Surfer®
Powerful contouring, gridding & surface mapping system

Full User’s Guide
Surfer® Registration Information

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DDF SDTS TVP Topological Vector Profile and Raster Profile File Description
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DEM USGS Digital Elevation Model File Description
DGN Microstation Design v7 File Description
DIC DICom3 Medical Image File Description
DLG USGS Digital Line Graph File Description
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DTED Digital Terrain Elevation Data [.DTED] File Description
DXF AutoCAD DXF File Description
E00 Esri ArcInfo Export Format (E00) File Description
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GML Geography Markup Language File Description
GPX GPS Exchange Format File Description
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GRI B Global Weather Data Grid File Description
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Chapter 1 - Introduction

Welcome to Surfer, a powerful contouring, gridding, and surface mapping package for scientists, engineers, educators, or anyone who needs to generate maps quickly and easily. Producing publication quality maps has never been quicker or easier. Adding multiple map layers and objects, customizing the map display, and annotating with text creates attractive and informative maps. Virtually all aspects of your maps can be customized to produce the exact presentation you want.

**Surfer** is a grid-based mapping program that interpolates irregularly spaced XYZ data into a regularly spaced grid. Grids may also be imported from other sources, such as the United States Geological Survey (USGS). The grid is used to produce different types of maps including contour, color relief, and 3D surface maps among others. Many gridding and mapping options are available allowing you to produce the map that best represents your data.

An extensive suite of gridding methods is available in **Surfer**. The variety of available methods provides different interpretations of your data, and allows you to choose the most appropriate method for your needs. In addition, data metrics allow you to map statistical information about your gridded data. Surface area, projected planar area, and volumetric calculations can be performed quickly in **Surfer**. Cross-sectional profiles can also be computed and exported.

The grid files can be edited, combined, filtered, sliced, queried, and mathematically transformed. For example, grids can be sliced to create cross-sectional profiles, or the Grids | Calculate | Math command can be used to create an isopach map from two grid files. Grids can be edited with an intuitive user interface in the grid editor.

**Scripter**

The **Scripter™** program, included with **Surfer**, is useful for creating, editing, and running script files that automate **Surfer** procedures. By writing and running script files, simple mundane tasks or complex system integration tasks can be performed precisely and repetitively without direct interaction. **Surfer** also supports ActiveX Automation using any compatible client, such as Visual BASIC. These two automation capabilities allow **Surfer** to be used as a data visualization and map generation post-processor for any scientific modeling system.

**New Features**

The new features in **Surfer** are summarized:

- In the web help at [http://surferhelp.goldensoftware.com/#t=topics%2Fnew_features.htm](http://surferhelp.goldensoftware.com/#t=topics%2Fnew_features.htm)
- In the program, click the help button 📚, and click on the New Features page in the Introduction book

**Who Uses Surfer?**

People from many different disciplines use Surfer. Since 1984, over 100,000 scientists and engineers worldwide have discovered Surfer’s power and simplicity. Surfer’s outstanding gridding and contouring capabilities have made Surfer the software of choice for working with XYZ data. Over the years, Surfer users have included hydrologists, engineers, geologists, archeologists, oceanographers, biologists, foresters, geophysicists, medical researchers, climatologists, educators, students, and more! Anyone wanting to visualize their XYZ data with striking clarity and accuracy will benefit from Surfer’s powerful features!
System Requirements

The system requirements for Surfer are:

- Windows 7, 8 (excluding RT), 10 or higher
- 512MB RAM minimum for simple data sets, 1GB RAM recommended
- At least 500MB free hard disk space
- 1024x768 or higher monitor resolution with a minimum 16-bit color depth

Installation Directions

Installing Surfer requires Administrator rights. Either an administrator account can be used to install Surfer, or the administrator's credentials can be entered before installation while logged in to a standard user account. If you wish to use a Surfer single-user license, the product key must be activated while logged in to the account under which Surfer will be used. For this reason, we recommend logging into Windows under the account for the Surfer user, and entering the necessary administrator credentials when prompted.

Golden Software does not recommend installing Surfer 15 over any previous versions of Surfer. Surfer 15 can coexist with older versions (e.g. Surfer 14) as long as both versions are installed in different directories. By default the program installation directories are different. For detailed installation directions see the Readme.rtf file.

To install Surfer from a download:

1. Log into Windows under the account for the individual who will be licensed to use Surfer.
2. Download Surfer according to the emailed directions you received.
3. Double-click on the downloaded file to begin the installation process.
4. Once the installation is complete, run Surfer.
5. License Surfer by activating a single-user license product key or connecting to a license server.

Updating Surfer

To update your version of Surfer, open the Surfer program and choose the File | Online | Check for Update command. This will launch the Internet Update program which will check Golden Software’s servers for any updates. If there is an update for your version of Surfer (e.g. Surfer 15.0 to Surfer 15.1), you will be prompted to download the update.

You can also email your registered Surfer product key to surfersupport@goldensoftware.com and request to download the full product update. See the Check for Update topic in the help for additional information.

Uninstalling Surfer

To uninstall Surfer, follow the directions below for your specific operating system.

Windows 7

To uninstall Surfer go to the Windows Control Panel and click the Uninstall a program link. Select Surfer 15 from the list of installed applications. Click the Uninstall button to uninstall Surfer.
Windows 8

From the Start screen, right-click the Surfer 15 tile and click the Uninstall button at the bottom of the screen. Alternatively, right-click anywhere on the Start screen and click All apps at the bottom of the screen. Right-click the Surfer 15 tile and click Uninstall at the bottom of the screen.

Windows 10

Select Settings in the Start menu. In Settings, select System | Apps & features. Select Surfer 15 and then click Uninstall. To uninstall Surfer from the Windows Control Panel, click Programs | Programs and Features. Select Surfer 15 and click Uninstall.

Surfer Trial Functionality

The Surfer trial is a fully functioning time-limited trial. This means that commands work exactly as the command works in the full program for the duration of the trial. The trial has no further restrictions on use. The trial can be installed on any computer that meets the system requirements. The trial version can be licensed by activating a product key or connecting to a license server.

Three-Minute Tour

We have included several sample files with Surfer so that you can quickly see some of Surfer's capabilities. Only a few files are discussed here, and these examples do not include all of Surfer's many map types and features. The Contents window is a good source of information as to what is included in each file.

To see the example files:

1. Open Surfer.
2. Click the File | Open command.
3. In the Open dialog, navigate to the Surfer Samples folder. The Surfer Samples folder is located in C:\Program Files\Golden Software\Surfer 15\ by default.
4. Select the sample .SRF file of interest and click Open. The sample file is now displayed. Repeat as necessary to see the files of interest.

Overview of Sample Surfer .SRF Files

Click on the links below to see an image of the sample file and a brief explanation of what the sample file contains.

3DView.SRF

The 3DView.SRF sample file includes contour and color relief layers, as well as a base (vector) layer that is used for a 3D view fly-through. Select the map and click Map Tools | View | 3D View to open a 3D view. Click 3D View | Fly-Through | Play to view the example fly-through.
Chapter 1 - Introduction

Axes.SRF
The Axes.SRF file contains a contour map layer and color relief map layer overlaid. The grid file used for the two map layers is the same and includes dates as the X values. The X Axis is displayed using date formatting.

Base.SRF
The Base.SRF sample file displays three base map layers showing road transportation, stream hydrology, and a USGS urban area satellite image for Golden, Colorado, USA. The individual polygons and polylines that make up the base maps can be edited or deleted by expanding the base map layer in the Contents window.

BaseMapFromServer.SRF
The BaseMapFromServer.SRF file contains five base maps of South America, showing Distribution of various minerals, national boundaries, and generalized geology. All base maps were created by downloading images from online servers.
BaseSymbology.SRF

The BaseSymbology.SRF sample file includes a base (vector) layer with classed colors symbology applied to a map of Nevada. Counties are classified and colored by population. A legend is included to indicate the upper class values for each of the five classes.
Using Surfer

The most common application of **Surfer** is to create a grid-based map from an XYZ data file. The **Grid Data** command uses an XYZ data file to produce a grid file. The grid file is then used by most of the **Home | New Map** commands to produce maps. **Post maps** and **base maps** do not use grid files. The general steps to progress from an XYZ data set to a finished grid-based map are as follows:

1. Create an XYZ data file. This file can be created in a **Surfer** worksheet window or outside of **Surfer** (using an ASCII text editor or Microsoft Excel, for example).

   ![Start with irregular XYZ data in three columns.](image)

2. To display the data points, click the **Home | New Map | Post** command.

   ![A post map displays the original XYZ data locations.](image)

3. Create a grid file .GRD from the XYZ data file using the **Home | Grid Data | Grid Data** command.
Gridding interpolates a Z value at the intersection of each row and column in the grid file. This fills the holes in the data. Here the rows and columns are represented by grid lines.

4. To create a map, select the map type from the Home | New Map commands. Select the grid file from step two. Grid-based maps include contour, 3D surface, 3D wireframe, color relief, shaded relief, vector, watershed, viewshed, and grid values maps.

5. Click on the map to display the map properties in the Properties window where you can customize the map to fit your needs.
The contour map layer is filled with a gradational color fill.

6. Click the **File | Save** command to save the project as a Surfer .SRF file which contains all the information needed to recreate the map.

**Surfer Flow Chart**

This flow chart illustrates the relationship between XYZ data files, grid files, vector files, image files, and various maps. This example displays only one of the grid based maps, a contour map.

**Using Scripter**

Tasks can be automated in **Surfer** using Golden Software's **Scripter** program or any ActiveX Automation-compatible client, such as Visual BASIC. A script is a text file containing a series of
instructions for execution when the script is run. **Scripter** can be used to perform almost any task in **Surfer**. Scripts are useful for automating repetitive tasks and consolidating a sequence of steps. **Scripter** is installed in the same location as **Surfer**. Refer to the **Surfer Automation** help book for more information about **Scripter**. We have included several example scripts so that you can quickly see some of **Scripter**'s capabilities.

To run a sample script file:

1. Open **Scripter** by navigating to the installation folder, C:\Program Files\Golden Software\Surfer 15\Scripter. If you are running a 32-bit version of **Surfer** on a 64-bit version of Windows, navigate to C:\Program Files (x86)\Golden Software\Surfer 15\Scripter. Right-click on the Scripter.exe application file and select **Run as administrator**.
2. Choose the **File | Open** command.
3. Select a sample script .BAS file. These are located in the C:\Program Files\Golden Software\Surfer 15\Samples\Scripts folder or, if you are running a 32-bit version of **Surfer** on a 64-bit version of Windows, the C:\Program Files (x86)\Golden Software\Surfer 15\Samples\Scripts folder.
4. Click the **Script | Run** command and the script is executed. Most sample scripts open **Surfer** and display a map in the plot window.

**Surfer User Interface**

**Surfer** contains four document window types: the plot document, worksheet document, 3D view, and grid editor. Maps are created and displayed in the plot document and 3D view. The worksheet document displays, edits, transforms, and saves data in a tabular format. The grid editor displays and edits Z values for the grid with various editing tools.

This is the **Surfer** plot window with the **Contents** and **Properties** windows on the left and the worksheet and grid editor tabs on the top of the horizontal ruler.
Surfer Layout

The following table summarizes the function of each component of the Surfer layout.

<table>
<thead>
<tr>
<th>Component Name</th>
<th>Component Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Title Bar</td>
<td>The title bar lists the program name plus the saved Surfer .SRF file name (if any). An asterisk after the file name indicates the file has been modified.</td>
</tr>
<tr>
<td>Quick Access Toolbar</td>
<td>All window types in Surfer include the quick access toolbar to the left of the title bar. The quick access toolbar contains buttons for many common commands. The quick access toolbar can be customized to add or remove buttons with the Customize Ribbon command.</td>
</tr>
<tr>
<td>Ribbon</td>
<td>The ribbon includes all of the commands in Surfer. Commands are grouped under the File menu and various tabs. Some commands and tabs are only available in specific views. For example, the Features</td>
</tr>
<tr>
<td>Tabbed Documents</td>
<td>The plot, 3D view, worksheet, and grid editor windows are displayed as tabbed documents. The tabs may be reordered by clicking and dragging. When more than one window is open, tabs appear at the top of the document, allowing you to click on a tab to switch to a different window. When a document contains unsaved changes, an asterisk (*) appears next to its tabbed name.</td>
</tr>
<tr>
<td>Contents</td>
<td>The Contents window contains a hierarchical list of all the objects in a Surfer plot document, grid editor, or 3D view window displayed in a tree view. The objects can be selected, added, arranged, or edited. Changes made in the Contents window are reflected in the plot document, grid editor, or 3D view and vice versa. The Contents window is initially docked at the left side of the window.</td>
</tr>
<tr>
<td>Properties</td>
<td>The Properties window contains all of the properties for the selected object or objects. Changes made in the Properties window are reflected in the plot document, grid editor, or 3D view. The properties in the Properties window are grouped by page. The Properties window is initially docked below the Contents window.</td>
</tr>
<tr>
<td>Status Bar</td>
<td>The status bar displays information about the current command or activity in Surfer. The status bar is divided into five sections. The sections display basic plot commands and descriptions, the name of the selected object, the cursor map coordinates and units, the cursor page coordinates, and the dimensions of the selected object.</td>
</tr>
</tbody>
</table>

Opening Windows

Selecting the File | Open command opens any of the three window types, depending on the type of file selected. The File | New | Plot command creates a new plot window. The File | New | Worksheet command creates a new worksheet window. The Map Tools | View | 3D View command opens a 3D view of the selected map. The Grids | Editor | Grid Editor command opens a grid in the grid editor.
Chapter 2 - Tutorial

The tutorial is designed to introduce basic Surfer features and should take less than an hour to complete. After you have completed the tutorial, you will have the skills needed to create maps in Surfer using your own data. The tutorial can be accessed in the program by clicking the ☀️ button and navigating to the Tutorial book or by clicking Tutorials in the Welcome to Surfer dialog.

If you find you still have questions after you have completed the tutorial, you should consider reviewing the material in Surfer’s extensive in-program help. The help is also available on the web. The Golden Software website contains a knowledge base of questions and answers, an interactive forum, and training videos. Usually, the answers to your questions are found in one of these locations. However, if you find you still have questions, do not hesitate to contact Golden Software’s technical support team. We are happy to answer your questions before they become problems.

Tutorial Overview

The following is an overview of lessons included in the tutorial.

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<tr>
<th>Lesson</th>
<th>Description</th>
</tr>
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<td>Starting Surfer</td>
<td>shows you how to begin a new Surfer session and open a new plot window.</td>
</tr>
<tr>
<td>Lesson 1 - Viewing and Creating Data</td>
<td>opens and edits an existing data file and creates a new data file.</td>
</tr>
<tr>
<td>Lesson 2 - Using the Map Wizard</td>
<td>creates a grid file, the basis for most map types in Surfer, and a map with contour, post, and color relief layers.</td>
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<td>Lesson 3 - Changing Layer Properties</td>
<td>edits the contour, post, and color relief layer properties.</td>
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<td>Lesson 4 - Modifying an Axis</td>
<td>edits the axis tick labels and axis title properties.</td>
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<td>Lesson 5 - Creating a Profile</td>
<td>creates a profile line on the contour map and displays the profile.</td>
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<tr>
<td>Lesson 6 - Saving a Map</td>
<td>saves your map and all the information it contains to a Surfer .SRF file.</td>
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<tr>
<td>Lesson 7 - Creating a 3D Surface Map</td>
<td>creates and edits 3D surface map.</td>
</tr>
<tr>
<td>Lesson 8 - Adding Transparency, Color Scales, and Titles</td>
<td>changes the transparency of various objects, adds a color scale, and adds a map title.</td>
</tr>
<tr>
<td>Lesson 9 - Creating Maps from Different Coordinate Systems</td>
<td>loads multiple map layers from different coordinate systems and sets the target coordinate system for the entire map.</td>
</tr>
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Advanced (optional) Lessons

Optional Advanced Tutorial Lessons are available to demonstrate additional features of Surfer.
A Note about the Documentation

Various font styles are used throughout the Surfer quick start guide and online help. **Bold** text indicates commands, dialog names, tab names, and page names. *Italic* text indicates items within a dialog or the Contents or Properties windows such as section names, options, and field names. For example, the **Save As** dialog contains a *Save as type* list. Bold and italic text may occasionally be used for emphasis.

Also, commands appear as **Home | New Map | Contour**. This means, "click or scroll to the **Home** tab at the top of the plot window, then click on the **Contour** command within the **New Map** command group." The first word is always the menu or ribbon tab name, followed by the command group, and finally the command name within the menu list or on the ribbon.

Sample File Location

The sample files used in the tutorial lessons are located in the **Surfer** SAMPLES folder. The SAMPLES folder is located by default at C:\Program Files\Golden Software\Surfer 15\Samples. Note, if you are running the 32-bit version of **Surfer** on a 64-bit version of Windows, the SAMPLES folder is located at C:\Program Files (x86)\Golden Software\Surfer 15\Samples, by default.

Starting Surfer

To begin a **Surfer** session:

1. Navigate to the installation folder, which is C:\Program Files\Golden Software\Surfer 15 by default.
3. The **Welcome to Surfer** dialog appears. Click **New Plot** to open a new blank plot window.
4. A new empty plot window opens in **Surfer**. This is the work area where you can produce grid files, maps, and modify grids.

If this is the first time that you have opened **Surfer**, you are prompted to license Surfer. Activate your Single-User product key, select a license server, or continue using the trial. Your product key is located in the download instructions email. You may also access your product key at your Golden Software **My Account** page.

If you have already been working with **Surfer**, open a new plot window before starting the tutorial. To open a new plot window, click the **File | New | Plot** command.

Lesson 1 - Viewing and Creating Data

An XYZ data file is a file containing at least three columns of data values. The first two columns are the X and Y coordinates for the data points. The third column is the Z value assigned to the XY point. Although it is not required, entering the X coordinate in column A, the Y coordinate in column B, and the Z value in column C is a good idea. **Surfer** looks for these coordinates in these columns by default. You can customize the default columns for XYZ data with the Assign XYZ Columns worksheet command. **Surfer** requires the use of **decimal degree** Latitude (Y) and Longitude (X) values when using Latitude and Longitude values.
A simple XYZ data file. Notice that the X, Y, and Z data are placed in columns A, B, and C, respectively.

Creating a New Data File - Tutorial

The **Surfer** worksheet can also be used to create a new data file. To open a worksheet window and begin entering data:

1. Click the **File | New | Worksheet** command, click the **+** on the quick access toolbar, or press **CTRL+W** on the keyboard. A new empty worksheet window is displayed.
2. Data is entered into the active cell. The active cell is selected by clicking on the cell or by using the arrow keys to move between cells. The active cell is indicated by a heavy border and the contents of the active cell are displayed in the active cell edit box. The **active cell location box** shows the location of the active cell in the worksheet. Letters are the column labels and numbers are the row labels.
3. When a cell is active, enter a value or text, and the information is displayed in both the active cell and the active cell edit box.
4. The BACKSPACE and DELETE keys can be used to edit data as you type.
5. To preserve the typed data in the active cell, move to a new cell. Move to a new cell by clicking a new cell with the pointer, pressing one of the arrow keys, or pressing **ENTER**. Press the **ESC** key to cancel without entering the data.

Data are entered into the active cell of the worksheet. Click on the text "A1" or "Active Cell" for the definition of the active cell, active cell location, and the active cell edit box.
Opening an Existing Data File - Tutorial

To look at an example of an XYZ data file, you can open any sample data file in a worksheet window:

1. Click the File | Open command, click the button on the quick access toolbar, or press CTRL+O on the keyboard to open the Open dialog.
2. If you are not in the Samples folder, browse to it. By default, the Samples folder is located in C:\Program Files\Golden Software\Surfer 15. In the list of files, click TutorWS.dat.
3. Click Open to display the file in the worksheet window.

Notice that the X coordinate (Easting) is in column A, the Y coordinate (Northing) is in column B, and the Z value (Elevation) is in column C. Although it is not required, row 1 contains header text, which is helpful in identifying the type of data in the column. When a header row exists, the information in the header row is used in the Properties window when selecting worksheet columns.

Adding New Data - Tutorial

To edit any value, click in the cell to select it. Type information and the existing value is overwritten. Data can be transformed, sorted, or filtered in this window. New columns can be added. For instance, an ID column can be added which labels each row with a unique identifier. To do this,

1. Click in cell D1.
2. Type the text Name.
3. Press ENTER to save the text and move the active cell to cell D2.
4. Click the Data | Data | Transform command.
5. In the **Transform** dialog, set the Transform with to Column variables (e.g., C = A + B).
6. Set the **Transform equation** to \(D = "MW" + \text{ITOA}(\text{ROW()} - 1)\). This equation will use a prefix of “MW” before a number. The number is the row number minus 1 for each row. The ITOA function converts the \(\text{ROW()} - 1\) number to text.
7. Set the **First row** to 2.
8. Set the **Last row** to 48 (the last row in the worksheet).
9. Leave the **Empty cells**, **Text cells**, and **Number cells** set to the defaults.
10. Click **OK** and each row will have a unique identifier.

The worksheet should now have a unique identifier column:

![Set the options in the Transform dialog as above to add a unique identifier to each row.](image)

The worksheet should now have a unique identifier column:
The new column contains a unique identifier for each row. This can be used for labels later in the tutorial.

Saving the Data File - Tutorial

When you have completed entering all of the data, the file can be saved.

1. Click the File | Save As command. The Save As dialog is displayed.
2. Navigate to the folder in which you wish to save the tutorial, for example the Documents folder.
3. In the Save as type list, choose the DAT Data (*.dat) option.
4. Type Tutorial into the File name box.
5. Click the Save button and the Data Export Options dialog opens.
6. Accept the defaults in the Data Export Options dialog by clicking OK.

The file is saved in the Data .DAT format as Tutorial.dat. The name of the data file appears in the title bar and on the worksheet tab.

Lesson 2 - Using the Map Wizard

Now that we have saved the data file, we will use the Map Wizard to create a grid and a map with contour and post layers. The Map Wizard steps through the map creation process from raw data to a map with one or more layers. The Map Wizard is useful for creating multiple map types from a single data file. The Map Wizard can use a data, grid, or boundary file as an input file.

1. If you have the worksheet window open, click on the Plot1 tab above the worksheet window. Alternatively, you can create a new plot window with the File | New | Plot command.
2. Click the Home | Wizard | Map Wizard command.

The Map Wizard opens to the first page, the Select Your Data page. The remaining topics in Lesson 2 will step through the pages of the Map Wizard.
Select Your Data - Tutorial

The first page in the Map Wizard is the Select Your Data page. Here you select the XYZ data, grid, vector data, or image file you wish to use to create your map.

1. By default, the Map Wizard displays the sample files in the Select File list. Click Sample files and select Browse from the list. The Open dialog is displayed. You can also display Recent files and Project files in the Select File list.
2. In the Open dialog, navigate to the Tutorial.dat file you saved in Lesson 1 - Saving the Data File.
3. Select the Tutorial.dat file and click Open. The Tutorial.dat file is loaded in the Data Preview section. The column letters and header row information is displayed in the Select Data Columns list. By default the X coordinate is column A, the Y coordinate is column B, and the Z coordinate is column C. Any other valid input files in the folder are also displayed in the Select File list.
4. Click Next in the Map Wizard.

Select Your Map Type - Tutorial

Now that you have selected a data file and specified the data columns, we can select which map layers will be included in the map on the Map Wizard - Select Your Map Type page.
Chapter 2 - Tutorial

XYZ data files are the most flexible input file type. All of the layers are available in the Select Your Map Type page after selecting an XYZ data file on the Select Your Data page. Some map types will be unavailable after choosing an image, vector, or grid file on the Select Your Data page. The data file type and the map type selections determine if a map is created after the Select Your Map Type page or if a grid must be created first.

For this tutorial we will include a contour and post layer in our map:

1. Click the Post map in the Map types - check all desired list to select it. Notice a description is displayed in the Description field.
2. Click the Contour map in the Map types - check all desired list to select it. The Finish button changes to Next. This is because we must create a grid from the XYZ data file before we can create a contour map.
3. Click Next.

Select Gridding Parameters - Tutorial

Grid files are required to produce a grid-based map. Grid-based maps include contour, color relief, shaded relief, vector, viewed, watershed, 3D wireframe, and 3D surface map layers. If necessary, grid files are created with the Map Wizard. Grid files can also be created at any time by using the Home | Grid Data | Grid Data command.
A grid must be created from the Tutorial.dat file to display a contour map. The Map Wizard - Select Gridding Parameters page controls the gridding options and output grid file name. The Select Gridding Parameters page displays a preview color relief map for you to quickly compare gridding methods. We will create a grid with the default gridding method and options.

![A map is created with default contour and post layers.](image)

1. Verify that the Gridding method is set to Kriging. If it is not, click the current gridding method and select Kriging from the list.
2. Verify that the Assign NoData outside convex hull of data option is not checked.
3. Verify that the Output grid file is named Tutorial.grd and in the desired directory, for example your Documents folder. If it is not, click ![File Explorer](image) and select the desired path for the created grid file.
4. Click Finish.

The grid is created and saved, and a map is created in the plot window with a contour and post layer. The map uses the default display properties. The Map Wizard is a useful tool for quickly creating maps and grids. However, it is not necessary to use the Map Wizard. Grids can be created with the Grid Data command, and maps and layers can be created with the Home | New Map and Home | Add to Map | Layer commands.

### Adding a Color Relief Layer - Tutorial

Map layers allow you to add multiple maps to an existing map to create one map object displaying a variety of map types. The map uses a single set of axes and the map layers are positioned according to the target coordinate system. For example, if you have a contour map of weather data, you can add a post map layer displaying the location and station names of each data collection station.

Multiple map layers can be created at one time when using the Map Wizard. However, map layers can also be added to an existing map by selecting the map and using the Home | Add to Map | Layer command, by dragging an existing map layer from one map object to another, or by selecting all maps and using the Map Tools | Map Tools | Overlay Maps command. Now we will add a color relief layer to the map:

1. Click on the Map object in the Contents window, or click on the map in the plot window, to select it.
2. Click the Home | Add to Map | Layer | Color Relief command. The Open Grid dialog is displayed.
3. Navigate to the Tutorial.grd file you created in Select Gridding Parameters and select it.
4. Click Open to add the color relief layer to the map.

![Color Relief Layer](image)

Now a color relief layer is also displayed in the map.

The color relief layer is added to the map and uses the default display properties. In Lesson 3, we will edit the appearance of the map by changing the color relief, contour, and post layer properties.

**Lesson 3 - Changing Layer Properties**

The map's appearance is mainly determined by the properties of the map layers. This lesson will demonstrate a few of the common properties for controlling the display of contour, post, and color relief layers. However, each map type has many properties and display options. A description and explanation is included for every property in the help.

![Color Relief Layer](image)

This color relief layer uses the Rainbow colormap.

We will begin by changing the color relief layer's colors:

1. Click the Color Relief-Tutorial.grd layer in the Contents window to select it. When multiple layers are overlaid in a single map, it is often easier to select the desired layer in the
Chapter 3 - Data Files and the Worksheet

Data files contain the raw information used to create a grid file, perform residual calculations, or produce post maps. Each record in a data file occupies a single row and is comprised of at least two values (X, Y) for post maps and at least three values for gridding (X, Y, Z). The X, Y, and Z values are each placed in separate columns. The X and Y coordinates define the position of the point on the map, and the Z value defines the value assigned to the specific X, Y location. Common examples of X, Y coordinates include longitude and latitude, easting and northing, or UTM (Universal Transverse Mercator) coordinates. The Z data might be topographic elevation, water depth, chemical concentration, temperature, or any other quantity amenable to mapping.

Data files can be created in the Surfer worksheet, a text editor, or any program that can produce files in one of the supported file formats. Regardless of the program used to create your data files, you must save the file on disk prior to performing any Surfer operation requiring a data file, including the gridding operation. Surfer reads data only from a data file in one of the recognized formats.

It is not necessary to open a data file in the worksheet in order to use the data file for a command (i.e. Grid | Data). If you want to view or alter the data in a data file, you can use the File | Open command to gain access to the worksheet data.

Surfer requires the use of decimal degree values when using Latitude and Longitude data.

XYZ Data Files

XYZ data files contain the raw data Surfer interprets to produce a grid file. Before you create a grid file in Surfer, you must create an XYZ data file. XYZ data files must be organized in column and row format. By default, Surfer expects the X data to be contained in column A, the Y data in column B, and the Z data in column C. However, the data can be placed in any order in any column.

Portions of two simple data files are shown below. The order of the data in the file is not important. These examples contain descriptive headers in Row 1 of each column. Such information is helpful but not required by Surfer to create a grid file. When text appears in Row 1 of a column, this text appears in list boxes in various Surfer dialogs as column titles. If a number resides in Row 1, it is not incorporated into the dialogs, and instead, the column heading (such as column B) is displayed.

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.1</td>
<td>0</td>
<td>90</td>
</tr>
<tr>
<td>2</td>
<td>3.5</td>
<td>0</td>
<td>45</td>
</tr>
<tr>
<td>3</td>
<td>4.9</td>
<td>0</td>
<td>65</td>
</tr>
<tr>
<td>4</td>
<td>6.2</td>
<td>0</td>
<td>40</td>
</tr>
<tr>
<td>5</td>
<td>7</td>
<td>0</td>
<td>55</td>
</tr>
<tr>
<td>6</td>
<td>9</td>
<td>0</td>
<td>25</td>
</tr>
<tr>
<td>7</td>
<td>9</td>
<td>5</td>
<td>55</td>
</tr>
<tr>
<td>8</td>
<td>9</td>
<td>3</td>
<td>48</td>
</tr>
</tbody>
</table>

This is a simple XYZ data file.
Chapter 3 - Data Files and the Worksheet

This is another example of an XYZ data file with header information in row 1 of each column in the data file.

Missing Entries

Rows with non-numeric entries (empty cells or text) in any of the X, Y, or Z columns are excluded when performing various tasks, including gridding or transforming data in the worksheet. If there is no Z information for a particular XY location, you can leave the Z cell blank for that row. In the example shown here, there are two data records without Z values. These records are not considered during the gridding operation.

Multiple Columns of Information for Additional Maps

Data files can contain up to one billion columns. Since you can specify the columns to be gridded, your X, Y, and Z values can occupy any three columns. This allows you to have columns containing other information particular to each point. The data file can contain several Z columns, so you can produce several contour maps using the same XY coordinates. For example, you might have concentrations of different contaminants at each sample location. All the contaminant concentration data can be placed in the same data file.
Additional Information in Data Files

Data files may contain information in addition to the X, Y, and Z values. For example, when posting data with the Home | New Map | Post command, additional columns can be used to specify the symbol, the rotation angle, the symbol color, labels, etc. The following is an example of such a data file. Columns A, B, and C contain the X, Y, and Z data used to produce a contour map of depth to the water table. Columns D, E, and F contain information used to create an overlaying post map.

A data file used to create a post map or a classed post map can contain several columns of data. Each column can have a different effect on the posted data points.

Data as Numbers or Text

Worksheet data are in one of two forms: numbers or text. Grid file creation, statistics, post maps, and other operations require data as numbers. Text data (even if it contains numeric digits) can be used for labels in Surfer, but it cannot be used to create grids or in any operation requiring numbers.

Numbers can consist of digits (0 - 9), decimal points (.), the letters "e," "d," "E," or "D" (indicating an exponent), and the plus (+) or minus (-) sign. If you type any characters other than these when entering a number (or type any of the special characters more than once), Surfer automatically converts the cell entry to text. For example, if your longitude data appears as 104.5 W in a worksheet cell, it is interpreted as text and cannot be used to grid data. To successfully read this data, use the -104.5 format to indicate a location 104.5 degrees west of the prime meridian. If a number has if formatted as text and should be formatted as a number, highlight the cell or group of cells to select them and click the Text to Number command.

You can also convert numeric data to text by typing a single quotation mark (') in front of the number. Surfer does not place the single quotation in the worksheet cell, however the single quotation is visible in the Active Cell Edit Box.

By default, numeric data is right justified in a cell, and text is left justified. Cell entries, whether numeric or text, can be justified by specifying the desired alignment using the options on the Alignment page of the Format Cells dialog. Use the Text to Number command to remove text formatting.
Notice that column B is left aligned. This means the numbers are formatted as text. When a cell is highlighted, an apostrophe appears in the active cell edit box, also indicating that the number is formatted as text.

### Data File Formats

**Surfer** can import and export data in several data file formats. A variety of commands in the plot document, worksheet document, and grid node editor can be used to import and export data. The commands are summarized below:

#### Import Data File Formats

- **File | Import** in the plot document
- **Data | Edit | Merge** in the worksheet document
- **File | Open** in the plot, worksheet, or grid editor

#### Export Data File Formats

- **File | Export** in the plot document
- **File | Save As** in the plot document
- **Grids | Edit | Convert** in the plot document
- **File | Save As** in the grid editor
- **File | Save As** in the worksheet document

### Date/Time Formatting

In addition to numbers and text, dates and times are format types in **Surfer**. Dates and times can be used to create a grid, as axis and plot labels, and to set axis limits.

#### Using Date/Time Formatting

To use dates and times in **Surfer**, the data need to be formatted as dates and times. One way to format data in **Surfer** is to use the worksheet. The worksheet can be accessed with the **File | New | Worksheet** or **File | Open** command. Highlight the column containing dates and times and select **Data | Format | Format Cells** to set the column as date/time in the worksheet. On the **Number** tab, select **Date/time** as the **Type**. Next, type the appropriate **Date/Time format** option, or click the button and select or create a date/time format in the **Date/Time Format Builder** dialog.
Once the formatting is set to date/time, you can use the date/time information just as you would use numbers in Surfer:

- you can create a post map of the data using date/time values
- you can set the map limits using date/time values
- you can grid date/time values

Date/time information can also be used as labels anywhere in the map layer or as axis tick labels.

Date/Time formats are made of combinations of year, month, day, hours, minutes, seconds, BC/AD or BCE/CE designation, and AM/PM designation. Years are shown as yy or yyyy. Months are shown as M, MM, MMM, MMMM, or MMMMM. Days are shown as d, dd, ddd, or dddd. Hours are shown as h, hh, H, HH, or [h]. Minutes are shown as m, mm, or [mm]. Seconds are shown as ss, ss.0, ss.00, ss.000, ss.0000, or [ss]. AM/PM designation is shown as tt or TT. BC/AD designation is shown as gg or GG. BCE/CE designation is shown as g, G, ggg, or GGG. See the Date Time Formats help topic for examples of date/time formats.

Date/Time Formatting Tips

- In the worksheet, save data files containing date/time formatting as Excel files to preserve the date time formatting as seen in the worksheet.
- You can save date/time-formatted data files as ASCII files (.DAT, .CSV, .TXT, .BNA, or BLN). Sometimes this is necessary if you exceed the Excel row or column limits. When opening the file in Surfer’s worksheet, you can make the serial numbers appear as dates by using Data | Format | Format Cells.
- If you have formatted the data as date/time in another spreadsheet program such as Excel, the data are formatted as date/time in Surfer.
- Whenever possible, enter and display dates and times in one of the many calendar formats, e.g., "6/14/2009" or "14-June-2009", and let the software handle converting to/from internal numeric representations.
- When the recognized format is ambiguous (i.e. 10/7/12), the month, day, and year order is determined by the Windows locale. In some countries, this will be recognized as M/d/yy, in others as d/M/yy, and in others as YY/M/d. It is important to use non-ambiguous date/time formats when the Windows locale may change.
- The year 0 is defined, according to the ISO 8601:2004 standard.
- If dates/times occur before 1/1/0000, use the BC or BCE suffix after the date. So, Alexander III of Macedon's birthday would be listed as 20-July-356 BCE in the worksheet. Using AD or CE is not necessary and the worksheet will automatically remove these in dates after 1/1/0000.
- When a two digit year is input in the worksheet (00 to 99), it means the year in the current century. For instance, inputting 11/4/13, indicates that the year is 2013, not 0013. In order to have the year 0013, the full four digits (0013) must be input for the date. So, the date would be input as 11/4/0013 CE for November 4, 0013 CE or 11/4/0013 BCE for November 4, 0013 BCE.

Working with Date/Time Values

Date/time values can be displayed as labels on axes, map layers, and used in setting limits on maps. Below are some methods available to work with date/time formats.
Chapter 3 - Data Files and the Worksheet

Formatting Data as Date/Time
To format cells in the worksheet as date/time, open the worksheet and select all of the cells that should be date/time format. Click the Data | Format | Format Cells command. In the Format Cells dialog, select Date/time as the Type and type the date/time format string into the Date/Time format field. Click OK and the selected cell is formatted as date/time. Alternatively, click the button to create the date/time format in the Date/Time Format Builder dialog. Save to a format, such as an Excel file, that accepts date/time formats to retain the date/time format.

Gridding Date/Time Values
Any worksheet column containing numbers, dates, or times can be used for gridding. When using date/time formats for any of the Data Columns, the values are stored in the grid as numbers, not in date/time format. To display date/time formats on the map, select the appropriate map part (axis, map layer, or map) and set the date/time label format.

Formatting Axes to Display Date/Time
Any axis can be changed to display dates or times for axis labels. To display date or time labels, click on the axis to select it. In the Properties window, click on the General tab. In the Labels section in the Label Format section, change the Type to Date/time. Then, set the Date/Time format to the desired label formats.

Formatting Contour Maps to Display Date/Time Labels
Any contour map label can be changed to display dates or times for axis labels. To display date or time labels, click on the contour map layer to select it. In the Properties window, click on the Levels tab.

For simple or logarithmic level methods: In the Labels section in the Label Format section, change the Type to Date/time. Then, set the Date/Time Format to the desired label formats.

For advanced level methods: Click the Edit Levels button next to the Contour levels command. In the Levels for Map dialog, click the Label button. Click the Format button to open the Label Format dialog. Change the Type to Date/Time. Then, set the Date/Time Format to the desired label formats. Click OK in all dialogs and the labels update.

Formatting Post or Classed Post Maps to Display Date/Time Labels
Any post map or classed post map label can be changed to display dates or times for axis labels. To display date or time labels, click on the post map layer or classed post map layer to select it. In the Properties window, click on the Labels tab. In the Label Set 1 section, set the Worksheet column to the column that contains the date/time values. In the Label Format section, change the Type to Date/time. Then, set the Date/Time Format to the desired label formats.

Setting Map Limits with Date/Time
When using date/time formats for any of the axis labels, the minimum and maximum on the Limits tab are entered in date/time format. To change the map limits, click on the Map object to select it. In the Properties window, click on the Limits tab. Highlight the existing date/time value in any of the xMin, xMax, yMin, or yMax boxes and enter the minimum or maximum date/time value. For instance, 02/02/2014 12:00:00 AM can be entered into the xMin option. The map limits must be entered in M/d/yyyy hh:mm:ss TT format.
Grid Residuals

The **Grids | Calculate | Residuals** command takes an existing grid and an X,Y,Z column from a data file and computes the residuals at the locations specified in the data file. The residual value is written to a new column in the worksheet. If the input Z values in the worksheet are in date/time format, then the residuals are the difference between the Z grid value and the input date/time Z value. This is not a date/time format, but is rather the difference between the times, signifying a time duration. The units are days.

Date Time Formats

Date and time formats can be set from the worksheet, from labels, and from axes. In addition, date and time formats can be used for data columns when creating post maps or when gridding data. Date and time options are case sensitive.

When dates are parsed during input/import, the month and day of week names must match those of the local language as set in the Windows Control Panel, otherwise the entry will not be recognized as a valid date and will be treated as a text string.

Date/Time formats are made of combinations of locale, year, month, day, hours, minutes, seconds, BC/AD or BCE/CE designation, and AM/PM designation. Years are shown as yy or yyyy. Months are shown as M, MM, MMM, MMMM, or MMMMM. Days are shown as d, dd, ddd, or dddd. Hours are shown as h, hh, H, HH, or [h]. Minutes are shown as m, mm, or [mm]. Seconds are shown as ss, ss.0, ss.00, ss.000, ss.0000, or [ss]. AM/PM designation is shown as tt or TT. BC/AD designation is shown as g or GG. BCE/CE designation is shown as g or GG. BCE/CE designation is shown as g or GG.

To add new date/time designations, use any combination of the following codes:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>d</td>
<td>Single digit day, excluding leading zero</td>
</tr>
<tr>
<td>dd</td>
<td>Double digit day, including leading zero</td>
</tr>
<tr>
<td>ddd</td>
<td>Shortened day of week name</td>
</tr>
<tr>
<td>dddd</td>
<td>Full day of week name</td>
</tr>
<tr>
<td>M</td>
<td>Single digit month, excluding leading zero</td>
</tr>
<tr>
<td>MM</td>
<td>Double digit month, including leading zero</td>
</tr>
<tr>
<td>MMM</td>
<td>Shortened month name</td>
</tr>
<tr>
<td>MMMM</td>
<td>Full month name</td>
</tr>
<tr>
<td>MMMMM</td>
<td>First letter of month name</td>
</tr>
<tr>
<td>yy</td>
<td>Two digit year</td>
</tr>
<tr>
<td>yyyy</td>
<td>Full year</td>
</tr>
<tr>
<td>g</td>
<td>Before Common Era designator - Includes space and bce or nothing if ce, lower case</td>
</tr>
<tr>
<td>gg</td>
<td>BC/AD designator - Includes space and bc or ad, lower case</td>
</tr>
<tr>
<td>ggg</td>
<td>Before Common Era designator - Includes space and bce or ce, lower case</td>
</tr>
</tbody>
</table>
### Chapter 3 - Data Files and the Worksheet

#### Custom Date/Time Example

<table>
<thead>
<tr>
<th>Format</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>mm/dd/yy</td>
<td>Month double digits, Day double digits, Year double digits</td>
</tr>
<tr>
<td>h:mm:ss tt</td>
<td>Hour in standard format, Minutes, Seconds and AM/PM designation</td>
</tr>
<tr>
<td></td>
<td>04/14/09 6:45:44 PM</td>
</tr>
</tbody>
</table>

When dates are parsed during input/import, the month and day of week names must match those of the local language as set in the Windows Control Panel, otherwise the entry will not be recognized as a valid date and will be treated as a text string.

When the recognized format is ambiguous (i.e. 10/7/12), the month, day, and year order is determined by the Windows locale. In some countries, this will be recognized as M/d/yy, in others
as d/M/yy, and in others as YY/M/d. It is important to use non-ambiguous date/time formats when the Windows locale may change.

The tables below show many examples of date/time format strings.

**Date Formats**

All rows below use the date September 7, 1998 for the *Example*.

<table>
<thead>
<tr>
<th>Date/Time Code</th>
<th>Example</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>(None)</td>
<td></td>
<td>Date not displayed</td>
</tr>
<tr>
<td>M/d/yy</td>
<td>9/7/98</td>
<td>Single digit month and day, two digit year, separated with /</td>
</tr>
<tr>
<td>MM/dd/yy</td>
<td>09/07/98</td>
<td>Double digit month, day, and year, separated with /</td>
</tr>
<tr>
<td>M/d/yyyy</td>
<td>9/7/1998</td>
<td>Single digit month and day, full year, separated with /</td>
</tr>
<tr>
<td>MMM dd, yyyy</td>
<td>Sep 07, 1998</td>
<td>Shortened month name, double digit day, full year, separated with spaces and comma</td>
</tr>
<tr>
<td>MMMM dd, yyyy</td>
<td>September 07, 1998</td>
<td>Full month name, double digit day, full year, separated with spaces and comma</td>
</tr>
<tr>
<td>MMMM-d-yyyy</td>
<td>September-7-1998</td>
<td>Full month name, single digit day, full year, separated with -</td>
</tr>
<tr>
<td>d MMMM yyyy</td>
<td>7 September 1998</td>
<td>Single digit day, full month name, full year, separated with spaces</td>
</tr>
<tr>
<td>d-MMM-yy</td>
<td>7-Sep-98</td>
<td>Single digit day, shortened month name, two digit year, separated with -</td>
</tr>
<tr>
<td>dd-MMM-yy</td>
<td>07-Sep-98</td>
<td>Double digit day, shortened month name, two digit year, separated with -</td>
</tr>
<tr>
<td>d-MMM-yyyy</td>
<td>7-Sep-1998</td>
<td>Single digit day, shortened month name, full year, separated with -</td>
</tr>
<tr>
<td>d-MMyyyy</td>
<td>7-Sep-1998</td>
<td>Single digit day, shortened month name, full year, separated with -</td>
</tr>
<tr>
<td>MMM</td>
<td>7-Sep</td>
<td>Single digit day, shortened month name, separated with -</td>
</tr>
<tr>
<td>MMM-yy</td>
<td>Sep-98</td>
<td>Shortened month name, two digit year, separated with -</td>
</tr>
<tr>
<td>MM-yyy</td>
<td>Sep-1998</td>
<td>Shortened month name, full year, separated with -</td>
</tr>
<tr>
<td>MMMM-yy</td>
<td>September-98</td>
<td>Full month name, two digit year, separated with -</td>
</tr>
<tr>
<td>MMMM-yyyy</td>
<td>September-1998</td>
<td>Full month name, full year, separated with -</td>
</tr>
<tr>
<td>MM-dd-yy</td>
<td>09-07-98</td>
<td>Double digit month and day, two digit year, separated with -</td>
</tr>
<tr>
<td>yyyy</td>
<td>1998</td>
<td>Full year</td>
</tr>
<tr>
<td>yyyy gg</td>
<td>1998 ad</td>
<td>Full year with lowercase bc/ad designation</td>
</tr>
</tbody>
</table>
### Chapter 3 - Data Files and the Worksheet

<table>
<thead>
<tr>
<th>YYYY GGG</th>
<th>1998 CE</th>
<th>Full year with uppercase BCE/CE designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>yy</td>
<td>98</td>
<td>Two digit year</td>
</tr>
<tr>
<td>MMMMM</td>
<td>S</td>
<td>First letter of month name</td>
</tr>
<tr>
<td>MMMM</td>
<td>September</td>
<td>Full month name</td>
</tr>
<tr>
<td>MMM</td>
<td>Sep</td>
<td>Shortened month name</td>
</tr>
<tr>
<td>MM</td>
<td>09</td>
<td>Double digit month</td>
</tr>
<tr>
<td>M</td>
<td>9</td>
<td>Single digit month</td>
</tr>
<tr>
<td>MMMMM-yy</td>
<td>S-98</td>
<td>First letter of month name, two digit year, separated with -</td>
</tr>
<tr>
<td>MMM-d</td>
<td>Sep-7</td>
<td>Shortened month name, single digit day, separated with -</td>
</tr>
<tr>
<td>M/d</td>
<td>9/7</td>
<td>Single digit month and day, separated with /</td>
</tr>
<tr>
<td>ddddd</td>
<td>Monday</td>
<td>Full day of week name</td>
</tr>
<tr>
<td>ddd</td>
<td>Mon</td>
<td>Shortened day of week name</td>
</tr>
<tr>
<td>dd</td>
<td>07</td>
<td>Double digit day</td>
</tr>
<tr>
<td>d</td>
<td>7</td>
<td>Single digit day</td>
</tr>
<tr>
<td>d/M/yy</td>
<td>7/9/98</td>
<td>Single digit day and month, two digit year, separated with /</td>
</tr>
<tr>
<td>d.M.yy</td>
<td>7.9.98</td>
<td>Single digit day and month, two digit year, separated with .</td>
</tr>
<tr>
<td>dd/MM/yy</td>
<td>07/09/98</td>
<td>Double digit day and month, two digit year, separated with /</td>
</tr>
<tr>
<td>dd/MM/yyyy</td>
<td>07/09/1998</td>
<td>Double digit day and month, full year, separated with /</td>
</tr>
<tr>
<td>yy/MM/dd</td>
<td>98/09/07</td>
<td>Two digit year, double digit month and day, separated with /</td>
</tr>
<tr>
<td>yyyy-MM-dd</td>
<td>1998-09-07</td>
<td>Full year, double digit month and day, separated with -</td>
</tr>
</tbody>
</table>

### Time Formats

All rows below use the time 2:45:44.12 PM for the Example.

<table>
<thead>
<tr>
<th>Date/Time Code</th>
<th>Example</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>(None)</td>
<td></td>
<td>Time not displayed</td>
</tr>
<tr>
<td>h:mm tt</td>
<td>2:45 PM</td>
<td>Hour in 0-12 (standard format), two digit Minutes 00 to 60, then a space and AM or PM</td>
</tr>
<tr>
<td>h:mm</td>
<td>14:45</td>
<td>Hour in 0-23 (military time), two digit Minutes 00 to 60</td>
</tr>
<tr>
<td>Format</td>
<td>Example</td>
<td>Description</td>
</tr>
<tr>
<td>-------------</td>
<td>---------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>hh:mm</td>
<td>14:45</td>
<td>Two digit Hour 00-23 (military time), two digit Minutes 00 to 60</td>
</tr>
<tr>
<td>h:mm:ss tt</td>
<td>2:45:44 PM</td>
<td>Hour in 0-12 (standard format), two digit Minutes 00 to 60</td>
</tr>
<tr>
<td>h:mm:ss</td>
<td>14:45:44</td>
<td>Hour in 0-23 (military time), two digit Minutes 00 to 60, two digit Seconds 00 to 60</td>
</tr>
<tr>
<td>hh:mm:ss</td>
<td>14:45:44</td>
<td>Two digit Hour 00-23 (military time), two digit Minutes 00 to 60, two digit Seconds 00 to 60</td>
</tr>
<tr>
<td>m:ss</td>
<td>45:44</td>
<td>Single digit Minutes 0 to 60, two digit Seconds 00 to 60</td>
</tr>
<tr>
<td>mm:ss</td>
<td>45:44</td>
<td>Two digit Minutes 00 to 60, two digit Seconds 00 to 60</td>
</tr>
<tr>
<td>m:ss.0</td>
<td>45:44.1</td>
<td>Single digit Minutes 0 to 60, two digit Seconds 00 to 60, fractional seconds rounded to the nearest tenth of a second</td>
</tr>
<tr>
<td>mm:ss.0</td>
<td>45:44.1</td>
<td>Two digit Minutes 00 to 60, two digit Seconds 00 to 60, fractional seconds rounded to the nearest tenth of a second</td>
</tr>
<tr>
<td>h:mm:ss.000</td>
<td>14:45:44.12</td>
<td>Hour in 0-23 (military time), two digit Minutes 00 to 60, two digit Seconds, 00 to 60, fractional seconds with full precision</td>
</tr>
<tr>
<td>m:ss.000</td>
<td>45:44.12</td>
<td>Single digit Minutes 0 to 60, two digit Seconds 00 to 60, fractional seconds with full precision</td>
</tr>
<tr>
<td>mm:ss.000</td>
<td>45:44.12</td>
<td>Two digit Minutes 00 to 60, two digit Seconds 00 to 60, fractional seconds with full precision</td>
</tr>
<tr>
<td>[h]:mm:ss</td>
<td>865094:45:44</td>
<td>Total hours (day value plus hour value), two digit Minutes 00 to 60, two digit Seconds 00 to 60.</td>
</tr>
</tbody>
</table>

Example Explanation: Date value 865080 = September 7, 1998
Hour value = 14, added to 865080 = 865094
Chapter 3 - Data Files and the Worksheet

Opening a Worksheet Window
You can view, enter, or modify data in the worksheet document.

To open a blank worksheet window:
- Click the File | New | Worksheet command in the plot document, grid editor, or worksheet document.
- Click the button in the toolbar.
- Press the CTRL + W keyboard command.

To view worksheet data:
- Click the File | Open command in the plot document, grid node editor, or worksheet document and then select a data file.
- Click the button in the toolbar. In the Open dialog, select a data file.
- Select the File | Open or File | Import command in the worksheet and then select a data file.
- If there is an open worksheet window, return to it at any time by clicking the desired worksheet tab.

To enter and modify worksheet data:
See Working with Worksheet Data for more information.

Worksheet Window
To enter data in a worksheet, click the File | Open command to open an existing data file or click the File | New | Worksheet command to create a blank worksheet. The components of the worksheet window are discussed below.

The components of a worksheet window shown above are described in the table below.
### Component Name

<table>
<thead>
<tr>
<th>Component Name</th>
<th>Component Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Column Letters</td>
<td>The letter that identifies a column of the worksheet.</td>
</tr>
<tr>
<td>Row Numbers</td>
<td>The number that identifies a row of the worksheet.</td>
</tr>
<tr>
<td><strong>Active Cell</strong></td>
<td>The cell highlighted with a bold outline. The active cell receives data input (numeric values or text strings) from the keyboard. Only one cell is active at a time.</td>
</tr>
<tr>
<td><strong>Active Cell Location</strong></td>
<td>The location of the active cell, specified by column letter and row number.</td>
</tr>
<tr>
<td><strong>Active Cell Edit Box</strong></td>
<td>The box displaying the data or text contained in the active cell. Data typed into an empty cell appears in both the edit box and the active cell.</td>
</tr>
<tr>
<td>Worksheet Name</td>
<td>The name of the data file displayed in the worksheet or the worksheet number prior to saving.</td>
</tr>
<tr>
<td><strong>Select Entire Worksheet Button</strong></td>
<td>The button used to select all cells in the worksheet. Located in the top left corner of the worksheet.</td>
</tr>
</tbody>
</table>

### Row and Column Label Bars

The worksheet cells are located by column label bars (A, B, C...) or row label bars (1, 2, 3...). Click the label to select entire rows or columns, to change row height, to change column width, or to hide or unhide rows and columns. To select multiple rows or columns, drag the mouse over several adjacent labels.

![The column and row label bars are highlighted in this example.](image)
Active Cell

The active cell is displayed with a heavy border surrounding the cell. The contents of this cell are displayed in the cell edit box. You can enter or edit data in the active cell. To edit existing data, activate the desired cell and press the F2 key or highlight the information in the cell edit box.

Special Key Functions when editing the active cell include the following:

<table>
<thead>
<tr>
<th>Keyboard Command</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>ESC</td>
<td>ESC cancels edit mode and restores the original contents of the active cell.</td>
</tr>
<tr>
<td>ENTER</td>
<td>ENTER stores the contents of the cell edit box and then moves the active cell down one cell.</td>
</tr>
<tr>
<td>CTRL+ENTER</td>
<td>CTRL+ENTER completes the entry and keeps the current cell active.</td>
</tr>
<tr>
<td>ARROWS (left and right)</td>
<td>Left and right ARROWS move within the cell's text if the F2 key has been pressed. Otherwise, these keys store the contents of the cell edit box and then move the active cell to the left or right.</td>
</tr>
<tr>
<td>ARROWS (up and down)</td>
<td>Up and down ARROWS store the contents of the cell edit box in the active cell and move the active cell above or below.</td>
</tr>
<tr>
<td>DELETE</td>
<td>DELETE deletes the character to the right of the cursor if the F2 key has been pressed. Otherwise, pressing the delete key deletes the entire contents of the cell.</td>
</tr>
<tr>
<td>BACKSPACE</td>
<td>BACKSPACE deletes the character to the left of the cursor if the F2 key has been pressed. Otherwise, pressing the backspace key deletes the entire contents of the cell.</td>
</tr>
<tr>
<td>PAGE UP and PAGE DOWN</td>
<td>PAGE UP and PAGE DOWN store the contents of the cell edit box in the active cell and move one page up or down.</td>
</tr>
<tr>
<td>TAB and SHIFT+TAB</td>
<td>TAB and SHIFT+TAB store the contents of the cell edit box in the active cell and move the active cell to the right or left.</td>
</tr>
</tbody>
</table>

Active Cell Location Box

The active cell location box shows the location of the active cell in the worksheet. Letters are the column labels and numbers are the row labels.
This example shows the active cell as cell C5. The name of the active cell "C5" is listed in the active cell location box in the upper left portion of the worksheet.

Active Cell Edit Box
The cell edit box is located at the top of the worksheet window just above the column letter bar. The cell edit box shows the contents of the active cell and is used for editing cells. Use the cell edit box to see the contents of a worksheet cell when the column is too narrow to display all of the cell contents.

To begin editing the selected cell, press the F2 key. Alternatively, highlight the contents of the cell edit box to edit the cell. To overwrite the current cell contents, simply begin typing without pressing F2. If the mouse is clicked on a new cell, the new cell becomes the active cell.

Right-click in the active cell edit box to access the following commands in the context menu:

<table>
<thead>
<tr>
<th>Command</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right to left Reading order</td>
<td>Toggles right to left reading order on or off.</td>
</tr>
<tr>
<td>Show Unicode control characters</td>
<td>Toggles the display of Unicode control characters on or off.</td>
</tr>
<tr>
<td>Insert Unicode control character</td>
<td>Select a Unicode control character from the list, and it is inserted in the active cell edit box at the cursor location.</td>
</tr>
<tr>
<td>Open/Close IME</td>
<td>When a user types a phonetic representation of a word, the IME displays a candidate list on the screen. The user can select the intended word or phrase from among several different possible representations in the candidate list, and the user's selection then replaces the phonetic representation in the document. This command toggles the IME on or off.</td>
</tr>
<tr>
<td>Reconversion</td>
<td>IME reconversion allows users who are typing in Japanese to convert back and forth between the phonetic spelling of a word (using the standard Western keyboard) and the Japanese character that represents the word.</td>
</tr>
</tbody>
</table>

Special Key Functions when Editing the Active Cell:

<table>
<thead>
<tr>
<th>Keyboard Command</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
ESC cancels edit mode and restores the original contents of the active cell.

ENTER stores the contents of the cell edit box and then moves the active cell down one cell.

CTRL+ENTER completes the entry and keeps the current cell active.

ARROWS (left and right) move within the cell's text if the F2 key has been pressed. Otherwise, these keys store the contents of the cell edit box and then move the active cell to the left or right.

ARROWS (up and down) store the contents of the cell edit box in the active cell and move the active cell above or below.

DELETE deletes the character to the right of the cursor if the F2 key has been pressed. Otherwise, pressing the delete key deletes the entire contents of the cell.

BACKSPACE deletes the character to the left of the cursor if the F2 key has been pressed. Otherwise, pressing the backspace key deletes the entire contents of the cell.

PAGE UP and PAGE DOWN store the contents of the cell edit box in the active cell and move one page up or down.

TAB and SHIFT+TAB store the contents of the cell edit box in the active cell and move the active cell to the right or left.

Select Entire Worksheet
Clicking on the small box above the row labels and to the left of the column labels selects the entire worksheet.

The Select Entire Worksheet button is located to the left of column A and above row 1.

Working with Worksheet Data
There are three ways to enter data into the worksheet. Data are entered into the worksheet by using File | Open and opening a data file, by typing data directly into the worksheet, or by copying
the data from another application and pasting it into the worksheet. Use the Data menu commands to sort the data, filter the data, view statistics, transform the data using mathematical functions, assign default columns for coordinate data, assign a coordinate system to the data, and project coordinates.

There are two basic modes in the worksheet. Normal mode is when the active cell can be moved throughout the worksheet, and edit mode allows the contents of a single cell to be edited in the active cell edit box. Only one mode may be active at a given time. ESC, ENTER, or clicking on another cell can be used to exit edit mode and return to normal mode.

**Entering Data Into a Cell**

Edit the contents of a cell by making it the active cell. The active cell is positioned by clicking on a cell with the mouse, by using the ARROW keys, PAGE UP, PAGE DOWN, TAB, HOME, END, and SHIFT+TAB. Press the F2 key or highlight the contents of the cell edit box to edit the contents of the cell.

To enter new data and delete the old, position the active cell and begin typing. Edit mode is entered automatically and the old data is deleted. Pressing the ENTER, Up or Down ARROWS, TAB, SHIFT+TAB, PAGE UP, or PAGE DOWN keys causes the edit changes to be recorded permanently in the cell. After pressing F2 or highlighting the cell edit box use the HOME, END, BACKSPACE, DEL, and ARROW keys to edit the cell. Pressing ESC while editing a cell cancels the changes and restores the original data.

**Moving the Active Cell**

You can designate any worksheet cell as the active cell by left-clicking on it with the mouse. The active cell can also be repositioned by using keyboard commands. The active cell is the cell with a thick border drawn around it.

<table>
<thead>
<tr>
<th><strong>Keyboard Command</strong></th>
<th><strong>Action</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>ARROW keys (Up, Down, Left, Right)</td>
<td>The ARROWS move the active cell to an adjacent cell.</td>
</tr>
<tr>
<td>PAGE UP/PAGE DOWN</td>
<td>Press the PAGE UP or PAGE DOWN to move the active cell up or down by the number of rows visible in the window.</td>
</tr>
<tr>
<td>HOME</td>
<td>Press HOME to move the active cell to the first occupied cell in the current column. Press HOME again to move the active cell to the top row in the current column.</td>
</tr>
<tr>
<td>END</td>
<td>Press END to move the active cell to the last occupied row in the current column. Press END again to move the active cell to the bottom row of the worksheet.</td>
</tr>
<tr>
<td>ENTER</td>
<td>Press ENTER to move the active cell down one row and end &quot;edit mode.&quot;</td>
</tr>
<tr>
<td>TAB</td>
<td>Press TAB to move the active cell right one column and end &quot;edit mode.&quot;</td>
</tr>
<tr>
<td>SHIFT + ENTER</td>
<td>Press SHIFT+ENTER to move the active cell up one row and end &quot;edit mode.&quot;</td>
</tr>
<tr>
<td>SHIFT + TAB</td>
<td>Press SHIFT+TAB to move the active cell left one column and end &quot;edit mode.&quot;</td>
</tr>
</tbody>
</table>
### Moving the Active Cell Within Selections

The ENTER, TAB, SHIFT+ENTER, and SHIFT+TAB keys move the active cell within a group of selected cells without canceling the selection.

### Pasting Data

If data are copied to the clipboard from another software application, the contents of the clipboard can be pasted into the worksheet. If the source application is Microsoft Excel, some formatting information is retained. When pasting data into the worksheet, select a cell and use **Home | Clipboard | Paste** (CTRL+V). Any data to the right or below the active cell is overwritten, so be sure to locate the active cell carefully. When data are copied to the clipboard, special formatting...
Chapter 4 - Creating Grid Files

Contour maps, color relief maps, shaded relief maps, vector maps, watershed maps, 3D surfaces, and 3D wireframes all require grids for their creation in **Surfer**. A grid is a regular, rectangular array of values. The **Home | Grid Data | Grid Data** command provides you with several methods for generating a **Surfer**.GRD grid file from your XYZ data. In addition to the grid files that **Surfer** creates, it can also read many common grid file formats directly. A grid with all NoData nodes cannot be saved.

A Gridding Example

Consider the scenario of producing a contour map of water table depth given well data collected over a region. The well locations are not regularly spaced over the area of interest. If you provide **Surfer** with the locations of the wells (the XY coordinates) and the depth to the water table (the Z value) in the form of an XYZ data file, **Surfer** can produce a grid file from the original data and a grid-based map from the gridded data. The following series of figures show the normal progression from a data file, to a grid file, to a contour map.

1. In a worksheet window, define well locations (X and Y coordinates) and water table depth (Z value) at each location in an XYZ data file.

   ![XYZdata](image)

   *This is the XYZ data file that defines the well locations and water table depth at each location.*

2. In the plot window, click the **Home | New Map | Post** command. Select the data file created in step 1 and click **Open** to create a post map displaying the data locations with Z value labels. This step is to show the irregularly spaced data across the map.
3. Click the **Grids | New Grid | Grid Data** command to create a regularly spaced grid .GRD file from the irregularly spaced XYZ data file. Use the default values in the **Grid Data** dialog and click OK to create the .GRD file.

Gridding interpolates a Z value at the intersection of each row and column in the grid file, thereby filling holes in the data. Here the rows and columns are represented by grid lines drawn across the map.
4. Click once on the post map to select it. Click the **Home | Add to Map | Layer | Contour** command to add a contour map of the grid file to the post map of the data file.

The irregularly spaced data points are used to interpolate grid node values. These interpolated values are written to a grid file. The grid file is used to produce the contour map. This figure shows the filled contour map, the posted data points, and the layout of the grid.

**Grid Data**

Grid files are necessary in **Surfer** to create grid-based maps types. Data files are typically randomly spaced files, and this data must be converted into an evenly spaced grid before using many of **Surfer's** features. Grid files are produced from XYZ data using the **Home | Grid Data | Grid Data** or the **Grids | New Grid | Grid Data** command. With this command, you can specify the parameters for the particular gridding method and the extents of the grid. The gridding methods define the way in which the XYZ data are interpolated when producing a grid file. Refer to the **tutorial** for more information on data and gridding data.

When creating a grid file you can usually accept all of the default gridding parameters and generate a grid file that represents your data well. Under most circumstances, the recommended gridding method is kriging with the default linear variogram. This is the selected default gridding method because it gives good results for most XYZ data sets.

There are several gridding parameters you can set when producing a grid file. Refer to the gridding method for more information on specific parameters. Most gridding methods require at least three non-collinear data points. The **Inverse Distance**, **Nearest Neighbor**, **Moving Average**, and **Data Metrics** methods require at least three data points, collinear or not. Some methods require more data points. For example, a higher-order polynomial fit needs more than three data points; there must be at least as many data as there are degrees of freedom. When the **Z Transform** is set to **Log, save as log** or **Log, save as linear**, at least three data points must contain Z values that are non-negative and non-zero. Click the **Grids | New Grid | Grid Data** or **Home | Grid Data | Grid Data** command to choose the data to be used in the gridding process.
Grid Data Dialog

Click the Grids | New Grid | Grid Data or Home | Grid Data | Grid Data command to display the Open Data dialog. Select a data file and click Open. The Grid Data dialog is displayed.

Gridding options are set in the Grid Data dialog.

Data Columns

Individually specify the columns for the X data, the Y data, and the Z data in the Data Columns section. Surfer defaults to X: Column A, Y: Column B, and Z: Column C. However, your data can be in any three columns. Click the down arrow on each box and select the appropriate column for each variable. If the data file was selected from the Open worksheets list in the Open Data dialog, assigned XYZ columns (if any) will populate the appropriate columns in the Data Columns group. Columns containing dates or numbers can be selected.

Note: When using date/time formats for any of the Data Columns, the values are stored in the grid as numbers, not in date/time format. To display date/time formats on the map, select the appropriate map part (axis, map layer, or map) and set the date/time label format.

Filter Data

You can filter the data before gridding based on a predefined filter or based on a user-defined equation by clicking the Filter Data button.
View Data
If you are unsure of which columns contain your XYZ data, click the View Data button to see the data file in a worksheet format. If you get an Insufficient data (3 or more XYZ triplets required) error, use View Data to check the layout of the data. One common reason for this warning is that the data is not numeric or date/time format. After clicking View Data, make sure that all three columns of data are right aligned. If one of the columns is left aligned, the data are text, not numbers. You can use the data view to determine the appropriate columns for the X, Y, and Z values.

Statistics
Click the Statistics button to display statistics based on the selected X, Y, and Z columns.

Grid Report
Check the box next to the Grid Report option to create a gridding report that includes all the gridding parameters used to generate a grid. This report also includes statistics about the grid. You can also access the grid statistics by creating a grid information report. Create a grid information report in the Grid Editor by clicking the Grid Editor | Options | Grid Info command or by clicking the Grids | Info | Grid Info command from any document window.

Gridding Method and Advanced Options
Surfer has several different gridding methods. These gridding methods define the way in which the XYZ data are interpolated when producing a grid file. Choose the Gridding Method and gridding options (Advanced Options button) in the Gridding Method group. Refer to the gridding methods help topics for more information on the options.

Cross Validate
Click the Cross Validate button to perform cross validation on your data. Cross validation is an objective way of assessing the gridding parameters for your data set. Cross validation is always performed on the linear Z values, not the transformed Z values.

Output Grid Geometry
The Output Grid Geometry section defines the grid limits and grid density. The Output Grid Geometry section also controls whether grid nodes outside the data are automatically assigned the NoData value.

Minimum and Maximum X and Y Coordinate (Grid Limits)
Grid limits are the minimum and maximum X and Y coordinates for the grid. Surfer computes the minimum and maximum X and Y values from the XYZ data file. These values are used as the default minimum and maximum coordinates for the grid.

Grid limits define the X and Y extent of the output grid. The extents of the grid define the extents of contour maps, color relief maps, shaded relief maps, vector maps, 3D wireframes, and 3D surfaces created from grid files. When creating a grid file, you can set the grid limits to the X and Y extents you want to use for your map. Once a grid file is created, you cannot produce a grid-based map larger than the extent of the grid file. If you find you need larger grid limits, you must regrid the data. You can, however, read in a subset of the grid file to produce a map smaller than the extent of the grid file.
When either the X, Y, or Z value is in a date/time format, the date/time values are converted and stored in the grid as numbers.

Spacing and # of Nodes (Grid Density)

Grid density is usually defined by the number of columns and rows in the grid, and is a measure of the number of grid nodes in the grid. The # of Nodes in the X Direction is the number of grid columns, and the # of Nodes in the Y Direction is the number of grid rows. The direction (X Direction or Y Direction) that covers the greater extent (the greater number of data units) is assigned 100 grid nodes by default. The number of grid nodes in the other direction is computed so that the grid nodes Spacing in the two directions are as close to one another as possible.

By defining the grid limits and the number of rows and columns, the Spacing values are automatically determined as the distance in data units between adjacent rows and adjacent columns.

Note on High Density Grid Files

Higher grid densities (smaller Spacing and a larger # of Nodes) increase the smoothness in grid-based maps. However, an increase in the number of grid nodes proportionally increases the gridding time, drawing time, and the grid file size. You can have up to 2,147,483,647 rows and columns in a grid file. It is likely your computer will run out of memory before reaching the maximum grid size. The primary use for the large grid size maximum is to allow grids with extreme aspect ratios to be created.

The larger the density of grid nodes in the grid, the smoother the map that is created from the grid. Contour lines and XY lines defining a wireframe are a series of straight-line segments. More X and Y grid nodes in a grid file result in shorter line segments for contours or wireframe maps. This provides a smoother appearance to contour lines on a contour map or smoother appearing wireframe.

Although highly dense grid files can be created, time and space are practical limits to the number of grid nodes you may want to create in a grid file. The grid density limit is based on the amount of available memory in your computer and the size of the data file used to create the grid. Limited memory, very large data files, very dense grids, or any combination of these factors can greatly increase gridding time. When gridding begins, the status bar provides you with information about the estimated gridding time to complete the task. If gridding time is excessive, click in the plot window to cancel the gridding operation.

Some examples of the amount of memory needed to grid large files:

- A 10,000 x 10,000 grid requires 10000*10000*8 = 763MB.
- A 15,000 x 15,000 grid requires 1.7GB.
- A 20,000 x 20,000 grid requires 3GB which is more than a 32-bit OS can address (although it is possible on an 64 bit OS)
- A 2,147,483,647 x 2 grid requires 32GB of contiguous RAM (most computers contain a maximum of 16GB RAM stored noncontiguously)

You can also increase or decrease the grid density by using the Grid | Spline Smooth, Grid | Extract, or Grids | Resize | Mosaic commands.
Output Grid Geometry Example

Consider these examples. The data range from 0 to 25 in the Y dimension and 0 to 10 in the X dimension. The two examples use different numbers of grid nodes, or grid spacing, during gridding.

In the example on the left above, the grid Spacing is set approximately equal in the X and Y dimensions (one unit each). This results in a different number of grid nodes in the X and Y dimensions. In the example on the right above, the same # of Nodes are specified in the two dimensions. This results in an unequal spacing in data units in the two dimensions.

The Output Grid Geometry information specified in the Grid Data dialog for each of the examples is displayed below.

This shows the Output Grid Geometry information for the 11 by 26 grid. The grid node spacing values are set to one, resulting in a different number of grid nodes in the X and Y dimensions.
Chapter 4 - Creating Grid Files

Grid Line Geometry

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Spacing</th>
<th># of Nodes</th>
</tr>
</thead>
<tbody>
<tr>
<td>X Direction:</td>
<td>0</td>
<td>10</td>
<td>2.5</td>
</tr>
<tr>
<td>Y Direction:</td>
<td>0</td>
<td>25</td>
<td>6.25</td>
</tr>
</tbody>
</table>

This shows the Output Grid Geometry information for the 5 by 5 grid. The number of nodes is equal, resulting in different spacing in the X and Y dimensions.

Grid Z Limits

In some cases, the gridding interpolation and extrapolation can result in undesired values, for example negative numbers in cases where negative values are physically impossible. The Grid Z Limits options clamp the grid output to specific minimum and maximum values.

The Grid Z Limits are applied after the interpolation operation. After the grid interpolation is performed, Surfer locates any grid values less than the Minimum and replaces them with the Data min or Custom value. Surfer locates any grid values greater than the Maximum and replaces them with the Data max or Custom value.

To clamp the output to a specific minimum value, click the current selection next to Minimum, and select None, Data min, or Custom from the list. If Data min is selected, the data minimum will be displayed in the field to the right of the Minimum list. Select Custom and type a value in the input box to use a user-defined Minimum.

To clamp the output to a specific maximum value, click the current selection next to Maximum, and select None, Data max, or Custom from the list. If Data max is selected, the data maximum will be displayed in the field to the right of the Maximum list. Select Custom and type a value in the input box to use a user-defined Maximum.

Convex Hull of Data

The convex hull of a data set is the smallest convex polygon containing all the data. The convex hull can be thought of as a rubber band that encompasses all data points. The rubber band only touches the outside points. So, areas inside the convex hull without data are still gridded.

Assign NoData Outside Convex Hull

Check the box next to the Assign NoData outside convex hull of data to automatically assign the NoData value to the grid nodes outside the convex hull of the data. Leave the box cleared to extrapolate the data to the minimum and maximum grid limits, regardless of whether data exists in these areas.

Inflate Convex Hull

The Inflate convex hull by option expands or contracts the convex hull. When set to zero, the boundary connects the outside data points exactly. When set to a positive value, the area assigned the NoData value is moved outside the convex hull boundary by the number of map units specified. When set to a negative value, the area assigned the NoData value is moved inside the convex hull boundary by the number of map units specified.

To change the value, highlight the existing value and type the desired value. Values are in horizontal (X) map units. If the value is set to a large positive value, the grid values may extend all the way to the minimum and maximum X and Y limits of the grid, essentially overriding the Assign