

The image repositions as you drag. Panning in 3D is useful when want to reposition the image in the window without changing the zoom factor or viewing perspective.

Summary of 3D movement procedures

- To tilt the image backward or forward, press left mouse button and drag toward the top of the image window (to tilt backward) or bottom (to tilt forward).
- To tilt the image side to side, press left mouse button followed by right mouse button and drag to the left (to tilt left) or right.
- To the zoom the image in or out, press right mouse button and drag toward the bottom of the image window (to zoom in) or top (to zoom out).
- To rotate the image around it center axis, press left mouse button and drag the left or right side of the image (or bounding box) toward the edge of the image window.
- To move the entire image within the window (without changing size or perspective), press right mouse button followed by left mouse button and drag to the desired location in the image window.

Change the color table for the 3D image

1 Select the **Surface** tab in the **Algorithm** dialog.

The **Surface** tab page now includes additional options for **Z scale** and **Z offset**. (These options only appear when 3D Perspective or 3D Flythrough is selected as the View Mode.)

2 From the **Color Table** drop-down menu, select **rainbow1**.

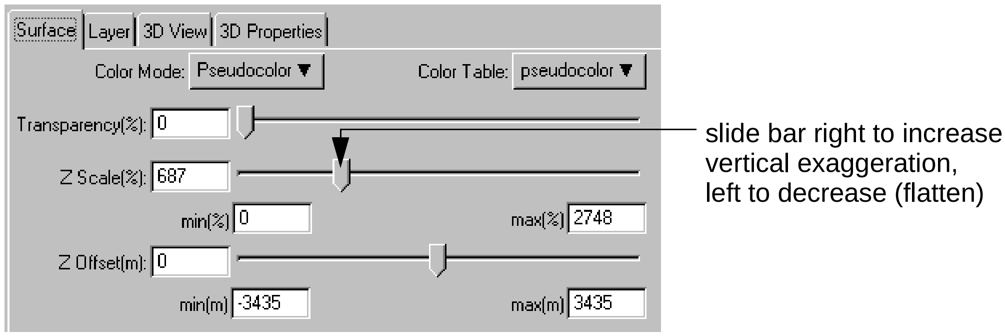
ER Mapper regenerates the 3D image using colors in the ‘rainbow1’ color table.

3 Click on the **Color Table** menu, then select **pseudocolor** again**.**

ER Mapper lets you change many parameters of the image display while viewing in 3D mode the same way you can when viewing the image in 2D. These include transforms, filters, formulas, sun angle shading, and more.

Increase the vertical exaggeration of the image

1 Move the **Z scale** slider bar slightly to the right.



The image redisplays with increased vertical exaggeration, so structural highs and lows in the image become more apparent.

2 Try different exaggerations by moving the the **Z scale** slider bar.

You can also type in an exact value in the **Z Scale%** field, and set new minimum and maximum values for the range.

Apply different rendering modes for the 3D image

1 Select the **3D View** tab in the **Algorithm** dialog.

The 3D View tab page provides draw mode, terrain detail, lighting, and other options. These setting affect the entire 3D image (which can contain multiple surfaces as you will see later).

2 From the **Draw Mode** drop-down list, select **WireFrame**.

ER Mapper redisplays the image as a mesh connected grid lines.

3 For **Draw Mode**, select **Textured**.

ER Mapper redisplays the image in blocks using a texture algorithm. (This mode requires the most calculations and may take some time for large images.)

4 For **Draw Mode**, select **Smooth Shaded** again.

ER Mapper redisplays the image with a smooth, solid fill. (Smooth shaded is generally the best choice for geophysical data such as time surfaces.)

Use the Lighting and Bounding Box options

1 Turn off the **Lighting** option.

The image redraws without illumination from a light source.

2 Turn the **Lights** option on again.

The image redraws with shading effects from a light source. (Lighting is recommended for geophysical datasets that have no natural shadowing.)

3 Turn on the **Bounding Box** option.

The image redraws with a bounding box surrounding it. The box shows the extents of the image in the X, Y and Z (vertical) directions.

4 Turn off the **Bounding Box** option.

Tip: The **Draw Mode** named **Auto** tells ER Mapper to choose a draw mode automatically based on the characteristics of your computer hardware. For seismic surfaces, Smooth Shaded mode with Lighting on is usually the best choice.

Adjust the Terrain Detail control

1 Move the **Terrain Detail** slider all the way to the left.

The image redraws with less detail in the time surface terrain.

2 Move the **Terrain Detail** slider to the right until the message below it reads "2 Mb of memory required for 255x255 terrain detail".

When the image finishes regenerating, it displays with increased terrain detail.

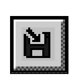
Terrain Detail refers to the resolution, or amount of detail, at which the image will be rendered. As you increase the detail, the rendering time and amount of system memory needed also increase. It is recommended that you start at low detail settings, then slowly increase the detail to get a more accurate, high resolution image.

Save the 3D algorithm

1 Adjust the viewpoint of the image to a pleasing position.

2 In the **Algorithm** dialog, change the **Description** field text to:

```
Horizon KA in 3D perspective
```

3 On the main menu, click the blue **Save As**  button.

4 From the **Directories** menu (on the **Save As...**dialog), select the path ending with the text **examples**.

5 Double-click on the 'miscellaneous\tutorial' directory to open it.

6 In the **Files of Type:** field, select 'ER Mapper Algorithm (.alg)'.

7 In the **Save As:** text field, enter a filename with your initials followed by the text 'Horizon_KA_3D.' Separate each word with an underscore (_). For example, if your initials are "TL," type in the name:

`TL_Horizon_KA_3D`

8 Click **OK** to save the algorithm.

Your 3D perspective algorithm is now saved to an algorithm file on disk. The next time you open it, the image automatically displays in 3D with the same viewpoint and rendering parameters.

2: 3D flythrough basics

Objective Learn to view an image in 3D Flythrough mode, and control the viewpoint and flight parameters.

In 3D Flythrough mode, it is as though the ground is stationary and you move around it, exploring the terrain. You depress the mouse button to begin your flight through the image, and the area where you position the mouse cursor controls the direction and speed of your flight.

Select 3D Flythrough mode to move through the image in 3D

1 From the 'View Mode' menu (on the **Algorithm** dialog), select **3D Flythrough**.

Change the viewing altitude

By default, you may initially see only part or an edge of the image. You can use the right mouse button to adjust your viewing altitude as desired.

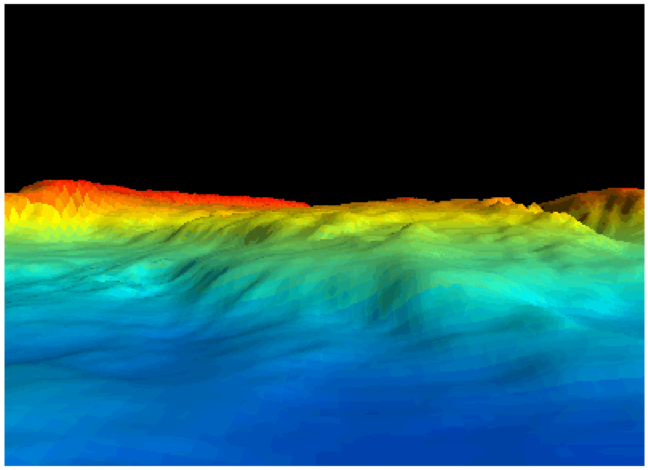
1 Point to the center of the image window and depress the right mouse button.

The mouse cursor changes to a double-headed arrow pointing up and down.

2 With the right button depressed, drag slightly upward.

Your altitude increases, so you look more down on the 3D image. Dragging up or down with the right button depressed lets you change viewing altitude.

3 Adjust your viewing altitude up (drag upward) or down (drag downward) until the image fills the lower portion of the window as shown below:



Fly through at different directions and speeds

To fly through the image, depress the left mouse button and point to an area of the image window to control the direction and speed of the flight. As you fly through the image, the terrain will appear to move in the opposite direction of your motion.

1 Point to the lower center of the image window and depress the left mouse button.

You fly backward away from the image.

2 Point to the upper center of the image and depress the left button.

You fly forward toward the image.

3 Point to the right center of the image and depress the left button.

You fly toward the right side of the 3D horizon.

4 Point to the left center and depress the left button.

You fly again toward the left side of the 3D horizon.

5 Point to the lower-right corner of the window and depress the left button.

You fly backward *and* to the right away from the 3D horizon.

6 Point slightly above the center point of the window and depress the left button.

You fly forward slowly into the 3D horizon. To fly slowly, point near the window center. To fly faster, point further out toward the window edges.

Summary of 3D Flythrough controls

- To fly forward or backward, press the left mouse button in the top half of the image window (to fly backward) or bottom half (to fly forward).
- To fly left or right, press the left mouse button in the left half of the image window (to fly left) or right half (to fly right).
- To the change viewing altitude, press the right mouse button and drag up or down.
- To control the speed of flight, point close to the center of the window for slow speed, and further out toward the window edges for progressively faster speeds.

3: Viewing multiple surfaces in 3D

Objective Learn to view two or more surfaces in 3D perspective, and control the offset, transparency, and other parameters of the view.

Up until now, you have created algorithms that contained only one surface. .In a sense, you can think of each surface as a separate image, or a separate view of your data. Since you use an algorithm to create a certain type of image, you can copy or merge different types of algorithms as separate surfaces in a single algorithm and stack the images in a single 3D view. Stacking multiple surfaces into a single 3D view can be an especially powerful feature for analyzing time surface and attribute data because it lets you quickly see relationships and anomalies.

Open the sample 3D horizon algorithm

1. On the main menu, click the **Open**  button.
2. From the **Directories** menu, select the **\examples** path.
3. In the ‘Applications\Oil_And_Gas_Exploration’ directory, double-click on the algorithm ‘Seismic_Horizon_3D.alg.’

   This algorithm is a simple color display of the inverted time data, and it is initially displayed in the 2D planimetric view.

Open another algorithm into the current one as a second surface

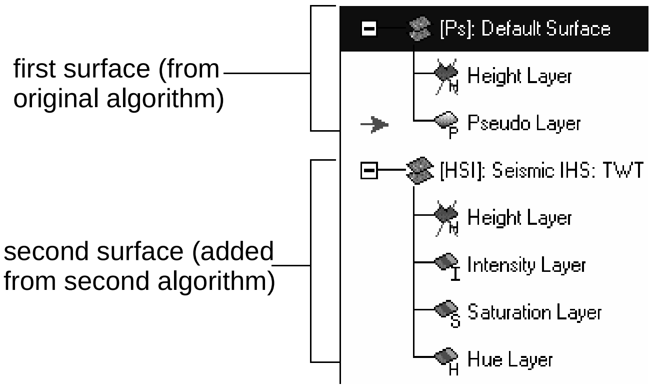
You can easily add a surface to an existing algorithm by opening another algorithm as a separate surface.

1. On the main menu, select **Open into New Surface** from the **File** menu.

   The **Open into New Surface** file chooser dialog opens.
2. From the **Directories** menu, select the **\examples** path.

3 In the ‘Applications\Oil_And_Gas_Exploration’ directory, double-click on the algorithm ‘Seismic_Horizon_3D_amplitude.alg.’

ER Mapper loads the four layers of the new algorithm into a second surface in the existing algorithm. Your algorithm now has two surfaces:



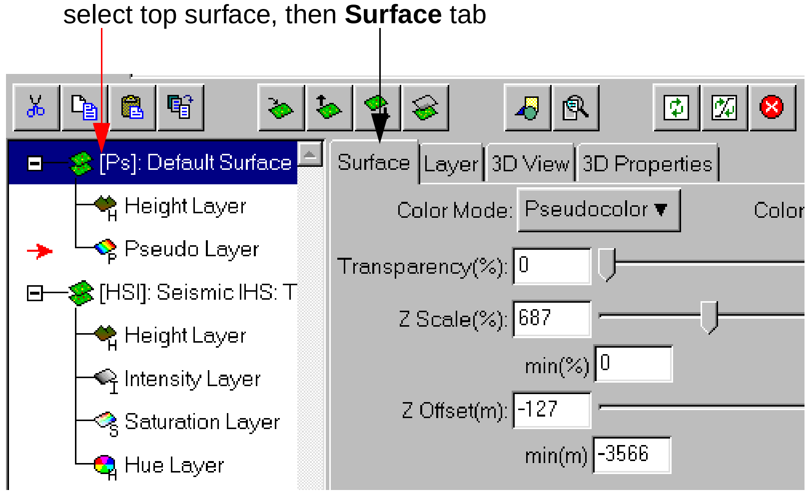
Notice that the two surfaces have different color modes (indicated in the surface name–[Ps] for Pseudocolor and [HSI] for Hue Saturation Intensity).

View the two surfaces in 3D perspective

1 On the **Algorithm** dialog, select **3D Perspective** from the **View Mode** menu.

Initially you see only the image created by one surface because both occupy the same 3D space. (This image is similar to the HSI image you created earlier where low amplitudes are shown as greyish colors and high amplitudes as vivid colors.)

2 On the **Algorithm** dialog, select the top surface ([Ps:Default Surface]) icon in the data structure diagram, then select the **Surface** tab.



3 Move the **Z Offset** slider to the right.

The image created by the top surface slides above the other image, so you now see two separate images.

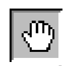
4 Move the **Z Offset** slider to the far left.

The top surface image slides underneath the other image. To move a surface relative to other surfaces in an algorithm, select the surface in the data structure diagram, then move the **Z Offset** slider.

5 Move the **Z Offset** slider right to raise the top surface above again.

Note: As you've seen, surfaces can be moved above or below each regardless of which surface is on top in the data structure diagram.

Change the transparency of the top surface

1 If needed, click the **Hand (Roam) Tool**  button and tilt the 3D image downward slightly until the top surface partially covers the one below.

2 Move the **Transparency** slider right to its midpoint.

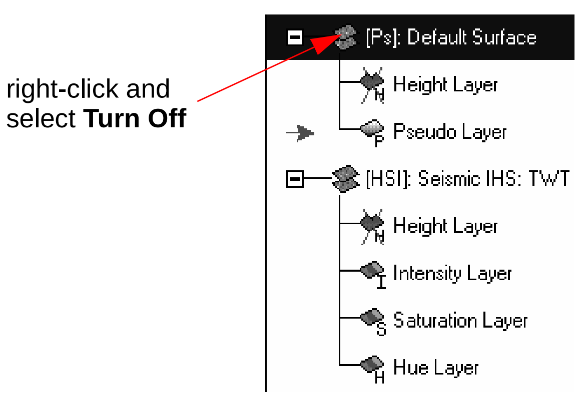
The top surface becomes semi-transparent, so the image below shows through.

The **Transparency** setting ranges from 0-100 to specify how the image is "blended" with other surfaces in the window. Zero displays the full image, 50 represents 50% transparency, and 100 makes the image invisible. Each surface can have it own transparency setting independent of others.

3 Move the **Transparency** slider to the far left to make the image fully visible.

Turn individual surfaces on and off

1 Right-click on the icon for the top surface, and select **Turn Off** from the short-cut menu.:



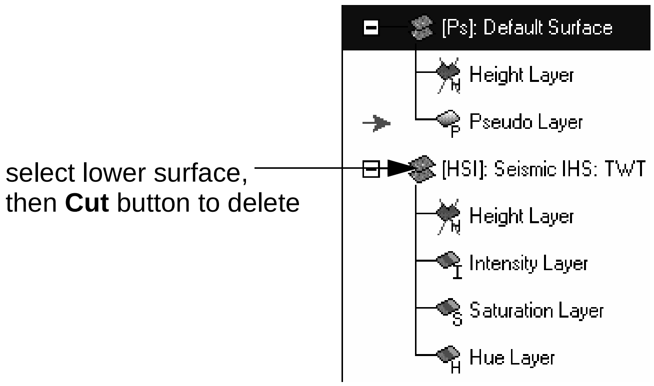
ER Mapper renders only the lower surface image.

2 Turn the top surface on again.

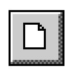
Both surfaces are again rendered.

Delete the lower surface from the algorithm

1 Select the lower surface in the data structure diagram, then click the **Cut**  button (above the diagram) to delete it.:



Open a second image window and algorithm

1 On the main menu, click the **New**  button.

Drag the new window down below the first one.

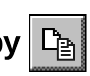
2 On the main menu, click the **Open**  button.

3 From the **Directories** menu, select the **\examples** path.

4 In the 'Applications\Oil_And_Gas_Exploration' directory, double-click on the algorithm 'Seismic_Horizon_3D_amplitude.alg.'

This is the same algorithm you viewed earlier, and it is initially displayed in the 2D planimetric view.

Copy and paste the surface into the first algorithm

1 Select the surface icon in the 2D algorithm, then click the **Copy**  button (above the data structure diagram).

The surface and its layers are copied into the clipboard.

2 Activate the 3D image window (click inside once).

3 Select the surface icon in the 3D algorithm, then click the **Paste** button.

The surface and its layers are pasted into the algorithm as a second surface.

Tip: To add surfaces to an existing algorithm, you can choose **Open into New Surface** from the **File** menu, or copy and paste surfaces between image windows. You can also copy and paste layers or surfaces within the same algorithm and modify them as desired, or a new empty surface and load datasets and specify processing as needed (using **Edit/Add New Surface** on the **Algorithm** dialog).

Close all image windows and dialog boxes

1 Close all image windows using the window system controls:

- For Windows, click the **Close** button in the upper-right window corner.

2 Click **Close** on the **Algorithm** window to close it.

Only the ER Mapper main menu should be open on the screen.

What you learned... After completing these exercises, you know how to perform the following tasks in ER Mapper:

- Prepare an algorithm for 3D viewing by adding a Height layer
- Change the viewpoint, zoom level, and other 3D view parameters
- Use the 3D Flythrough viewing mode
- Stack multiple surfaces in a 3D view and set surface offset and transparency
- Merge separate algorithms into surfaces in a single algorithm

General procedures and considerations

Notes about processing speed

ER Mapper can render very large image files quickly in 3D due to it's progressive rendering technology (i.e., starting with a low resolution view and progressively increasing detail with subsequent processing iterations). However, large files can take much longer to render, especially at higher Terrain Detail settings and using Textured draw mode. The speed at which the image renders in 3D is proportional to the processing speed of your computer and the 3D capabilities of your graphics display card.

ER Mapper’s 3D viewer features are designed take full advantage of the latest 3D graphics hardware rendering technologies. If your graphics card has 3D acceleration, images will render much faster when using ER Mapper’s 3D view modes. Be sure to turn on 3D acceleration if your graphics card supports it.

10

Geolinking images

This lesson explains how to use ER Mapper's geopositioning controls to display images with exact geographic extents, and use the Geolinking controls to geographically link two or more image windows. Geolinking is a powerful visualization technique that can help you analyze the same geographic area using a variety of different datasets or processing techniques (including 2D and 3D views).

About Geopositioning

In ER Mapper, the term "geopositioning" refers to specifying the position and extents of an image in geographic coordinate space. This can be useful for creating maps that cover an exact area, for example. Once an image is registered to a map projection, its display can be controlled using ER Mapper's geopositioning options. If the image is not rectified to a map projection, its extents can be controlled in terms of the row and column numbers of the dataset pixels.

About Geolinking

gIn ER Mapper, the term "geolinking" refers to linking two or more image windows in geographic coordinate space. This can be useful for viewing the same geographic area with different types of datasets or processing algorithms, and other applications. Once a dataset is registered to a map projection, it can be geographically linked with other image windows using ER Mapper's geolinking options. ER Mapper provides the following geolinking modes:

Window	Link two or more image windows to show the same geographic extents. Zooming or panning in one window triggers the same operation in other linked windows.
Screen	Link image windows to one "master" image that acts like a virtual map sheet on the screen. Linked windows display the geographic extents of their datasets relative to the master window.
Overview Zoom	Link image windows to one "master" overview control window. Defining a zoom box on the control window causes the other windows to zoom to the defined area.
Overview Roam	Link image windows to one "master" control window. Dragging the mouse to pan in the control window causes other windows to pan (or "roam") so their center point matches the mouse position in the control window.

The Algorithm Geoposition Extents Dialog Box

The **Algorithm Geoposition Extents** dialog box lets you precisely control the geographic extents and display resolution of images, and geographically link (geolink) two or more image windows together. The dialog has five tab pages that display different sets of functions as follows:

Zoom	Lets you use buttons to zoom or pan the image in the window by predefined amounts, or zoom to the extents of specific datasets, page extents, or page contents.
Geolink	Lets you set up geolinking between two or more image windows, and set the window size and display resolution of any image window.
Extents	Lets you view or specify geographic display extents for an image using Latitude/Longitude, Eastings/Northings, or dataset X (column) and Y (row) values.
Center	Lets you view or specify the center point for the image display using Latitude/Longitude, Eastings/Northings, or dataset X (column) and Y (row) values.
Mouse info	Shows quick help for using the mouse and keyboard keys to zoom and pan.

Hands-on exercises

These exercises introduce you to many of the basic features of the **Algorithm Geoposition Extents** dialog box and how to use them to control image display extents and set up geolinking between windows.

Note: The sample “Seismic3D” dataset used in the following exercises was previously rectified to a datum and map projection. If two or more datasets are to be displayed in separate windows and you wish to geolink them, the datasets must be rectified to a common datum and map projection.

What you will learn...

After completing these exercises, you will know how to perform the following tasks in ER Mapper:

- Display images with exact geographic extents and display resolutions
- Link image windows (2D and 3D) to show the same geographic extents
- Link image windows to a virtual map sheet window

Before you begin...

Before beginning these exercises, make sure all ER Mapper image windows are closed. Only the ER Mapper main menu should be open on the screen.

1: Geopositioning images

Objectives

Learn how to use the Geoposition controls to display an exact geographic area of an image, specify an image center point, and change window sizes and display resolutions.

Open the sample TWT colordrape algorithm

1 On the main menu, click the **Open**  button.

An image window and the **Open** dialog box appear.

2 From the **Directories** menu, select the **\examples** path.

3 In the directory named ‘Applications\Oil_And_Gas_Exploration,’ open the algorithm named ‘Seismic_Horizon_Colordrape.alg’

This algorithm displays two-way time in color draped over shaded two-way time to enhance structural features in the horizon.

Open the Algorithm Geoposition Extents Dialog Box

1 From the **View** menu, select **Geoposition...**.

The **Algorithm Geoposition Extents** dialog box appears. If needed, drag the dialog to the right side of the screen.

Tip: You can also open the **Algorithm Geoposition Extents** dialog by clicking the **Geoposition Window**  button on the **Algorithm** dialog.

Display an exact area by entering geographic values

1 .In the **Algorithm Geoposition Extents** dialog, select the **Extents** tab.

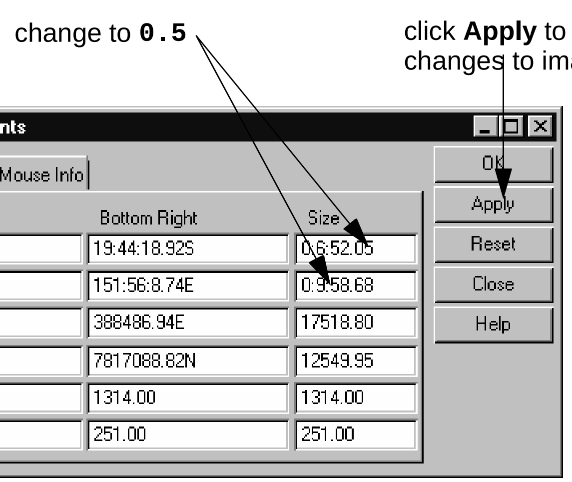
The contents of the dialog change to show a group of text fields for entering coordinate values. Note that the current dataset extents (shown in the Size fields) show approximately 6 minutes 52 seconds of Latitude and 9 minutes 58 seconds of Longitude.

2 Edit the value in the **Latitude** and **Longitude Size** field as follows.

Latitude/Size = **0:5**

Longitude/Size = **0:5**

3 Click the **Apply** button to apply your new values..



The image redisplays with your new image extents–an area exactly 5 minutes of Latitude by 5 minutes of Longitude. (By default ER Mapper keeps the same upper-left coordinate, so you “zoomed” on the upper-left portion of the dataset.)

Display an exact part of the dataset by entering cell values

1 Edit the contents of the four fields as listed below to display an exact portion of the dataset using cell X (column) and cell Y (row) values:

Cell X/Top Left = **500**

Cell Y/Top Left = **100**

Cell X/Bottom Right = **1000**

Cell Y/Bottom Right = **200**

2 Click the **Apply** button to apply your new values.

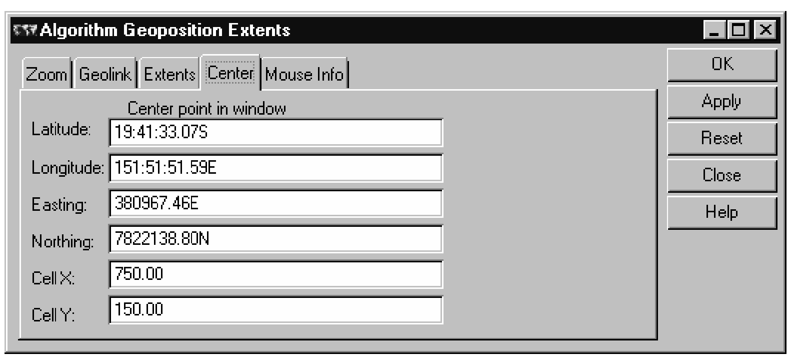
ER Mapper reprocesses the algorithm with your new dataset extents and displays an area 500 pixels (cells) wide by 100 pixels in height. The origin (upper-left corner) is at dataset cell column (X) 500 and dataset cell row (Y) 100.

Note: This dataset has greater cell resolution in the X (horizontal) direction than the Y (vertical) direction, so these extents yield an approximately square image.

Center the image on an exact point

1 In the **Algorithm Geoposition Extents** dialog, select the **Center** tab..

The contents of the dialog change to show a text fields for entering the center point of the image in geographic or dataset X and Y values.



2 .Edit the value in the **Easting** and **Northing** field values as follows:

Easting = **`376700`**

Northing = **`7822000`**

(ER Mapper adds the “E” and “N” to the string automatically.)

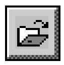
3 Click the **Apply** button to apply your new center point values.

ER Mapper reprocesses the algorithm and centers the image on the location you defined (the tip of the V-shaped uplifted fault block). Centering can be useful for viewing the exact center point of an image, or for centering on an exact feature of interest or geographic location for map production.

2: Linking windows to common extents

Objectives Learn to link image windows in Geolink “Window” mode, so each linked window displays the same geographic extents.

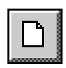
Open the amplitude colordrape algorithm

1 Click the **Open**  button on the main menu.

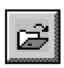
2 Open the algorithm ’Seismic_Horizon_Dip.alg.’

This algorithm processes the two-way time data to derive an image showing the dip of the time surface (dark greys are steep slopes).

Open a second window and algorithm

1 On the main menu, click the **New**  button.

A second image window opens on the screen.

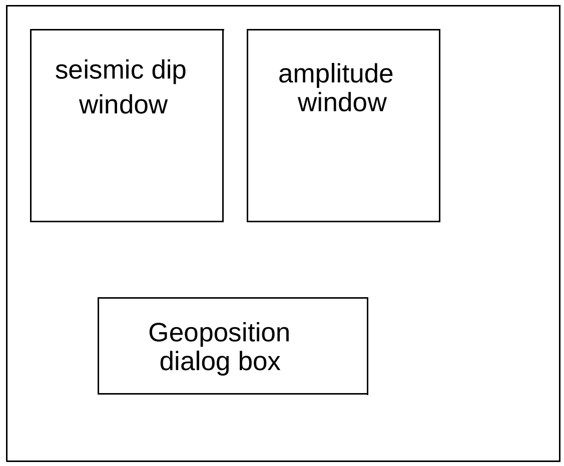
2 Click the **Open**  button on the main menu.

3 Open the algorithm ’Seismic_Horizon_twt_amplitude.alg.’

This algorithm drapes amplitude in color over the shaded two-way time. Reds and yellows indicate strong amplitudes, blues indicate weak amplitudes.

Resize and position the two windows

1 Reposition the two windows as shown in the following diagram, and resize them if needed. (You must able to view the contents of each window clearly.)



You should now have two image windows of about the same size next to each other in the upper part of the screen, and **Geoposition** dialog below them.

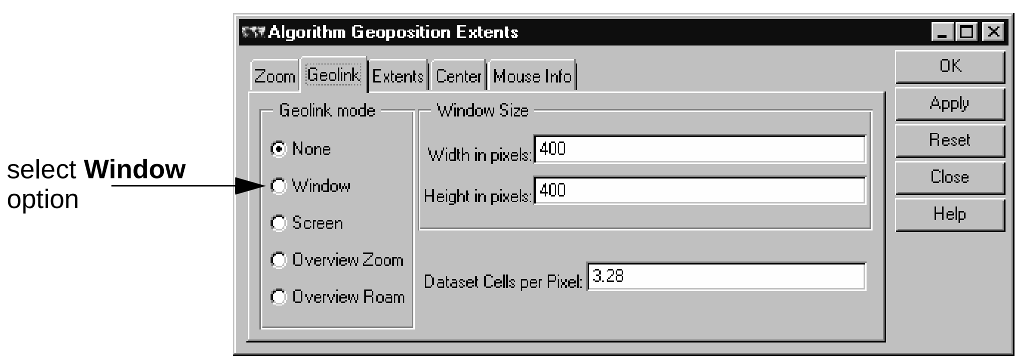
Set the Dip image window to Geolink Window mode

1 Click inside the 'Seismic_Horizon_Dip' image window to activate it (three stars (***) should appear next to the title).

2 On the **Algorithm Geoposition Extents** dialog, select the **Geolink** tab.

The contents of the dialog show 'Geolink mode' option buttons on the left side.

3 Select the **Window** option button, then click the **Apply** button.



The title bar of the 'Seismic_Horizon_Dip' image window indicates that it is now set to "WINDOW" geolink mode.

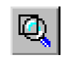
Set the amplitude image window to Geolink Window mode

1 Click once inside the ‘Seismic_Horizon_twt_amplitude’ image window to activate it.

2 In the **Geoposition** dialog, select the **Window** option, then click **Apply**.

The amplitude image is now also set to geolink Window mode. Since the two windows are linked, any changes you make to the extents in one window will be automatically duplicated in the other.

Zoom and pan in both images

1 On the main menu, click the **Zoom Box Tool**  button.

The mouse is now set to perform zoom and pan functions in image windows.

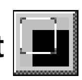
2 Click inside the ‘Seismic_Horizon_Dip’ image window to activate it, then drag a zoom box to magnify the central portion of the image.

The images in both windows automatically zoom to share the same extents.

3 Click once inside the ‘Seismic_Horizon_twt_amplitude’ image window to activate it, then click on the right part of the image to pan to the right.

Both images pan to the right.

4 On the **Algorithm Geoposition Extents** dialog, select the **Zoom** tab.

5 Under ‘Pan,’ click the **Pan upper-left**  button.

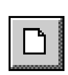
Both images pan 50% to the upper-left (the previous center point is now on the lower-right corner of the image).

6 Under ‘Set extents to,’ click the **Raster Datasets** button.

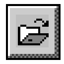
Both zoom out to their full extents (the same since they both use the same dataset).

Tip: Geolink Window mode is a helpful way to view the same geographic area of the a single dataset processed in different ways (as shown here), or entirely different datasets that share the same map projection. You can link as many image windows as desired. The order in which windows are linked does not matter.

Add a third window and 3D image

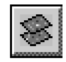
1 On the main menu, click the **New**  button.

A third image window opens, drag it to an open area. (Resize the windows to make them smaller if needed.)

2 Click the **Open**  button on the main menu.

3 Open the algorithm ’Seismic_Horizon_3D.alg.’

This algorithm shows two-way time in color. It also contains a Height layer so you can view it in 3D perspective.

4 On the main menu, click the **Edit Algorithm**  button.

5 On the **Algorithm** dialog, select **3D Perspective** from the **View Mode** menu.

The image redisplays in 3D perspective.

6 Click **Close** on the **Algorithm** dialog.

7 If desired, manipulate the 3D view to get a better perspective.

8 On the **Algorithm Geoposition Extents** dialog, select the **Geolink** tab.

9 In the **Geoposition** dialog, select the **Window** option, then click **Apply**.

The 3D view image is now also linked with the other two in Window mode.

Zoom and pan in all three images

1 Click inside the ‘Seismic_Horizon_Dip’ image window to activate it, then drag a zoom box to magnify part of the image.

The portion of the horizon shown in the 3D view is “trimmed” to match the extents of the 2D views. (Its viewing perspective does not change.)

2 Zoom or pan to other areas in either the ‘Seismic_Horizon_twt_amplitude’ or ‘Seismic_Horizon_Dip’ image windows.

The extents of the 3D view change to match them.

Note: As shown, image windows displaying 3D views can be controlled by zoom and pan operations in 2D windows geolinked in “Window” mode. However, zooming or panning in the 3D window does not affect images in 2D windows.

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3 Select the **Zoom** tab (in the **Geoposition** dialog), then click the **Raster Datasets** button.

All three windows zoom out to display the full dataset extents.

Close the 3D view image window

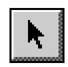
1 Close the ‘Seismic_Horizon_3D’ image using the window system controls:

- For Windows, click the  **Close** button in the upper-right window corner.

3: Linking windows to the screen

Objectives Learn to link image windows in Geolink “Screen” mode, so a “master” image window becomes a virtual map sheet on the screen. The screen assumes the coordinate space of the master image window. Other windows subsequently set the “screen” mode display the geographic extents of their datasets relative to the master window.

.Set both windows to Geolink None mode

1 On the main menu, click the **Pointer Tool**  toolbar button.

The mouse is now set as a pointer. (This prevents accidentally panning or zooming when you click inside a window to activate it.)

2 On the **Algorithm Geoposition Extents** dialog, select the **Geolink** tab.

3 Click inside the ‘Seismic_Horizon_Dip’ image window to activate it.

4 In the **Geoposition** dialog, select the **None** option button, then click **Apply**.

The words “WINDOW:geolink” disappear from the window title, indicating that the window is no longer geolinked.

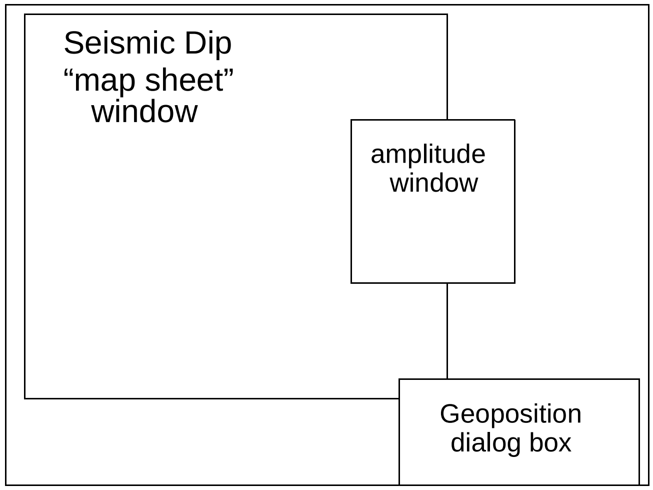
5 Click inside the ‘Seismic_Horizon_twt_amplitude’ image window to activate it.

6 Select the **None** option button, then click **Apply**.

Tip: Image windows can also be geolinked and unlinked using the **View/Quick Zoom** menu on the main ER Mapper main menu.

Resize and position the two windows

1 Resize and reposition the two windows as shown in the following diagram. (You must be able to view the contents of each window clearly.)



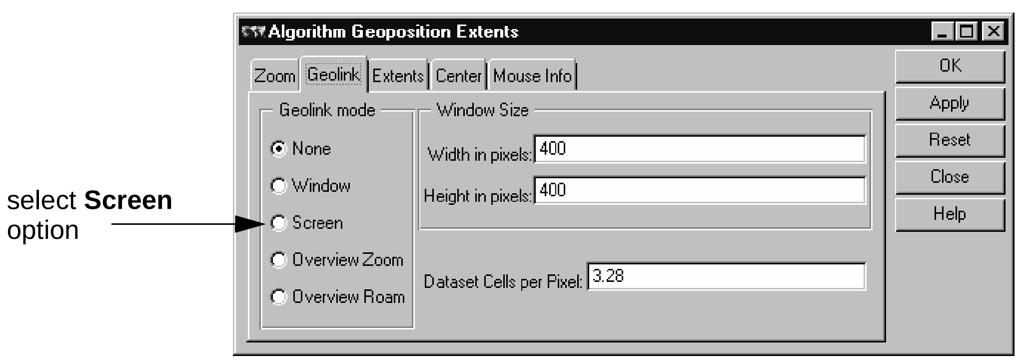
2 Right-click over each image and select **Zoom to All Datasets** from the **Quick Zoom** menu.

You should now have a smaller ‘Seismic_Horizon_twt_amplitude’ window partially overlaying the larger ‘Seismic_Horizon_Dip’ window, and the **Geoposition** dialog in the lower-right corner.

Set the large Dip image window to Geolink Screen mode

1 Click inside the large ‘Seismic_Horizon_Dip’ image window to activate it.

2 In the **Geoposition** dialog, select the **Screen** option button.



3 Click the **Apply** button.

The window title indicates that it is now set to “SCREEN” geolink mode. This is the first window assigned to Screen mode, it becomes the “master” window and the entire screen assumes its coordinate space (shown clearly later).

Set the Amplitude window to Geolink Screen mode

1 Click inside the 'Seismic_Horizon_twt_amplitude' window to activate it.

2 Select the **Screen** option button.

3 Click the **Apply** button.

The 'Seismic_Horizon_twt_amplitude' window is now linked to the "master" window, and it automatically redraws to show its portion of the larger "map sheet" window.

Move the Amplitude window over the Dip master window

1 Drag the smaller 'Seismic_Horizon_twt_amplitude' window by its title bar to the left side of the larger window.

The amplitude image automatically redraws to show its new extents in the context of the Dip "map sheet" window. By comparing the two images, you can clearly see how variations in event amplitude correspond to structural features described by the two-way time dip image.

Tip: It helps to think of the larger "master" window as a paper map sheet. Any other windows moved on top of the map sheet act like a viewing port into a different dataset or processing technique over the same geographic area.

Zoom in on the Amplitude window

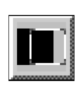
1 On the main menu, click the **Zoom Box Tool**  button.

The mouse is again set to perform zoom and pan functions in image windows.

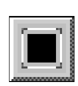
2 Inside the 'Seismic_Horizon_twt_amplitude' window, drag a zoom box to magnify part of the image.

The images in both windows automatically zoom in the same amount.

3 On the **Algorithm Geoposition Extents** dialog, select the **Zoom** tab.

4 Under **Pan**, click the **Pan right**  button.

Both images pan 50% to the right (the previous image center point is now on the left side of the both windows).

5 Under **Zoom**, click the **Zoom out 50%**  button.

Both images zoom out 50% from their previous magnification level.

6 Experiment by moving or resizing the smaller window to view the amplitude data over corresponding areas of the seismic dip image.

Note: ER Mapper also two other geolinking modes named Overview Zoom and Overview Roam. These are designed to allow detailed analysis of small areas in zoom windows by controlling interactive image zooming and panning functions from a master window. See the *ER Mapper Tutorial* and *User Guide* manuals for details.

Close all image windows and the Geoposition window

1 Close all image windows using the window system controls:

- For Windows, click the  **Close** button in the upper-right window corner.

2 Click **Close** on the **Algorithm Geoposition Extents** dialog to close it.

Only the ER Mapper main menu is now open.

What you learned...

After completing these exercises, you know how to perform the following tasks in ER Mapper:

- Display images with exact geographic extents and display resolutions
- Link image windows (2D and 3D) to show the same geographic extents
- Link image windows to a virtual map sheet window

11

Algorithm wizards

This chapter shows you how to use ER Mapper's toolbars and wizards to automate the creation of many types of common image processing algorithms. Using toolbars and wizards greatly increases the speed and efficiency with which you use ER Mapper.

About algorithm toolbars and wizards

Up until now, you have learned to develop your own algorithms by loading datasets, creating algorithm layers, and modifying the process diagram in each layer. This is necessary so that you understand how ER Mapper works and how to apply the different types of processing functions. You have also used the Standard and Common Function toolbars on the main ER Mapper menu to open image windows, save algorithms, and other simple tasks (as an alternative to accessing those functions from menus).

However, ER Mapper also provides other toolbars that let you develop algorithms quickly and easily with a few mouse clicks. For example, if you want to create a greyscale algorithm, you can just click the **Image Display and Mosaic Wizard** toolbar button, select the desired dataset, and let ER Mapper do the rest.
ER Mapper also provides image "wizards" that guide you step-by-step through the process of creating specific types of algorithms.

Under the **Toolbar** menu, ER Mapper provides several toolbars to automate specific tasks and image processing techniques and applications. In this case, you will using the toolbars named “Oil and Gas” and “Geophysics.”

The toolbar functions are implemented using scripts written in ER Mapper’s batch scripting language. When you initiate the selected toolbar function, ER Mapper runs the associated batch script in the background and performs the desired tasks.

Note: With a bit of simple programming knowledge, you can also create your own batch scripts and wizards. This gives you fast access to site specific functions and processing techniques, and also lets you give less sophisticated users access to these functions without the need for them to understand the processing in detail. (Use the existing scripts and *Customizing ER Mapper* documentation as a guide for creating your own.)

Hands-on exercises

These exercises show you how to use ER Mapper toolbar buttons and image wizards to automate the creation of several types of common algorithms.

What you will learn...

After completing these exercises, you can perform the following tasks in ER Mapper:

- Open a dataset directly (ER Mapper creates a simple display algorithm)
- Use toolbar buttons to create pseudocolor and colordrape algorithms
- Use toolbars to create specialized processing algorithms
- Use image wizards to create customized algorithms

Before you begin...

Before beginning these exercises, make sure all ER Mapper image windows are closed. Only the ER Mapper main menu should be open on the screen.

1: Open a dataset directly

Objectives Learn to open a dataset directly and have ER Mapper automatically create a simple display algorithm for it.

Up until now, you have created algorithms by loading a dataset into the **Algorithm** dialog box and setting appropriate processing options. For fast viewing, however, you can simply open the dataset directly and have ER Mapper automatically create a simple algorithm based on the number of bands in the dataset, cell size and other characteristics.

Open the sample Seismic3D dataset

1 On the main menu, click the **Open**  button.

An image window and the **Open** dialog box appear.

2 From the **Directories** menu (on the **Open** dialog), select the **\examples** path.

3 Double-click on the 'Shared_Data' directory to open it.

The **Open** dialog can be set to display files with certain extensions, or all files. In previous exercises, you have using the **Open** dialog to load algorithm (.alg) files.

4 From the **Files of Type** drop-down list, select 'ER Mapper Raster Dataset (.ers)**'.**

The contents now show only files with ".ers" file extensions. There are other raster files on disk, or ER Mapper Virtual Datasets (you will learn about these later).

5 Double-click on the 'Seismic3D.ers' dataset.

ER Mapper automatically loads the dataset and creates a simple greyscale algorithm. This procedure is a fast way to view any geophysical dataset that has only one or two bands (such as a seismic grid or aeromagnetics image).

Note: If the dataset has three or more bands, ER Mapper creates an RGB algorithm for it. This is typically used to display satellite images and airphotos.

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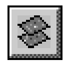
6 Select **Close** from the **File** menu to close the image window.

2: Using the Oil and Gas toolbar

Objectives Learn to use the Oil and Gas toolbar buttons to have ER Mapper automatically create Pseudocolor, colordrape, and other algorithms for you.

Open an image window and Algorithm window

1 Click the **Edit Algorithm**  button on the main menu.

ER Mapper opens a new image window and the **Algorithm** window.

Display the Oil and Gas toolbar

1 From the **Toolbars** menu (on the main menu), select **Oil and Gas**.

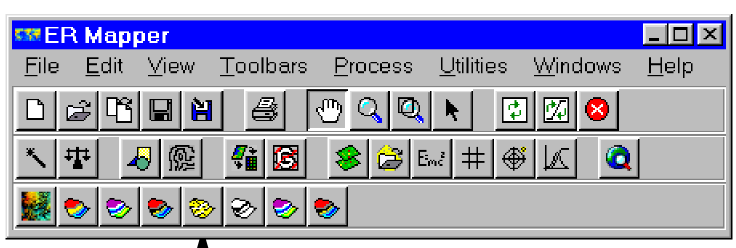
ER Mapper adds a third row of toolbar buttons to the main menu. These buttons are designed to help you create algorithms with processing techniques specific to Oil and Gas seismic applications.

2 Point to the buttons on the Oil and Gas toolbar.

A “tooltip” description of each button’s function displays next to it.

Create a seismic azimuth algorithm

1 On the Oil and Gas toolbar, click the **Horizon Azimuth**  button (the yellow horizon).



The **Select a Dataset** dialog box appears to prompt you for a dataset.

2 On the **Select a Dataset** dialog, click the **Load dataset** button.

3 From the **Directories** menu on the **Select File** dialog, select the path ending with **\examples**.

4 Double-click on the directory 'Shared_Data' to open it, then double-click on the 'Seismic3D.ers' dataset to load it.

5 Click the **OK** button on the **Select a Dataset** dialog.

ER Mapper executes a batch script that loads the Seismic3D dataset into the Pseudocolor layer of the algorithm, sets the Color Table to 'azimuth' and adds the appropriate filters and azimuth formula in the process diagram.

Convert the azimuth image to a realtime shade image

1 On the Oil and Gas toolbar, click the **Horizon RTS** button.

Horizon RTS
button

ER Mapper executes a batch script that deletes the filters and formula used for the azimuth algorithm, sets the Color Table to 'greyscale' and turns on sun angle shading for the layer. It also opens the **Edit Sun Angle** dialog automatically so you are ready to change the sun angle as desired.

2 Experiment with different sun angles (if desired).

As you can see, using automatic toolbar functions can save time for quickly viewing datasets in many different ways. (Note that you may need to adjust the default algorithms they create to match bands or other characteristics of your own datasets.)

3 From the **Toolbars** menu (on the main menu), select **Oil and Gas**.

The Oil and Gas toolbar is hidden (only the Standard and Common Functions toolbars should be displayed).

Note: The Pseudocolor and Colordrape toolbar buttons on the Oil and Gas toolbar are specialized for processing geophysical data, so they behave differently than the similar looking ones on the Common Functions toolbar. For seismic data you should always use the buttons on the Oil and Gas toolbar.

3: Using an image wizard

Objectives

Learn to use an image wizard to have ER Mapper automatically guide you through the process of creating several types of algorithms for geophysical data such as interpreted seismic.

Image wizards are more sophisticated versions of the toolbar buttons you used previously. One wizard can be used to create many different types of algorithms depending upon the options you choose as you proceed.

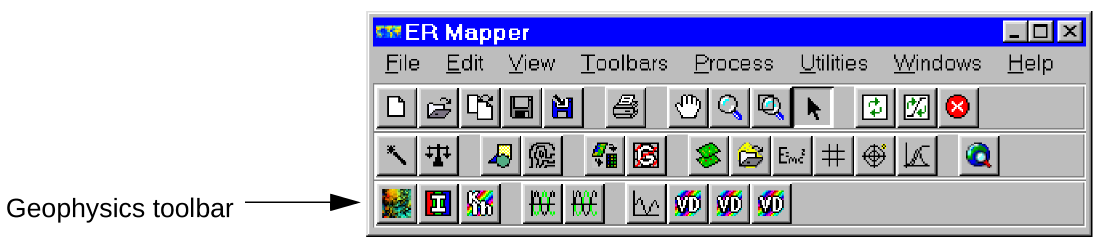
Close image windows and dialogs

1. Close the image window by selecting **Close** from the **File** menu.
2. Click **Close** on the **Edit Sun Angle** and **Algorithm** dialogs to close them.

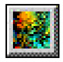
Display the Geophysics toolbar

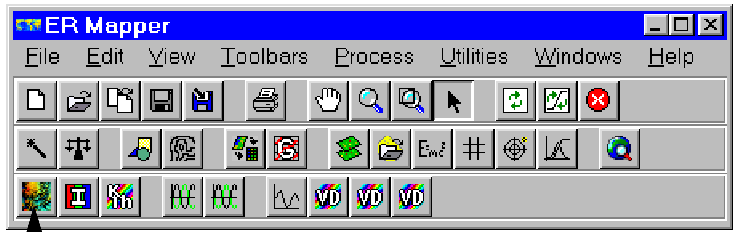
1. From the **Toolbars** menu (on the main menu), select **Geophysics**.

ER Mapper adds a third row of toolbar buttons to the main menu. These buttons are designed to help you create common types of algorithms used to enhance geophysical data (seismic, magnetics, gravity and so on).



Start up the Geophysical Images wizard

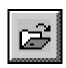
1 On the Geophysics toolbar, click the **Common Geophysical Images Wizard**  button.



ER Mapper opens the **Common Geophysical Images Wizard** dialog.

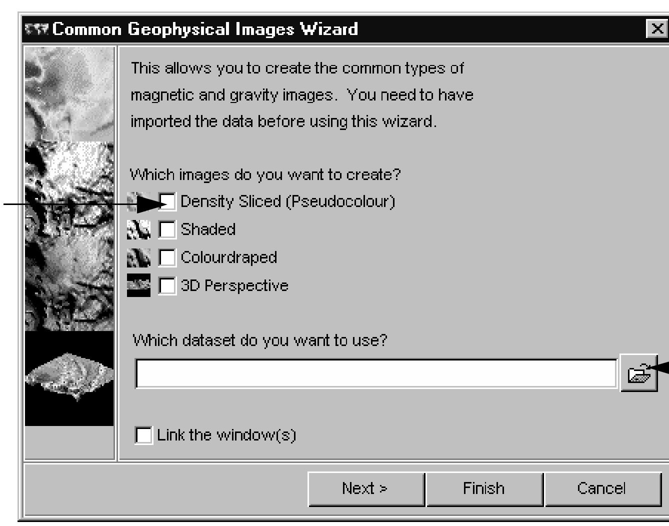
Create a pseudocolor two-way time image

1 On the **Common Geophysical Images Wizard** dialog, select the 'Density sliced (pseudocolor)' option box.

2 Click the **Load dataset**  button.

3 From the **Directories** menu, select the **\examples** path.

4 Double-click on the directory Shared_Data' to open it, then double-click on the 'Seismic3D.ers' dataset to load it.



5 Click the **Next>** button.

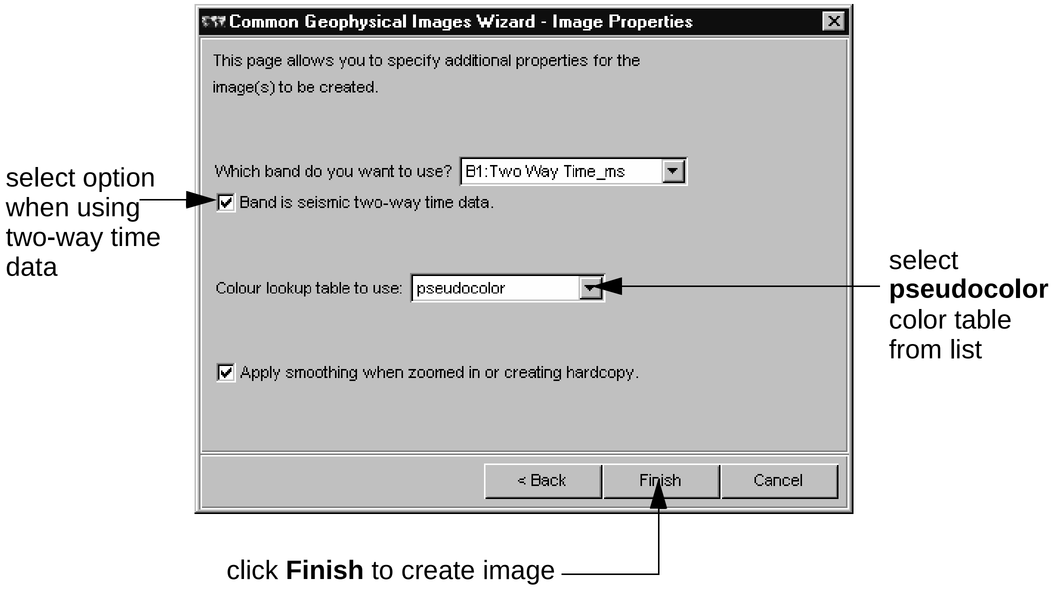
ER Mapper displays the **Image Properties** panel in the wizard to ask for additional information.

Select additional properties and create the image

1 Select the ‘Band is seismic two-way time data’ option box.

This tells ER Mapper that the selected band is two-way time, so it will the invert the data by adding the “-input1” formula to the algorithm. (If you were displaying amplitude or other attributes you would not usually do this.)

2 From the ‘Color lookup table to use’ list, select **pseudocolor**.



3 Click the **Finish** button to create the image.

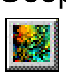
ER Mapper opens an image window, creates the algorithm according to your input, then displays the image. At the end, it opens the **Transform** dialog to let you make any desired color mapping enhancements.

Close the Transform dialog and image window

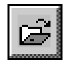
1 Click **Close** from the **Transform** dialog.

2 Select **Close** from the **File** menu to close the image window.

Use the wizard to create linked colordrape and 3D images

1 On the Geophysics toolbar, click the **Common Geophysical Images Wizard**  button again

2 On the **Common Geophysical Images Wizard** dialog, select both the ‘Colourdraped’ and ‘3D Perspective’ options.

3 Click the **Load dataset**  button, then select the **\examples** path from the **Directories** menu (on the **Select File** dialog).

4 Double-click on the directory ‘Shared_Data’ to open it, then double-click on the ‘Seismic3D.ers’ dataset to load it.

5 Select the ‘Link the windows’ option.

This tells ER Mapper to geolink the two image windows together.

6 Click the **Next>** button.

7 Select the ‘Band is seismic two-way time data’ option box.

8 From the ‘Color lookup table to use’ list, select **pseudocolor**.

9 Click the **Finish** button.

ER Mapper first opens an image window and creates a colordrape image, then opens a second window and creates 3D perspective image of the same dataset. ER Mapper has done most of the work for you, now you can “fine tune” the images as you desire. Also notice that the two image windows are automatically geolinked in “Window” mode, so any zoom or pan operation performed in the 2D window is replicated in the 3D window.

As you can see, using image wizards can greatly increase the speed and efficiency with which you use ER Mapper.

Hide the Geophysics toolbar again

1 From the **Toolbars** menu (on the main menu), select **Geophysics**.

The Geophysics toolbar is hidden (only the Standard and Common Functions toolbars should be displayed).

Close both image windows and the Algorithm dialog

1 Close both image windows using the window system controls or by selecting **Close** from the **File** menu.

Only the ER Mapper main menu is now open.

What you learned...

After completing these exercises, you know how to perform the following tasks in ER Mapper:

- Open a dataset directly (ER Mapper creates a simple display algorithm)
- Use toolbar buttons to create pseudocolor and colordrape algorithms
- Use toolbars to create specialized processing algorithms
- Use image wizards to create customized algorithms

12

Saving images to disk

This chapter explains how to send the processing results of an algorithm to a raster output file on disk, and calculate and view statistics for the new file.

About Writing Images to Disk

Up until this point you have not needed to write image files to disk since you have been doing all processing interactively directly to the display (using ER Mapper algorithms). In general, processing your data interactively to the display is preferred since it is faster, easier, and takes full advantage ER Mapper's flexibility and the processing power of your computer.

However, there are times when you may want to save your processing results to a separate raster dataset file on disk:

- If you are using very complex, compute-intensive algorithms, you may want to write a processed copy of the data to disk at some point so it does not need to be recomputed each time.
- Saving your processing as an image file is sometimes necessary if you want to use the processed image in another software application.

- Merging multiple datasets into one dataset, for example, merge three horizons stored as separate files into a single file with three bands. This speeds access to the data and lets you use features like Traverse to profile all three horizons at once. (See the Notes section at the end of this chapter for more information.)

  To have ER Mapper send the output from an algorithm to a disk file, set up your algorithm with the appropriate layers and processing, then select **Save As...** from the **File** menu or click the **Save As** toolbar button.

  Raster layers in the **Algorithm** dialog can be combined when output, or they can be output to separate bands in the output dataset file. The layers in the **Algorithm** dialog are processed as follows:

- Non-Classification raster layers with no layer description or the same layer description are combined upon output.
- Non-Classification raster layers with unique layer descriptions are written as a separate band in the output dataset.
- All Classification raster layers are processed into a single band in the output dataset.

  You can save the image in a number of different formats. These are:

- ER Mapper Raster Dataset (.ers)
- ECW v2 Compressed (.ecw)
- ESRI BIL and GeoSPOT (.hdr)
- Windows Bitmap (.bmp)
- GeoTIFF (TIFF)
- JPEG (.jpg)
- UDF (.ers)

  The format you use depends on what you are going to do with the image. The ER Mapper Raster Dataset has the header file which contains georeferencing and statistical information about the image. The ER Mapper ECW compressed format also has a separate header file which can be discarded. This information will not be saved with the image if you save another format.

Note: There are a number of free plugins available that allow you open images in ER Mapper native formats in other GIS applications.

Hands-on exercises

This exercise demonstrates the procedure for sending algorithm output to a file on disk, and to calculate and view datasets statistics.

What you will learn...

After completing these exercises, you will know how to perform the following tasks in ER Mapper:

- Create an algorithm to send output to a raster dataset on disk
- Specify output dataset parameters and write the dataset to disk
- Calculate and view statistics for the new dataset
- View information about the output dataset

Before you begin...

Before beginning these exercises, make sure all ER Mapper image windows are closed. Only the ER Mapper main menu should be open on the screen.

1: Saving a dataset to disk

Objectives

Learn how to send algorithm processing output to a raster dataset on disk. In this case, you will create a subset of the “Seismic3D” sample dataset that includes two bands (inverted time and amplitude).

Load a Pseudocolor algorithm

1 On the main menu, click the **Edit Algorithm** button.

An image window and the **Algorithm** dialog appear.

2 On the main menu, click the **Open** button.

3 In the **Files of Type:** field, select ‘ER Mapper Algorithm (.alg)’.

4 From the **Directories** menu, select the **\examples** path.

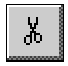
5 In the ‘Applications\Oil_And_Gas_Exploration’ directory, open the algorithm ‘Seismic_Horizon.alg.’

The algorithm displays an enhanced color image of an interpreted seismic horizon. Blues correspond to structural lows transitioning into reds for structural highs. You will zoom in to define a smaller portion of the image, and save the subset to a new raster dataset on disk.

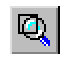
Delete the Intensity layer from the algorithm

This algorithm contains an Intensity layer that is currently turned off, you will delete it since it is not needed for this exercise.

1 On the **Algorithm** dialog, select the Intensity layer (in the data structure diagram on the left).

2 Click the **Cut**  button to delete the layer.

Zoom in to define a subset of the image

1 On the main menu, click the **Zoom Box Tool**  button to set the mouse for use as a zoom tool.

2 Position the mouse pointer in the upper-left corner of the image, then drag a zoom box around the V-shaped uplifted block displayed in red tones. (This should be about 50% of the original image area.)

ER Mapper zooms in on the defined area. This is the portion of the original dataset that you will save to a separate raster file.

Tip: You can also use the **Algorithm Geoposition Extents** dialog to crop an area by exact geographic coordinates (select **View/Geoposition**).

Label the layer to indicate its contents

Notice that the layer already has dataset band 1 (two-way time) selected. When creating an algorithm to write an output dataset, you usually need to enter a label for each layer that describes its contents.

1 Change the layer's label from 'Pseudo Layer' to **`Inverted TWT (ms)`** and press Enter of Return.

Create a second layer for the amplitude data

1 In the **Algorithm** dialog, click the **Duplicate** button.

A second Pseudocolor layer is added, and it already contains the 'Seismic3D' dataset since it is a duplicate.

Tip: Another option for adding the second layer would be selecting **Edit/Add Raster Layer/Pseudo** on the **Algorithm** dialog and loading the 'Seismic3D' dataset.

Select the amplitude band and label the new layer

1 With the new (lower) layer selected, choose **B2:Amplitude** from the **Band Selection** drop-down list in the process diagram.

The new layer now contains the amplitude data.

2 Change the new layer's label to read **`Amplitude`**, then press Enter or Return.

Reset the invert formula from the amplitude layer

Since this algorithm was originally designed to display the time data, it contains a formula to invert the dataset values (so larger time values are color-coded as structural lows). It is important to reset the formula in the new layer so the amplitude data does not get inverted as well in the output dataset.

1 With the 'Amplitude' layer selected, click the **Formula** button in the process diagram.

2 In the **Formula Editor** dialog, select **Default** from the **Edit** menu.

ER Mapper resets the formula back to the default "INPUT1." (This formula performs no changes to the original data.)

3 Click **Close** on the **Formula Editor** dialog.

4 Click on the surface icon in the data structure diagram–you should then see the process diagrams for both layers.

You have now created an algorithm that will output both bands from the original dataset (the time and amplitude data). By zooming in, you have defined a subset of the image, and only that area will be saved to the output dataset. The descriptions you specified for each layer will become the labels for each band in the output dataset. (Using a formula to reverse the polarity of the time data was optional but may be desirable in many cases.)

The order of layers in the algorithm determines the order of bands in the output dataset (the first layer becomes the first dataset band). In addition, make sure all layers to be output are turned on (turned off layers are ignored when creating output datasets).

Specify a filename for the output dataset

1 On the main menu, select **Save As...** from the **File** menu (or click the **Save As** button).

The **Save As...** dialog box appears. This dialog lets you specify a path and name for your output disk file, and options for creating the new dataset.

2 On the **Save As...** dialog, select ‘ER Mapper Raster Dataset (.ers)’ in the **Files of Type:** field.

3 From the **Directories** menu, select the **\examples** path.

4 Double-click on the ‘miscellaneous\tutorial’ directory to open it.

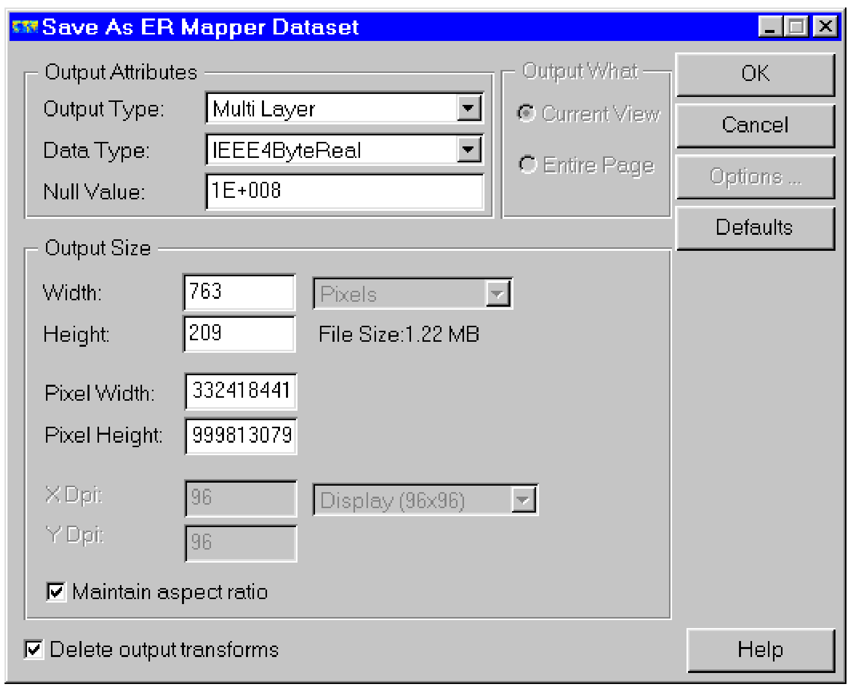
5 In the **Save As:** text field, type a name for the disk file using your initials followed by the text ‘horizon_subset,’ and separate each word with an underscore (_). For example, if your initials are “CJ,” type in the name:

```
CJ_horizon_subset
```

6 Click **OK** to close the file chooser dialog.

The **Save As ER Mapper Dataset** dialog opens.

Choose options for the output dataset



1 Click the **Defaults** button.

ER Mapper automatically fills in appropriate values in the **Width** and **Height** fields by examining the extents of the area you zoomed on, and figuring the corresponding numbers of actual dataset pixels to be output.

Notice also that the **Output Data Type** has been set to **IEEE4ByteReal**. ER Mapper determined this by examining the data type of the original ‘Seismic3D’ dataset. (You could change this to another type if desired, but it is usually best to maintain the native data type and precision.)

The fields on the **Save As ER Mapper Dataset** dialog are:

- **Output Type** is the number of bands in the saved dataset. It can be other multi layer or have a Red Green and Blue (RGB) layer.
- **Data Type** is the data format for the new output dataset. For example, if your dataset is type real (or algorithm processing produces floating point data using a formula), you should get a real data type after clicking **Defaults**. (If desired, you could change the data type to signed or unsigned integer).
- **Null Value** specifies a cell value that will be interpreted as “null” in the output dataset. Null cell values are ignored during processing, and are often used to mask a specific background value that you wish to ignore.
- **Width** and **Height** specify the width and height of the new output dataset in pixels. Clicking the **Defaults** button tells ER Mapper to figure out the number of cells in the input dataset based on the area currently displayed, then fill those values in automatically (recommended). If desired, you can enter any size and ER Mapper automatically subsamples or supersamples the original image data to fill the requested dimensions.

Tip: It is recommended that you *always* use the **Defaults** button to automatically set the output data type and cells across and down to the correct values for the current algorithm. If desired, you can then change the output data type or size by selecting different options or values.

- **Maintain aspect ratio** maintains the symmetry of the image. If you alter the Width or Height the other dimension will change to keep the aspect ratio.
- **Delete output transforms** automatically deletes any transforms in the algorithm.

Note: If you want to maintain the native data range of the input dataset when writing output datasets to disk, you should always delete the transforms for each raster layer in the algorithm first. Otherwise, the output data will be scaled or clipped according to the current transform. (There are times, however, when rescaling the range of an output dataset can be desirable.)

Write the output disk file

1. Click **OK** on the **Save As ER Mapper Dataset** dialog.

   A dialog box appears to show the progress of the write to disk operation, then a confirmation dialog appears when the process is complete.

2. Click **OK** on the confirmation dialog to close it.

Display the new dataset and adjust the color mapping

1. Click the **New** button on the main menu, then drag the new window below the first one.
2. On the **Algorithm** dialog, click the **Load Dataset** button in the process diagram.
3. From the **Directories** menu, select the **\examples** path.
4. In the 'miscellaneous\tutorial' directory, double-click on your new dataset to load it (it will have a '.ers' file extension).
5. Select the **Surface** tab in the **Algorithm** dialog, then select the **Color Table** named **pseudocolor**.

   The image appears blue initially because you need to adjust the color mapping.

6. In the process diagram, click the right-hand **Edit Transform Limits** button.
7. From the **Limits** menu (on the **Transform** dialog), select **Limits to Actual**.

   The X axis data range changes to match the Actual Input Limits.

   The image redisplays showing the same area as the zoomed in area of the original algorithm in the other window.

View the amplitude band in the new dataset

1. Select the **Layers** tab in the **Algorithm** dialog.
2. Open the **Band Selection** drop-down list in the process diagram to see the two bands in your output dataset.

   Notice that the band labels are the same as the layer descriptions you entered previously in the first algorithm.

3. From the **Band Selection** drop-down, select **B2:Amplitude**.

   The layer now contains the amplitude data.

4. From the **Limits** menu (on the **Transform** dialog), select **Limits to Actual**.

   The X axis range changes to match the Actual Input Limits of the amplitude data.

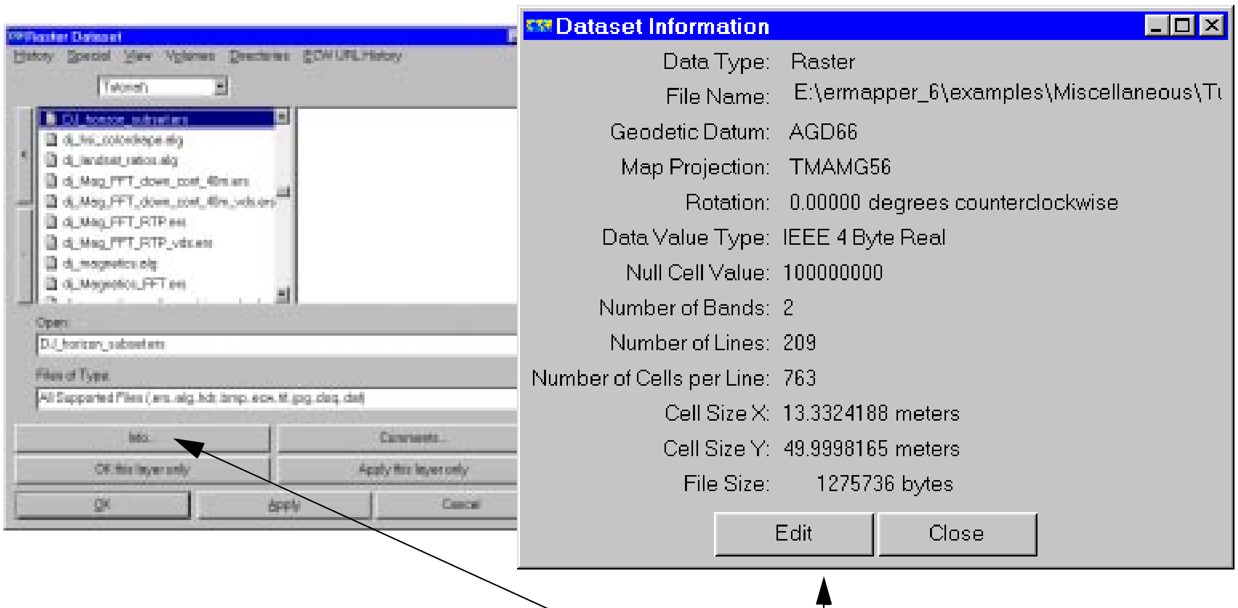
   The amplitude data redisplays with enhanced color contrast.

5. Click **Close** on the **Transform** dialog to close it.

View information on the new dataset

1 On the **Algorithm** dialog, click the **Load Dataset**  button in the process diagram.

2 On the **Raster Dataset** file chooser dialog, click the **Info...** button.



click **Info** to view dataset information

The **Dataset Information** dialog displays showing the map projection, number of bands (2), X and Y pixel dimensions, and file size. Information such as the map projection was carried over from the source 'Seismic3D' dataset.

Tip: You can edit the information in the ER Mapper header file (.ers file) by clicking the **Edit** button on the **Dataset Information** dialog.

---

3 Click **Close** to close the **Dataset Information** dialog.

4 Click **Cancel** to close the **Raster Dataset** file chooser dialog.

Calculate statistics for the new dataset

When a new dataset is imported or created in ER Mapper, some minimal statistics such as those shown in the previous **Dataset Information** dialog are created. You can also generate detailed statistics to provide in depth information about each band in the dataset.

1 From the **Process** menu (on the main menu), select **Calculate Statistics...**.

The **Calculate Statistics** dialog box opens. Your ‘horizon_subset’ dataset should be chosen by default because it is the dataset used in the current algorithm. (If it is not chosen, load it from the ‘tutorial’ directory).

2 Set the **Subsampling Interval** to **1**.

(For very large datasets it can take quite a bit of time to calculate statistics. The subsampling option lets you sample fewer pixels to decrease calculation time at the expense of slightly less accurate statistics.)

3 Select the **Force Recalculate stats** option (to calculate statistics again in case they have previously been calculated).

4 Click **OK** to start the statistics calculation.

5 When the calculation is finished, click **OK** in the dialog indicating successful completion, then close the other statistics dialogs with **Close** or **Cancel**.

View tabular statistics for the new dataset

1 From the **View** menu, select the **Statistics**, then select **Show Statistics**.

The **Statistics Report** dialog box appears. The ‘horizon_subset’ dataset should be selected by default. You can choose to view statistics for selected regions or bands in the dataset, or for all regions and bands.

2 Click **OK** to display statistics for all bands in the dataset.

The **Display Dataset Statistics** dialog opens showing statistics for all your regions in both dataset bands.

3 Scroll through the list to view statistics (you can make the dialog larger if needed).

You can view simple statistics such as the minimum, maximum, and mean values in each band, correlation and covariance matrices, and other calculations.

Note: The region named ‘All’ is the entire dataset. If there were additional regions defined in the source dataset, they would be carried on to the new dataset and their statistics would appear here as well. (For example you could easily see the area size of a region.)

---

4 When finished viewing statistics, click **Close** on the **Statistics Report** dialog to close both dialogs.

Close all image windows and dialog boxes

1 Close all image windows using the window system controls:

- For Windows, click the **Close** button in the upper-right window corner.

2 Click **Close** on the **Algorithm** dialog to close it.

Only the ER Mapper main menu should be open on the screen.

What you learned

After completing these exercises, you know how to perform the following tasks in ER Mapper:

- Create an algorithm to send output to a raster dataset on disk
- Specify output dataset parameters and write the dataset to disk
- Calculate and view statistics for the new dataset
- View information about the output dataset

Notes on combining datasets

Sometimes when you import interpreted seismic horizons and attribute grids into ER Mapper, the horizons and attributes import as single-band datasets. For example, if you have three horizons to import, you may end up with each horizon being a separate raster file in ER Mapper format.

It is often desirable to combine these separate single-band files into one file that has multiple bands. Each horizon would become a band in the new combined dataset. This gives you several advantages:

- You have faster access to the data (instead of managing and loading three datasets, you only have one).
- Math functions (formulas) can now be easily carried out between the different horizons and/or attributes. For example, you can create an isochron by subtracting one horizon (band) from another. (This is also possible using the Virtual Datasets feature described later.)
- You can use the **Cell Profiles** and **Traverse** features and see the values and traverse profile of all horizons and/or attributes simultaneously.

Procedure to combine datasets

To merge or combine several single-band datasets into one multi-band dataset, you follow basically the same steps as described in this chapter. That is, do the following:

- Load each dataset into its own raster layer in the algorithm. (Use the **OK this layer only** or **Apply this layer only** buttons when loading the datasets.)
- Enter a unique label for each layer that describes the dataset it contains
- Delete the post-formula transform for each layer

- Choose **View/Quick Zoom/Zoom to All Datasets** (this is important to determine the full geographic extents of the datasets in *all* layers).
- Use the **File/Save As....** option as described here
- Save the image in an appropriate format.

Normalizing data ranges of attributes

If you are combining multiple attribute grids into a single dataset, it can be useful to normalize the range of values in each attribute to a common data range. This is especially helpful for using the traverse profile feature (**View/Traverse**), so you can easily see the change in magnitude and relationship between various attributes across any profile.

Normalization is helpful because various attributes often have very different data ranges. For example, some have large positive-to-negative ranges, some very small negative ranges, some large negative ranges, and so on. If you display attributes with very different ranges in the same traverse profile, the profile is dominated by the attribute with the greatest range. Attributes with smaller ranges may end up looking like flat lines at the top or bottom of the profile display, so direct comparison of the changes in magnitude is not possible.

One simple way to normalize your data into a common range is to use a transform in each layer (do not delete the transforms as described previously). Modify the procedure in the previous section “Procedure to combine datasets” as follows:

- Do *not* delete the transforms from each layer
- The **Zoom to All Datasets** step will generate a histogram for the attribute dataset in each layer (needed).
- Open the **Transform** dialog and select **Limits/Limits to Actual** for the final transform in each layer of your algorithm. (On the **Transform** dialog, you can use the button to move between the layers and do this for each one.)

When you save the output dataset (the last step), each attribute band will be rescaled in a zero-to-255 (0-255) data range to allow direct comparison in traverse profiles.

You can also use a formula in each layer to normalize your data, for example divide by the standard deviation. (If you do this, you should delete the transforms from each layer before saving the new dataset.)

Note: When you normalize the data ranges, you lose the original data range associated with each attribute. You may want to create two datasets–one with the original data ranges, and another special version with normalized ranges for use in traverse profiling.

13

Virtual datasets

This chapter explains how to create and use a special type of algorithm called a Virtual Dataset. Virtual datasets are a very powerful ER Mapper feature that allow you to work with data in an intermediate processed state without actually needing to write the results to a file on disk.

About virtual datasets

A Virtual Dataset ("VDS" for short) is a special type of algorithm that can be used as if it were a file on disk, except that the data is computed on demand so it takes no additional disk space. Virtual Datasets are an extension of the algorithms concept, so you can carry out processing on a raw dataset, then save the results as a "virtual" dataset for use as input for another algorithm. By saving processing results in a Virtual Dataset, you can define "views" into your data that can be used in subsequent processing as if they were real datasets on disk.

Virtual Datasets offer many advantages:

- *Reduced data complexity*–layers that process combinations of bands can become a single band of data in the virtual dataset. (For example, an isochron created from two horizons.)
- *Reduced disk storage*–virtual datasets are computed on demand, so no extra disk storage is needed.
- *Virtual image mosaics*–two or more adjacent images can be merged and processed as if they were a single image. (For example, horizons from adjacent surveys can be referenced as a single entity.)

Note: The Image Balancing Wizard does not support Virtual Datasets, so the algorithm would have to be balanced before being saved as a Virtual Dataset.

- *Linking multiple datasets*–link several datasets on disk together so they can be accessed and processed as if they were bands in a single dataset. (For example, multiple horizons stored as single-band files can be merged into one multiple-band file.)
- *New types of data*–datasets with different characteristics can be merged to create hybrid virtual datasets.

All of these types of operations can be saved as Virtual Datasets, thereby making the processing techniques used to create them transparent to the user.

Note: Virtual Datasets have restrictions to their usage. See the 'Notes about using Virtual Datasets' section at the end of this chapter for details.

Hands-on exercises

These exercises give you practice creating Virtual Datasets and understanding how to use them in subsequent image processing algorithms.

What you will learn...

After completing these exercises, you will know how to perform the following tasks in ER Mapper:

- Prepare an algorithm to be saved as a Virtual Dataset
- Create algorithm layers for time, amplitude, dip, and azimuth computations, and save them as pre-computed bands in a single Virtual Dataset
- Load and use a Virtual Dataset

Before you begin...

Before beginning these exercises, make sure all ER Mapper image windows are closed. Only the ER Mapper main menu should be open on the screen.

1: Creating a multiple band VDS

Objectives Learn to create a Virtual Dataset (VDS) with four bands: inverted time, amplitude, dip, and azimuth. Also learn how to prepare an algorithm for use as a VDS, and save and use the VDS.

Open the sample seismic dip algorithm

1 Click the **Edit Algorithm** toolbar button.

An image window and the **Algorithm** window appear.

2 On the main menu, click on the **Open** button.

3 From the **Directories** menu, select the **\examples** path.

4 In the 'Applications\Oil_And_Gas_Exploration' directory, open the algorithm named 'Seismic_Horizon_Dip.alg.'

This algorithm uses a formula operating on two inputs (values produced by easterly and northerly dip filters), and combines them to create a true dip image. Dip images are useful for highlighting features such as the strike of faults, and let you view both sides of a fault.

Prepare the Dip layer to be saved in a Virtual Dataset

Preparing an algorithm to be saved as a Virtual Dataset is very similar to preparing one for use in saving a new dataset to disk as you did earlier. You typically need to define a description label to each layer, and delete the transform used to enhance the color mapping to the display.

1 On the **Algorithm** dialog, change the 'Pseudo Layer' label to **`seismic dip`** then press Enter or Return.

By saving this layer as a band in a VDS, the filtering and formula calculations used to produce the dip image will become transparent to the user.

Create a second layer that generates seismic azimuth

1 With the 'seismic dip' layer selected, click the **Duplicate** button on the **Algorithm** dialog.

A copy of the layer is added to the algorithm. Since the azimuth calculation works on the same two easterly and northerly filters already used for the dip calculation, you can simply change the formula in the new layer to create an azimuth image.

2 In the new (lower) layer, change the current description label to read **`seismic azimuth`**, then press Enter or Return.

3 With the 'seismic azimuth' layer selected, click the **Edit Formula** button in the process diagram.

4 In the **Formula Editor** dialog, select **Azimuth** from the **Seismic** menu.

ER Mapper replaces the previous dip formula with the formula that generates seismic azimuth.

5 Click **Close** on the **Formula Editor** dialog to close it.

You have now added a second layer that processes the two-way time data to perform the azimuth calculation. It will appear as the 'seismic azimuth' band in your Virtual Dataset.

Create a third layer for the amplitude data

Since the other layers had filters and formulas already added, it is easier to add an empty new layer (rather than duplicating one) so you don't have to delete the filters and formula that you don't want for the amplitude data. You will need to load the dataset and delete the transform again.

1 On the **Algorithm** dialog, click the **Edit** menu, choose **Add Raster Layer**, then choose **Pseudo**.

A third Pseudocolor layer (empty) is added to the algorithm layer list.

2 With the new (empty) layer selected, click the **Load Dataset** button in the process diagram.

3 From the **Directories** menu, select the **\examples** path.

4 In the directory 'Shared_Data', double-click on the dataset 'Seismic3D.ers' to load it.

5 With the new layer still selected, choose **B2:Amplitude** from the **Band Selection** drop-down list in the process diagram.

The new layer is now set to process the amplitude data.

6 Enter the description label **`amplitude`** for the new layer.

You have now created a third layer from scratch to process the amplitude data with no modifications. It will appear as the 'amplitude' band in your Virtual Dataset.

Create a fourth layer for the inverted time data

Since the 'amplitude' layer already has the desired dataset, you can simply duplicate it, select band 1 (time), and modify the formula to invert the data.

1 With the ‘amplitude’ layer selected, click the **Duplicate** button on the **Algorithm** dialog.

A copy of the ‘amplitude’ layer is added to the algorithm layer list.

2 With the copied layer selected, choose **B1:Two Way Time_ms** from the **Band Selection** drop-down list in the process diagram.

The new layer is now set to process the two-way time data.

3 In the new (lower) layer, change the description label to read **`inverted TWT (ms)`** then press Enter or Return.

4 Click the **Edit Formula** button in the process diagram.

5 In the **Formula Editor** dialog, edit the text string “INPUT1” to add a minus sign (-) in front. Your formula should now look like this:

```
-INPUT1
```

6 Click **Apply changes** on the **Formula Editor** dialog.

7 Click **Close** on the **Formula Editor** dialog to close it.

You have now created a fourth layer to process and invert the two-way time data. It will appear as the ‘inverted TWT (ms)’ band in your Virtual Dataset.

Reorder the layers in the algorithm

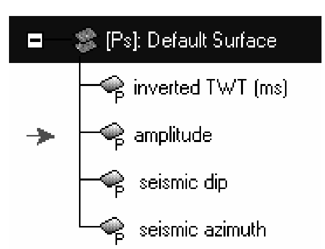
Because of the types of operations you were performing, it was easiest to create the four layers in the current order. Now you can use buttons or drag-and-drop layers to put them in any order you prefer. (The order of the layers is the same as the order of bands in the subsequent Virtual Dataset.)

1 Drag the ‘inverted TWT (ms)’ layer above the ‘seismic dip’ layer.

The time layer is now on top of the layer list.

2 Select the ‘amplitude’ layer, then click the **Move Up** button twice to move it up two layers.

The ‘amplitude’ layer moves up two positions in the layer list. Your layer list in the data structure diagram should now look like this:



(If your list has a different order, drag-and-drop the appropriate layers or use the **Move Up** or **Move Down** buttons until they are in the right order.)

You have now prepared an existing algorithm to be saved as a Virtual Dataset. The four layers are:

- 'inverted TWT (ms)'–the original two-way time data, but inverted using a formula to reverse the polarity.
- 'amplitude'–the original amplitude data with no modifications.
- 'seismic dip'–a dip image derived from the two-way time data using the appropriate filters and a formula.
- 'seismic azimuth'–an azimuth image derived from the two-way time data using the appropriate filters and a formula.

Each layer has a description that will become its band label in the Virtual Dataset ('amplitude,' etc.), and each layer has the transform deleted to prevent rescaling the original or created data range.

2: Saving and using a VDS

Objectives Learn to save a Virtual Dataset and display and process it using another algorithm.

Save the algorithm as a Virtual Dataset

Note: Before saving an algorithm as a Virtual Dataset, *make sure all algorithm layers you wish to use are turned on*. Layers that are turned off cannot be accessed in the Virtual Dataset.

---

1 On the main menu, select **Save as...**.from the **File** menu (or click the **Save As...** button).

The **Save As...** dialog box opens.

2 In the Files of Type: field, select 'ER Mapper Virtual Dataset (.ers)'.

3 From the **Directories** menu, select the **\examples** path.

4 Double-click on the 'miscellaneous\tutorial' directory to open it.

5 In the **Save As:** text field, type a name for the Virtual Dataset using your initials followed by the text 'seismic_processing_VDS,' and separate each

word with an underscore (_). For example, if your initials are “DJ,” type in the name:

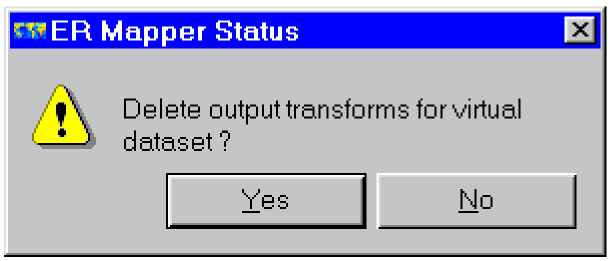
`DJ_seismic_processing_VDS`

Tip: It is often helpful to append the text “VDS” on the end of the name you assign to a Virtual Dataset. This helps you easily determine that the dataset is *virtual*, and not an actual dataset file on disk.

---

6 Click **OK** to save the Virtual Dataset and close the file chooser dialog.

7 Click on the **Yes** button to query about deleting the output transforms.

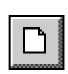


Note: When creating algorithms for use as Virtual Datasets, you should usually delete the transforms for each raster layer to maintain the native data range of the input dataset. Otherwise, the output data will be scaled or clipped according to the current transform. (You can, however, use a transform to rescale the data if desired.)

The Virtual Dataset is actually saved as a small ASCII text file on disk that describes the processing and dataset used in each layer (very similar to an algorithm file). Because of this, it consumes almost no additional disk space.

Open a new window to display your Virtual Dataset

1 Close the current image window by selecting **Close** from the **File** menu.

2 On the main menu, click the **New**  button.

A new empty image window opens on the screen.

Load the Virtual Dataset into the algorithm

1 In the **Algorithm** dialog, click the **Load Dataset**  button in the process diagram.

2 From the **Directories** menu, select the path ending with **\examples**.

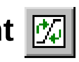
3 Double-click on the 'miscellaneous\tutorial' directory to open it.

4 Double-click on your 'seismic_processing_VDS.ers' dataset to load it.

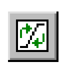
Note: Virtual Datasets have '.ers' file extensions the same as actual datasets on disk. Therefore using "VDS" makes it easy to distinguish them quickly.

View the inverted time band in your Virtual Dataset

By default, the first band in a dataset (inverted time in this case) is selected after loading it.

1 On the main menu, click the **99% Contrast Enhancement**  button.

Band 1 of the Virtual Dataset (the inverted time data) displays.

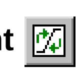
Tip: The **99% Contrast Enhancement**  toolbar button automatically sets the transform limits to actual and applies a 99% clip transform to the data (you have been doing this manually using the **Transform** dialog previously). This shortcut lets quickly view each band with a basic color mapping enhancement.

View images for other "virtual" bands

1 Open the **Band Selection** drop-down list in the process stream to see the four bands in your Virtual Dataset.

The band order and labels are the same as the layer order and labels you set up in the algorithm you built earlier.

2 From the **Band Selection** drop-down, select **B2:amplitude**.

3 On the main menu, click the **99% Contrast Enhancement**  button.

The amplitude data (band 2) displays with a basic color mapping enhancement.

4 From the **Band Selection** drop-down, select **B3:seismic dip**.

5 On the main menu, click the **99% Contrast Enhancement** button.

The seismic dip image displays with a basic color mapping enhancement.
ER Mapper automatically creates the dip image on demand using the processing steps (filters and dip formula) you set up when creating your Virtual Dataset.

6 From the **Band Selection** drop-down, select **B4:seismic azimuth**.

7 On the main menu, click the **99% Contrast Enhancement** button.

The seismic azimuth image displays with a basic color mapping enhancement. As with the dip image, ER Mapper automatically creates the azimuth image on demand using the processing steps saved as part of your Virtual Dataset.

(You may wish to display the dip and azimuth images using the greyscale and azimuth color tables respectively–click the **Surface** tab to do this.)

By saving the dip and azimuth calculations as a Virtual Dataset, you have reduced the complexity of the data, and no longer need to use the filters and formulas in future algorithms to generate these images. (ER Mapper does this for you automatically. This makes it easier for advanced users to quickly visualize and manipulate data, and also for setting up data viewing for less sophisticated users).

View information on the Virtual Dataset

1 On the **Algorithm** dialog, click the **Layer** tab (if needed), then click the **Load Dataset** button.

2 On the **Raster Dataset** file chooser, click the **Info...** button.

The **Dataset Information** dialog indicates that the dataset is Virtual. Since it is not actually a dataset on disk, it cannot be edited using the dataset header editor.

3 Click **Cancel** to close the **Dataset Information** dialog.

4 Click **Cancel** to close the **Raster Dataset** file chooser dialog.

Tip: If you need to edit a Virtual Dataset, re-open it using **Open from Virtual Dataset** from the **File** menu. The VDS will open into its original algorithm, so you can add or delete layers, make changes, and then re-save it again (using **File/Save As...**).

Close all image windows and dialog boxes

1 Close all image windows using the window system controls:

- For Windows, click the [X] **Close** button in the upper-right window corner.

2 Click **Close** on the **Algorithm** dialog to close it.

Only the ER Mapper main menu should be open on the screen.

What you learned...

After completing these exercises, you know how to perform the following tasks in ER Mapper:

- Prepare an algorithm to be saved as a Virtual Dataset
- Create algorithm layers for time, amplitude, dip, and azimuth computations, and save them as pre-computed bands in a single Virtual Dataset
- Load and use a Virtual Dataset

Notes about using virtual datasets

From the user's point of view, a Virtual Dataset is very similar to saving a dataset to disk, but it uses only a few kilobytes of disk space. By saving the algorithm processing steps as a Virtual Dataset, you have greatly simplified the complexity of the data and gained faster access to it. For example, ER Mapper now performs the dip calculation automatically "behind the scenes" so you don't need to use the filters and formula in your display algorithm. Or, the two-way time data is now automatically inverted, so no negation formula is needed to perform that operation.

Virtual Datasets do have some limitations. You may consider saving the algorithm as an actual dataset on disk if these are important. These limitations include:

- You cannot use the **Cell Value Profile** or **Traverse** features under the **View** menu. You can only use these features on real raster datasets stored on disk.
- You cannot perform a rectification on a Virtual Dataset (see the 'Map Projections' chapter), or export a VDS using the **Utilities/Export** options.
- The Virtual Dataset header file (for example 'seismic_vds.ers') contains pointers to the actual datasets. For example, the VDS you created in this exercise references the actual dataset 'Seismic3D.ers.' If you were to move this dataset to a different directory, you could no longer use the Virtual Dataset as is. The solution is to use **File/Open from Virtual Dataset** option, then reload the dataset from its new directory (to update the pointer) and re-save the VDS.
- If you zoom into an area and then save the algorithm as a Virtual Dataset, ER Mapper assumes the zoom extents to be the entire extents of the Virtual Dataset. (After loading the VDS, you cannot zoom back out to the original dataset's extents.) This is a useful feature for map making, but one to be aware of when saving a VDS.

14

Compressing images

This chapter shows you how to save your images in ECW compressed format.

About ECW compression

ER Mapper compresses images using wavelet compression technology which offers very high quality results at high compression rates. You can typically compress a color image to less than 2% to 5% of its original size (50:1 to 20:1 compression ratio) and compress a grayscale image to less than 5% to 10% of its original size (20:1 to 10:1 compression ratio).

This means that, at 20:1 compression, 10GB of color imagery will compress down to 500MB, which is small enough to fit on to a single CD-ROM. You may actually achieve higher compression rates where your source image has a structure well suited to compression.

In addition to reducing storage requirements, you can also use the free imagery plug-ins for GIS and office applications to read the compressed imagery in a wide range of software applications such as ArcView®, AutoCAD MAP®, MapInfo®, ER Viewer, Photoshop™, Microsoft Office® and Excel®, and other software applications.

Saving a compressed image to disk

Objectives Learn how to save multiband images in compressed format using the ER Mapper ECW compression.

Input image to be compressed

1 From the main ER Mapper **File** menu, select **Open from a Virtual Dataset...**

2 From the **Open** dialog **Directories** menu, select the **\examples** path.

3 Open the ‘Miscellaneous\Tutorial’ directory, then double-click on the ‘Seismic_Processing_VDS.ers’ virtual dataset you created in the previous exercise.

This will open the algorithm that you used to create the Virtual Dataset, and not the Virtual Dataset itself. This enables you to make any changes before compressing the image.

4 Click on the **Standard** toolbar **99% Contrast Enhancement**  button.

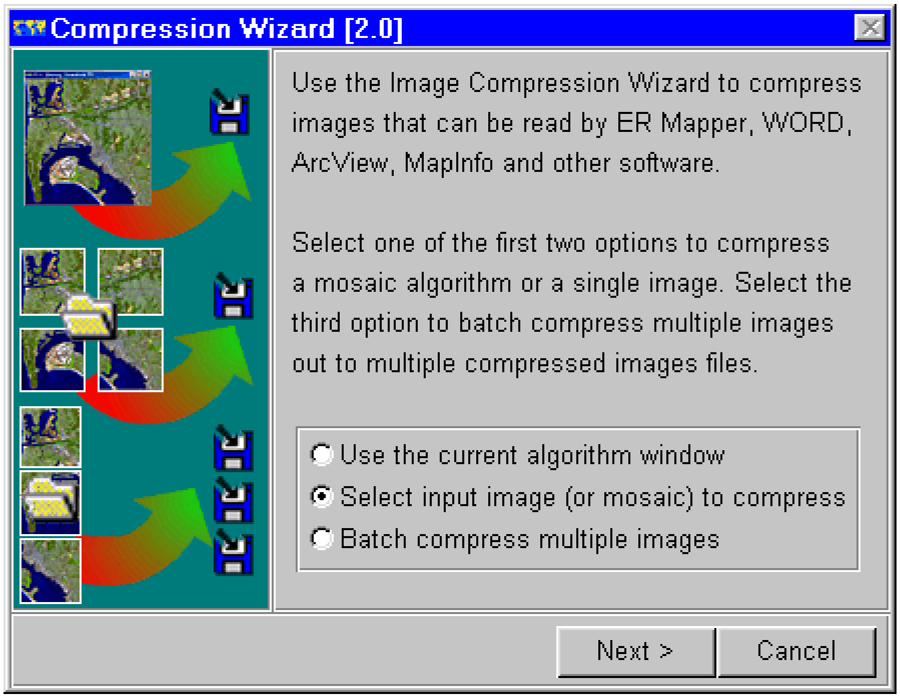
This will make the image visible.

Note: It is not generally advisable to do a 99% Contrast Enhancement on an image before compressing it because the compressed image will be different to the original.

---

5 From the main ER Mapper **File** menu, select **Save as a Compressed Image**.

The **Compression Wizard** will open.



6 Select the **Use the current algorithm window** option as the source of the image(s) to be compressed and click on the **Next >** button.

In addition to using an algorithm as the source image to be compressed, you could specify any other file format supported by ER Mapper, such as ESRI BIL, TIFF, JPG as the input.

Compressed image file name

7 In the **Output file:** field, click the **Select File**  button.

8 From the **Directories** menu, select the **\examples** path.

9 In the **Select File** dialog, choose ER Mapper compressed images (.ecw) in the **Files of Type** field.

10 Open the 'Miscellaneous\Tutorial' directory.

11 In the **Open:** text field, enter the text **`<your initials>_seismic_processing_compressed`**, and separate each word with an underscore (_).

12 Click **OK** on the **Select File** dialog.

Your file name appears as the **Output File** name with a '.ecw' extension.

ER Mapper will save the compressed image as a header (.ers) and a compressed data (.ecw) file. You can use **File / Open** or one of the wizards to open the header (.ers) or data (.ecw) file just like any other image file supported by ER Mapper.

Note: The data (.ecw) file contains embedded georeferencing information, so the header (.ers) file can be dispensed with if the compressed image is to be used in applications other than ER Mapper.

Compress to Grayscale, RGB or Multi

13 In the **Compress to:** field, select the **Multiband** option.

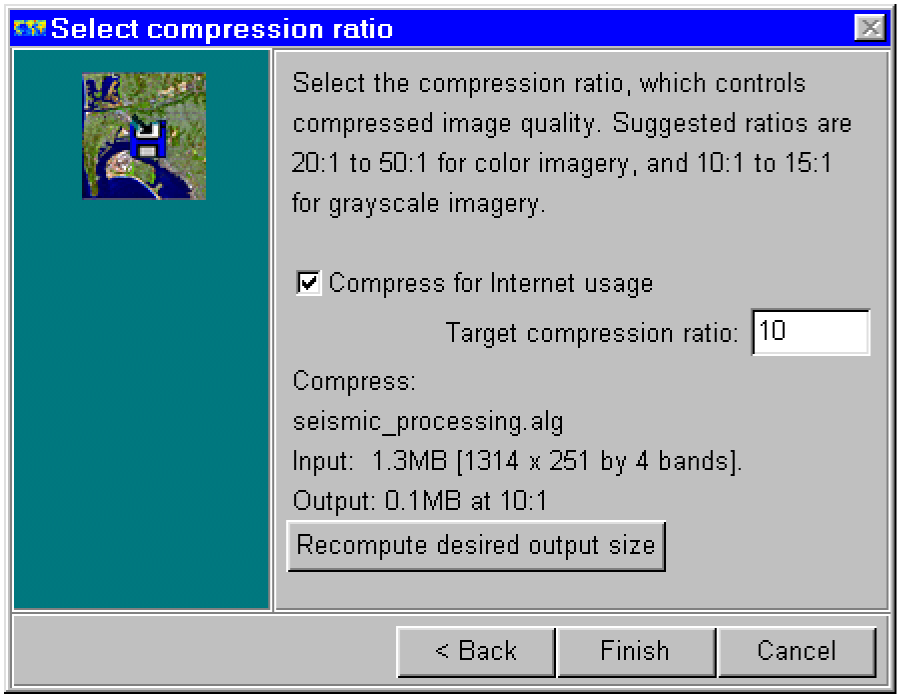
The compression engine will compress all four bands of the multi-band image. This is a unique feature of ECW v2 compression in that it allows you to access the individual bands in a hyperspectral compressed image rather than just enabling you to view the image as color RGB or Grayscale.

Other compression options available are:

Grayscale	The compression engine constructs and compresses a grayscale view of your input image data using the normal formula for Intensity from Red, Green and Blue.
Color (RGB)	The compression engine internally converts the RGB color image into YUV color space, specifically the one defined as the "JPEG Digital version of YUV". YUV is a color space that separates out intensity (Y) from chromatic or color changes (U and V). This enables more efficient compression of color imagery, ensuring that detail is preserved. The RGB to YUV conversion (and back again for decompression) is automatic; the user always sees the file as a RGB file.

14 Click on the **Next >** button to continue

Compression ratio



15 Check the **Compress for Internet** usage box.

This option is for compressed images to be served on an ER Mapper Internet Web Server (IWS). The transfer rate over a network for images compressed with this option is higher, thus allowing faster zooming and roaming. However, the actual compression ratio achieved will be less than that for images compressed without this option. For more information on the IWS, refer to the ER Mapper web site, http://www.ermapper.com.

16 If necessary change the **Colorscale ratio:** to **`10`** and click on the **Recompute desired output size** button.

This value is the desired compression ratio that you would like to achieve. For example, you might specify a ratio of 20:1 for an input file of 1,000MB to achieve a desired a 50MB compressed image (so the output image is 5% of the size of the input image).

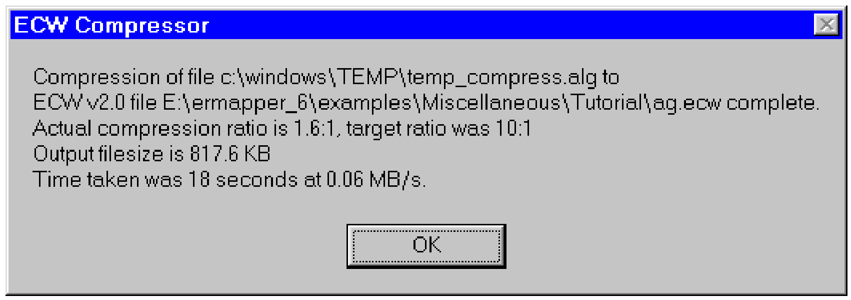
The Compression Wizard uses the Target Compression ratio as a measure of how much information content to preserve in the image; i.e as a quality indicator. If, however, your image has areas that are well suited to compression, a greater rate of compression may be achieved while still achieving the desired information content. The actual compression ratio could also be less than the target if you are compressing small files. The Compression Wizard uses multiple wavelet encoding techniques at the same time, and adapts and chooses the best technique depending on the area currently being compressed.

Note: The image in this example is too small to really show the ECW compression capabilities.

17 Click on the **Finish** button to start the compression process.

Compression process

A status dialog will display the progress of the compression. When the compression is complete, a dialog will display the Target and Actual compression rates.



The actual compression ratio achieved is 1.6:1, which is not particularly good. This is because the input image file size is much smaller than what you would normally compress. ECW compression is most effective on images with very large file sizes.

Except when compressing very small files (less than 2MB in size), the Actual compression ratio will generally be greater than the Target compression ratio.

Open a new window to display your compressed image

1 On the main menu, click the **New** button.

A new empty image window opens on the screen.

Load the compressed image into an algorithm

1 Click on the **Edit Algorithm** button on the **Common Functions** toolbar to open the Algorithm dialog.

2 In the **Algorithm** dialog, click the **Load Dataset** button in the Pseudo Layer process diagram.

3 From the **Directories** menu, select the path ending with **\examples**.

4 Double-click on the ‘miscellaneous\tutorial’ directory to open it.

5 Double-click on your ‘seismic_processing_compressed.ecw’ image to load it.

View images for compressed bands

1 Open the **Band Selection** drop-down list in the process stream to see the four bands in your compressed.

The labels are the same as the those you set up in the original algorithm. The band order is reversed.

2 From the **Band Selection** drop-down, select **B4:inverted TWT (ms)**.

3 The inverted TWT data (band 4) displays with a basic color mapping enhancement.

4 From the **Band Selection** drop-down, select **B3:amplitude**.

The amplitude data (band 3) displays with a basic color mapping enhancement.

5 From the **Band Selection** drop-down, select **B2:seismic dip**.

The seismic dip image displays with a basic color mapping enhancement.

6 From the **Band Selection** drop-down, select **B1:seismic azimuth**.

The seismic azimuth image displays with a basic color mapping enhancement.

(You may wish to display the dip and azimuth images using the greyscale and azimuth color tables respectively–click the **Surface** tab to do this.)

View information on the compressed image

1 On the **Algorithm** dialog, click the **Layer** tab (if needed), then click the **Load Dataset**  button.

2 On the **Raster Dataset** file chooser, click the **Info...** button.

The **Dataset Information** dialog displays the image information which you can edit using the dataset header editor.

3 Click **Cancel** to close the **Dataset Information** dialog.

4 Click **Cancel** to close the **Raster Dataset** file chooser dialog.

Close the image windows and dialog boxes

1 Close the image windows using the window system controls:

- For Windows, click the **Close** button in the upper-right window corner.

2 Click **Close** on the **Algorithm** dialog.

Only the ER Mapper main menu should be open on the screen

What you learned

After completing these exercises, you know how to perform the following tasks in ER Mapper:

- Save the image in compressed format using the ECW compressor.

15

Map projections

This chapter explains concepts related to geometrically correcting datasets to real world coordinate systems and map projections, and how to transform a dataset from one projection system to another.

Note: For more information on registering images to map projections in ER Mapper, see the section 'Notes on dataset registration' at the end of this chapter and the *ER Mapper User Guide* manual.

About map projections

Whenever accurate area, direction and distance measurements are required, raw image data must usually be processed to remove geometric errors and rectify the image to a real world coordinate system. Seismic datasets are usually corrected and registered to a specific datum and map projection during the processing stage performed in gridding and interpreting the raw seismic data. Sometimes, however, you may need to rotate a dataset to re-orient it, or transform the dataset from one projection system to another. ER Mapper also provides the capability register one dataset to another by choosing common points (called ground control points, or GCPs) on both images.

ER Mapper provides a library of over 700 standard map projections for large areas or specific regions of the world. You can use any of the standard datums and map projections, and add your own datums and projections to ER Mapper's library.

ER Mapper's Geocoding utilities are commonly used to perform different types of operations:

- **Image to map rectification**–using triangulation or polynomial (control point) warping to rectify an image to a datum and map projection using GCPs.
- **Image to image rectification**–using triangulation or polynomial (control point) warping to rectify one image to another using GCPs.
- **Orthorectification**-a more accurate form of rectification that takes into account terrain variations and camera characteristics. This is normally used for airphotos.
- **Known point registration**- registering a point (normally cell 0,0) on an image to world coordinate values.
- **Map to map reprojection**–transforming a rectified image from one datum/map projection to another.
- **Image rotation**–rotating an image any number of degrees.

For seismic horizon datasets, the last two functions are most commonly used (since the datasets are usually already transformed into a specific projection). You can also use ER Mapper's Geocoding utilities to simply resample a dataset from one cell size to another without performing any geometric correction or rotation.

Hands-on exercises

These exercises give you practice using ER Mapper's Rectification features.

What you will learn...

After completing these exercises, you will know how to perform the following tasks in ER Mapper:

- Choose a particular datum and map projection
- Transform a dataset from one map projection to another
- Rotate an image any number of degrees

Before you begin...

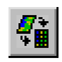
Before beginning these exercises, make sure all ER Mapper image windows are closed. Only the ER Mapper main menu should be open on the screen.

1: Map-to-map reprojection

Objectives Learn how to use ER Mapper's Geocoding utilities to perform a map-to-map reprojection.

In some cases you may find it necessary to transform a dataset from one map projection to another. For example, if your seismic horizon and another dataset are in two different map projections, you would need to transform them to a common projection so the datasets could be accurately combined or overlaid.

Run the Geocoding Wizard

1 From the Process menu, select Geocoding Wizard, or click on the **Ortho and Geocoding Wizard**  button on the **Common Functions** toolbar.

The first page of the Geocoding Wizard opens. This allows you to enter the file name of the image to be geocoded and to specify the type of geocoding.

Enter the image file name

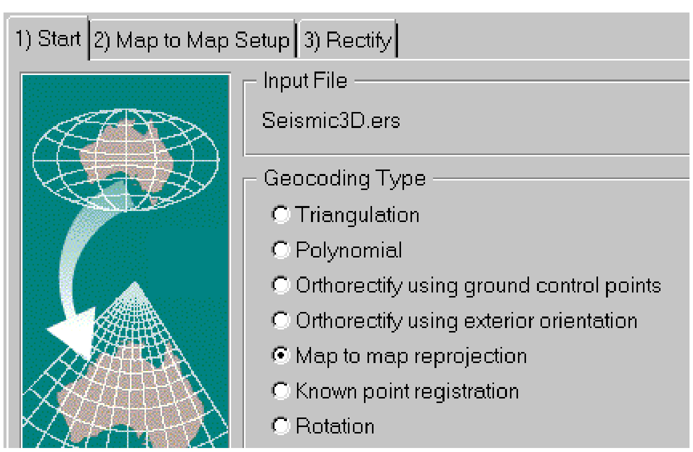
1 Click the File chooser  button.

2 From the **Directories** menu, select the **\examples path**.

3 In the 'Applications\Oil_And_Gas_Exploration' directory, double-click on the algorithm 'Seismic_Horizon_Realtime_Sun_Shade.alg' to select it.

The geocoding wizard **Input File** field will indicate that the 'Seismic3D.ers' dataset is selected.

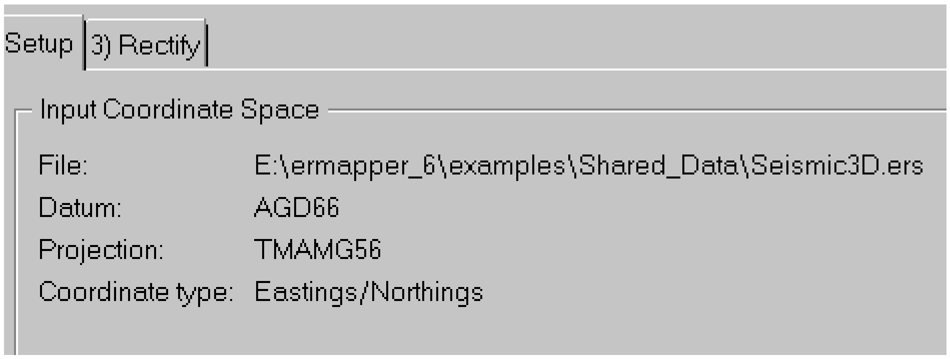
4 Select **Map to map reprojection** for the **Geocoding Type**.



View the datum and map projection of the dataset

1 On the Geocoding Wizard. dialog, click the **2) Map to Map Setup** tab.

The **Input Coordinate Space** field shows that the dataset is rectified to the ‘AGD66’ datum (Australian Geodetic Datum 1966) and the ‘TMAMG56’ map projection (Australian Map Grid Transverse Mercator, Zone 56).

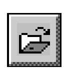


Tip: To find the actual datum and projection names associated with the ER Mapper mnemonic strings, see Appendix D in the *ER Mapper User Guide*.

Setup the TMAMG66 to UTM projection transformation

For this example, assume that you have several other associated datasets already registered to the UTM (Universal Transverse Mercator) map projection system. You want to transform the ‘Seismic3D’ dataset to the appropriate UTM projection so it can be combined or overlaid with the other datasets.

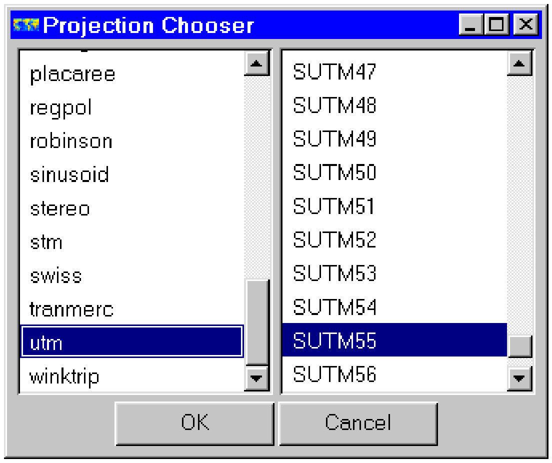
The **Output Coordinate Space** box lets you define the output datum and map projection.

1 Click the **Projection**  file chooser button.

The **Projection Chooser** dialog opens. Directories of projection types are shown in the left column, and specific projections within the selected directory are shown on the right.

2 Scroll down to the bottom of the left column, then click on the ‘utm’ directory to open it.

3 In the list of UTM projections on the right, scroll down to one named ‘SUTM55’ and double-click on it to select it.

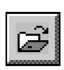


SUTM55 (South Universal Transverse Mercator, Zone 55) is the appropriate UTM map projection for this part of the world. (Assume the datum is already consistent with the other datasets, so you won’t change it here.)

Note: The **Optimize speed** option is designed to speed the transformation processing at the expense of slightly less absolute accuracy. When transforming very large datasets speed can be an issue, in this simple example it does not matter.

Perform the projection transformation

1 Click the Geocodiing Wizard **3) Rectify** tab.

2 Click the **File**  file chooser button on the **Output Info** box.

3 From the **Directories** menu, select the **\examples** path.

4 Double-click on the ‘miscellaneous\tutorial’ directory to open it.

5 Enter the filename ‘Seismic3D_UTM’ (prefix the name with your initials), then click **OK**.

6 Leave the **Cell Attributes** box fields as they are.

7 Do not select the **Display rectified image** option.

This option causes the wizard to display the reprojected image on completion of the reprojection. For this exercise, we will display the dataset later in an algorithm.

8 Click the **Save Files and Start Rectification.**

ER Mapper opens a status dialog to indicate the progress of the rectification.

ER Mapper saves the new projection information in the 'Seismic3D.ers' header file, and creates a new dataset 'Seismic3D_UTM.ers' that has the new projection.

9 When the operation finishes, click **OK** of the successful completion dialog. Then click **Close** on the **Geocoding Wizard** dialog.

You have now transformed the Seismic3D dataset and created a new dataset rectified to the UTM map projection system.

Display the new UTM-projected dataset

1 On the main menu, click the **Open**  button.

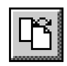
An empty image window and the **Open** dialog box appear.

2 In the Files of Type: field, select 'ER Mapper Algorithm (.alg)

3 From the **Directories** menu, select the **\examples** path.

4 In the 'Applications\Oil_And_Gas_Exploration' directory, double-click on the algorithm 'Seismic_Horizon_Realtime_Sun_Shade.alg' to open it.

The algorithm will display the image with the original 'Seismic3D.ers' dataset.

5 On the main menu, click the **Copy Window**  button.

ER Mapper makes a copy of the current algorithm in a new image window. Move the new window so you can see the original underneath.

6 On the main menu, click the **Load dataset**  button.

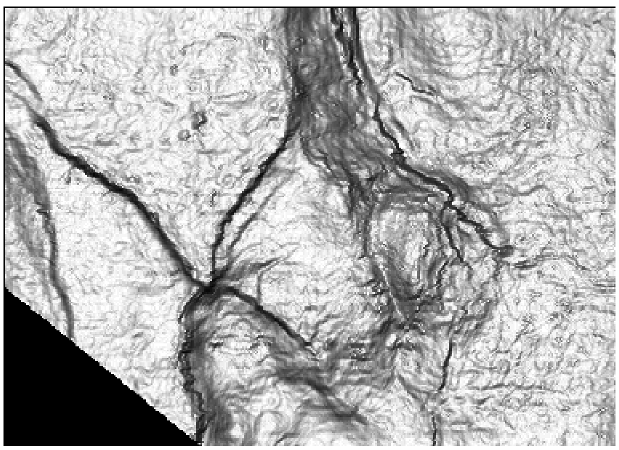
The **Raster Dataset** file chooser appears. You will load your UTM dataset into the copied algorithm to compare it with the original.

Tip: The second set of buttons on the Common Functions toolbar have the same function as the corresponding buttons on the **Algorithm** dialog. It is often faster to access those functions directly as you are doing here.

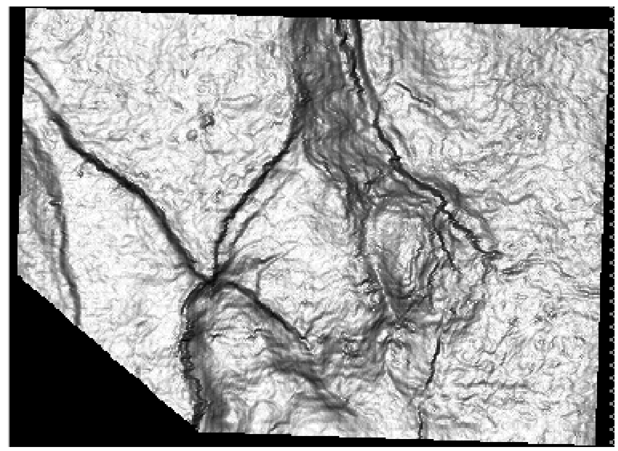
7 From the **Directories** menu, select the **\examples** path.

8 Double-click on the ‘miscellaneous\tutorial’ directory to open it, then double-click on the ‘Seismic3D_UTM.ers’ dataset with your initials to load it.

Notice that the new image is slightly rotated and skewed compared to the original. This is the effect of transforming the dataset from the original Australian Map Grid projection system to the UTM system.



Seismic3D



Seismic3D_UTM

Close the image window containing the UTM dataset

1 Using the window system controls, close the image window containing the transformed UTM dataset:

- For Windows, click the **Close** button in the upper-right window corner.

2: Dataset rotation

Objectives Learn how to use ER Mapper’s Rectification utilities to rotate a dataset any number of degrees.

In some cases you may find that a dataset has the appropriate datum and map projection, but has been rotated a number of degrees from north for one reason or another. (Sometimes datasets are rotated by ER Mapper during the importing process to make them fit in the most efficient file size.) This example shows how to perform a simple rotation of dataset while keeping the same projection and cell size.

Setup the dataset rotation

1 From the **Process** menu, select **Geocoding Wizard...**,

The **Geocoding Wizard** dialog box opens on the first page that allows you to enter the file name of the image to be rotated, and select the type of geocoding which, in this case, is Rotation.

2 Click the **Input File**  file chooser button.

3 From the **Directories** menu, select the **\examples** path.

4 Double-click on the ‘Shared_Data’ directory to open it, then double-click on the dataset ‘Seismic3D.ers’ to load it.

5 Select **Rotation** for the **Geocoding Type**.

6 Click the Geocoding Wizard **2) Rotation Setup** tab.

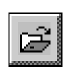
The **Rotation Setup** wizard page lets you define the number of degrees of rotation.

7 In the **Rotation** field, type the value **45**, then press Return or Enter to validate.

This tells ER Mapper to rotate the dataset 45 degrees counter-clockwise. (To rotate clockwise 45 degrees, you would enter **-45**.)

Perform the dataset rotation

1 Click the Geocoding Wizard **3) Rectify** tab.

2 Click the output info **File**  file chooser button.

This enables you to specify the file name of the rotated dataset.

3 From the **Directories** menu, select the **\examples** path.

4 Double-click on the ‘Miscellaneous\Tutorial’ directory to open it.

5 Enter the filename ‘Seismic3D_45_rotated’ (prefix the name with your initials), then click **OK**.

6 Click the **Save File and Start Rectification** button to start the rotation**.**

ER Mapper opens a status dialog to indicate the progress of the rectification.

7 When the operation finishes, click **OK** of the successful completion dialog. Then click **Cancel** on the **Rectify Dataset** dialog.

You have now created a new dataset rotated 45 degrees counter-clockwise.

8 Click the Geocoding Wizard **Close** button to exit the wizard.

Display the new rotated dataset

1 On the main menu, click the **Copy Window** toolbar button.

ER Mapper makes a copy of the current algorithm in a new image window. Move the new window so you can see the original window underneath.

2 On the main menu, click the **Load dataset** toolbar button (it has a yellow background).

The **Raster Dataset** file chooser appears. You will load your rotated dataset into the copied algorithm to compare it with the original.

3 From the **Directories** menu, select the **\examples** path.

4 Double-click on the ‘miscellaneous\tutorial’ directory to open it, then click ***once*** on your ‘Seismic3D_45_rotated.ers’ dataset to select it.

5 Click the **Apply** button to load the dataset without closing the dialog.

The new dataset is rotated exactly 45 degrees counter-clockwise from the original. The rotated dataset appears smaller, but it actually has the same cell size as the original. Null cells have been added around the edges of the new dataset to fill out the raster grid to a rectangle, so the actual file size is larger than the original.

View information on the new dataset

1 On the **Raster Dataset** dialog, click the **Info...** button.

The **Dataset Information** dialog displays. The information shows that the dataset has the same projection and other parameters as the original dataset except that it has been rotated 45 degrees.

Note: Rotating a dataset does not change the geographic location of the dataset cells or pixels. To verify this, select **Cell Coordinate** from the **View** menu and compare the coordinate locations of the same features in the two image windows.

---

2 Click **Cancel** on the **Dataset Information** and **Raster Dataset** dialogs to close them.

Close all image windows and dialog boxes

1 Close all image windows using the window system controls or by selecting **Close** from the **File** menu.

Only the ER Mapper main menu should be open on the screen.

What you learned...

After completing these exercises, you know how to perform the following tasks in ER Mapper:

- Choose a particular datum and map projection
- Transform a dataset from one projection to another
- Rotate an image any number of degrees

Notes about registering datasets

When you open or import a dataset in ER Mapper, sometimes the map projection details are not carried through to the ER Mapper format file. The main reason for this is lack of a standard way of encoding map projections that all software products can understand. If the map projection details are not carried through, you can edit the ER Mapper dataset header (.ers) file to add them. Typically you need to query this information from your seismic interpretation software, then transfer it into ER Mapper.

There are four key pieces of information that ER Mapper needs in order to properly register a dataset:

Datum & Projection–The geodetic datum and map projection to which the seismic grid has been registered. You must choose a specific text string from ER Mapper's library that represents the correct datum and projection (see the *User Guide* manual). You can also add datums and projections to ER Mapper's library if the ones you need are not already provided (most already are).

Rotation–The number of degrees the dataset has been rotated from north. ER Mapper always records this information during import (no editing needed).

Registration point–The true earth location of one pixel in the dataset. You need four values here: a registration cell (row and column location of the pixel) and a registration coordinate (the true earth location of that pixel, usually expressed in Lat/Long or Eastings/Northings). Usually this information is transferred to the ER Mapper file during import, however it is possible you may need to edit it occasionally.

Cell size–The dimensions that a single pixel occupies on the earth (pixel size or ground sample distance). Usually this information is transferred to the ER Mapper file during import, however it is possible you may need to edit it occasionally. This value is always expressed in meters. (The only exception is decimal degrees for a geodetic map projection.)

Editing the ER Mapper header (.ers) file

In the most typical case, you will need to edit the ER Mapper file to add the correct Datum and Projection. Some ER Mapper import utilities prompt you to specify the Datum and Projection during the import process, in which case the information will be added to the header file automatically. Occasionally you may also need to add the registration point and cell size information.

To edit the header file and add or change the registration information, first open the **Raster Dataset** dialog using the **Load Dataset**  button. Click once on the dataset name (.ers file) to select it, then click the **Info** button to display the **Dataset Information** dialog (as you did in the previous exercise). Then use the following sequence of buttons to access the appropriate editor fields to add or change the information:

- To edit the datum and/or projection name, select **Edit->Coordinate Space**

  (You will need to consult the *ER Mapper Reference* manual for the text strings ER Mapper uses for specific datums and projection first.)

- To edit the registration point, select **Edit->Raster Info->Registration Point**
- To edit the cell size, select **Edit->Raster Info->Cell Size**

When finished, click **OK** on all dialogs to save the new information.

16

Vector and tabular data

This chapter explains how to use ER Mapper to add overlays of vector and tabular data from external products and sources.

About vector data and Dynamic Links

In addition to drawing your own annotation using ER Mapper's drawing tools, you can also display vector data imported from other applications, and link directly to data in external formats without translation. These functions can be useful for overlaying geological interpretations stored in vector format, or linking to and displaying tabular data (such as well locations) or vector data (such as lease boundaries) in external formats.

Vector data can come from GIS products or external file formats such as DXF or Postscript. Typical uses for vector Dynamic Links include displaying subsurface geological interpretations, surface geology, or cultural data such as lease boundaries or road networks. You also use ER Mapper's contours feature to automatically create contours and labels for horizons or other datasets.

Tabular data can come from database products or tabular data files. ER Mapper can display tabular (point) data as colored circles of varying sizes. This capability is useful for applications such as plotting the locations of wells, drill sites, sample sites, and so on.

Hands-on exercises

These exercises introduce you to the basic features for displaying vector and tabular data in ER Mapper.

Note: Most of the following exercises uses a satellite image as the reference raster image for overlaying vector and tabular data, but the same concepts apply to using seismic or other geophysical datasets.

What you will learn...

After completing these exercises, you will know how to perform the following tasks in ER Mapper:

- Add annotation layers to display vector data stored in ER Mapper format (.erv)
- Add Tabular Data layers to display data stored in tabular text format (.tbl)
- Add Dynamic Link layers to display data stored in an external vector GIS format
- Generate a contour layer and labels
- Change the order and display priority of vector layers

1: Overlaying vector data

Objectives

Learn to add a layer to an algorithm to display vector data imported from an external format. In this case you will overlay vectors for a road network previously imported using ER Mapper's vector import utilities.

Load a greyscale satellite image algorithm

1 On the main menu, click the **Edit Algorithm**  button.

An image window and the **Algorithm** dialog box appear.

2 Click the **Open**  button.

3 From the **Directories** menu, select the **\examples** path.

4 Open the 'Data_Types' directory, then open the 'SPOT_Panchromatic' directory.

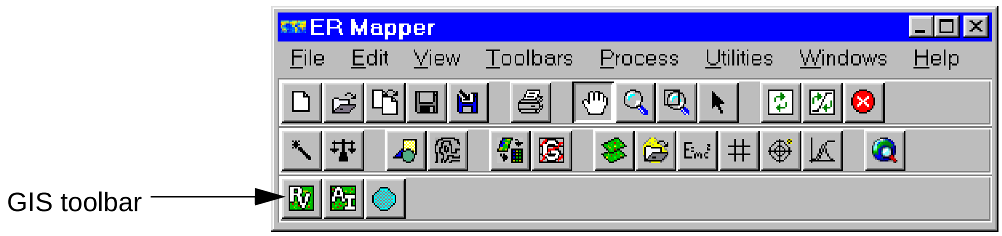
5 Double-click on the algorithm named 'Greyscale.alg.'

The algorithm displays a satellite image of the San Diego, California area from the SPOT satellite system. The dataset has 10-meter spatial resolution, so it provides good detail and is often used for base mapping applications.

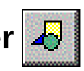
Display the GIS toolbar

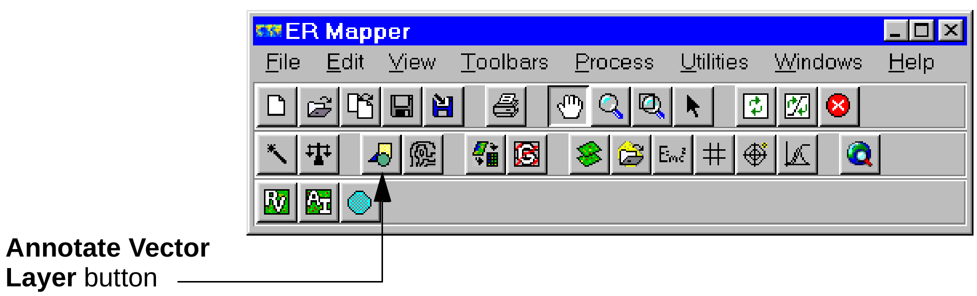
1 On the main menu, select **GIS** from the **Toolbars** menu.

ER Mapper adds a third row of toolbars buttons to the main menu. These buttons give you fast access to features for displaying and editing vector and tabular datasets.



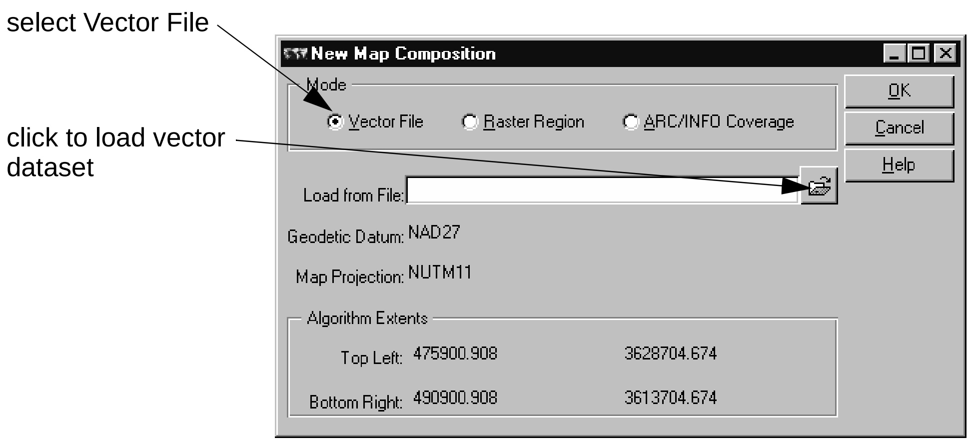
Add an Annotation layer and display a vector roads dataset

1 On the **Common Functions** toolbar, click the **Annotate Vector Layer**  button.



The **New Map Composition** dialog opens.

2 With the ‘Vector File’ option selected, click the  button to the right of the ‘Load from File’ field.



The **Load Map Composition File** dialog opens.

3 From the **Directories** menu, select the **\examples** path.

4 Open the ‘Shared_Data’ directory, then double-click on the dataset ‘San_Diego_roads.erv’ to load it.

5 Click **OK** on the **New Map Composition** dialog.

ER Mapper runs the algorithm again and displays a vector road network as a white overlay. The **Tools** dialog also opens to let you edit the vectors to add, delete or modify them if desired. Also notice that an ‘Annotation layer’ has been added to the algorithm layer list.

(This is a vector dataset of roads in the greater San Diego area. It was previously imported from a Digital Line Graph (DLG) file format using the ER Mapper import utilities and converted to an ER Mapper format vector file with an “.erv” file extension.)

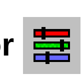
Label the vector layer and choose a color

1 Click **Close** on the **Tools** dialog to close it.

(Use of the annotation tools is covered in the chapter on Map Composition.)

Notice that the process diagram for the vector layer includes only three buttons. The image processing options such as formulas and transforms do not apply to vector layers.

2 Change the Annotation layer’s label text to **`San Diego roads`** and press Enter or Return.

3 In the process diagram, click the **Edit Layer Color**  button.

4 Choose a red color, then click **OK** to close the **Color** chooser dialog.

The roads redraw in red this time. Vector layers are designed to show line data, such as interpreted faults or lease block boundaries on a time surface.

2: Overlaying tabular data

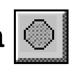
Objectives Learn to add a layer to an algorithm to display point data stored in a tabular format. (The examples used here are fire station locations, but they could just as easily be well locations on an interpreted time surface.)

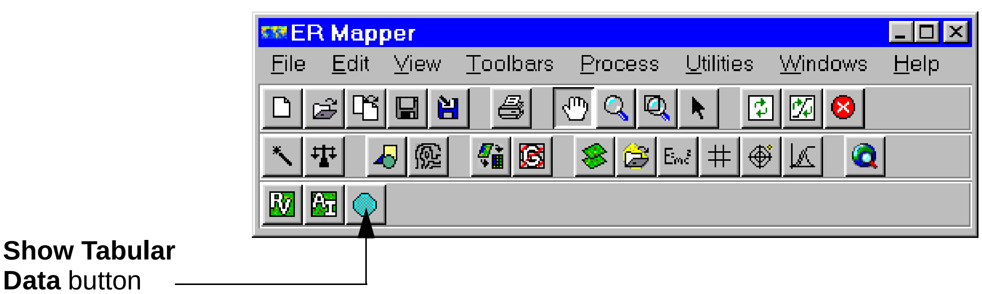
Turn off the vector roads layer

1 Turn off the vector ‘San Diego roads’ layer by right-clicking the layer and selecting **Turn Off**.

(This will make it easier to see the tabular data where there is overlap.)

Add a Tabular Data layer and load a sample dataset

1 On the **GIS** toolbar, click the **Show Tabular Data**  button.



The **Tabular Dataset** dialog opens.

2 On the **Tabular Dataset** dialog, click the **Load Dataset**  button.

3 From the **Directories** menu, select the **\examples** path.

4 Open the ‘Data_Types\SPOT_Panchromatic’ directory, then double-click on the dataset ‘San_Diego_Fire_Stations.tbl’ to load it.

5 Click **OK** on the **Tabular Dataset** dialog.

ER Mapper runs the algorithm and displays the location of each fire station as a white circle. Also notice that a ‘Table of Data as Circles’ layer has been added to the algorithm layer list. (To display the circles, ER Mapper is accessing data in an external ASCII text file with an Easting and Northing value for each location and other information.)

Label the tabular layer and choose a color

Notice that the process diagram for the tabular layer includes only two buttons. You can use the **Edit Dynamic Link** button to choose a different tabular dataset, or the **Edit Layer Color** button to change the color.

1 Change the Table of Data layer's label text to **`fire stations`** and press Enter or Return.

2 In the process diagram, click the **Edit Layer Color** button.

3 Choose a cyan (light blue) color, then click **OK** to close the **Color** chooser dialog.

The table data circles redraw in cyan this time. Tabular data layers are designed to show point data, such as the locations of wells on a time surface.

Tip: ER Mapper looks for files with the extension ".tbl" for Table of Data layers. To view the format of these files, open any of the sample files in a text editor. You can create your own table data files by converting your data into this simple ASCII text format and naming the file with a ".tbl" extension.

3: Overlaying GIS vector data

Objectives Learn to add a Dynamic Link layer to an algorithm to display vector data stored in an external GIS product format (ARC/INFO in this case). In this case, you will display a network of roads stored in an ARC/INFO format coverage file.

Turn off the Tabular Data layer

1 Turn off the vector 'fire stations' layer by right-clicking the layer and selecting **Turn Off**.

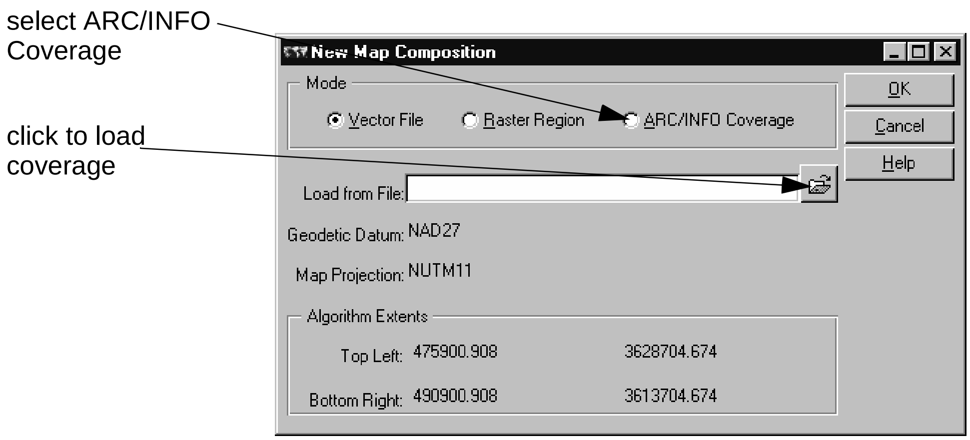
(This will make it easier to see the GIS data where there is overlap.)

Add an ARC/INFO layer and link to a workspace

1 On the **Common Functions** toolbar, click the **Annotate Vector Layer** button.

The **New Map Composition** dialog opens.

2 Select the ‘ARC/INFO Coverage’ option, then click the  button to the right of the ‘Load from File’ field.



The **ARC/INFO Chooser** dialog opens to let you choose the workspace and coverage you want to link.

3 On the **ARC/INFO Chooser** dialog, click the ‘Workspace’  button.

The **ARC/INFO Workspaces** dialog opens to let you specify the location of the workspace directory containing the ARC/INFO coverage files on your system.

4 From the **Directories** menu, select the **\examples** path.

5 Click on the ‘Shared_Data’ directory to select it.

6 Click *only once* on the directory named ‘arc_info_workspace’ to select it, then click the **Select** button.

The **ARC/INFO Chooser** dialog now shows the selected workspace, and the ‘Coverage’ drop-down list shows the available GIS vector coverages.

Note: To view ARC/INFO coverages, you select (not open) a directory as shown here, then ER Mapper will displays a list of coverages in the directory.

Choose a workspace and coverage to display

1 From the ‘Coverage’ drop-down list, select **lajollards** .

This coverage contains vectors representing the road network for the La Jolla area of San Diego (covering the northern portion of this SPOT satellite image).

2 Select **1.0** from the **Line Width** drop-down list.

3 Click **OK** on the **ARC/INFO Chooser** dialog.

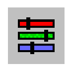
4 Click **OK** on the **New Map Composition** dialog.

ER Mapper runs the algorithm again and displays a large area network of roads in the La Jolla area (upper half of the SPOT image). The **Tools** dialog also opens to let you edit the vectors and attributes of the coverage if desired. Also notice that an ‘ARC/INFO Layer’ has been added to the algorithm layer list.

(This data was accessed directly from an ARC/INFO coverage file, so no file translation was needed to display it. You can also edit ARC/INFO coverages and save them back to coverage format.)

Label the layer and choose a line color

1 Click **Close** on the **Tools** dialog to close it.

2 Click the **Edit Layer Color**  button in the ARC/INFO layer’s process diagram.

3 Choose a yellow color, then click **OK** to close the **Color** chooser dialog.

4 Change the ARC/INFO layer’s label text to **`La Jolla roads`** and press Enter or Return.

Turn on all three color layers

1 Turn on the ‘San Diego roads’ and ‘fire stations’ layers (right-click them and select **Turn On**).

The algorithm now includes the vector, tabular and ARC/INFO direct link layers.

Note: Vector layers always appear on top of any raster layers in an algorithm, regardless of their position in the layer list. Relative to each other, the uppermost vector or tabular layer has display priority where there is spatial overlap with other vector or tabular layers.

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2 Move the ‘fire stations’ layer to the top of the layer list by dragging and dropping it.

The ‘fire stations’ tabular layer moves above the other two vector layers, so it now has the highest display priority.

The circles representing fire station now appear on top of the vector roads overlays.

4: Overlaying contour lines and labels

Objectives Learn to add a Contours layer to an algorithm to automatically generate contour lines and labels.

Open the sample TWT colordrape algorithm

1 On the main menu, click the **Open** button.

2 From the **Directories** menu, select the **\examples** path.

3 In the 'Applications\Oil_And_Gas_Exploration' directory, open the algorithm named 'Seismic_Horizon_Colordrape.alg'

This algorithm displays two-way time in color draped over shaded two-way time to enhance structural features in the horizon.

Add a Contours layer to the algorithm

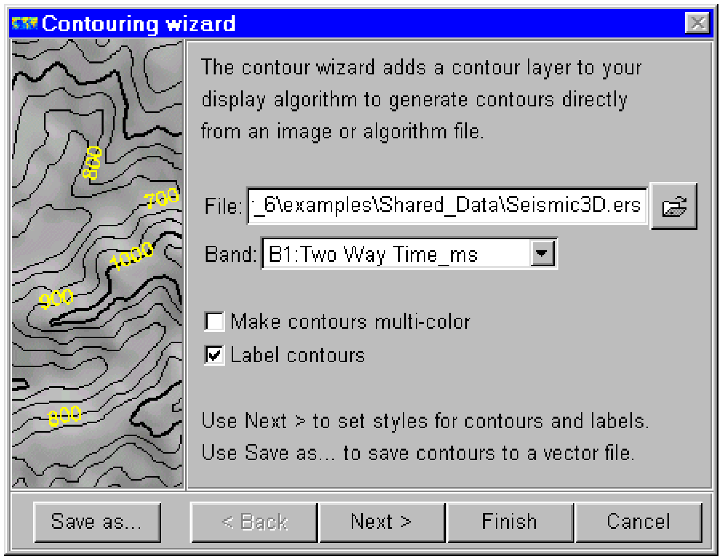
1 On the **Algorithm** dialog, open the **Edit** menu, choose **Add Vector Layer**, then choose **Contours**.

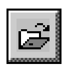
A 'Contours' layer is added to the algorithm layer list.

Specify the dataset and parameters for contouring

1 On the **Algorithm** dialog, click the **Dynamic Link Chooser** button in the process diagram.

The **Contouring Wizard** dialog opens.



2 Click the **File:**  file chooser button.

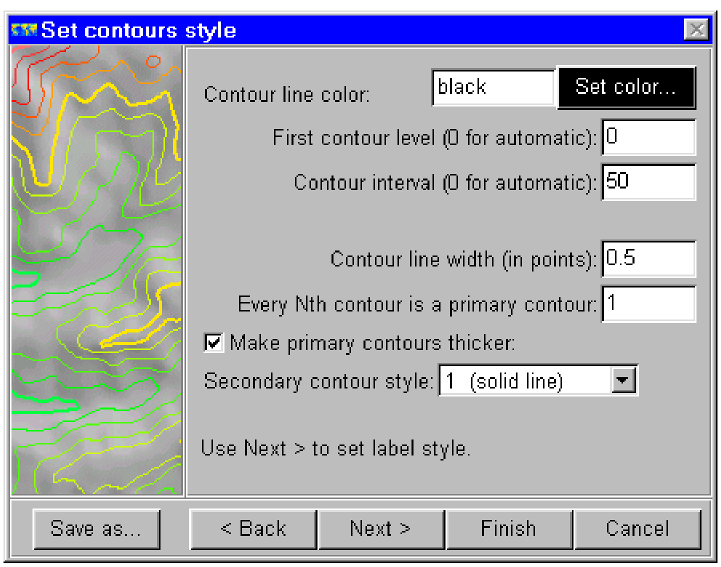
3 From the **Directories** menu, select the **\examples** path.

4 In the directory named ‘Shared_Data’, double-click on the ‘Seismic3D.ers’ dataset to load it.

5 Deselect the **Make contours multi-color** option and select the **Label contours** option.

6 Click on the **Next>** button.

7 In the **Set contours style** dialog, set the **Contour Interval** to **`50`**.



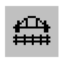
8 Click the **Finish** button.

Black contour lines are drawn over the image at 50 unit spacing (the spacing is two-way time data values). The lines have labels to indicate the contour level.

Change the contouring interval and coloring

1 Right-click the ‘Pseudo Layer’ in the layer list and select **Turn Off**.

The image will now be displayed in greyscale (since the color layer is off).

2 Select the ‘Contours’ layer again, then click the **Dynamic Link Chooser**  button in the process diagram to open the Contouring Wizard.

3 On the Contouring Wizard dialog, select both the **Make contours multi-color** and **Label contours** option.

4 Click on the **Next>** button.

5 For **Contour Interval,** enter **25**.

6 Click the **Finish** button.

The image first displays as greyscale (since you turned off the Pseudocolor layer), then contour lines are drawn at 25 unit intervals with a different color for each interval.

Close all image windows and dialog boxes

1 Close the image window using the window system controls or by selecting **Close** from the **File** menu.

2 Click **Close** on the **Algorithm** dialog to close it.

3 On the main menu, select **GIS** from the **Toolbars** menu to hide the GIS toolbar.

Only the ER Mapper main menu should be open on the screen.

What you learned...

After completing these exercises, you know how to perform the following tasks in ER Mapper:

- Add annotation layers to display vector data stored in ER Mapper format (.erv)
- Add Tabular Data layers to display data stored in tabular text format (.tbl)
- Add Dynamic Link layers to display data stored in an external vector GIS format
- Generate a contour layer and labels
- Change the order and display priority of vector layers

17

Composing maps

This chapter explains how to use ER Mapper's Page Setup and Map Composition tools to create top quality cartographic maps. You will learn about setting up a page size, scale and extents for your map, how to draw vector interpretations, how add map objects such as coordinate grids and scale bars, and considerations for printing to hardcopy devices.

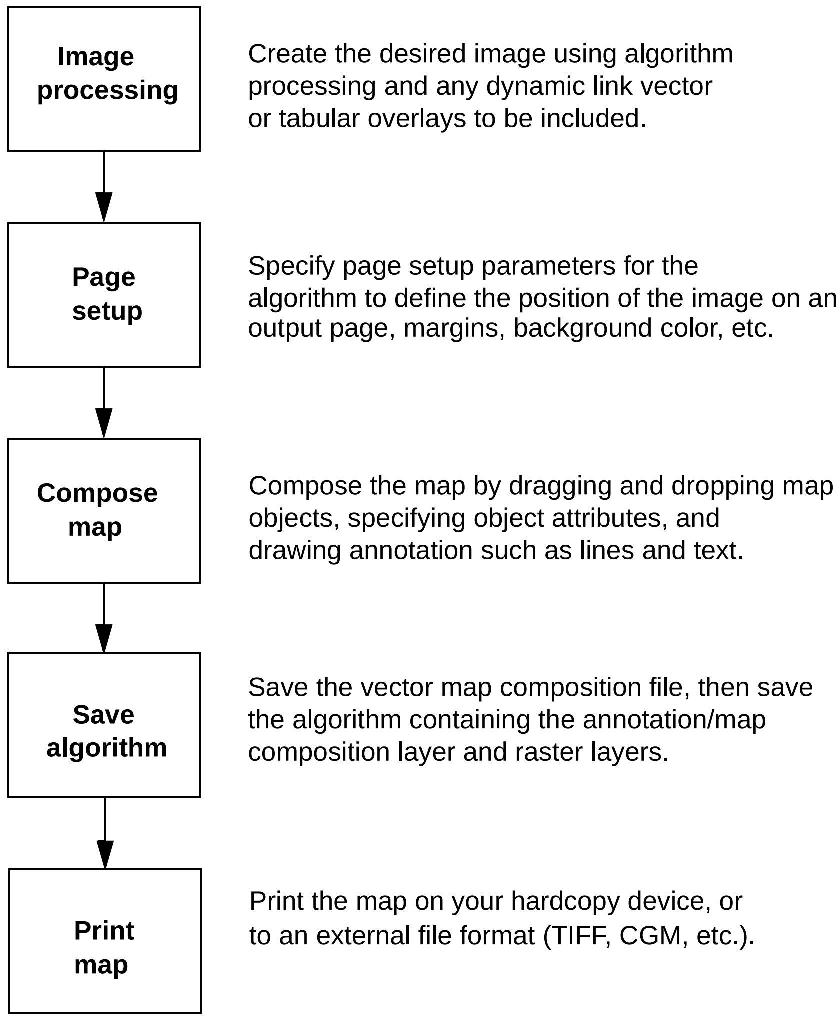
Note: The following exercise is a simplified example of creating a map. More details on some aspects are provided at the end of the chapter, and you are referred to the *ER Mapper User Guide* manual for more complete information.

About map composition

ER Mapper provides a complete set of map composition tools that let you easily transform images into top quality image maps. Your maps can include common map objects such as coordinate grids, scale bars, symbols, legends, north arrows, and more. You can use the annotation tools to draw lines, text, shaded polygons, and other vector objects. Your maps can also include other layers to add vector data from GIS systems, tabular data, or other external data.

ER Mapper's map composition also has an open design and is user-extendable. You can add your own Postscript map objects to ER Mapper's map object library, such as company logos or north arrows, include external text or graphic image files, and many other types of data. You can also modify the default attributes of map objects and save them under your own unique names for later use.

The following diagram shows the general procedure for creating and printing a map in ER Mapper:



Hands-on exercises

These exercises give you practice setting up an algorithm to create a map, defining Page Setup parameters, and composing the map by adding map objects and other annotation.

What you will learn...

After completing these exercises, you will know how to perform these tasks in ER Mapper:

- Define Page Setup parameters for an algorithm
- Add an Annotation/Map Composition layer to an algorithm
- Draw annotation objects (lines, text, polygons, etc.) on your map
- Place map objects (grids, scale bars, etc.) on your map
- Specify color and other attributes for annotation and map objects

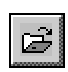
Before you begin... Before beginning these exercises, make sure all ER Mapper image windows are closed. Only the ER Mapper main menu should be open on the screen.

1: Setting up the page

Objectives Learn to use ER Mapper's Page Setup options to define the position of an image on an output page, and specify other options such as map scaling parameters and background color. In this case, you will create a 1:100,000 scale map to be printed on a hardcopy device that uses an A3 size page.

Note: The following example is a simple exercise that is designed to familiarize you with basic procedures for producing a map. It does not cover all possible modes and options. See the *ER Mapper User Guide* manual for details.

Display the sample seismic colordrape algorithm

1 On the main menu, click the **Open**  button.

An image window and the **Open** dialog box appear.

2 From the **Directories** menu, select the **\examples** path.

3 Open the 'Applications\Oil_And_Gas_Exploration' directory, then double-click on the algorithm 'Seismic_Horizon_Colordrape.alg' to open it.

This algorithm displays the two-way time data draped over shaded two-way time to enhance structural features. This is the image you will use to create your map.

Display the Annotation toolbar

1 On the main menu, select **Annotation** from the **Toolbars** menu.

ER Mapper adds a third toolbar with buttons for quick access to common functions used for annotation and map composition.

Specify Metric or Imperial units for page setup

1. On the main menu, select **Preferences** from the **Edit** menu.

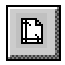
   The **Preferences** dialog opens providing **General**, **3D Options**, and **Advanced** tab pages.

2. Select the **General** tab page (if needed), then select either **Metric** or **Imperial** from the ‘Display Units’ drop-down list (whichever you prefer).

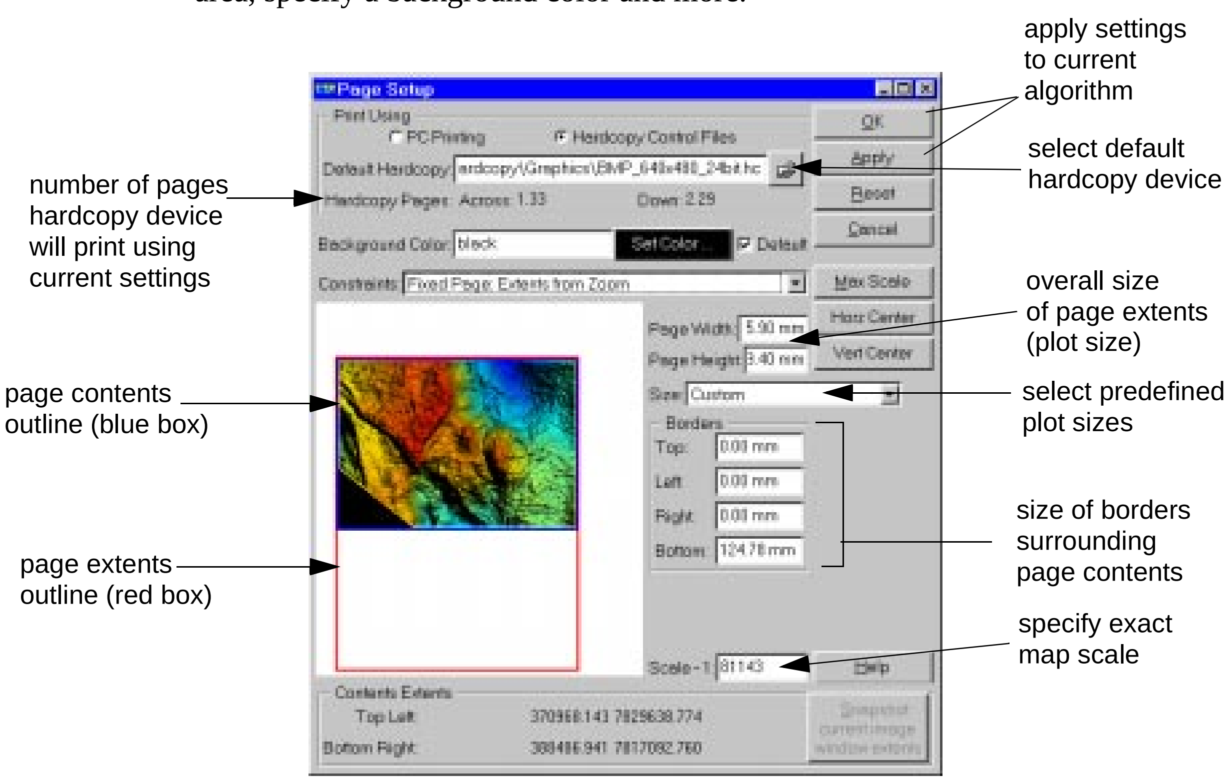
3. Click **Close** on the **Preferences** dialog to close it.

   All values regarding the plot size, margin sizes and other page setup parameters will be displayed in the measurement units you selected.

Open the Page Setup dialog box

1. From the **File** menu, select **Page Setup** (or click the **Setup Algorithm Page Size**  button on the **Annotation** toolbar).

   The **Page Setup** dialog box opens. This dialog provides controls for you to choose a default hardcopy device, position and scale your image on the output plot area, specify a background color and more.

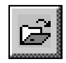


The area on the left side shows the size and shape of the plot in red (the “page extents”), and the relative size and position of the algorithm image within the plot area in blue (the “contents extents”).

Select the destination hardcopy device

1 Select the ‘Hardcopy Control Files’ option at the top (if it is present).

This tells ER Mapper to use its own set of device drivers. (If you are running ER Mapper on a PC, you are advised to use the Windows drivers.)

2 Click the **Default Hardcopy**  file chooser button.

The **Default Hardcopy** dialog opens to let you select the type of printer or graphics file that you will be using.

3 From the **Directories** menu, select the **\hardcopy** path.

A list of directories for categories of hardcopy devices and file formats displays.

4 Double-click on the directory named ‘HP’ to open it and view a list of available options for Hewlett-Packard printers.

5 Double-click on the entry ‘HP_DesignJet_300dpi_A1.hc’ to select it.

This device is now selected as your default hardcopy device, and we will assume that your example map will be printed on it. It is a good idea to choose the device you intend to print on so you can see how large your plot will be later.

(The HP DesignJet is a large format color inkjet plotter. The entry you selected is designed to tell the printer to print at 300 dots per inch on an A1 size area (22 inches or 56 cm wide) of the device’s total printable area.

Specify how the page or map contents can be scaled

The **Constraints** drop-down list lets you specify how map objects are scaled relative to the output page. Typically you need to decide which parameters are most important for your map: a fixed page size, fixed borders, or a fixed map scale.

1 From the **Constraints** drop-down list, select **Auto Vary:Page**.

The outlines representing the page extents (red) and page contents (in blue) shift down to the center of the white area on the **Page Setup** dialog, and the **Border** and **Scale** fields are now editable.

Auto Vary:Page mode tells ER Mapper that it can automatically change the size of the image extents (size) to accommodate any changes you make to the map scale or the size of borders surrounding the image. (Other **Constraints** options will automatically change plot borders or map scale if other parameters are changed.)

Snap Shot the current algorithm extents

1 Click the **Snap Shot Current Extents** button.

ER Mapper updates the values in the **Contents Extents** fields. (For example if you had zoomed in or out in your algorithm, **Snap Shot** updates the contents extents to match the current display extents of your algorithm.)

Specify the output map scale

1 In the **Scale - 1:** text field, enter the value **`50000`** then press Enter or Return to validate.

ER Mapper sets the size of the page contents (the physical size of the image on the page) to print at 1:50,000 map scale.

Specify borders surrounding the page contents

Right now the page extents and page contents are the same size. Next you will add borders around the contents (the seismic image) so you have space to add a title, scale bar, map grid, and other items.

1 In the text fields under ‘Borders,’ enter the following values for each field in the units you are using (press Enter or Return after each to validate):

Top: **`63.5`** (mm) or **`2.5`** (inches)

Left: **`63.5`** (mm) or **`2.5`** (inches)

Right: **`63.5`** (mm) or **`2.5`** (inches)

Bottom: **`76.2`** (mm) or **`3`**(inches)

By adding borders, you increased the total plot size to 477.38 by 390.70 mm (or 18.79 by 15.38 inches). The blue outline shows the relative size and position of the page contents in the new, larger plot size. The physical size of the seismic image (page contents) has not changed, it will still print at 1:50,000 scale.

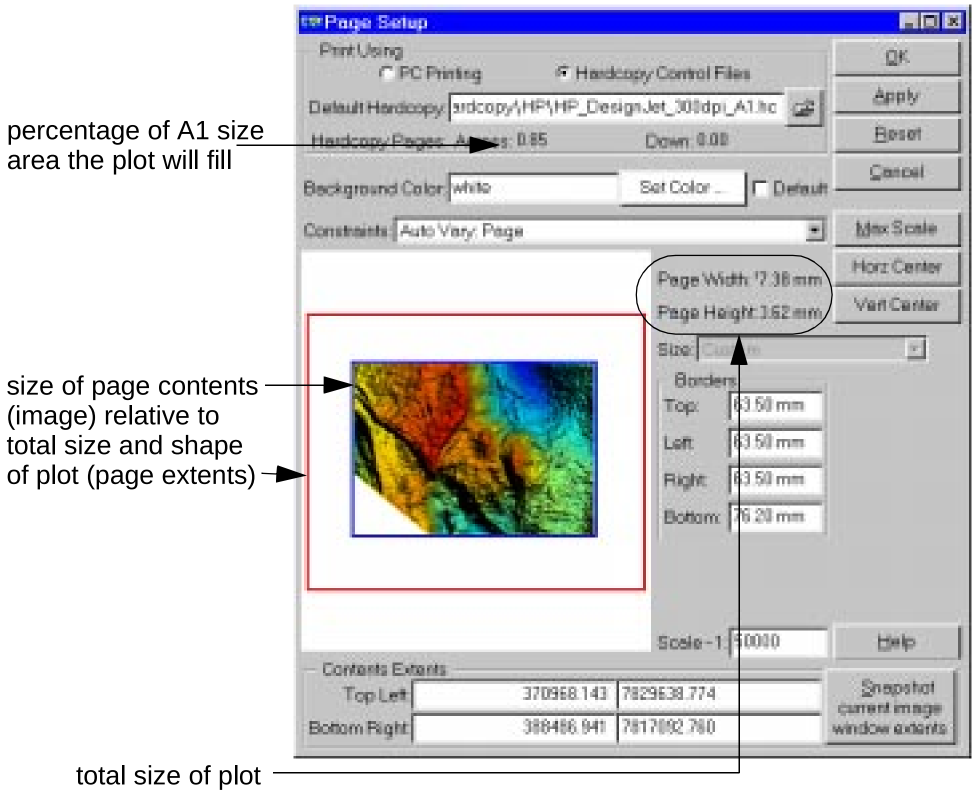
Tip: After setting the desired map scale and border values, notice that the Hardcopy Pages Across and Down fields show the percentage of device’s the A1 size print area that the plot will occupy (85% of the width of an A1 page in this case). If your total plot size (page extents) is larger than the print area of your device, these values will be greater than one, indicating that ER Mapper would divide the plot and print each portion on a separate page or strip.

Set the background color to white

1 Select the text in the **Background Color** field, type **`white`**, and press Enter or Return to validate.

ER Mapper sets the page background color to white (the areas of the page surrounding the page contents). If you will be printing on a device that has a white background, it is often helpful to set the background color to white while you are composing the map to get a better idea of the final output. (You can use the **Set Color** button as well to choose any arbitrary background color.)

Your **Page Setup** dialog should now look like this (units shown are Metric):



Save the algorithm with the Page Setup parameters

1 Click **OK** on the **Page Setup** dialog to close it.

ER Mapper redisplays the colordrape image to show the white page border areas that you added in **Page Setup**.

2 From the **File** menu, select **Save As...** to save the algorithm under your own name.

3 In the **Files of Type** field, select ‘ER Mapper Algorithm (.alg)’.

4 From the **Directories** menu, select the **\examples** path.

5 Double-click on the ‘miscellaneous\tutorial’ directory to open it.

6 In the **Save As:** text field, type a name using your initials at the beginning, followed by the text ‘horizon_map.’ Separate each word with an underscore (_). For example, if your initials are “JR,” type in the name:

`JR_horizon_map`

7 Click **OK** to save the algorithm, which now includes your page setup parameters.

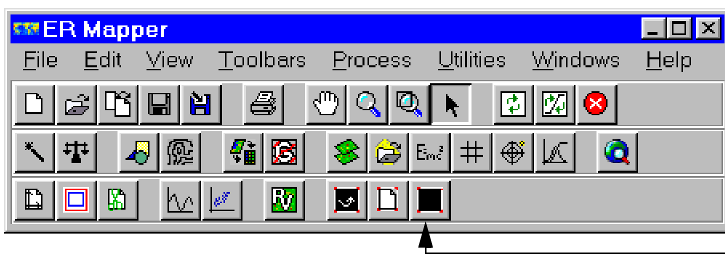
2: Drawing interpretations on the image

Objectives Learn to use ER Mapper's Annotation tools to draw interpretations and annotation objects such as polylines, polygons, and text. Also learn to zoom the image in or out to the page extents or page contents.

Zoom to the Page Contents and Page Extents

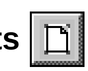
Currently the image is zoomed out to show the page extents and the relative position of the image within it.

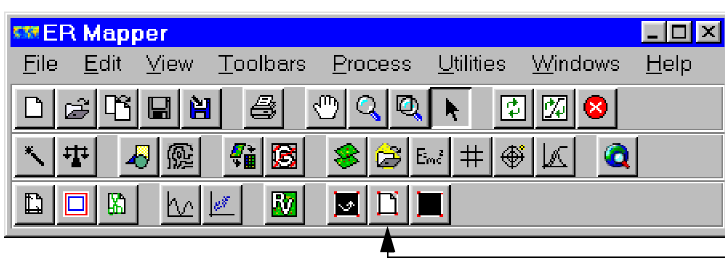
1 On the **Annotation** toolbar, click the **Zoom to Contents Extents**  button.



Zoom to Contents Extents button

The image zooms in to the extents of the page contents (the extents of the seismic image itself).

2 On the **Annotation** toolbar, click the **Zoom to Page Extents**  button.



Zoom to Page Extents button

The image again zooms out to the extents of the page defined for the algorithm, and the image (the page contents) appears with the surrounding white borders.

3 Click the **Zoom to Contents Extents** button again.

The image zooms in to the extents of the page contents again. (Since you will draw interpretations on the image, it is helpful to maximize the area on the screen used for the image. Later you will zoom to the extents again to add map objects in the border areas.)

4 Expand the image window size to make it slightly larger. (Try to shape the window so it approximately matches the shape of the image).

Note: ER Mapper should have automatically set the **View Mode** in the Algorithm dialog to 'Page Layout'. If it is set to 'Normal', then **Zoom to Page Extents** will display the contents, and not the full page.

Add a vector layer for map annotation

1 On the **Common Functions** toolbar, click the **Annotate Vector Layer** button, or, from the **Edit** menu (on the main menu), select **Annotate Vector Layer...**.

The **New Map Composition** dialog box opens to ask what type of annotation you want to create. You can create a vector file, raster regions (as you did in an earlier exercise), or an ARC/INFO GIS coverage file.

2 Make sure the **Vector File** option is selected, then click **OK** on the **New Map Composition** dialog.

ER Mapper opens the **Tools** dialog containing your drawing tools. Move the **Tools** dialog next to the right side of your image.

Label the annotation layer

1 Click the **Edit Algorithm** button on the main menu.

On the **Algorithm** dialog, notice that ER Mapper has added an 'Annotation Layer' to the algorithm layer list to display the interpretations you create.

2 Change the annotation layer's label to `interpretations`.

3 Click **Close** on the **Algorithm** dialog to close it.

Draw a polyline to trace linear features

1 On the **Tools** dialog, click once on the **Polyline** button.

2 Point to a linear feature inside the image (such as a fault). Then draw a line to trace the feature by clicking once at each point, then double-clicking to end the line.

A line appears on your image to highlight the linear feature. Note that markers appear on the line at each node to indicate that the line is "selected."

View and modify the attributes of the polyline

1 On the **Tools** dialog, *double-click* on the **Polyline** button.

The **Line Style** dialog box opens to let you choose attributes for your polylines.

2 Click the **Set Color** button, choose any contrasting color, then click **OK** to close the **Color** chooser dialog. (Black or white are good choices.).

The line color on the image changes to your selected color.

3 Click the **Width** drop-down list and choose **3.0** to increase the line width.

4 Click on a dashed line style under **Line Pattern** to select a line style.

The attributes for your selected polyline change interactively.

5 On the **Tools** dialog, click on the **Edit Object Extents** button.

The **Map Composition Extents** dialog opens to show information about the polyline object. It shows the line length in map units, and other attributes such as the number of vertices, geographic extents, and so on.

6 Click **Close** on the **Object Extents** dialog.

Tip: To draw a straight line with an arrowhead, use the **Polyline** tool to draw the line, then turn on the 'Start' or 'End' option under 'Arrow at:' in the **Line Style** dialog.

Draw a second polyline and modify it

1 Draw a second polyline to define another linear feature of interest (click once at each point, then double-click to end the line).

The new polyline inherits the current attributes set in the **Line Style** dialog.

2 Click the **Set Color** button, choose a different color for the new line, then click **OK**.

3 On the **Tools** dialog, click the **Select/Edit Points Mode** button.

4 Drag any node of the selected polyline to move it.

When a polyline is selected and **Select/Edit Points Mode** is active, you can reshape the line as desired by dragging the line nodes. (You will learn how to move entire objects later.)

5 Click on your first polyline to select it (selection handles should appear).

The **Line Style** dialog changes to show the attributes of the first (selected) polyline.

6 In the **Line Style** dialog, turn on the 'Curved' option.

ER Mapper applies a spline function to the selected line and reshapes it into smooth, rounded curves. This can be helpful to create more visually pleasing lines when tracing faults and other linear features.

7 Turn off the 'Curved' option.

The line returns to its original appearance with straight segments at each node.

8 Click **Close** on the **Line Style** dialog.

Draw a shaded polygon around a feature

1 On the **Tools** dialog, click on the **Polygon** button.

2 Point to the V-shaped uplifted block in the upper-left part of the image. Then draw a polygon around the feature by clicking once at each point, then double-clicking to close the polygon.

The polygon object appears surrounding the fault block, and it is selected. By default, your polygon displays the currently selected line color, thickness, etc.

3 On the **Tools** dialog, double-click on the **Polygon** button.

The **Line Style** dialog box opens to let your set polygon attributes. (The same dialog is used for polylines, rectangles, and other vector objects.)

4 Click the **Set Color** button, choose a cyan (light blue) color, then click **OK** to close the **Color** chooser dialog.

5 Under **Fill Pattern**, click on one of the diagonal line fill patterns.

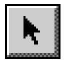
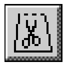
The pattern you choose appears in the **Current Fill** window on the dialog. The polygon is filled with a diagonal cyan shade pattern.

6 Click **Close** on the **Line Style** dialog.

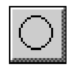
7 On the **Tools** dialog, click on the **Edit Object Extents** button.

The **Object Extents** dialog opens to show information about the polygon object, including the perimeter length and area.

8 Click **Close** on the **Object Extents** dialog to close it.

Tip: To delete a node from an existing polyline or polygon, use **Select/Edit Points Mode**  to select it, click on the node to delete, then click the **Delete Point**  button. To add a node, click the **Add Points Mode**  button, then click on the line to add a node at that point.

Draw a shaded oval and move and resize it

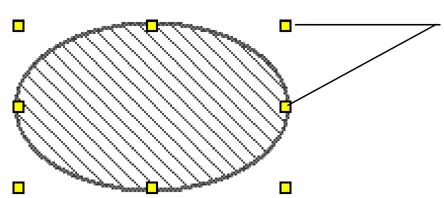
1 On the **Tools** dialog, click the **Oval**  button.

2 Point anywhere inside the image, drag an oval shape and release.

A shaded cyan oval appears. By default, the oval is selected.

3 On the **Tools** dialog, click the **Select and Move/Resize Mode**  button.

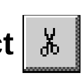
Select and Move/Resize Mode lets you move and/or resize the selected object. Notice that the oval's selection handles change–now there are eight handles.

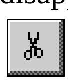


4 Drag one of the selection handles to increase the oval size.

5 Point inside the oval, and drag it to a new location.

When an object is selected and **Select and Move/Resize Mode**  is active, you resize or reshape the object by dragging a handle, or move the object by dragging it from inside.

6 In the **Tools** dialog, click the **Delete Object**  button.

The selected oval object disappears from the image. Selecting an object and clicking **Delete Object**  is how you delete any vector annotation object.

Tip: If you delete an object by mistake, immediately click the **Undo Last Delete** button to restore it.

Tips for selecting objects

ER Mapper's annotation tool set provides two "select" tools for different tasks:

- Use the **Select/Edit Points Mode** button to select a polyline or polygon object when you want to move the individual line nodes, or select nodes.
- Use the **Select and Move/Resize Mode** button to select any annotation object when you want to move the entire object (drag from the center) or resize the entire object (drag one of the yellow handles).
- To select multiple objects at once, choose the **Select and Move/Resize Mode** button. Then either drag a marquee box around all the objects, or select them one at a time by holding down the Shift key and clicking on them.

Draw and modify a text string

1. On the **Tools** dialog, click the **Text Object** button.

   The **Text Style** dialog box opens.

2. Drag a box inside the image with the same height as desired for the text.
3. In the **Text Style** dialog, click in the **Text** field at the bottom to position the cursor, then type **`gas bearing block`**.

   The text appears on the image as you type.

4. In the **Text Style** dialog box, select the following text attributes:

   Size: 48.0

   Color: choose any bright color

   Font Type: PostScript Stroke

   Font: Helvetica-Bold

   Notice that the text object automatically updates as you change the attributes.

5. Click the **Select and Move/Resize Mode** button, then drag the text in the image to cover the V-shaped fault block.

Draw and rotate a text string

1 Drag a box in another part of the image near the center.

2 In the **Text Style** dialog, click in the **Text** field to position the cursor, then type **`rotated text`**.

3 From the **Angle (deg)** drop-down list, select **45.0**.

The text string rotates 45 degrees counter-clockwise, so it now points down toward the upper right. (Text strings rotate around their origin in the upper-left corner.)

4 On the **Tools** dialog, click the **Select and Move/Resize Mode**  button.

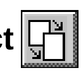
5 Point to the text block, and drag it to any desired position.

You have now learned to draw and modify simple annotation objects such as lines, polygons, and text. Next you will add map objects to your page.

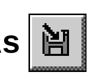
Tip: Text drawn as annotation can be set to always print at an exact point size (the **Fixed Text** option on), or to automatically scale up or down proportionally at whatever size the image is printed (**Fixed Text** option off).

---

6 Click **Close** on the **Text Style** dialog to close it.

Tip: To duplicate an object, select it and click the **Clone Object**  button. This can useful, for example, for copying blocks of text or creating exact copies of polygons, ovals, and so on.

Save the interpretations to an annotation file

1 On the Tools dialog, click the blue **Save As**  button.

The **Map Composition Save As** dialog opens.

2 Make sure the ‘Vector File’ option is selected, then click the  button next to ‘Save to File.’

3 From the **Directories** menu (on the file chooser dialog) , select the **\examples** path.

4 Double-click on the ‘Miscellaneous\Tutorial’ directory to open it.

5 In the **Save As:** text field, type a name using your initials at the beginning, followed by the text ‘interpretations.’ For example, if your initials are “CR,” type in the name:

```
CR_interpretations
```

6 Click **OK** to validate the filename.

7 Click **OK** on the **Map Composition Save As** dialog.

Your vector annotation objects are saved to an ER Mapper format vector file (.erv) on disk.

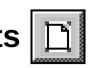
8 Click **Close** on the **Tools** dialog.

3: Defining map objects

Objectives Learn to use ER Mapper's Map Composition tools to place and modify map objects such as scale bars, coordinate grids, north arrows, and others.

Up until this point, you have used ER Mapper's vector annotation tools to draw line, polygon, and text objects. Now you will use the Map Composition tools to automatically create complex color map objects that you can position on the page.

Zoom to the Page Extents to view the entire map page

1 On the **Annotation** toolbar, click the **Zoom to Page Extents**  button.

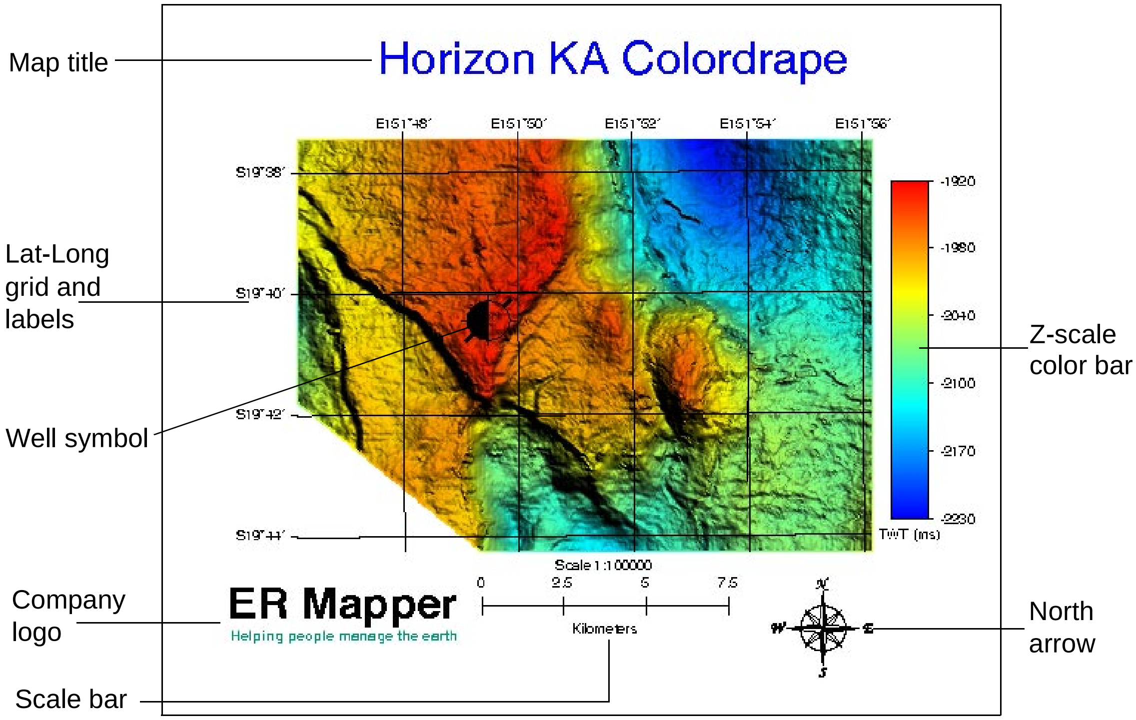
The image zooms out to the extents of the page defined for the algorithm, and shows the white border areas where you will place map objects.

2 On the **Tools** dialog, click on the **Map Rectangle**  button.

The **Map Object Select** and **Map Object Attributes** dialog boxes open on the right side of the screen. These dialog boxes let you drag and drop map objects onto the page in your image window, and specify attributes for the objects.

Layout the types and positions of map objects

Before creating your map, it is a good idea to determine which types of map objects you want to use, and their relative sizes and positions on the page. In this exercise, you will create a map with the following objects similar to this one



You will define these objects on your image window “page” in two ways:

- draw a bounding box and drag-and-drop the object into it; or
- drag-and-drop the object onto the page and resize the bounding box afterward

Refer back to the diagram above as a guide for the size and position of map objects you are asked to create in the next sections.

Add a second vector layer for map annotation

1. On the **Common Functions** toolbar, click the **Annotate Vector Layer** button.

   The **Open Map Composition** dialog box opens showing the name of the first annotation file you created. You want to create a second new one.

2. Click **New** on the **Open Map Composition** dialog.
3. On the **New Map Composition** dialog that opens, make sure the **Vector File** option is selected, then click **OK**.

   ER Mapper opens the **Tools** dialog containing your drawing tools.

Add a scale bar below the image

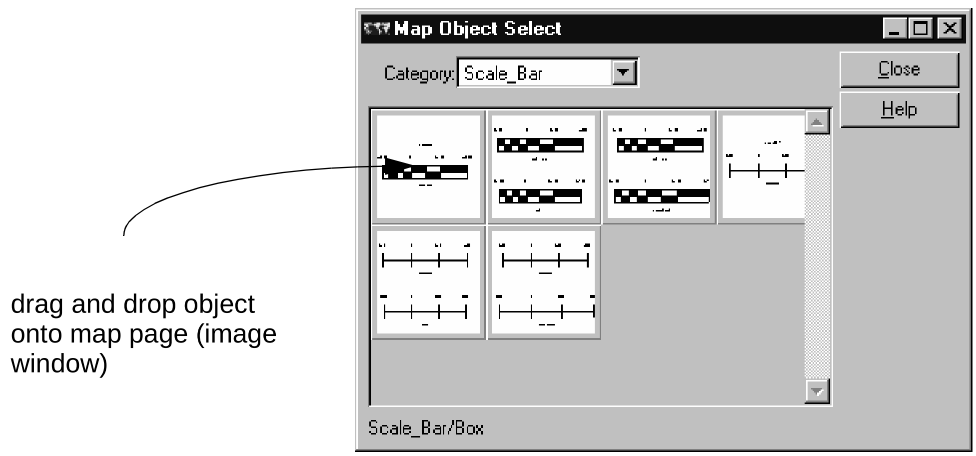
1 On the **Tools** dialog, click on the **Map Rectangle**  button.

The **Map Object Select** and **Map Object Attributes** dialogs open. These dialogs let you drag-and-drop map objects onto your page and specify color, text style, and other attributes.

2 In the **Map Object Select** dialog, select **Scale Bar** from the **Category** drop-down list.

Previews of the various types of scale bar objects appear. The name of the object is shown in the status line at the bottom of the dialog when you point to it.

3 Point to the icon titled **Scale_Bar/Box**, then drag and drop it into a position below the color image.



The scale bar object is "dropped" onto the page and it draws a few seconds later. Notice that the scale bar is contained inside a box defined by four selection handles. This is called the object *bounding box*, and it lets you control the size and position of the map object on the page.

The default attributes for the scale bar appear in the **Map Object Attributes** dialog box.

Zoom in on the scale bar and change the attributes

1 On the **Tools** dialog, click the **ZoomBox Mode**  button.

2 Inside the image window, drag a box around the scale bar object to zoom in on it.

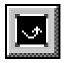
3 On the **Map Object Attributes** dialog, change the following attributes for your scale bar:

Labels Color: black

Labels Font: Helvetica-Bold (Font Type: PostScript Stroke) (select from pop-up fonts dialog)

Units Font: Helvetica-Bold (Font Type: PostScript Stroke)

Notice that the scale bar object automatically updates as you change the attributes.

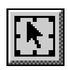
4 On the Annotation toolbar (on the main menu), dialog, click the **Previous Zoom**  button.

ER Mapper zooms out to the previous zoom level (the page extents).

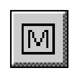
5 On the **Tools** dialog, click the **Select and Move/Resize Mode**  button.

6 Drag your scale bar object into the desired position, or resize it by dragging one of the selection handles.

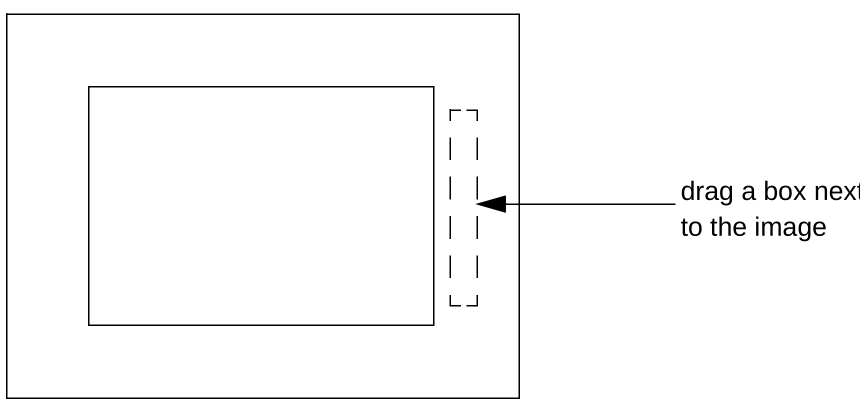
If you resize the scale bar (make it wider or narrower), ER Mapper automatically adjusts the scale and divisions (it is a “smart” map object).

Tip: To resize or move any map object, select it first using the **Select and Move/ Resize Mode**  button, then move or resize it as desired.

Add a z-scale color bar next to the image

1 On the **Tools** dialog, click the **Map Rectangle**  button.

2 Drag a tall narrow box along the right side of the image.



A dotted bounding box appears, and it is selected by default.

In this case, you are defining the desired size and position of your map object first by drawing a bounding box, then you will drag the object inside it.

3 In the **Map Object Select** dialog, select **ZScale** from the **Category** drop-down list.

A list of various types of z-scale color bar objects appears.

4 Point to the icon titled **ZScale/Algorithm_LUT** (top left icon), then drag and drop it into the bounding box you drew.

A z-scale color bar draws to fill the box. (Note that the box must be selected first before you can drop an object into it.)

5 On the **Map Object Attributes** dialog, change the following attributes for your z-scale color bar:

Color: black

Units: type the text **`TWT (ms)`** then press Enter or Return

You now have a z-scale color bar with labels to indicate how two-way time values are mapped to the lookup table colors used to display the image.

Tip: To make a horizontal z-scale color bar, simply make your bounding box wider than it is tall. As with most map objects, z-scale color bars are smart, so the colors change automatically if you change the color table in your algorithm.

Add a north arrow on the lower-right

1 In the **Map Object Select** dialog, select **North Arrow** from the **Category** drop-down list.

A list of icons representing various types of north arrows appears.

2 Point to the compass north arrow (**North_Arrow/Compass**), and drag it to a position in the lower-right of the page.

The north arrow object drops onto the page.

3 Click the **Select and Move/Resize Mode** button (on the **Tools** dialog), and resize and position the north arrow as desired.

Tip: ER Mapper’s north arrows are “smart” and will always point to north on a rectified image.

Add a company logo on the lower-left

1 In the **Map Object Select** dialog, select **Logo** from the **Category** drop-down list.

A list of icons showing some sample company logos appears.

2 Point to the **ER Mapper** logo icon, and drag-and-drop it onto the lower-left part of the page.

The logo object drops onto the page. Resize or position it if desired.

Tip: You can add your own company logos as Postscript files and access them from the standard Logos category used here.

Add a well symbol to the image

1 On the **Tools** dialog, click on the **Map Rectangle** [M] button.

2 Drag a square bounding box on the V-shaped red fault block in the image

3 In the **Map Object Select** dialog, select **Wells** from the **Category** drop-down list.

A list of icons showing standard well symbols appears.

4 Point to the **Wells/Symbol16** icon, and drag-and-drop it onto your bounding box.

The well symbol object drops onto the page. Resize or position it if desired. (Symbol 16 is the symbol for a Suspended Gas Condensate well as shown in the **Map Object Attributes** dialog.)

Add a main title above the image

1 On the **Tools** dialog, click on the **Map Rectangle** [M] button.

2 Drag a bounding box centered at the top of the image window (leave some space below it for grid labels).

3 In the **Map Object Select** dialog, select **Title** from the **Category** drop-down list.

4 Point to the icon titled **Title/Scaling**, drag it into the bounding box you defined above the image.

(The default title color is white so it does not appear initially.)

5 On the **Map Object Attributes** dialog, change the following text and attributes for your title:

Title: Horizon KA Colordrape (press Enter or Return afterward)

Font Color: blue

The title object automatically updates as you change the attributes.

Define a Latitude/Longitude coordinate grid over the image

1 In the **Map Object Select** dialog, select **Grid** from the **Category** drop-down list.

2 Point to the **Grid/LatLong** icon, drag it into the image.

The grid map object draws on the image.

3 On the **Map Object Attributes** dialog, click the **Fit Grid** button.

ER Mapper automatically resizes and positions the bounding box for the grid to fit exactly to the extents of the page contents (image) on the page.

4 On the **Map Object Attributes** dialog, turn on the **Fast Preview** option.

Fast Preview tells ER Mapper *not* to update the object interactively as you change the attributes.

5 On the **Map Object Attributes** dialog, change the following attributes for your grid (use defaults for all others):

Grid Style: Full Grid

Grid Spacing X: 2 minutes)

Grid Spacing Y: 2 minutes

Top labels orientation: Horizontal Right

6 On the **Map Object Attributes** dialog, turn off the **Fast Preview** option.

The grid map object is rendered using the attributes you defined.

Tip: The **Fast Preview** option is very useful for working with complex map objects that take time to redraw (such as a grid or algorithm image). This lets you change all the attributes you desire or fine tune object size/position without ER Mapper trying to update the object on the screen each time.

Adjust the size or position of any object

If desired, you can easily resize or position any map object by moving or resizing the bounding box that contains it.

1 In the **Tools** palette dialog, click the **Select and Move/Resize Mode**  button.

2 Click on any map object to select it (the handles will appear), and drag the bounding box to reposition it or change the size by dragging a handle.

Save the map composition file to disk

1 On the Tools dialog, click the blue **Save As** button.

The **Map Composition Save As** dialog opens.

2 Make sure the 'Vector File' option is selected, then click the button next to 'Save to File.'

3 From the **Directories** menu (on the file chooser dialog) , select the **\examples** path.

4 Open the 'miscellaneous\tutorial' directory.

5 In the **Save As:** text field, type a name using your initials at the beginning, followed by the text 'map_composition.' For example, if your initials are "JT," type in the name:

```
JT_map_composition
```

6 Click **OK** to validate the filename.

7 Click **OK** on the **Map Composition Save As** dialog.

Your map objects are saved to an ER Mapper format vector file (.erv) on disk.

8 Click **Close** on the **Tools** dialog.

Note: When you close the **Tools** dialog (exit edit mode), ER Mapper redisplays the image exactly as it will look when printed. (During edit mode, line thickness is slightly exaggerated to help editing and modifications.)

Label the map composition layer

1 Click the **Edit Algorithm** button on the main menu.

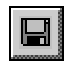
On the **Algorithm** dialog, you now have two annotation layers–your first 'interpretations' layer and your map composition layer (labelled 'Annotation Layer' by default).

2 Change the 'Annotation Layer' label to `map composition`.

3 Click **Close** on the **Algorithm** dialog to close it.

Tip: It is often helpful to separate different types of annotation into separate files as you did here–one for interpretations and another for map objects. This makes it easier to work with the data, and you can simply turn the desired vector layers on/off to display/not display those items in your algorithm. (You could have saved both your vector interpretations and map objects in the same file.

Save the algorithm to update the changes

1 On the main menu, click the **Save**  toolbar button.

2 When asked to confirm the overwrite, click **OK**.

Your algorithm can now be printed using the **Print**  toolbar button or by selecting **Print** from the **File** menu.

Note: It is important to remember to save your algorithm after defining map objects. Otherwise the annotation layers and files will not be part of the algorithm when you go to print it later.

Close all image windows and dialog boxes

1 Close the image window using the window system controls or by selecting **Close** from the **File** menu.

Only the ER Mapper main menu should be open on the screen.

What you learned...

After completing these exercises, you know how to perform the following tasks in ER Mapper:

- Define Page Setup parameters for an algorithm
- Add an Annotation/Map Composition layer to an algorithm
- Draw annotation objects (lines, text, polygons, etc.) on your map
- Place map objects (grids, scale bars, etc.) on your map
- Specify color and other attributes for annotation and map objects

Additional features of Map Composition

The preceding simple example covered only the basics of using ER Mapper's Map Composition, and following are some additional features. Refer to the chapter on creating maps in the *ER Mapper User Guide* for complete information.

- If you drag an object into a bounding box that already contains an object, the old object is replaced by the new one. This is an easy way to try several north arrows, for example.
- Objects that are dragged and dropped to replace a current object automatically inherit any common attributes from the previous object. For example, if you have a red north arrow in a bounding box and then drag in a scale bar object, the scale bar automatically inherits the red color (since both objects have the "Color" attribute in common).
- You can modify the default attributes of map objects and save them under your own names (using **Save As** on the **Map Object Attributes** dialog).
- You can draw other image processing algorithms you've created as map objects on the page (using the **Category: Algorithm** on the **Map Object Select** dialog). This is useful for drawing inset images that show an overview map, inset image, or other types of processing techniques or data of the same area.
- You can plot objects from external files like TIFF, EPS, or Targa (using the **Category: Image** on the **Map Object Select** dialog)
- You can import text directly from ASCII text files and plot it on your map page (using the **Category: Text** on the **Map Object Select** dialog)

Page Relative and Map Unit Relative map objects

The vector map objects you defined in this exercise have their position and size specified relative to the page, rather than to map units (such as Latitude Longitude). This allows you to create standard map sheets with objects that remain in a fixed size and position on the page, regardless of how the page is scaled or the extents of the datasets used in the page contents are changed.

You can also specify the position of map objects in geographic coordinate units. The position of each object is tied to a particular geographic location and map sheet size.

To specify a map object as map unit relative, turn off the **Page Relative** option on the **Map Object Attribute** dialog box. The page relative attribute can be assigned either before or after the object is dragged-and-dropped onto the page. See the *ER Mapper User Guide* for more information.

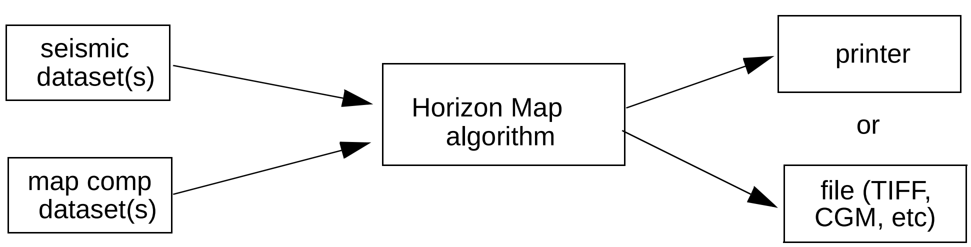
Page Setup Constraints options

In the previous simple example, you chose the ‘Auto Vary:Page’ option, although you could have chosen others as well. The Constraints options you can use are summarized briefly below:

- **Fixed Page:Extents from Zoom**–This is the default setting for all new algorithms, where the contents scale and borders are taken from the current zoom extents of the algorithm. For map making purposes, Extents from Zoom is not recommended because it can effect line thickness and text sizing.
- **Auto Vary:Page**–This mode allows ER Mapper to automatically vary the page size to account for any changes made to the map scale or page borders. This mode is easiest, for example, to print a map at an exact scale without regards to constraining it to a specific page size. If you want to place map objects outside the image (page contents) area, enter the desired border sizes to create space for them. (This is a good initial choice when you are prompted to change the mode when using the annotation tools.)
- **Auto Vary:Borders**–This mode allows ER Mapper to automatically vary the page borders to account for any changes made to the map scale or page size. This mode is most useful for printing at both an exact map scale and exact plot size.
- **Auto Vary:Scale**–This mode allows ER Mapper to automatically vary the map scale to account for any changes made to the page size or page borders. This mode is useful, for example, for printing an image at various sizes when exact map scale is not important.

Printing your map

When you want to print your final map algorithm (using **File/Print** or the **Print**  button), ER Mapper asks for the name of the algorithm. When the print operation begins, ER Mapper automatically locates, processes and renders all the datasets used in the algorithm into one final print image. In this case, your map algorithm uses two datasets–a seismic horizon raster dataset, and a vector map annotation dataset (which you created).



Since the map algorithm is made of several layers (and datasets), you can easily change it. For example, to print the image without the map annotation, simply turn off that layer in the algorithm, resave it, and print it.

Tip: If you select **Print** while your algorithm is open on the screen, ER Mapper makes a temporary copy of the algorithm in memory and automatically loads it into the **Print** dialog. This lets you print the current algorithm, even if you have not re-saved it after you added vector layers.

18

Gridding

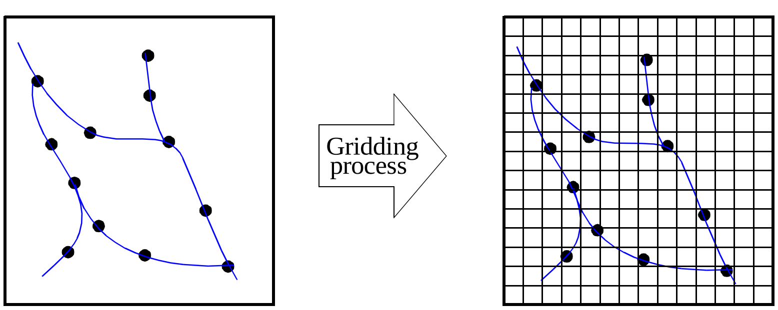
This chapter explains how to use ER Mapper's Gridding Wizard to create gridded raster images from different types of data.

Overview

There are many instances where you require data to be in a regularly spaced grid, but is only available as samples taken at irregularly spaced locations.

A gridding process will use irregularly spaced data to create a gridded raster image. It does this by laying a regularly spaced grid over the whole area and calculating a value for each cell in the grid. The accuracy of these calculations depends on the method used and the density and spacing of the input data.

The diagram below illustrates how a set of sample measurements taken at different spots along a road network are used by a gridding process to create a gridded raster image of the whole area. As can be seen, there are large areas on the output where no input data is available.



Geologists, mainly those in the mining industry, would use a gridding process to manipulate or “grid up” random geochemical samples.

You can use the ER Mapper Gridding Wizard to extract regularly gridded raster files from a combination of any or all of the following types of data.

- Random line data
- Contour data, with faults, streamlines, ridgelines, and breaklines
- Random point data
- Regular line data
- Regularly gridded raster file

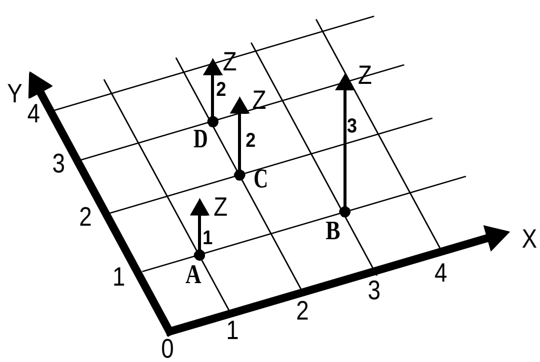
The output data is a raster (.ers) file with single or multiple bands containing regularly spaced grids.

Gridding methods

Gridding produces a regularly spaced array of Z (e.g. height) values from irregularly spaced XYZ data. It does this by extrapolating or interpolating Z values at the regularly spaced locations where the data is missing.

XYZ data designates the location and the value of measurement or sample points in a dataset. The XY component specifies the coordinates of the position of the measurement point and the Z component is the value at that point. This value depends on the application. An example would be height.

The diagram below is a simplified illustration showing how the locations and values of measurement points, A,B,C and D are represented as XYZ data:



Point	X	Y	Z
A	1	1	1
B	3	1	3
C	2	2	2
D	2	3	2

ER Mapper supports two gridding techniques:

- Triangulation
- Minimum Curvature Under Tension

Triangulation

This method generates the gridded image in two steps. The first step constructs a TIN (Triangulated Irregular Network) from the set of input points, with the vertices of each triangle corresponding to and having the same height value as each input point. This produces an irregular ungridded DEM. The second step “regularizes” the grid by using a linear approximation for each triangle to calculate values at grid points.

Triangulation works best when the input points are evenly distributed over the grid area. If the data sets contain areas with widely distributed points, then a surface plot or contour map will have distinct triangular facets.

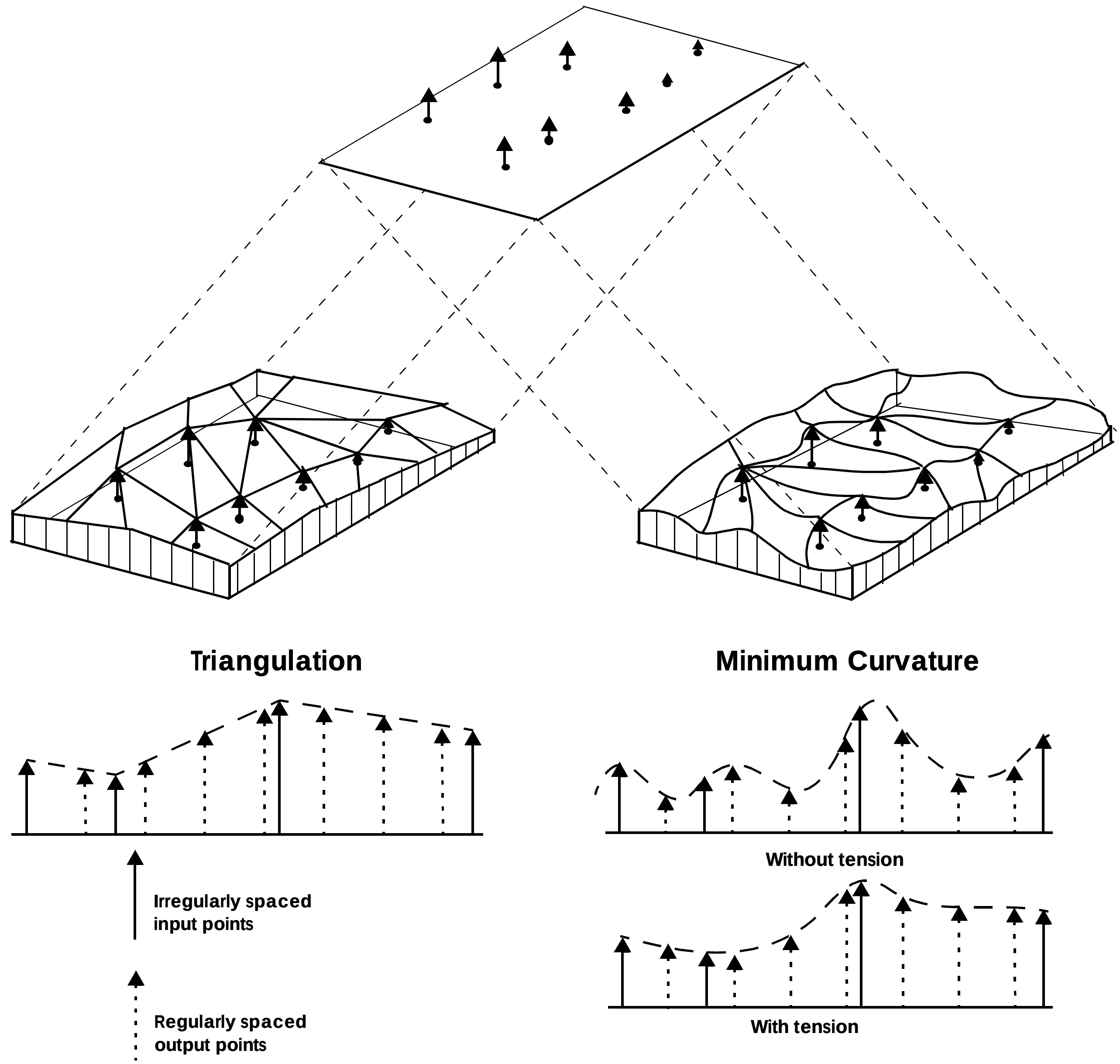
Triangulation has the advantage of being very quick to process. However, because it only takes information from three neighboring points, it cannot take into account any form of spatial variation.

Minimum Curvature

The minimum Curvature interpolation method generates a surface similar to a thin linearly elastic plate passing through each of the input points. It generates the smooth surface by repeatedly applying an equation over the grid. This continues until either the user specified maximum number of iterations is reached or the successive changes in the values are less than a pre-set convergence limit.

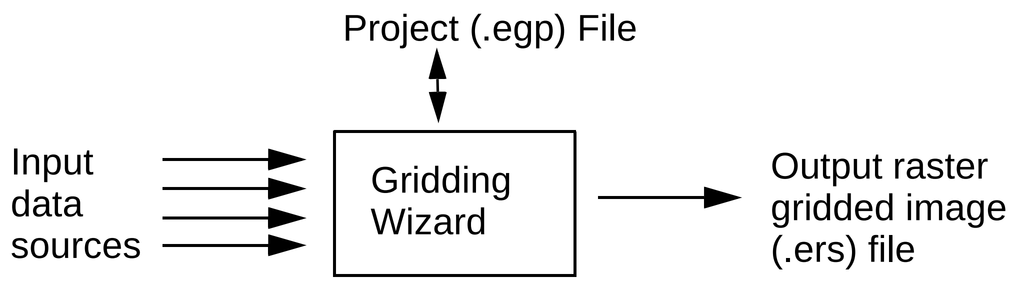
A common drawback of this method is that it may have large oscillations and extraneous inflection points particularly in sparse data areas. ER Mapper uses Boundary and Interior tension parameters to minimize this problem.

The diagram below illustrates the differences between the Triangulation and Minimum Curvature methods.



Gridding Wizard

The ER Mapper Gridding Wizard creates a project file which specifies how one or a number of input data sources are to be used to develop a raster gridded image file. It then uses this or a previously saved project file to create the gridded image file.



Project File

The Gridding Wizard requires you to specify a Project File before it can perform the gridding. If you do not specify the name of an existing project file, the Gridding Wizard will create a new one for you to enter the necessary specifications. You can save this project file for future use.

You can use a previously saved Project File to re-generate a gridded output file without having to re-enter the specifications. You can also edit existing project files to create new gridded images.

Input sources

You can use point, line and polygon data from one or more sources. ER Mapper will automatically handle any of the input formats listed below.

- Generic ASCII XYZ
- DXF
- USGS contour format (DLG-3)
- Any raster formats directly readable by ER Mapper (including .ers)
- ER Mapper .erv format

An ER Mapper point extractor converts the above formats into XYZ triplets, which is the required format for the gridding process.

Output gridded image

The ER Mapper gridding facility differs from many other products in that you can use it to generate a multiband raster image file. Where you have specified multiple input sources, you can select one of the following options:

- Each input source goes to its own output band, thus creating a number of thematic overlays.
- All input sources are combined into a single mosaiced output band.
- You can customize the output by assigning specific input sources to any number of output bands.

  You can then collectively or separately specify the gridding method (i.e. Triangulation or Minimum Curvature) for each output band.

Creating a gridded image file

Creating a gridded image file involves the following steps using the Gridding Wizard.

- Choose the input data sources
- Setup the output bands by allocating the input sources to them.
- Select the gridding method to be used (Triangulation or Minimum Curvature)
- Setup the output information and create the gridded file.

If you have an existing project file you can open it in the Gridding Wizard, modify it, if necessary, and create the gridded image. If required, you can save the project file under a new name. Otherwise you can use the Gridding Wizard to create a project file from scratch.

Hands-on exercise

These exercises give you practice in using the Gridding Wizard to create a gridded raster image.

Before you begin...

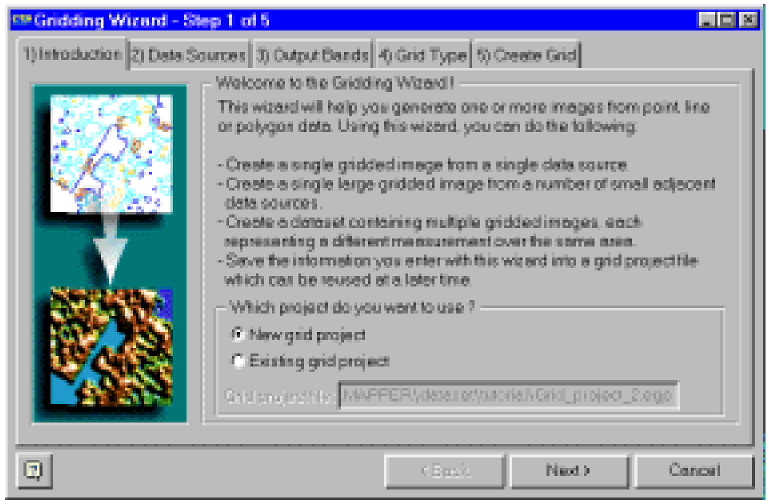
Before beginning these exercises, make sure all ER Mapper image windows are closed. Only the ER Mapper main menu should be open on the screen.

1: Create a gridded image from text files

Open the Gridding Wizard

1 Click the **Gridding Wizard** button on the **Common Functions** toolbar. 

The Gridding Wizard dialog opens with the **1)Introduction** tab selected.



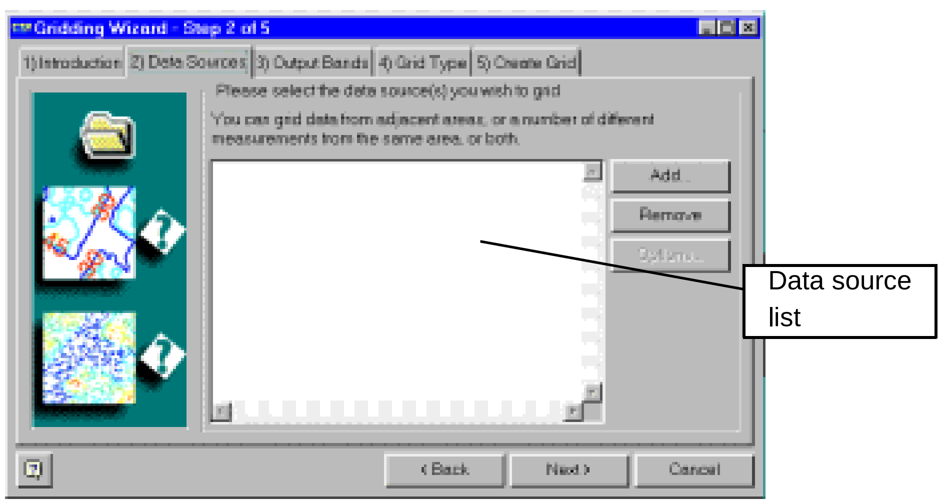
2 Select the **New grid project** option.

Notice that the **Grid project file:** field is grayed out. This is because you are creating a new project file. Therefore, you do not have to specify an existing one.

3 Click on the **Next>** button or select the **2) Data Sources** tab.

Both actions will take you to the next step by opening the Data Sources tab

Select the input data source.



This tab allows you to enter one or more data sources for gridding. The data sources can be from the same or adjacent areas. For this example we are going to choose a number of text files as data sources.

The list of data sources should be empty because we have not yet entered any.

1 Click on the **Add...** button to enter a data source.

A file chooser dialog should open.

2 In the chooser dialog **Files of Type** field, select **AsciiXYZtext(.txt)**.

3 From the **Directories** menu, select the path ending with the text **\examples**

4 Double-click on the directory named ‘Functions_And_Features’ and then on the ‘Gridding’ directory.

The directory has five text files, supplied with the permission of the Geological Survey of Western Australia, that list geochemical sample readings at locations specified by Easting/Northing coordinates. An extract from the ‘Peak_Hill_Al203.txt’ file listing aluminum oxide sample readings is shown below

#Easting	Northing	Al203
679346	7186699	11
675848	7182842	10.4
675882	7180203	7.22
680312	7182703	8.76

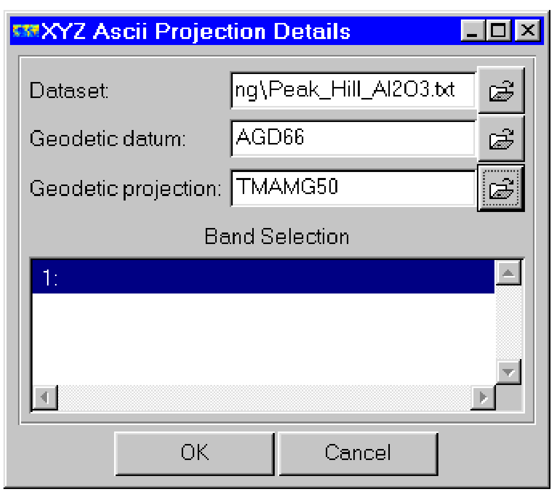
The information contained in the file is known as ASCIIXYZ data. The X Y components are the Easting/Northern coordinates of the locations, and the Z component is the aluminum oxide reading at each of the X Y locations.

The other three files are ‘Peak_Hill_CaO.txt’, ‘Peak_Hill_Fe203.txt’ and ‘Peak_Hill_MgO.txt’ which list traces of calcium oxide, copper oxide and magnesium oxide respectively.

In this exercise we will use the Gridding Wizard to create a gridded raster image with separate bands each showing overall concentrations of aluminum oxide, calcium oxide, copper oxide and magnesium oxide.

5 Click on the file named ‘Peak_Hill_Al203.txt, and then click **Apply**.

The Ascii Projection Details dialog box should open.



6 Check that the projection details are as shown above and then click on the OK button to return to the data source chooser.

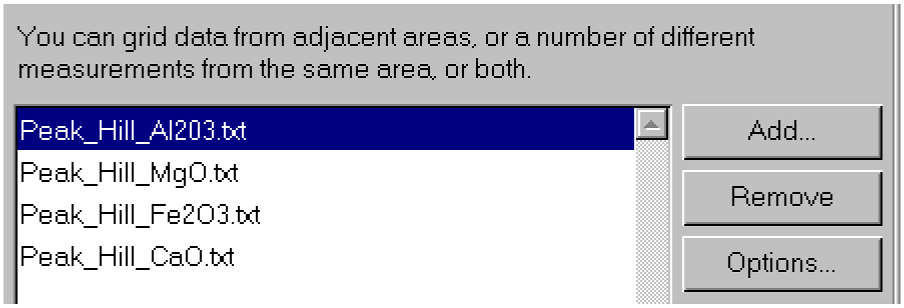
If the projection details are not as shown above, use the file chooser buttons  on the **Geodetic datum** and **Geodetic projection** fields to select 'AGD66' for the datum, and 'TMAMG50' from the 'tranmerc' projection list. Set **Coordinates** to 'Easting/Northing'.

7 Repeat steps 5 and 6 to add the following files to the data source list:

- Peak_Hill_CaO.txt
- Peak_Hill_Fe203.txt
- Peak_Hill_MgO.txt

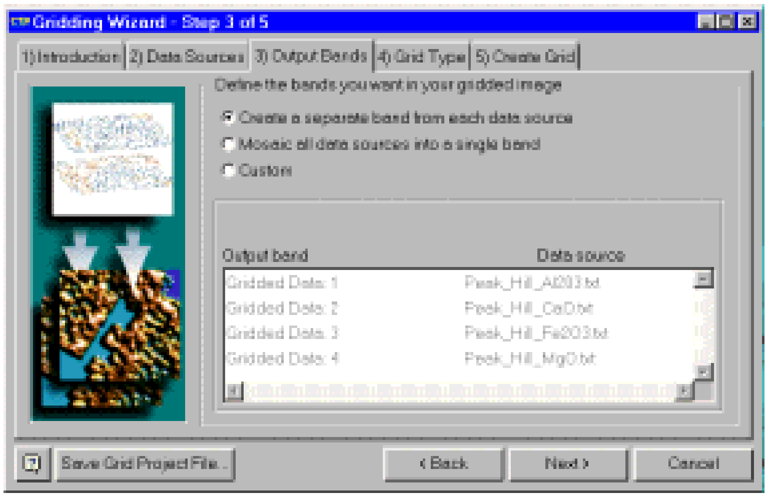
Click **OK** instead of **Apply** after selecting the last file.

The file names will appear in the source list box.



8 Click on the **Next>** button to go to the **3) Output Bands** tab.

Define the output bands



The output gridded raster image can have one or more bands of information. The “Output Bands’ tab allows you to specify how the input sources are to be mapped to these output bands. There are three main options:

Create a separate band from each data source	Each input source is allocated to a separate band. This creates an output gridded image with multiple bands as thematic overlays.
Mosaic all data sources into a single band	All the input sources are allocated, i.e. mosaiced, into a single band. This creates a single band output gridded image.
Custom	Enables the toolbar buttons for you to customize the output. You can specify the number of output bands and their descriptions, and then allocate individual or combinations of input sources to the output bands.

1 Select the default option **Create a separate band from each data source.**

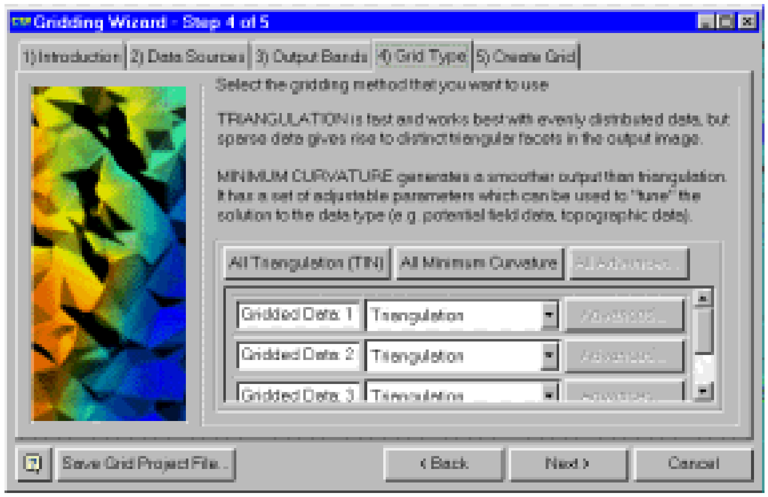
The list box will show:

Output band	**Data source**
Gridded Data:1	Peak_Hill.Al203.txt
Gridded Data:2	Peak_Hill.MgO.txt
Gridded Data:3	Peak_Hill_Fe203.txt
Gridded Data:4	Peak_Hill.CaO.txt

You will not be able to edit the entries in the list box.

2 Click on the **Next>** button to go to the **4) Grid Type** tab.

Select the gridding method



There are two gridding methods available, viz. Triangulation and Minimum Curvature. Triangulation is simpler and works best with evenly distributed data. Minimum Curvature has a number of parameters which you can adjust to suit the input data.

The ‘Grid Type’ tab allows you to set the gridding method for the output bands collectively or individually.

We will set all the bands to Triangulation.

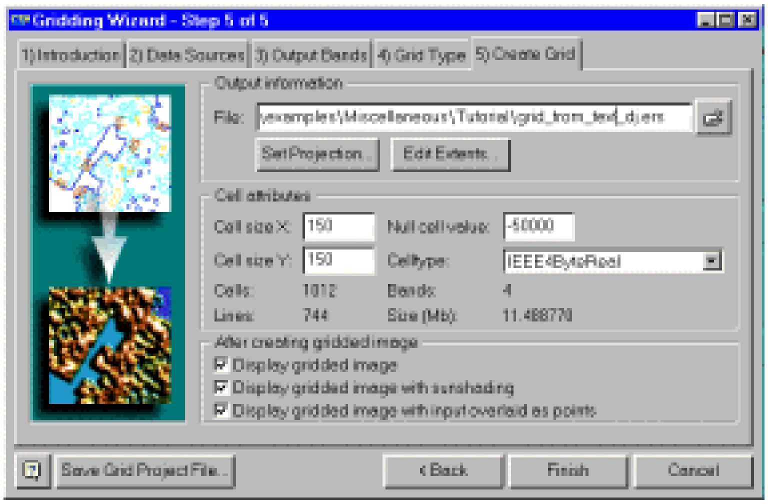
1 Click on the **All Triangulation (TIN)** button to set the gridding method to Triangulation.

You could also have selected Triangulation from the drop-down list next to each band description.

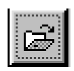
Notice that the **Advanced...** buttons are grayed out. This is because you do not have to set any further parameters for Triangulation.

2 Click on the **Next>** button to go to the **5) Create Grid** tab.

Create the gridded image



The ‘Create Grid’ tab allows you to specify the file name and define the Extents, Projection and Cell attributes of the output gridded file. You can also select how you want the gridded image to be displayed.

1 Click on the File Chooser  button to open the **Gridding Wizard Output File** chooser dialog box.

2 From the **Directories** menu, select the path ending with the text **\examples**

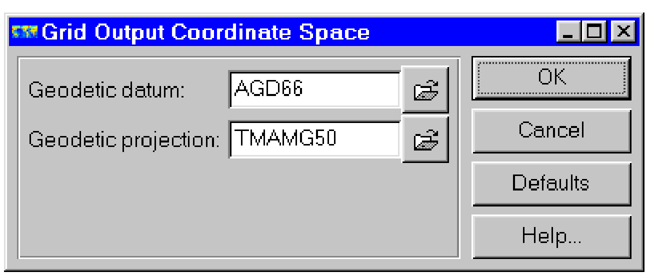
3 Double-click on the directory named ‘Miscellaneous’.

4 Double-click on the directory named ‘Tutorial.’

5 Enter ‘**minerals_triangulated_grid_*<your initials>***’ in the chooser **Save as:** field, and click on the **OK** button.

The name with its path and a ‘.ers’ extension will be inserted in the **File:** field of the ‘Create Grid’ tab. When you create the gridded image it will be saved to that file name.

6 Click on the **Set Projection...** button to open the **Grid Output Coordinate Space** dialog.

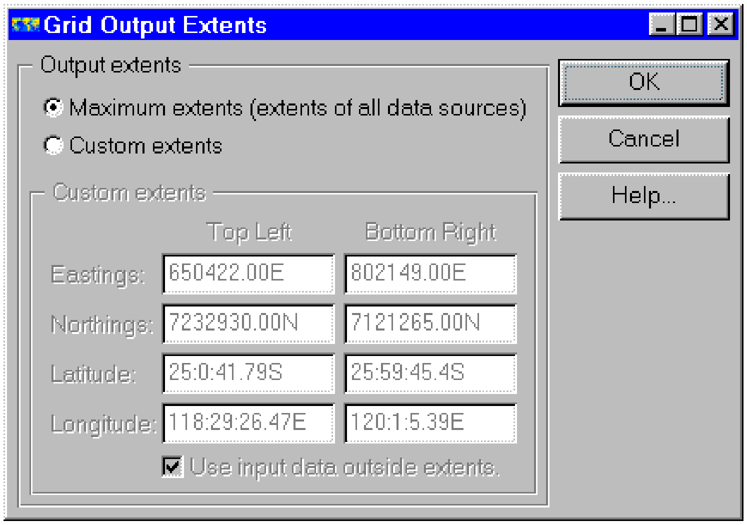


This dialog allows you to select a Geodetic datum, Geodetic projection and Coordinate type for the output gridded image. For this example we will use default values.

7 Click on the **Defaults** button to select the default values.

8 Click on the **Cancel** button to return to the Gridding Wizard.

9 Click on the **Edit Extents...** button to open the **Grid Output Extents** dialog box.



This dialog box allows you to specify the area to be included (extents) in the output gridded image. If you select the **Maximum extents** option, the output image will include the full extents of all the data sources. If you select the **Custom extents** option, you can then enter the top left and bottom right coordinates of the gridded image in the units you specified in the **Grid Output Coordinate Space** dialog. Generally this is in Eastings/Northings Longitude/Latitude or meters. This enables you to limit the extents of the gridded image to an area of interest.

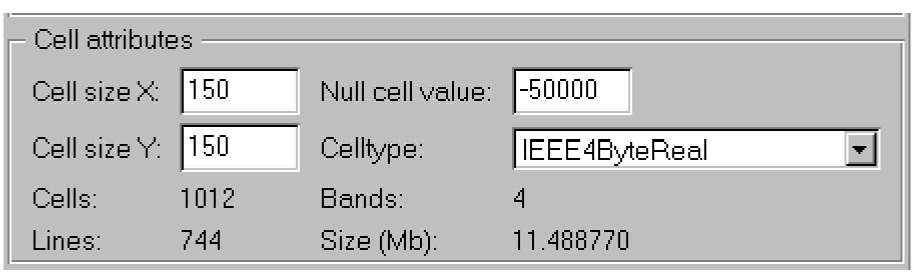
10 Select the **Maximum extents** option.

11 Click on the **OK** button to return to the Gridding Wizard.

12 Check that the number of cells and lines in the **Cell attributes** box show reasonable values.

13 If the size of the output file is larger than 12 Mb, increase the Cell size X: and Cell Size Y: values until the size is less than 12Mb.

Cell size values of 150 should result in the file size shown below



14 Select the following display option:

- **Display gridded image with input overlaid as points**

15 Select the **Save Grid Project File** button the open the chooser dialog.

All the grid data sources and settings you entered are stored in a project file which you can save and re-use.

16 From the **Directories** menu, select the path ending with the text **\examples**

17 Double-click on the directory named ‘Miscellaneous’.

18 Double-click on the directory named ‘Tutorial.’

19 Enter ‘**`grid_project_1_<your initials>`**’ in the chooser **Save as:** field, and click on the **OK** button.

The project file is saved to the file name with a ‘.egp’ extension.

20 Click on the **Finish** button to generate the gridded image and close the Gridding Wizard

A Status dialog will indicate the progress of the gridding. On completion, ER Mapper will display an image window displaying the following algorithm;

- The gridded image in a pseudo layer and a grid datasource points vector layer.

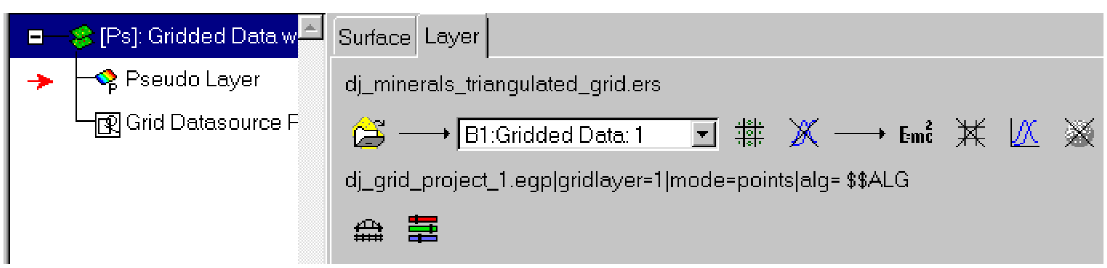
21 Click on the **Close** button to close the **Status** dialog.

View an algorithm with the gridded image

1 Click on the image window title bar to make it active.

2 Open the Algorithm dialog by clicking on the **Edit Algorithm** button  on the **Common Functions** toolbar.

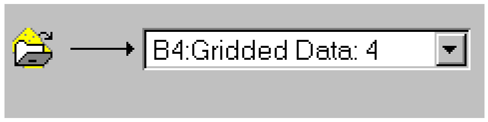
The algorithm has a surface with Pseudo and a Grid Datasource Points vector layer.



3 Select the Pseudo layer

This layer contains band **B1 Gridded Data:1** of the raster image you created. This displays the overall traces of aluminum oxide gridded from the ‘Peak_Hill_Al203.txt’ data source

4 Select bands B2 to B4.



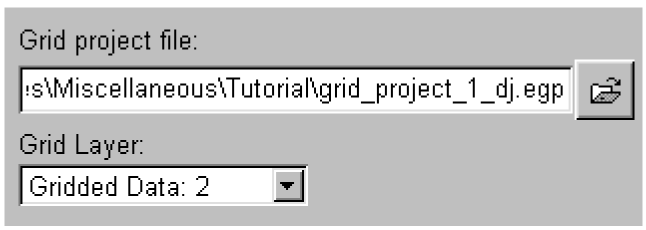
The image window will display the gridded trace of mineral associated with the band.

5 Select the Grid Datasource Points layer.

Notice that this layer is a Dynamic Link to the Project File you created. It shows point locations for the layer 1 (aluminum oxide) sample readings.

6 Click on the Dynamic Link Chooser button in the layer process diagram to open the **Display grid datasource** points dialog box.

7 Select ‘Gridded Data:2’ from the **Grid Layer** drop-down list, and click on the **Finish** button to exit the dialog.



The image window will now show the point locations for the layer 2 (calcium oxide) sample readings.1

Close all image windows and dialog boxes

1 Close all image windows using the window system controls:

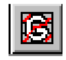
- For Windows, select **Close** from the window control-menu.

Only the ER Mapper main menu should be open on the screen.

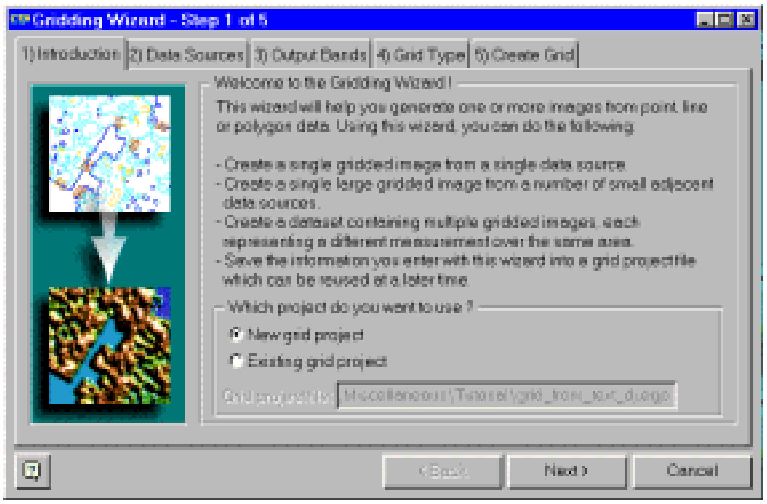
2: Create a gridded image using Minimum Curvature

In this exercise, we will create the same gridded image as we did previously. Instead of using Triangulation for all the bands we will now use Minimum Curvature for two of them. We will also gave the bands more meaningful names.

Open the Gridding Wizard

1 Click on the **Gridding Wizard**  button on the **Common Functions** toolbar.

The Gridding Wizard dialog opens with the **1)Introduction** tab selected.



2 Select the **Existing grid project** option.

3 Select your previously saved 'grid_project_1_*<your initials>*.egp' project file from the '\examples\Miscellaneous\Tutorial' directory.

4 Click on the Gridding Wizard **Next>** button or select the **2) Data Sources** tab.

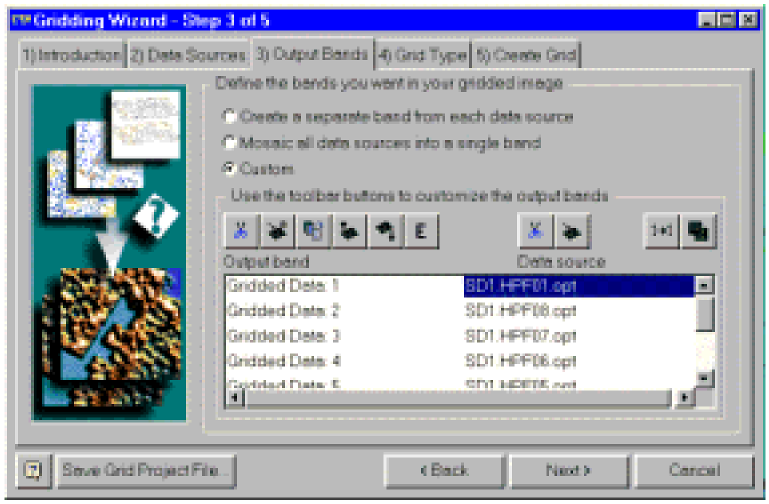
Both actions will take you to the next step by opening the 'Data Sources' tab

5 The list of data sources should show the four 'Peak_Hill' text files you selected in the previous exercise.

Leave the data sources unchanged.

6 Click on the **Next>** button to go to the **3) Output Bands** tab.

Define the output bands



1 Select the option **Custom.**

This should already be the default selection because we are using an existing Project File. The toolbar buttons will now be visible.

We want to give the output bands more meaningful names.

2 Select the ‘Gridded Data:1’ entry under **Output band**.

3 Click on the **Edit output band description** E button.

The Edit band description dialog will open.

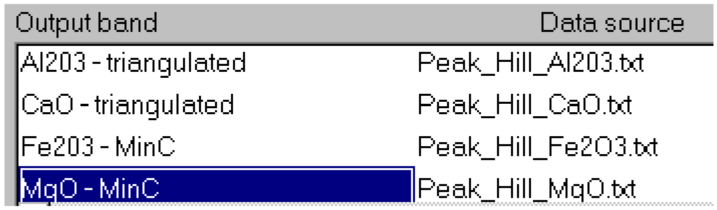
4 In the **Band description** field, enter the text “Al203 - triangulated”. Make sure that the ‘Peak_Hill_Al203.txt’ data source is allocated to this output band. If not, change the name accordingly.

5 Click on the **OK** button to return to the Gridding Wizard.

The Output band name will have changed to “Al203 - triangulated”.

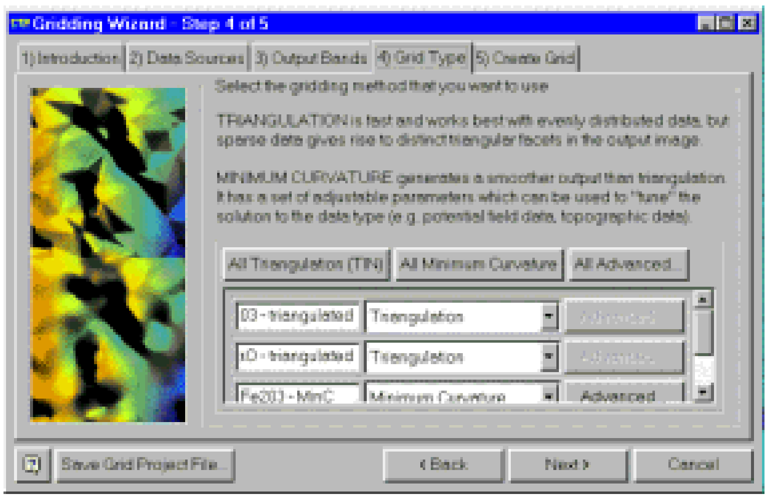
6 Repeat the previous two steps and rename the other bands, “CaO - triangulated”, “Fe203 - MinC” and “MgO - MinC”.

You should now have the following entries in the list:



7 Click on the **Next>** button to go to the **4) Grid Type** tab.

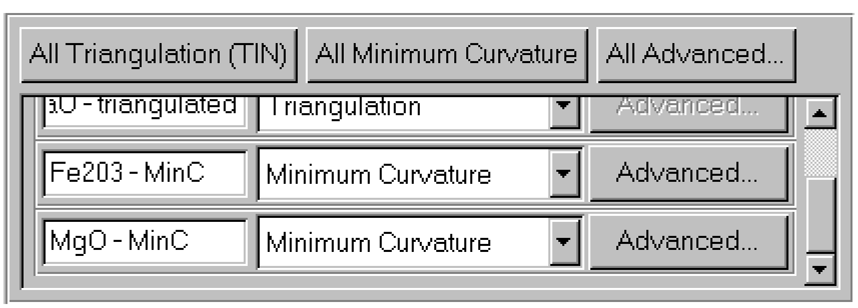
Select the gridding method



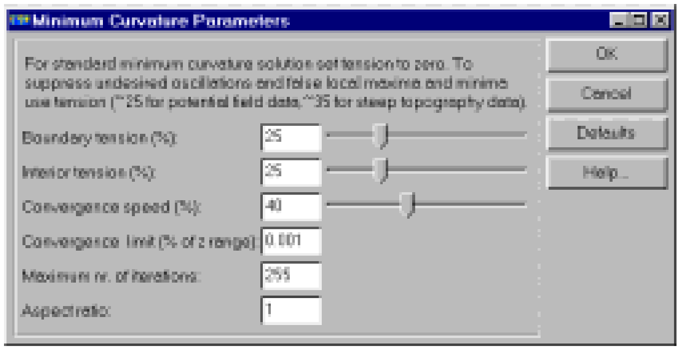
We will set two bands to Triangulation, and the others to Minimum Curvature.

1 Select **Triangulation** from the drop-down list next to ‘Al203 - triangulated’ and ‘CaO - triangulated’.

2 Select **Minimum Curvature** from the drop-down list next to ‘Fe203 - MinC’ and ‘MgO - MinC’.



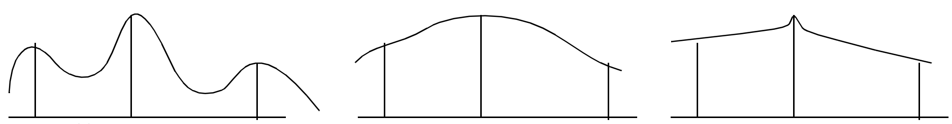
3 Click on the **Advanced...** button next to the ‘Fe203 - MinC’ entry to open the **Minimum Curvature Parameters** dialog.



4 Use the sliders to set the **Boundary tension(%)** and **Interior tension(%)** to 25.

Boundary and Interior tension

These parameters are used to suppress spurious oscillations particularly where the input points are far apart. This can create non-existent peaks and troughs in the output image. Adding tension smooths out these ripples. Too much tension can create a “pin-cushion” effect.



Insufficient tension Correct tension Too much tension

Boundary tension is effective around the edges of the image, while interior tension operates inside the image.

Convergence speed This parameter is used to accelerate the convergence. A value of 0% iterates the equations exactly, and will always assure stable convergence. Larger values will reach a solution more rapidly but may become unstable. If you use a large value for this factor, it is a good idea to monitor each iteration in the ER Mapper Status window.

Convergence limit. The convergence limit is a threshold value which is used to determine whether the gridding is complete. After each iteration the gridding process checks the absolute change in the grid value against this threshold. When it falls below the convergence limit, the process is assumed to be complete and the iterations will cease.

Maximum number of iterations
Iteration will cease when the convergence limit is reached or when the number of iterations reaches this parameter value.

Aspect ratio
If desired, you can specify a y to x value anistropy ratio. This affects the way the gridding is done by giving more weighting to points located along one axis than those located along the other axis. The default value of 1 gives equal weighting to both axes.

This parameter does not affect the aspect ratio of the output image cells.

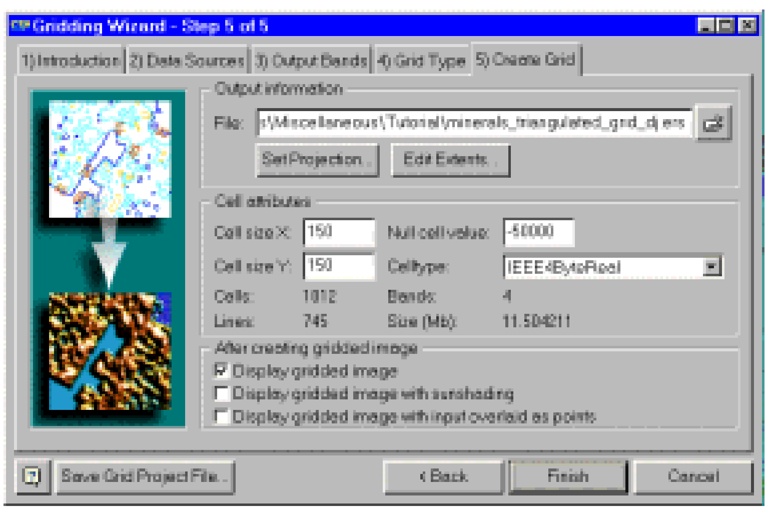
Note: You should generally not change these values from the defaults unless you are an advanced user and have a good reason for doing so.

This will create the 'Fe203 - MinC' band with Minimum Curvature under tension, and the 'MgO - MinC' band with Minimum Curvature.

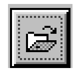
5 Click on the **OK** button to close the dialog and return to the Gridding Wizard.

6 Click on the **Next>** button to go to the **5) Create Grid** tab.

Create the gridded image



The 'Create Grid' tab allows you to specify the file name and define the Extents, Projection and Cell attributes of the output gridded file. You can also select how you want the gridded image displayed.

1 Click on the File Chooser  button to open the **Gridding Wizard Output File** chooser dialog box.

2 From the **Directories** menu, select the path ending with the text **\examples**

3 Double-click on the directory named ‘Miscellaneous’ and then select the ‘Tutorial’ directory.

4 Enter ‘**`minerals_MinC_grid_`*`<your initials>`***’ in the chooser **Save as:** field, and click on the **OK** button.

The name with its path and a ‘.ers’ extension will be inserted in the **File:** field of the ‘Create Grid’ tab. When you create the gridded image it will be saved to that file name.

5 Select all the display options:

- Display gridded image
- Display gridded image with sunshading
- Display gridded image with input overlaid as points

The image will be displayed in three separate image windows.

6 Select the **Save Grid Project File...** button to open the chooser dialog.

All the grid data sources and settings you entered are stored in a project file which you can save and re-use.

7 From the **Directories** menu, select the path ending with the text **\examples**

8 Double-click on the directory named ‘Tutorial.’

9 Enter ‘grid_project_2_*<your initials>*’ in the chooser **Save as:** field, and click on the **OK** button.

The project file is saved to the file name with a ‘.egp’ extension.

10 Click on the **Finish** button to generate the gridded image and close the Gridding Wizard

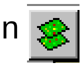
A status dialog will indicate the progress of the gridding.

On completion, ER Mapper will display three image windows displaying the following algorithms;

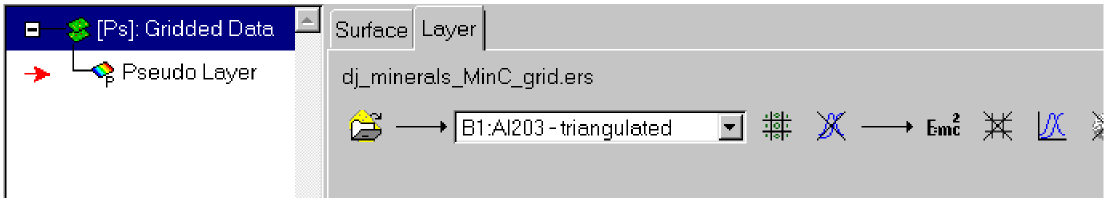
- The gridded image in a pseudo layer
- The gridded image in a pseudo layer and an intensity layer with sunshading on.
- The gridded image in a pseudo layer and a grid datasource points vector layer.;

View an algorithm with the gridded image

1 Click on the ‘pseudo layer’ image window title bar to make it active.

2 Open the Algorithm dialog by clicking on the **Edit Algorithm** button  on the **Common Functions** toolbar.

The algorithm has a surface with Pseudo layer.



3 Select the Pseudo layer

This layer contains band **B1:Al203 - triangulated** of the raster image you created. This displays the overall traces of aluminum oxide gridded from the ‘Peak_Hill_Al203.txt’ data source.

4 Select the B3:Fe203 - MinC band from the drop -down list.

The image window will now display the overall iron oxide traces gridded from the ‘Peak_Hill_Fe302.txt’ data source using the Minimum Curvature method.

Close all image windows and dialog boxes

1 Close all image windows using the window system controls:

- For Windows, select **Close** from the window control-menu.

  Only the ER Mapper main menu should be open on the screen.

What you learned...

After completing these exercises, you know how to perform the following task in ER Mapper:

- Use the Gridding Wizard to create a multi-band gridded image from text files.
- Select some of the output bands to use Triangulated gridding, and others to use Minimum Curvature and Minimum Curvature under tension.

A

System setup

This appendix describes the steps needed to set up your system for students to perform the hands-on exercises in this manual. The copying files section is divided into separate sections for users of ER Mapper running on Windows and ER Mapper running on Unix platforms. There are three tasks:

- Installation of sample datasets
- Copying the sample file for the region definition exercise (Chapter 8)

In order to carry out the following instructions, you should have some basic knowledge of copying files in Windows or Unix and setting file permissions (if needed).

1: Installation of “application” datasets

All of the hands-on exercises in this workbook require students to access the sample images supplied on the ER Mapper CD-ROM. You must install the ‘\examples\Applications\.Oil_And_Gas_Exploration’ and the examples\Shared_Data directories.

2: Copying files to the ‘tutorial’ directory

The exercises using regions in Chapter 8, “Using formulas” require that each student have their own copy of the dataset “Seismic3D” under the name “Seismic_practice” in ER Mapper’s ‘tutorial’ directory. (The ‘tutorial’ directory is created automatically during the ER Mapper installation.) Follow these steps to copy and rename the header file and data file.

Note: Users must have **read and write** access to the practice dataset. Set the file permissions appropriately if needed. If you have multiple users sharing the same ‘tutorial’ directory, it is recommended that you make a copy under a different name for each student and notify them which one to use.

Copying files for Windows installations

1 Use the Windows Explorer to copy and rename the following files in the ‘examples\Shared_Data’ directory to the ‘examples\Miscellaneous\Tutorial’ directory as indicated:

Shared_Data\Seismic3D.ers *copy to* **Miscellaneous\Tutorial\Seismic_practice.ers**

Shared_Data\Seismic3D *copy to* **Miscellaneous\Tutorial\Seismic_practice**

B

Reference texts

This appendix provides references to journal articles describing application of image processing techniques to interpreted seismic datasets. These articles may be helpful to those new to seismic image processing, or those who want details about image processing techniques as applied to real world oil and gas exploration applications. Also refer to the *ER Mapper Applications Manual* for examples and information about image processing for many earth science applications.

McQuaid A. S. J., and J. Bradley. "Surely That's Not Seismic! The Benefits of Image processing" *In publication, reference available from Earth Resource Mapping upon request.*

Paterson, G. A. D. "A New Approach to Signature Analysis in Seismic Interpretation Using an Interactive Workstation" Landmark Research Laboratory, Dept. of Exploration Geophysics, Curtin University of Technology, 1 Kent St., Bentley, Western Australia 6102.

Pettifer, G., A Tabassi, and B. Simons. 1991. "A New Look at the Structural Trends in the Onshore Otway Basin, Victoria, Using Image Processing of Geophysical Data" The Australian Petroleum Exploration Association Journal, 1991, pp. 213-227.

Tilbury, L. A., and D. Bush. 1991. "Image Processing of Interpreted 3D Seismic Data to Enhance Subtle Structural Features/Lineations" Exploration Geophysics (1991), Vol. 22, pp. 391-396.

C

Importing data

ER Mapper allows you to import data from the following Schlumberger Geoquest and Landmark Graphics formats. These formats are those commonly used in the seismic industry, and they are accessed using the Utilities menu on the ER Mapper main menu.

You will commonly need to specify datum and map projection information to ER Mapper either during the import or afterward (by editing the .ers header file). For more information on these imports please see the relevant sections in the *ER Mapper User Guide* and under the Help menu.

Schlumberger/Geoquest formats

Format	Menu option under ER Mapper Utilities menu
Mapview	Import Schlumberger Formats/GeoQuest (IESX) Mapview
GeoQuest (IESX) ASCII Grid Dump	Import Schlumberger Formats/GeoQuest (IESX) ASCII Grid Dump

Landmark Graphics raster formats

Format	Menu option under ER Mapper Utilities menu
Zycor ASCII Grid	Import Landmark Formats/ Zycor ASCII Grid

Landmark Graphics vector formats

Format	Menu option under ER Mapper Utilities menu
OpenWorks 3.1 Wells	Import Landmark Formats/OpenWorks 3.1 Wells
Seisworks Fault Polygons	Import Landmark Formats/ SeisWorks Fault Polygons
Seisworks Manual Contours	Import Landmark Formats/SeisWorks Manual Contours

Part Two - Enterprise Wide Imagery

About this section

This section of the manual is intended to help explain the problems and solution to sharing imagery throughout your enterprise, and focuses on free software plug-ins provided by Earth Resource Mapping. The hands-on exercises in this document require that certain software and sample data be installed beforehand. Please read the introduction to each chapter for more information.

Chapter contents

Most chapters in this section give you hands-on experience using the ER Mapper software plug-ins inside of the host application, such as ArcView GIS, MapInfo, Autodesk World, and office and word processing applications. In general, each chapter is independent of the others.

The emphasis is on learning and using the ER Mapper software plug-ins, not on teaching image processing and remote sensing concepts. For more detailed information on the principles of image processing or remote sensing for specific applications, please refer to the *ER Mapper Applications Manual*, or any of the text books available.

19

Enterprise Wide Imagery

Enterprise wide imagery is the concept of making imagery easily available and accessible to all users and software applications within your organization. This chapter explains how you can use free ER Mapper tools to overcome problems with using and sharing imagery. It also includes a short introduction to imagery, and an overview of the capabilities of the ER Mapper software.

Using imagery within your organization

Many groups within an organization can benefit from the use of imagery such as aerial photographs and satellite images in their everyday work. These include departments such as engineering, marketing, mapping/GIS, graphics, publications and others. Because these groups use a wide range of software applications, it has been difficult to share imagery across an entire enterprise. Two primary reasons:

- **Incompatible file formats**–Images used by one group cannot be used by other groups because the file format is not compatible with their software.
- **Large file sizes**–Even when your software can read an image file's format, it often cannot process large image files. Large image files, such as airphotos, are increasingly demanded by clients to show high levels of detail and coverage of large geographic areas of interest.

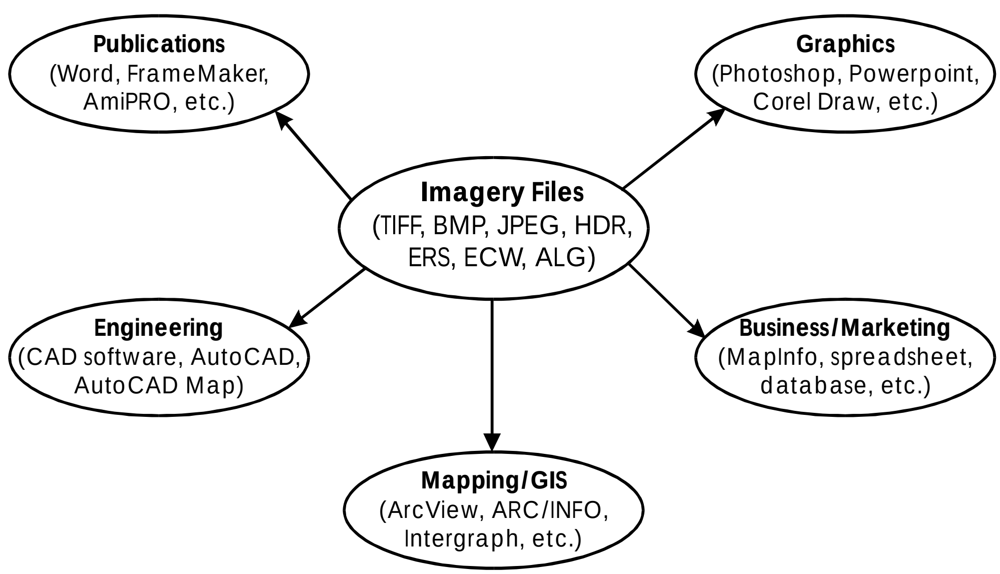
- **Images served over the Internet**–Images that you access over the internet have to retrieved via a browser and stored locally before you can use them in your software application. It would be far more efficient to be able to access images from within the software application by specifying their URL (Universal Resource Locator) as you would with an Internet browser like Internet Explorer.

  Now ER Mapper provides ***free software solutions*** to help you overcome these problems. Anyone who wants to use imagery can do so without having to convert between formats, reduce file sizes, learn complex imaging products, and so on.

Enterprise wide imagery

Enterprise wide imagery is the concept of making imagery easily available and accessible to all users and software applications within your organization. These applications include desktop mapping and GIS products, graphics and presentation products, word processing products, database products, and others.

Sharing Imagery Throughout an Enterprise



ER Mapper's free imagery products provide solutions to the two main problems:

- **Incompatible file formats**–Images used by one group can now be used by all groups because ER Mapper's free solutions allow most products to read an industry standard set of imagery formats. For example, word processing or graphics applications can now directly display satellite images in their native formats.

- **Large file sizes**–ER Mapper's free solutions allow your applications to read image files of virtually any size very quickly. Mosaics of aerial photographs, for example, often require 100's of megabytes (even gigabytes) of disk space. ER Mapper's solutions handle the underlying technology, so even simple word processors can display very large image files in a snap.
- **Images served over the internet**–ER Mapper 6.1 allows you to directly access images served over the internet by specifying their URL. The free plug-ins allow most other GIS and Office products to do the same.

ER Mapper free imagery solutions

ER Mapper's free Enterprise Wide Imagery solutions are tightly integrated software tools and plug-ins that let you share images throughout your enterprise.

- **ER Viewer**–A free image viewer that lets you view ER Mapper images and algorithms, TIFF and GeoTIFF files, Windows BMP, JPEG, Universal Data Format (UDF), ESRI BIL, and SPOTView image formats.
- **Imagery plug-in for Office users**–Users of office products (word processing, graphics, spreadsheets, etc.) can use ER Viewer's OLE capabilities to directly display large imagery files quickly within their applications.
- **ER Mapper Imagery Extension for ArcView GIS**–A free extension that lets ArcView GIS users display ER Mapper format images and smart data algorithms.
- **MapImagery plug-in for MapInfo**–A free plug-in that lets MapInfo users display and enhance the same image formats supported by ER Viewer.
- **AutoCAD Map plug-in**–A free plug-in that lets AutoCAD Map users display the same image formats supported by ER Viewer.
- **Autodesk World imagery viewer**–Autodesk World lets users display any images supported by ER Viewer (this functionality is embedded in the World software).

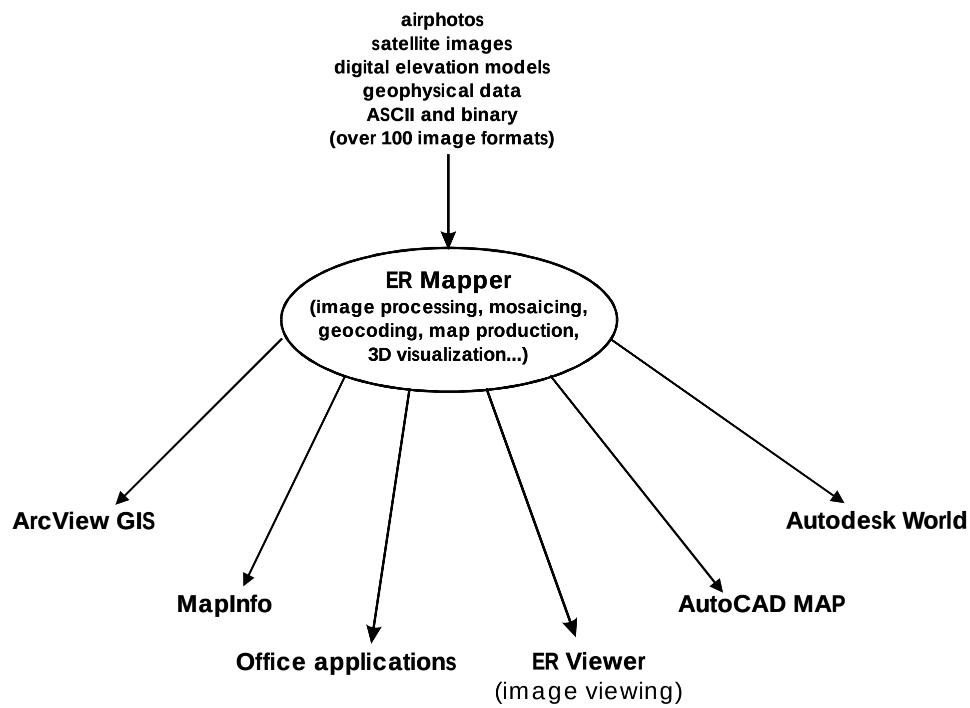
Using ER Mapper for imaging

By using the plug-ins and tools in conjunction with ER Mapper, you gain access to the powerful capabilities of this leading integrated mapping and image processing application. ER Mapper can be used as a central depository for all image data, where it can be processed as needed before passing on to other applications in you organization via the plug-ins and tools.

Adding ER Mapper to your enterprise gives you capabilities to:

- Import and display over 100 different image formats

- Directly read TIFF, GeoTIFF, BMP, ER Mapper images and algorithms, ESRI BIL, SPOTView and Universal Data Format (UDF) imagery without the need for import or conversion
- Easily view the entire project area in one image–no limits on image file sizes
- Geocode and orthorectify imagery easily to precisely register with GIS vector data
- Automatically display, mosaic and color balance numerous images
- Combine imagery, vector and tabular data from any number of sources
- Create and edit vector data over imagery backdrops, and highlight features of interest and save them as vectors with ER Mapper's raster to vector conversion tools
- Use advanced image processing functions such as contrast enhancement, multispectral classification, vegetation indexes, color shaded reliefs, filtering, merging images, and many others.



ER Mapper can serve as a central hub for all the image data, so you can process and enhance images if needed before passing them onto other applications in your enterprise.

ER Mapper image compression

ER Mapper also lets you create and distribute royalty-free compressed images using the patent pending ER Mapper ECW Compression facilities and the free plug-ins for other applications. You can now achieve significant compression ratios with no noticeable deterioration in image quality.

Working with large images

When working with satellite imagery, airphotos, scanned topographical maps and other types of imagery, the size of image files can become very large. For example, it takes 3 terrabytes (3,000GB) of color imagery to take aerial photographs of typical city at 3 inch resolution. It takes 1.5TB (1,500GB) of color imagery to cover all of California at a resolution of one meter.

Compression of imagery offers several advantages including:

- reduced image file size
- faster access
- easier distribution
- the ability to work with imagery covering larger areas

20

Using ER Viewer

This chapter explains how to use the free ER Viewer application to display and analyze several types of image files. ER Viewer is a free Windows application that can be installed from the ER Mapper installation CD-ROM or downloaded from the ER Mapper website at www.ermapper.com.

About ER Viewer

ER Viewer is a free, easy to use image viewing application featuring interactive roaming and zooming of very large image files. It also acts as an OLE server application to let you view images inside your favorite Windows applications.

ER Viewer offers unequalled stability and supports a wide range of image formats, including:

- Universal Data Format (UDF) images
- ER Mapper compressed and uncompressed images
- TIFF and GeoTIFF images
- Windows BMP images
- SPOTView images
- ESRI BIL (ARC/INFO and ArcView) images
- Smart Data ER Mapper algorithms

Hands-on exercises

These exercises show you how to use ER Viewer to display image files and perform zooming, roaming and measuring distances.

What you will learn...

After completing these exercises, you will know how to perform the following tasks in ER Viewer and OLE-enabled Windows applications:

- Use ER Viewer to display images in several different formats
- Interactively zoom and roam images
- View geographic coordinates and measure distances on an image
- Print an image (optional)

Before you begin...

Before beginning these exercises, you must have installed ER Viewer on your system. You can download it free of charge from the ER Mapper web site at www.ermapper.com if needed.

Note: The following examples use image files supplied with ER Mapper as sample data. If it is not possible to install ER Mapper, you must have a sample TIFF or BMP image file to use for the exercises.

1: Using ER Viewer to display images

Objectives

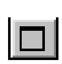
Learn how to use ER Viewer to display images, zoom and roam around the images, and measure distances on geocoded images.

Start ER Viewer

1 Start ER Viewer by double-clicking the  icon on your desktop or selecting **Start/Programs/ER Mapper/ER Viewer**.

ER Viewer starts up and displays the Getting Started information dialog that contains basic instructions for using ER Viewer.

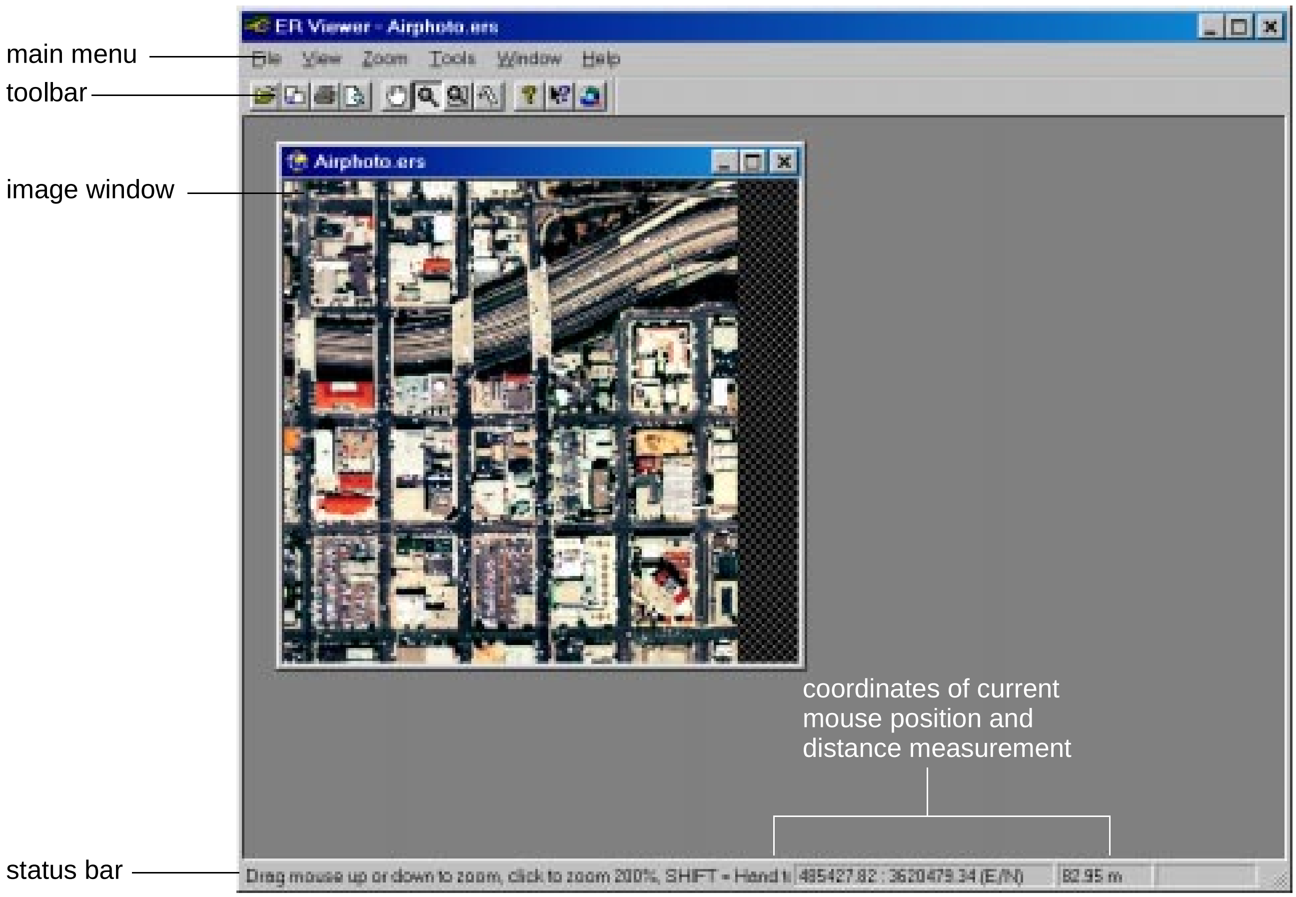
2 Click **Close** on the **Getting Started With ER Viewer** dialog.

3 Click the **Maximize**  button in the upper-right corner of the ER Viewer window (if it is not already maximized)

ER Viewer expands to fill your desktop.

About the ER Viewer interface

The ER Viewer user interface has the following components:



Tip: To get help on using any ER Viewer component, click the **What's this?** button then and click on the component of interest.

Open an ER Mapper-format image file

1 Click the **Open** toolbar button (or select **File > Open**).

2 On the **Open algorithm or image files** dialog, open the **Files of type** menu.

A list of image formats supported by ER Viewer displays. You can open ER Mapper-format images and algorithms, graphics formats like TIFF and BMP, satellite image formats such as GeoSPOT and ESRI BIL, and others.

3 Select the **All image files** option.

4 Navigate to the directory where ER Mapper is installed. Open the 'examples\Shared_Data' directory. Double-click on the file 'airphoto.ers.'

ER Viewer displays an aerial photograph of the San Diego, California area. (This file was previously imported and saved in ER Mapper '.ers' image file format.)

Note: If the ER Mapper sample data is not installed, navigate to a directory containing an image in TIFF, BMP or other supported format an open it instead.

Enlarge the image window

1 Drag the image window by a corner to make it larger.

2 From the **Zoom** menu, select **Data Extents**.

The image expands to fill the new image window size.

Use the Zoom Tool to zoom freely in and out

1 Click the **Zoom Tool** button on the toolbar (or press **F6**).

2 Point to the center of the image, then drag downward to zoom in.

3 Point to the center of the image, then drag upward to zoom out.

By dragging up or down, you can zoom in or out by any amount. When you release the mouse, ER Viewer refreshes the image detail as needed.

Use the Zoom Tool to zoom by fixed amounts

1 From the **Zoom** menu, select **Data Extents**.

The airphoto image zooms out to show the entire image extents.

2 Click on the center of the image to zoom in.

The image zooms in to twice (200%) the previous magnification.

3 While holding down the Ctrl key, click the image center again.

The image zooms out to half (50%) of the previous magnification. With the **Zoom Tool** selected, clicking zooms in and Ctrl-clicking zooms out by fixed amounts.

Use the Zoom Box Tool to zoom on an exact area

1 From the **Zoom** menu, select **Data Extents**.

The image zooms out to show the entire image extents.

2 Click the **ZoomBox Tool** button (or press **F5**).

3 Drag a box around the central portion of the image.

ER Viewer zooms in to display the area you defined with your box. Use the **ZoomBox Tool** tool to zoom in on an exact area of interest.

Use the Hand Tool to roam around (pan) the image

1 Click the **Hand Tool** button (or press **F7**).

2 Drag the airphoto within the image window.

ER Viewer roams (or pans) to display the adjacent area of the image. Use the **Hand Tool** tool to roam around and quickly view adjacent areas of the image.

Tip: When the **Zoom Tool** is selected, pressing Shift temporarily enables the **Hand Tool**.

View geographic locations on the image

1 Without depressing the mouse, point to different locations on the image.

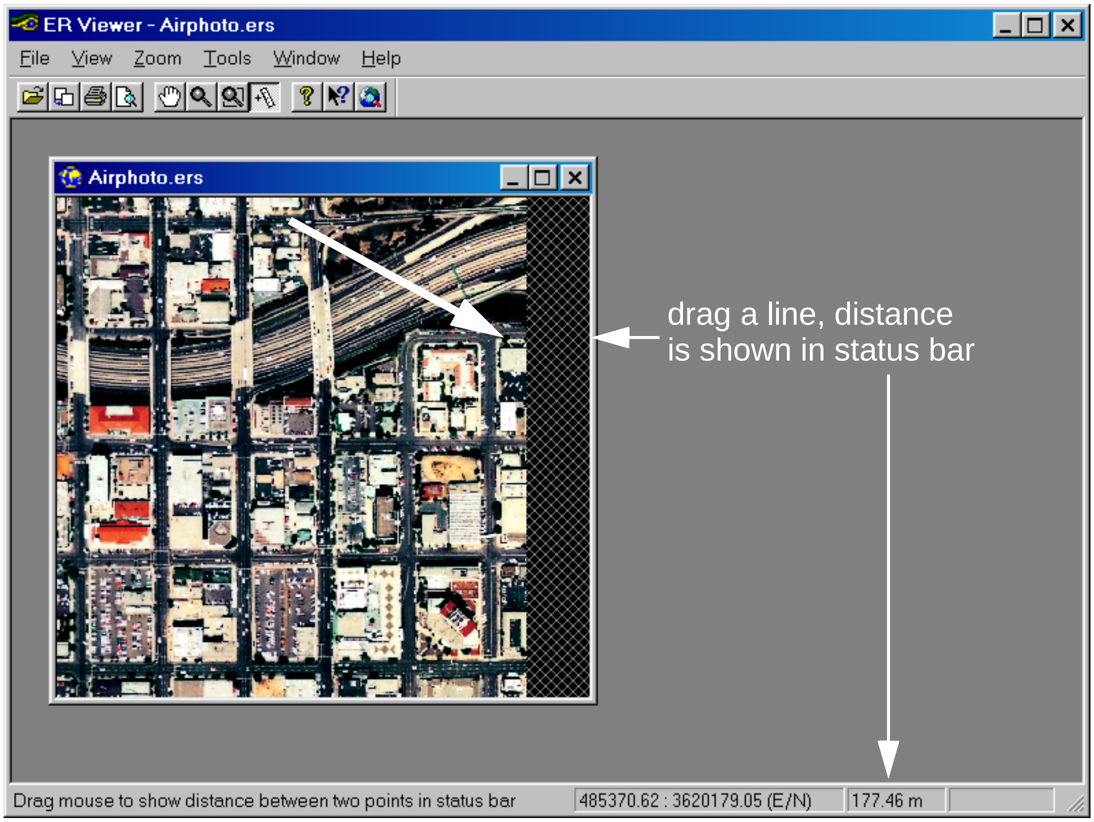
The geographic locations of the current mouse position are shown in the lower right part of the ER Viewer window. (Locations are shown in the units of the map projection. This airphoto is registered to the UTM coordinate system, so the locations are in meters of Easting and Northings.)

Note: Geographic locations only display when your image has been registered to a map projection. If your image in unregistered, the locations appear as row and column (cell) values instead.

Use the Measure Tool to measure distances in the image

1 Click the **Measure Tool** button (or press **F8**).

2 Drag a line between two points on the image.



ER Viewer shows the distance between the start and end points on the right side of the status bar.

3 While keeping the mouse button depressed, drag to different points on the image.

The distances are updated interactively as you move the mouse. As with locations, distances are shown in the units of the map projection (in this case meters).

Tip: Ctrl-Shift temporarily enables the **Measure Tool** when the **Zoom Tool**, **ZoomBox Tool** or **Hand Tool** is selected.

Open a second ER Mapper image file

1 Click the **Open** button.

2 Navigate to the directory where ER Mapper is installed. Open the directory ‘examples\Applications\Land_Information.’

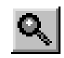
Tip: The ‘Automatically adjust contrast on dataset load’ option enhances the contrast of any image you open automatically. You should usually leave this option turned on.

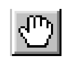
---

3 Double-click on the file ‘SPOT_XS_07Aug88.ers’ to display it.

ER Viewer displays a SPOT XS satellite of the San Diego, California area in a new image window. This is a color infrared image, so vegetated areas are shown in red tones.

4 Make the image window two times larger, then select **Zoom > Data Extents**.

5 Zoom in to an area of interest using the **Zoom Tool**  or **ZoomBox Tool** .

6 Pan or scroll the image as desired using **Hand Tool** .

View properties of the image file

1 From the **View** menu, select **Properties**.

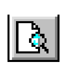
ER Viewer displays tab pages showing properties of the image file.

2 On the **Properties** dialog, click the **Registration** tab.

The geodetic datum, map projection, units and other georeferencing information about the image file is shown.

3 Click **Cancel** on the **Properties** dialog.

Preview a hardcopy print of the image

1 Click the **Print Preview**  button.

ER Viewer redisplays the image to show how it would be sized and positioned on your default printer. ER Viewer tries to center the image on the page and fill the printable area.

Tip: Only the area you zoomed into will be printed, so you can easily print any portion of a large image.

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2 Click **Close** or click the [X] button on the image window.

The image redisplays in normal mode for zooming and roaming.

Print of the image (optional)

1 Click the **Print** button.

The Windows **Print** dialog for your default printer opens to let you select a printer, change the properties, and print the image.

2 If desired, select the printer and properties, then click **OK** to print the image. Otherwise click **Cancel** to close the **Print** dialog.

Close ER Viewer

1 Click the **Close** [X] button on the ER Viewer window (or select **File > Exit**).

What you learned

After completing these exercises, you know how to perform the following tasks in ER Viewer:

- Use ER Viewer to display images in several different formats
- Interactively zoom and roam images
- View geographic coordinates and measure distances on an image
- Print an image (optional)

21

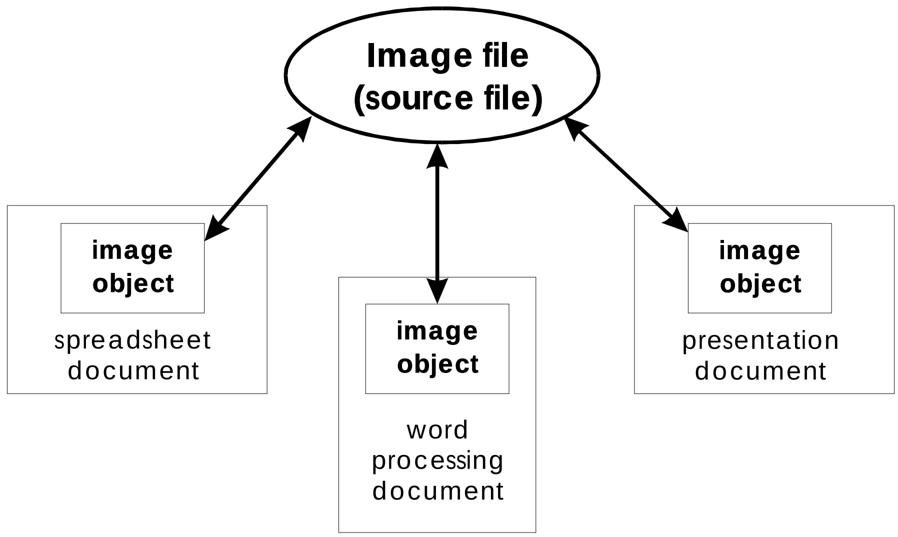
Office applications (OLE)

This chapter explains how you can use your office software's OLE capabilities to easily display and manipulate large images inside Windows applications (without having to save the image as part of the file).

Note: To use the OLE capabilities described here, make sure you first install ER Viewer and perform the exercises in the previous chapter to become familiar with it. You can install ER Viewer from the ER Mapper installation CD-ROM or download it from the ER Mapper website at www.ermapper.com.

What is OLE?

Many Windows applications support OLE–*Object Linking and Embedding*. OLE is a program-integration technology developed by Microsoft that lets you easily share information between programs. This capability allows you to insert an object (such as an image) into any OLE-enabled application. Most office applications running under Microsoft Windows support OLE.



With a *linked object*, information is created in one file (the *source* file) and inserted into another file (the *destination* file) while maintaining a connection or “link” between the two files. When you save the destination file (such as a word processing document), you save only the link to the source file and do not embed the image as part of the document.

For example, several different documents can display the same image, all via links to the single source image file. If the source image file is modified, the linked image objects in the destination files are also automatically updated to reflect any changes.

Sharing image files using OLE

In addition to letting you view images, ER Viewer also acts as an OLE server application to let you view images inside your favorite Windows applications. Using ER Viewer’s OLE capabilities provides many advantages for sharing large image files throughout your enterprise, including:

- You can display image files much larger than the application itself is capable of displaying (for example a 500MB airphoto) since ER Viewer performs the processing (not the application where the image is displayed)
- Much faster display of large image files in documents, since ER Viewer performs the processing (not the application where the image is displayed)

- Word processing documents, spreadsheets, presentations, and other applications can all share a single copy of the original imagery files
- Documents can display images in many additional image formats not supported by the destination application, but that are supported by ER Viewer
- Images can be displayed in the application without having to permanently embed and save the image files as part of the document (so the documents remain small in size)
- You can access the power of ER Mapper Smart Data Algorithms to apply complex processing enhancements that create beautiful images interactively without changing the original image files

Hands-on exercises

These exercises show you how to insert an image into another Windows application as a linked OLE object using ER Viewer as the source application.

What you will learn...

After completing these exercises, you will know how to perform the following tasks in OLE-enabled Windows applications:

- Insert an image as a linked OLE object into another Windows application
- Edit the image object within the application using the ER Viewer toolbar
- Copy and paste an OLE image form one area to another

Before you begin...

Before beginning these exercises, you must have installed ER Viewer on your system.

Note: The following examples use image files supplied with ER Mapper as sample data. If it is not possible to install ER Mapper, you must have a sample TIFF or BMP image file to use for the exercises.

1: Using OLE to display images

Objectives Learn how to use ER Viewer as an OLE server to display and edit large image files within OLE-enabled Windows applications.

In the past, it was usually necessary to embed large image files in word processing documents, spreadsheets or presentations in order to display and print them at full resolution. Since the image file was saved as part of the document, it created *very* large document files and the data could not be edited once it was inserted.

With Object Linking and Embedding (OLE), you can use ER Viewer as a powerful image viewing engine to display and edit large image files directly inside your Windows applications. This allows you to display images in many formats that cannot be read by the application itself, and also makes the document files much smaller because only a link to the image file is saved with the document.

The following example uses Microsoft Word as the example OLE-enabled application. You can use any other OLE-enabled word processing application if desired (WordPerfect, Framemaker, and so on).

Start Microsoft Word (or other OLE-enabled word processor)

1. Start up the Word application on your system (or another OLE-enabled word processor).
2. Type the text **`San Diego Airphoto`** as the first line of your document, then press Enter to create a new line.

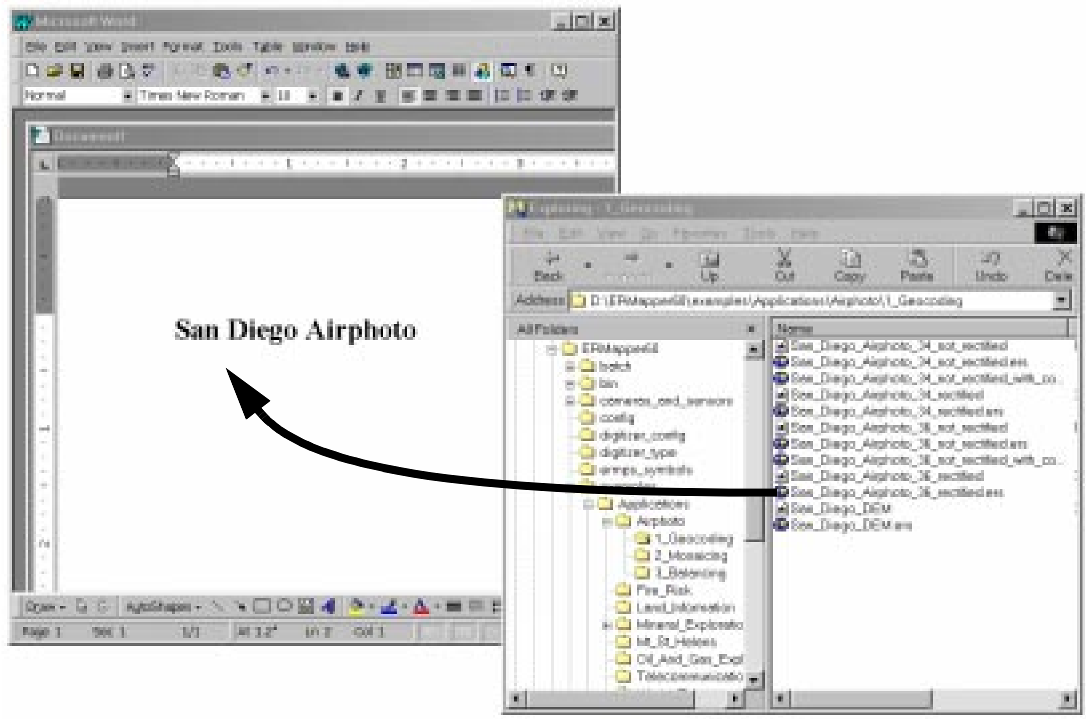
Open the Windows Explorer

1. Open the Windows Explorer application (select **Start > Programs > Windows Explorer**).
2. Open the ER Mapper installation directory. Then open the directory ‘examples\Applications\Airphoto\1_Geocoding.’

   You should see a list of files beginning with ‘San_Diego_Airphoto.’
3. Move the Word application window and the Explorer window side by side (resize them if needed).

Drag an image file into the Word document

1 Drag the file 'San_Diego_Airphoto_36_rectified.ers' from the Explorer window and drop it into the Word document window.



After a short time, the image file displays in your document.

2 In the word processor, click once on the image to select it, then drag the lower-right corner handle to make it much larger.

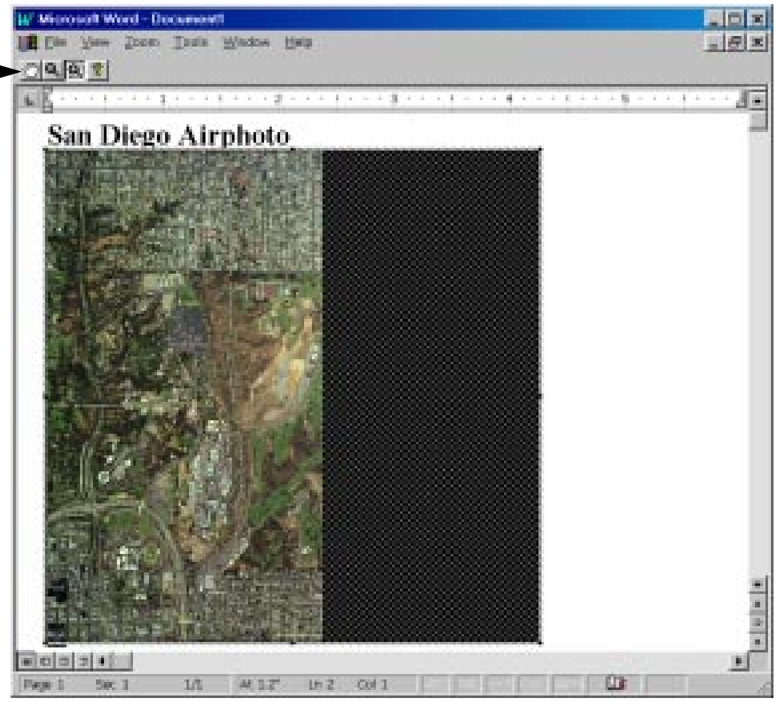
The image redisplays at the larger size. This image is a color aerial photograph of the San Diego, California area. The source image file is over 34MB in size.

Zoom and roam using the ER Viewer toolbar

1 In Word, double-click on the image.

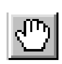
The word processor's native toolbar changes to display the ER Viewer zoom and roam tools. When you double-click on a linked object, the object's *server application* (ER Viewer) is temporarily enabled inside the *container application* (the word processor) so you can edit the object.

ER Viewer toolbar



2 Click the **ZoomBox Tool**  button, then drag a box to enclose the area of white buildings in the lower central portion of the image.

3 ER Viewer zooms in to display the area you defined with your box.

4 Click the **Hand Tool**  button, then drag the image.

5 ER Viewer roams (or pans) to display the adjacent area of the image.

Return to the Word application

1 In the word processing document, click outside the image area.

The usual word processor toolbar and interface returns, and the image is updated to the new extents you defined.

Drag and drop a second image into the document

1 Press Enter twice to create two new lines below the image, then type the text **`Mount St. Helens Volcano`**.

2 In the Explorer window, open the ER Mapper home directory, then open the directory examples\Applications\Mt_St_Helens.

3 Drag the file ‘2D_after_eruption.alg’ from the Explorer window and drop it into the word processing document window.

After a short time, the image file displays in your document.

4 Click once on the image to select it, then drag the lower-right corner handle to make it larger.

This is an image of the Mount St. Helens Volcano in the state of Oregon, USA after an eruption that blew out the central portion of the mountain. The image data from which this is created is a Digital Elevation Model (DEM) where each pixel value represents a terrain elevation. The special processing technique is called a “colordrape” that combines a color image that shows elevation with a shaded relief image that shows terrain features.

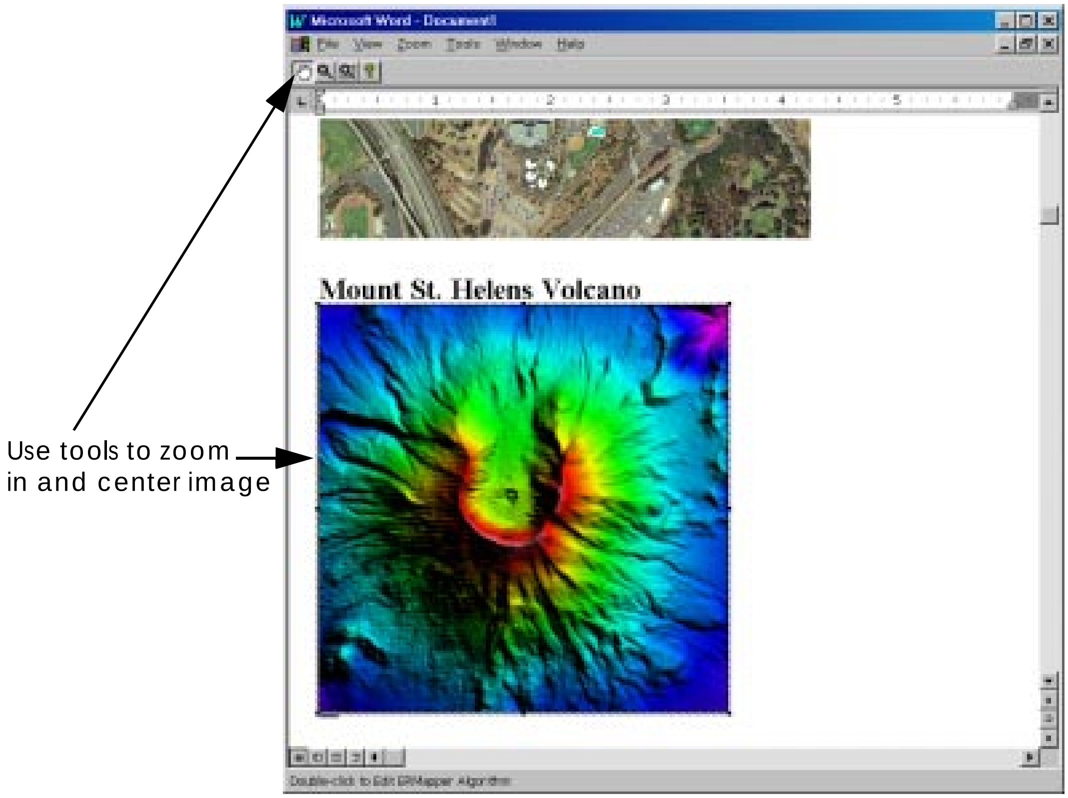
In this case, the image file you linked to is an ER Mapper Smart Data Algorithm (.alg). The algorithm file runs the ER Mapper processing engine in the background to interactively create the enhanced colordrape image from the original DEM image data.

Tip: Most OLE-enabled applications also let you insert a linked OLE object into a document using a menu command (as an alternative to the drag and drop method shown in the previous example).

Zoom into and center the volcano image

1 Double-click on the inserted image to display the ER Viewer toolbar.

2 Use the **Zoom Tool** to zoom in on the central portion of the image (the volcanic caldera), then use the **Hand Tool** to drag the image and center it.



3 When finished, click outside the image to return to the word processing application.

Copy and paste the volcano image

1 Click once on the volcano image to select it.

2 Press Ctrl+C (or select **Edit > Copy**) to copy it.

3 Press Enter twice to create two new paragraphs in your document.

4 Press Ctrl+V (or select **Edit > Paste**) to paste the volcano image into the new location.

It is sometimes useful to copy and paste OLE images from one part of your document to another. For example, you might insert an airphoto covering a large area, then copy and paste it to different parts of the document and zoom in to show different areas of interest.

(Optional) Save your word processing document.

1 Save your document, then close the application.

Note: If you check the file size of your word processing document, it should only be about 1MB. Yet this document displays images that are created from almost 40MB of image files. This is one of the big advantages of OLE–you can display very large image files inside a document very quickly without having to embed the image files. (That is, images are not saved as part of the document, only the link to them is saved.)

What you learned

After completing these exercises, you know how to perform the following tasks in OLE-enabled Windows applications:

- Insert an image as a linked OLE object into another Windows application
- Edit the image object within the application using the ER Viewer toolbar
- Copy and paste an OLE image from one area to another

22

ArcView GIS Users

This chapter explains how to use the free ER Mapper Imagery Extension for ESRI's ArcView GIS software. It also explains how to obtain and install the extension, and the additional imaging capabilities ArcView users can gain by using the extension in conjunction with ER Mapper.

Note: You must have a licensed copy of ArcView GIS version 3.1 or greater to install and run the ER Mapper Imagery Extension. You do not need to have a copy of ER Mapper installed, but this is recommended to gain access to sample ER Mapper imagery and algorithms used in the following tutorial. (You can order the free ER Mapper installation CD-ROM from www.ermapper.com.)

About the ER Mapper Extension for ArcView GIS

As imagery data sources become more important for GIS applications, the need to efficiently process, enhance and display large image files also becomes more important. Earth Resource Mapping (developers of ER Mapper) provides a free extension (or "plug-in") that lets ArcView GIS users directly display ER Mapper imagery and algorithms. With the ER Mapper Imagery Extension, ArcView GIS users are no longer restricted by limited image handling capabilities. In addition, you can experience the full power of ER Mapper algorithms from within ArcView GIS, and give your vector GIS data real world meaning by presenting it over image backdrops.

Using the extension with ER Mapper

By using the extension in conjunction with ER Mapper, ArcView GIS users gain access to the extensive capabilities of this powerful integrated mapping and image processing software, including:

- Import and display over 100 different image formats
- Directly read TIFF, GeoTIFF, BMP, ER Mapper images and algorithms, ESRI BIL, SPOTView and Universal Data Format (UDF) imagery without the need for import or conversion
- Easily view the entire project area in one image–no limits on image file sizes
- Geocode and orthorectify imagery easily to precisely register with GIS vector data
- Automatically display, mosaic and color balance numerous images
- Combine imagery, vector and tabular data from any number of sources
- Create and edit vector data over imagery backdrops, and highlight features of interest and save them as vectors with ER Mapper's raster to vector conversion tools
- Use advanced image processing functions such as contrast enhancement, multispectral classification, vegetation indexes, color shaded reliefs, filtering, merging images, and many others.

How to obtain the ER Mapper Imagery Extension

You can obtain the free ER Mapper Imagery Extension from two sources:

- **The ER Mapper installation CD-ROM**–The extension can be installed as a separate component from the ER Mapper installation CD-ROM. (It is recommended that you also install ER Mapper to gain access to a wide variety of sample data and test drive the software in free evaluation mode to see what it can do for you.)
- **The ER Mapper web site**–You can download the latest version of the extension from the ER Mapper web site at www.ermapper.com. Navigate to the “free software” area and download the ArcView GIS plug-in.

Hands-on exercises

These exercises show you how to use the ER Mapper Imagery extension for ArcView GIS.

What you will learn...

After completing these exercises, you will know how to perform the following tasks in ArcView GIS using the ER Mapper Imagery Extension:

- Enable the ER Mapper Imagery Extension after starting ArcView GIS
- Display an ER Mapper image file (.ers) as an Image Data Source
- Display an ER Mapper algorithm file (.alg) as an Image Data Source
- Display a vector theme on an ER Mapper image

Before you begin...

Before beginning these exercises, you must have installed ArcView GIS version 3.1 or higher and the ER Mapper extension for ArcView on your system. These exercises use sample ER Mapper imagery and algorithm files from the ER Mapper installation CD-ROM. You may also follow the general procedures using your own ER Mapper imagery (.ers) or algorithm (.alg) files.

1: Using the ER Mapper extension

Objectives

Learn to enable the ER Mapper extension for ArcView and display ER Mapper imagery (.ers) files and algorithm (.alg) files.

Start ArcView GIS

1 Start the ArcView GIS software on your system.

2 If the **Welcome to ArcView GIS** dialog appears, click **Cancel**.

3 Click the **Maximize** button in the upper-right corner of the ArcView GIS application window (if it is not already maximized)

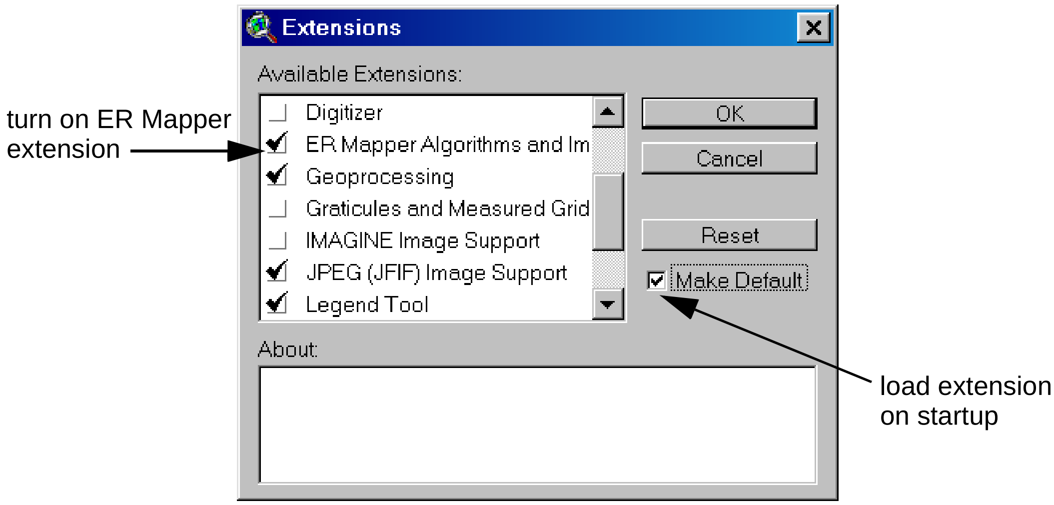
ArcView GIS expands to fill your desktop.

Load the ER Mapper extension

1 From the **File** menu, select **Extensions...**.

2 On the **Extensions** dialog, click on the box next to ‘ER Mapper Algorithms and Imagery’ (a check mark should appear).

3 Turn on the ‘Make Default’ option, then click **OK**.



The ER Mapper Imagery Extension for ArcView GIS loads. You can now display ER Mapper algorithm and imagery files. Since you selected ‘Make Default,’ the extension will load automatically each time you start ArcView GIS.

Open an ER Mapper-format (.ers) image file

1 If the Project window is not open, select **File > New Project**.

2 On the Project window, click **New** to open a View window. (It should titled ‘View1’.)

3 Click the **Add Theme**  button (or select **View > Add Theme**).

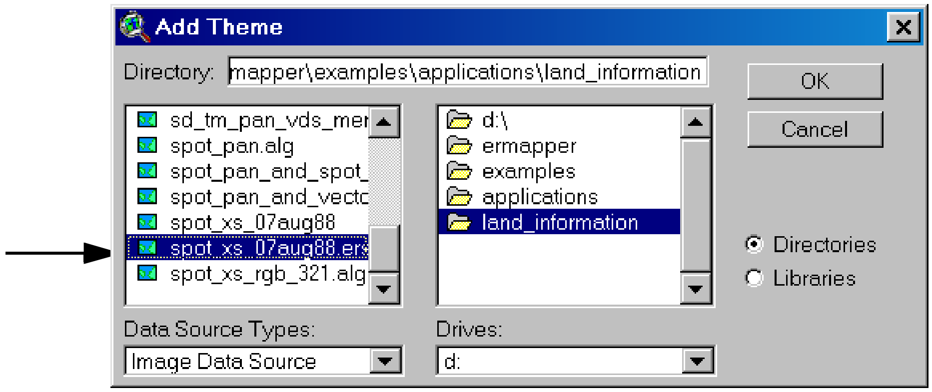
4 On the **Add Theme** dialog, select ‘Image Data Source’ from the ‘Data Source Types’ list. (ER Mapper imagery and algorithms are always image data sources in ArcView GIS.)

5 Double-click on the folder where ER Mapper is installed. Then open the ‘examples\applications\land_information’ folder.

A list of ER Mapper imagery (.ers) and algorithm (.alg) files appears.

6 Scroll down to the bottom, then double-click on the file ‘spot_xs_07aug88.ers.’

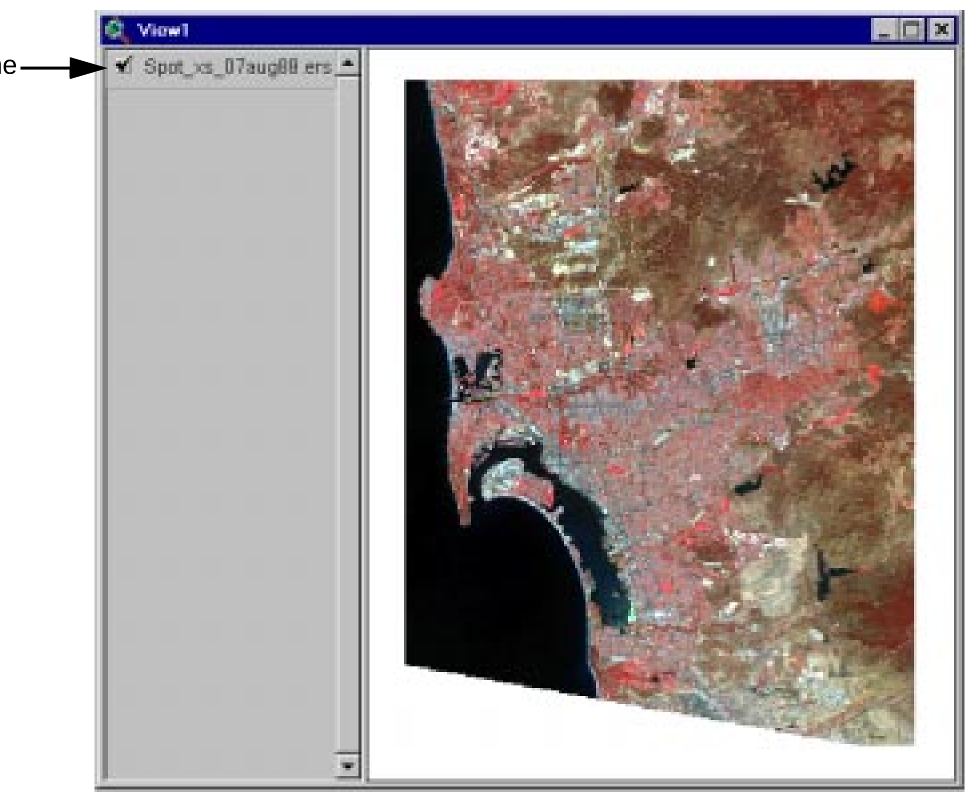
load image



7 Click the check box next to the ‘Spot_xs_07aug88’ theme to turn it on.

ArcView GIS displays a SPOT XS color satellite image of the San Diego, California area. This is a 3-band color infrared image, so vegetated areas appear in red tones.

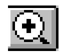
turn on theme



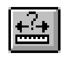
This image file is in ER Mapper's native '.ers' imagery format. The extension enables ArcView GIS to read it as one of its native formats. (ER Mapper's imagery format is composed of a binary data file and an ASCII header '.ers' file similar to the '.hdr' files also used by ESRI products.)

8 Resize the 'View1' window to make the image larger.

Zoom, pan and measure the image

1 Click the **Zoom In**  tool, then drag a box over the central part of the SPOT image to zoom into it.

2 Click the **Pan**  tool, then drag the image to view adjacent areas.

3 Click the **Measure**  tool, then drag a line to view distances across an area.

The line length appears in the lower-left corner of the ArcView GIS dialog.

4 Move the mouse pointer around inside the image.

Geographic coordinates appear in the upper-right area indicating that the image is georeferenced. (In this case to the UTM projection, so units are meters of Easting and Northings.)

Tip: When you load an ER Mapper imagery (.ers) file, the contrast is automatically enhanced by the ER Mapper Imagery Extension (using a 99% linear contrast stretch). You can further adjust image contrast if desired using **Theme > Edit Legend**, however this is usually not necessary.

Open an ER Mapper algorithm (.alg) file

In ER Mapper, an *algorithm* is a list of processing steps or instructions ER Mapper uses to transform a raw imagery file into a final, enhanced image on your screen or printer. Algorithms let you define a "view" into your data that you can save, reload, and modify at any time. By using the ER Mapper Imagery Extension, you can display ER Mapper algorithms just like an other image data source.

Tip: You need a license for ER Mapper to create algorithms, but you only need the free ER Mapper Imagery Extension to view them in ArcView GIS. This means that anyone using ER Mapper can create algorithms and send them to you for viewing.

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1 From the **Edit** menu, select **Delete Themes**. When prompted to delete the theme ‘Spot_xs_07aug88.ers’ click **Yes**.

The theme is deleted from your view.

2 Click the **Add Theme**  button (or select **View > Add Theme**).

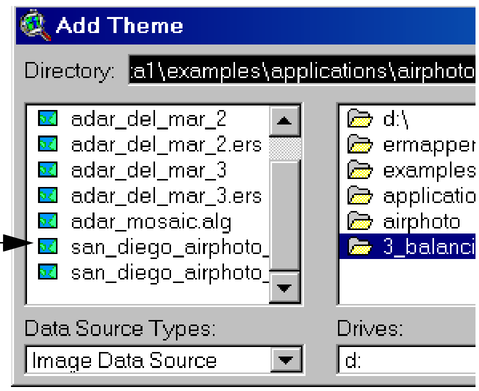
The files in the ‘land_information’ directory should be displayed.

3 Open the ‘applications\airphoto\3_balancing’ folder.

A list of ER Mapper imagery (.ers) and algorithm (.alg) files appears.

4 Scroll down to the bottom, then double-click on the file ‘san_diego_airphoto_34_36_balanced_mosaic.alg’ (the next to last file).

balanced mosaic algorithm



5 Click the check box next to the theme to turn it on.

ArcView GIS displays a mosaic of two orthorectified color airphotos of the downtown San Diego, California area. This image is created from an ER Mapper algorithm, so it has several processing enhancements applied to the two airphoto imagery (.ers) files used as input:

- brightness and color variations within each image are normalized to remove “hotspots” or light-to-dark variations across each photo
- the contrast and brightness of the two normalized images are then balanced to each other ensure uniform color and brightness across the mosaic
- the seam between the two images is feathered to ensure a smooth transition between the two images and make the mosaic truly “seamless”

6 Click the **Zoom In**  tool, then drag a box over the central part of the mosaic image to zoom into it.

7 Click the **Pan**  tool, then drag the image to view adjacent areas.

This example shows how you can access the power of ER Mapper algorithms to apply complex image enhancements and display them directly with ArcView GIS. This example uses only two airphotos, but you could just as easily display a mosaic algorithm containing 100's of megabytes (even gigabytes) of airphoto images.

Add a second view to display a merged satellite image

1. Click the **Minimize** button on the 'View1' window to minimize it (or close it if desired).
2. On the Project window, click **New** to open a new View window. (It should be titled 'View2'.)
3. Click the **Add Theme** button (or select **View > Add Theme**).

   The files in the '3_balancing' directory should be displayed.
4. Open the 'examples\functions_and_features\data_fusion' folder.

   A list of ER Mapper algorithm (.alg) files appears. These algorithms all show different ways of merging (or "fusing") two different images into one.
5. Double-click on the file 'brovey_transform.alg.'
6. In the 'View2' window turn on the 'Brovey_transform' theme.

   ArcView GIS displays a color image of the San Diego, California area. This is a merge of a Landsat TM satellite image (bands 5, 4 and 2) and a SPOT Panchromatic satellite image. By merging the two types of data, you get the high spatial detail provided by the SPOT Pan image (10-meter resolution) with the multispectral color information provided by the Landsat TM image (seven bands at 30-meter resolution).

   The Brovey Transform is a mathematical way of combining the two images that also greatly enhances the color. Merging or fusion techniques like this are used to combine the strengths of different satellite sensors and create up-to-date views of the earth's surface.
7. Enlarge the 'View2' window to make the image larger.
8. Zoom in and pan to different parts of the image using the **Zoom In** and **Pan** tools.

   The image shows a high resolution, color-enhanced view of the area. As with the airphoto mosaic, the ER Mapper algorithm creates this image interactively from the two separate Landsat and SPOT satellite imagery files. (The Brovey Transform technique usually requires up to three intermediate image files to be created when using traditional imaging software, but ER Mapper performs the processing in real time from the two source images without creating intermediate files.)

9 Click the **Zoom to Full Extent** button (or select **View > Full Extent**) to zoom out to the full image extents again.

Add a second theme (algorithm) showing thematic land cover

1 Click the **Add Theme** button (or select **View > Add Theme**).

The files in the ‘data_fusion’ directory should be displayed.

2 Open the ‘functions_and_features\classification_display’ folder.

3 Double-click on the file ‘isoclass_classification.alg.’

4 In the ‘View2’ window turn on the ‘isoclass_classification’ theme.

ArcView GIS displays a thematic color image of the same area of San Diego. Different colors correspond to different types of landuse in the area. This image was created from a 1985 Landsat TM satellite image using ER Mapper’s ISOCLASS unsupervised classification feature. Classification groups pixels with similar spectral values into classes that can represent different types of landuse or land cover.

5 Turn the ‘isoclass_classification’ theme on and off to compare it with the ‘brovey_transform’ merged satellite image theme.

Adding several themes showing different types of data or processing techniques as backdrop images can be very helpful to aid analysis of your vector GIS data.

Add a third theme (algorithm) showing topography

1 Click the **Add Theme** button (or select **View > Add Theme**).

The files in the ‘classification_display’ directory should be displayed.

2 Open the ‘examples\data_types\digital_elevation’ folder.

A list of ER Mapper algorithm (.alg) files appears. These algorithms all show different ways displaying and processing digital elevation model (DEM) data files.

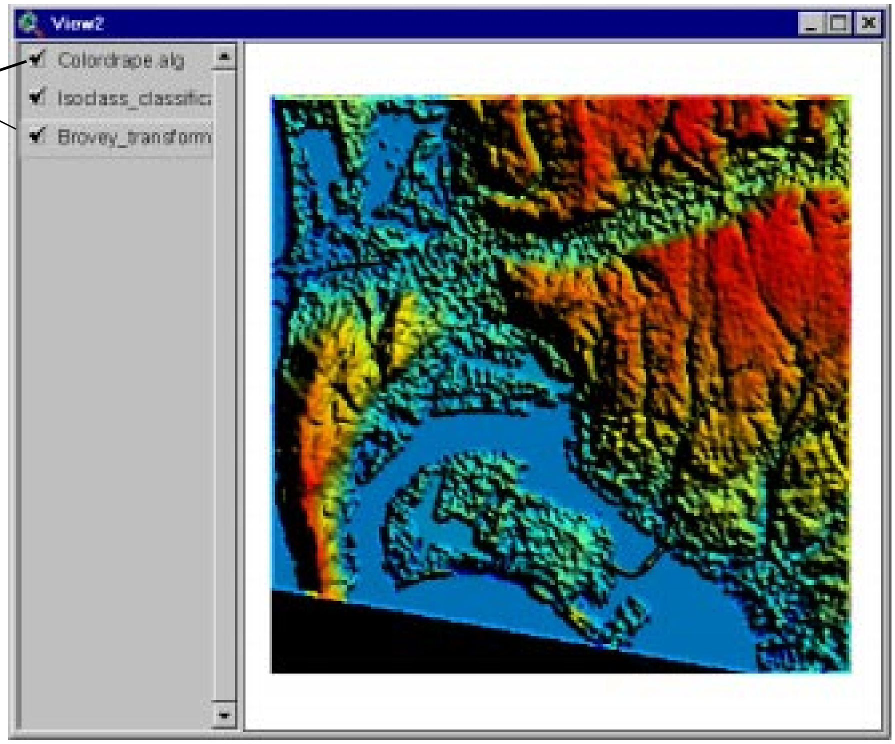
3 Double-click on the file ‘colordrape.alg.’

4 In the ‘View2’ window turn on the ‘Colordrape.alg’ theme.

ArcView GIS displays a color shaded relief (or “colordrape”) image of the same area of San Diego. Colors represent elevation (reds are highest) and the shading effect highlights topographic features such as hills and valleys. This image is illuminated from the northeast, so shadows appear on the southwest side of terrain features. ER Mapper has a built-in “realtime shading” feature that lets you interactively change the shading parameters without creating output files.

5 Turn the three themes on and off to compare them (if more than one is on, the top theme covers the others).

turn on any theme (drag and drop to reorder)



Add a third view to display an image and vector data

1 If desired, click the **Minimize** button on the 'View2' window to minimize it.

2 On the Project window, click **New** to open a new View window. (It should be titled 'View3'.)

3 Click the **Add Theme** button (or select **View > Add Theme**).

The files in the 'digital_elevation' directory should be displayed.

4 Open the 'examples\shared_data' folder.

A list of ER Mapper image (.ers) and algorithm (.alg) files appears.

5 Double-click on the file 'airphoto.ers.'

6 In the 'View3' window turn on the 'Airphoto' theme.

ArcView GIS displays a color aerial photo of a small area near downtown San Diego, California.

Overlay vector roads (in DXF format) on the airphoto

You can display any vector data such as shapefiles, coverages, and other supported vector formats on your ER Mapper image data. In this example, you will overlay a vector roads file of the corresponding area stored in DXF format.

1 From the **File** menu, select **Extensions...**.

2 Click on the box next to ‘Cad Reader’ (if not already turned on), then click **OK**.

This enables the CAD Reader extension, so ArcView GIS can now display DXF and DWG vector files.

3 Click the **Add Theme** button (or select **View > Add Theme**).

The files in the ‘shared_data’ directory should be displayed.

4 Open the ‘examples\data_types\autocad_dxf’ folder.

5 On the **Add Theme** dialog, select ‘Feature Data Source’ from the ‘Data Source Types’ list.

6 Double-click on the file ‘roads.dxf.’

7 In the ‘View3’ window turn on the ‘Roads.dxf’ theme.

ArcView GIS displays a vector roads coverage over the airphoto.

8 If desired, select ‘roads.dxf’ theme and change the vector color and line size to make them more visible. (Select **Theme > Edit Legend**, then double-click on the vector in the Symbol column).

9 Close the views by clicking the **Close** button on the view windows.

These simple examples show how you can use the power of ER Mapper algorithms showing various “views” of your image data, and display them directly inside ArcView GIS.

Open a URL file

The ER Mapper extension enables you to open an ECW compressed image, served via an ER Mapper Image Web Server, inside arcview by specifying its URL. You can then zoom into and roam over this image in real time. The Image Web Server sends the compressed image blocks as they are requested.

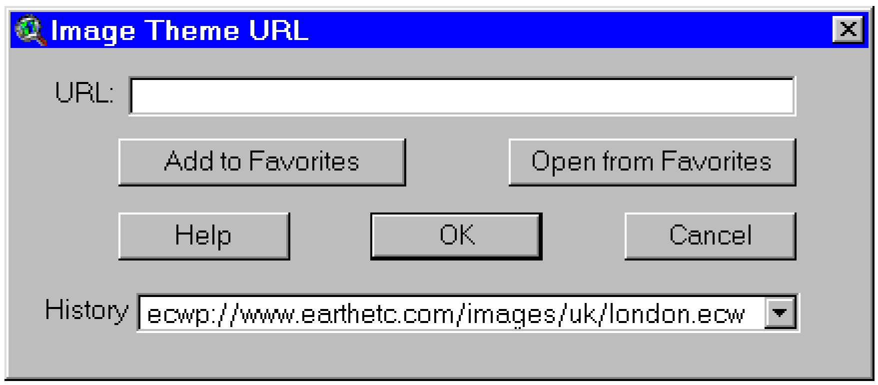
The extension includes the facility to store image URLs in a ‘Favorites’ list so that they can easily be accessed in later ArcView® sessions. You can also select URLs from a ‘History’ list that displays the last 20 URLs requested.

In order for you to do these exercises, the PC in which ArcView is installed must have access to an Image Web Server over the Internet or private intranet. In this example we will use the public ‘www.earthetc.com’ web site.

1 On the Project window, click **New** to open a new View window. (It should be titled ‘View1’.)

2 Click the **Add ECW Image Theme from an Image Web Server URL**  button (or select **View > Add URL Theme**).

This should open the **Image Theme URL** dialog box.



3 Enter the following URL in the **URL:** field.

`ecwp://www.earthetc.com/images/world/gtopo30.ecw`

This URL will access the gtopo30.ecw compressed image file at the Earth Resource Mapping www.earthetc.com web site. The protocol to be used is ECWP (Enhanced Compression Wavelet Protocol).

Note: This step requires your PC to have Internet Access. If you are accessing another Image Web Server on a local network, you must change the URL accordingly.

The 1 Km resolution image of the world was created by using the ER Mapper Image Display and Mosaic Wizard to mosaic 30 gtopo DTMs (Digital Terrain Maps). The resultant 2.8GB image was then compressed to 50 MB using ECW compression.

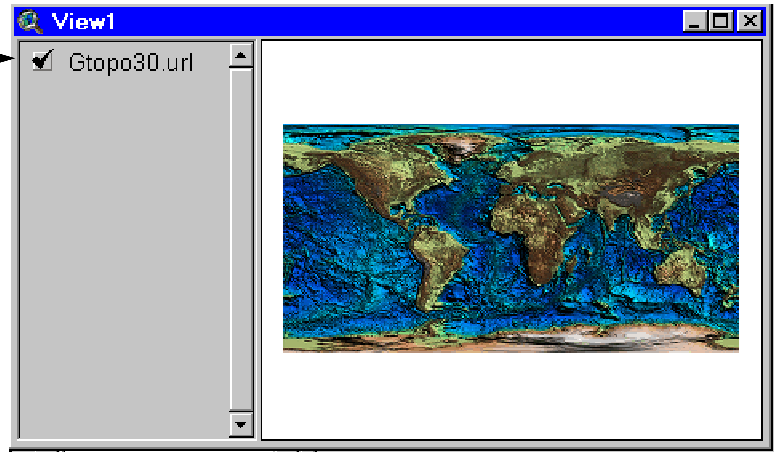
4 Click on the **OK** button.

The image will be loaded as theme via the Internet. If you have a slow connection to the Internet this step could take a few minutes. If your PC is not able to access the www.earthetc.com web site, it will display an error message.

5 In the ‘View1’ window turn on the ‘Gtopo30.url’ theme.

ArcView GIS displays the world image.

Turn on the theme



6 In the ‘View1’ window, select the ‘Gtopo30.URL’ theme and then select **Edit > Delete Themes** to remove the theme. Answer **Yes** to the **Delete Themes** query.

7 Click the **Add ECW Image Theme** button (or select **View > Add URL Theme**) to reopen the **Image Theme URL** dialog box.

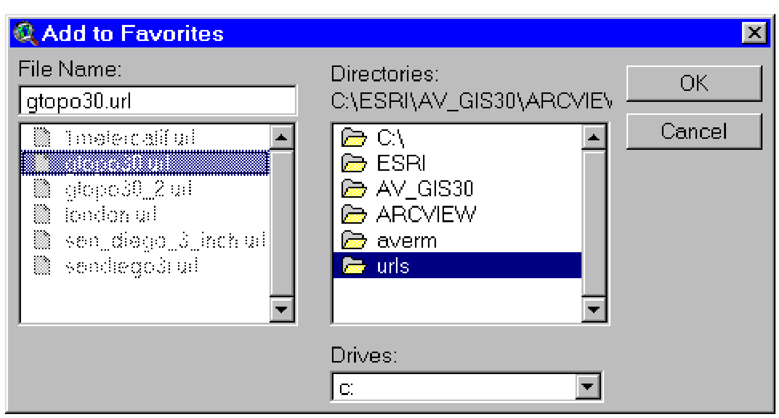
The **URL:** field should now be blank.

8 From the **History:** list select the ‘ecwp://www/earthetc.com/images/world/gtopo30.ecw’ entry.

The **History:** list contains the last 20 URLs entered. This saves you from having to type in the full URL to re-open a recently accessed image.

The **URL:** field should now contain the URL that you selected from the **History:** list. If you were to click on the **OK** button, it would re-load the image as a theme in the ‘View1’ window.

9 Click on the **Add to Favorites** button to open the **Add to Favorites** dialog box.



This box allows you to select a directory and file name to store URLs that you are likely to access again. The file names all have a .url extension.

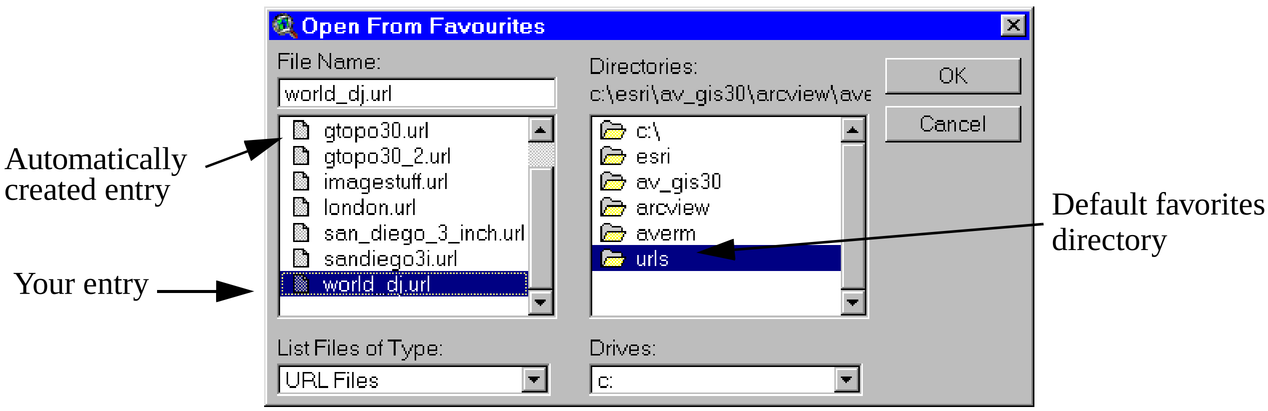
You should note that there is already a ‘gtopo30.url’ entry in the ‘arcview\averm\urls’ directory. The ER Mapper extension automatically creates these files in the default directory whenever you access a URL. The **Add to Favorites** facility is really only required if you want to save the URL to another directory and/or under another name.

10 Select the default directory, which should be ‘ARCVIEW\averm\urls’.

11 Enter **`World_`**<***your initials***>**`.url`** in the **File Name:** field and click on the **OK** button to return to the **Image Theme URL** dialog box.

12 Click on the **Open from Favorites** button.

This opens the **Open From Favorites** dialog box



13 Select the ‘arcview\averm\urls’ directory if it is not already selected.

14 Select the ‘World_<*your initials*>.url’ file which you previously added. There should also be ‘gtopo30.url file’ that was automatically created by the ER Mapper extension.

15 Click on the **OK** button to return to the Image Theme URL dialog.

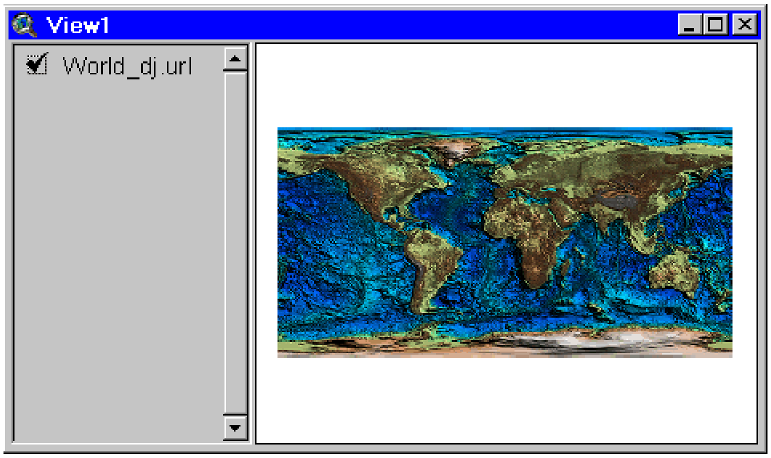
The URL: field should now contain he full URL .

16 Click on the **OK** button.

The image will be loaded as theme via the Internet. If you have a slow connection to the Internet this step could take a few minutes. If your PC is not able to access the www.earthetc.com web site, it will display an error message.

You should also note that the theme name is now the same as that you entered for the ‘Favorites’ file.

17 In the ‘View1’ window turn on the ‘World_*<your initials>*.url’ theme.



The same world image will open with the new theme name.

Zoom, pan and measure the image

1 Click the **Zoom In**  tool, then drag a box over the central part of the image to zoom into it.

2 Click on the **Refresh View**  button to improve the image resolution.

Tip: If you are connected to the Internet via a slow link, you may have to click on the **Refresh View** button a number of times to get the best resolution. This is because ArcView® may display the image before it is fully downloaded from the server. The **Refresh View** button reloads the image with all new information that has been cached on the PC.

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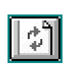
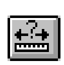
3 Click the **Pan**  tool, then drag the image to view adjacent areas.

4 Click on the **Refresh View**  button to improve the image resolution.

5 Click the **Measure**  tool, then drag a line to view distances across an area.

The line length appears in the lower-left corner of the ArcView GIS dialog.

Close ArcView GIS

1 If desired, save your views as an ArcView project using **File > Save Project As....**

2 Close ArcView GIS by clicking the **Close** button on the application window or selecting **File > Exit**.

What you learned...

After completing these exercises, you know how to perform the following tasks in ArcView GIS using the ER Mapper Imagery Extension:

- Enable the ER Mapper Imagery Extension after starting ArcView GIS
- Display an ER Mapper image file (.ers) as an Image Data Source
- Display an ER Mapper algorithm file (.alg) as an Image Data Source
- Display a vector theme on an ER Mapper image
- Display an ER Mapper URL file (.ecw) as an Image Data Source.

23

MapInfo Users

This chapter explains how to use the free MapImagery plug-in for MapInfo software to view ER Mapper imagery and algorithm files. (The free MapImagery plug-in is developed by GID Australia.) It also explains how to obtain and install the plug-in, and the additional imaging capabilities MapInfo users can gain by using the plug-in in conjunction with ER Mapper.

Note: You must have a licensed copy of MapInfo version 4.5 or greater to install and run the MapImagery plug-in. You do not need to have a copy of ER Mapper installed, but this is recommended to gain access to sample ER Mapper imagery and algorithms used in the following tutorial. (You can order the free ER Mapper installation CD-ROM from www.ermapper.com.)

About the MapImagery plug-in for MapInfo

As imagery data sources become more important for GIS applications, the need to efficiently display, process and enhance large image files also becomes more important. GID Australia provides a plug-in that lets MapInfo users directly display ER Mapper imagery and algorithms. This plug-in uses the ER Mapper processing engine to display imagery within MapInfo.

Using the plug-ins, MapInfo users can choose from three levels of imagery support:

- **Level 1 (using the free MapImagery plug-in)**–By installing the free MapImagery plug-in, MapInfo users can directly display ER Mapper imagery and algorithms from within MapInfo. You can also use the plug-in to display other imagery formats directly supported by ER Mapper such as GeoTIFF, BMP, GeoSPOT and others.

- **Level 2 (using the commercial MapImagery plug-in)**–By installing the commercial version of MapImagery plug-in, MapInfo users add advanced image processing capabilities to MapInfo. These include contrast enhancement, convolution filtering, image mathematics functions, color lookup tables, and much more. The commercial version can also create ER Mapper algorithms. For information on the commercial version, contact GID Australia at their web site at www.gid.com. (GID Australia also makes other ER Mapper and MapInfo tools. See their website for information.)
- **Level 3 (using the free MapImagery plug-in with a licensed copy of ER Mapper)**–By purchasing a license for ER Mapper, MapInfo users can access the full range of high-level ER Mapper image processing functions, and display the images within MapInfo using the free or commercial MapImagery plug-in. ER Mapper provides functions for easily creating seamless, color balanced mosaics of many large image files such as airphotos. It also provides advanced image processing functions such as orthorectification, image reprojection, multispectral classification, color shaded reliefs, raster to vector conversion, image merging/ fusion, support for over 100 imagery formats and over 200 hardcopy printing devices, and much more.

How to obtain the free MapImagery plug-in

You can obtain the free MapImagery plug-in from three sources:

- **The GID Australia web site**–GID Australia regularly updates the MapImagery plug-in and posts the latest version on their web site at www.gid.com. Navigate to the “products and services” area and download the free MapImagery plug-in.
- **The ER Mapper web site**–You can download the plug-in from the ER Mapper web site at www.ermapper.com. Navigate to the “free software” area and download the MapInfo plug-in.
- **The ER Mapper installation CD-ROM**–The plug-in can be installed as a separate component from the ER Mapper installation CD-ROM. (Note that this may not be the latest version. Check the GID Australia web site for the latest update.)

Hands-on exercises

These exercises show you how to use the free MapImagery plug-in for MapInfo.

What you will learn...

After completing these exercises, you will know how to perform the following tasks in MapInfo using the free MapImagery plug-in:

- Display an ER Mapper image file (.ers) as a MapInfo table
- Display an ER Mapper algorithm file (.alg) as MapInfo table
- Overlay MapInfo vector and tabular table data on an ER Mapper image

- Choose MapImagery setup options to control image display and printing

Before you begin... Before beginning these exercises, you must have installed MapInfo version 4.5 or higher and the free version of the MapImagery plug-in on your system.

Note: These exercises use sample ER Mapper imagery and algorithm files from the ER Mapper installation CD-ROM. You may also follow the general procedures using your own ER Mapper imagery (.ers) or algorithm (.alg) files.

1: Open an ER Mapper image file

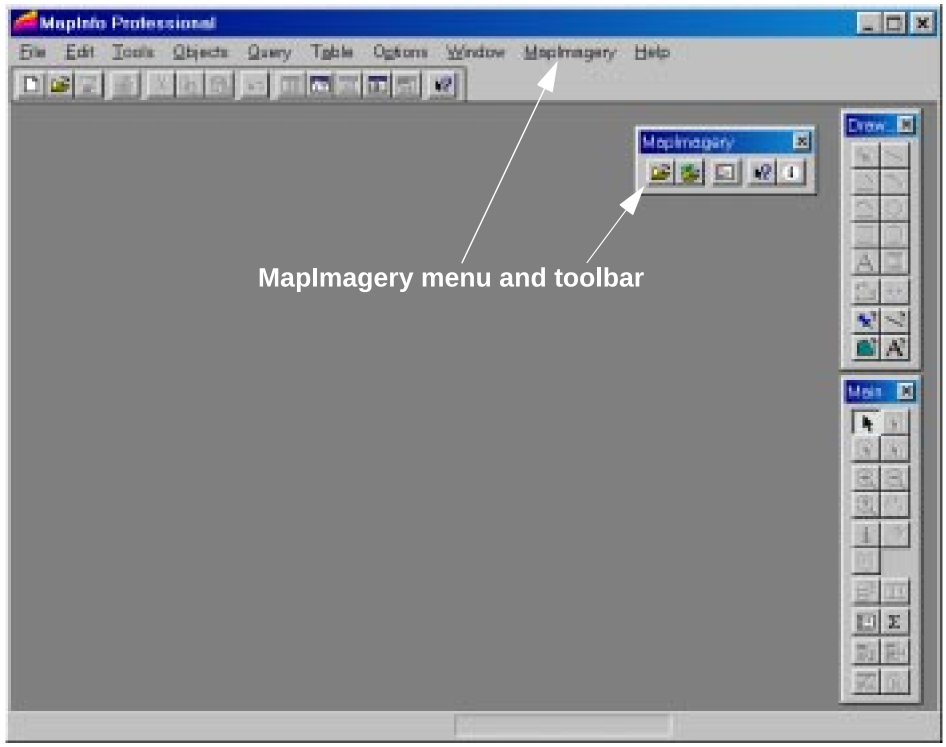
Objectives Learn to use the MapImagery plug-in to display ER Mapper imagery (.ers) files and to zoom, pan and measure distances on the image.

Note: You can use the following procedure to open any image formats supported by MapImagery, including TIFF, Windows BMP, JPEG, SPOTView, ESRI BIL, and others. (Additional formats are added periodically, so make sure you are using the latest version of MapImagery.)

Start MapInfo

1. Start the MapInfo software on your system.
2. If the **Quick Start** dialog appears, click **Cancel** on it.

In the MapInfo application window, you should see the MapImagery plug-in enabled as both a floating toolbar and menu:

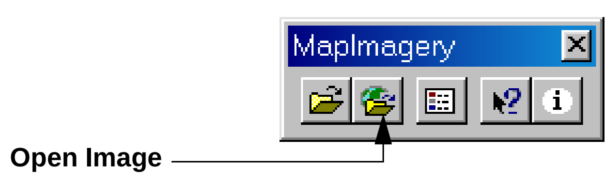


3 Click the **Maximize** button in the upper-right corner of the MapInfo application window (if it is not already maximized)

MapInfo expands to fill your desktop.

Open an ER Mapper-format (.ers) image file

1 Click the **Open Image** button on the **MapImagery** toolbar (or select **MapImagery > Open Image**).



The option lets you open several types of imagery files directly inside MapInfo.

2 On the **Open Image Files** dialog, open the 'Files of Type' list.

A list of all the supported imagery formats displays. You can open ER Mapper imagery (.ers) and algorithm (.alg) files, as well as TIFF and BMP and compressed formats such as ER Mapper's compressed wavelet (.ecw), and JPEG. (Make sure the 'All Image Files' option is selected when closing the list.)

3 Double-click on the folder where ER Mapper is installed. Then open the directory 'examples\Applications\Land_Information.'

A list of ER Mapper imagery (.ers) and algorithm (.alg) files appears.

4 Scroll down to the bottom, then double-click on the file 'SPOT_XS_07Aug88.ers.'

5 If you see a message asking to overwrite the existing .alg file, click **Yes**.

The **Choose Algorithm Style** dialog appears. This lets you select how you want MapImagery to display the image.

6 Select the 'Automatic contrast stretching' option, then click **OK**.

7 If you see a message asking to overwrite the previous .tab file, click **Yes**.

The **MapImagery Projection** dialog appears.

8 Select the correct MapInfo projection items (as follows), then click **OK**:

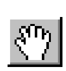
- **MapInfo Category**–>Universal Transverse Mercator (NAD27 for US)
- **MapInfo Category Members**–>UTM Zone 11 (NAD27 for US)
- **MapInfo Units**–meters

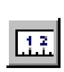
MapImagery displays a SPOT XS color satellite image of the San Diego, California area in a new map window. This is a 3-band color infrared image, so vegetated areas appear in red tones. The spatial resolution (pixel size) is 20 meters.

Note: When you open image or algorithm file, MapImagery creates a MapInfo table (.tab) file to allow correct coordinates and georeferencing. You may be prompted to overwrite this file; see "Table (.tab) files created by MapImagery" in part 3 in this chapter for details on when and why to do this.

Zoom, pan and measure the image

1 Click the **Zoom-in**  button on the **Main** toolbar, then drag a box around the central part of the SPOT image to zoom in on it.

2 Click the **Grabber**  tool, then drag the image to view adjacent areas.

3 Click the **Ruler**  tool, then drag a line between two points on the image and double-click to end it.

The distance along the line is displayed in the pop-up **Ruler** dialog.

4 Select **Map > View Entire** Layer, then click **OK** on the pop-up dialog.

The image zooms out to the full extents of the SPOT satellite image.

View geographic coordinates on the image

1 Select **Map > Options**.

2 On the **Map Options** dialog, select **degrees** or **meters** for ‘Coordinate Units’ (whichever you prefer).

3 Under ‘Display in Status Bar,’ click ‘Cursor Location.’ Then click **OK**.

4 Move the cursor around inside the satellite image.

Geographic coordinates appear in the Status Bar (lower-left area). The coordinates are in Latitude/Longitude (if you chose degrees) or meters of Eastings and Northings in the UTM projection (if you chose meters).

5 Select **File > Close All** to close all current tables (in case any others were also open).

2: Open ER Mapper algorithm files

Objectives Learn to use the MapImagery plug-in to display ER Mapper algorithm (.alg) files, and to add several images as different layers in your map.

Open an ER Mapper algorithm (.alg) file

In ER Mapper, an *algorithm* is a list of processing steps or instructions ER Mapper uses to transform a raw imagery file into a final, enhanced image on your screen or printer. Algorithms let you define a “view” into your data that you can save, reload, and modify at any time. By using the MapImagery plug-in, you can display ER Mapper algorithms just like any other imagery file.

Tip: You can *create* algorithm files with ER Mapper or with the commercial version of the MapImagery plug-in. You only need the free MapImagery plug-into *view* algorithm files in MapInfo.

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1 Click the **Open Algorithm** button on the **MapImagery** toolbar (or select **MapImagery > Open Algorithm**).

Open Algorithm

The files in the ‘Land_Information’ directory should be displayed.

2 Backup one directory (to ‘Applications’). Then double-click on the ‘Airphoto’ folder, then double-click on the ‘3_balancing’ folder.

A list of ER Mapper imagery (.ers) and algorithm (.alg) files appears.

3 Double-click on the ‘San_Diego_Airphoto_34_36_Balanced_Mosaic.ers’ file.

4 If you see a message asking to overwrite the previous .tab file, click **Yes**.

5 The correct MapInfo projection parameters are displayed, then click **OK**.

MapImagery displays a mosaic of two orthorectified color airphotos of the downtown San Diego, California area. This image is created from an ER Mapper algorithm, so it has several processing enhancements applied to the two airphoto imagery (.ers) files used as input:

- brightness and color variations within each image are normalized to remove “hotspots” or light-to-dark variations across each photo
- the contrast and brightness of the two normalized images are then balanced to each other ensure uniform color and brightness across the mosaic
- the seam between the two images is feathered to ensure a smooth transition between the two images and make the mosaic truly “seamless”

6 Click the **Zoom-in** button on the **Main** toolbar, then drag a box around the central area of the airphoto mosaic.

MapImagery applies the algorithm processing to the airphotos, then zooms in to display your area of interest.

7 Click the **Grabber** tool, then drag the image to view adjacent areas.

MapImagery applies the algorithm processing, then pans to display the adjacent area.

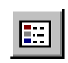
8 Select **File > Close All** to close all current tables (in case any others were also open).

This example shows how you can access the power of ER Mapper algorithms to apply complex image enhancements and display them directly within MapInfo. (Each one of these airphotos is over 30MB in size.) This example uses only two airphotos, but you could just as easily display a mosaic algorithm containing 100’s of megabytes (even gigabytes) of airphoto images.

Note: When you have displayed an image and selected the projection information in MapInfo, MapImagery remembers this in the future. See “Choosing map projection information” in part 3 in this chapter for more information on how and when to select projections.

Set the option to add multiple images to the current mapper

For this next example, you will add several images as layers in the same mapper window. MapImagery has setup options to make this easier.

1. Click the **MapImagery Options**  button (on the **MapImagery** toolbar), or select **MapImagery > MapImagery Options**.
2. Click the **General** tab. Under ‘When Opening an Algorithm Table’ select the ‘Add to Current Mapper’ option. Click **OK**.

   This tells MapImagery to add new images to the same mapper, rather than open a new mapper each time.

Open a merged satellite image algorithm

1. Click the **Open Algorithm**  button on the **MapImagery** toolbar (or select **MapImagery > Open Algorithm**).

   The files in the ‘3_Balancing’ directory should be displayed.
2. Backup to the ‘examples’ directory. Double-click on the ‘Functions_and_Features’ folder, then double-click on the ‘Data_Fusion’ folder.

   A list of ER Mapper algorithm (.alg) files appears. These algorithms all show different ways of merging (or “fusing”) two different images into one.
3. Double-click on the file ‘Brovey_Transform.alg.’
4. The correct MapInfo projection parameters are displayed, then click **OK**.

   MapImagery displays a color image of the San Diego, California area. This is a merge of a Landsat TM satellite image (bands 5, 4 and 2) and a SPOT Panchromatic satellite image. By merging the two types of data, you get the high spatial detail provided by the SPOT Pan image (10-meter resolution) with the multispectral color information provided by the Landsat TM image (seven bands at 30-meter resolution).

The Brovey Transform is a mathematical way of combining the two images that also greatly enhances the color. Merging or fusion techniques like this are used to combine the strengths of different satellite sensors and create detailed, up-to-date views of the earth’s surface.

5 Use the **Zoom-in**  tool to zoom into the image. Then use the **Grabber**  tool to pan around inside it.

MapImagery applies the algorithm processing to merge the two image files, then displays your new area of interest.

The image shows a high resolution, color-enhanced view of the area. As with the airphoto mosaic, the ER Mapper algorithm creates this image interactively from the two separate Landsat and SPOT satellite imagery files. (The Brovey Transform technique usually requires up to three intermediate image files to be created when using traditional imaging software, but ER Mapper performs the processing in real time from the two source images without creating intermediate files.)

6 Select **Map > View Entire Layer**, then click **OK** on the pop-up dialog.

The image zooms out to the full extents of the merged satellite image.

Add a second image (algorithm) showing thematic land cover

1 Click the **Open Algorithm**  button on the **MapImagery** toolbar (or select **MapImagery > Open Algorithm**).

The files in the ‘Data_Fusion’ directory should be displayed.

2 Open the ‘examples\Functions_and_Features\Classification_Display’ folder.

3 Double-click on the file ‘ISOCLASS_Classification.alg.’

4 The correct MapInfo projection parameters are displayed, then click **OK**.

MapImagery displays a thematic color image of the same area of San Diego. Different colors correspond to different types of landuse in the area. This image was created from a 1985 Landsat TM satellite image using ER Mapper’s ISOCLASS unsupervised classification feature. Classification groups pixels with similar spectral values into classes that can represent different types of landuse or land cover.

Add a third image (algorithm) showing topography

1 Click the **Open Algorithm**  button on the **MapImagery** toolbar (or select **MapImagery > Open Algorithm**).

The files in the ‘Classification_Display’ directory should be displayed.

2 Open the ‘examples\Data_Types\Digital_Elevation’ folder.

A list of ER Mapper algorithm (.alg) files appears. These algorithms all show different ways displaying and processing digital elevation model (DEM) data files.

3 Double-click on the file ‘Colordrape.alg.’

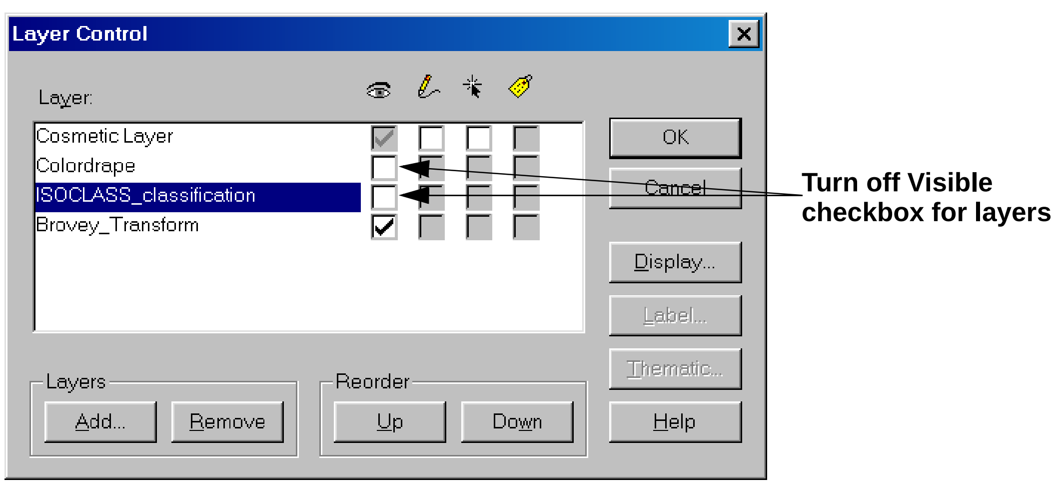
4 The correct MapInfo projection parameters are displayed, then click **OK**.

MapImagery displays a color shaded relief (or “colordrape”) image of the same area of San Diego. Colors represent elevation (reds are highest) and the shading effect highlights topographic features such as hills and valleys. This image is illuminated from the northeast, so shadows appear on the southwest side of terrain features. ER Mapper has a built-in “realtime shading” feature that lets you interactively change the shading parameters without creating output files.

View the three images (layers) in the mapper

1 Click the **Layer Control**  button on the **Main** toolbar (or select **Map > Layer Control**).

2 In the **Layer Control** dialog, turn off the Visible checkboxes for the ‘Colordrape’ and ISOCLASS_classification’ layers, then click **OK**.



MapImagery redisplays the Brovey Transform algorithm.

3 If desired, repeat step 2 to view other images (turn on only the one you want, then click **OK**).

4 If desired, save your workspace using **File > Save Workspace**.

5 Select **File > Close All** to close any open tables.

3: Overlay MapInfo vector data

Objectives Learn to overlay MapInfo vector and point table data on an ER Mapper algorithm image. In this case, you will display a world shaded relief image generated by an ER Mapper algorithm, then overlay MapInfo data of a Lat/Long grid, world capitals, and country borders.

Open an ER Mapper world topography algorithm

1 Click the **Open Algorithm**  button on the **MapImagery** toolbar (or select **MapImagery > Open Algorithm**).

2 Backup to the 'examples' folder, open the 'applications' folder, then open the 'World_Topography' folder.

A list of ER Mapper imagery (.ers) and algorithm (.alg) files appears.

3 Double-click on the 'World_Topography.alg' file.

4 If you see a message asking to overwrite the previous .tab file, click **Yes**.

5 Select the correct MapInfo projection items (as follows), then click **OK**:

- **MapInfo Category**–>Longitude / Latitude
- **MapInfo Category Members**–>Longitude / Latitude
- **MapInfo Units**–degrees

MapImagery displays a color shade relief image (a "colordrape") of the world. Colors of the land areas represent elevation (magenta are the highest, red are the lowest). Ocean areas are colored blue, and bathymetric features such as mid-ocean ridges are shown by the shading effect.

Note: When displaying data that is in a Longitude Latitude coordinate system, it is important to select 'degrees' as the map projection units. This lets you overlay any other data that is also stored in degrees.

View Longitude Latitude coordinates on the image

1 Select **Map > Options**.

2 On the **Map Options** dialog, select **degrees** for 'Coordinate Units.'

3 Under ‘Display in Status Bar,’ click ‘Cursor Location.’ Then click **OK**.

4 Move the cursor around inside the satellite image.

Longitude Latitude coordinates appear in the Status Bar. (Negative Longitudes indicate the western hemisphere, and negative Latitudes indicate the southern hemisphere.)

Overlay a Longitude Latitude coordinate grid

1 Select **File > Open Table**.

2 On the **Map Options** dialog, open the ‘WORLD’ directory (under the MapInfo ‘Data’ directory).

3 Double-click on the ‘GRID15.TAB’ file.

MapInfo overlays a Longitude Latitude grid (graticule) with a 15-minute grid spacing.

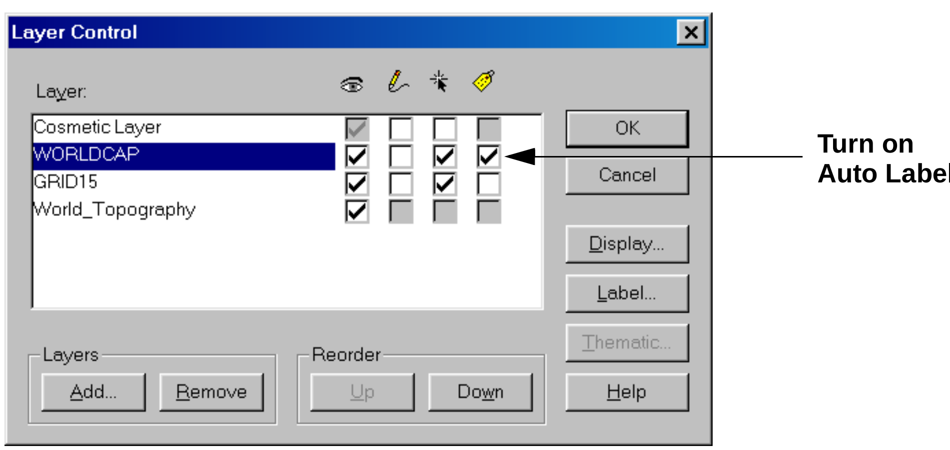
Overlay a table of world capital cities

1 Select **File > Open Table**.

2 Double-click on the ‘WORLDCAP.TAB’ file.

MapInfo overlays the locations of world capital cities.

3 Click the **Layer Control** button on the **Main** toolbar (or select **Map > Layer Control**). Turn on auto labelling, then click **OK**.



MapInfo redisplays the world map with labels (city names) plotted next to the symbols. (If desired, you can make the labels bigger, change fonts, and so on by selecting **Layer Control** again and clicking **Labels**...).

Overlay a table of vector country borders

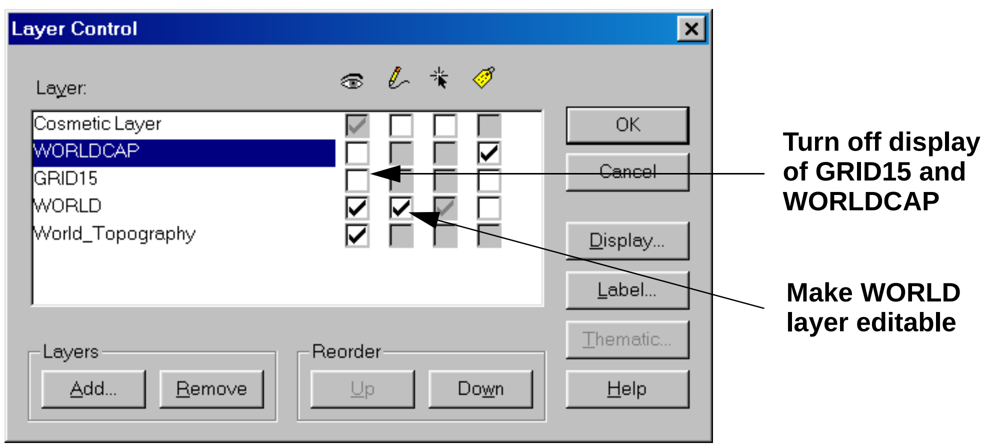
1 Select **File > Open Table**.

2 Double-click on the ‘WORLD.TAB’ file.

MapInfo overlays the borders of countries on the world map.

Turn off the GRID15 and WORLDCAP layers

1 Click the **Layer Control** button again. Turn off the ‘GRID15’ and ‘WORLDCAP’ layers, make the ‘WORLD’ layer editable, then click **OK**.



MapInfo redisplays the map without the grid and capital cities layers.

Make the Africa country border polygons transparent

1 Click the **Marquee Select** button on the **Main** toolbar, then drag a selection box around the continent of Africa.

MapInfo selects all the polygons in your selection marquee.

2 Click the **Region Style** button on the **Draw** toolbar (or select **Options > Region Style**).

3 On the **Region Style** dialog, select the ‘Pattern’ of ‘None,’ then click **OK**.

The selected region polygons redisplay without the fill pattern, so you can see the country borders in relation to the ER Mapper world topography image.

4 Click **Zoom-in** on the **Main** toolbar, then drag a box around the African continent to zoom in on it.

Query the country data or go to other areas of the world

1. If desired, use the MapInfo query tools to get information about the countries, or follow the same steps as above to make country borders for other regions transparent.
2. (Optional.) Save your workspace using **File > Save Workspace**.

4: MapImagery settings and options

Objectives Learn to understand the way MapImagery handles and displays imagery, and how to setup default options to control the way images are displayed and printed in MapInfo. (There are no exercises here, only information.)

Table (.tab) files created by MapImagery

When you open an ER Mapper imagery or algorithm file (or any other supported format), MapImagery automatically creates a MapInfo table (.tab) file for the image. The table file contains information on the map projection, image extents, viewing resolution, and other information MapInfo needs to properly display the image. When you open an image or algorithm file that was already opened in the past, MapImagery prompts you to overwrite the previously created table file in case you have changed any parameters since then.

You would want to overwrite the existing table file in the following cases:

- You selected the wrong map projection information the first time. Click **Yes** to overwrite the existing table file for the image, and select the correct projection information for the future.
- You change the 'Supersampling Factor' on the **MapImagery Options** dialog's **Supersampling** tab. This option lets you manipulate the quality of images within MapInfo, but is also tied to the image extents and coordinates saved in the table file. If you change the supersampling factor, you must regenerate the table files for all imagery files you opened in the past. Click **Yes** to overwrite the existing table file for the image to update the supersampling setting. (If you do not overwrite the existing table file, your image will display but the map coordinates will be wrong, so this is very important.)

Algorithm (.alg) files created by MapImagery

When you open an ER Mapper imagery (.ers) or other supported image file, MapImagery automatically creates an ER Mapper-format algorithm file for the image (in addition to a MapInfo table file). The algorithm file tells MapImagery how to display the image file, and is independent from the image file itself.

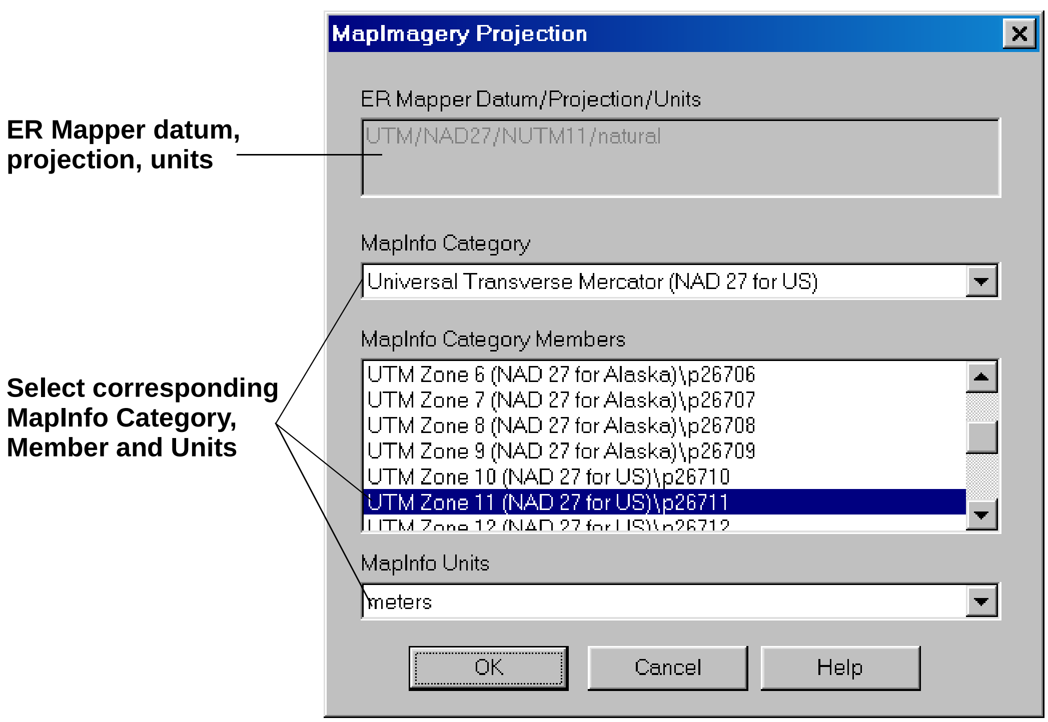
When you open an image file that was already opened in the past, MapImagery prompts you to overwrite the previously created algorithm file. You should do this if you want to change the contrast enhancement option you selected the first time you opened the image. Otherwise, you do not need to overwrite it.

Choosing map projection information

When you open an ER Mapper or other image file for the first time, or when you choose to overwrite an existing table (.tab) file, you are presented with MapInfo projection options. These options let you choose the correct map projection and coordinate units, and these are important to make sure that georeferenced images display with correct coordinates in MapInfo.

Since the image often originated in ER Mapper, it usually has georeferencing information attached to it (stored in the .ers header file). You need to match the ER Mapper projection information to the equivalent information in MapInfo. Once you do this one time for a given projection type, MapImagery remembers this setting and will automatically set the MapInfo defaults for you when you open another image that has the same ER Mapper projection parameters.

To match the ER Mapper projection information to the MapInfo equivalent, examine the ER Mapper information at the top, then make the appropriate selections from MapInfo projection database:



The Supersampling setting

When you open an ER Mapper or other image file, MapImagery processes and displays the image data at a predefined resolution. This is called *supersampling*, and is controlled by the 'Supersampling Factor' on the **MapImagery Options** dialog's **Supersampling** tab. For example, if you set supersampling to 8, then an 8x8 pixel area is displayed for every underlying pixel.

You should set the supersampling factor according to these guidelines:

- Use lower values to speed display of very large images, or mosaic algorithms containing many images. Lower values may not produce optimal hardcopy prints however.
- Use higher settings to improve detail in on the screen when smoothing is enabled in the ER Mapper algorithm, and when hardcopy printing from MapInfo.

Contrast enhancement options

When you open an ER Mapper imagery (.ers) file and are prompted to create an algorithm for it, clicking **Yes** displays the **Choose Algorithm Style** dialog. This dialog lets you choose how contrast will be adjusted to improve the image presentation:

- **Create an algorithm with No contrast stretching**–This displays the image without enhancing the contrast. Use this option if you wish to view the image without enhancement or if your image is already contrast enhanced. Non-photographic images like digital terrain models (DEMs) may look better when displayed this way, or may look better with contrast stretching.
- **Create an algorithm with Automatic contrast stretching**–This displays the image with a linear contrast enhancement to improve color and brightness. Use this option for images that are not already contrast enhanced (like satellite images) or if your images look too dark or light or lack contrast using the no stretching option.

  The type of contrast enhancement applied is a linear contrast stretch that "clips" (or saturates) a certain percentage of brightest and darkest pixels at the high and low ends of the image histogram. The amount of clipping (percentage) is set in the **MapImagery Options** dialog's **Algorithm Generation** tab. A 99% clip applies a mild contrast enhancement that look good on many types of images. If the image still lacks contrast, choose 97.5. (The smaller the percentage the more contrast, but experiment for best results.)

Note: The algorithm file contains the contrast enhancement settings, so the setting you choose is automatically applied to all images you open (if you choose to overwrite an existing algorithm file). If you have a problem image, try smaller percent values for that image, then set the default back to 99% so it is used in the future.

Close MapInfo

1 Close MapInfo by clicking the **Close**  button on the application window or selecting **File > Exit**.

What you learned...

After completing these exercises, you know how to perform the following tasks in MapInfo using the free MapImagery plug-in:

- Display an ER Mapper image file (.ers) as a MapInfo table file
- Display an ER Mapper algorithm file (.alg) as MapInfo table file
- Overlay MapInfo vector and tabular table data on an ER Mapper image
- Choose MapImagery setup options to control image display and printing

24

Autodesk World Users

This chapter explains how to use the capabilities of the Autodesk World software to display ER Mapper imagery and algorithm files as backdrops. This chapter covers steps similar to those described in the Autodesk World software documentation and help system.

Note: You must have a licensed copy of Autodesk World 2.0 to run this tutorial. You do not need to have a copy of ER Mapper installed, but this is recommended to gain access to sample ER Mapper imagery and algorithms used in the following tutorial. (You can order the free ER Mapper installation CD-ROM from www.ermapper.com.)

About Autodesk World's ER Mapper image viewing engine

As imagery data sources become more important for GIS applications, the need to efficiently process, enhance and display large image files also becomes more important. Many projects require the analysis of vector GIS drawing data by presenting it over image backdrops that show a "real world" perspective. For example, you gain a better understanding of parcel ownership, tax zones, zip codes, and many other vector entities by overlaying them on an airphoto showing landuse and buildings.

Autodesk World incorporates the ER Mapper viewing engine, which lets you incorporate nearly any type of image data into your projects. These include aerial photographs, satellite images, digital elevation (topography) images and many more image types.

By incorporating the ER Mapper image viewing engine, Autodesk World users are not restricted by limited image handling capabilities as are some other GIS products. You can directly display ER Mapper imagery and algorithms, and image formats with location information such as GeoTIFF, ESRI/GeoSPOT HDR, and others. In addition, you can experience the full power of ER Mapper algorithms from within Autodesk World.

Using Autodesk World with ER Mapper

By using Autodesk World in conjunction with a copy of the ER Mapper software, you gain access to the extensive capabilities of this powerful integrated mapping and image processing product, including:

- Import and display over 100 different image formats
- Use advanced image processing functions such as contrast enhancement, multispectral classification, vegetation indexes, color shaded reliefs, filtering, merging images, and many others.
- Directly read TIFF, GeoTIFF, Windows BMP, ER Mapper images and algorithms, ESRI BIL, SPOTView and Universal Data Format (UDF) imagery without the need for import or conversion
- Easily view the entire project area in one image–no limits on image file sizes
- Geocode, orthorectify or reproject imagery easily to precisely register with GIS vector drawing data
- Automatically display, mosaic and color balance numerous images
- Combine imagery, vector and tabular data from any number of sources
- Create and edit vector data over imagery backdrops, and highlight features of interest and save them as vectors with ER Mapper's raster to vector conversion tools

Hands-on exercises

These exercises show you how to use the ER Mapper image display capabilities within Autodesk World.

What you will learn...

After completing these exercises, you will know how to perform the following tasks in Autodesk World:

- Insert an ER Mapper image into an Autodesk World drawing

- Enhance the image contrast and apply image smoothing
- Choose equivalent coordinate systems in Autodesk World and ER Mapper
- Insert an ER Mapper smart data algorithm into an Autodesk World drawing
- Stack and change the order of multiple images in a drawing
- Combine image and vector drawing data in a project

Before you begin... Before beginning these exercises, you must have installed Autodesk World version 2.0 or higher on your system. These exercises use sample ER Mapper imagery and algorithm files from the ER Mapper installation CD-ROM. You may also follow the general procedures using your own ER Mapper imagery (.ers) or algorithm (.alg) files.

1: Inserting an ER Mapper image

Objectives Learn to insert ER Mapper imagery (.ers) files into an Autodesk World drawing. (You can also use the following procedure to open any image formats directly supported by ER Mapper, including TIFF and GeoTIFF, Windows BMP, SPOTView, ESRI BIL, and others.)

The ER Mapper imagery (.ers) format stores image data in its “raw” form. That is, the imagery may not be processed or enhanced for best presentation. When you insert an ER Mapper image, Autodesk World gives you options to enhance the imagery as it is loaded and displayed.

Start Autodesk World

1. Start the Autodesk World software on your system.
2. Click the **Maximize** button in the upper-right corner of the Autodesk World application window (if it is not already maximized).

   Autodesk World expands to fill your desktop. You should start with a new project.
3. If you do not already have a new (empty) project open, start one by choosing **File > New**, then clicking **Blank Template**.
4. If the **Display Manager** window is open, close it.

Set the coordinate system for the new project

All projects have an associated coordinate system. If you are beginning with an ER Mapper image that has location information as your “basemap,” you should choose the same coordinate system as the image for your project.

1 Choose **File > Properties**.

2 Click the **Coordinate System** tab, then click **Change....**

3 On the **Project Detail** dialog, select **UTM27-11** from the **Coordinate System** list.

This selection specifies a coordinate system using the NAD27 datum and the Universal Transverse Mercator (UTM) map projection (zone 11 in the northern hemisphere). The coordinate units are meters, so locations are defined in meters of Eastings and Northings.

4 Click **OK** on the **Project Detail** dialog, then click **OK** on the **Project Properties** dialog.

This coordinate system is now assigned to your project, and is the same one used by the ER Mapper images you will use in the upcoming examples.

Insert an ER Mapper-format (.ers) image into the drawing

1 Choose **Insert > ER Mapper Image**.

2 On the **Insert ER Mapper Image** dialog, click the I**mage** tab, then click **Browse**.

3 Double-click on the folder where ER Mapper is installed, then open the ‘examples/Applications/Airphoto/1_Geocoding’ folder.

A list of ER Mapper algorithm (.alg) files appears.

4 Turn off the ‘Bilinear Smoothing’ and ‘Contrast Stretching’ options. (These will be explained later).

5 Click on the ‘Files of Type’ list to view the different image formats.

You can insert ER Mapper algorithms (.alg) and datasets (.ers), as well as TIFF, BMP, ARC/INFO-GeoSPOT HDR, and others.

6 From the ‘Files of Type’ list, select **Datasets (*.ers)**.

7 Double-click on the file ‘San_Diego_Airphoto_34_rectified.ers.’

8 Click the **Zoom All**  button or choose **View > Zoom All**.

Autodesk World displays a color aerial photograph of the downtown San Diego, California area. This image has been *rectified* to the NAD27 datum and UTM zone 11 map projection, so it has geographic location information (true earth coordinates).

Zoom in to a small area to see the pixel resolution

1 Click the **Zoom Window** button (or choose **View > Zoom Window**), then drag a very small box over part of the photo to zoom into it.

If needed, do this again until you can see the small square areas that comprise the digital image. These squares are called *pixels* (for picture elements), and are roughly equivalent to the smallest object you can see in the photo. In this image, each pixel is about 1 meter in diameter, which is termed “1-meter resolution.”

Reload the image with smoothing and contrast enhancement

1 Choose **Insert > ER Mapper Image**.

2 This time *turn on* the ‘Bilinear Smoothing’ and ‘Contrast Stretching’ options.

3 From the ‘Files of Type’ list, select **Datasets (*.ers)**.

4 Click **Browse**, then double-click on the file ‘San_Diego_Airphoto_34_rectified.ers’ again to reload it.

The airphoto image redisplays with improved contrast and a “smoother” appearance.

- **Bilinear Smoothing** improves the display of zoomed images or large hardcopy prints by averaging the pixel values to remove the “blocky” look you saw previously when smoothing was not turned on. (You only see the effect of smoothing when you zoom into the pixel level.)
- **Contrast Stretching** generally improves the image color and presentation by increasing contrast between the light and dark areas. This option is recommended when inserting most image files, otherwise they may lack contrast or look too dark or light.

Zoom in and out in the image

1 Click the **Zoom All** button or choose **View > Zoom All**.

The image zooms out to display the full extents of the airphoto.

2 Click the **Zoom Window** button (or choose **View > Zoom Window**), then drag a box over the central part of the photo to zoom into it.

3 Click the **Zoom In** or **Zoom Out** buttons, then click on the image to zoom in or out by fixed amounts.

4 When finished, click the **Zoom All** button or choose **View > Zoom All** to zoom out to the full image extents.

5 Once again, click **Zoom Window** , then drag a box over the central part of the photo to zoom into it.

Pan (scroll) the image

1 Click the **Pan 2 Points** button (or choose **View > Pan**). Click on one point in the photo, then click on a second point.

The image pans (scrolls) in the direction and distance you defined by your two points. This is one way to view adjacent areas of an image.

2 Drag the scroll bars on the right or lower areas of the project window.

The image pans in the direction you drag the scroll bar.

View geographic coordinates on the image

1 Choose **Tools > Format Options**.

2 Click the **Coordinate** tab, select **Latitude Longitude** from the 'Display Type' list, then click **OK**.

3 Point to various locations in the image.

The Latitude Longitude coordinates of the current cursor location appear in the status bar. (The format is decimal degrees, and negative longitudes indicate the western hemisphere.)

4 Choose **Tools > Format Options** again.

5 Click the **Units** tab, then select **m** from the 'User Unit' list.

6 Click the **Coordinate** tab, select **Projection Coordinate** from the 'Display Type' list, then click **OK**.

7 Point to various locations in the image.

The UTM map projection coordinates appear in the status bar. (The format is meters of Northings and Eastings in UTM zone 11.)

Close the project

1 Choose **File > Close**.

When asked to save the contents or save changes, click **No**.

2: Inserting multiple coregistered images

Objectives Learn to insert ER Mapper smart data algorithm (.alg) files into an Autodesk World drawing. Also learn to “stack” multiple images covering the same geographic area, and to turn images on/off and move them to the top of the display.

An ER Mapper *algorithm* is a list of processing steps or instructions ER Mapper uses to transform a raw image file into a final, enhanced image on your screen or printer. An algorithm does not contain the actual image data, but only stores references to it. (The actual image data is stored in ERS or other files.) When you insert an ER Mapper algorithm into an Autodesk World drawing, it follows the steps in the algorithm and displays the finished image accordingly.

Note: In order to precisely overlay multiple images (as you will do next), the images must have the same coordinate system information.

Start a new project

1. Start a new project by choosing **File > New**, then clicking **Blank Template**.

Set the coordinate system for the new project

1. Choose **File > Properties**.
2. Click the **Coordinate System** tab, then click **Change....**
3. On the **Project Detail** dialog, select **UTM27-11** from the **Coordinate System** list.

Set the data viewing coordinate type

1. Choose **Tools > Format Options**.
2. Click the **Units** tab, then select **m** from the ‘User Unit’ list.
3. Click the **Coordinate** tab, select **Projection Coordinate** from the ‘Display Type’ list, then click **OK**.

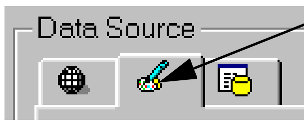
   The display coordinates are now set to the units of the map projection (meters of Northings and Eastings in UTM zone 11.)

Create drawing layers to display three different images

1 Choose **File > Data Manager**.

The **Data Manager** dialog lets you add and controls layers in your drawings.

2 Click the **Drawing Data** tab to view drawing layers



Drawing Data tab

3 Right-click on 'Drawing1' then select **New Layer**.

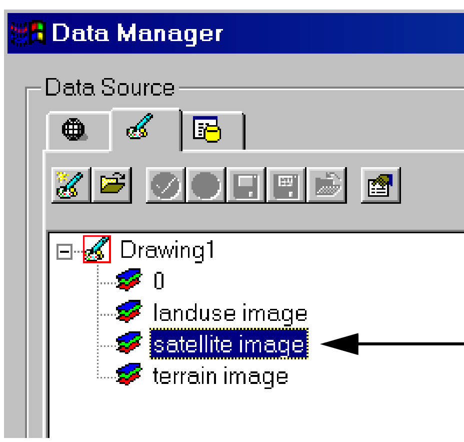
A new 'Layer1' is added in addition to the default '0' layer.

4 Click on the 'Layer1' text and change it to **`satellite image`**.

5 Right-click on 'Drawing1' again, select **New Layer**, then name the new layer **`landuse image`**.

6 Right-click on 'Drawing1' again, select **New Layer**, then name the new layer **`terrain image`**.

You should have three new labelled layers (the order does not matter for now):



new drawing layers where images will be inserted

7 Click **Close** on the **Data Manager** dialog box.

Insert an ER Mapper satellite image algorithm (.alg) file

1 Choose **Insert > ER Mapper Image**.

2 On the **Insert ER Mapper Image** dialog, click the **Image** tab, then click **Browse**.

3 On the **Insert Picture** dialog, select Algorithms (*.alg) from the 'Files of Type' list.

Note: When you insert an algorithm file, the Bilinear Smoothing and Contrast Stretching options are disabled because the algorithm file contains the contrast enhancement and other information.

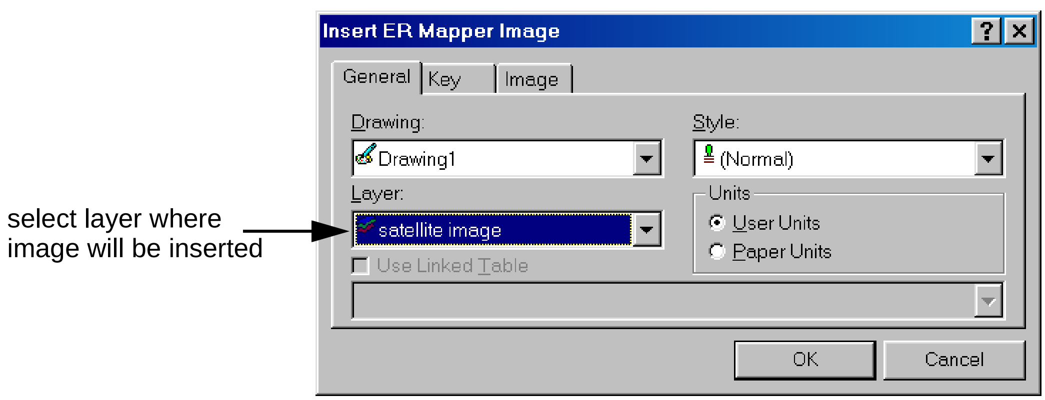
4 Double-click on the folder where ER Mapper is installed, then open the 'examples/Functions_And_Features/Data_Fusion' folder.

A list of ER Mapper algorithm (.alg) files appears. These algorithms all show different ways of merging (or "fusing") two different images into one picture.

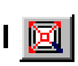
5 Double-click on the file 'Brovey_Transform.alg.'

Tip: You need a license for ER Mapper to create algorithms, but you can insert and view them in directly in Autodesk World. This means that anyone using ER Mapper can create algorithms and send them to you for use in your projects.

6 Click **General** tab, then select **satellite image** from the 'Layer' list.



You can insert ER Mapper algorithms (.alg) and datasets (.ers), as well as TIFF, BMP, ARC/INFO-GeoSPOT HDR, and others.

7 Click **OK** to insert the image into the drawing layer, then click **Zoom All**  or choose **View > Zoom All** to display it.

Autodesk World displays a color image of the San Diego, California area. This is a merge of a Landsat TM satellite image (bands 5, 4 and 2) and a SPOT Panchromatic satellite image. By merging the two types of data, you get the high spatial detail provided by the SPOT Pan image (10-meter resolution) with the multispectral color information provided by the Landsat TM image (seven bands at 30-meter resolution).

The Brovey Transform is a mathematical way of combining the two images that also greatly enhances the color. Merging or fusion techniques like this are used to create to combine the strengths of different satellite sensors and create up-to-date views of the earth's surface.

8 Click **Zoom Window** (or choose **View > Zoom Window**), then drag a box over the central part of the image to zoom into it.

The image shows a high resolution, color-enhanced view of the area. The ER Mapper algorithm creates this image interactively from the two separate Landsat and SPOT satellite imagery files. (The Brovey Transform technique usually requires up to three intermediate image files to be created when using traditional imaging software, but ER Mapper performs the processing in real time from the two source images without creating intermediate files.)

9 When finished, click the **Zoom All** button or choose **View > Zoom All** to zoom out to the full image extents.

Insert a second algorithm image showing thematic landuse

1 Choose **Insert > ER Mapper Image**.

2 On the **Insert ER Mapper Image** dialog, click the **Image** tab, then click **Browse**.

3 Double-click on the folder where ER Mapper is installed, then open the 'examples/Functions_And_Features/Classification_Display' folder.

A list of ER Mapper algorithm (.alg) files appears. These algorithms all show different ways of merging (or "fusing") two different images into one picture.

4 Double-click on the file 'Isoclass_classification.alg.'

5 Click **General** tab, then select **landuse image** from the 'Layer' list.

6 Click **OK** to insert the image into the layer and display it.

Autodesk World displays a thematic color image of the same area of San Diego. Different colors correspond to different types of landuse in the area. This image was created from a 1985 Landsat TM satellite image using ER Mapper's ISOCLASS unsupervised classification feature. Classification groups pixels with similar spectral values into classes that can represent different types of landuse or land cover.

Insert a third algorithm image showing terrain and topography

1 Choose **Insert > ER Mapper Image**.

2 On the **Insert ER Mapper Image** dialog, click the **Image** tab, then click **Browse**.

3 Double-click on the folder where ER Mapper is installed, then open the 'examples/Data_Types/Digital_Elevation' folder.

These algorithms all show different ways displaying and processing digital elevation model (DEM) data files.

4 Double-click on the file 'Colordrape.alg.'

5 Click **General** tab, then select **terrain image** from the 'Layer' list.

6 Click **OK** to insert the image into the layer and display it.

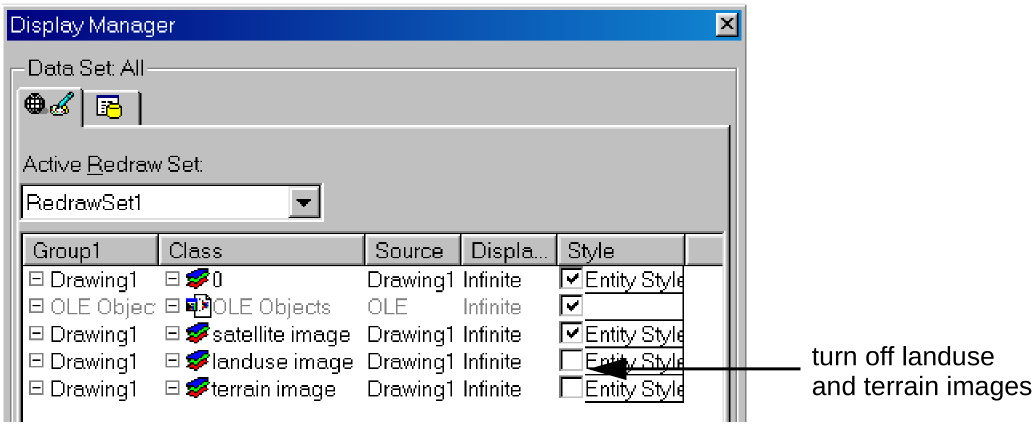
Autodesk World displays a color shaded relief (or "colordrape") image of the same area of San Diego. Colors represent elevation (reds are highest) and the shading effect highlights topographic features such as hills and valleys. This image is illuminated from the northeast, so shadows appear on the southwest side of terrain features. ER Mapper has a built-in "realtime shading" feature that lets you interactively change the shading parameters without creating output files.

View any of the three images

It is often helpful to "stack" multiple different types of images of the same geographic area (as you did here). Images are treated as CAD entities in Autodesk World, so you stack multiple images the same way you stack vector data–put each image on a separate layer and just turn the layers on and off. You can also control the redraw order (which image is on top) of the layers by dragging them around in the Display Manager to achieve the desired ordering.

1 Choose **View > Display Manager**.

2 In the **Display Manager** dialog, turn off the Entity Style checkboxes for the 'landuse image' and the 'terrain image.'



3 Press **F5** (or select **View > Refresh View**).

The merged color satellite image displays.

4 In the **Display Manager**, turn off the 'satellite image' checkbox and turn on the 'landuse image' checkbox, then press **F5**.

5 View any of the three images by turning on its layer and turning the other two off, then pressing **F5** to refresh the view.

These simple examples show how you can use the power of ER Mapper algorithms to showing various “views” of your image data as backdrops for analysis of your vector data in Autodesk World.

Close the project

1 If desired, save your project using **File > Save As...**.

2 Choose **File > Close** to close the project.

3: Combining image and drawing data

Objectives Learn to use both image (raster) and drawing (vector) data in a project. In this example, you will overlay a network of roads on a small aerial photograph image.

Note: Before beginning, make sure the ‘AutoCAD DXF’ GDX driver has been added to Autodesk World. Consult your Autodesk World documentation or on-line help if needed to do this before continuing.

Start a new project

1 Start a new project by choosing **File > New**, then clicking **Blank Template**.

Set the coordinate system for the new project

1 Choose **File > Properties**.

2 Click the **Coordinate System** tab, then click **Change....**

3 On the **Project Detail** dialog, select **UTM27-11** from the **Coordinate System** list.

Set the data viewing coordinate type

1 Choose **Tools > Format Options**.

2 Click the **Units** tab, then select **m** from the ‘User Unit’ list.

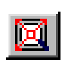
3 Click the **Coordinate** tab, select **Projection Coordinate** from the ‘Display Type’ list, then click **OK**.

The display coordinates are now set to the units of the map projection (meters of Northings and Eastings in UTM zone 11.)

Create a drawing layer to display an airphoto image

1. Choose **File > Data Manager**.
2. Click the **Drawing Data** tab to view drawing layers.
3. Right-click on ‘Drawing1’ then select **New Layer**.
4. Click on the ‘Layer1’ text and change it to **`airphoto image`**.

Insert an ER Mapper airphoto image into the drawing

1. Choose **Insert > ER Mapper Image**.
2. On the **Insert ER Mapper Image** dialog, click the **Image** tab, then click **Browse**.
3. From the ‘Files of Type’ list, select **Datasets (*.ers)**.
4. Double-click on the folder where ER Mapper is installed, then open the ‘examples/Shared_Data’ folder.
5. Double-click on the file ‘Airphoto.ers.’
6. Turn on the ‘Bilinear Smoothing’ and ‘Contrast Stretching’ options.
7. Click **General** tab, then select **airphoto image** from the ‘Layer’ list.
8. Click **OK** to insert the image into the layer and display it.
9. Click the **Zoom All**  button or choose **View > Zoom All**.

   Autodesk World displays a color aerial photograph of small part of the downtown San Diego, California area.

Open a DXF drawing to overlay on the airphoto image

1. Choose **File > Data Manager**.
2. Click the **Drawing Data** tab, then click the **Open Drawing**  button.
3. From the ‘Files of Type’ list, select **Autodesk DXF File (*.dxf)**.

Note: If ‘Autodesk DXF’ does not appear as a filetype option, you need to install the AutoCAD DXF GDX driver.

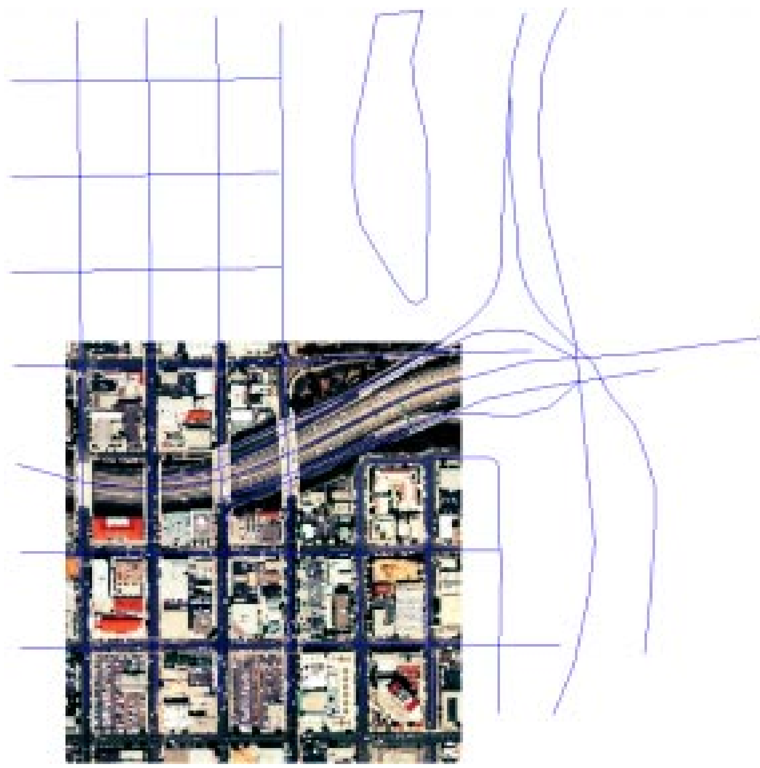
4. Open the ER Mapper ‘examples/Data_Types_AutoCAD_DXF’ folder.

5 Double-click on the file ‘Roads.dxf.’

The DXF file is added as a layer in your project.

6 Click **Close** on the Data Manager, then click the **Zoom All** button or choose **View > Zoom All**.

Autodesk World displays a vector road network over the airphoto image. This is a very simple example of combining image and drawing (vector) data. This is the most common way you will be using the ER Mapper image handling capabilities within Autodesk World.



Close the Autodesk World application

1 If desired, save your project using **File > Save As....**

2 Close Autodesk World by clicking the **Close** button on the application window or selecting **File > Exit**.

What you learned...

After completing these exercises, you know how to perform the following tasks in Autodesk World:

- Insert an ER Mapper image into an Autodesk World drawing
- Enhance the image contrast and apply image smoothing

- Choose equivalent coordinate systems in Autodesk World and ER Mapper
- Insert an ER Mapper smart data algorithm into an Autodesk World drawing
- Stack and change the order of multiple images in a drawing
- Combine image and vector drawing data in a project

Index

Numerics

A

B

C

D

E

F

G

H

I

K

L

M

N

O

P

R

S

T

V

W

X

Z