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HEC-MetVue
Meteorological Visualization Utility Engine

User's Manual

Version 3.0
June 2019

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14. ABSTRACT
The Hydrologic Engineering Center's Meteorological Visualization Utility Engine, HEC-MetVue, was developed to facilitate viewing of spatial meteorological datasets and performing a variety of computations and analyses. HEC-MetVue currently supports reading particular data products with formats that include: HEC-DSS, PRISM, XMRG, ESRI ASCII Grid with sidecar metadata and projection files as specified later in this manual, GRIB for specific products such as HRRR, and NetCDF based on Climate Forecast (CF) metadata conventions. Primary output formats that HEC-MetVue currently supports are HEC-DSS and ESRI GRID ASCII and Binary Format.

HEC-MetVue performs temporal and spatial aggregation of meteorological datasets and performs areal average computations using input polygon shapefiles. HEC-MetVue provides tools for animating datasets, trimming spatial extents of datasets, applying spatial translations and rotations to datasets, and applying temporal shifts to datasets. In additions, special computational tools are available for performing Calibration of Radar datasets, Disaggregation of total storm images, Depth-Area-Duration analyses, and Development of Design Storms based on the HMR52 procedures. HEC-MetVue also includes utilities for automating the application of its primary tools.

15. SUBJECT TERMS
HEC-MetVue, HEC-DSS, HEC-DSSVue, HEC-HMS, HEC-RAS, HEC-RTS, CWMS, USACE, US Army Corps of Engineers, Hydrologic Engineering Center, HEC, gridded data, spatial data, raster data, grids, grid cells, time series, viewing, visualize, animate, extract, mosaic, mathematical operations, values, units, coordinates, time interval, hydrology, water resources studies, precipitation, meteorology, environment, HRAP, SHG, XMRG, NetCDF, NWS, RFC, NEXRAD, storage, software, computer program, graphical user interface, GUI, Java

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Meteorological Visualization Utility Engine, HEC-MetVue User's Manual

HEC cannot provide technical support for this software to non-Corps users. Non-Corps individuals should use any internet search engine to locate a vendor that can provide support for the HEC software of interest. However, we will respond to all documented instances of program errors. Documented errors are bugs in the software due to programming mistakes, not model problems due to user-entered data.

HEC-MetVue uses the following third party libraries:

1. JDOM - This library is used for reading and writing xml files. http://www.jdom.org/

2. Geotools - This library is used for managing coordinate systems and projections. This affects reading and writing of spatial data. http://geotools.org/

3. OpenStreetMap - This library is used for drawing the internet map layers. https://wiki.openstreetmap.org/wiki/Main_Page

4. SLFJ4 - Logging dependency of the HDF Group library - https://www.slf4j.org/

5. Hierarchical Data Format (HDF) - Library for reading and writing HDF files - https://support.hdfgroup.org/products/java/

6. NetCDF Java Library - Libraries provided by UCAR for reading NetCDF and GRIB files - https://www.unidata.ucar.edu/software/thredds/current/netcdf-java/

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By using this program you voluntarily accept these terms and conditions. If you do not agree to these terms and conditions, uninstall the program, delete all copies, and cease using the program.

PREFACE

This manual will teach you how to use the various features and capabilities of the program. It is not an exhaustive reference on spatial data processing, geographic coordinate transforms or the like. It does contain information on many of the methods supplied in the HEC-MetVue program in order to give an understanding of any limitations that may exist.

Many engineers and computer specialists have contributed to the success of HEC-MetVue. Each one has made valuable contributions that enhance the overall success of the program. The original version of this program was developed by MCB Systems and managed by the Corps of Engineers Fort Worth District and in consultation with the Hydrologic Engineering Center (HEC) and several Corps Districts. The development of this version of the program was primarily performed by MCB Systems Inc. with contributions by RMA Inc. under contract with the Hydrologic Engineering Center (HEC) with Fauwaz Hanbali providing managerial and technical oversight. Mike Perryman of HEC was instrumental in the success of this project, contributing to both the theoretical and practical aspects of the program as well as making enhancements to existing systems to accommodate the requirements of this program. Development of version 1 of the program was overseen by Jerry Cotter and Michael Schwind of the Fort Worth District. Tom Evans of HEC oversaw the development of version 2 of the program, and he also helped on the HEC-DSS integration, mapping subsystem, and overall feature set of version 2 of the program. Fauwaz Hanbali of HEC oversaw the development of version 3 of HEC-MetVue.

Chapter 1

1. Introduction

This program is designed to display, verify, manipulate and edit spatial data by interactive/visual means. Any dataset consisting of points in space with coordinates and measurement values ([X, Y, M_n]) can be used in the program. Most often, HEC-MetVue is used to manipulate precipitation data but is not limited to precipitation. It has the capability to display the data in a variety of ways such as by contouring it or showing measurement values. HEC-MetVue can perform spatial computations, such as basin averages using a combination of the dataset along with georeferenced polygon data. The program supports many data storage and projection formats and also provides an Input/Output (I/O) provider specification to allow additional formats to be incorporated to meet a variety of needs without requiring external data conversion.

1.1 Scope

The program features a completely integrated work environment including a database, data entry utilities, computation engine, and results reporting tools. A graphical user interface allows the seamless movement between the different parts of the program. Program functionality and appearance are the same across all supported platforms.

1.2 History

HEC-MetVue is loosely based on a program named ViewRain that was developed in the early 1990s by the Tulsa District office of the U.S. Army Corps of Engineers (USACE). The original ViewRain program was written specifically for the Windows™ platform using the C language. ViewRain was developed to display rainfall information from automated rain gages and National Weather Service Observers. ViewRain was later modified to support LFM (NEXRAD) radar grids. Later versions supported some limited datasets other than precipitation. All data was kept in binary files designed specifically for use with ViewRain. The Tulsa District provided additional programs to help users import data in flat files with the necessary format; however, no coordinate transformations were provided or supported. ViewRain only supported data with longitude/latitude coordinates.

The current HEC-MetVue version builds upon many of the capabilities that the original ViewRain program provided such as Delaunay Triangulation of irregular, non-gridded datasets as well as many other geometric algorithms ViewRain supplied. All source code for the HEC-MetVue is now written in Java™ to enhance the portability aspects of the program. HEC-MetVue is built using the Netbeans Platform to provide a common use windowing environment that provides support for menus and window placement. HEC-MetVue supports the original ViewRain file formats used to contain the datasets that were developed by the Tulsa District. But HEC-MetVue also supports HEC-DSS for spatial image storage and retrieval, and the I/O provider model provides the necessary facilities for the addition of other file formats such as XMRG, NetCDF, and GRIB. The original file format used to hold mapping files was abandoned in favor of using industry standard shapefiles along with interfaces built to accommodate other standards in the future.

1.3 Prerequisites

Although the program will display either map input files (shapefiles) or spatial datasets (Triangulated Irregular Network (TIN) or Gridded datasets), HEC-MetVue requires the combination of both to make the program useful. The shapefiles (especially maps with polygons representing subbasin boundaries) help to visualize the geographic location and overlay of the TIN or gridded datasets. The TIN or gridded datasets contain the georeferenced measurement values while subbasin shapefiles contain area extents that are both needed to compute areal statistics such basin averages.

Legacy users of ViewRain should review the appendix "Transitioning from ViewRain to HEC-MetVue" for help in creating base maps for this program.

Other users can use their own shapefiles or download shapefiles from the web. Please read the discussion of shapefiles which gives information regarding requirements and extensions the program supports to make them more useful.

Included in the HEC-MetVue distribution are a small assortment of shapefiles to demonstrate the usage of the program as well as to illustrate various shapefile projections supported by the program.

A small sampling of the various TINs (Gridded datasets are also referred to throughout the rest of this manual as TINs) are also included in the distribution.

1.4 Documentation Conventions

The following conventions are used throughout the manual to describe the graphical user interface:

- Screen titles are shown in *italics*.
- Menu names, menu items, and button names are shown in **bold**.
- Menus are separated from submenus with the right arrow ->.
- Data typed into an input field or selected from a list is shown using the `courier font`.
- A column heading, tab name, or field title is shown in "double quotes".

Chapter 2

2. Installing and Running the Program

This chapter describes the recommended computer system requirements for running the program. Step-by-step installation procedures are also provided. Currently the program is deployable on the Windows™ platform. Although written in and theoretically deployable to other platforms, the inclusion of specialized libraries for DSS for the other platforms has not yet been tested or included in the deployment.

2.1 Operating System Requirements

The program has been created using the Java programming language. Programs written in this language can run on many operating systems. However, as stated above, the HEC-DSS library used by the program still has OS specific components. These libraries are currently only available for the Microsoft Windows, Sun Microsystems Solaris, and Linux operating systems. Therefore, the program itself is also only available for those operating systems. Nevertheless, because the program was created with the Java language, the program looks and behaves substantially the same on all operating systems.

The program is available for:

- Windows 7 and Windows 10

The program has only been tested on various iterations of the Windows™ platform.

2.2 Hardware Requirements and Recommendations

The typical hardware requirement for the Microsoft Windows installation includes:

- 4 GB or greater of memory recommended.
- 300 MB of available hard disk space for installation.

Significantly more resources may be needed depending on your application. The minimum equipment for any operating system will be suitable for displaying a single image panel with a relatively small dataset consisting of 100K points or less. However, as the datasets become increasingly large, potentially spanning several states, or when working with several panels simultaneously, 2 GB of memory or more will make a significant difference in HEC-MetVue's performance. HEC-MetVue also makes extensive use of threads to speed computations and improve the user interface response and will benefit from a multiprocessor machine.

2.3 Installation

Installation packages for the program are available at http://www.hec.usace.army.mil/. The standard installation package requires administrative rights, and when executed it includes a setup wizard to guide through the installation steps and automatically install HEC-MetVue in the Windows target directory for programs. The portable installation package is a ZIP file that can be placed and unzipped at any other directory that does not require administrative privileges.

To install the portable program package, simply unzip the ZIP file to the desired location and create a shortcut to the <install directory>/metvue/bin/metvue.exe file. Depending on intended use, additional modifications may be required to the <install directory>/metvue/etc/metvue.conf file. For example, it may be necessary to modify this file to add command line switches to control how the program starts.

Currently, HEC-MetVue is available in both a 32 and 64 bit versions. Using the 64 bit version is encouraged if the operating system supports it.

A partial listing of the contents in the program package are shown in Figure 1, while Table 1 provides descriptions of the various directories, files, commands, and executables.

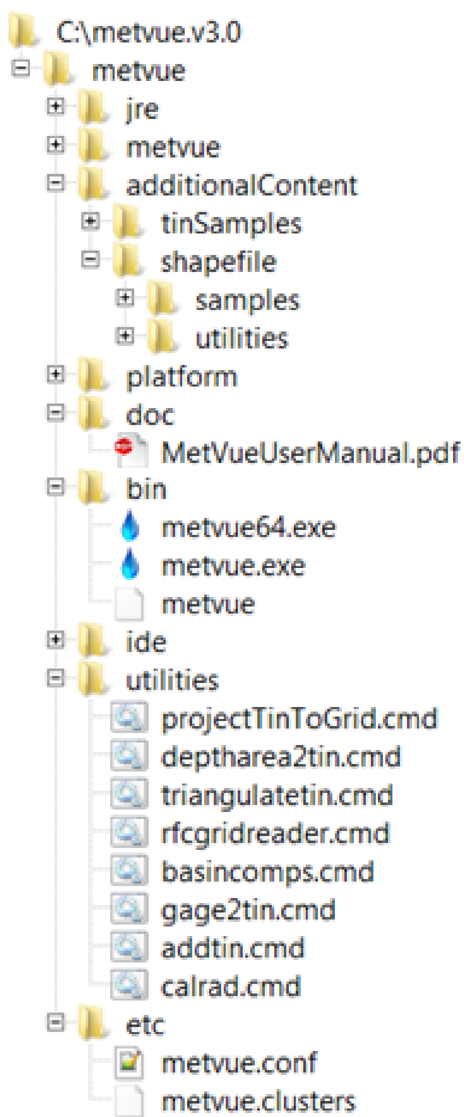


Figure 1 - HEC-MetVue distribution file layout

Table 1 - HEC-MetVue distribution description

Directory	Files	Purpose
metvue 3.0		The root folder from the install package. It can be named anything. Utilities such as 7-zip can use the zip file name for root directory which is a convenient way have multiple versions of the program.
additonalContent/shapefile/samples/		This directory contains several shapefiles that have various coordinate systems or coverages.
additonalContent/shapefile/utilities/		The utilities in this folder are to help in the transition from the ViewRain legacy program to this program. Those not converting legacy overlays do not need to use these utilities.
	MapTools.dll	Required DLL for overlay file translation
	Overlay2ShapeFile.exe	Program (.Net ™). This program converts legacy overlay files to shapefiles. This is discussed further in the appendix on transitioning from ViewRain to HEC-MetVue.
	Shpaefile2Stdout.exe	Utility to help verify the contents of a shapefile.
	Shapelib.dll	Required DLL for overlay file translation
bin/		
	metvue.exe	The 32 bit executable.
	metvue64.exe	The 64 bit executable.
etc/		
	metvue.conf	The HEC-MetVue configuration file. Additional switches and command line options to control both the JRE and HEC-MetVue can be placed in this file.

utilities/		The command utilities in this folder can be used without starting the HEC-MetVue GUI. A small number of the classes within the Java jars have entry points that can be used in this manner. The entry command files typically have the '?' command line switch defined so that they can be executed from the `utilities` directory with the correct relative pathing. They are intended as a template which can be copied and modified to create batch files to process data for a specific purpose without starting the main program. A more detailed usage of each entry point can be found in Chapter 18 of this manual.
	addtin.cmd	This batch file can be used to aggregate multiple TINs together such as .Equivalent to the legacy programs used to add the surfaces of TINs together. This replaces both utilities to aggregate TINs and grids.
	basincomps.cmd	Used to compute basin averages based on the given TIN data and polygon shapefile(s) provided and write that data to DSS or text output files.
	calrad.cmd	Used to perform a surface adjustment of one image using another. Typically used to adjust radar data which is spatially well defined but lacks precision, using an irregular mesh of rainfall gages/observers which are precise but lack the spatial resolution of the radar.

deptharea2tin.cmd	Used to generate an elliptical TIN storm pattern series from depth-area data.
gage2tin.cmd	A process capable of transforming a set of known location hyetographs into a time series of TINs as either irregular TINs or grids.
rfcgridreader.cmd	Used to convert NWS XMRG, NetCDF, and GRIB files into a native HEC-MetVue file format.
triangulatetin.cmd	Used to triangulate data contained in a text file with coordinates in longitude and latitude into an irregular TIN.
ProjectTinToGrid.cmd	A special purpose utility that is used to rotate and translate a TIN/grid and project it onto an output grid with a 0.1 degree lon/lat grid in an ASCII file format.

2.4 Uninstalling or Reinstalling the Program

In addition to the install directory where HEC-MetVue was originally installed, additional information used by the program such as window placement, recent project files, and activated/deactivated plugins is kept in a separate location. By default, on Windows platforms the location of that information is in a subdirectory of the folder defined by the APPDATA environment variable. A new folder under that directory will be created with a name similar to `'HEC/HEC-MetVue/3.0.20.7'` depending on the version of the program installed. The location of the cache files is defined in the `metvue.conf` file and can be overridden using optional command line arguments.

In order to completely uninstall or reinstall HEC-MetVue so that it does not have any of the previous settings it is necessary to remove the files from both the installation directory and the program cache location. The following is the procedure to follow to insure a complete removal of HEC-MetVue:

1. While in the HEC-MetVue program, make note of the location of the cache location currently being used. This can be found using the menu option Help->About to display the program information. There will be two entries similar to the following in the dialog:

   ```
   User directory: C:\Users\...\AppData\Roaming\HEC\HEC-MetVue\3.0.20.7\user
   Cache directory: C:\Users\...\AppData\Roaming\HEC\HEC-MetVue\3.0.20.7\cache
   ```

   If the program has become corrupted and cannot be started successfully, the cache directory is also specified in the `metvue.conf` file. For example, the corresponding entries in the configuration file are similar to this:

```
default_userdir="${HOME}/HEC/HEC-MetVue/3.0.20.7/user"
default_cachedir="${HOME}/HEC/HEC-MetVue/3.0.20.7/cache"
```

The `${HOME}` is a placeholder for the APPDATA environment variable in Windows.

2. Exit the program.
3. Delete the root cache directory from above which contains the user and cache data. In this case the root cache directory is `C:\Users\...\AppData\Roaming\HEC\HEC-MetVue\3.0.20.7`. Note: Window layouts and most recently used project files are kept in the 'user' directory. Depending on the cause of the corruption it may be possible to leave this directory and only delete the 'cache' directory. If, after attempting this and reinstalling the problem persists, both the 'cache' and 'user' directories must be deleted.
4. Keep any modification that may have been made to the `metvue.conf` so that they can be re-added once the program is re-installed.
5. Delete the HEC-MetVue install directory.
6. Unzip the original install file and make any necessary edit changes to the `metvue.conf` file.
7. Restart the program and enable/disable any desired plugins. Reconfigure the layout as desired.

2.5 Configuring and Running the Program

Normally running HEC-MetVue is as simple as either navigating to the '`<install directory>/metvue/bin`' folder and selecting `metvue.exe` or creating a shortcut to it. However, HEC-MetVue has several options that can be specified through a variety of command line options, Java properties, and configuration file settings that can more precisely control the HEC-MetVue startup and running environment.

As stated earlier, the executable `<install directory>/metvue/bin/metvue.exe` starts the program and uses the information in the configuration file `<install directory>/metvue/etc/metvue.conf` along with any settings specified on the command line or shortcut to control the program.

```
# ${HOME} will be replaced by user home directory according to platform. For Windows this is from
# the environment variable APPDATA.

default_userdir="${HOME}/HEC/HEC-MetVue/3.0.20.7/user"
default_cachedir="${HOME}/HEC/HEC-MetVue/3.0.20.7/cache"

# options used by the launcher by default, can be overridden by explicit command line switches
default_options=" --branding metvue -J-Xms128m -J-Xmx3200m
    -J-Dcom.sun.media.jai.disableMediaLib=true -l=%t/metvue.%g.log,5 "

# for development purposes you may wish to append: -J-Dnetbeans.logger.console=true -J-ea

# default location of JDK/JRE, can be overridden by using --jdkhome <dir> switch
jdkhome=jre

# This deployment developed with Netbeans Platform NetBeans IDE 8.1 (Build 201510222201)
```

Figure 2 - metvue.conf file sample

Table 2 – metvue.conf file description

Entry	Purpose
`default_userdir`	This entry specifies the location to use to store settings related to the HEC-MetVue environment that are persisted between program invocations and not related directly to a specific HEC-MetVue project file. Window positioning and layouts are kept here as is a list of most recently used HEC-MetVue project files and plugin configuration information.
`default_cachedir`	Every running HEC-MetVue program instance requires a cache area while the program is running. More often than not, HEC-MetVue has enough flexibility to define adequate sessions and map panels so that a single running instance of the program is sufficient. If an attempt is made to start HEC-MetVue when it is already executing it will simply bring the existing instance of HEC-MetVue to the foreground if the same cache directory is specified. By using multiple settings for the cache directory (via a command line option) running multiple simultaneous instances of the program is possible. It is recommended that when doing so, a separate HEC-MetVue project file should be used for each running instance of the program.
`default_options`	This entry is where options for running the program can be specified permanently. Any command line options specified elsewhere will take precedence over the settings given here.
`Jdkhome`	This entry is the location of the Java Runtime Environment (JRE) to use for the program. HEC-MetVue is deployed with its own JRE but a different one can be specified here if necessary.

Executing HEC-MetVue with the '`-?`' option displays help for the program command line options. Executing HEC-MetVue with the '`–help`' option will display help for both the program launcher as well as the HEC-MetVue program itself. Doing so will display the following:

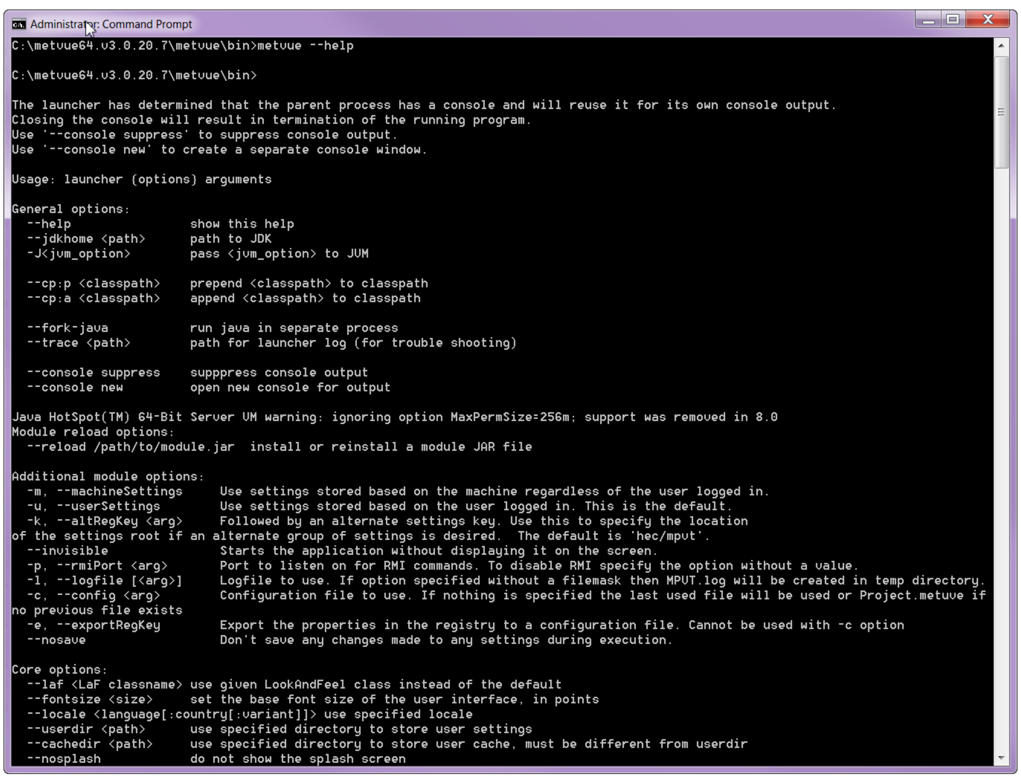


Figure 3 - HEC-MetVue command line help screen

In addition to specifying the options on the command line of the program, it is also possible to specify them in the HEC-MetVue configuration file. This file is located at <HEC-MetVue Install>\etc\metvue.conf. A small portion of the file is shown here:

```
default_options=" --branding metvue -J-Xms128m -J-Xmx3200m "
```

To add command line switches to the configuration file place them on the `default_options` line and within the quotes. For example to use the option to set the machine settings option the line would be modified to look as shown here:

```
default_options="--branding metvue -J-Xms128m -J-Xmx1024m –m "
```
[1]

2.6 Transitioning from HEC-MetVue 2.x Versions

HEC-MetVue version 3.x uses project files to store configuration information and most settings. HEC-MetVue version 2.x and earlier used the Windows registry to store all settings. When using the registry, the –m/--machineSettings, -u/--userSettings, and the –k/--altRegKey options could be used to point the program to different root registry keys and this could be used in a similar manner to using project files. Corporate security policies made the Windows registry a poor choice since many users could not use programs such as RegEdit and other standard Windows utilities to access it or use it to import and export settings.
In HEC-MetVue version 3.x, the aforementioned settings options are used to specify the location of an HEC-MetVue Version 2.x configuration to export to an HEC-MetVue v3.x project file. The options that are specified for the export affect the filename that is created to store the settings. Files are always exported to directory denoted by the USERPROFILE environment variable. For example:

-u: Creates a file named '`Project.metvue`'
-m: Creates a file named '`Project.AllUsers.metvue`'
-u –k hec/metvue/AltCfg: Creates a file named '`Project.hec_metvue_AltCfg.metvue`'
-m –k hec/metvue/AltCfg: Creates a file named '`Project.hec_metvue_AltCfg.AllUsers.metvue`'

If these settings options are repeatedly used, the project file will be recreated each time. If the project file already exists, it will be renamed before the registry settings are exported again. If this renaming occurs, a new file with the same name and the extension '`.orig`' will be created for the original project file. If this file already exists, a file with the extension '`.bak`' will be created or overwritten. Typically, the registry is exported once for some specified key and then never used again.

HEC-MetVue now supports a 'Most recently Used' Project file list that tracks the last ten project files that have been used. Normally, when the program is started, the last project file from the previous HEC-MetVue instance is reloaded. An alternate configuration file can be specified using the –c/--config option on the command line. If the specified file does not exist an empty one with the given name is created. Table 3 defines the result of various combinations of command line options and the project file used for startup.

[1] Options that begin with '–J' are used to configure the Java Virtual Machine (JVM). Other options are for the HEC-MetVue program.

Table 3 - Startup options that control poject file selection

Command options	MRU file list exists	Result
None	**no**	User settings from key hec/mpvt exported from registry to a new project file as specified above. If no registry settings exist a new empty project file is created.
None	**yes**	The last project file used is reloaded.
-u or –m with or without -k	**yes or no**	User settings exported from the Windows Registry to a new project file as specified above. If no registry settings exist a new empty project file is created.
-c projectFile	**yes**	The given project file is used.
-c projectFile	**no**	A new project file with the given name is created and added to the MRU file list.

Table 4 gives a synopsis of some of the command line options that are relevant to the HEC-MetVue startup. Some startup options are instructions for the Java Virtual Machine (JVM). Those options all start with a '-J' preceding the actual JVM option.

Table 4 - Command line options

Option	Purpose
-help	Give help for the Java Virtual Machine (JVM) options.
-?	Give help for the HEC-MetVue platform program options.
-m or --machineSettings	This option has been deprecated. Refer to Table 3 for an explanation of this option.
-u or –userSettings	This option has been deprecated. Refer to Table 3 for an explanation of this option.
-k or --altRegKey <arg>	This option has been deprecated. Refer to Table 3 for an explanation of this option.
--invisible	Starts the program without displaying it on the screen.
-p or --rmiPort <arg>	Listening port to establish for commands sent via the RMI protocol. To disable RMI, specify the option without a value. The default RMI port used by the program if no option is specified is 9196.
-J-Dlog.level=<value>	This Java option allows one to specify a logging value to help create information for problem resolution.
--nosave	Prevents any options or files that are modified during the execution of the program to be discarded when the program exits. This includes any new scale and palette definitions. This option was intended to aid in the transition from the legacy ViewRain program which never modified the startup settings.
-l or –logfile	Specifies one or more log files to use with the program. The default of `-l= %t/metvue.%g.log,5` creates up to 5 log files in the directory defined by the Windows TEMP environment variable.

-J-DenableAllPlugins	On first startup after HEC-MetVue is installed, it typically does not enable all the plugins that are in the zip file. Each plugin requires memory resources and can have significant impact on performance, especially when the option to filter and process TIN files based on time spans is used. Specifying this option will enable all the plugins that are deployed in the zip file. It is only valid the first time a new version of HEC-MetVue is executed after installation.
-c or –config	Specifies the project file to use on startup. For example: `–c=c:\myProjectFile.metvue`. Refer to Table 3 for more information on this option.

2.7 Managing Memory Allocation

The 64 bit program defaults to using up to 3200 MB of memory. This amount of memory is usually sufficient for even the most demanding applications of the program. The program has the ability to run an arbitrary number of sessions simultaneously with each session having an arbitrary number of map panels within it. In addition, very large datasets, typically radar grids that encompass several states may require significant resources. In general, the program will not cease but will give an out of memory error. After that happens, it is usually best to at least close the session or map window that was consuming the resources. In addition the program has a memory monitor available on the toolbar line available.

To adjust the memory used by the program edit the `<install directory>/etc/metvue.conf` and modify the `default_options` string -J-`Xmx3200m` and replace the 3200 with the number of MB's that the program is allowed to use.

The amount of usable memory depends on the operating system. A typical computer using 32 bit Microsoft Windows® or Linux® can usually use up to 1,350 Mb. Java running on Microsoft Windows 7/64 can utilize much more. These are general guidelines and your situation will depend on the specifics of your hardware and other processes that may be executing at the same time as the program.

Chapter 3

3. Overview

This chapter describes the basics of working with the program. It includes descriptions of the main parts of the program's graphical user interface.

3.1 Program Screen

The program screen contains a title bar, menu system, toolbar, and several panels. These panels include the Project Explorer window, Properties Panel, Session Panel (example shown below containing two tiled Map Panels), Legend Panel, and Output Panel as shown in Figure 4.

Figure 4 is an example of a panel layout. All panels can be moved around and docked to various places within the GUI by simply grabbing the portion of the panel with the small title bar and dragging that window to the desired location. As it is being dragged an outline will be shown to designate where that window would be placed if the left mouse button were to be released. If the window is dropped so that it shares a common location with another window, the two windows will be placed in the area with small tabs. Select the appropriate tab to bring the panel into the foreground.

In the view below, a single session panel is shown containing two map panels. More than one session panel can be open simultaneously. Session panels are somewhat special in that they cannot be dropped on locations with non-session panels like the other panels can. However, session panels can share the same screen area and be accessed via their tabs or they can be dragged and positioned in a tiled manner in relation to other session windows.

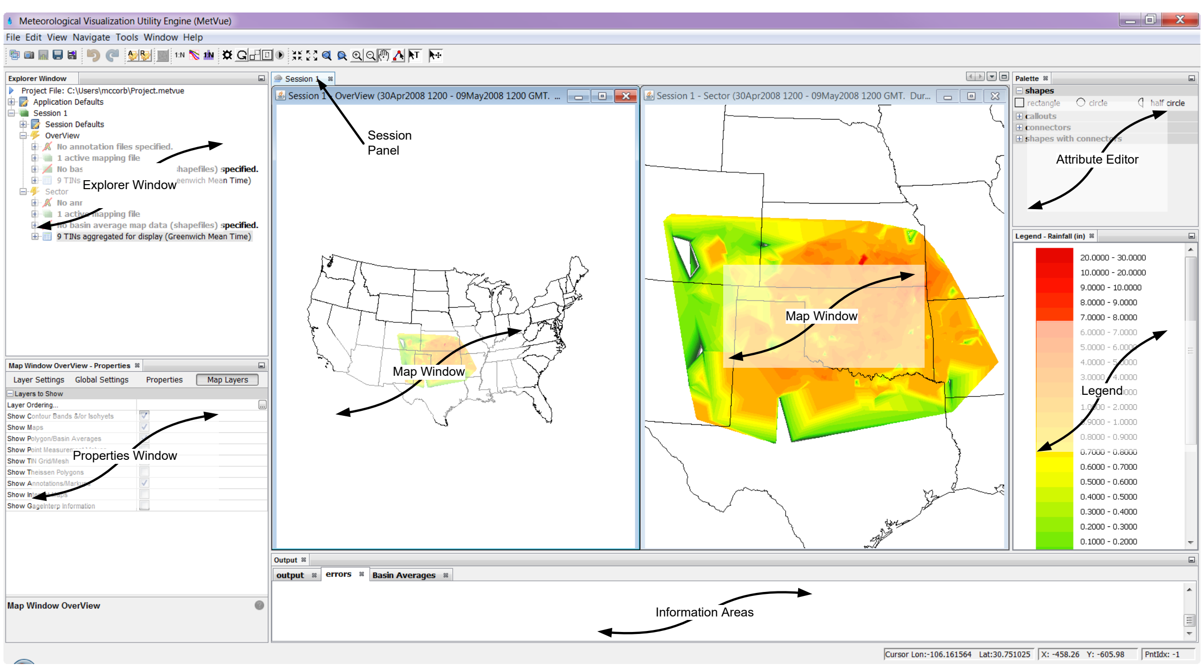


Figure 4 - Main program screen.

Map panels are always constrained to reside inside a session window and cannot be moved outside of it. In other words, session panels 'own' the map panels. When attempting to move a map panel window outside of a session panel, it is simply clipped at the extent of the session window.

There is no limit to the number of sessions that can be open at the same time. Likewise, each session can manage and display any number of map panels simultaneously. Figure 5 illustrates the map panel controls, while Table 5 provides a description of each feature.

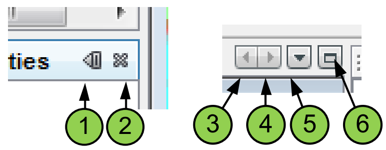


Figure 5 - Panel controls

Table 5 - Panel controls description

Item	Description
1	Panels having this symbol can be minimized to the GUI border area. The small arrow points in the direction of the border where the panel will be minimized
2	Close the panel. The Project Explorer window cannot be closed.
3	On the Session panel only. This button moves to the previous session.
4	On the Session panel only. This control moves to the next session.
5	On the Session panel only. This control opens a small menu that allows a session to be selected directly.
6	Maximize/restore a session.

Menu System

The menu system contains several menus to help navigate the program. Each menu contains a list of related commands. For example, the **Windows** menu contains a list of commands to control the display and positioning of various panels within the GUI. Items in an individual menu are inactive, cannot be selected, if the command cannot be carried out by the program at the current time.

Commands for managing the opened project are available from the **File** menu (Figure 6). **File** menu items and the resulting actions are provided in Table 6.

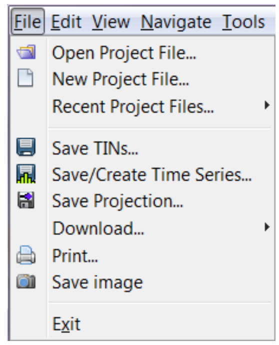


Figure 6 - File menu

Table 6 - Commands available from the File menu.

File Menu Commands	Action
Open Project File…	Used to open an existing project file. Project files are used to hold the settings for the various sessions and map panels.
New Project File…	Used to open a new project file. By default project files have a '.metvue' extension.
Recent Project Files…	Displays a submenu that contains up to 10 previously used project files.
Save TINs…	Displays a dialog that allows the saving of TINs that have been edited. The selection is context sensitive and tied to the currently selected map panel. If no map panel currently has the focus the menu item will be disabled.
Save/Create Time Series…	Displays a dialog that allows the saving of hyetographs based on the currently selected map panel. If no map panel currently has the focus the menu item will be disabled.
Save Projection…	Display a dialog where the desired storage location type (for example DSS or ASCII files) along with the projection grid can be defined.
Print…	Print the current map panel.
Save Image	Saves the image based on the settings in the Properties panel->Global settings->Image Settings section.
Exit	Exit the program.

The **Edit** menu (Figure 7) contains commands for cycling through the edit changes which have been made to the aggregate TIN in a particular map panel. The undo and redo commands are similar to the undo and redo actions in a word processing program. For example, if 20 unique editing changes have been made to an aggregate TIN and then **Undo Txn** has been used five times then it appears as though only the first 15 edits have been done. If a new edit is performed, it then becomes the 16th and final edit operation in the chain, replacing the older edit operations 16-20. **Edit** menu commands and the resulting actions are provided in Table 7.

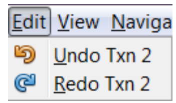


Figure 7 - Edit menu

Table 7 - Commands available from the Edit menu.

Edit Menu Commands	Action
Undo Txn#	Undo last edit change made on current map panel.
Redo Txn#	Redo last undone edit change on current map panel.

The **View** menu (Figure 8) contains a list of commands for various aspects of the of the user interface. A list of **View** menu items and the resulting actions are provided in Table 8.

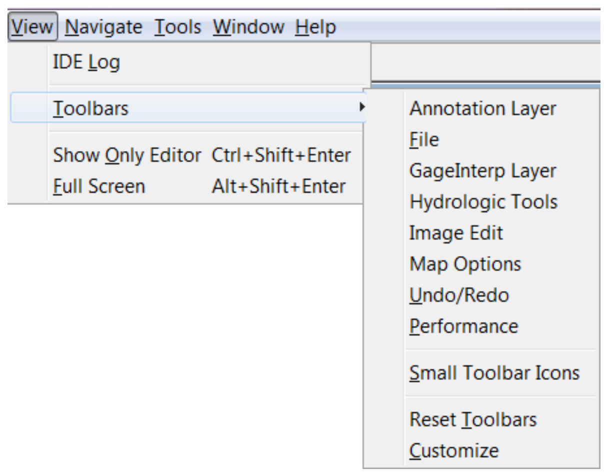


Figure 8 - View menu

Table 8 - Commands available from the View menu.

View Menu Commands	Action
IDE Log	Opens the IDE log. The IDE log contains information about the Java Environment along with information about certain exceptional conditions that may occur. Most all logged information and error messages appear in this log.
Toolbars	Contains a submenu with all the various toolbars that are available that can be displayed.
Show Only Editor	Hides all panels except for the tab container for the map panels.
Full Screen	Toggle showing the GUI in full screen, giving the maximum amount of screen area by removing the outer sizing border and the title bar.

The **Tools** menu (Figure 9) contains various data analysis and computational tools available. It also provides access to the program plugin interface.

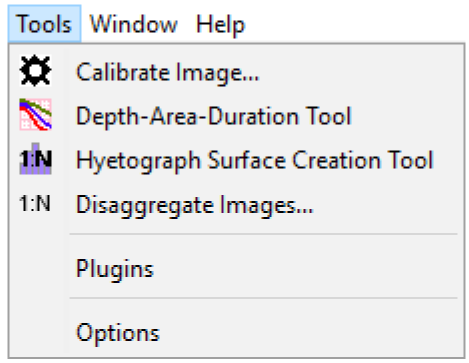


Figure 9 - Tools menu

Table 9 - Commands available from the Tools menu.

Tools Menu Commands	Action
Calibrate Image…	Used to open the *Calibrate Image* editor. This selection will be disabled if no map panel has the focus.
Depth-Area-Duration Tool	Used to open the 'Depth-Area-Duration' analysis tool. This selection will be disabled if no map panel has the focus.
Hyetographs Surface Creation Tool	Used to take an aggregate TIN or a series of TINs with relatively long timespans and convert it/them to a series of disaggregated TINs that respect the temporal distribution of a given set of hyetographs or a defined temporal pattern. This selection will be disabled if no map panel has the focus.
Disaggregate Images…	A special tool used only in conjunction with the HMR52 plugin. This tool is used to change a composite HMR52 elliptical TIN into series of individual TINs.
Plugins	This command displays the plugin editor which allows the enabling and disabling of various I/O and storm analysis plugins in the program.
Options…	Opens a settings manager that controls various global aspects of the program such as hot key selection.

The **Window** menu (Figure 10) contains a list of the windows in the user interface that can be displayed. In addition, actions to set the view on the current map panel are provided.

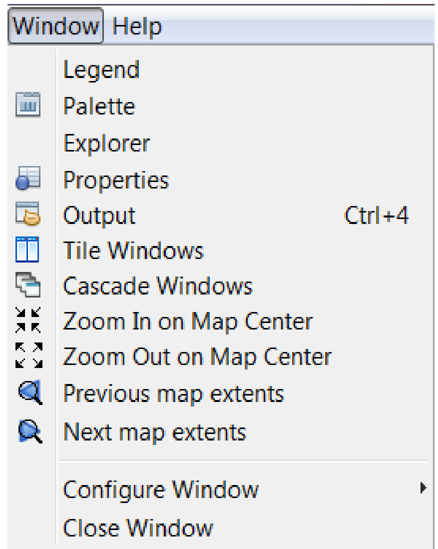


Figure 10 - Window menu

Table 10 - Commands available from the Window menu

Window Menu Commands	Action
Legend	Opens the legend panel or brings it to the foreground if it is hidden by another panel.
Explorer	Opens the Project Explorer window or brings it to the foreground if it is hidden by another panel.
Palette	Opens the palette control for doing annotation editing.
Properties	Opens the properties panel or brings it to the foreground if it is hidden by another panel. Note that this panel may not be opened when the program first starts. Its use is essential.
Output	Show the output window. This window contains multiple tabs for various types of output.
Tile Windows	Tile the map panels within a session window.
Cascade Windows	Cascade the map panels within a session window.
Zoom In on Map Center	Performs a fixed zoom in of the currently selected map panel keeping approximately 50% of the area original image. This option is a more convenient than selecting the zoom tool especially for systems without a mouse wheel to zoom with.
Zoom Out on Map Center	Performs a fixed zoom out on the currently selected map panel approximately doubling the area of the original image. This option is a more convenient than selecting the zoom tool especially for systems without a mouse wheel to zoom with.
Previous Map Extents	The program keeps a list of views that have been used for a map panel. Selecting this sets the view to the previous extents by iterating through the list of views. Selecting this action when positioned on the first view will simply loop back around to the last view in the list.

Next Map Extents	The program keeps a list of views that have been used for a map panel. Selecting this sets the view to the next extents by iterating through the list of views. Selecting this action when positioned on the last view will simply loop back around to the first view in the list.
Configure Window	Brings up a submenu that controls docking/undocking of the various top level windows.
Close Window	Close the current session.

The Help menu can be used to view various information about the program as described in Table 11.

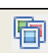
Table 11 - Commands available from the Help menu

Help Menu Commands	Action
About	Shows the program information including the program version, Java version and user directory where the framework keeps some information about which windows are docked/undocked.

Toolbar

Like the menu system, the toolbar groups tools with similar uses. Also, tools are inactive if the resulting action for the tool cannot be carried out by the program. Table 12 contains a description of tools on the toolbar.

Table 12 - Description of the tools in the toolbar

Tool		Action
File		
		Select this tool to create animation loops of the data.
		Take a snapshot of the active session. Picture settings can be specified in the Properties->Global Settings->Image Settings section.
		Used to create basin average time series for the active map panel and associated polygon shapefiles.
		Save the edited TIN dataset. Use this tool to save the aggregate TIN as well as apply edit changes made to the original TIN datasets that created the aggregate. Note that if a gridded TIN has been rotated or translated, it may no longer be a grid in the strictest sense and has limited options for saving. This is also a convenient way to save a set of TINs in a different format. For example, if an HRAP grid was originally read from a NetCDF file, this tool can be used to store them in a DSS file.

	Save current set of TINs by projecting them onto a new grid. This option is useful if a TIN has been rotated or translated. It is also useful for creating a grid in a different projection. The new grid measurements are computed by sampling the original TINs at the location of the new grid cell center points. The sampling method is more appropriate for situations where the new grid has an equal or higher density than the original TINs. If the grid density is less than the original TINs then using an average over area technique for each of the grid cells in the new grid may be a better alternative. HEC-MetVue does not currently provide average over area or 'nearest neighbor' grid projection options.

Undo/Redo

	Undo an edit.
	Redo an undone edit.

Annotations

	Turn on absolute annotation edit mode. This is used to add callouts to the map panel that stay fixed with respect to the map panel
	Turn on relative annotation edit mode. This is used to add callouts to the map panel that stay fixed to a geographic location regardless of its location within a panel.

Map Options

	Performs a fixed zoom in of the currently selected map panel keeping approximately 50% of the area original image. This option is a more convenient than selecting the zoom tool especially for systems without a mouse wheel to zoom with.
	Performs a fixed zoom out on the currently selected map panel approximately doubling the area of the original image. This option is a more convenient than selecting the zoom tool especially for systems without a mouse wheel to zoom with.
	The program keeps a list of views that have been used for a map panel. Selecting this sets the view to the previous extents by iterating through the list of views. Selecting this action when positioned on the first view will simply loop back around to the last view in the list.
	The program keeps a list of views that have been used for a map panel. Selecting this sets the view to the next extents by iterating through the list of views. Selecting this action when positioned on the last view will simply loop back around to the first view in the list.
	Sets the left mouse button action to zoom in/magnify the map view. Once selected press and hold the mouse button on the selected map panel and drag the mouse to create a box. When the box covers the desired spatial extents release the mouse button. The portion of the map that was contained within the box will be expanded to the entire map panel. The use of the mouse wheel may be preferred to using this tool.
	Sets the left mouse button action to zoom out the map view. Once selected press and hold the mouse button on the selected map panel and drag the mouse to create a box. Once the button is released the current view in the map panel is 'squeezed' into the box selection. The use of the mouse wheel may be preferred to using this tool.

	Left mouse button pan in the map view.
	Left mouse button selects points on the map for defining an area. An area can be created by pressing the left mouse button at the desired point locations or by holding the left mouse button and dragging the mouse. Once an area is created a right click on the map panel will close the polygon and bring up a context menu with the item 'Ad-Hoc Polygon Operations'. This menu item has several submenu items, such as 'Compute Average', which can operate on the polygon created. While editing the polygon the backspace key can be used to remove the last added point. The escape key will clear the entire polygon. Any change to the map panel view such as zooming or panning also clears the polygon.
	On/off toggle controls the location information tracking on status bar. The Properties->Global Settings has a setting for toggling the Longitude/Latitude display from DMS to decimal degrees.
	On/off toggle to mimic the cursor location in other map panels in the same session. This tool is useful to help inspect multiple TINs for the same geographic location.

Image edit

1:N	Convert a composite TIN (multiple timespans) into multiple TINs. Some tools, such as the HMR52 plugin uses a composite TIN storage medium. This tool can be used to decompose the TIN information into multiple TIN files, one for each time span, so that the data can be used without the need for the plugin to act as an I/O provider. This selection will be disabled if no map panel has the focus.
	Opens the Depth-Area-Duration tool which can use the set of TINs for the active map panel to compute depth-area-duration data. This selection will be disabled if no map panel has the focus.
	Used to take an aggregate TIN or a series of TINs with relatively long timespans and convert it to a series of disaggregated TINs that respect the temporal distribution of a given set of hyetographs or a defined temporal pattern. This selection will be disabled if no map panel has the focus.
	Opens the Calibrate Image Editor. This selection will be disabled if no map panel has the focus.
	This tool activates the HMR52 storm analysis tool. The HMR52 plugin must be activated for this tool to be displayed. When the tool is in use, re-computes based on location changes can be enabled or disabled using the adjacent tool .
	Left mouse button rotates dataset. Once selected, pressing and holding the left mouse button on a map panel while moving the mouse will rotate the TIN. Currently the TIN is always rotated about the center point of the map panel. Also, while still holding the left mouse button, if the right mouse button is also pressed it temporarily activates the translate tool so that rotate and translate actions can be combined.
	Left mouse button scales dataset.
	Left mouse button translates dataset to a new position. Once selected, pressing and holding the left mouse button on a map panel while moving the mouse will move the TIN to the new mouse location. Also, while still holding the left mouse button, if the right mouse button is also pressed, it temporarily activates the rotation tool so that rotate and translate actions can be combined.

	Expand rotate/translate/scale tool to show controls for specifying values numerically. When expanded, this toolbar is shown to control the TIN placement. Rotation units are in degrees. X and Y translation units are dependent on the map projection units currently being used. For example, if the display units are miles then a translate X value of 10 will move the TIN 10 miles. As the values are changed in the control it show the new TIN position similar to what happens when the mouse is used. The new TIN position is not recorded until the 'Apply Transform' button is pressed. This is analogous to releasing the left mouse button when doing special edits with the mouse. 
	Collapse rotate/translate/scale tool.
	Expand tool showing total resultant rotation/translation/scaling that has occurred. This shows the accumulated amount of rotation/translation/scaling that has taken place.
	Collapse tool showing total resultant rotation/translation/scaling that has occurred.

Project Explorer

The Project Explorer was designed to provide quick access to many settings of the program, session and individual map components within the program. As stated earlier, a project can have many simultaneous sessions open with its descendant map panels. It is this hierarchical relationship of the program having many sessions and each of the sessions having possibly more than one map panel that lends itself well to the Project Explorer window. The Project Explorer window can be a convenient way to navigate and establish settings for the various components.

The Project Explorer shows the relation between each of the individual components in the program as a set of descendant properties and objects. Typically, it is necessary to have a **Properties** panel open in conjunction with the Project Explorer window as both are almost always needed. A sample Project Explorer is shown in Figure 11.

The top level node shows the name of the Project File being used. Following the Project node, there are 'Project Defaults'. These are items such as definitions of annotation files, shapefiles, basin average files, and TIN dataset definitions. When a new session is created it inherits settings from the Project Defaults.

Once a session (for example 'Session 1' shown below) is created, a set of 'Session Defaults' settings are created. Notice that some of the node descriptions in the figure below are in normal text, some are in bold text and some are grayed out. The nodes containing items that can be changed, such as the session default of '**1 active basin average file'** is bold because it was set on that session. Had the default setting been inherited from the project defaults, the default settings would have been in a normal font. Likewise, notice for the map panel 'Sector', the '1 active mapping file' node is in normal font because it is using an inherited setting from the session. The '2 **active mapping files**' on the 'Overview' map panel is in a bold font because it was set on that specific map panel and not inherited from the session settings. Also, the 'Adjusted' map panel is grayed out because it is closed. Closed sessions and map panels consume minimal amounts of memory, so avoid having too many of them open at the same time.

This inheritance model has many advantages. Not only do the inherited settings get assigned when the new Settings or Map panel is created, but they continue to use the inherited settings until overridden or customized with their own unique settings. For example, if you want to have a session with three map panels displaying a single rainfall event over three different geographic areas and do this repeatedly over the course of a week. The rainfall event could be defined once at the session level and then each map panel would create a list of different maps showing the area of concern. If you want to view a different storm over the same three areas, the definition of the storm would only have to be changed once at the session level to affect all three map panels.

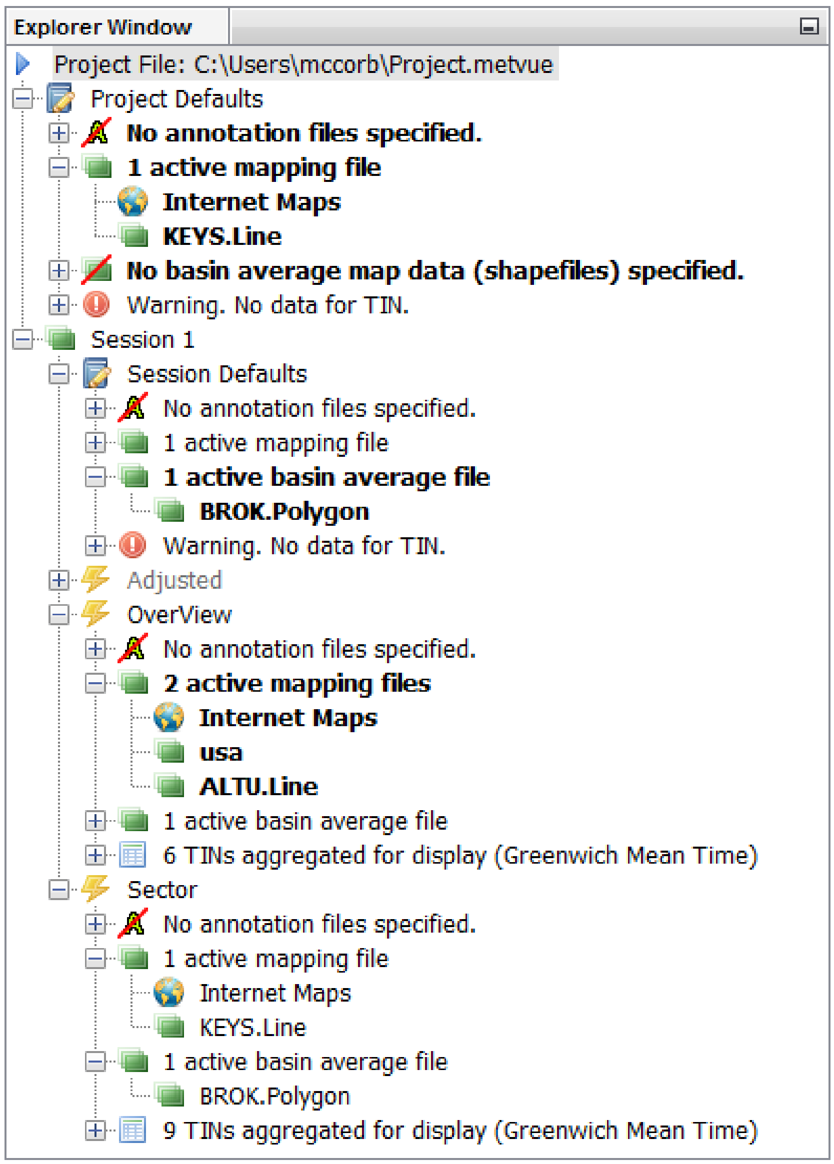


Figure 11 - HEC-MetVue Project Explorer

Properties Editor

The Properties Editor panel (Figure 12) holds most of the configurable settings for the Program, Session, and Map panels. The Property Editor window displays settings based on the last significant context that was selected. The significant context is either a selected item in the Project Explorer or a Map Panel. For example, to make settings adjustments to a Map, select it in the Project Explorer or click on the map panel directly. Table 13 provides a list of Properties items and their descriptions.

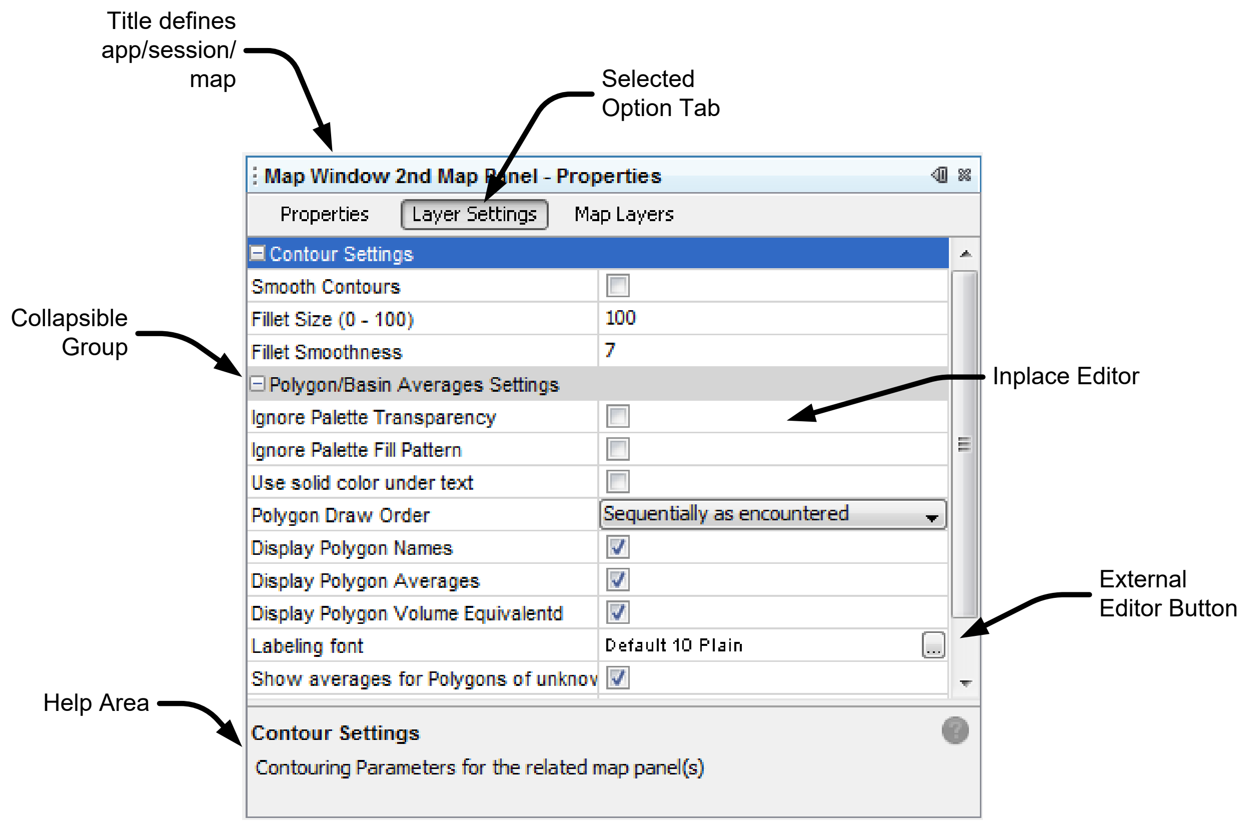


Figure 12 - Sample Properties editor panel

Table 13 - Properties editor panel description

Item	Description
Title	The title area gives feedback that relates which part of the program the properties window is displaying the settings for.
Option Tabs	Directly under the title there can be one or more options tables to select the category of option to work on. In the figure above there are 3 categories for the given map panel.
Group	Within a category, there can be multiple groups. Clicking on the +/- will expand or hide the group.

In place Editor	These items can be changed without bringing up an external editor. Typically, they are text fields, check boxes, or dropdown lists. Usually, the effect on the map panels when making property change(s) is immediate.
External Editor	Used when there is simply too much information to input or an existing control that can be used to help make the selection.
Help Area	Provides help about the selected property.

Output Panel

The Output Panel (Figure 13) typically contains one or more tabs with textual information. Currently, there are four tabs that the program uses. The *output* and *error* tabs are used to capture output that would normally be written to the console. The *Basin Averages* tab display output from any basin average computations that may occur. The IDE log tab, usually not shown until selected using the menu `View->IDE Log,` displays the messages that are logged by the program. Over time, more information has been migrated to the IDE Log tab with the intent of eventually removing the Output and Error tabs from the program.

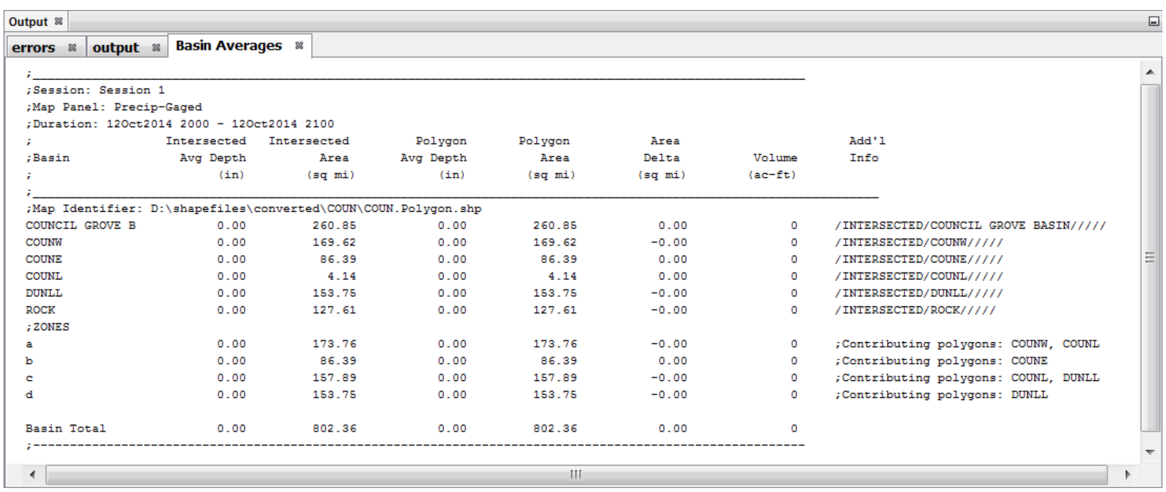


Figure 13 - Sample Output panel

Legend Panel

The Legend Panel (Figure 14) displays the legend of the active map panel. Currently, it is concerned solely with the magnitudes of the measurement portion of the TIN datasets. Like the other panels, it can be docked nearly anywhere in the program panel or left undocked. There are no options or interaction with the Legend Panel other than to change its size and placement. Its layout will change to best accommodate the shape that it is given.

Figure 14 - Legend panel

Chapter 4

4. Program Global Objects and Settings

Program global objects are objects that are used globally by all other entities in the program. A fixed set of program global objects are available from which to select for a session or a map window. An example of this would be the contour color palettes that have been defined. Multiple color palettes can be defined. Any session or map window can then select to use one of them. The following are examples of global object sets:

- Contour/measurement color palettes
- Scale definitions
- Map display attribute sets

Program settings are simply the default settings that a session or map panel inherits until it defines its own.

4.1 Global Program Objects

Contour Color Palettes

Contour palettes are used to define the colors used to display the measurement data contained within the TINs and Grids. The contour color palettes are used for contouring Thiessen polygons, basin/polygon averages, and measurement labeling.

Scale Definitions

Scales are the numerical breakpoint definitions that are used when determining how to break the measurement data into discrete values that can then be applied to and associated with a color palette. The scales and the contour palettes are independent of each other but closely related.

Map Attributes

Map attributes are how the program associates map data from shapefiles with how they are to be displayed. For example, an attribute set can be defined that has major basin outlines defined as a dark green line with double width, and a snowmelt gage to be represented by an 'x' symbol with a blue label applied for the gage name[2].

[2] Note that there is more than one way to associate a map attribute with a shapefile and this program supports some extensions to take advantage of additional data in the shapefile's .dbf file if it is present.

4.2 Contour Palettes

Accessing the Palette Editor

The Palette Editor (Figure 16) can be accessed by selecting it from the Properties editor panel on the Global Settings tab when Project, Session, Map Panel nodes or an actual map panel is selected (Figure 15).

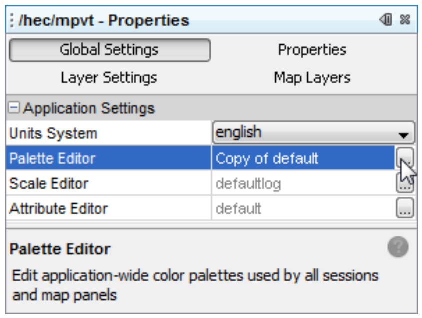


Figure 15 - Edit palettes option

Using the Palette Editor

When the program is installed, at least one contour color palette is provided and it becomes the default selection until more palettes are created[3].

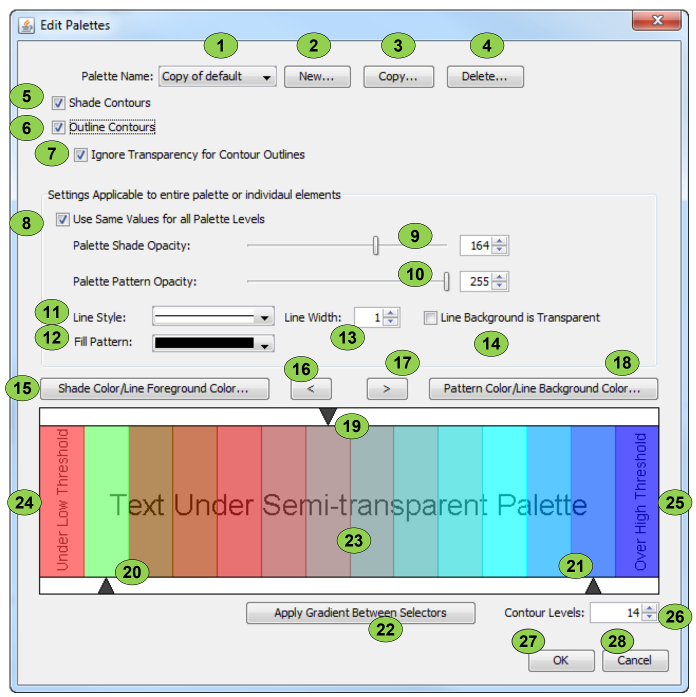


Figure 16 - Palettes editor

[3] Palettes are fairly easy to create. However, creating Palettes can take time and effort. If the same palette sets are needed on multiple machines, it may be worthwhile to copy the Palettes entries in an existing HEC-MetVue project file into another HEC-MetVue Project file.

Table 14 provides a description for the Palettes editor features.

Table 14 - Palettes editor description

Item	Description
1	Selects the palette to edit
2	Pressing this button creates a new palette. It will create a minimal palette with the given name that can be further modified to fit the need. When the button is pressed, the dialog shown in Figure 17 is displayed.
3	Copies an existing palette. This is a convenient way to create variations of the same palette to make editing more efficient. For example if one wanted to have their favorite palette but make it semi-transparent instead of opaque, this option makes it easy and quick. When the button is pressed, the dialog shown in Figure 17 is displayed.
4	Delete the selected palette. A confirmation dialog is given to give a chance to cancel as shown in Figure 18.
5	Contours can be shaded or drawn as lines or both. Note that for any contour interval the shade color and the line color must be the same although a combination of patterns and line styles with `background and foreground colors can be used to get additional effects.
6	Outline contours. This draws lines at the intervals defined by the selected scale.
7	Often, it is desirable to draw the contours shaded and then draw the lines opaque. However, when not shading, drawing the lines thick and semi-transparent[4] maybe more desirable.
8	Most of the time, it is desirable to have a consistent palette, such as all contour lines drawn to the same width and all shaded contours with the same amount of opacity. If this option is selected, all palette levels can be edited simultaneously (shade opacity, pattern opacity, line style, line width, line background, and fill pattern)
9	Sets the shade opacity level for the palette level selected, or all levels if item 8 is selected. It can be set by using either the slider or the spinner.
10	Sets the shade opacity level for the fill pattern if a fill pattern is selected. Again this is affected by item 8 similar to the shade. It can be set by using either the slider or the spinner.
11	Selects the line style to use for the contour level or levels as determined by the selection of item 8
12	The fill pattern to use for the palette level or levels as determined by the selection of item 8. If the fill pattern is solid, the pattern color is ignored.
13	The width of the palette line or lines as determined by the selection of item 8.
14	Lines can be drawn solid or with a line pattern such as a dashed or dotted line. If drawn with a pattern then the spaces in between the dashes or dots can be left 'empty' or drawn with the color defined as the pattern/line background color. Again, item 8 influences how this is applied to the palette.

[4] Drawing using semi-transparent shading and lines is processor intensive. Expect semitransparent objects to take approximately twice as long to draw as opaque objects.

15	Selecting this displays a color selector dialog to pick the desired color for the level. The color it is operating on is selected using the selector denoted by item 19.
16	Moves the currently selected color one position to the left. The palette item to move is selected using the selector denoted by item 19.
17	Moves the currently selected color one position to the right. The palette item to move is selected using the selector denoted by item 19
18	Selecting this brings up a color selector dialog to pick the color for the pattern &/or background color of a line. The color it is operating on is selected using the selector denoted by item 19.
19	Used to pick the palette item to operate on. To move it, press the left mouse button on it and drag. When the mouse is released, it will 'pop' to the closest level.
20	Sets the lower range selector. It operates similar to the palette item selector. It is used to set the lower range when the gradient pushbutton is used.
21	Sets the upper range selector. It operates similar to the palette item selector. It is used to set the upper range when the gradient pushbutton is used.
22	Applies a gradient between selectors. It can make it very simple to create palettes where the item colors change a small amount between levels. The gradient is applied to colors of all patterns, lines, and backgrounds. The transparency/opacity between the selected levels is also incrementally adjusted if it is different between the lower and upper selector.
23	This field is a sample of the palette. Levels can be added or removed by right clicking on one of the levels to delete it or add a new one to the right. Text is displayed under the palette in order to give an indication of how the transparency will display on the map panels.
24	The lowest palette level is not used for contouring. It is used to draw objects that need to be displayed under the low threshold scale value. For example, on a map that displays contours and basin averages, when using a linear scale that starts contouring at ½" the basin averages that are less than ½" will be displayed using this palette level.
25	The highest palette level is not used for contouring. It is used to draw objects that need to be displayed over the high threshold scale value. For example, on a map that displays contours and basin averages, when using a linear scale that stops contouring at 3" the basin averages that are more than 3" will be displayed using this palette level.
26	A quick way to add or remove palette levels. New levels are added to the right of the palette selector location.
27	Save all changes and new palettes.
28	Cancel all changes made. Note that if a palette is added and then a second one and then Cancel, neither palette is saved.

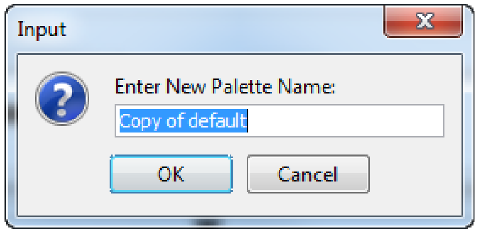


Figure 17 - Dialog used to create and copy palettes

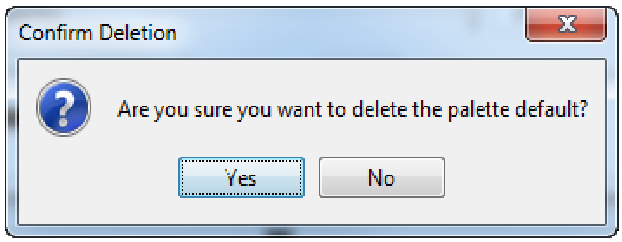


Figure 18 - Delete palette confirmation

A Word on Semi Transparent Palettes

Drawing using semi-transparent shading, lines, and other objects is processor intensive. Expect semitransparent objects to take approximately twice as long to draw as opaque objects.

However, using transparency can actually speed workflow. For example, without transparency it may be necessary to draw the contour layer first and then map objects following in order to prevent the contours from obscuring the map data. When zooming and panning with opaque objects, one must wait until the contours are drawn and the map layers update before determining whether or not the desired view is attained. Now, with the semi-transparent palettes, the map layer can be drawn first and then the contours making zooming and panning to the desired geographic position much more efficient.

Semitransparent palettes can also be used create some more interesting ways to represent data. For example, suppose that one wants to display a dataset representing turbidity or humidity or cloud cover. The colors of the color palette could be left the same color and the transparency amount varied to give the desired effect of a scale that goes from clear to hazy.

4.3 Scales

Scales are used in conjunction with contour palettes to render contour map layers in HEC-MetVue. When the program is installed, it provides at least one linear and one logarithmic scale. This linear scale becomes the default selection until a different scale is selected.

The Scale Editor can be accessed by selecting it from the Properties editor panel (Figure 19) on the Global Settings tab when Project, Session, Map Panel nodes or an actual map panel is selected.

There are three different types of scales that can be defined.

- Linear scale. This scale has a lower threshold, an interval and an upper threshold.
- Logarithmic scale. This scale has a lower threshold, a number of divisions per cycle, and an upper threshold.
- Custom or user defined scales. This scale can be used to define a special scale, such as a probability or exponential scale. The values must be in ascending order. The program will auto-sort them to assure this is the case. The first value entered sets the lower threshold. The last item sets the upper threshold.

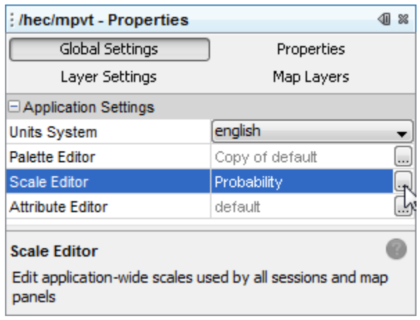


Figure 19 - Edit scales option

Liner Scale Editor

Linear scales are as the name implies. Every increment between the various levels is the same. Many times the lower threshold is the same as the contour increment but does not have to be. Figure 20 and illustrates the linear scales definition panel, while Table 15 provides a description of each feature.

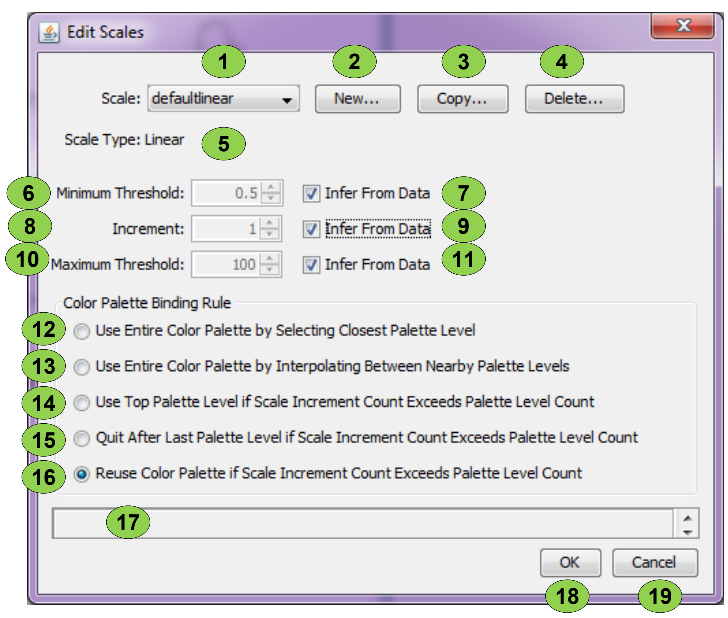


Figure 20 - Linear scales definition panel

Table 15 - Linear scales definition panel description

Item	Description
1	Pick list to select the scale to operate on.
2	Create a new scale. The dialog in Figure 23 will be displayed to complete the addition.
3	Copy the scale shown. The dialog in Figure 24 will be displayed to complete the addition.
4	Delete the scale shown. The dialog in Figure 25 will be shown to confirm the deletion.
5	Indicator shows what type of scale is being displayed. Once a scale is established, its type cannot be changed.
6	Sets the minimum threshold to show from the measurement data. Note that the basin/polygon averages layer will display anything below this threshold in lowest palette level.
7	If selected, the program will attempt to determine the lower threshold based on the range of measurements in the dataset. If not selected the value in 6 will be used.
8	The contour increment to use when displaying the measurement data.
9	If selected the program will attempt to determine an appropriate contour increment for the range of measurements in the dataset. If not selected the value in 8 will be used.
10	Sets the maximum threshold to show from the measurement data. Note that the basin/polygon averages layer will display anything above this threshold in highest palette level.
11	If selected the program will attempt to determine the upper threshold based on the range of measurements in the dataset. If not selected, the value in 10 will be used.
12	Selecting this will use the entire range of the color palette but will use only the colors that appear on the palette. For example, if the scale has 10 divisions representing values from 1-10 and the palette has 20 color values, then color 1 would be used for values from 1.0-2.0, color 3 would be used for level 2.0-3.0, and so on.
13	Selecting this is similar to 12 but the color palette is considered a spectrum and colors are derived by taking a proportional color mix using the palette colors adjacent to the scale value when the scale is 'stretched' to match the palette.
14	If there are more scale values needed for the measurement data than the number of palette levels defined and this is checked, then the last palette item used for contouring will be used for all measurements values exceeding the number of palette items. For example, suppose a scale was designed with a min/increment/max of 0.1/0.1/1.0 respectively giving nine levels to segregate the data into. If there were only 4 contouring palette levels defined for the palette, they would be applied to the first four scale values (0.1 – 0.2), (0.2 – 0.3), (0.3 – 0.4), and (0.4 – 0.5). Any measurement data that extended from (0.5 – 1.0) would use the same palette level as (0.4 – 0.5).
15	If there are more scale values needed for the measurement data than the number of palette levels defined and this is checked, then the last palette item used for contouring will be used for all measurements values exceeding the number of palette items. For example, suppose a scale was designed with a min/increment/max of 0.1/0.1/1.0 respectively giving nine

levels to segregate the data into. If there were only four contouring palette levels defined for the palette they would be applied to the first four scale values (0.1 – 0.2), (0.2 – 0.3), (0.3 – 0.4), and (0.4 – 0.5). Any measurement data that extended from (0.5 – 1.0) would be ignored regardless of the fact the scale extends to 1.0

16 If more scale values are needed for the measurement data than the number of palette levels defined and this is checked, then the palette items used for contouring will be reused until all measurement data is displayed up to the top of the scale. For example, suppose a scale was designed with a min/increment/max of 0.1/0.1/1.0 respectively giving nine levels to segregate the data into. If there were only 4 contouring palette levels defined for the palette, they would be applied to the first 4 scale values (0.1 – 0.2), (0.2 – 0.3), (0.3 – 0.4), and (0.4 – 0.5). After that the measurement (0.5 – 0.6) would reuse the first palette level, (0.6 – 0.7) would use the second, and so on.

17 This field shows any inconsistencies in the scale that is being defined.

18 Accept changes to the scales being defined.

19 Discard any changes to scales that were made.

Logarithmic Scale Editor

Logarithmic scales are as the name implies. Increments between the levels are based on a log10 scale. Measurement data with negative values or zero values cannot be displayed with a log scale. Log scales can only display the portion of the measurement data that is greater than zero. Figure 21 and Table 16 discuss only the differences between the linear and log scales.

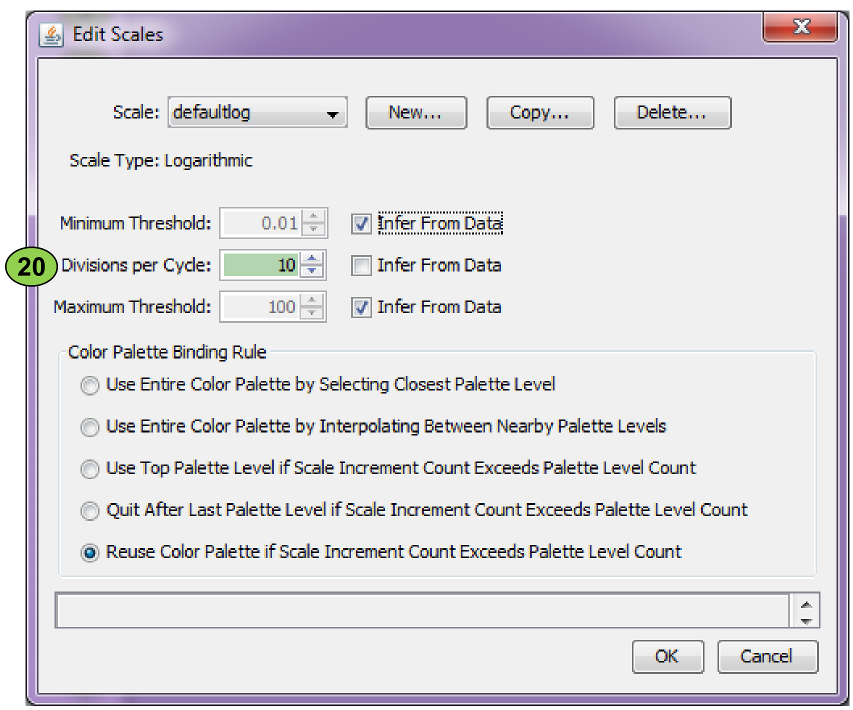


Figure 21 - Logarithmic scales definition panel

Table 16 - Logarithmic scales definition panel description

Item	Description
20	Sets the number of divisions between log cycles. For example, for a log scale that extended from .01 to 10 (3 log cycles) with the number of divisions set to 5, the scale would have a total of 15 discrete scale ranges.

Custom Scale Editor

HEC-MetVue cannot always predict the special scaling needs that some uses may require. For example, probability, exponential and irregular interval scales are examples of the type of scales that can be defined with this editor. So for example, if a probability scale was defined and the value 50 was accidentally left out, it can either be inserted into the correct location or simply added to the end of the list. Figure 22 illustrates the custom scale definition panel while Table 17 describes its features.

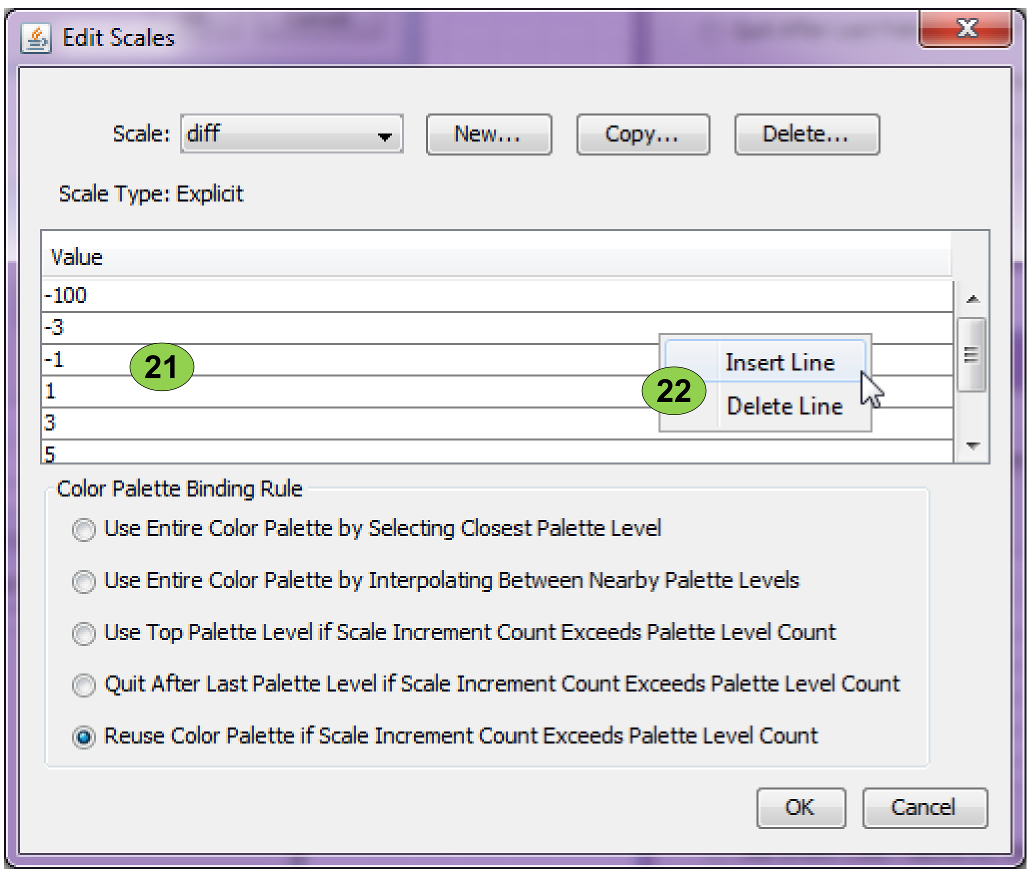


Figure 22 - Custom scale definition panel

Table 17 - Custom scale definition panel

Item	Description
21	The scale values should be in ascending order. If they are not, the program will sort them into an ascending series.
22	Context menu that can be used to delete the current selection or to insert a new value below the current line.

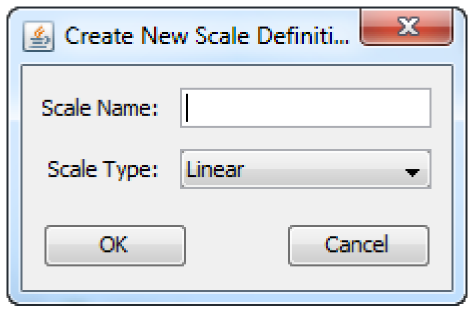


Figure 23 - Dialog used to create a new scale

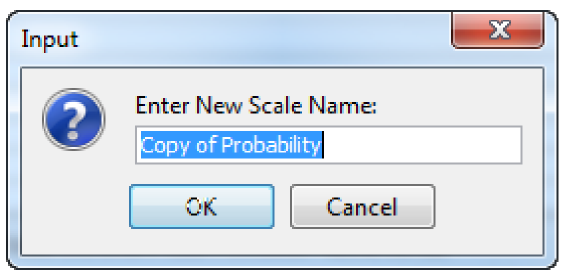


Figure 24 - Dialog used to copy and existing scale

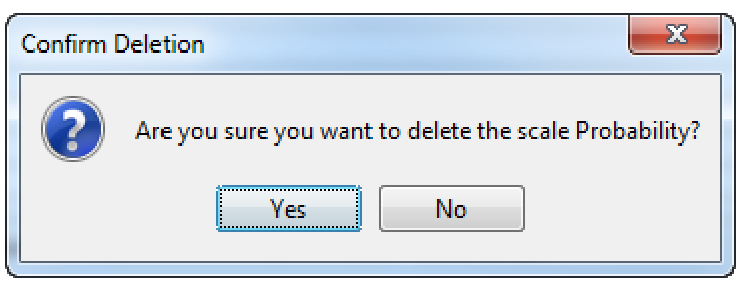


Figure 25 - Scale delete confirmation

4.4 Attribute Sets

Attributes are used to customize the display of map objects such as county lines and state lines. The Attribute Editor used to define these attributes. There are multiple options to attach these attributes to the appropriate shapefile objects. Refer to the sections on selecting map objects for more on this.

Defining Global Attributes

The Attribute Editor can be accessed by selecting it from the Properties editor panel on the Global Settings tab when Project, Session, Map Panel nodes, or an actual map panel is selected.

The editor shown in Figure 26 is used to define attributes that are defined as line or polygon data. The dialog shown in Figure 27 is used to define point values that optionally have labels defined. Items 1-10 and 26 -30 are applicable to all three attribute types.

Table 18 describes the attributes for all three attribute types. Certain elements apply to either the line/polygon types (Table 19) or the point type (Figure 28 and Table 20).

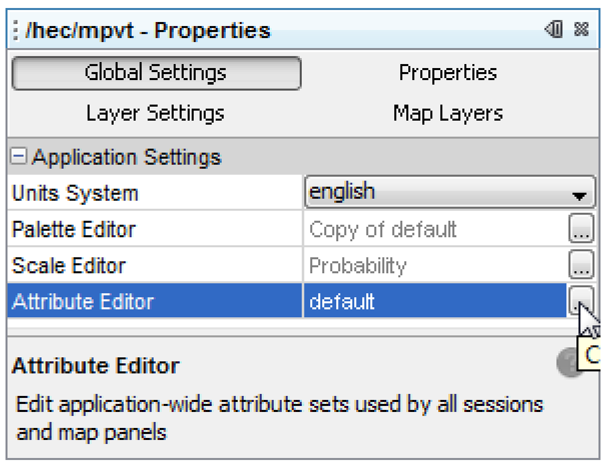


Figure 26 - Edit Attribute option

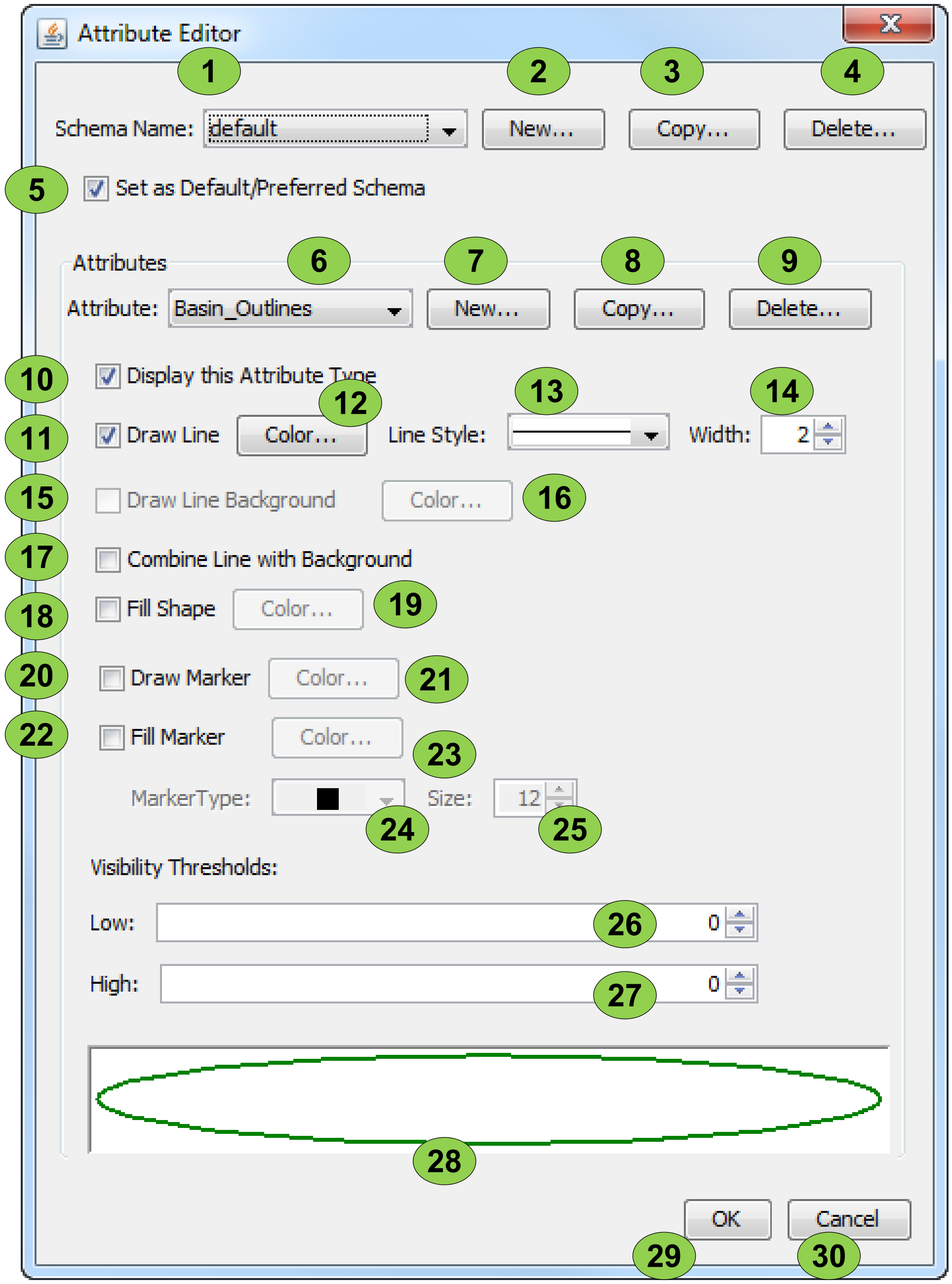


Figure 27 - Attribute editing panel for line and polygon data types

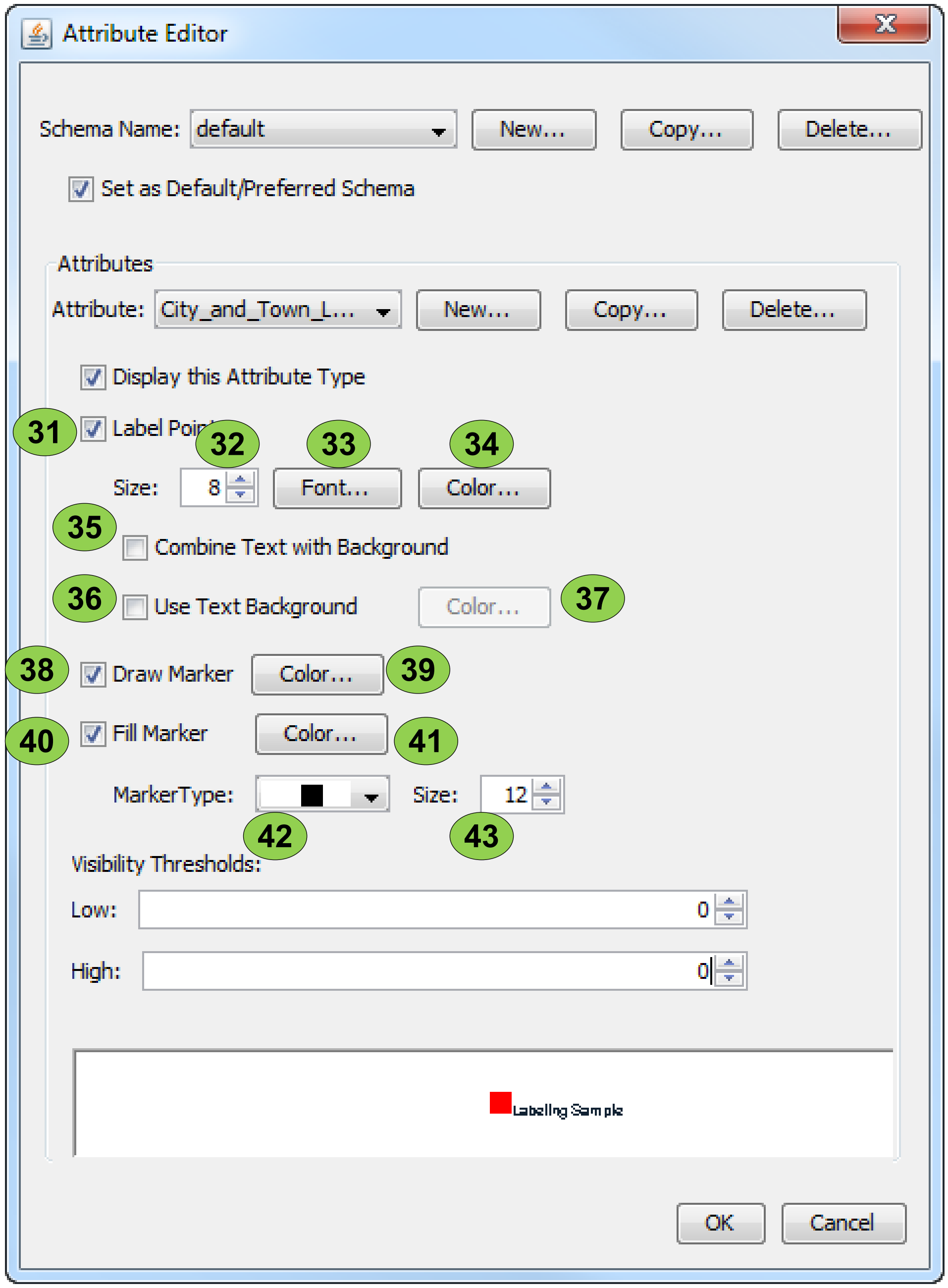


Figure 28 - Attribute editing panel for point/location date types

Table 18 - Attribute options common to all attribute types

Item	Description
1	Select the schema (collection of custom definition of attributes) to edit. Multiple schemas can be defined. With a varying array of attribute definitions. The program creates a default schema when it is first run if no schemas exist.
2	Create a new empty schema. The dialog in Figure 29 will be displayed to create the schema.
3	Copy the currently selected schema. . The dialog in Figure 29 will be displayed to create the schema.
4	Delete the specified schema. The dialog in Figure 30 will be shown to confirm the deletion.
5	Sets the schema as the default schema to use when new sessions are created. There are additional ways to specify this option via the global properties.
6	Displays the defined attributes for the current schema. The list of attributes between schemas does not have to be the same however some shapefile extensions to relate attributes to shape objects may expect certain attributes to exist in the schema that is being used.
7	Create a new attribute for the selected schema. When this is selected the dialog in Figure 31 is displayed. A unique name must be given to the attribute and the attribute type must be selected from the dropdown.
8	Copy the current attribute. When this is selected the dialog in Figure 32 is displayed and a unique attribute name must be entered. Note when copying an attribute, the type is shown but cannot be changed.
9	Delete the currently selected attribute. A confirmation dialog as shown in Figure 33 is displayed.
10	Determines whether the program should display this attribute type or not.
26	Sets the lower visibility threshold. This represents the lower bounds of the map scale (X-Y scale not the measurement scale) which can be displayed and still be able to show this attribute type. This number is difficult to set manually and can usually be done more effectively set via the map panel context menu. The number is a unitless representation of the map which represents a ratio between the screen and the actual coordinates. Since the map can be displayed in a number of different map projections it cannot be represented in miles or kilometers as the original ViewRain program did.
27	Sets the upper visibility threshold. This represents the upper bounds of the map scale (X-Y scale not the measurement scale) which can be displayed and still be able to show this attribute type. This number is difficult to set manually and can usually be done more effectively set via the map panel context menu. Since the map can be displayed in a number of different map projections it cannot be represented in miles or kilometers as the original ViewRain program did.
28	Shows a sample of how the attribute will be displayed in the map panel. The attribute is always drawn on a white background regardless of the color that the map panel uses.
29	Save all editing changes made to all schemas and attributes.

30	Discard all editing changes made to all schemas and attribute sets.

Table 19 - Attribute options common to line and polygon types

Item	Description
11	If the attribute is enabled, this designates whether a line should be drawn to connect the individual points making up the line. If the shape is a polygon, the last point is connected to the first point to close the object.
12	If a line is to be drawn this selects the color.
13	The line style to draw the line.
14	The width to draw the line.
15	If a line style other than a solid one is selected The option to have a line background can be selected. Line backgrounds occupy the space between the defined patterns of the line. If not checked, the space between the line patterns is transparent.
16	The color of the line background.
17	If this option is selected the line will be able to be seen regardless of what is drawn below it. For example, if this is unchecked and a black line goes through a black area the line cannot be seen. However, if it is checked and a black line goes through a black area, the line will show up as a white line over this portion.[5]
18	Shapes can be filled. It is closed by connecting the last and first points if necessary.
19	The color used to fill the shape.
20	Draw a marker at the points defining the line or polygon. This can create an image with a considerable amount of clutter.
21	The color of the marker outline or shape. For example, circular markers will be outlined in this color. Shapes such as 'X' will be drawn in this color.
22	Fill the marker if the marker contains a closed area such as a circle or square. Marker shapes such an 'X' ignore this.
23	The color to fill a marker.
24	The type of marker to use.
25	The size of the marker.

[5] This logical operation is commonly referred to as XOR, XORed or XORing by many computer programming references.

Table 20 - Attribute options common to point types

Item	Description
31	Determines whether the point should be labeled or not. If selected, it labels the point by using the "LOCATION" column in the .dbf file associated with the shapefile.
32	The point size of the font to use. Use this to change the size of the currently selected font without having to open the font selection dialog.
33	Opens a font selection dialog to set the font to use for the point labels.
34	Sets the color of the labeling font.
35	If this option is selected, the text will be visible regardless of what is drawn below it.
36	If this option is selected, the text will be drawn on a small rectangle under the text. This will obscure the information drawn before the label but it will assure the label can be shown.
37	The color to make the small rectangle under a text label.
38	Draws a marker at the location of the point.
39	The color of the marker outline or shape. For example, circular markers will be outlined in this color. Shapes such as 'X' will be drawn in this color.
40	Fill the marker if the marker contains a closed area such as a circle or square. Marker shapes such an 'X' ignore this.
41	The color to fill a marker.
42	The type of marker to use.
43	The size of the marker.

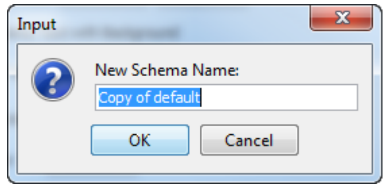


Figure 29 - Dialog used to create and copy attribute schemas

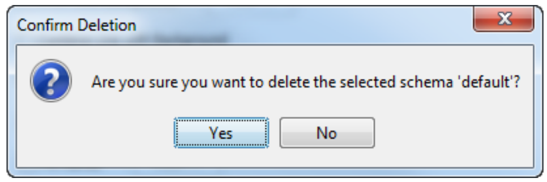


Figure 30 - Delete attribute schema confirmation

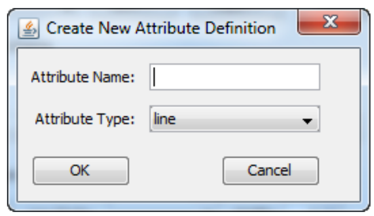


Figure 31 - Create attribute

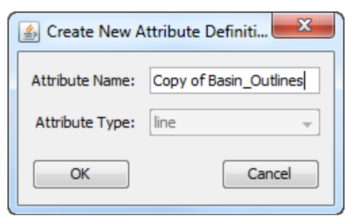


Figure 32 - Copy attribute

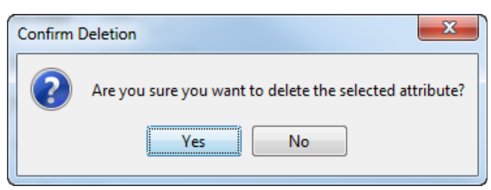


Figure 33 - Delete attribute confirmation

4.5 Global Settings

Global settings (Figure 34) apply to all sessions and map panels in the project. For example, if the unit system is changed from Metric to English, all the map panels that may be displaying data in millimeters will refresh using inches instead. Table 21, Table 22, and Table 23 provide descriptions for settings.

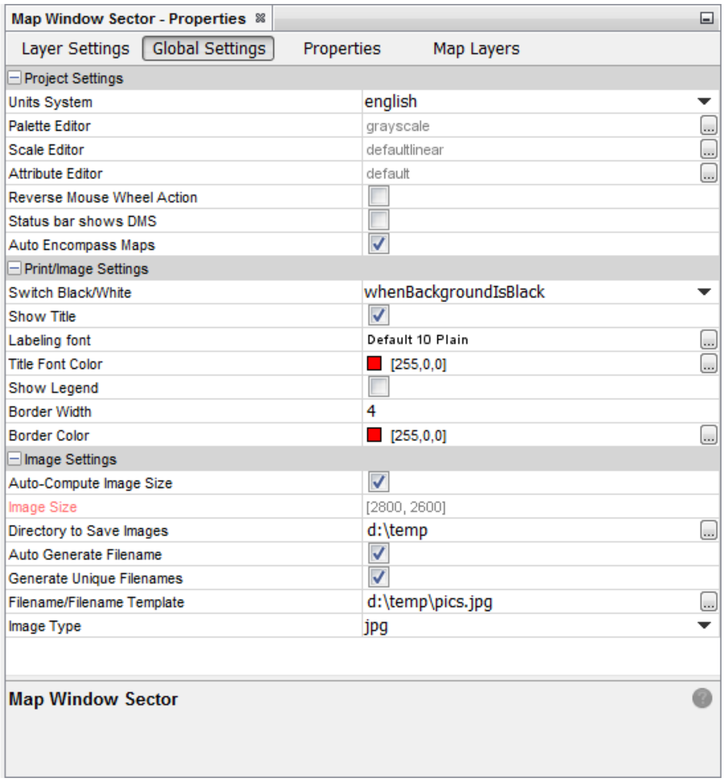


Figure 34 - Global Settings

Table 21 - Project Settings description

Item	Description
Unit System	As discussed earlier, most options in the program defined at the program level are defaults that are inherited by the session, and in turn the map objects themselves. However, the unit system is special. It is either English or SI and it affects all sessions and windows in the program. It is not possible to have one session displaying SI units and another session displaying English. This is a global option which affects all sessions and map panels.
Reverse Mouse Wheel Action	Context menu that can be used to delete the current selection or to insert a new value below the current line.
Status Bar Shows DMS	This controls whether program the status bar displays longitude and latitude coordinates in DMS or decimal degrees
Auto Encompass Maps	When this option is selected and a shapefile is added to a map panel, the program will re-compute a new view which will keep all the current information in view and insure that the new shapefile is included also.

Table 22 - Print/Image Settings description

Item	Description
Switch Black/White	Switches black and white when printing. The default is to only switch black and white when printing if the map panel background is colored black.
Show Title	When set, the Map Panel title is placed at the top of the printed map window
Labeling Font	The font to use for the title
Title Font Color	The font color for the title
Show Legend	If selected, the legend panel is plotted along with the map panel. The program attempts to maintain the same aspect and positioning for the map panels and legend as what is displayed on the screen. Note that the legend is associated with the active map panel and may differ for other displayed map panels within the session.
Border Width	The width of the outline border around each map panel
Border Color	The color of the border around each map panel

Table 23 - Image Settings description

Item	Description
Auto Compute Image Size	When selected, the output image size matches the image size of the Session displayed on the screen.
Image Size	Sets the size of the image in pixels when auto compute is not selected.
Directory to Save Images	The directory to save images to when the image save icon  is pressed on the program toolbar.
Auto Generate Filename	Attempts to generate a filename based on the metadata from the map panels in the session. If more than one map panel is opened in the session, the map panel with the focus will be used.
Generate Unique Filenames	Generate a unique filename for the image so that a sequence of images, all having the same basic name, can be saved without having to modify the image save properties between snapshots.
Filename/Filename Template	If generate unique filenames is selected this will act as the base name for the file and a new filename will be generated to assure a new image file is created. If generate unique filenames is not selected this will be the filename of the saved image and the image file will be overwritten if it exists.
Image Type	Type of image to generate. Choices are JPEG, PNG, GIF and BMP.

Chapter 5

5. Session Management

5.1 Sessions

Sessions are the work area for organizing your sub-work units (Map panels). Just as there is no right or wrong way to store files on disk, there really is no right or wrong way to use a session. They are meant to allow flexibility in organizing work. It may be important to one individual to have different sessions for different geographic areas. Another person may wish to have different sessions for different storm events. While a third person may have different sessions with different display attributes with differing attribute sets for making presentations or printouts that require different output line styles and colors.

Creating a New Session

Adding a session can be done from a context menu in the Project Explorer. Simply right click on the main program node and select 'New Session…' (Figure 35). An input window will open (Figure 36). Type in the name for the session and select **OK.** A new session will be created. All the settings used by the new session will be inherited from the project defaults.

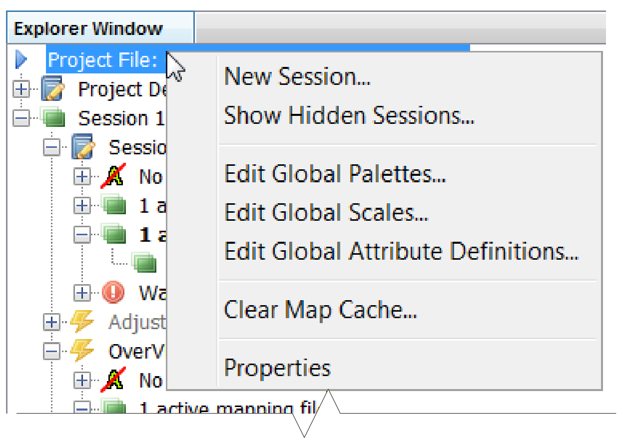


Figure 35 - Create new session

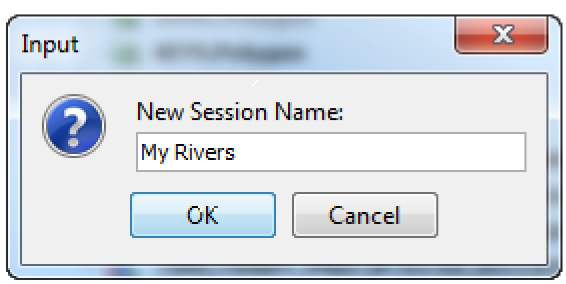


Figure 36 - New session creation and confirmation

Opening a Session

There are two ways to open a session. If it is displayed/visible in the Project Explorer window but grayed out, right click and select 'Open Session' or simply double click on it (Figure 37). However, many sessions that are available may not be visible in the Project Explorer, because they have been hidden. To open a hidden session, make the appropriate selection from the context menu as shown in Figure 39. Note that if there are no hidden sessions that can be opened, this option will be grayed out. Select 'OK' to open the session or Cancel to quit (Figure 38).

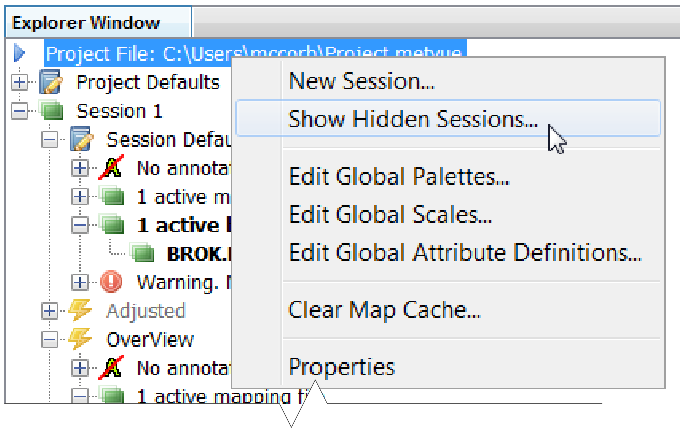


Figure 37 - Opening a hidden session

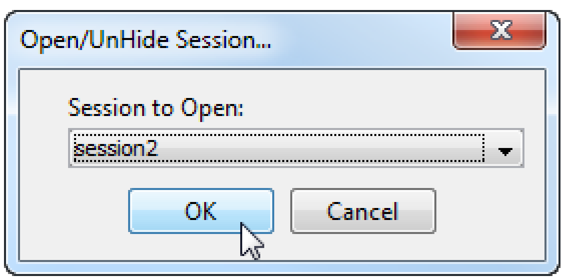


Figure 38 - Open hidden session selection and confirmation

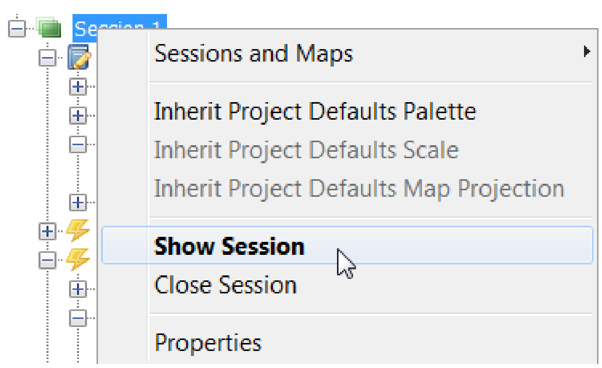


Figure 39 - Opening a closed but visible session

Closing a Session

Multiple ways are available to close a session. Method 1 is to right click on the session node and select 'Close Session' (Figure 40). The second method is to simply close the session tab by clicking on the small 'x' in the corner of the tab (Figure 41). After the session is closed it will still show in the Project Explorer but be will be grayed out. Nearly all resources that it was consuming will be released. When closing a session, all map panels contained within that session will also be closed but will retain their original open/closed/hidden state when the session is re-opened.

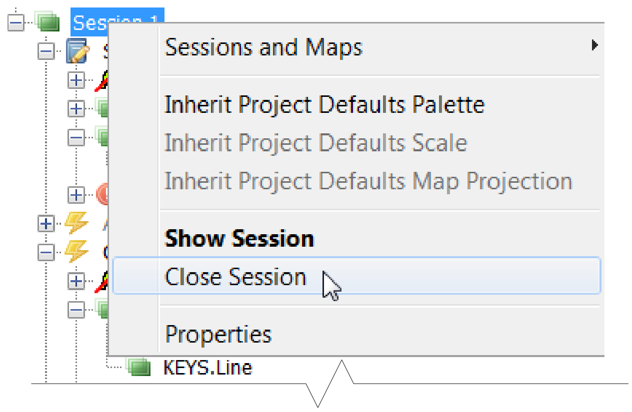


Figure 40 - Closing a session from the Project Explorer

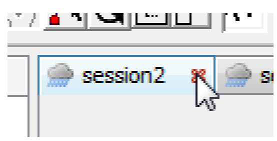


Figure 41 - Closing a session by using the tab control

Hiding a Session

This option will both close a session if it is open and remove it from the Project Explorer window (Figure 42). The purpose of this option is just to help keep the clutter to a minimum in the Project Explorer window. The session is not deleted.

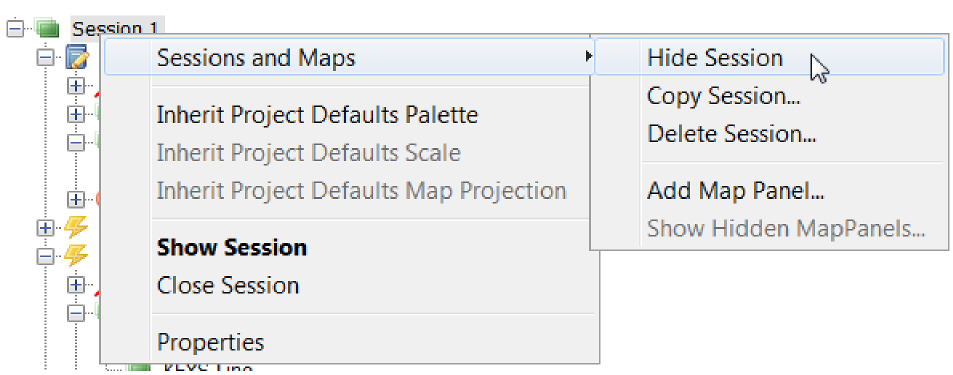


Figure 42 - Hide session

Copying a Session

Sessions can be copied by right clicking on the session node to copy. Select 'Copy Session…' from the submenu (Figure 43). This will subsequently bring up the dialog where the name of the new session can be entered (Figure 44). Copying the session has the advantage that it makes a complete copy of the original session including map panels and their properties. It is much easier to copy an existing session that is similar to what is needed and modify it than to create a new session from the main program node and set all the options.

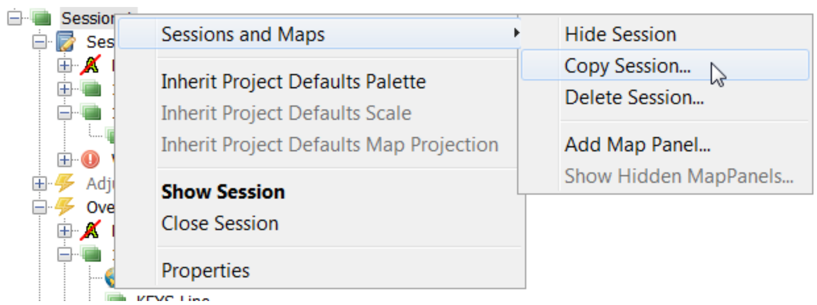


Figure 43 - Copy an existing session

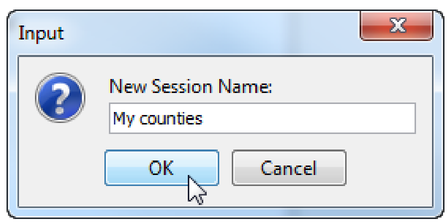


Figure 44 - Copy an existing session confirmation

Deleting a Session

Sessions can be deleted by right clicking on the session node to delete. Select 'Delete Session…' from the submenu (Figure 45). This will subsequently bring up the dialog to confirm the deletion of the session with a warning that the deletion is permanent (Figure 46).

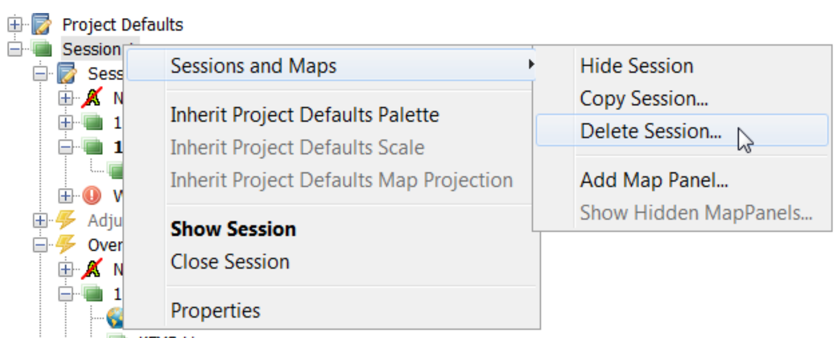


Figure 45 - Delete session

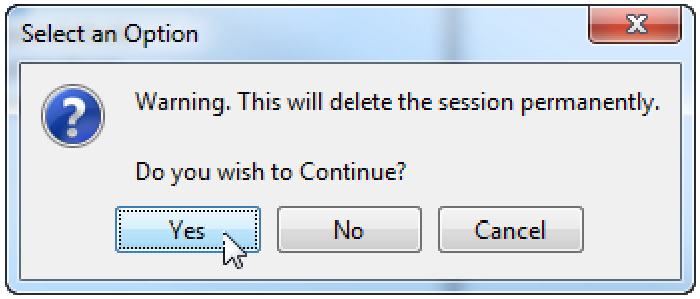


Figure 46 - Delete session confirmation

Show Session

If multiple sessions are open, selecting this option or double clicking on the session node will bring the session and its map(s) to the top (Figure 47).

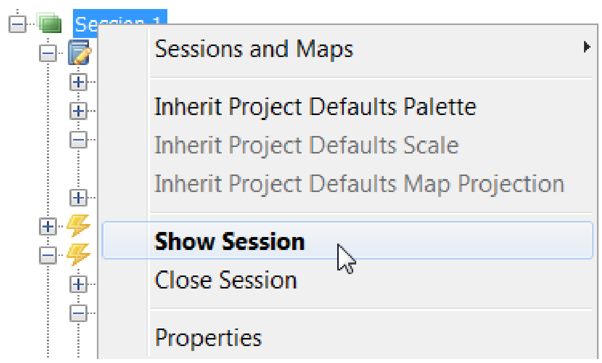


Figure 47 - Position the session window to the top of the session stack

Reverting Session to Use the Program Settings

Sessions can revert to using the project settings for many of the settings. Defaulting to project Palettes, Scales and Map Projections can be done by right clicking on the appropriate session node in the Project Explorer and making the desired selection as shown in Figure 48. Defaulting to the project settings for which maps to use for display or use for basin averages can be accomplished by right clicking on the 'mapping files' or 'basin averages' node respectively as shown in Figure 49. Defaulting to the project specified attribute schema can be done as shown in Figure 50.

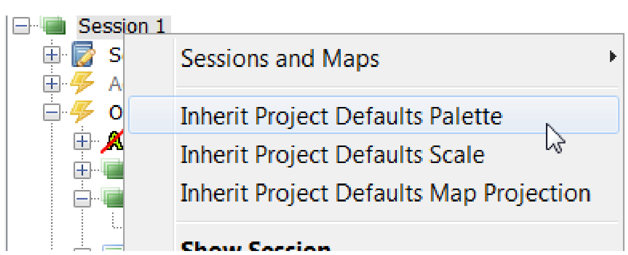


Figure 48 - Reverting palette scale and map projection to project settings

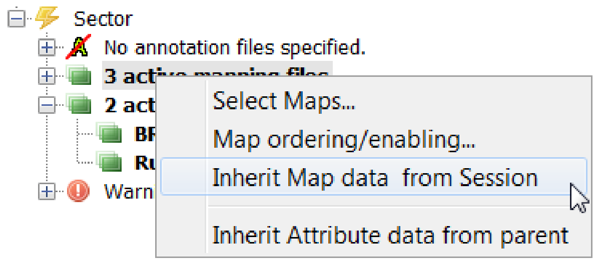


Figure 49 - Reverting to project defined map defaults for display or basin averages

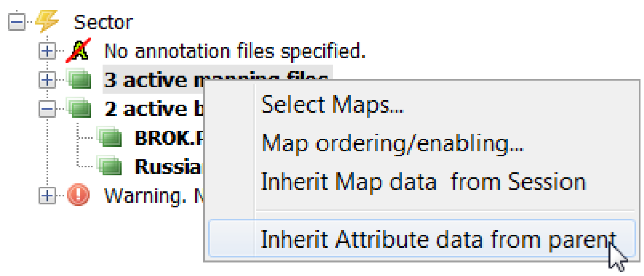


Figure 50 - Reverting attributes to use the project specified attribute schema

Session Properties

To open a properties window (Figure 51), right click on the session node and select 'Properties…'. Discussion of each of the properties is included elsewhere. It is often more convenient to have a property window that is always open. Use the menu item `Window->Properties` to display a docked properties window that is context aware.

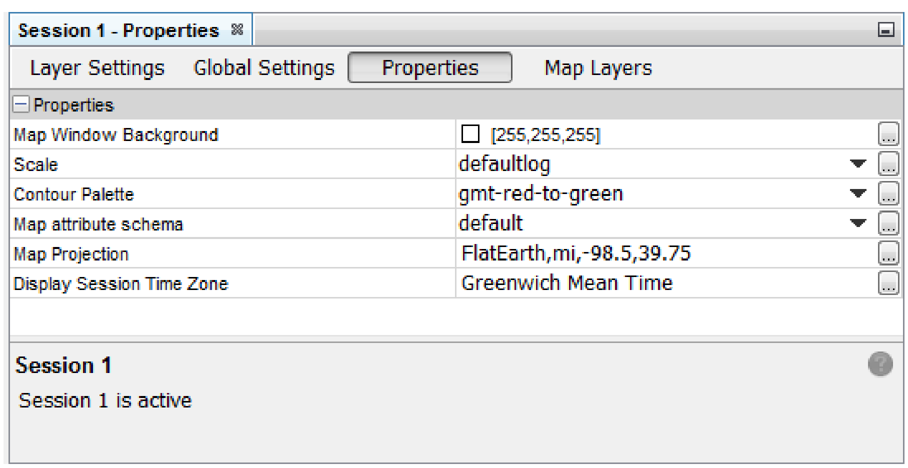


Figure 51 - Session Properties window

Chapter 6

6. Map Panel Management

6.1 Map Panels

Map panels are the individual panels that actually contain the information that one views and edits. Map panels are always contained within a session. A session can have one or more map panels associated with it. Just as sessions inherit defaults from the project, map panels inherit defaults from the session they are in. As will be seen in this chapter, map panel management is similar to session management. The major difference is that sessions use a minimal amount of memory to hold settings and lists of TINs to aggregate, while map panels can consume large amounts of memory when open. Large TIN models use significant resources as do the mapping layers that each map panel maintains to make the program more responsive. If the computer used has limited memory or the Java virtual machine is configured to use a relatively small amount of memory, closing any unnecessary map windows is the most effective way to keep memory usage to a minimum.

Creating a Map Panel

Creating a new map panel can be done from a context menu in the Project Explorer. Right click on the session node to contain the new map panel select 'Add Map Panel' as shown in Figure 52. An input window will open as shown in Figure 53. Type in a unique the name for the map panel and select **OK.** Map panel names within a session must be unique. All the settings used by a map panel will be inherited from its session until overridden.

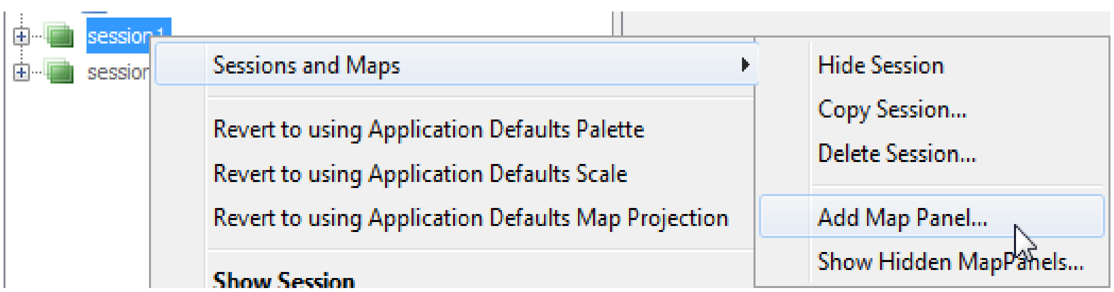


Figure 52 - Create new map panel

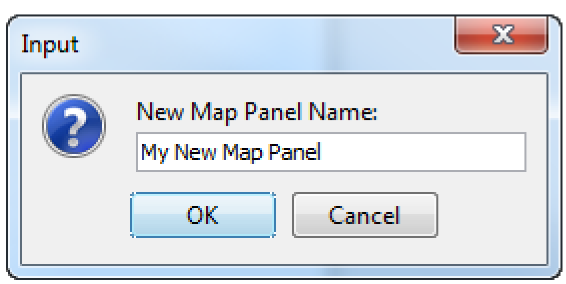


Figure 53 - New map panel creation and confirmation

Opening a Map Panel

Map panels can be opened in two ways. If it is displayed/visible in the Project Explorer window and grayed out, right click and select 'Open Map' (Figure 56) or simply double click on it. However, many map panels that are available may have been hidden and not visible in the Project Explorer. To open a hidden map panel, make the appropriate selection from the context menu as shown in Figure 54. Note that if there are no hidden map panels that can be opened this option will be grayed out. Select the appropriate map panel and select 'OK' to open the map or Cancel to quit as shown in Figure 55.

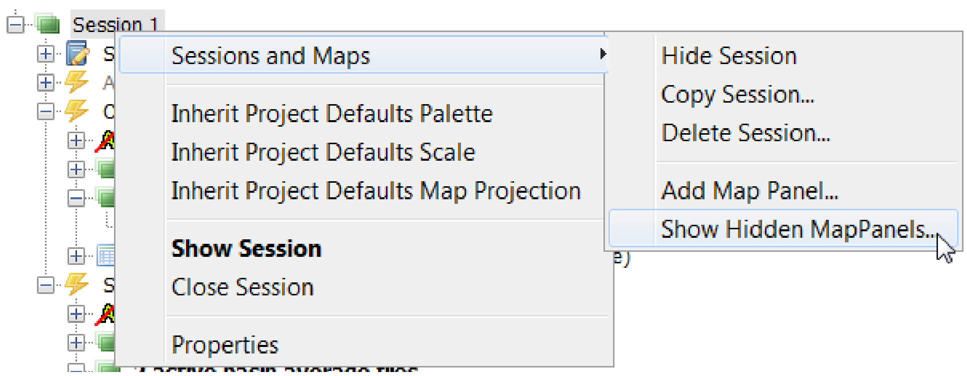


Figure 54 - Opening a hidden map panel

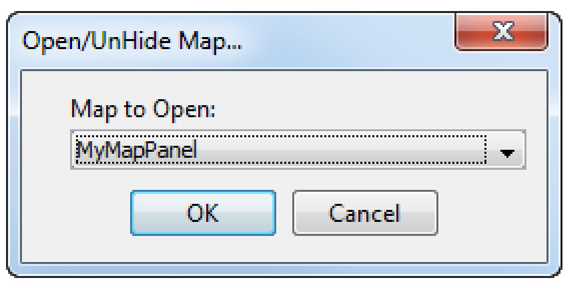


Figure 55 - Open hidden map panel selection and confirmation

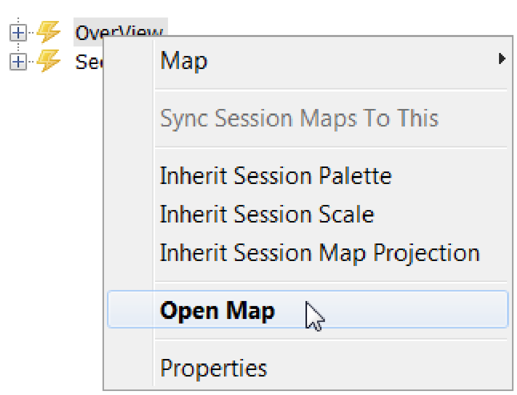


Figure 56 - Opening a closed but visible map

Closing a Map

Map panels can be closed in multiple ways. Method 1 is to right click on the session node and select 'Close Map' (Figure 57). The second method is to simply close the map panel by clicking on the small 'x' in the window (Figure 58). After the session is closed, it will still show on the Project Explorer but will be grayed out. Nearly all resources that it was consuming will be released.

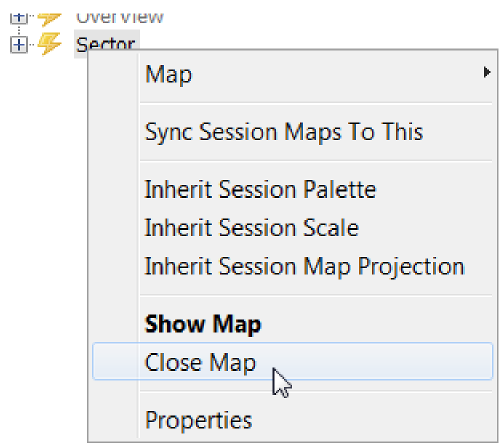


Figure 57 - Closing a map from the Project Explorer

Figure 58 - Closing a map panel directly

Hiding a Map Panel

This option (Figure 59) will both close a map panel if it is open and remove it from the Project Explorer window. The purpose of this option is just to help keep the clutter to a minimum in the Project Explorer window. The map panel is not deleted.

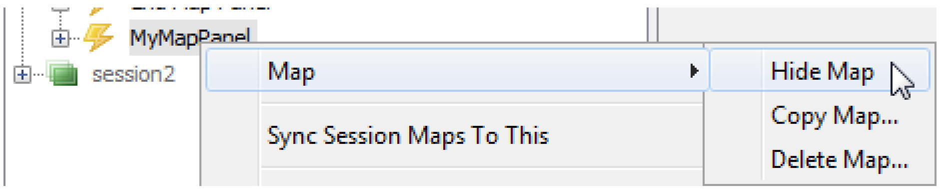


Figure 59 - Hide map panel

Copying a Map Panel

Map panels can be copied by right clicking on the map panel node to copy. Select 'Copy Map…' from the submenu (Figure 60). This will subsequently bring up the dialog to input the name for the new map panel (Figure 61). Copying the map panel has the advantage that it makes a complete copy of the original map panel settings. It is much easier to copy an existing map panel similar to what is needed and then modify the few things that need to be changed as opposed to creating a new map panel from the session node. Map panels cannot be copied between sessions. Any map panel that is copied will be in the same session as the copy it was created from.

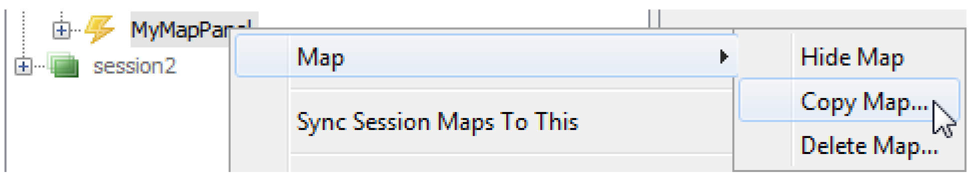


Figure 60 - Copy an existing map panel

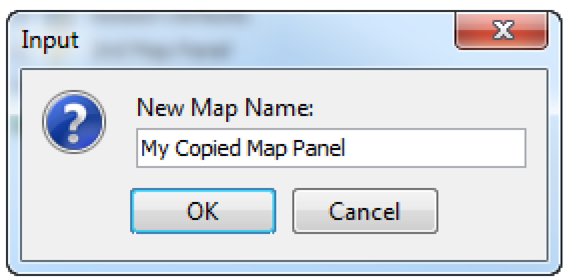


Figure 61 - Copy an existing map panel confirmation

Deleting a Map Panel

Map panels can be deleted by right clicking on the map panel node to delete and selecting 'Delete Map…' from the submenu (Figure 62). This will subsequently bring up the dialog to confirm the deletion of the map panel with a warning that the deletion is permanent (Figure 63).

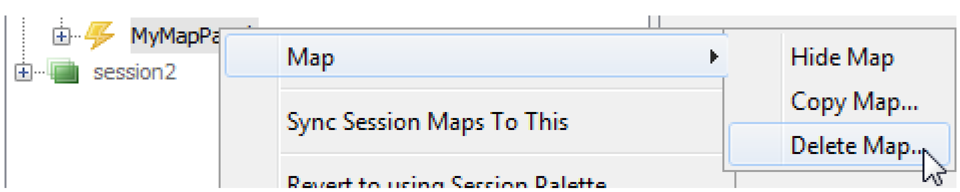


Figure 62 - Delete map panel

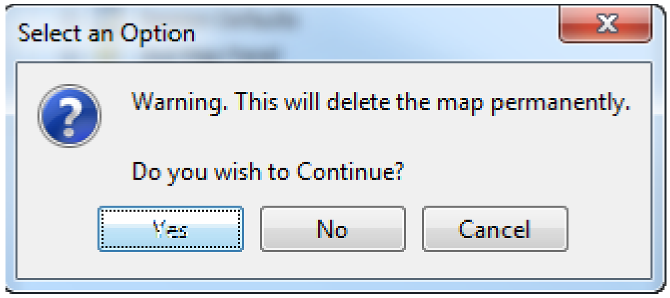


Figure 63 - Delete map panel confirmation

Show Map Panel

If multiple map panels are open, selecting this option or double clicking on the map panel node will bring the session and its map(s) to the top (Figure 64).

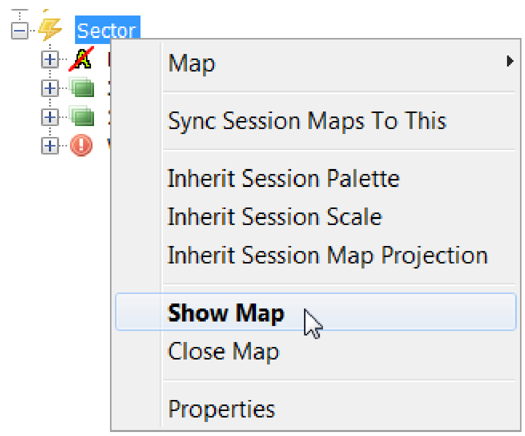


Figure 64 - Position the map window to the top of the stack

Synchronizing Map Panels

Many times a session will have multiple map panels open and they will be zoomed or panned to differing areas within the map information. By selecting this option (Figure 65), all maps within the session are adjusted to have the same view with respect to spatial extents in as much as possible. Since the map panels may be different shapes and use varying coordinate systems, the synchronization is just an approximation. The synchronization option works only within each session; therefore, syncing maps is not possible across different sessions.

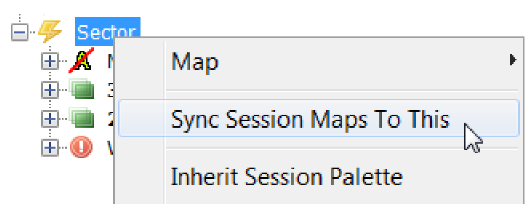


Figure 65 - Synchronization of map panels within the same session

Map Properties

To open a non-dockable properties window[6], right click on the map panel node and select 'Properties…' (Figure 66). Discussion of each of the properties is included elsewhere.

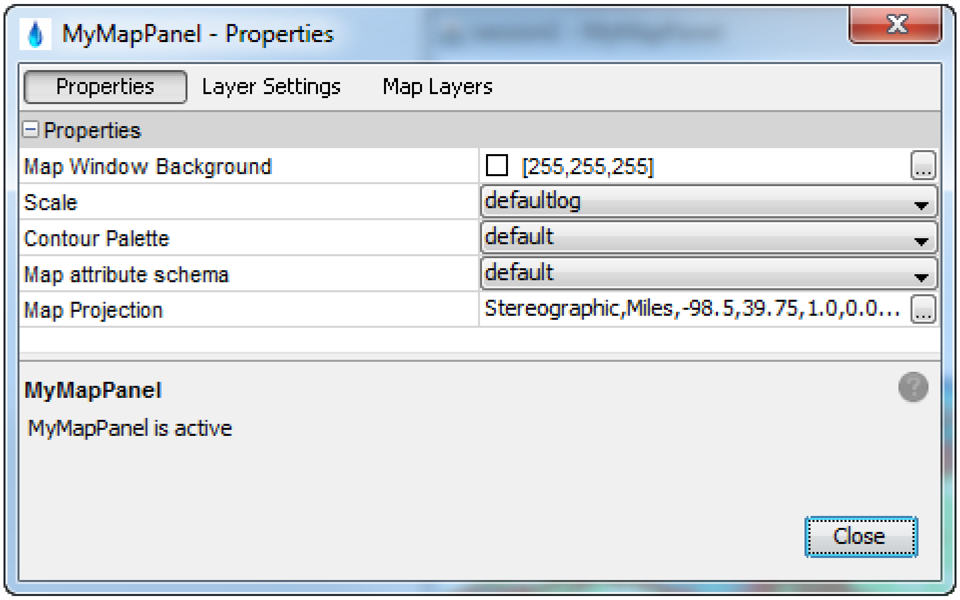


Figure 66 - Map Panel Properties window

[6] It is usually more convenient to always have to properties window open (Window->Properties from the main menu). It is context sensitive and will automatically display all the properties associated with a map panel

Chapter 7

7. Map Projections

7.1 General Discussion

There are several usages for map projections within HEC-MetVue. Maps (shapefiles) that form the georeferencing context for the map panels are usually available in a variety of different coordinate systems specified via the '.PRJ' file that is a part of any shapefile definition. TINs and grids also have their data supplied in various projections. These coordinate systems may be different from the coordinate systems of the map data. Regardless of which coordinate system the supplied data comes in, it may not necessarily be the one that is used to display the data in the map panel. Also, projections that have a 'nice' view when displayed typically distort the true [X, Y] or resultant area of objects making them unacceptable for computational purposes. Data that is useful for one purpose must be converted to make it useful for another. Maintaining the same data in different coordinate systems becomes unworkable very quickly and edited datasets can become out of sync.

HEC-MetVue attempts to solve this problem by supporting many different coordinate systems natively without the need for converting the data prior to using the program. The model that the program uses makes it very easy to add new coordinate system support as time goes on. When using these coordinate systems, it means that a UTM shapefile, an Albers Equal Area shapefile, a shapefile using longitude/latitude with an LFM radar grid can all be used on the same map panel without having to translate the coordinates prior to using them.

This manual is not a definitive source on coordinate systems. The information given here is simply to highlight the necessary parameter settings for display and to give some of the benefits and drawbacks of the various methods.

7.2 How to Specify the Correct Coordinate Converter

For shapefiles, the coordinate converter must be specified in the '.PRJ' files that accompanies the coordinate file. If no .PRJ file is present, the program will not use the shapefile.

For TINs stored on disk or in DSS, the coordinate system used is encoded in the metadata that accompanies the data. The programs will instantiate the correct coordinate converter for the measurement data. Other plugins and I/O providers can use any coordinate system for which a valid WKT or EPSG code can be supplied.

All computations performed by the program are done using an Albers Equal Area coordinate projection, because this coordinate system preserves areas.

All the map projections that can be specified by the user are used solely for the purposes of display within the map panel and are discussed below.

Longitude/Latitude Coordinate Converter

Although not technically a projection, this coordinate system (Figure 67) creates a view where 1 degree longitude is equal to 1 degree latitude. This will give an acceptable view when the area being displayed is close to the equator. The closer to the North or South poles the area viewed becomes, the more distorted the view will appear since longitudes converge towards the poles. However, this is the fastest projection to draw on a map panel due to the fact that there are no compute intensive trigonometric coordinate conversions required to render the image. Map panels using this coordinate converter can render the map panel much quicker than most other coordinate converters.

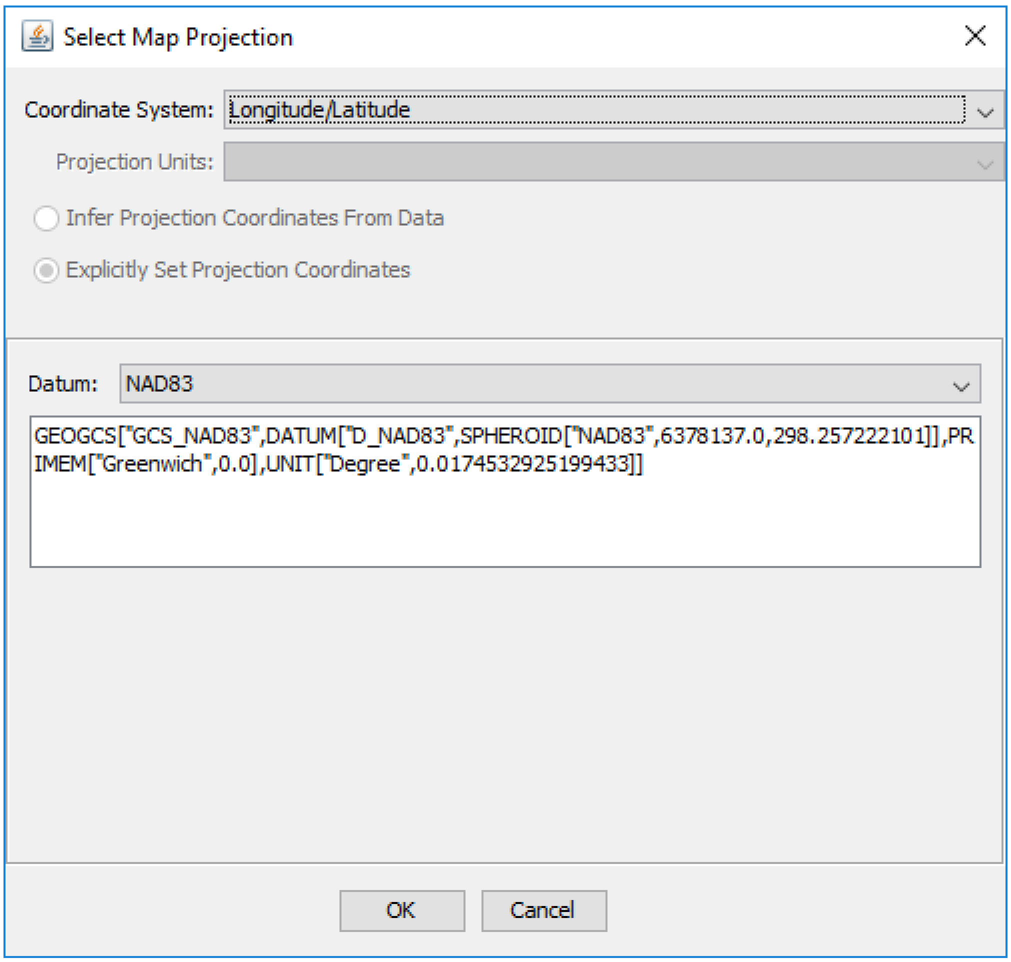


Figure 67 - Longitude/Latitude coordinate converter

Stereographic Coordinate Converter

This is a coordinate system that is typically used to make maps look 'nice' (Figure 68). Most weather maps are shown using this coordinate system. The tangent point is an imaginary point on the earth where the flat projection pane touches to create the view of the world. If the program determines the tangent point, the program will inspect the data to determine the lon/lat midpoint and use that for the tangent point. For the U.S., a typical tangent point is [-98.5, 39.75]. The false easting and northing do impact the cursor location feedback on the status bar if tracking is enabled but not much else. The scale is set to 1.0 which is appropriate for the earth. For another planet or satellite, this would be set to the ratio of radius between that and the earth. The drawing performance of a stereographic projection is relatively slow due to the number of trigonometric operations that must be performed when drawing.

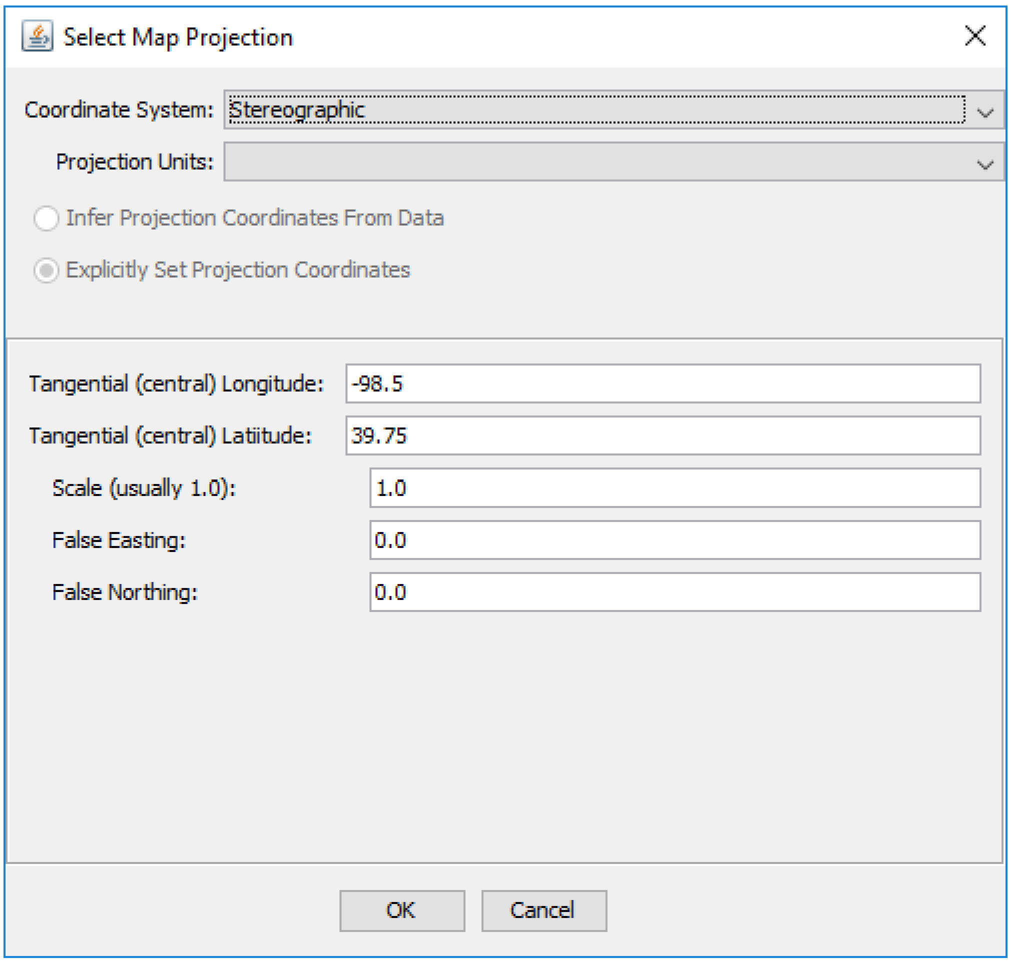


Figure 68 - Stereographic coordinate converter

Limited Fine Mesh (LFM) Coordinate Converter

This is used extensively by the National Weather Service for encoding of meteorological data. It is a specific stereographic projection with a specified grid size (Figure 69). Because it ignores the fact that the Earth is not really a sphere, the performance is somewhat better than a projection that takes the earth eccentricity into account. The grid sizes used are defined as a fraction of an LFM grid. For example NEXRAD grids use an LFM grid size of 40, meaning that they have measurement data at intervals of 1/40 of a standard LFM grid which works out to a grid size of 4.7625 km per grid cell in both the X and Y directions. Use this coordinate choice if displaying LFM gridded data and want it to appear rectangular.

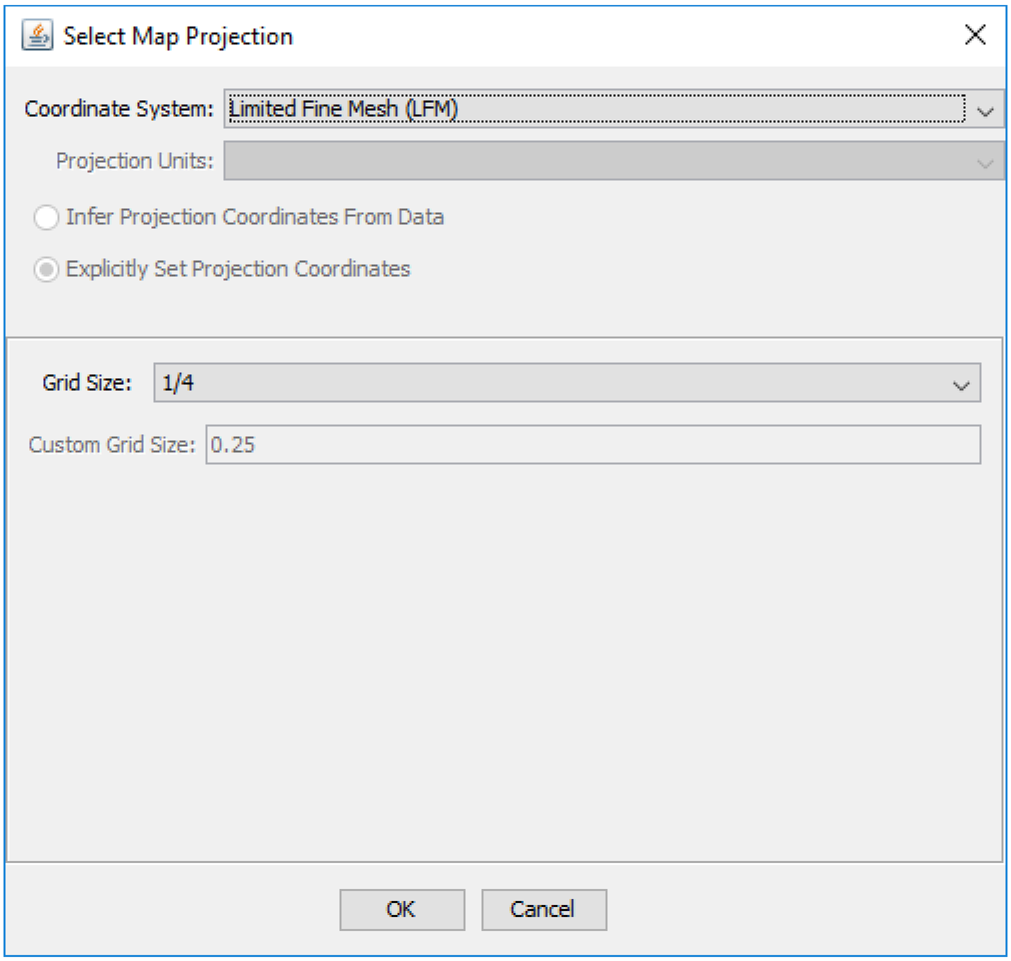


Figure 69 - Limited Fine Mesh (LFM) coordinate converter

Universal Transverse Mercator (UTM) Coordinate Converter

The UTM coordinate system (Figure 70) is a grid-based method of specifying locations on the surface of the Earth that is a practical application of a 2-dimensional Cartesian coordinate system. The UTM system is not a single map projection. The system instead employs a series of sixty zones, each of which is based on a specific transverse Mercator projection.

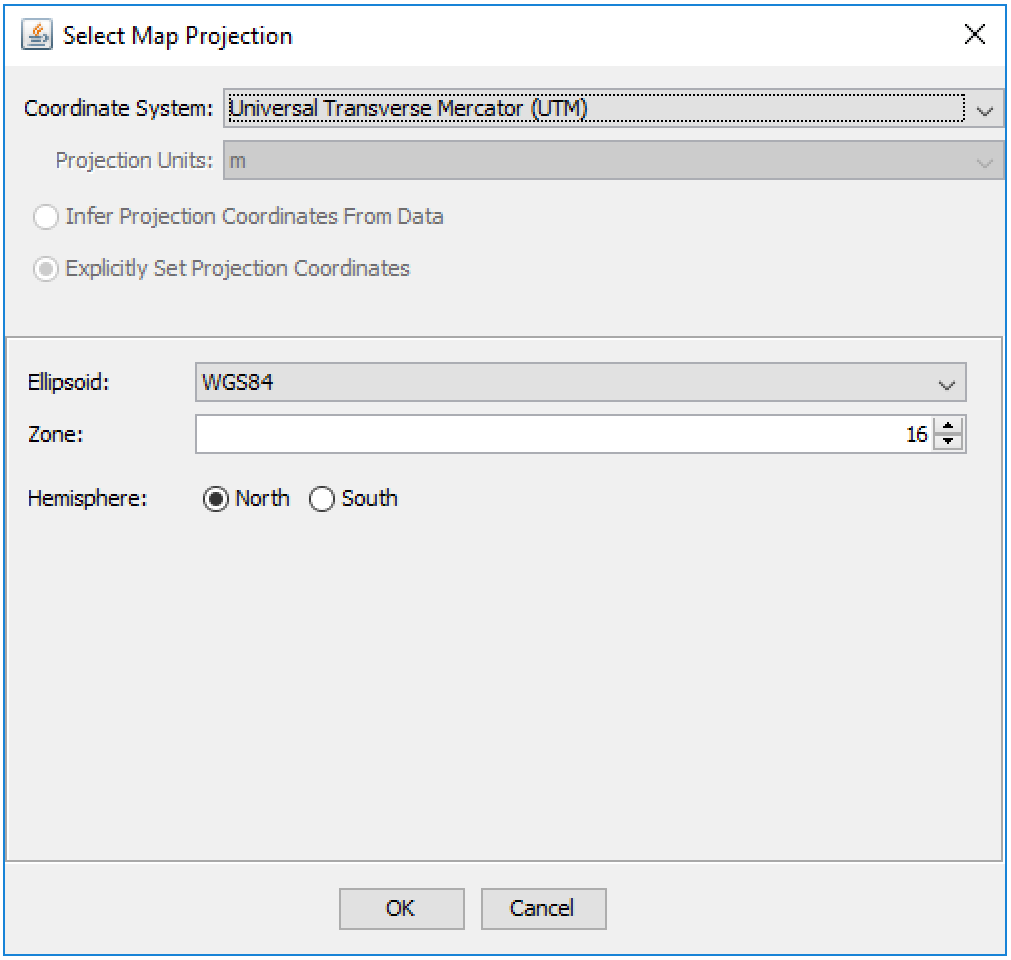


Figure 70 - Universal Transverse Mercator (UTM) coordinate converter

Albers Equal Area Coordinate Converter

This projection (Figure 71) displays the image with the X and Y coordinates representing the best approximation of proportional area. In addition to this display setting for Map Panels, this is the same coordinate system that is also used in HEC-MetVue for all computations.

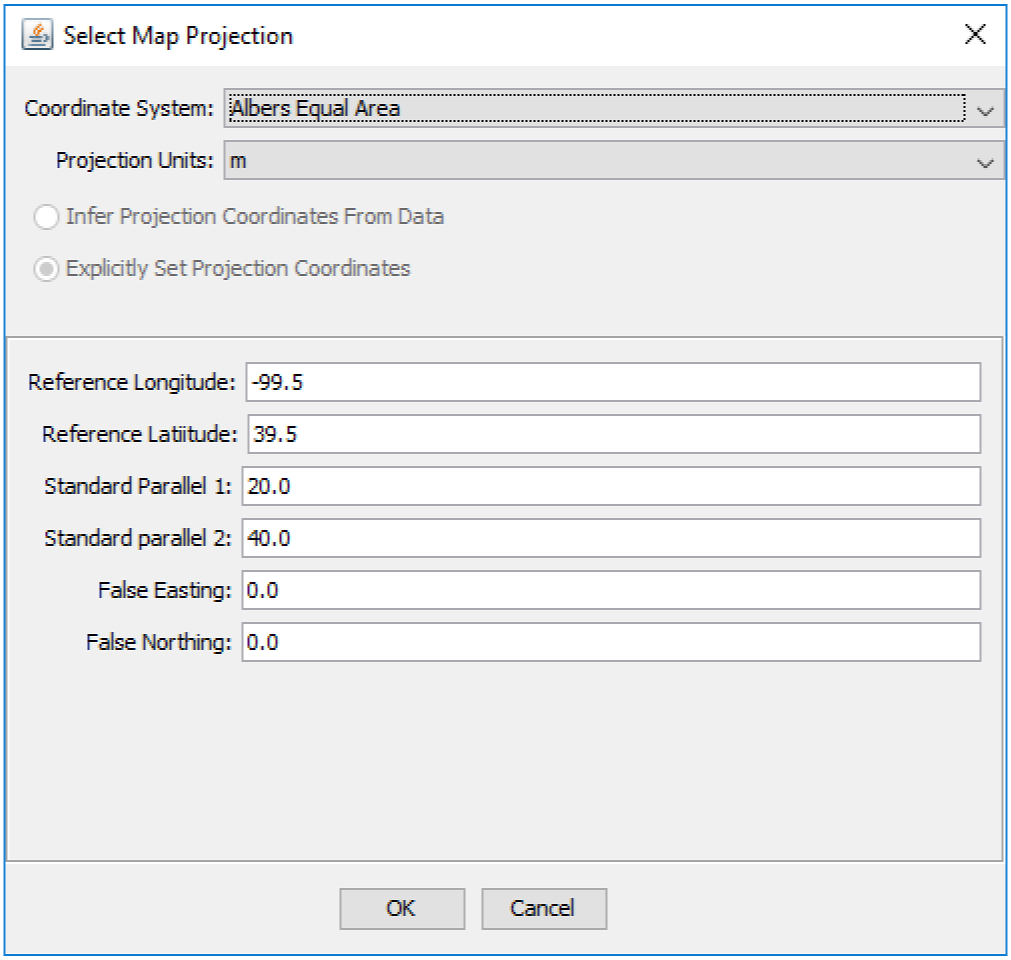


Figure 71 - Albers Equal Area coordinate converter

Standard Hydrologic Grid (SHG) Coordinate Converter

The projection used for the SHG is an Albers Equal Projection with pre-defined values for the Reference Longitude and Standard Parallels (Figure 72). The choice of whether or not to infer the coordinates from the data is ignored.

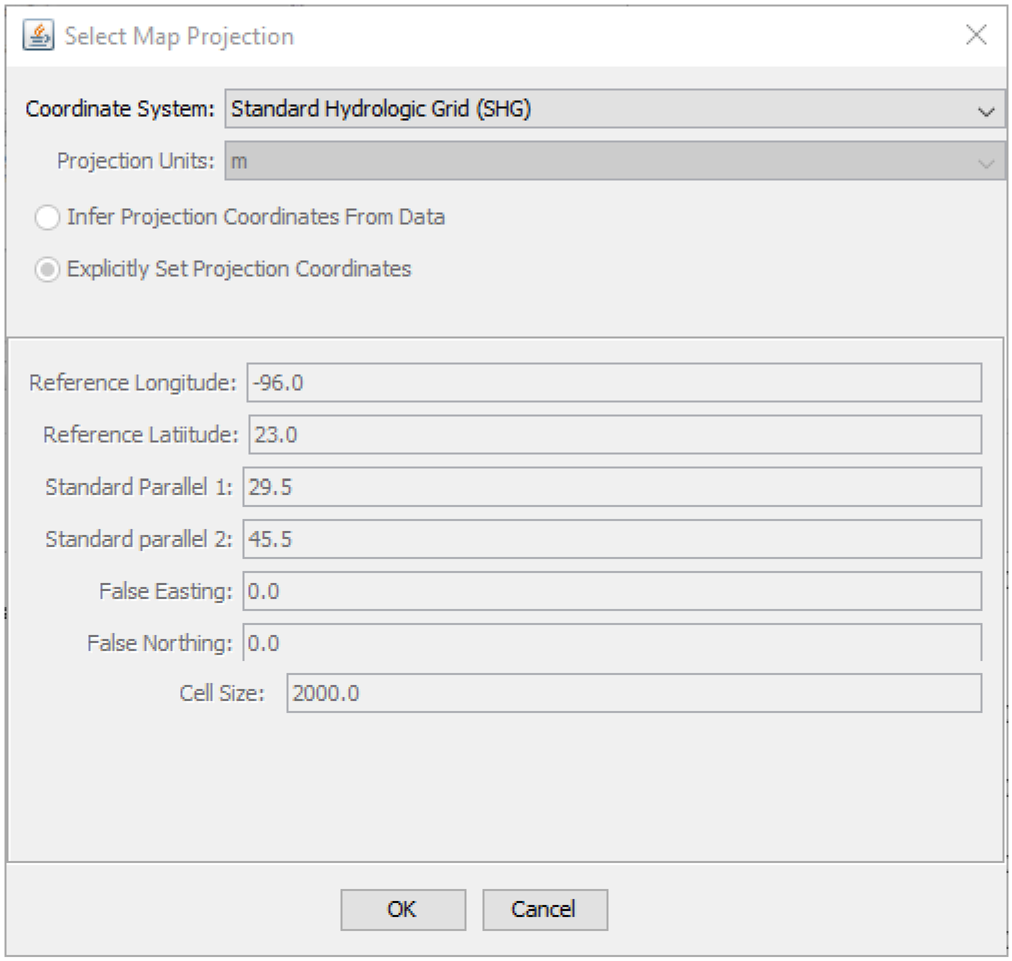


Figure 72 - Standard Hydrologic Grid (SHG) coordinate converter

Chapter 8

8. Maps

8.1 General Discussion

HEC-MetVue uses maps for two purposes. First, the TIN data typically does not mean much if it cannot be georeferenced. A radar image without any background maps does not convey enough information to be useful. Some mapping information such as a state line or basin boundary must be present to give context to the measurement data. Second, map data, especially defined polygon shapes, can be used in conjunction with TIN data to compute averages and volumes.

Currently this program supports mapping information supplied in shapefiles. Shape types of Point, Polyline, and Polygon are currently supported. A shapefile definition is really made up of a set of files representing the map with a common name and different extension. Shapefiles must contain the '.shp', '.shx', '.dbf', and '.prj' components to be used by this program. The data must be in a coordinate system that the program supports.

8.2 Shapefiles and Attribute Schemas

Shapefiles in and of themselves do not contain enough information to draw maps intelligently. For example, suppose a shapefile that has twenty Polygon definitions. Nothing within the shapefile specification informs us what these polygons represent. The polygons could represent lake surfaces, basin outlines, or a political district. It is useful to relate this polygon line to an attribute type so that it could be displayed as a double width green line or a dotted blue line. Point values, such as a rainfall gage location can be defined in a shapefile. But, again, nothing in the shapefile specification defines what this point represents or even a name to give it. Custom specifications must be defined that are in addition to the shapefile specifications in order to supply enough information to make use of the spatial features.

Relating Shapefile shapes to Schema/Attribute sets

There is more than one way to associate shapefiles with the attribute that is used to draw it. The first is to directly associate the attribute with the shapefile when it is selected. This associative action can be done via the Project Explorer on the project defaults, the session defaults, or one of the map panels. Under any one of these nodes, right click on the `'Maps'` node and choose the `'Select Maps'` option as shown in Figure 73. Doing so then displays the dialog shown in Figure 74. Table 24 provides a description of the available features.

In the example shown, the map file `usa` has the attribute `'State Outlines'` associated with it and will use that attribute for all shapes in the file. This will override any attribute type that is defined in the DBF file.

The shapefile specification states that only a single type of shape, either 'Point', 'Line' or 'Polygon' can be in the file. Other shapefiles specified, such as `ALTU.Line`, use the '<default for data type>' attribute. The program has a default attribute defined for any shape type without a defined attribute. For points, this is a square symbol with a black outline and white fill. For Line and Polygon shapes, a solid, thin, black line is the default. If the wrong type of attribute is associated with a shapefile, the program will use the default attribute for that shape type and produce warnings in the output window.

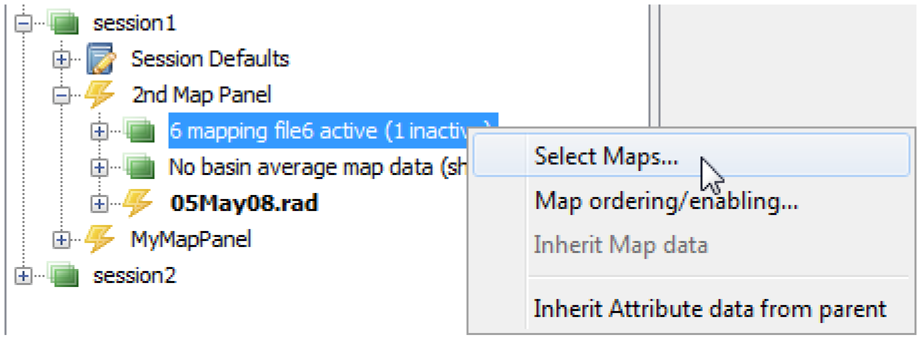


Figure 73 - Selecting maps for the map panel

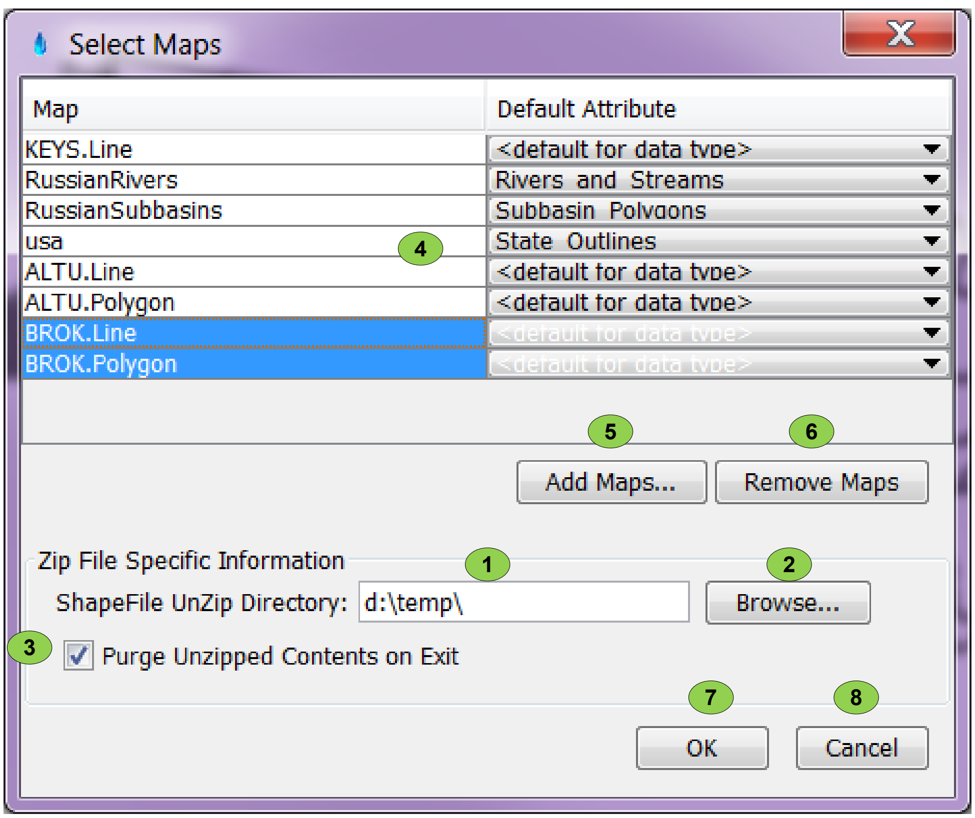


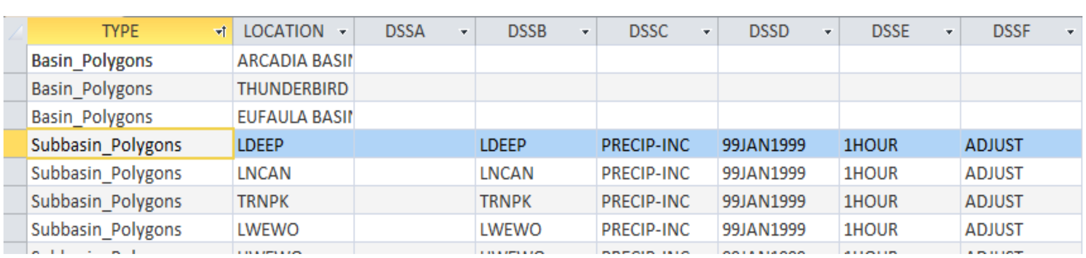
Figure 74 - Dialog to select maps and assign attributes

Table 24 - Shapefile selection

Item	Description
1	Shows the default directory location to use for unzipping shapefile archives. By default it uses the temp directory location.
2	Used to set the location for the zip archives to be unzipped to. It brings up a standard directory browser.
3	If this box is checked, when the program exits it cleans up all the unzipped content it created. When the program is restarted, it will look for the specified shapefile in the unzip directory. If it cannot find it, it will unzip the original zip file again. If left unchecked, the program will create the unzipped content required in the unzip location specified. When it exits it will leave the files. On restart the files will be there, saving the unzip step.
4	A list showing the currently selected maps and the attribute to associate with them if the TYPE attribute is not present in the .dbf file. Note that if a zip file is selected, the program will show all the shapefiles in the zip file in this list and not the zip file itself.
5	Making this selection brings up a standard file selection dialog which by default will show all the shapefiles and zip files available. Multiple files can be selected at once using standard shift and ctrl keys.
6	Removes any maps that are highlighted on the panel in 4. Standard shift and ctrl keys can be used to make multiple, discontinuous selections.
7	Save all changes
8	Discard all changes. Note that by this time any specified zip files have already been processed and will not be cleaned up until the program exits.

The second method is to associate the individual shapes within a shapefile directly to an attribute using a column in the DBF file. This is done by specifying the attribute type using the column 'TYPE'. It does not matter what column position the TYPE field is in. When the DBF file does not contain a TYPE column or the TYPE column contains some other sort of metadata other than an attribute of the attribute schema being used, the program simply assigns the attribute that was associated with the shapefile as shown in Figure 75.

Also, note that since the TYPE attribute of each shape object in the file can be different, a single shapefile can be used to contain multiple attribute types (e.g. Basin_Polygons and Subbasin_Polygons) as long as the file still only contains Point, Line or Polygon data exclusively. This exclusivity of the shapefile object type is part of the shapefile specification.



TYPE	LOCATION	DSSA	DSSB	DSSC	DSSD	DSSE	DSSF
Basin_Polygons	ARCADIA BASII						
Basin_Polygons	THUNDERBIRD						
Basin_Polygons	EUFAULA BASII						
Subbasin_Polygons	LDEEP		LDEEP	PRECIP-INC	99JAN1999	1HOUR	ADJUST
Subbasin_Polygons	LNCAN		LNCAN	PRECIP-INC	99JAN1999	1HOUR	ADJUST
Subbasin_Polygons	TRNPK		TRNPK	PRECIP-INC	99JAN1999	1HOUR	ADJUST
Subbasin_Polygons	LWEWO		LWEWO	PRECIP-INC	99JAN1999	1HOUR	ADJUST

Figure 75 - Small portion of a DBF file

Supplying Labels for Shapefile Shapes

Just as the TYPE column in the DBF file is used to associate attributes, another specification is necessary for a text label to be displayed with a Point value, or to be used for a Line or Polygon name to identify the objects on the map, as well as writing the created time series hyetographs to a DSS file. For choosing text labels, the program will look for a column with one of the following names in this order and use the first one found for the label:

- NAME
- LOCATION
- ID
- DSSB
- STATION

This list of default names can be overridden using the tool to create time series from TINs which has an option to override the B part of a DSS record pathname. Once overridden, it is used for labels on the map panel polygons and DSS B part designators. If multiple polygon shapefiles are used and some do not contain the column name ion the DBF file that has been selected, the program logic will fall back to using the default column names shown above. If none of the column names exist, the program will label the polygons such that unique names are created to identify them.

Managing Shapefiles

For each shapefile selected, four files with the following extensions: SHP, SHX, DBF, and PRJ are actually required. In addition, because shapefiles must be segregated by shape type, a minimum of three shapefiles for Point, Line and Polygon types is needed if the shapefiles utilize the TYPE column in the DBF file for drawing attributes. For shapefiles that do not use the TYPE extension, a shapefile set is required for each drawing attribute type.

Some shapefiles are designed as layers, where a shapefile can represent all the rivers within a large area while another shapefile could be used for all the basin outlines. However, many shapefile sets are aligned with a specific project or basin. For an entity that was project aligned, it would not be unusual to need sixty or more files to describe all the various attributes required. A project consisting of a single Point, Line, and Polygon would require twelve shapefile components to define it.

HEC-MetVue supports the direct use of ZIP files to help manage this problem. Several shapefile sets can be placed into a ZIP file, and just like specifying an individual shapefile, a ZIP file can be specified. When a ZIP file is specified it is unzipped before use. ZIP files can have a hierarchical structure similar to a computer file system with many levels of subdirectories. HEC-MetVue will not search ZIP file subdirectories for shapefile. Only the shapefiles that reside in the ZIP file root will be used.

Map Ordering and Enabling

By default, maps are displayed in a map window in the same order that they are specified. Many times, more control is needed over the map layering[7] so that filled areas such as lakes do not obscure other features, such as a road. Ordering maps can be done by right clicking on the appropriate map or basin average node in the Project Explorer as shown in Figure 76. As can be seen from the partial menu, the file 'COPA.Polygon' is grayed out meaning that it is part of the map set but is not enabled and will not be shown on the map panel. This menu selection brings up the dialog shown in Figure 77. This dialog can be used to do two things:

- Order the maps in the necessary order by highlight one or more maps and then using the four buttons on the right to move them to the desired position
- Enable and disable the maps to control their visibility in the map panels.

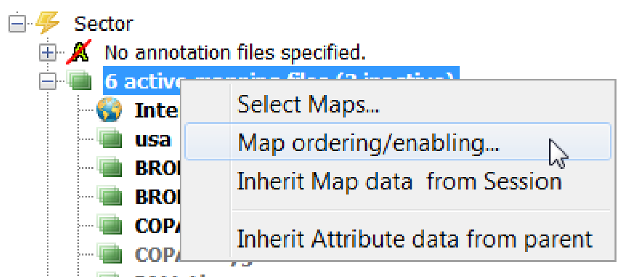


Figure 76 - Map ordering and enabling menu selection

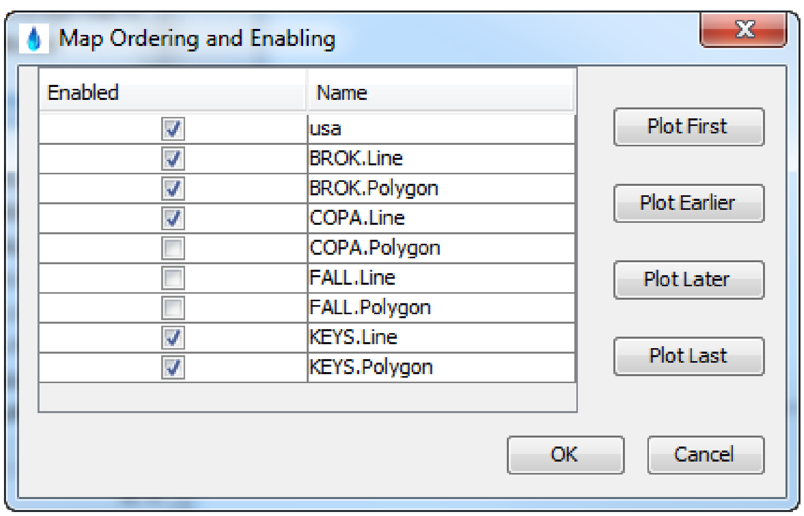


Figure 77 - Map ordering and enabling dialog

There is a second method for enabling or disabling the maps. Right click on the desired map and either activate it or deactivate it as shown in Figure 78 and Figure 80. To select multiple maps to activate or deactivate, hold down the shift key while

[7] Do not confuse the map layering with the various layers drawn on a map. In the map panels, all maps are drawn in a single layer in the order specified. The map file layer is combined with various other layers such as a contour layer or a basin average layer.

pressing the left mouse button to select a range of maps or hold down the control key and right click the mouse on each map to perform a non-contiguous selection. Once selected, right click the mouse to bring up the context menu and select the desired operation on the selected maps as shown in Figure 79 and Figure 81. Regardless of which of these methods is used to control map visibility, it is much easier and quicker to keep a list and Activate/Deactivate available than it is to go back to the file system browser and select the maps again.

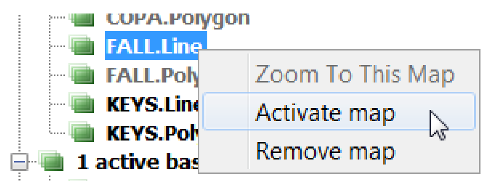


Figure 78 - Activate a deactivated map

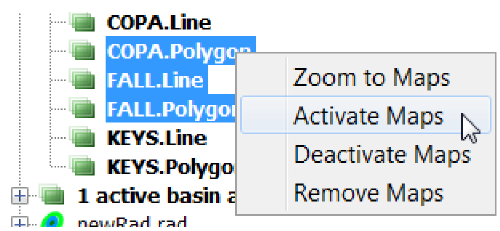


Figure 79 - Activate multiple maps

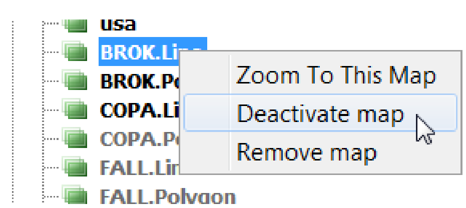


Figure 80 - Deactivate an active map

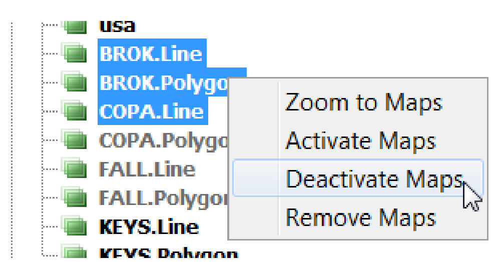


Figure 81 - Deactivating multiple maps

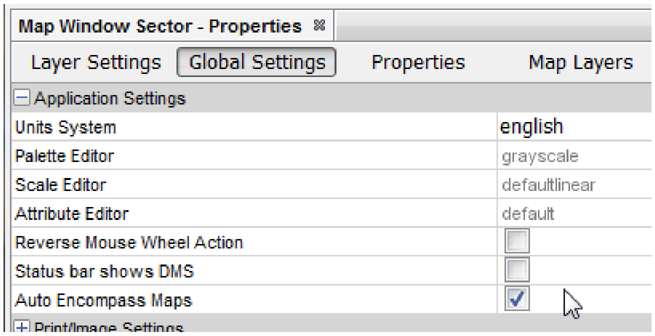


Figure 82 - Auto encompass maps

In addition to the methods above for activating maps, it is also possible to drag a '.SHP' shapefile and drop it on the map panel. Doing so will add this map to the list of maps displayed. If the shapefile is a polygon shapefile, the map will also be added to the list of shapefiles in the Basin Average Node. When the Properties->Global Settings->Auto Encompass Maps setting it selected, any maps that are activated or added to the map panel will be brought into view as shown in Figure 82.

Zoom To Map(s)

For maps that are active, right clicking on one of the maps will bring up a menu similar to what is shown in Figure 78 - Figure 81. By selecting 'Zoom to This Map' or 'Zoom to Maps', all map panels that are in the hierarchy of the selected node will be zoomed to the given location. If multiple maps are selected, the map panel view will be adjusted to be large enough to encompass all the selected maps. For example, if the map is selected from the project defaults maps, then every map panel in the system will attempt to zoom to the extents of the selected map regardless of whether the map panel contains the map or not. Of course, due to the fact that the various map panels are different shapes and sizes and possibly using different coordinate projections the resultant views may vary somewhat.

Basin Average Files

In addition to using shapefiles for mapping, shapefiles can also be used for computing basin averages, totals, and other statistics based on the intersection of various polygon shapes and TIN/measurement data.

In the Project Explorer, under every mapping node is a basin average node. Shapefiles that are placed here are not used in the map layer of the program. Instead they are used to perform basin average computations. In the map panels, shapefiles designated for basin average computations have their own distinct draw layer. All the above discussion dealing with how to select and manage these shapefiles applies to the basin average shapefiles as well. In fact, the same shapefile can be used for both purposes and often is.

Shapefiles used for basin computations can also take advantage of the TYPE field in the DBF file if it is present. The `Properties->Layer Settings-> Polygon/Basin Averages Settings` portion of the Properties panel will enumerate the various polygon attributes available for the selected attribute schema and allow them to be turned off or on in the map window. Polygon shapes that do not have a recognizable TYPE field will also be accounted for. By using these extensions, it is possible to turn off a basin average polygon rendering while leaving on a subbasin polygons contained within the same shapefile. This is particularly convenient if the basin polygon is defined later in the file than the subbasin polygons, obscuring the smaller subbasins with the basin polygon.

The basin average layer associates the polygons with a particular display characteristic, similar to the contouring layer, using both the currently selected contour palette and scale to make the rendering depending on the computed value for the basin polygon.

Basin Zone Computations

In addition to computing basin averages for each polygon in a shapefile, the program also has support for basin zones. A zone is a collection of one or more subbasins. Zones are useful for aggregating results. For example, a shapefile may contain polygons that define areas both above and below a dam. By defining each as a zone, the averages for each zone will be computed in addition to the individual subbasins and tabulated in the 'basin averages' pane. The zone is defined using the ZONE column in a shapefile DBF. To include a subbasin in a particular zone(s), add the zone name to the column. For example, Figure 83 shows the contents of a DBF file with zones a, b, c, and d defined. Both subbasins COUNW and COUNL are in zone 'a'. A subbasin can be a member of multiple zones simply by separating the zone names with a comma. COUNL and DUNLL are members of more than one zone.

	B	C
1	**LOCATION**	**ZONE**
2	COUNCIL GROVE BASIN	
3	COUNW	a
4	COUNE	b
5	COUNL	c,a
6	DUNLL	c,d
7	ROCK	
8		

Figure 83 - Sample shapefile DBF

Chapter 9

9. TIN and Gridded Data Sets

9.1 Triangulated Irregular Network (TIN)

A triangulated Irregular network (TIN) is a dataset made up of interconnected points forming a series of triangles. The triangle vertexes are the points with a known measurement value. The majority of the computations HEC-MetVue performs use this interconnected set of triangles as its basis for the [X, Y] components of the dataset. This triangulation is referred to as a Delaunay Triangulation. The mathematics for generating this triangulation are beyond the scope of this manual, however a Delaunay Triangulation states that given any three points that make up the vertex of a triangle within the dataset, a circle that contains these points on the circumference of a circle will contain no other points within the circle. The inverse of a TIN, created from bisecting each line in a TIN with a perpendicular line and then interconnecting those intersecting lines forms a Voronoi Diagram, is also known as Thiessen polygons. A small TIN is shown in Figure 84.

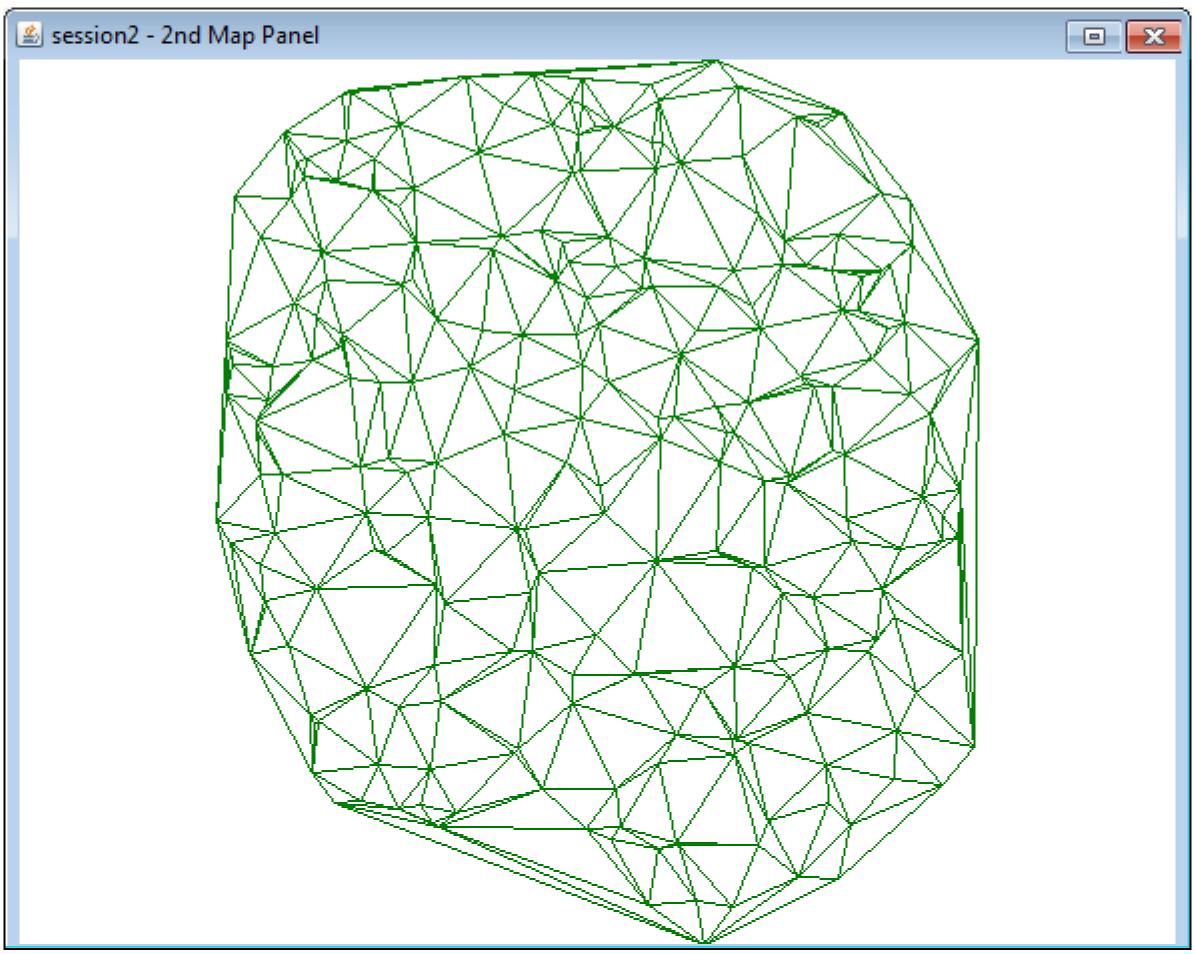


Figure 84 - TIN example

9.2 Gridded Datasets

Gridded datasets, as the name implies, are made up of a grid of data that is typically in rows and columns, at least in the map projection in which it is stored. Implied from this is the fact that the same gridded data, in some other map projection, will likely not be either equidistant or rectangular. In addition, in terms of geometric computations, gridded datasets are degenerate, meaning they can contain more than one solution to the same problem. Refer to the grid cell in Figure 85. The numbers in the corner are the measurements at those locations. The thick double arrow lines represent the contours passing through the cell. Note that there are 2 solutions to the same problem and therefore the dataset is degenerate. There is not a right or wrong solution to this, only two equally valid solutions. As both solutions are equally valid, the program simply bisects each grid cell, turning each one into two triangles, and then using the same algorithms that were used for TINs in nearly all computations[8].

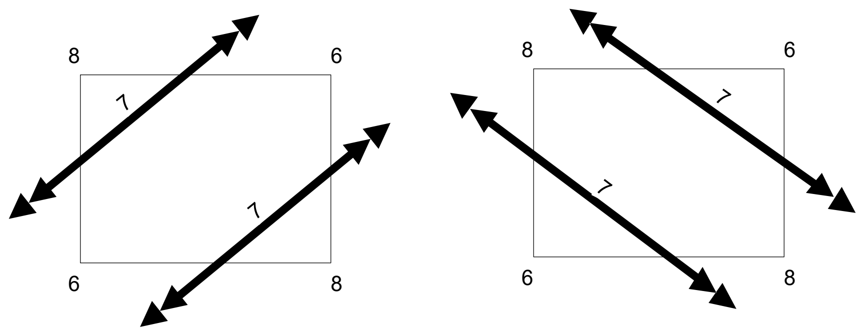


Figure 85 - Degenerate dataset grid cell with contour lines passing through

9.3 An Important Note on Grid Cell Average Datasets

A gridded dataset can be either 'area average' where the value assigned to the grid cell represents the average measurement value over the area of the grid cell or a point value where the grid cell measurement value is actually a discrete measurement value at the center point of the grid cell. Gridded radar data is typically supplied as an average over area grid. Other types of data may be some sort of sampled data at discrete point locations at the grid center points. When evaluating a gridded dataset as a TIN, the program assigns the measurement value for the grid cell to the location at the center of the TIN. For gridded datasets where the grid cell value represents an average over area, this representation as a TIN is an approximation of the surface. Some algorithms in the program, such as the Depth-Area-Duration tool have the capability to process the TIN as either a TIN or grid cell average. Under normal circumstances, this approximation is insignificant. However, in the case where an area being analyzed is smaller than the area of just a few grid cells, the combination of the modelling grid cell average data as point values and the resolution of a degenerate dataset with grid cells bisected in an arbitrary direction could give inaccurate results.

For example, referring to Figure 86, consider a group of 9 grid cells where the center cell has a measurement value of 10 and the surrounding 8 grid cells have a 0 measurement value. If a polygon, shown as a thick black outline, occupied the same area as the center grid cell, considering the polygon as a basin average would obviously give an average over the area of 10. However when modeled as a TIN, the interconnected point values now would give a

[8] Some search algorithms are optimized for gridded data sets.

surface that resembles a pyramid and results in average of 5.9. Also note that the direction of the degeneracy resolution could impact the results if the surrounding points were not all the same value.

By the time the polygon encompasses a total of 4 grid cells made up of the center cell and ½ of the surrounding grid cells as shown in Figure 87, the TIN approximation of the grid and the computation of the grid as cell averages give the same value of 2.5. This leads to the conclusion that any results for polygons with an area smaller than about 4 grid cells should be inspected closely.

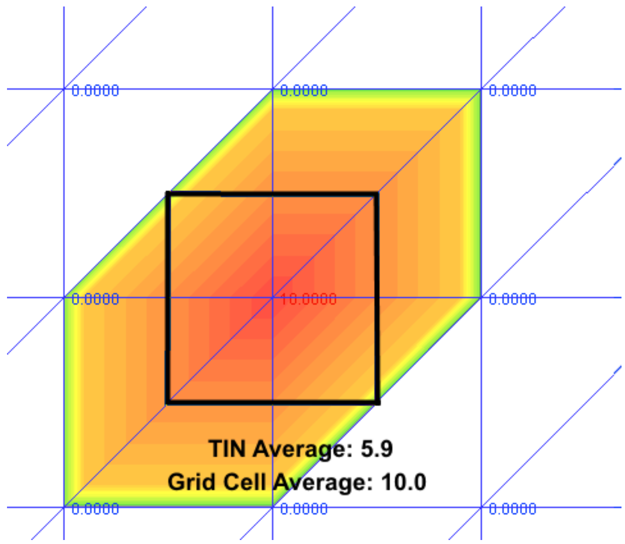


Figure 86 - Grid cell average for center cell

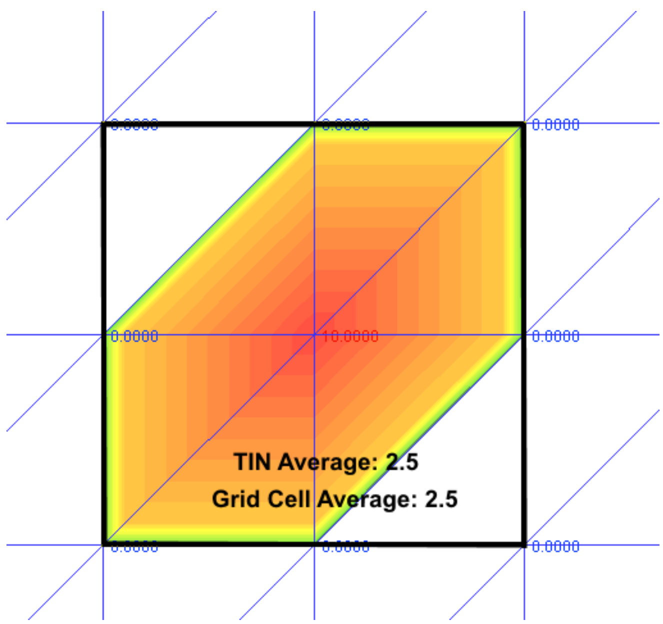


Figure 87 - Grid cell average for 4 grid cells

9.4 Polygon-based Basin Average and Volume Computation

When HEC-MetVue computes basin averages, it is actually computing a volume based on the intersection of the TIN and the polygon in question and then applying this volume to either the entire polygon area or the intersected area of the polygon and defined TIN. Grids cells that are missing do not contribute to either the volume or the intersected area applied to the polygon. A normal TIN that does not represent a grid cannot have missing cells since it is a representation of existing data with any missing data excluded from the triangulation. HEC-MetVue can display averages for any type of data but only displays volumes if the measurement value is in a unit of length, such as inches.

An example of a dataset where it is more appropriate to use the intersected area for a computation would be a gridded dataset that represented snow depth having the grid cells over water bodies set to missing. If the objective is to compute the average snow depth over land, the intersected area between the defined portions of the TIN and the polygon will give the desired value. Figure 88 is an example of a TIN with missing cells (blue mesh) intersecting a polygon and displaying both intersected and total area averages and their associated areas. Note that HEC-MetVue will only display both averages and areas if both types are selected in the Properties panel->Layer Settings->Polygon/Basin Averages section and the intersected and total areas for a polygon actually differ. As an alternative to using intersected area, a shapefile with the water bodies represented as 'holes' within the polygon should give nearly the same result as long as the cell resolution can closely approximate the water body area.

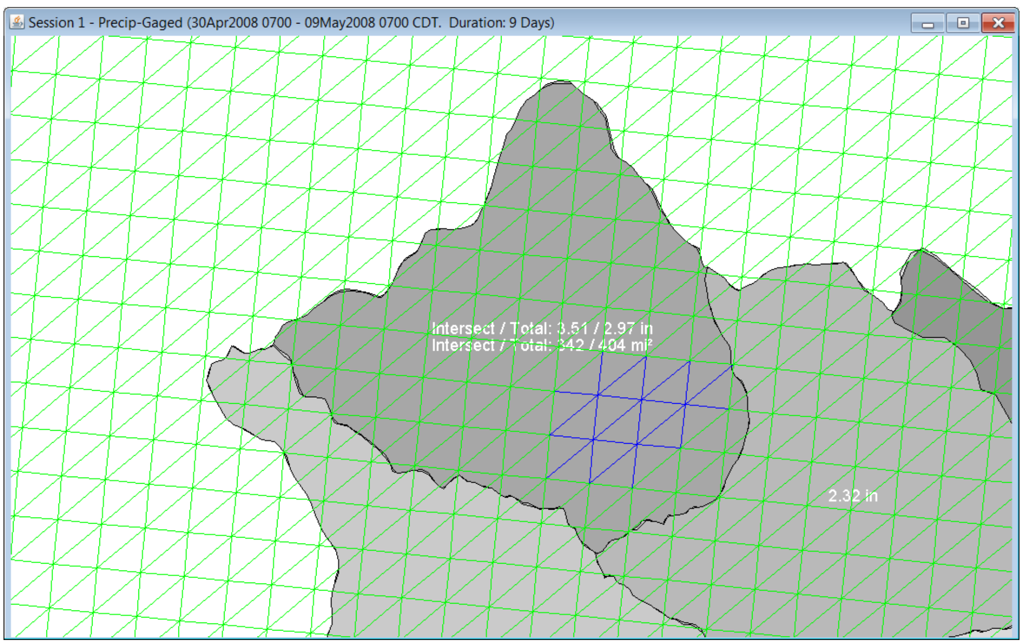


Figure 88 - Example TIN with missing cells

When using observer data for a TIN (especially a historical storm), it is typical for the storm to be defined by observer reports. However, the area directly adjacent to the storm would not have observer reports, even though in actuality the area just outside the storm had zero precipitation. Although the TIN does not encompass the zero precipitation area since no reports actually exist, zero precipitation over areas not covered by the TIN is implied. In this case, the correct area average for a polygon is the total polygon area. Figure 89 is an example of a TIN where it is more appropriate to use the polygon total area for the computation. In this example, the observer network reports stop short of covering entire areas of subbasins in the eastern side of the watershed as there were no reports there just outside the limits of the storm. Therefore, it would more appropriate in this case to rely on the total polygon area average, which uses a fair assumption of zero precipitation over the portions of the subbasins outside the observer TIN limits.

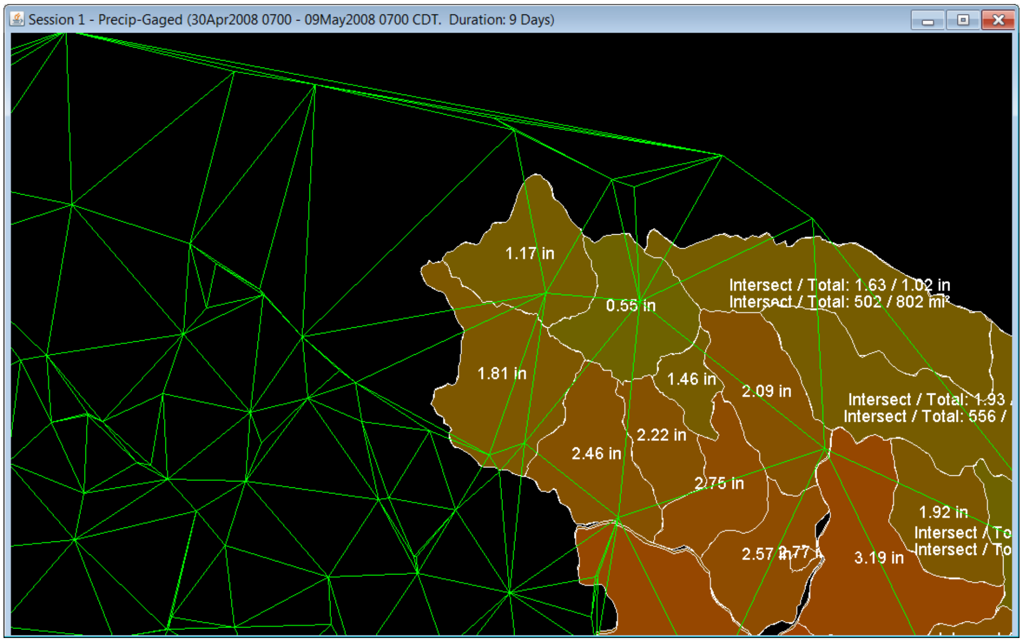


Figure 89 - Example TIN based on observer data

9.5 Specifying TIN Datasets from the Project Explorer

As with most all the other options, the TINs can be specified at the project, session, or map level. An example is shown in Figure 94.

File Masks and Naming Templates

To aid in naming files or directories for retrieving or saving data, many I/O providers and other tools in the program use file masks or templates so that, for example, a single template specification could be used to write several TINs to the file system. There are several flags that can be used for the template. All flags start and end with the percent '%' sign and act as placeholder for the actual starting or ending date of the TIN and the sequence number. Table 25 is a reference to the supported flags.

Table 25 - File masks and naming templates

Flag	Description
%s:<dateformat>%	Specifies the start date of the TIN to be operated on. The <dateformat> can be any valid Java Date format string. For example the string %s:ddMMMyyyy_HHmm% would perhaps translate to 01Jan2016_0408. An in depth discussion of Java date formats can be found at https://docs.oracle.com/javase/8/docs/api/java/text/SimpleDateFormat.html
%<dateformat>% or <%e:<dateformat>%	Specifies the ending data of the TIN. The 'e:' is optional for the ending date. The ending date works exactly the same as the starting date defined above.

%durfmt1%	This will determine the largest integral time unit to display the time in. For example a TIN that has a 24 hour duration will result in a duration string of '1DAY'. The durations will either be in units of DAY(S), HR(S), MIN(S), SEC(S), or MS.
%durfmt2%	This will print the duration in a format supported by the W3C XML Schema 1.0 Specification. For example the string **P5Y2M10DT15H** represents a period of five years, two months, 10 days, and 15 hours.
%nnn%	This is a sequence number. If 72 TINs are to be written they would have sequence numbers 1 through 72. The number of 'n' characters denotes the width of the string. For example %nnnn% would return sequence numbers 0001, 0002…0072. %n% would return 1, 2…72.
%t%	This is a placeholder for the TEMP file directory. It is replaced with the temporary directory location defined for the system being used.

Note that many of the I/O providers support templates that have varying directory names as well as file names. For example, given a set of 1-HR duration output TINs that cover the timespan 30Dec2015 0000 through 03Jan2016 2400, the following template: C:/MyRadarFiles/%yyyy%/%MMM%/%dd%/%yyyyMMdd-HHmm% would create the appropriate directories and put 24 hourly TIN files in each one. The files would be named:

- C:/MyRadarFiles/2015/DEC/30/20151230-0100
- C:/MyRadarFiles/2015/DEC/30/20151230-0200
- …
- C:/MyRadarFiles/2015/DEC/30/20151231-2400
- C:/MyRadarFiles/2016/JAN/01/20160101-0100
- …
- C:/MyRadarFiles/2016/JAN/03/20160101-2300
- C:/MyRadarFiles/2016/JAN/03/20160101-2400

TIN Input/Output (I/O) Plugin Provider Specification

HEC-MetVue uses I/O plugins to supply TINs to the program and save edited TINs from the program. A plugin is a software component that adds a specific feature to an existing program. In this case, the plugin is used to read or write a specific file format, such as an ESRI ASCII formatted file, that is not supported natively by the HEC-MetVue program. HEC-MetVue incorporated this capability beginning with version 2 to expand the capability of the program to accommodate data stored in any format that is required. A document describing how to write an HEC-MetVue plugin is available from the Hydrologic Engineering Center (2015). Plugins are much easier to write than attempting to modify the HEC-MetVue program to add capabilities.

Starting with Version 3 of the program, HEC-MetVue provides a user interface component within the program to manage plugins. This replaces the command line methodology that Version 2 employed. The plugin manager can be accessed from the Tools menu as shown in Figure 90.

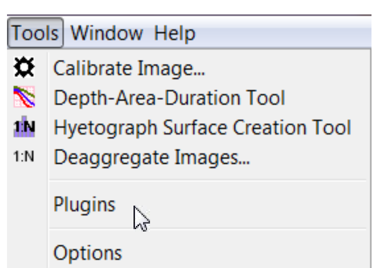


Figure 90 - Accessing the Plugin Manager

Figure 91 is an example of the Plugin Manager dialog. HEC-MetVue is deployed with some plugins and they are shown on the 'Installed' tab in the dialog. Notice that although the plugins are installed, many are not activated. The only plugins that are activated by default are for reading NetCDF and XMRG files. This is to provide backward compatibility with earlier versions of HEC-MetVue. In additon to the plugin providers shown, HEC-MetVue has built in support for reading its own native TIN and NEXRAD HRAP grid files as well as HRAP and SHG grids stored in DSS. Although the native file and DSS readers are plugins, they are not displayed in the Plugin Manager and cannot be deactivated.

The left side of the dialog tab shows the available plugins. Active plugins are marked with the symbol. The category lists the type of plugin. The right side of the dialog tab gives a description of the currently selected plugin. Plugins that are deployed with MetVe can be activated and deactivated. **Plugins that are deployed with HEC-MetVue should never be uninstalled.** These plugins are supplied in the various jars that accompany the deployment and are not contained in a separate ".NBM" module file.

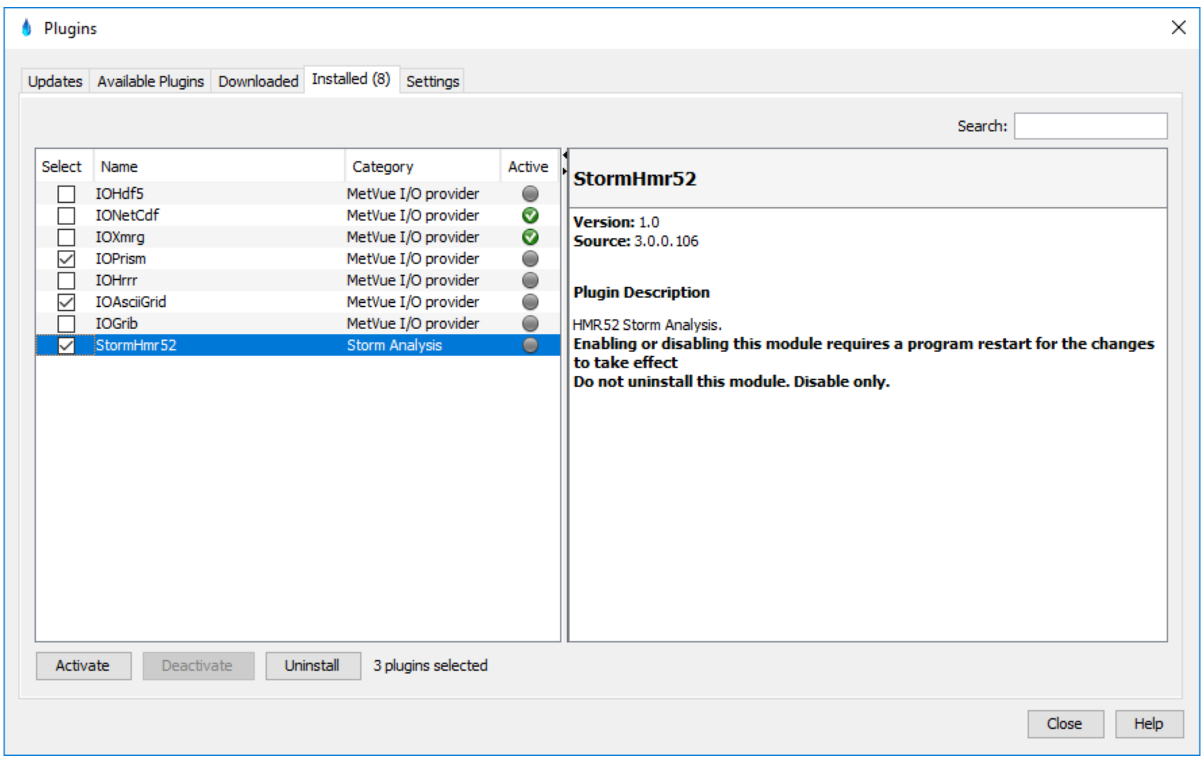


Figure 91 - Plugin Manager (Installed components)

In the event a plugin is accidentally uninstalled that was part of the original install, the most straighforward way to recover is to completely uninstall and reinstall the program following the instructions in this manual. Figure 92 and Figure 93 illustrate the Plugin Manager activation and confirmation dialogs.

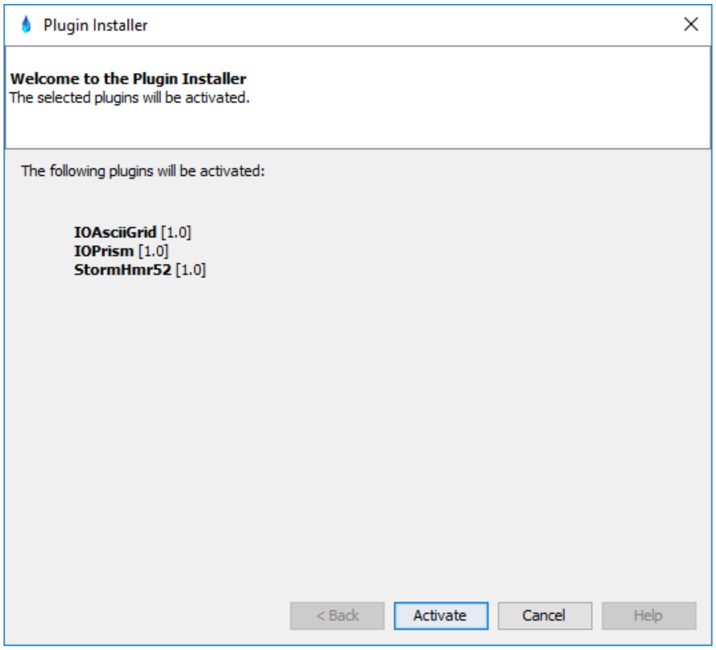


Figure 92 - Plugin Manager (Activation dialog)

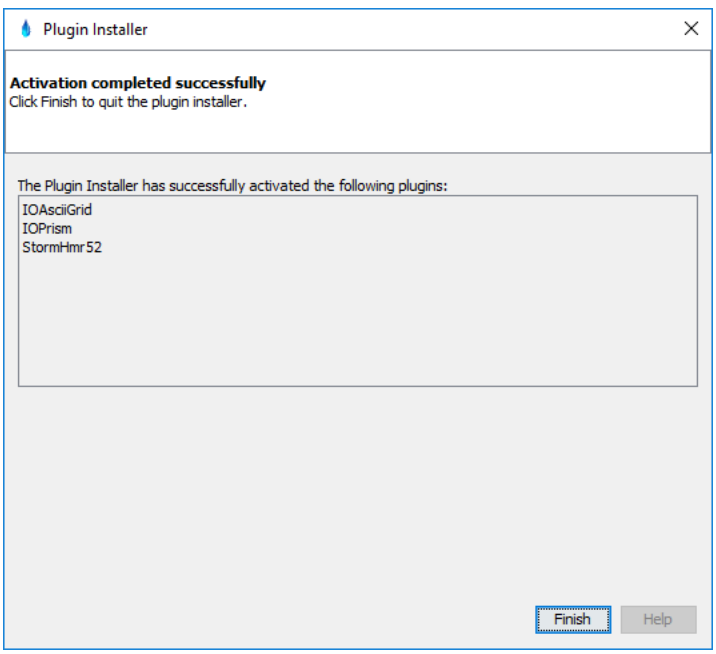


Figure 93 - Plugin Manager (Confirm dialog)

HEC-MetVue has two variations of I/O providers. The first is a generic provider that reads data from a file such as an HEC-DSS file or ESRI ASCII grid file. Providers that read data from a file can use the generic HEC-MetVue FILE I/O provider dialog for the user interfaces. Regardless of whether the input file is an ESRI ASCII grid file, an NWS HRRR file, or a NEXRAD XMRG file, the same dialog is usually used to specify the input files. The second variation of the I/O provider requires the plugin to provide its own user interface. For example, the StormHmr52 provider provides its own user interface to specify the input data necessary to generate TIN datasets since the plugin was designed to not use the built in file or DSS dialogs. Likewise an I/O provider that connected to an Oracle database would need a custom dialog to specify the necessary input for retrieving TIN datasets. The designer of the I/O provider can decide which variation supports the input data source.

Certain I/O providers are loaded by default. Providers that supply native HEC-MetVue TIN files and the DSS provider for LFM and SHG grids are always loaded. Also, for backwards compatibility reasons, the providers for NEXRAD XMRG and NetCDF files are always loaded but this may change in a future release. The first time HEC-MetVue is executed after it is installed, it ensures the correct providers are enabled. If one wishes to have all the plugins enabled the command line option **-J-DenableAllPlugins** can be used. Note that this only works the first time HEC-MetVue is executed after it is installed. Loading all the I/O providers takes more memory and degrades performance to a degree. There is also a chance that two providers could interfere with each other, but that is a low probability. As time progresses there could be dozens of I/O providers available and perhaps only a few are required. There may be specific providers to access private databases that are not accessible by the current user but if that provider was loaded the user would still have to sift through all the menus and dialogs that provider adds to the program.

Table 26 provides a list of known I/O plugin providers currently deployed with the program.

Table 26 - Known I/O Providers

I/O Provider	Provider Type	Description
Native TIN	FILE	This is the legacy TIN file format developed in the 1990's by the Tulsa District Corps
Native NEXRAD	FILE	This is the legacy TIN file format developed in the 1990's by the Tulsa District Corps to hold NEXRAD data decoded from XMRG and NetCDF files.
XMRG	FILE	A format used by the NWS for data interchange. There are actually multiple variations of the XMRG file format that the I/O provider supports.
NetCDF	FILE	A format used by the NWS for data interchange. There are actually multiple variations of the NetCDF file format that the I/O provider supports.
LFM	DSS	This is the format used in DSS for a native NWS NEXRAD image.
SHG	DSS	This is the Standard Hydrologic Grid format used by many HEC programs. It is a grid when used in a specific Albers Equal Area projection. A common use is for storage NEXRAD radar images. Since it is on a different grid than the original NEXRAD grid, programs that process NEXRAD grids to this format must use some sort of sampling mechanism of the original image. This sampling is 'lossy' and they grid density of the SHG grid is higher to help compensate for this. SHG grids are used for many purposes other than radar images.

HRRR	FILE	HRRR is the NWS High Resolution Rapid Refresh data. These are hourly forecasts, up to a lead-time of 16 hours, at a 3km resolution over the contiguous USA.
NEXRAD_GRIB	FILE	Another file format the NWS uses for data interchange of NEXRAD radar data.
PRISM	FILE	The PRISM data format comes from the PRISM Climate Group. More information on PRISM data can be found at http://www.prism.oregonstate.edu/. The PRISM data must be available on the file system and downloaded prior to using as the I/O provider does not include a web or ftp interface at this time.
ASCII_GRID	FILE	This I/O Provider is capable of reading ESRI ASCII grid file

FILE I/O Provider

The FILE I/O provider is used to read TIN data from files. To select data from a file, right-click on the node in the Project Explorer window denoting the TINs selected for either the project, session, or map panel of interest. An example is shown in Figure 94. Selecting the TIN brings up the following dialog samples as shown in Figure 95. Note that the dialogs shown in this example are examples. The actual look of the dialog will change depending on the options selected. Options include whether or not to use absolute or relative time specifications, and more functionality is described in Table 27 below.

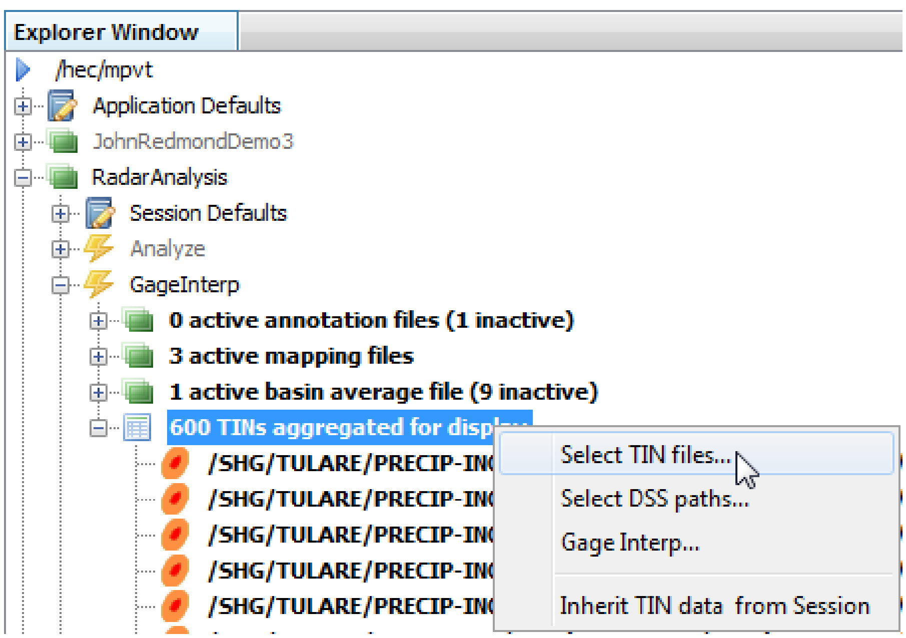


Figure 94 - Selecting the FILE Provider

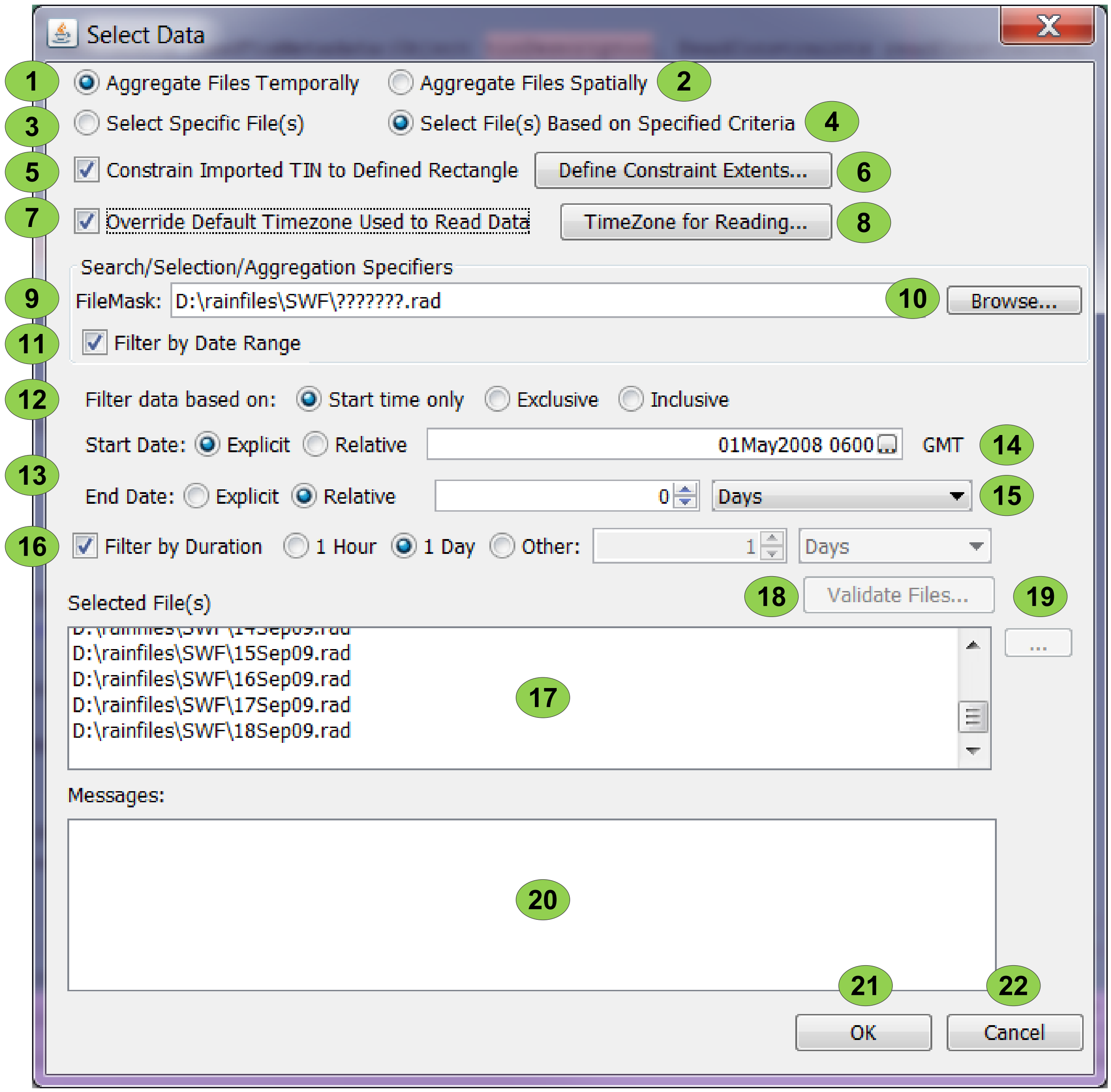


Figure 95 - Selection of TIN files

Table 27 - Selection of TIN files description

Item	Description
1	Use this option to aggregate datasets over different timespans, where the datasets have the same approximate spatial location. If this item is checked, then the grids of the files that are aggregated together are summed to get the total for the resultant dataset[9].
2	Indicates that the dataset aggregation is being done primarily to cover a larger area for the same time span. When datasets are aggregated spatially, the overlap in the datasets is averaged as opposed to summed.
3	When 'Select Specific Files' is selected all the filtering denoted by items 9 through 16 are disabled (not shown here) and the buttons 18 and 19 are enabled to allow selection and validation of files for either time or spatial addition. The text field 17 is also directly editable in this mode. Note that validating as shown in 18 is a convenience to ascertain any unwanted overlaps that the data may have. Regardless of the warnings, the TINs can always be aggregated together when this is selected.
4	This activates the controls that allow filtering of the data. The textbox that shows the selected files cannot be edited in this mode and buttons 18 and 19 are disabled. This option along with the time filters must be selected and active for the dynamic time window control bar at the bottom of the map panels to function.
5	This is used to constrain any TINs read to be just large enough to contain the defined rectangle. The intent of this option is to limit the size of the created TINs to improve the memory utilization and computation speed of the program by 'clipping' the TIN to the required extents. Using this option can significantly improve program performance.
6	This button will display the dialog shown in Figure 96 to input the spatial constraints. Note: The native TIN I/O provider that reads irregular TINs ignores this constraint.
7	Use this option if the program I/O provider cannot find Time Zone information in the input dataset's metadata, or if the program is reading the timespan of the data incorrectly. For example, the PRISM I/O provider reads data with an implied 12 hour offset from GMT due to the fact that the ending date/time is encoded with only the date and no time. So end time is read as 0000 on the specified date but the end date is actually 0700 EST based on the implied 12 hour offset from GMT per the PRISM Climate Group's online documentation. More common examples are TINs stored as GMT and the program is reading them in local time or vice versa.
8	Selecting this button brings up the Time Zone selection dialog (Figure 97, Table 29) so that one can specify the time zone to use when reading the data.
9	This filter restricts the list of potential files to the file mask selected. Normal search masks of '*' and '?' are supported.
10	This is used to select a file or directory to use for a file mask template so the entire directory location does not need to be typed.

[9] Some NWS Stage III radar grids have been set to 0 outside of the calibrated area of the image. If the values were summed for temporal aggregation or averaged for spatial aggregation, the result would be flawed. This application ignores 0 grid cells when aggregating radar images unless all cells are zero.

11	If this is checked, any files that match the file mask are further filtered by the time filtering criteria defined by items 12 through 15. For all the files that match the given file mask, the program inspects the metadata within each file header to ascertain if it meets the timespan filtering criteria. This is done in in a way so as not to stall the program while the files are inspected. However, it can take a significant amount of time to accomplish this, especially on directories with many files matching the given file mask. This option, along with the option above to select files based on specified criteria, must be selected and active for the dynamic time window control bar at the bottom of the map panels to function.
12	This specifies how to apply the time filter to the files matching the given mask. When set to 'Start time only' the program inspects only the start time of the data. If it falls within the 'Start Date' and 'End Date' filters it will be included. When set to 'Exclusive' both the start times and end times of the data must occur within the given time filter. When set to 'Inclusive' either the start time or the end time must occur within the given time filer.
13	This is the time filter used to set the start and end times used to filter the file list. Either date can be specified in either an explicit or relative way. When specified as 'Relative' as shown above for the start date, every time a search is done, a date is computed based on adding the specified timespan from the current time. If the timespan is negative as shown above, then the date computed would occur before the current date. When the filter is specified as 'Explicit' as shown for the end date, an actual date is specified which does not change with the current time.
14	When 'Explicit; is selected, a single date specified control is available to select the desired date.
15	When 'Relative' is selected, two controls will be shown to specify a timespan which is added to the current time to compute a date. If it is negative, it occurs before the current date. The dropdown box specifies whether the scalar is in Days, Hours, etc.
16	Select this item if the duration of the TIN is known. Most often the duration is 1 hour or 24 hour. In the event it is not, elect 'Other' and pick a different supported duration from the list.
17	This shows the resultant files selected from the filename and time filtering. This field in not editable unless the 'Select Specific File(s)' option is selected. Note: for legacy reasons, this program will read image data directly from a text file but does not yet have facilities for specifying the timespan, image type, or data units for the data. It can be displayed.
18	This button is enabled only if the 'Select Specific File(s)' option is selected. It inspects the metadata in the files and prints out warning for any issues with aggregating them.
19	This button is enabled only if the 'Select Specific File(s)' option is selected. It opens a standard file selection dialog where one or more files can be selected.
20	Any warnings dealing with invalid images will be displayed here.
21	Accepts the selections made. If the selection is being made for a map panel or a map panel inherits these settings then the program starts a process (thread) to aggregate these images. If no map panel (perhaps a session with no active map panels) currently uses these settings, then the information is stored until needed and no action is taken.
22	Cancels any changes made. All edits are discarded.

The constraints editor shown in Figure 96 is used to create a TIN from a subset of the data that is available. Although the constraint rectangle is defined in terms of longitude/latitude coordinates, the data may be stored in some other coordinate reference system such as UTM. The program compensates for this and the resultant TIN may end up being somewhat larger than what was specified. Also, if the constraint rectangle exceeds the limits of the actual data, most I/O providers will trim the resultant TIN.

This is a fairly simple editor but because the map views are continually changing and the program persists all settings to the project file, including these constraints, no matter which option was selected to set the constraints, they are always stored as 'Custom' constraints. This is due to the fact that once set, the source map panel view or defined polygon will change but the coordinates that were selected are fixed. If values are saved by pressing the 'OK' button and then the editor is invoked again, it will always show the extents choice as 'Custom'. This means that once a constraint selection is made then the view changes or the program is restarted and TINs have to be re-read, the original constraint rectangle remains intact. Table 28 provides a description of the features available in the constraints editor.

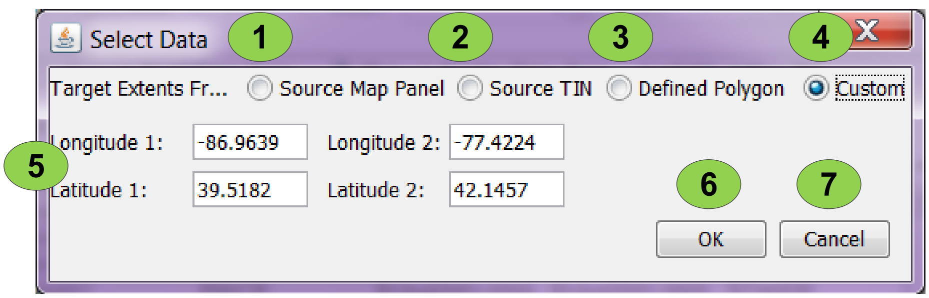


Figure 96 - Spatial extents constraints dialog

Table 28 - Spatial extents constraints description

Item	Description
1	This option uses the map panel extents for creating the subset of data used for the TIN. It may convenient to set the map panel view to the area of interest and then to use this for the extents.
2	This option uses the TIN in the associated map window to set the extents for future TINs.
3	If a polygon has been defined in the associated map panel this option will be enabled. The program will inspect the polygon and define an encompassing rectangle to use.
4	Select this to input custom coordinates for the constraint rectangle.
5	This is where the constraint rectangle is defined for the 'Custom' option. For all other options the coordinates are shown but cannot be edited.
6	This button saves the constraints. Constraints are always saved as custom constraints regardless of what extents were used to create them originally.
7	Cancels any changes made. All edits are discarded.

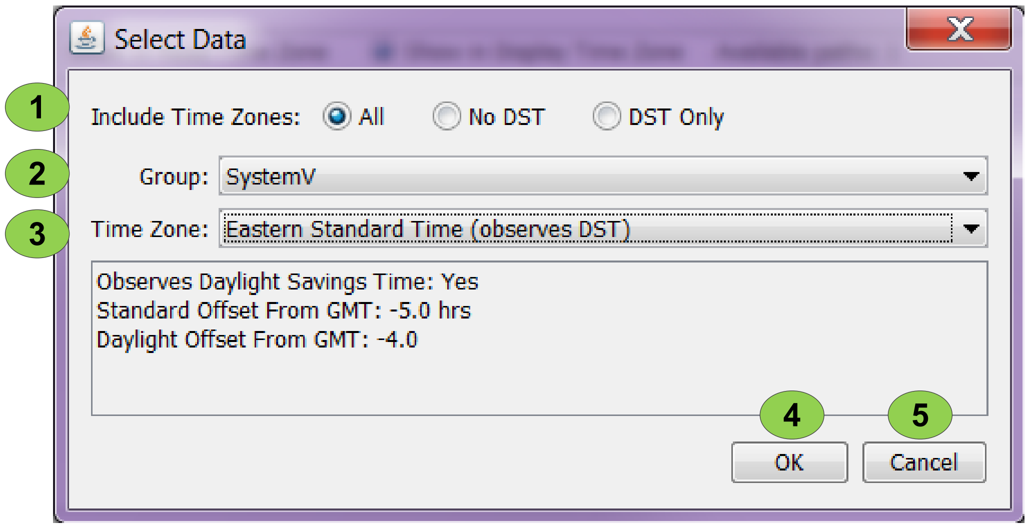


Figure 97 - Time Zone selection editor

Table 29 - Time Zone selection editor description

Item	Description
1	This acts as a filter for the time zone selections so that the choices in the Time Zone drop down selector contains only conforming choices.
2	The groups of time zones. The groups and time zones are based on standard definitions which can be viewed at https://en.wikipedia.org/wiki/List_of_tz_database_time_zones
3	The time zones for the selected group.
4	This button saves the constraints. Constraints are always saved as custom constraints regardless of what extents were used to create them originally.
5	Cancels any changes made. All edits are discarded.

ESRI ASCII Grid File Provider Special Considerations

1. HEC-MetVue requires the PRJ file that is associated with the gridded data file to have a standard well known text (WKT) format. Some ESRI products create an alternative PRJ file by default which is not supported by HEC-MetVue.

2. The ESRI ASCII Grid File Provider can read or write ASCII files in either TXT or FLT format. However, the file specification for this file type does not have a means to specify additional metadata that the program requires for many of the operations it performs. This is a significant deficiency that limits the usability of ASCII files. The most essential metadata is:

   - Starting date
   - Ending date
   - Measurement units such as inches or mm

   Adding additional metadata to the HDR or ASC file would invalidate the files for other programs that required them since it would not adhere to the specification. The alternative currently supported is to include a 'sidecar' file with the gridded data file.

A sidecar file is simply a file that has the same name as the original file but with a different file extension. ESRI ASCII files already have a sidecar file with a PRJ extension to specify the coordinate reference system.

PRISM data has a sidecar file with an XML extension that has a format that supports the metadata requirements of HEC-MetVue. It was decided to adopt this metadata format instead of developing a completely new one. HEC-MetVue requires only a subset of the metadata that the PRISM file specification supports. The sample in Figure 98 is an XML metadata file created by HEC-MetVue that contains the minimum amount of necessary information.

```xml
<?xml version="1.0" encoding="UTF-8"?>
<metadata>
  <idinfo>
    <citation>
      <citeinfo>
        <title>Projected from D:\rainfiles\SWT\07may08.rf</title>
      </citeinfo>
    </citation>
    <timeperd>
      <timeinfo>
        <rngdates>
          <begdate>20010501</begdate>
          <begtime>1800</begtime>
          <enddate>20010502</enddate>
          <endtime>0000</endtime>
        </rngdates>
      </timeinfo>
    </timeperd>
  </idinfo>
  <eainfo>
    <detailed>
      <attr>
        <attrdomv>
          <rdom>
            <attrunit>in</attrunit>
          </rdom>
        </attrdomv>
      </attr>
    </detailed>
  </eainfo>
</metadata>
```

Figure 98 - Sample metadata file for ESRI ASCII grid files

DSS I/O Provider

The DSS I/O provider is used to read gridded data from DSS files. To select data from a DSS file right click on the node in the Project Explorer window denoting the TINs selected for either the project, session, or map panel of interest. An example is shown in Figure 99. Selecting this brings up the following dialog samples as shown in Figure 100 and Figure 101. Note that the dialogs shown in this example are examples. The actual look of the dialog will change depending on the options selected. For example, whether the option to use absolute or relative time specifications is selected, but the functionality is as described in the accompanying tables below.

Figure 100 is an example of the selection editor when used to filter selections from a DSS file. The Select Specific Path(s) mode allows manual selections from the filtered path list. When operating in this mode, since the actual paths are manually selected, the 'Selected Paths' list will never change without taking some action to manually edit the list. The 'Available Paths' list will change depending on the paths in the DSS catalog file along with the path, time, and duration filters. In this mode, the filters are used solely to make the list of paths to select from more manageable. Using this mode, it is possible to select paths with different characteristics or even from different DSS files into a single map panel. In fact, the paths read can even be stored in different time zones; therefore, it would be possible to aggregate observed hourly radar data stored in Pacific Standard Time from one DSS file with 6 hour QPF data store in GMT from a different DSS file. Table 30 provides a description of the features available in the selection editor.

Figure 101 is an example of the selection editor when used to filter selected paths from the DSS file. When operating in this mode, the paths selected are based solely on the path, time, and duration filters. All the paths selected will conform to the same path, time, and duration filters and come from the same DSS file. Every time the program is started, the lists of paths is re-evaluated based on the current time in conjunction with the existing filter settings that were previously selected and the current contents of the DSS file. While displaying the editor, every time a filter is changed, the list of matching paths is reevaluated based on the current time. Once the editor is dismissed by pressing the 'OK' button, the filtered list of paths is not re-evaluated until the program restarts or the editor is displayed and 'OK' is again pressed. This guarantees that right clicking on the map panel context menu to refresh the TINs will give the same results as when the filtered list was originally created. Of course, if the contents of the DSS file changed, the change may impact the paths that could actually be retrieved. The Project Explorer window can help with detecting this situation along with many other anomalies when dealing with DSS based data. This option must be selected for the Dynamic Time Window Control Bar in the corresponding map panel to be functional.

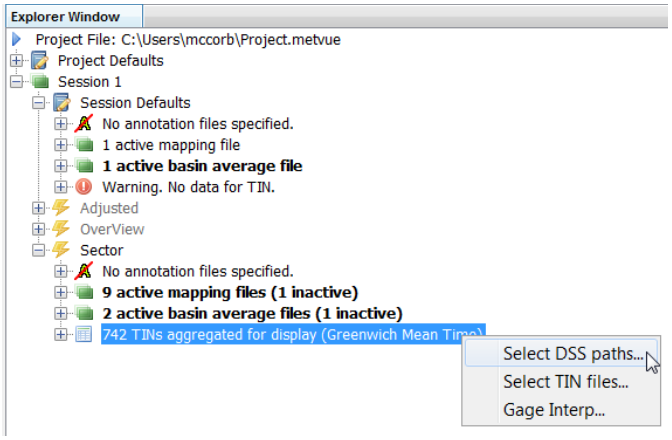


Figure 99- Selecting the DSS Provider

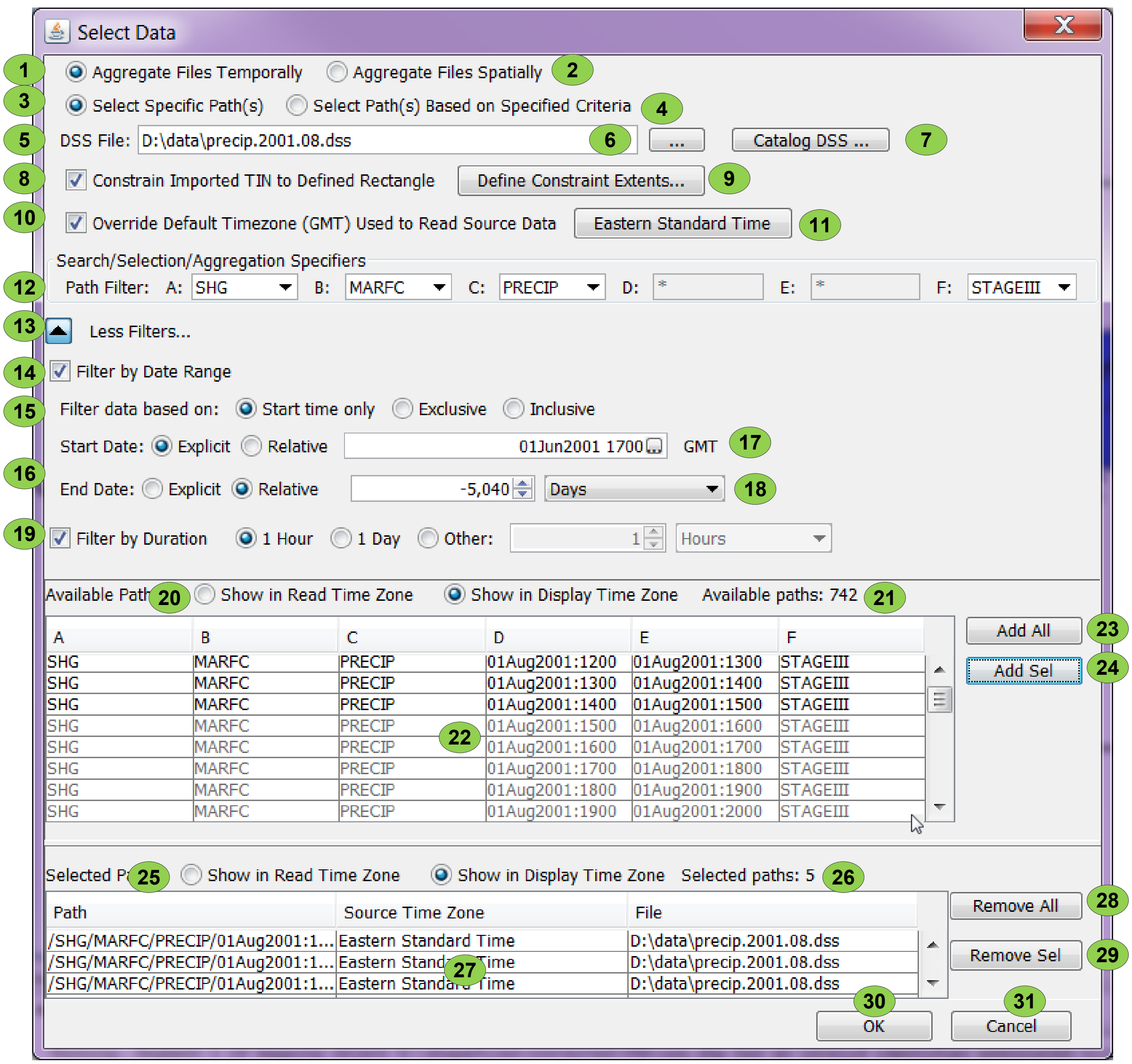


Figure 100 - Manual selection of TINs from DSS

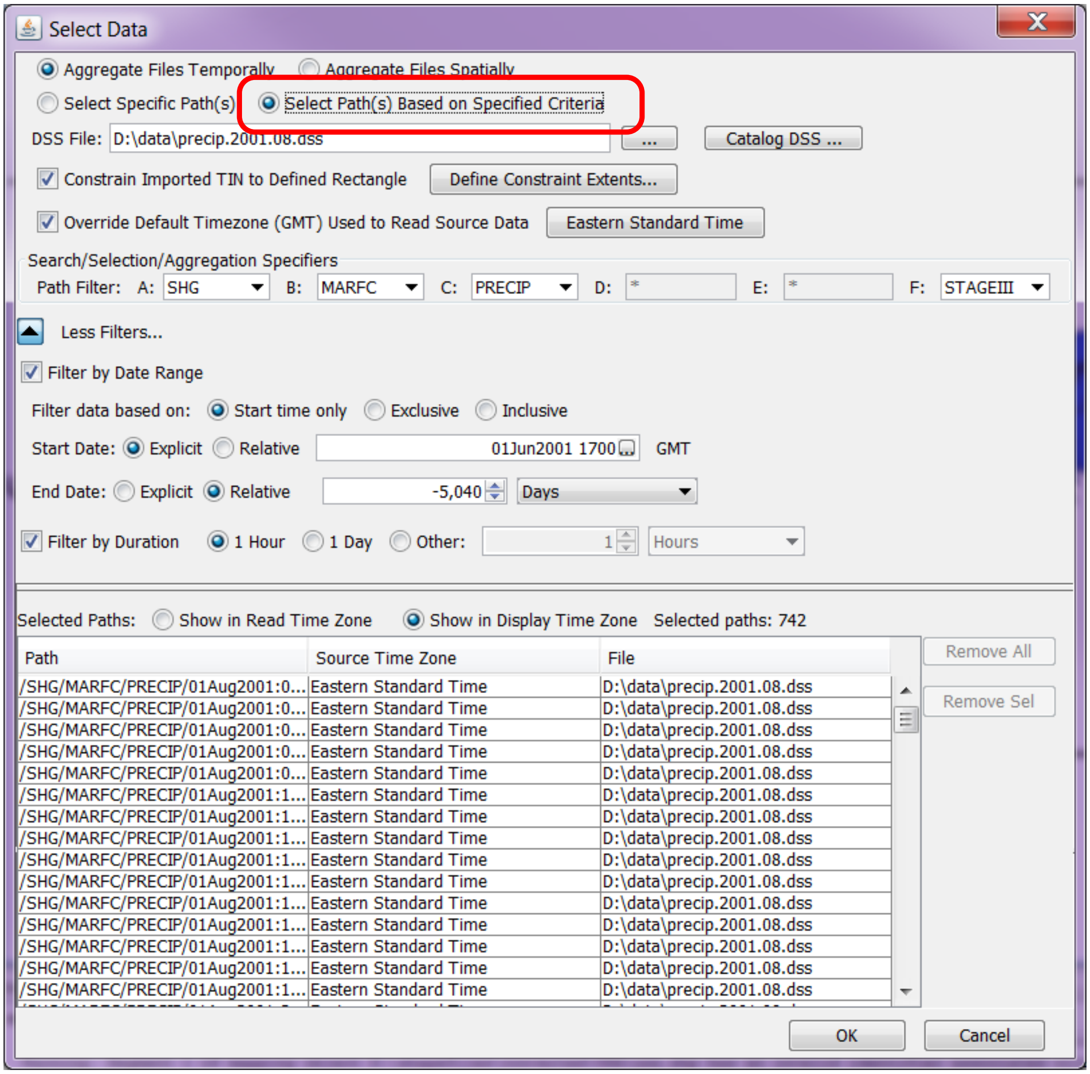


Figure 101 - Filtered selection of TINs from DSS

Table 30 - Selection of TINs from DSS description

Item	Description
1	Use this option to aggregate datasets over different timespans and that have the same approximate spatial location. If this item is checked then the grids of the files that are aggregated together are summed to get the total for the resultant dataset.
2	Indicates that the dataset aggregation is being done primarily to cover a larger area for the same time span. When datasets are aggregated spatially, the overlap in the datasets is averaged as opposed to summed. However when averaged, zero values are ignored to account for an issue where NEXRAD radar data supplied by some river forecast centers used to set radar data outside of their boundaries to zero as opposed to missing. Future versions of HEC-MetVue will add controls to select the appropriate aggregation method to use.

3 When 'Select Specific Path(s)' is selected, the listing of available paths is shown. Refer to the discussion above for a detailed explanation of this option.

4 When this option is selected all the filter criteria is available but the 'available paths' portion of the control is not shown. All the selected paths are based on the constraints of path parts and time filtering. Refer to the discussion above for a detailed explanation of this option.

5 Used to select the DSS file to use. Multiple paths from multiple DSS files can be selected if option 3 is used. If option 4 is used the path selection is restricted to data retrieval from a single DSS file.

6 This is used to select a DSS file from the file system.

7 This catalogs the DSS file so that the search/selection criteria shows the paths that are in the DSS file.

8 This is used to constrain any TINs read to be just large enough to contain the defined rectangle. The intent of this option is to limit the size of the created TINs to improve the memory utilization and computation speed of the program by 'clipping' the TIN to the required extents. Using this option can significantly improve program performance.

9 This button will display the dialog shown in Figure 96 to input the spatial constraints.

10 Use this option if the data is stored in a different time zone that the DSS provider is expecting. The DSS convention is to store all gridded data in GMT. This can be overridden for data that does not follow standard convention.

11 Selecting this button brings up the Time Zone selection dialog so that one can specify the time zone to use when reading the data.

12 This is the control for filtering DSS by path part. The dropdown lists contain all the possible parts for the A, B, C, and F path parts that a DSS file contains. These fields are editable so, for example, if a DSS file contained A parts of SHG, SHG-EDITED, HRAP, and HRAP-EDITED; using a mask of HRAP* would show all paths starting with HRAP and exclude everything else. The D and E path filters can be used to put in a mask to filter the results. The D and E filters are only available if date range filtering is not being used.

13 This is used to collapse the time filters so that more data can be displayed in the path lists. The filters are still active. When collapsed, there will be an indicator about which filters are active.

14 If this is checked, any paths that match the path masks are further filtered by the time filtering criteria defined by items 15 through 18. For all paths that match the given path mask, the program applies the timespan criteria to the D and E parts of the pathname respecting the time zone settings as specified.

15 This specifies how to apply the time filter to the paths matching the given mask. When set to 'Start time only' the program inspects only the start time of the data. If it falls within the 'Start Date' and 'End Date' filters it will be included. When set to 'Exclusive' both the start times and end times of the data must occur within the given time filter. When set to 'Inclusive' either the start time or the end time must occur within the given time filter.

16 This is the time filter used to set the start and end times used to filter the file list. Either date can be specified in either an explicit or relative way. When the filter is specified as 'Explicit' as shown for the start date, an actual date is specified which does not change with the current time. When specified as 'Relative' as shown above for the end date, every time a search is done, a date is computed based on adding the specified timespan from the current time. If the timespan is negative as shown above, then the date computed would occur before the current date.

17 When 'Explicit; is selected, the time zone is displayed and matches the display time zone (defined for a session in the Properties panel using the Properties->Display Session Time Zone setting). All dates and times must be displayed using the session time zone.

18 When 'Relative' is selected, two controls will be shown to specify a timespan which is added to the current time to compute a date. If it is negative it occurs before the current date. The dropdown box specifies whether the scalar is in Days, Hours, etc.

18 Select this item if the duration of the TIN is known. Most often the duration is 1 hour or 24 hour. In the event it is not, elect 'Other' and pick a different supported duration from the list.

19 Select this option to constrain the paths shown by their duration. Since gridded paths do not have a duration specified in the E pathname part, use this to accomplish the same function. Note: if using a time zone that supports daylight savings time, record durations are computed using the same time offset to keep a 1 hour record from being interpreted as either 0 or 2 hour duration.

20 Paths are read and filtered based on either the default time zone (GMT) or the overridden time zone defined by items 10 & 11 above. The paths can be shown in the read time zone or the display time zone for the session. The read time zone shows the paths exactly as they are recorded in the DSS catalog. When the display time zone is selected, the pathnames are modified to show them in the context of the display time zone.

21 This shows the number of paths that match the filter criteria and are displayed in the related list.

22 This list displays the paths from the selected DSS file that matches the filter criteria. Paths that are shown as greyed have already been selected into the 'Selected Paths' list. This list is only displayed when the selection related to item 3 above is selected.

23 This option will add all the paths shown in the 'Available Paths' list to the list of selected paths.

24 This option will add the highlighted paths from the 'Available Paths' list to the list of selected paths. The paths can be highlighted by clicking with the mouse. Multiple paths can be selected by using the normal control and shift keys in conjunction with the left mouse click.

25 This controls how the selected paths are displayed in the accompanying list similar to item 20 above. The read time zone shows the paths exactly as they are recorded in the DSS catalog. When the display time zone is selected, the pathnames are modified to show them in the context of the display time zone. The 'Source Time Zone' column displays the time zone that will be used when the path is read from the file. Entries in this list can have different time zones and come from different DSS files when item 3 is selected.

26 This shows the number of paths in the list of selected paths.

27 This list displays the selected paths and the file that contains them to be aggregated together.

28 This button can be used to clear the selected paths list. This item is available only when item 3 is selected.

29 This button will remove the highlighted paths from the list of selected paths. The paths can be highlighted by clicking with the mouse. Multiple paths can be selected by using the normal control and shift keys in conjunction with the left mouse click. This option is available only when item 3 is selected.

31	Accepts the selections made. If the selection is being made for a map panel or a map panel inherits these settings then the program starts a process to aggregate these images. If no map panel (perhaps a session with no active map panels) currently uses these settings, then the information is stored until needed and no action is taken.
32	Cancels any changes made. All edits are discarded.

The Project Explorer window display has been enhanced with additional features when using the DSS I/O provider that are not yet available when using other I/O providers. The path lists have informative icons (Table 31) that can help with detecting issues with the data series that is not obvious when working with the aggregate data itself.

Table 31 - Project Explorer data icon displays for DSS records

Icon	Description
	This is used for DSS records that have the expected relation to the other DSS records in the dataset and no timespan anomalies were detected in the metadata.
	This icon indicates that the DSS record either has an overlap or a gap with respect to the other DSS records in the dataset. Instantaneous data does not use this icon for feedback.
	This indicates there is some problem with the DSS record's metadata. The most common issue is that the metadata encoded times do not match the pathname time.
?	This is used when the DSS record could not be located. It may indicate that the DSS catalog that was used to select the record pathname needs to be regenerated or that, between the time the selection was made and the records were read from the file, something removed the record from the DSS file.

In addition to the icons, hovering the mouse pointer over the path of interest will display an informative tooltip that will help further with diagnosing the problems with the data series (Figure 102 - Figure 105). The paths displayed in the Project Explorer window always use the display time zone for the project or session. This is not necessarily the path that was actually read from the DSS file as the read time zone and the display time zone can differ. The tooltip shows the actual path read from the DSS file to help make it easier to diagnose data issues which may require other programs such as DSSVue.

Referring to Figure 104, this indicates a serious error which will impact any results that the program generates. The most common issue is that the timespan encoding in the DSS metadata does not match the timespan in the DSS pathname.

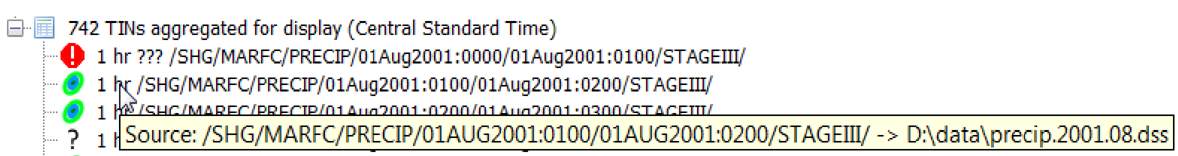


Figure 102 - Tooltip for a DSS record without issues

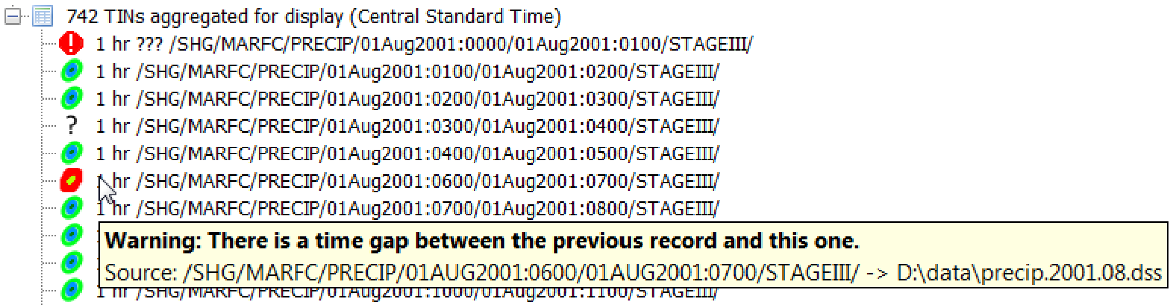


Figure 103 - Tooltip for a DSS record with time overlap or gap with the previous record

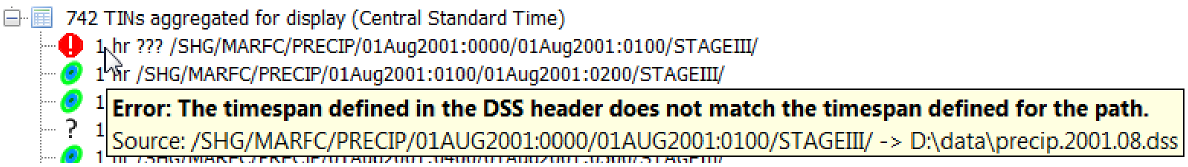


Figure 104 - Tooltip for a DSS record with a serious error

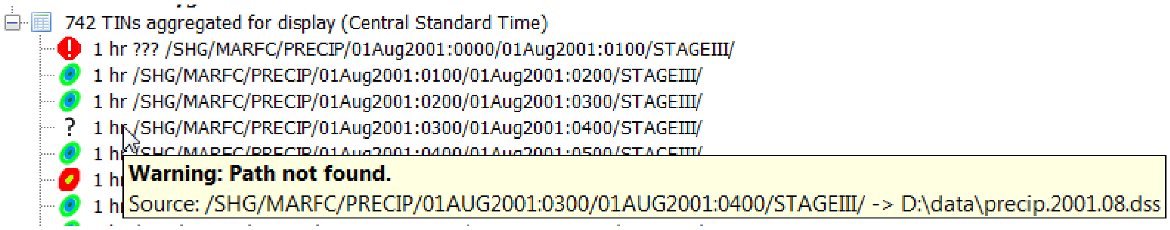


Figure 105 - Tooltip for a missing DSS record

Specifying TIN Datasets using Drag and Drop

Map panels within the program are also capable of being the receptor of a drag and drop operation from other programs. This can be a very convenient way of specifying TIN datasets for use in the program. The program can accept one or more TIN files dropped onto a map panel. If more than one is dropped, the program aggregates them together. By default the program replaces the currently selected TINs in the map window with the new ones dropped on it. However, if the keyboard 'Ctrl' key is held down during the drop action, the TIN files will be added to the TIN datasets already present in the map panel. Be aware that dropping TIN files on the map panel will change/disable many of the TIN filtering options set for the map panel. In general it will leave the filtering options set as before but will disable using the filters.

Time Adjustments on the TIN Selection Dialog

When using the time filters on the TIN selection dialog to select date ranges for inclusion/exclusion of data, the times can be specified as either 'Explicit' or 'Relative' for both Starting and Ending dates. These selections are used to adjust the times selected to move forward along with the change in time.

Start Date	End Date	Description
Explicit	Explicit	The dates and times are not adjusted. When the program determines which files/paths are included, these times will be as they were before and the image aggregation is as it was before. Note that if any new files/paths have become available they will be included in the final dataset.
Relative	Explicit	The start time is set to adjust but not the end time. It would be unusual to set the options this way. When the program determines which files/paths are included it would adjust the starting time based on the current time. Since the end time is fixed, the timespan would continue to get smaller and smaller until the start time became later than the end time and then no data would show up.
Explicit	Relative	Only the end time is adjusted for current time. This would be a common setting if, for example, a storm was being watched over several days. The storm start time does not change but every time the program reevaluates the timespan it adjusts the ending time to encompass an ever widening timespan. Note that if a map window had this option set and the static starting time was not manually modified then the list of images being aggregated would continue to grow larger unbounded.
Relative	Relative	Both times are adjusted for current time. This would be a common setting if, for example, one wished to always see the last 3 days of data aggregated together when the program reevaluated the time window.

Aggregating TIN Datasets

As discussed briefly, there are both irregular TINs and Gridded datasets that are handled internally as TINs. However, what if one wishes to aggregate several radar images together to get a storm total and one or more of the hourly images are missing? It would be helpful if the program would allow these gaps' to be filled in with rain gage data converted into a TIN for the missing time periods. It would not be as resolute as the radar data but it would be better than nothing at all. Also, what if a user had to acquire radar images from two different sources covering two mostly distinct but overlapping areas and one came in an HRAP projection and the other in an SHG projection?

HEC-MetVue will aggregate all the various image types it supports and it follows a set of fairly simple rules in doing so.

- When adding together 2 or more TINs, the resultant image is a TIN. The points that are the same in both images are not simply added together. A TIN made up of the distinct [X, Y] points for all the images is created and then the individual TINs are projected onto the aggregate TIN. Points on the aggregate TIN that do not exist on a specific TIN are estimated for that image timespan based on interpolation within the specific TIN triangle in which the missing point is located. In essence, the program adds the surfaces of the individual TINs, giving a much better result than simply adding together the reporting data.

- When adding together one or more gridded datasets, the program inspects all the grids and determines the grid that has the most resolute data (smallest grid size). It then forms a master grid with that cell size and inspects all datasets to determine the extents of the grid necessary. If all grids specified share a common projection type, then nearly all the computation of image addition can be skipped and the resultant images are aggregated

significantly quicker. If the images have a different coordinate projection, the technique of aggregating the data is similar to adding a TIN and a grid as described below. Regardless, the grid extents and cell resolution are computed the same.

- When adding one or more TINs to one or more gridded datasets, the grids are inspected as above to determine the required grid size. All datasets are inspected to determine the size of the resultant grid. All TINs and other grids that are not in the same projection as the resultant TIN are converted to a compatible grid by projecting the individual TINs onto a compatible grid and interpolating the values at the grid cells based on the triangle in which they reside.

Saving TIN Datasets

When an aggregate TIN has been edited or modified, the changes can be saved using the File->Save TINs… selection on the main menu or the save Icon  on the toolbar. Editing changes that modify the geographic position of the aggregate TIN, such as using the rotate or translate tool to move the aggregate TIN, may require using the 'Save Projection…' option instead of the 'Save TINs…' option when working with gridded datasets.

As discussed earlier, a TIN image may be a composite image, made up by aggregating two or more 'base' images. If the composite image has been rotated or had erroneous measurements deleted then, in addition to possibly saving the composite image, it would also be desirable to have these edits applied to the base images. The implications of being able to do this are significant. If a faulty rainfall gage is deleted from a composite image, which is an aggregation of 24 hourly images, having the edit made to the single composite image would save a significant amount of time as compared to editing multiple timespans. In another example, a study which repositions the composite TIN storm to maximize precipitation would then also cascade those changes to the base images used to create the TIN. Any changes made to the positioning of the aggregate TIN can be applied to all the base TINs that were used to create it.

- Any edit changes that are made to the aggregate TIN which change the measurement values of the TIN points can be applied proportionally to the base TINs. For example, if a single TIN point on an aggregate TIN originally had the measurements of 1, 3, and 5; the aggregate would originally be 9. If the aggregate was modified to be 18, when the images were saved the measurements of the base images would be 2, 6, and 10 respectively. If a measurement on the aggregate TIN was originally zero and the modified TIN had this measurement to a non-zero value, the aggregate total would be equally distributed to the base images. This operation of proportioning the aggregate to the base images occurs on a point by point basis so even operations that result in massive differential modifications to the aggregate surface such as radar calibration can successfully applied to the base images.

- Any spatial translation, rotation, or scaling of the aggregate image is applied to the base images. However, moving gridded data usually means that the data is no longer a true X-Y grid in the coordinate system in which it was originally stored. Most I/O providers do not have the capability to store a grid that has been repositioned, but HEC-MetVue has built in support for user-created I/O providers that wish to implement this feature. The alternative is to save the TINs as a projection using the Project TIN(s) to Grid tool.

Similar to reading TINs, HEC-MetVue relies on I/O providers to write TINs. Not all I/O providers have write capabilities. For example, the PRISM I/O provider can read PRISM data but not write it. Edited PRISM data must be saved to some other file format such as ESRI ASCII grids. When the save tool is used, HEC-MetVue displays an editor similar to the one shown in (Figure 106). The dropdown at the top of the dialog along with the 'OK' and 'Cancel' buttons is controlled by HEC-MetVue. Depending on which I/O provider is selected, the contents of 'I/O Provider Area' will change to support whatever information is required by that I/O provider to save the TINs. HEC-MetVue gives I/O providers access to its File and DSS Save controls so that other providers that are saving to one of these types of storage medium do not have to create a custom control to do so. Other providers, such as a provider that stores results to an oracle database or a remote web server will likely have a completely different set of requirements for saving the edited data that cannot be satisfied by using one of the built in controls. Figure 107 and Figure 108 illustrate additional save dialogs. Table 32, Table 33, and Table 34 provide a description of the features available in the save dialog.

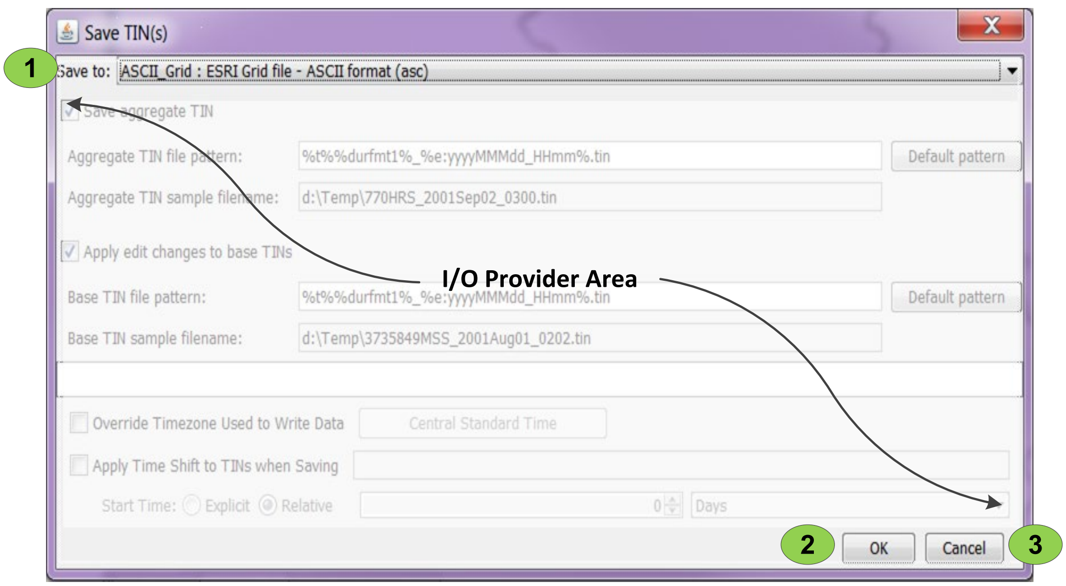


Figure 106 - Sample Save dialog

Table 32 - Sample Save dialog description

Item	Description
1	This dropdown gives a list to select the output target for the saved TINs. Depending on the edit changes made the list will vary. For example once a TIN has been rotated, most I/O providers cannot save the result so they would not appear in the list.
2	Press this button to dismiss the dialog and save the selected TINs with the options given.
3	Cancel the operation.

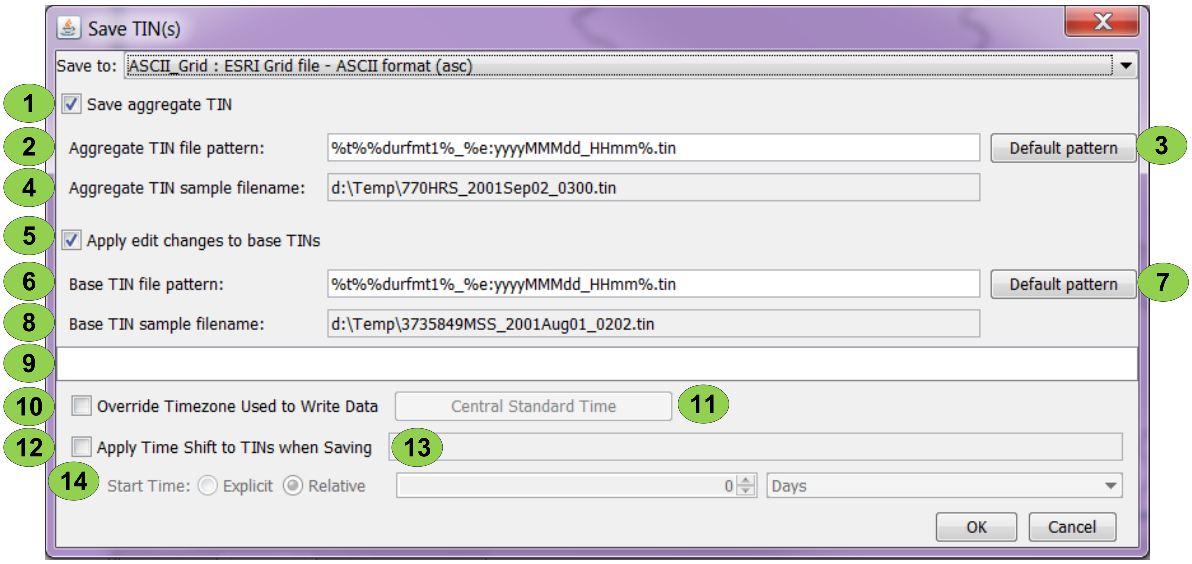


Figure 107 - Standard dialog for file based saves

Table 33 - Standard dialog for file based saves

Item	Description
1	Check this to save the aggregate TIN to a file.
2	This is the location to enter the filename or file pattern for storing the aggregate TIN file. Strictly speaking, a file pattern is not actually required since only 1 aggregate TIN needs to be written. However by using a pattern the entry does not need to be continually changed for repetitive tasks that the program may be used for. The specification for how to define file patterns can be found in Table 25.
3	Press this button to replace the pattern in the edit field in item 2 with the default pattern defined by the program for aggregate TINs. This is convenient if the pattern in the edit field is invalid and starting from an existing valid pattern is preferred.
4	This field is a sample of what the filename used for the aggregate TIN will resemble based on the given pattern. It is non-editable.
5	Check this to save edited base TINs that were used create the aggregate TIN.
6	This is the location to enter the file pattern for storing the base TIN files. A file pattern is required so that each TIN written can be written to a different file. The specification for how to define file patterns can be found in Table 25.
7	Press this button to replace the pattern in the edit field in item 6 with the default pattern defined by the program for base TINs. This is convenient if the pattern in the edit field is invalid and starting from an existing valid pattern is preferred.
8	This field is a sample of what the filenames used for the base TINs will resemble based on the given pattern. It is non-editable.
9	This is an area where the I/O providers may display messages regarding the settings in the editor. It is non editable.

10	Use this to instruct the program to write the data in a specific time zone. By default the program writes the data in the same time zone which it used to read the data. The display time zone is not used during the writing of edited TINs.
11	Use this control to select the time zone to write the data. See Figure 97 and Table 29 for information on time zone selection. It is disabled unless item 10 is selected.
12	Select this to shift the time when writing the TINs. All the written TINs will be shifted the same amount of time.
13	This gives feedback to help select the correct time shift for the TINs. It is non editable and reflects the changes made to the controls in item 14.
14	This is the control for setting the amount of time to shift the TINs. It is disabled unless item 12 is selected. Setting the option to 'Explicit' will display an edit field to enter a start date and time (not shown). Setting the option to 'Relative' will enable the control to shift the data by a set number of specified units of time.

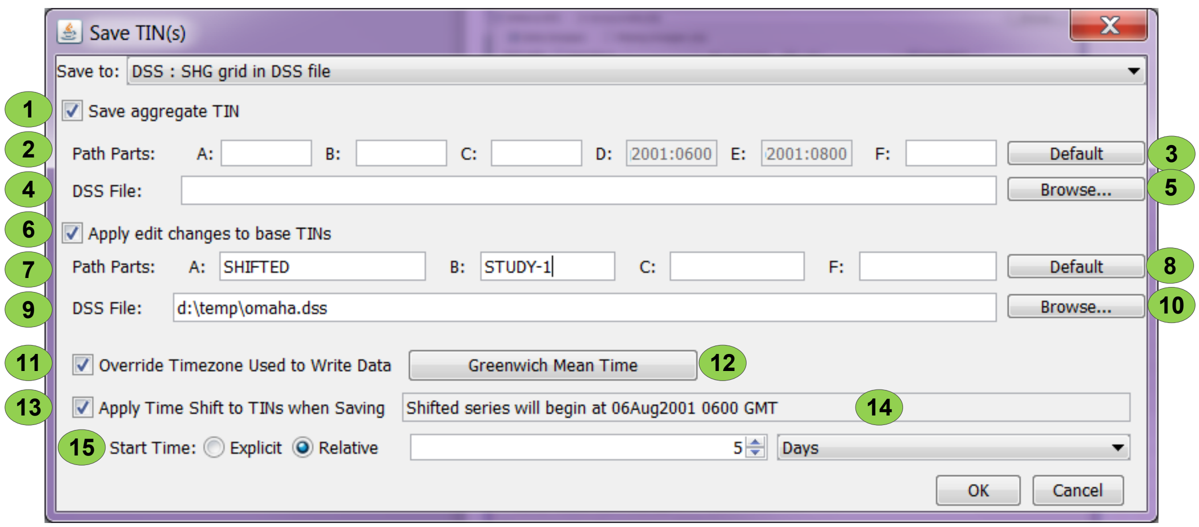


Figure 108 - Standard dialog for DSS based saves

Table 34 - Standard dialog for DSS based saves

Item	Description
1	Check this to save the aggregate TIN to a file.
2	The DSS path parts to use when saving the TIN. The program controls the D and E path parts.
3	Used to set the default path parts. If the source of the TIN was a DSS path originally, using this option will populate the path with these parts.
4	The DSS file to save the new aggregate TIN to. The DSS file can use file name patterns to store the TIN to a file based on the data. The specification for how to define file patterns can be found in Table 25.
5	Select this to browse the file system for the DSS file to use for the output of the aggregate TIN.

6	Check this to save edited discrete TINs that were used create the aggregate TIN.
7	The DSS path parts to use when saving the TINs.
8	Used to set the default path parts. If the source of the TIN was a DSS path originally, using this option will populate the path with these parts.
9	The DSS file to save the new discrete TINs to. The DSS file can use file name patterns to store the TIN to a file based on the data. The specification for how to define file patterns can be found in Table 25.
10	Select this to browse the file system for the DSS file to use for the output of the discrete TINs.
11	Use this to instruct the program to write the data in a specific time zone. By default the program writes the data in the same time zone which it used to read the data. The display time zone is not used during the writing of edited TINs.
12	Use this control to select the time zone to write the data. See Figure 97 and Table 29 for information on time zone selection. It is disabled unless item 11 is selected.
13	Select this to shift the time when writing the TINs. All the written TINs will be shifted the same amount of time.
14	This gives feedback to help select the correct time shift for the TINs. It is non editable and reflects the changes made to the controls in item 15.
15	This is the control for setting the amount of time to shift the TINs. It is disabled unless item 13 is selected. Setting the option to 'Explicit' will display an edit field to enter a start date and time (not shown). Setting the option to 'Relative' will enable the control to shift the data by a set number of specified units of time.

Saving TIN Datasets as a Projection

When an aggregate TIN has been translated/rotated/scaled, it may be necessary to save the result using a projection instead of saving the native TIN. This is particularly true when working with gridded datasets due to the fact that a gridded dataset that is moved to a new position is no longer considered to be a rectangular grid by the program. This is due to the fact that the coordinate system in which the grid is defined may be different than the coordinate system in which the translation or rotation occurred. Use the 'File->Save Projection…' selection on the main menu or the save projection icon  on the toolbar to save a TIN projection.

When saving a projection, the program uses the same steps as discussed above for saving TIN datasets and then adds an additional step of projecting the TIN to the new grid selected for output. Currently, all projected results are obtained by sampling the measurement values of the modified aggregate and discrete TINs at the center points of the grid cells of the target projection grid. If the grid cell size of the target grid is the same size or smaller than the source grid then the sampling method gives a good approximation of the original TIN. However, if this procedure is repeated by continually re-projecting a TIN that is itself a projection, the result will be a dataset with precision loss. This is analogous to using a camera to take a picture of a picture of a picture. Eventually the picture will become blurry.

Important note: If a target grid is defined with grid cells that represent a significantly larger area than the source data, then the sampling method may not be appropriate. A better alternative may be to use a sampling technique that considers each grid cell to be a 'subarea' and compute an average value for each grid cell in the target grid. Another valid method may be to find the nearest defined measurement on the source grid and use this value for the target grid cell. This method is commonly called 'nearest neighbor' and there are variations on it which may find a nearest neighbor within a specified distance or fall back to TIN sampling. Also, the type of data must be considered. Precipitation data may be better projected using an average over area whereas elevation data may be better sampled using nearest neighbor. Currently, HEC-MetVue does not provide either the 'average over area' or the 'nearest neighbor' options when performing grid projections.

Similar to writing TINs, HEC-MetVue relies on I/O providers to project TINs. Not all I/O providers have projection capabilities. When the project tool is used, HEC-MetVue displays an editor similar to the one shown in Figure 109. HEC-MetVue supplies a 'Save Projection' dialog that the various I/O providers can use, or the providers supply their own projection capability. The dropdown at the top of the dialog along with the 'OK' and 'Cancel' buttons is always controlled by HEC-MetVue. Depending on which I/O provider is selected the contents of 'I/O Provider Area' will change to support whatever information is required by that I/O provider to project the TINs. HEC-MetVue gives I/O providers access to its File and DSS Save Projection controls so that other providers that are saving to one of these types of storage medium do not have to create a custom control to do so. Other providers, such as a provider that stores results to an oracle database or a remote web server, will likely have a completely different set of requirements for saving the edited data that cannot be satisfied by using one of the built in controls. Table 35 provides a description of the features available in the save dialog.

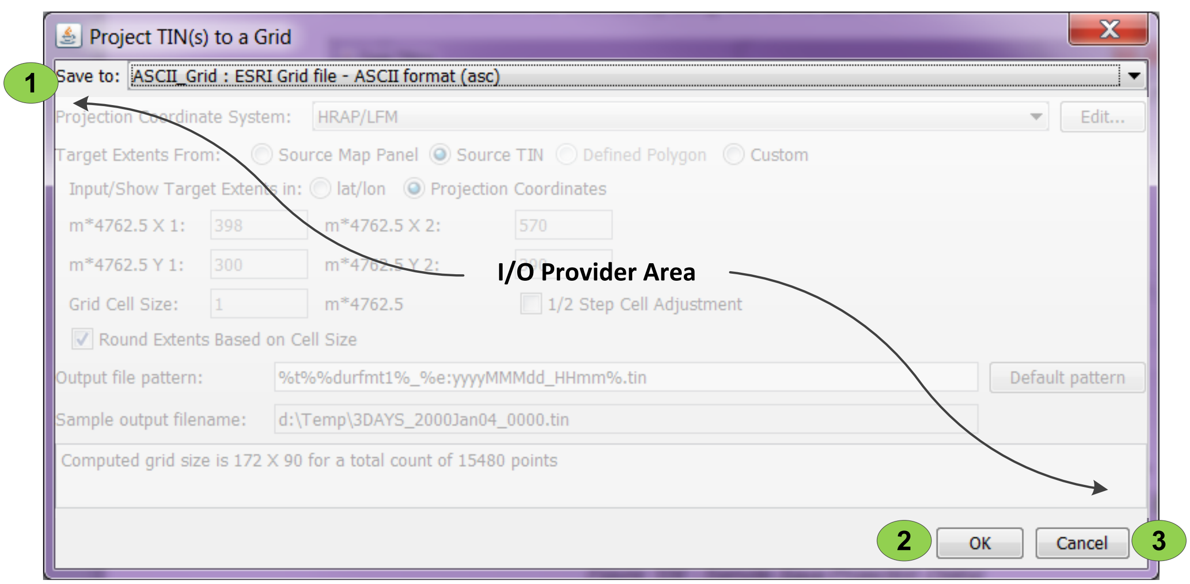


Figure 109 - Sample Save Projection dialog

Table 35 - Sample Save Projection dialog description

Item	Description

1	This dropdown gives a list to select the output target for the projected TINs.
2	Press this button to dismiss the dialog and save the projected TINs with the options given.
3	Cancel the operation.

Saving TIN Datasets as a Projection to DSS

HEC-MetVue currently supports saving HRAP and SHG grids to DSS (Figure 110, Table 36). Future DSS support will include storing grids in any coordinate references system and grid size as well as support for irregular TINs.

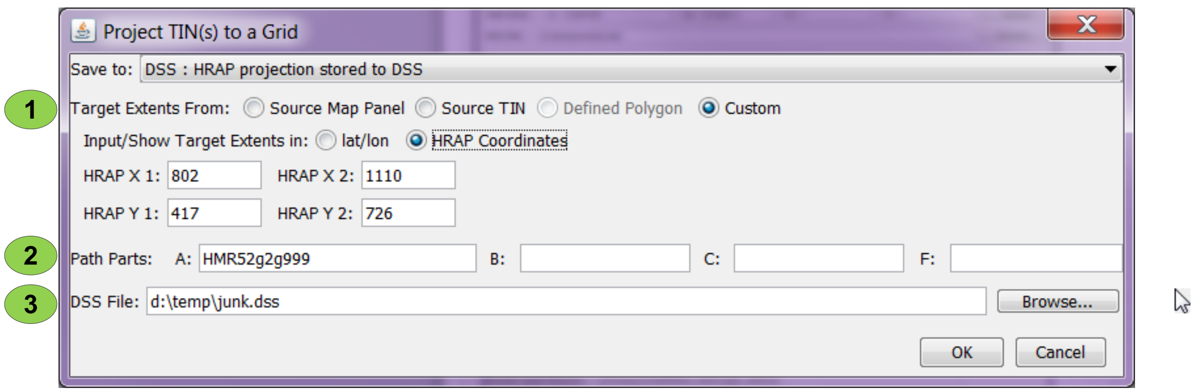


Figure 110 - Dialog for DSS based Save Projection

Table 36 - Dialog for DSS based Save Projection

Item	Description
1	This defines the extents to use to form the target grid for the output gridded TINs. Refer to Figure 96 and Table 28 for more information on these parameters.
2	The DSS path parts to use when saving the TINs.
3	The DSS file to save the projected TINs to. The DSS file can use file name patterns to store the TIN to a file based on the data. The specification for how to define file patterns can be found in Table 25.

Saving TIN Datasets as a Projection to HEC-MetVue Native Format

HEC-MetVue supports saving HRAP grids to its native file format (Figure 111, Table 37).

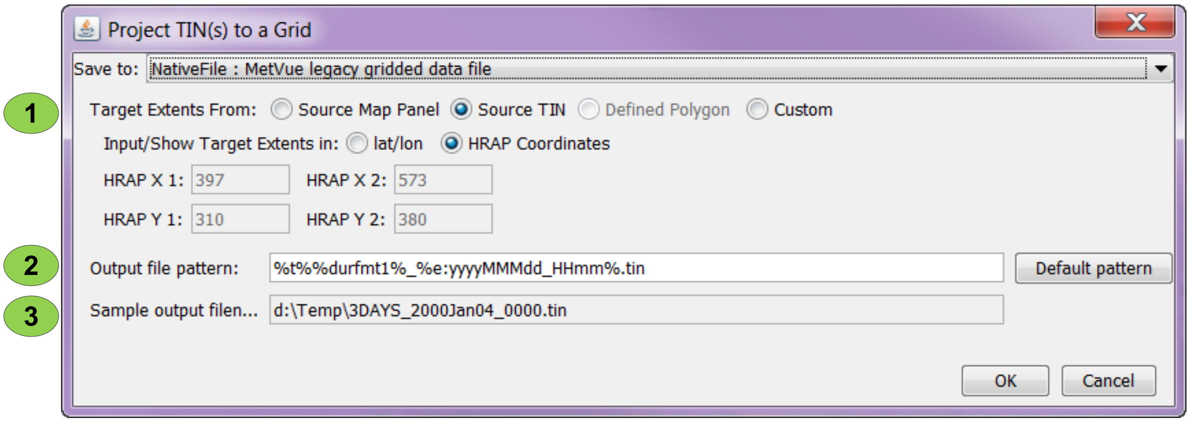


Figure 111 - Dialog for Native File based Save Projection

Table 37 - Dialog for Native File based Save Projection description

Item	Description
1	This defines the extents to use to form the target grid for the output gridded TINs. Refer to Figure 96 and Table 28 for more information on these parameters.
2	This is the location to enter the file pattern for storing the projected TIN files. A file pattern is required so that each TIN written can be written to a different file. The specification for how to define file patterns can be found in Table 25.
3	This field is a sample of what the filenames used for the base TINs will resemble based on the given pattern. It is non editable.

Saving TIN Datasets as a Projection to Files

HEC-MetVue provides support to writing projected TINs to files in in virtually any coordinate system with any grid size using an I/O provider plugin. One provider that supports a wide range of choices is the provider that writes ESRI grid files (Figure 112, Table 38).

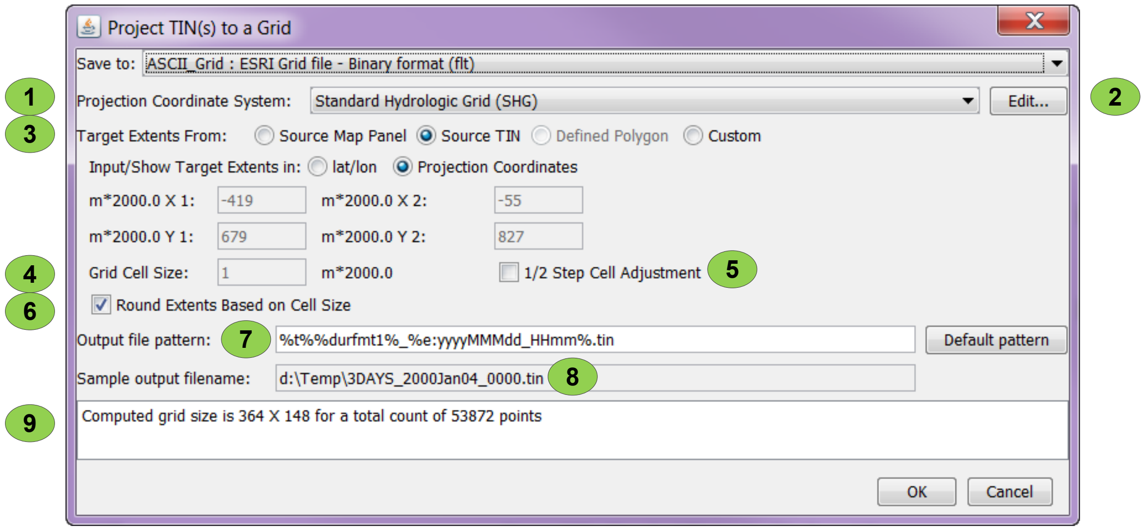


Figure 112 - Generic dialog for File based Save Projection

Table 38 - Generic dialog for File based Save Projection description

Item	Description
1	This gives a list of the coordinate systems that can be used by the specified I/O provider that are currently defined within HEC-MetVue. By default HEC-MetVue provides coordinate system definitions for Lon-Lat, HRAP, and SHG coordinate systems. Other user defined coordinate systems that are supported by the currently selected I/O provider also appear in this list.
2	Use this button to add more coordinate system definitions or to modify or copy an existing definition. Refer to the coordinate system editor, Figure 113 and Table 39 for how to define additional coordinate systems.
3	This defines the extents to use form the target grid for the output gridded TINs. Refer to Figure 96 and Table 28 for more information on these parameters.
4	This specifies the size of the grid cell in units defined by the coordinate system projection. In the example above, the coordinate system is SHG with every coordinate increment being 2000 meters. Therefore the size of the grid cell is 1 which means a grid cell is 2000m in each direction.
5	Selecting this will cause the projected grid to contain a half cell offset so that the source grid sampling is done at the centers of the defined grid cells instead of the grid intersections themselves.
6	Selecting this will assure that the grid cell count in both the X and Y directions are integer numbers.
7	This is the location to enter the file pattern for storing the projected TIN files. A file pattern is required so that each TIN written can be written to a different file. The specification for how to define file patterns can be found in Table 25.
8	This field is a sample of what the filenames used for the projected TINs will resemble based on the given pattern. It is non editable.
9	This field is used to provide feedback about the target projected grid that will be created so that the created grid will have the expected number of grid cells defined.

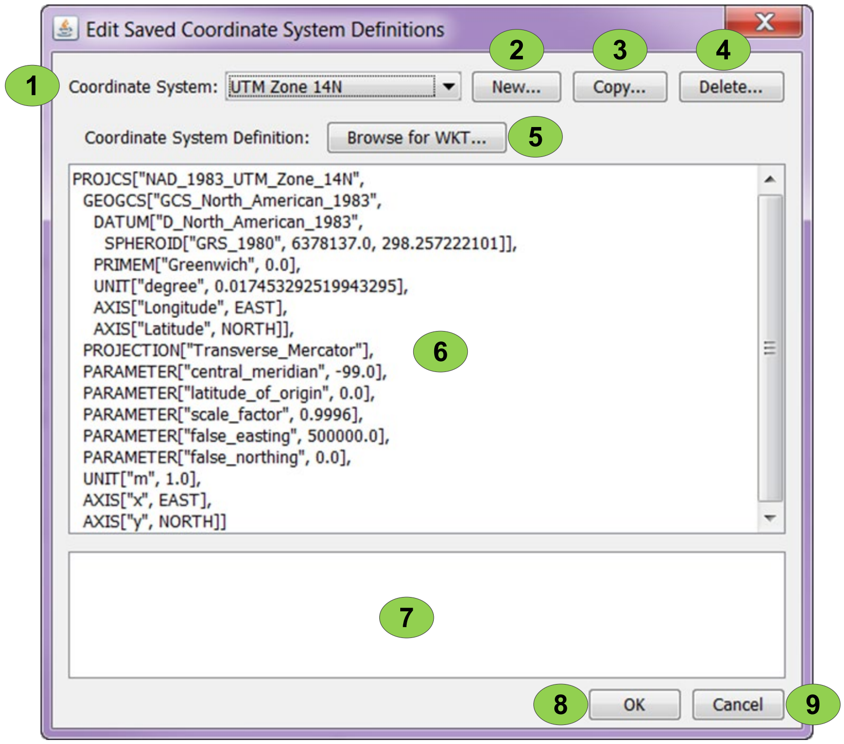


Figure 113 - Coordinate System definition editor

Table 39 - Coordinate System definition editor description

Item	Description
1	This dropdown is used to select the coordinate system to edit, copy, or delete.
2	Use this button to create a new coordinate system definition.
3	Use this button to copy the current coordinate system definition.
4	Use this button to delete the current coordinate system definition. Note that HEC-MetVue defined coordinate systems cannot be deleted.
5	Use this button to brows the file system for a file that contains a valid Well Known Text (WKT) definition for a coordinate system
6	This box shows the WKT for the current coordinate system definition. HEC-MetVue defined coordinate system definitions appear greyed out and can be viewed but not edited.
7	This box shows any errors that occur when the WKT string is parsed to create a valid coordinate system. If any errors appear here, the coordinate system definition cannot be saved.
8	Accept the edit changes and save the coordinate system definitions.
9	Cancel all edits and dismiss the coordinate system editor dialog.

Chapter 10

10. Hyetograph/Time Series Creation

Creating hyetographs and other time series from the TIN datasets is one of the basic functions of HEC-MetVue. To create a time series (Figure 114), select 'File->Save/Create Time Series…' from the main menu or press the  icon on the toolbar. These tools are enabled when a map panel has the focus, contains one or more TIN datasets, and contains one or more active polygon shapefiles. Table 40 provides a description of features available in the Compute Time Series dialog.

When creating time series, it is advantageous to use multiple aggregated images that are temporally resolute enough to give a reasonable hyetograph. For example, if using a single TIN dataset representing a 24 hour time period, the program will still allow for the generation of hourly time series for the polygons, however, each of the hyetograph ordinates for any particular polygon will be the same; 1/24 of the computed total since that is the temporal resolution of the original data. A better solution would be to use twenty-four 1 hour TINs aggregated together. Following any edit operations and data cleanup, the generated hyetographs would maintain the temporal resolution of the original data. Any edits performed on the data are back applied to the original images making up the aggregate prior to creation of the time series.

When the program generates polygon averages, it does so for each TIN composing the aggregated TIN and, for each polygon it creates a mass curve over time based on these base images. The time intervals of the TIN and that of the desired hyetographs are independent of each other. It is even possible to generate hyetographs from irregular TIN image data if desired since the actual values are ascertained directly from the temporal mass curve for the polygon. From these mass curves, HEC-MetVue then determines the appropriate values at the selected intervals along each polygon curve.

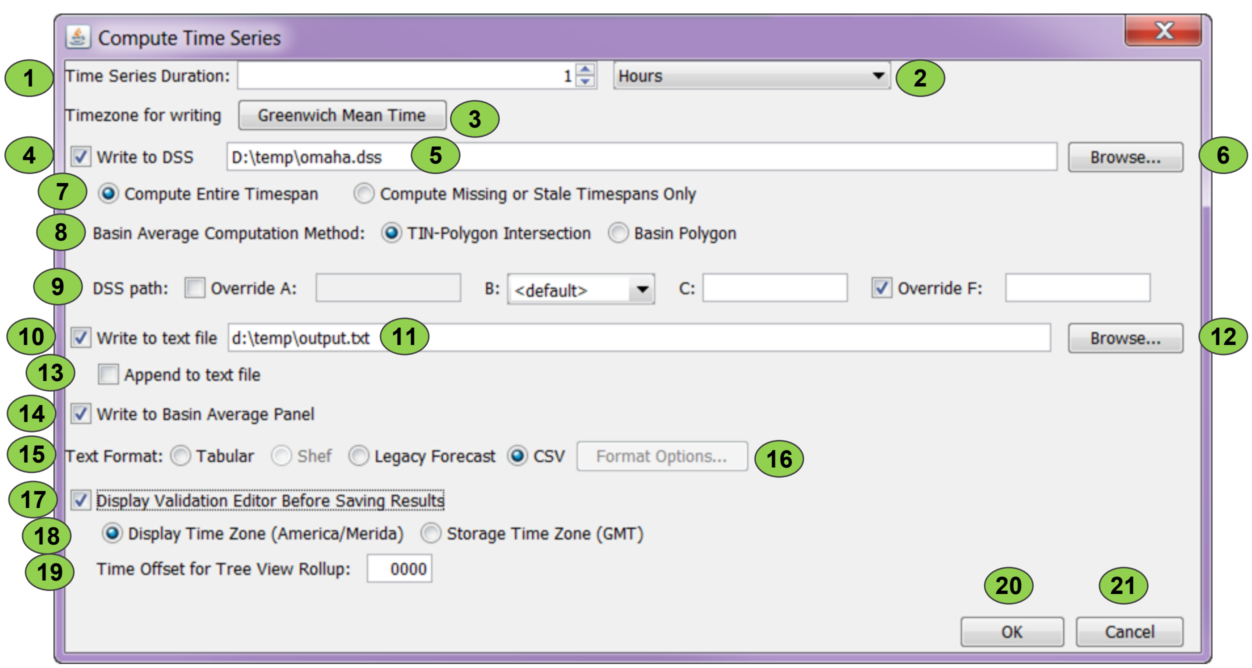


Figure 114 - Compute Time Series dialog

Table 40 - Compute Time Series dialog description

Item	Description
1	The time interval to use for creating time series.
2	The time interval units to use for creating time series.
3	Displays the time zone which will be used when saving the time series. Press this button to change the time zone. Refer to Figure 97 and Table 29 for working with the time zone selection editor.
4	Check this to write the time series to DSS.
5	The DSS file to write the time series data to.
6	Use this to brows the file system to locate the desired DSS file to use.
7	If 'Entire timespan' is selected, the time span covered by the aggregate TIN will be used to create the time series. Selecting 'Missing timespan only' will inspect the hyetographs in DSS and determine the portion of the time span that is undefined and use that to compute and write/extend the time series. This option is an optimization to speed computations for certain operations such as forecasting where the TIN data is simply covering a new time span but each of the existing discrete TIN datasets previously used are unchanged. If the aggregate TIN is edited in any way the 'Entire timespan' option should be selected.
8	The basin average computation method is used to select the area to compute the polygon averages. It is analogous to the properties options on the Layer Settings Tab, Polygon/Basin Averages Settings section. If set to 'TIN-Polygon Intersection' it will generate hyetographs based on the area common to both the polygon and the defined area of the TIN. When set to 'Basin Polygon' the hyetograph will be based on the polygon area only.
9	This is used to specify the path to use to write to DSS. The A and F DSS pathname parts can be defined in the basin average shapefile DBF file using the column names DSSA and DSSF respectively. Checking 'Override A' or 'Override F' will instruct the program to ignore the definitions in the shapefile DBF file and use the displayed values instead. The DSS B part is defined by the name of the shapefile DBF column. If more than one basin average shapefile is being used, the column names that are present in both shapefiles will be shown in the dropdown using the normal black text. Columns that do not appear in all the shapefiles will be shown in a lighter gray color to indicate the discrepancy. If a column is selected that is not in all the shapefiles, the program will attempt to find a column named 'NAME', 'LOCATION', 'ID', 'DSSB', 'STATION' in that order. If this fails, the program will form a B pathname part using the file identifier along with the segment number within the shapefile to generate a unique name. Any conflict that causes multiple subareas to result in the same DSS pathname will cause an error message to be displayed similar to what is shown in Figure 115.
10	Select this to write the time series to a text file.
11	This specifies the text file to write the time series data to.
12	Select this to browse the file system to locate the output text file.

13	Select this to have the time series data appended to the output file. When not selected, the computed time series will overwrite the contents of the output file.
14	Select this to write the results to the screen. The results will be essentially the same as what is written to the file but the formats may be modified slightly for readability.
15	This specifies the format to write the data to the text file &/or screen. The most common option is to use the Tabular format. The Legacy Forecast format is to help in the transition to HEC-MetVue and will likely be removed in future versions of the program. The SHEF format is not yet implemented.
16	Currently not implemented. Intended to give additional control over the output formatting in future versions of the program.
17	If this option is selected, prior to saving the time series a validation editor will be displayed which allows the modification of individual time series. Refer to Figure 116-Figure 117 and the accompanying description for use of the validation editor.
18	This choice allows the data to be viewed and edited in either the display time zone or the storage time zone.
19	The validation editor displays the data in either a tree view where sub hourly ordinals are wrapped up into hourly, hourly to daily, and so on. This value specifies in hours and minutes 'hhmm' the start time of day to use for the daily rollup. For example, specifying 0700 would cause the daily rollup to go from 0700-0700 instead of midnight to midnight.
20	Confirm.
21	Cancel.

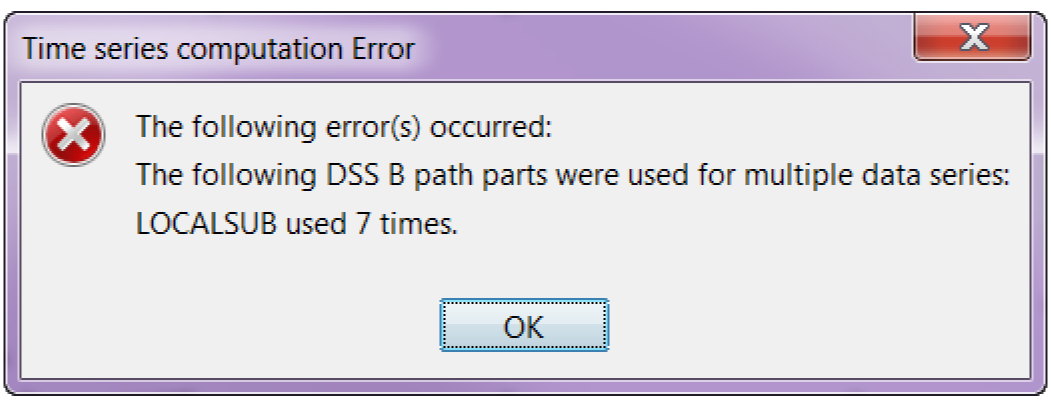
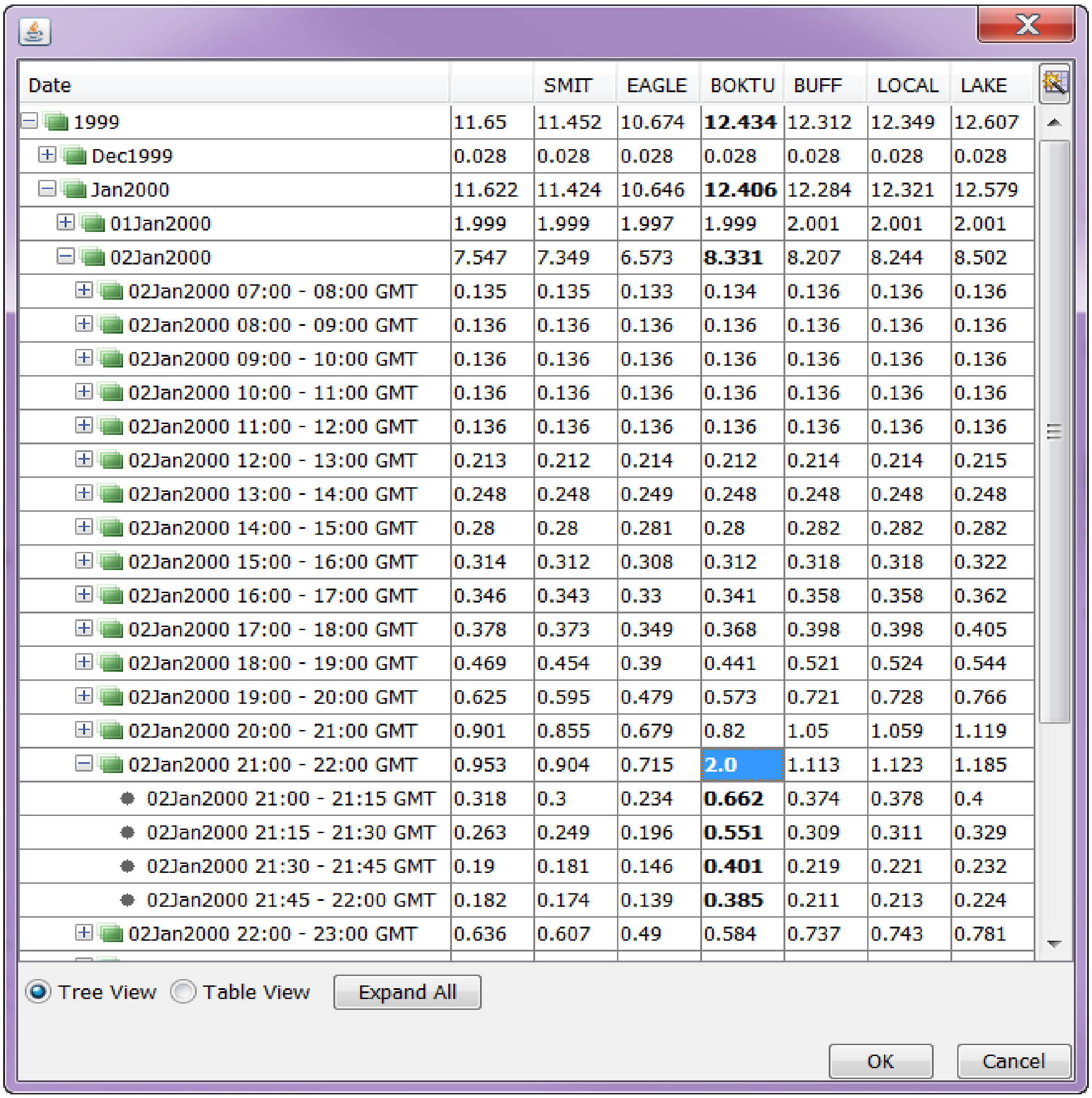


Figure 115 - Time Series computation error

Time Series Validation Editor

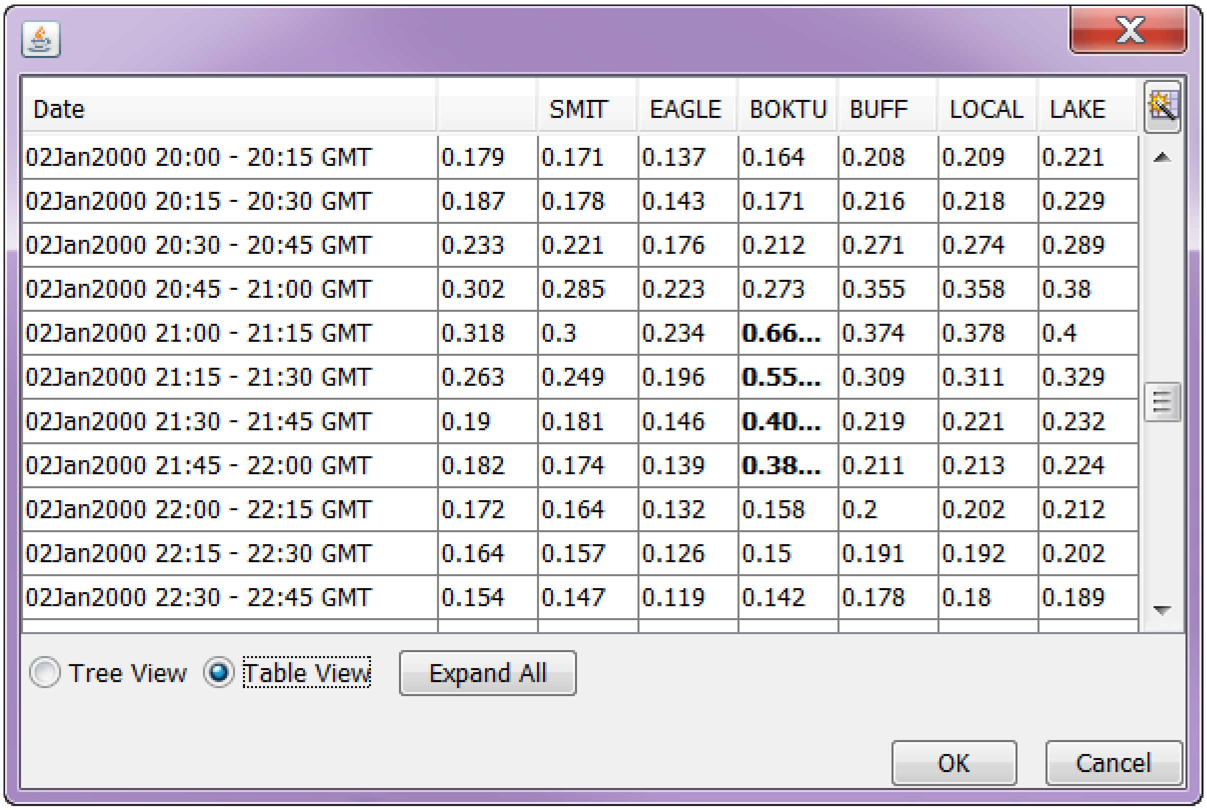
The Time-Series Validation Editor is used to override any values in the computed basin average hyetographs prior to saving the final time series output. Figure 116 is an example of the validation editor when displaying a tree view. The highlighted cell was changed to contain the value 2.0. This change was then applied proportionally to the 4 time series values that are represented by the rollup value. All the totals that are changed at the daily, monthly, and yearly levels of the tree due to the cell edit are also denoted by a bold font.



Date		SMIT	EAGLE	BOKTU	BUFF	LOCAL	LAKE
1999	11.65	11.452	10.674	**12.434**	12.312	12.349	12.607
Dec1999	0.028	0.028	0.028	0.028	0.028	0.028	0.028
Jan2000	11.622	11.424	10.646	**12.406**	12.284	12.321	12.579
01Jan2000	1.999	1.999	1.997	1.999	2.001	2.001	2.001
02Jan2000	7.547	7.349	6.573	**8.331**	8.207	8.244	8.502
02Jan2000 07:00 - 08:00 GMT	0.135	0.135	0.133	0.134	0.136	0.136	0.136
02Jan2000 08:00 - 09:00 GMT	0.136	0.136	0.136	0.136	0.136	0.136	0.136
02Jan2000 09:00 - 10:00 GMT	0.136	0.136	0.136	0.136	0.136	0.136	0.136
02Jan2000 10:00 - 11:00 GMT	0.136	0.136	0.136	0.136	0.136	0.136	0.136
02Jan2000 11:00 - 12:00 GMT	0.136	0.136	0.136	0.136	0.136	0.136	0.136
02Jan2000 12:00 - 13:00 GMT	0.213	0.212	0.214	0.212	0.214	0.214	0.215
02Jan2000 13:00 - 14:00 GMT	0.248	0.248	0.249	0.248	0.248	0.248	0.248
02Jan2000 14:00 - 15:00 GMT	0.28	0.28	0.281	0.28	0.282	0.282	0.282
02Jan2000 15:00 - 16:00 GMT	0.314	0.312	0.308	0.312	0.318	0.318	0.322
02Jan2000 16:00 - 17:00 GMT	0.346	0.343	0.33	0.341	0.358	0.358	0.362
02Jan2000 17:00 - 18:00 GMT	0.378	0.373	0.349	0.368	0.398	0.398	0.405
02Jan2000 18:00 - 19:00 GMT	0.469	0.454	0.39	0.441	0.521	0.524	0.544
02Jan2000 19:00 - 20:00 GMT	0.625	0.595	0.479	0.573	0.721	0.728	0.766
02Jan2000 20:00 - 21:00 GMT	0.901	0.855	0.679	0.82	1.05	1.059	1.119
02Jan2000 21:00 - 22:00 GMT	0.953	0.904	0.715	**2.0**	1.113	1.123	1.185
02Jan2000 21:00 - 21:15 GMT	0.318	0.3	0.234	**0.662**	0.374	0.378	0.4
02Jan2000 21:15 - 21:30 GMT	0.263	0.249	0.196	**0.551**	0.309	0.311	0.329
02Jan2000 21:30 - 21:45 GMT	0.19	0.181	0.146	**0.401**	0.219	0.221	0.232
02Jan2000 21:45 - 22:00 GMT	0.182	0.174	0.139	**0.385**	0.211	0.213	0.224
02Jan2000 22:00 - 23:00 GMT	0.636	0.607	0.49	0.584	0.737	0.743	0.781

Figure 116 - Validation editor in tree view

Figure 117 is an example of the table view of the validation editor. This table shows the actual time series values. Note that the values that were modified in the tree view also show in bold in the table view.



Date		SMIT	EAGLE	BOKTU	BUFF	LOCAL	LAKE
02Jan2000 20:00 - 20:15 GMT	0.179	0.171	0.137	0.164	0.208	0.209	0.221
02Jan2000 20:15 - 20:30 GMT	0.187	0.178	0.143	0.171	0.216	0.218	0.229
02Jan2000 20:30 - 20:45 GMT	0.233	0.221	0.176	0.212	0.271	0.274	0.289
02Jan2000 20:45 - 21:00 GMT	0.302	0.285	0.223	0.273	0.355	0.358	0.38
02Jan2000 21:00 - 21:15 GMT	0.318	0.3	0.234	**0.66...**	0.374	0.378	0.4
02Jan2000 21:15 - 21:30 GMT	0.263	0.249	0.196	**0.55...**	0.309	0.311	0.329
02Jan2000 21:30 - 21:45 GMT	0.19	0.181	0.146	**0.40...**	0.219	0.221	0.232
02Jan2000 21:45 - 22:00 GMT	0.182	0.174	0.139	**0.38...**	0.211	0.213	0.224
02Jan2000 22:00 - 22:15 GMT	0.172	0.164	0.132	0.158	0.2	0.202	0.212
02Jan2000 22:15 - 22:30 GMT	0.164	0.157	0.126	0.15	0.191	0.192	0.202
02Jan2000 22:30 - 22:45 GMT	0.154	0.147	0.119	0.142	0.178	0.18	0.189

Figure 117 - Validation editor in table view

Chapter 11

11. Properties Window

11.1 General Discussion

Property panels are used extensively in this program for making settings changes. Some of the properties have external editors but most can be set directly from the Property panel. Map window properties or properties in sessions or the program default properties show up immediately in the map panels as the changes are made.

The information in the properties window follows the selected node in the Project Explorer or the current map window, whichever had the focus last. If the last window to be accessed was the Project Explorer then the properties window displays the information for the selected node within the Project Explorer. If the last window selected was a map panel then the properties for that panel are displayed. Figure 118 shows the conventions used to refer to property windows.

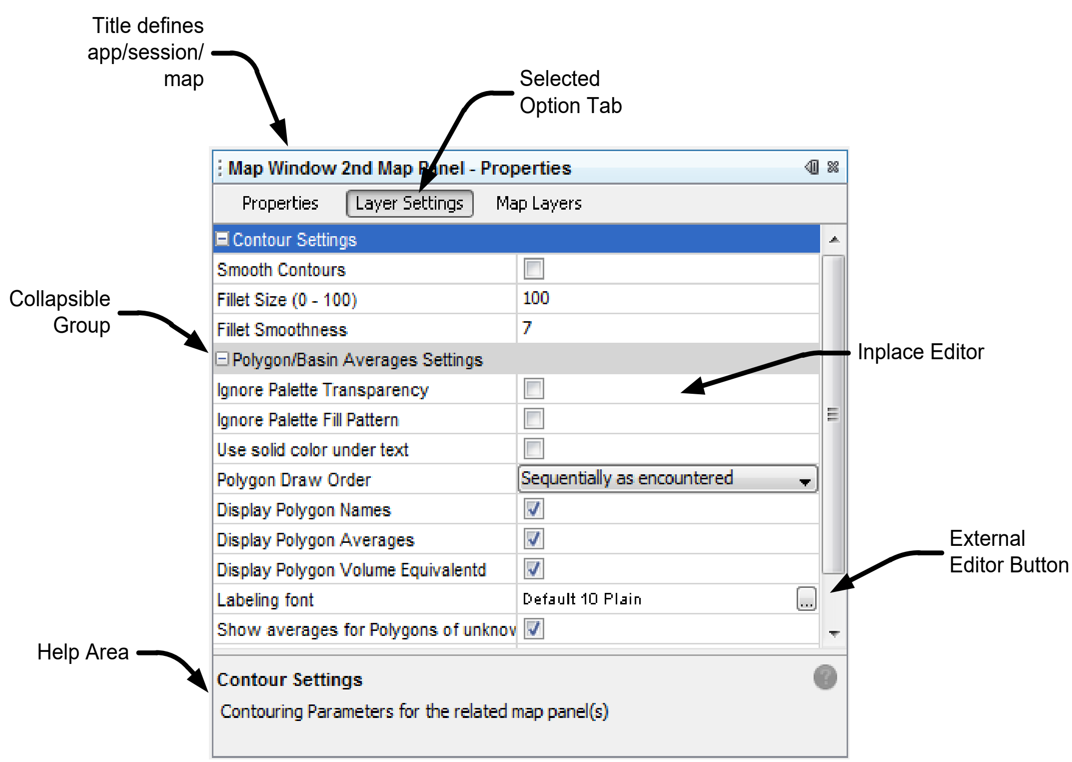


Figure 118 - Sample properties window

11.2 Global Settings Tab

The global settings (Figure 119) set the default for the unit system and give access to the global palette, scale and attribute editors. The global settings are visible from the very top node in the Project Explorer as well as every Session and Map Panel node. Table 41 provides definitions for the features available in the global settings tab.

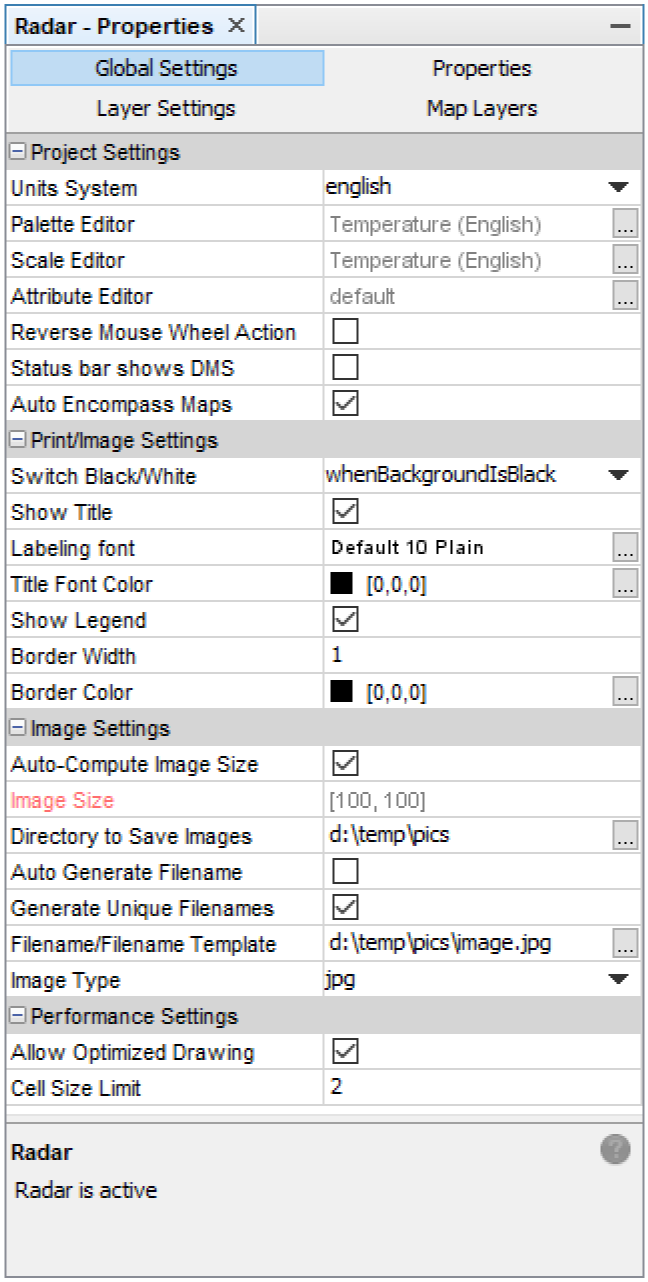


Figure 119 - Global Settings tab

Table 41 - Global Settings tab description

Section	Option	Definition
Project Settings		These settings apply project-wide.
	Units System	The units system to use for all sessions and map panels in use. It is not possible to have some map panels display English units and others use SI as it was deemed to be too error prone. However, if the program does not recognize the measurement units or cannot convert them it will display the measurement data in the given units. HEC-MetVue can be used to display a variety of non-precipitation data however it can only aggregate measurement TINs if the units are consistent or the units are recognized. For example the program can directly add TINS where one is in inches and the other in mm.
	Palette Editor	Links to the external palette editor for defining palette objects. Palette objects are used to define the various attributes (such as colors and line styles) used to render contours and other measurement related data.
	Scale Editor	Links to the external scale editor for defining scale objects. Scale objects are used in conjunction with palettes to render contours and other measurement related data.
	Attribute Editor	Links to the external attribute editor for defining attribute objects and new attribute schemas. Attributes are used to define the line styles, colors, and symbols used to render the shapefile information.
	Reverse Mouse Wheel Action	The mouse wheel provides an easy way to zoom in/out on a map panel. The default action is to zoom in when the mouse wheel is pulled away from the screen. Checking this option will cause the mouse wheel to zoom out when pulled away from the screen.
	Status Bar Shows DMS	If this is checked, when mouse cursor tracking is enabled, the cursor longitude/latitude value are displayed in degrees, minutes, and seconds. When unchecked, coordinates are displayed in decimal degrees.
	Auto Encompass Maps	When this is checked and a map is added to the map panel, the map panel view will be adjusted so that the map is displayed in the map window. If unchecked, when new maps are added to the map panel, the extents of the view remain unchanged.
Print/Image Settings		The settings in this section apply to both printing and imaging
	Switch Black/White	This option is used to modify the colors that objects are drawn with when printing and imaging as opposed to rendering on the screen. Options are:

		• Yes – always switch black and white colors when printing. Everything that is rendered on the screen as white is drawn black. Everything that is rendered black is drawn white. Objects that are shades of gray are not adjusted. • No – Printed objects are drawn in exactly the same color as screen rendering. • whenBackgroundIsBlack – This is a convenience method that only switches the printing black/white if the map panel (or legend panel) that is being printed is black.
	Show Title	The title in the title bar of the map panel will be placed in the map panel when printed.
	Labeling Font	Selects the font to use for the title.
	Title Font Color	Selects the color to use for the title font.
	Show Legend	If this is selected the legend is made a part of the page print or image capture. The location of the legend is relative to the session being rendered. It would be as if a rectangle that encompasses the legend and the session panel was used to map the desired image to the paper.
	Border Width	This simply selects the width of the border used to define various session and map panel bounds within the print.
	Border Color	The color to draw the border.
Image Settings		These settings apply only to image capture.
	Auto compute image size	This option determines the size of the image based on the size the image is drawn on the screen and matches it.
	Image Size	If a specific image size is desired this is where to define it. Note that font sizes are specified in points and that if the image size is significantly different that the image on the screen, the fonts that are rendered may be different than expected.
	Directory to Save Images	This is the location to store the images that are created.
	Auto Generate Filename	If this is selected the filename to use for image save is automatically generated based on the TIN image times of the topmost map panel of the session.
	Generate Unique Filenames	Selecting this will modify the filename. The idea here is to make it convenient to create multiple images without having to keep entering a filename. For example if this is chosen and the filename template is d:\temp\pics.png, the filenames actually generated will be d:\temp\pics.png, d:\temp\pics.001.png, d:\temp\pics.002.png etc.

	Filename/Filename Template	This specifies the filename to use for taking a snapshot. If the 'generate unique filenames' option is selected then this specifies the base filename to use. This filename will be modified as new images are created.
	Image Type	Options are (note: options may change depending on the version of Java being used) • bmp or wbmp – Windows bitmap • jpeg or jpg – jpeg image • png – portable network graphic image • gif – graphic interchange format image
Performance Settings		These settings apply to balance performance and memory consumption of the program.
	Allow Optimized Drawing	Optimized drawing can dramatically improve performance with large gridded datasets and should always be enabled unless problems occur. The drawing layers which display the TIN/grid as contoured areas/isohyets, Thiessen polygons, and the TIN mesh all employ optimized drawing. The contour/isohyet layer is the most CPU intensive layer to compute and draw, especially when contour smoothing is enabled. When displaying the contour layer for a map panel, if the TIN represents a gridded dataset, the width and height of screen pixels that an individual grid cell occupies is computed. This value is compared to the 'Cell Size Limit'. If the number of pixels is less than the limit, the layer is drawn by drawing small rectangular blocks of color instead of attempting to contour the cell. Each time a map view is computed the program makes this computation so as an image is zoomed in or out it will automatically select the correct draw technique for the area being displayed. The TIN mesh and the Thiessen polygon layer work in a similar manner. Disable this if drawing anomalies occur in map panels.
	Cell Size Limit	This specifies the upper limit on the number of pixels in the map panel that can be represented by a grid cell. Once the ratio of pixels per grid cell falls below this the program reverts to normal drawing methods. A larger number means that images draw more efficiently but the resultant images begin to appear 'pixelated' if the number is too large.

11.3 Properties Tab

The properties option tab (Figure 120) defines general properties for the program, session, or map panel. This panel is available when any of those nodes are selected in the Project Explorer or when a map panel is selected. Table 42 provides definitions for the features available in the properties tab.

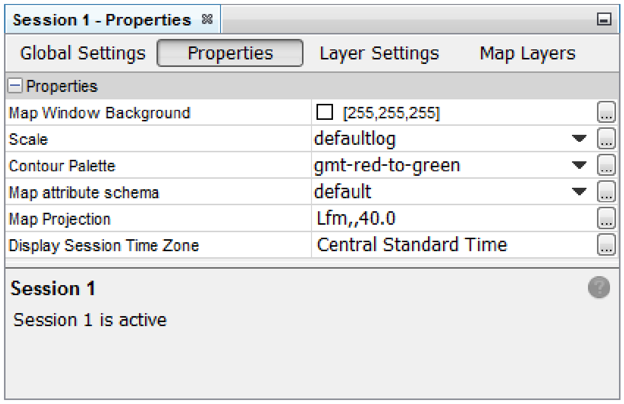


Figure 120 - Properties tab

Table 42 - Properties tab description

Properties Settings Options	Definition
Map window Background	Sets the background color for the selected object. . The small button on the side invokes an external editor which displays a standard color dialog.
Scale	The defined scale to use and relate to the Contour Palette
Contour Palette	The selected contour palette to use
Map attribute schema	The attribute schema to use to relate shapefile objects to line styles.
Map Projection	The projection used by the selected object for display. The button on the side invokes an external editor to make map projection selections.

11.4 Layer Settings Tab

This sets the layer options (Figure 121 - Figure 123) for the various layers in the map panels. Not all layer options are currently exposed yet. However, settings for many layers are minimal. These properties are inherited as a block. Once a property is changed for the map or session, the map or session maintains its own copy of all these properties from that point forward. Table 43 provides definitions for the features available in the layer settings tab.

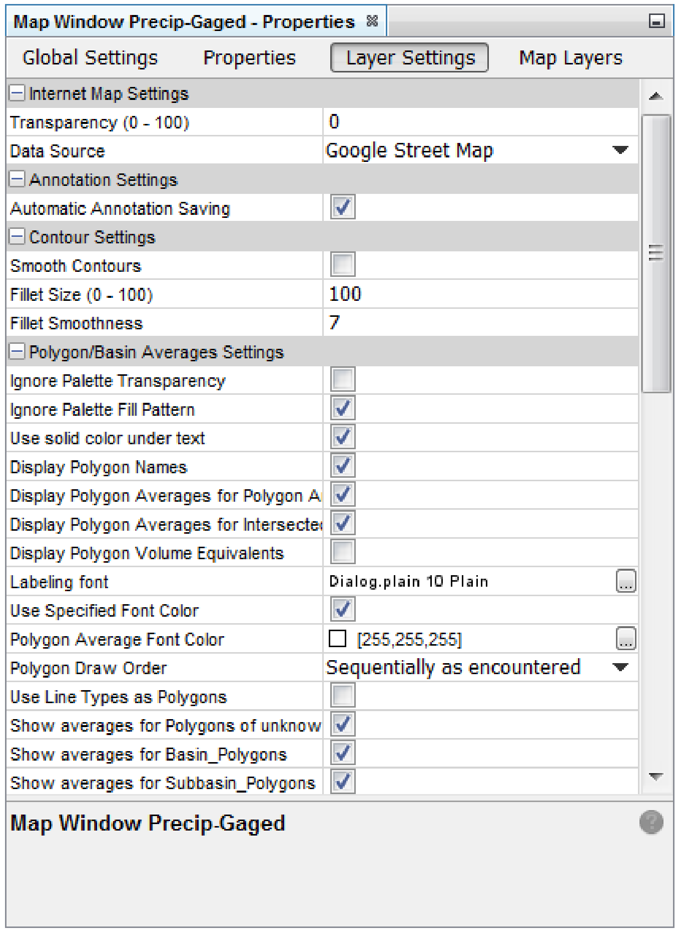


Figure 121 - Layer Settings tab panel, part 1

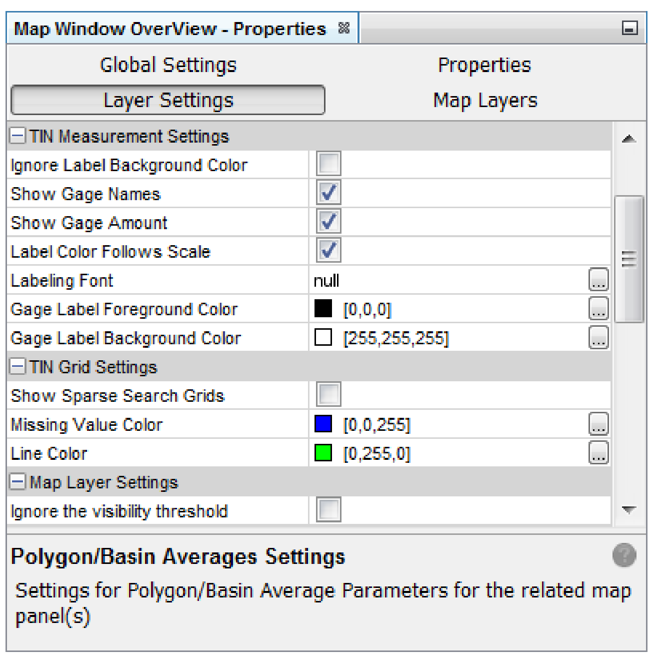


Figure 122 - Layer Settings tab panel, part 2

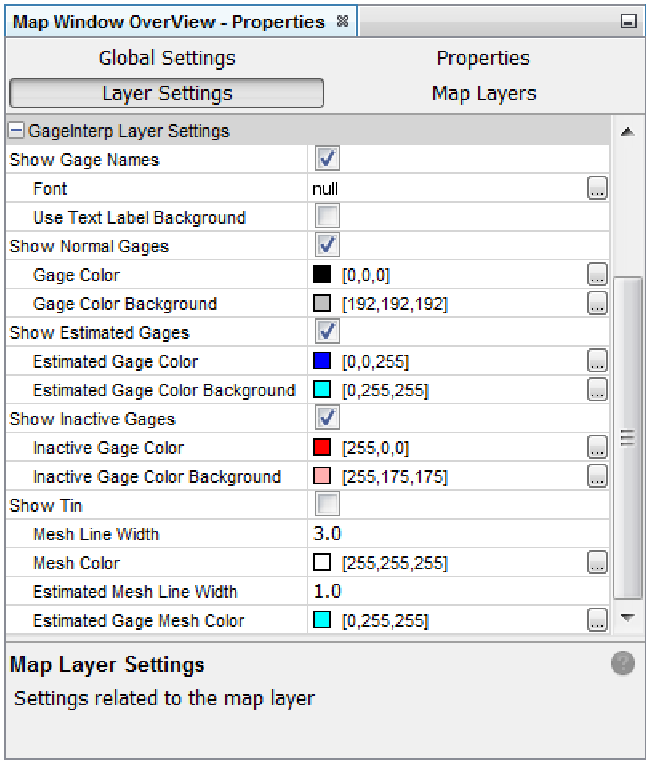


Figure 123 - Layer Settings tab, part 3

Table 43 - Layer Settings tab description

Group	Layer Setting	Definition
Internet Map Settings	**Transparency (0-100)**	Used to set the transparency level of the maps in the event that this layer is not the first layer drawn.
	Data Source	This sets the data source to use for the maps.
Annotation Settings	**Automatic Annotation Saving**	When checked, this will assure annotations are automatically saved as the edits are occurring. When not checked, saving annotation edits requires right clicking on the correct file in the active annotations node via the Project Explorer pane and selecting 'Save File' from the context menu for the node.

Contour Settings	**Smooth Contours**	Sets whether the contours should be smoothed or not. Smoothed contours look nicer but draw much slower.
	Fillet Size (0-100)	Sets the size of the fillet to smooth the contour with. Normal set to 100 for the best look.
	Fillet Smoothness	The number of points to draw a fillet with. Using more points will result in smoother fillet appearance and increased draw times.
Polygon/Basin Averages Settings	**Ignore Palette Transparency**	If set, the basin averages use the palette color but draw them opaque.
	Ignore Palette Fill Pattern	If set, the basin averages ignore any palette fill patterns and just use the shade color.
	Use solid color under text	If set, uses the palette color as an opaque color under the text.
	Display Polygon Names	If set, the name of the polygon is displayed in the center of the polygon. The name is from the shapefile .dbf file LOCATION column.
	Display Polygon Averages	If set, the polygon average is displayed in the appropriate units in the center of the polygon.
	Display Polygon Volume Equivalents	If set, the volume equivalents are computed for the basin. This is only done if the program can convert the measurements units and average to a known resultant unit type.
	Labeling font	Shows the current font in use. Button instantiates a standard font selection dialog.
	Use Specified Font Color	Select this to override using the palette to set the font colors for the labels. Normally the labeling font color is computed from the palette/scale in use.
	Polygon Average Font Color	This is the color to use for the labeling font if the font color is specified.
	Polygon Draw Order	This can be set to either 'Sequentially as Encountered' or 'By Defined Attribute Type'.
	Use Line Types as Polygons	If set, then in addition to giving a list of polygon types that can be used for computations, it also allows the use of line types for polygon type computations. Normally this is set off because the shapefile has the necessary objects identified as polygons.

	Show Averages for <Attribute>	There will be on one of these for each polygon attribute type defined in the schema being used plus one named 'Polygons' for unknown type polygons. In the event that the option to use line types for polygons is selected, the enumeration will also include all the line types for the schema.
Tin Measurement Settings	**Ignore Background Label Color**	When checked, the label background color is not used. When un-checked the label background color is used. When many labels are present and overlap, leaving this unchecked will assure that the topmost TIN measurement settings can be read at the expense of obscuring earlier rendered data in the map panel.
	Show Gage Names	Check this to show the names of the gages at their locations.
	Show Gage Amount	Check this to show the gage measurements
	Label Color Follows Scale	If this is checked the color of the label text matches the corresponding color from the specified color palette for the measurement value. This is similar to computing a contour color to use for the contour layer. If unchecked, the label is colored using the applicable background and foreground colors.
	Labeling Font	The font to use to label point.
	Gage Label Foreground Color	The text color to use when not basing the colors on the measurement value.
	Gage Label Background Color	The text background color to use when not basing the colors on the measurement value and the 'Ignore background label color' is not checked. It results in a small box under the text label to improve readability although it may obscure earlier rendered data in the map panel.
Tin Grid Settings	**Show Sparse Search Grids**	Primarily used for debugging, this option shows the layered sparse search TINs which are used to improve program performance. There are no options for setting the color attributes of the sparse search grids.
	Missing Value Color	The color to use for TIN grids triangles that are undefined or out of bounds.

	Line Color	The color to use for TIN grid triangles that have valid measurement data defined.
Map Layer settings	**Ignore the Visibility Threshold**	Some map attributes have visibility thresholds defined which limit the amount of data displayed at various zoom levels within the program. For example, if viewing a map showing the continental U.S., an active map that shows city streets would likely create map clutter and convey very little. As the image is zoomed, perhaps to the city limits, the city streets become visible. Selecting this option disables the threshold parameters and draws everything within the view.

11.5 Map Layers Option Tab

The Map Layers tab (Figure 124) gives access to which map layers are drawn and in which order it occurs. These properties are inherited as a block. Once a property is changed in the map or session, it maintains its own copy of all these properties from that point forward. Table 44 provides definitions for the features available in the map layers tab.

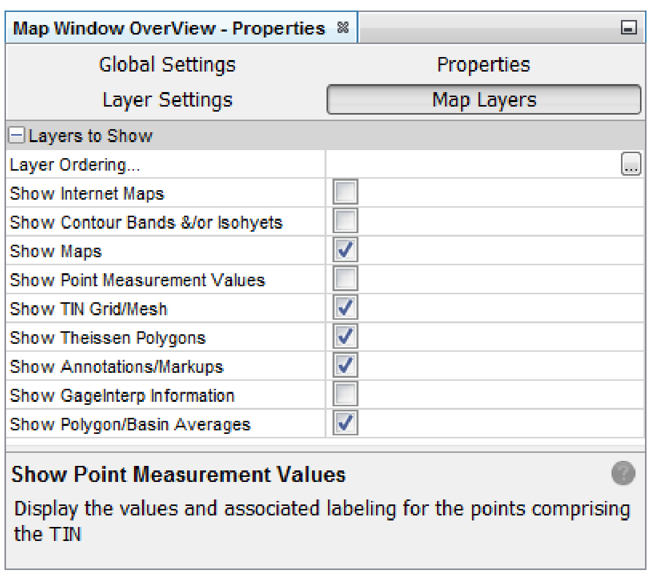


Figure 124 - Map Layers tab

Table 44 - Map Layers tab description

Map Layer Settings Options	Definition
Layer Ordering…	Displays the editor shown in Figure 125 to set the order that the map layers are rendered in. The layers can also be enabled or disabled from this dialog. The remaining settings in this tab group reflect the ordering set in by this editor.
Show Internet Maps	If selected this will show maps retrieved from a map server such as Google Maps. Currently internet maps are displayed only when the map panel projection is set to 'Trivial'
Show Maps	If selected, the active maps are drawn. The position within the property sheet indicates the drawing order. In this example, the maps layer will be drawn first.
Show Contour Bands &/or Isohyets	If selected, renders the contour layer.
Show Polygon/Basin Averages	If selected, renders the basin average layer. Note that basin averages are computed for a map panel when it is drawn regardless of whether they are displayed on the map panel. They will be tabulated in the message area on the basin averages tab.
Show Point Measurement Values	If selected, displays the point measurement values at the triangle vertex points of the TIN. It is linked to the contour palette and scale choices for color choices.
Show Tin Grid/Mesh	If selected shows a wire frame of the TIN
Show Thiessen Polygons	Shows the polygons computed by creating a perpendicular bisector of all the TIN triangle sides and connecting them to the bisectors of the adjacent triangles.
Show Annotations/Markups	If selected, renders the annotations from the currently selected annotation layer files.

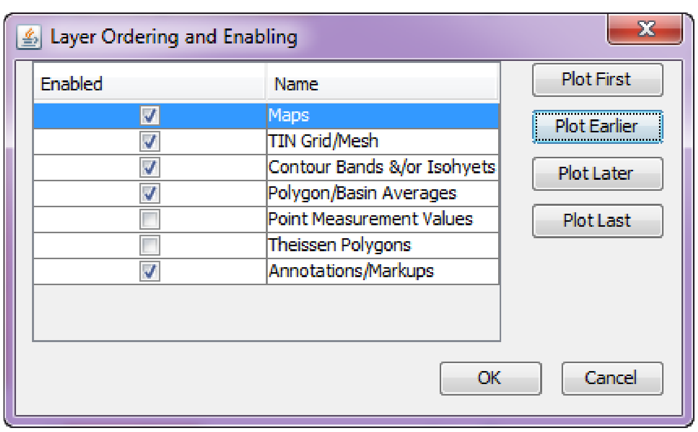


Figure 125 - Layer ordering and enabling dialog

Chapter 12

12. Map Window

12.1 General Discussion

The map window is the window where all the maps are drawn. As stated earlier, a map window belongs to a session and as such is always contained with the session window. Map windows cannot be undocked from the session. If one attempts to drag a map window outside of the session window it is simply clipped off at the session window boundary. A map window is made up of many types of information, such as georeferenced map data, basin average renderings, and contoured measurement data. All these various types of information are referred to as map layers and each has its own unique set of properties and settings. All map windows can be individually manipulated. Map windows can either specify their own sets of properties and data or inherit defaults from the session that they are a member of.

Although a map panel does inherit default settings from the session to which it belongs, any TINs being used belong solely to the map window. For example, when a session specifies a TIN dataset and two different map windows inherit this information from the session, they each create their own copy of the TIN which can be edited and changed independently of the other map window.

12.2 Mouse Modes/Tools

The mouse mode sets the tool to assign to the left mouse button while working in the map panel. The following modes are currently supported.

- Zoom In Tool, discussed in a later section.
- Zoom Out Tool, discussed in a later section.
- Pan Tool, discussed in a later section.
- Polygon Tool. This sets the left mouse button to create a polygon by either holding down on the left mouse button and tracing or continually clicking the left mouse button to select specific points. The polygon is completed by right clicking with the mouse to activate the context menu.
- Rotate Image Tool, discussed in a later section.
- Scale Tool, discussed in a later section.
- Translate Tool, discussed in a later section.

The various modes can either be selected by using the toolbar or by making a selection from the map panel context menu as shown in Figure 126. All modes are discussed below in the sections dealing with view control or editing.

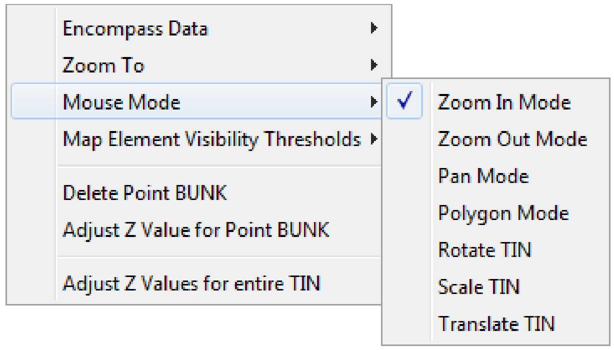


Figure 126 - Mouse Mode options menu

12.3 Controlling the View

To give a better response, HEC-MetVue draws maps asynchronously. This means that it is not necessary to wait for the map to finish drawing in order to readjust the view. As the map is drawing simply keep working and the map drawing will stop and restart with the latest viewing information as needed to keep in synch with the view adjustments being made.

Zooming In

There are 3 ways to zoom in on a view.

- Use the left mouse button when the mouse mode is set to Zoom In. Simply hold down on the mouse button and drag the mouse. A rectangular area will be displayed on the screen and follow the mouse cursor. When the button is released, the view will be zoomed to an appropriately scaled view.
- If the mouse being used has a mouse wheel, put the mouse cursor to the point on the map to zoom to. Scroll the wheel to zoom in. Note: the map window must have the mouse focus for this to work.
- Select the menu item 'Window->Zoom in on Map Center' or use the toolbar icon. The view will be adjusted to contain approximately 70% of the area of the current view.

Zooming Out

- Use the left mouse button when the mouse mode is set to Zoom Out. Simply hold down on the mouse button and drag the mouse. A rectangular area will be displayed on the screen and follow the mouse cursor. When the button is released, the view that was originally on the screen will be 'squeezed' to fit into the rectangle defined. The smaller the rectangle, the greater the zoom out will be.
- If the mouse being used has a mouse wheel, put the mouse cursor to the point on the map to zoom out on. Scroll the wheel away to zoom out. Note: the map window must have the mouse focus for this to work.
- Select the menu item 'Window->Zoom out on Map Center' or use the toolbar icon. The view will be adjusted to contain approximately 140% of the area of the current view.

Selecting a Previously Selected View

HEC-MetVue maintains a list of previously selected views. The menu commands 'Window->Previous map extents' and 'Window->Next map extents' or their respective icons from the toolbar  and  can be used to iterate through the list. New views will be inserted in the list at the current position. When iterating thought the views in a forward direction and the end of the list is reached, the map window will simply start over at the beginning of the list. This action works in both directions, wrapping around to the other end of the list when the end is reached.

Zooming to a Specific Map Object(s)

- Select the map object(s) from the Project Explorer (Figure 127). Multiple map objects can be selected by using the standard Shift and Control key combinations along with the left mouse button to make the selections.

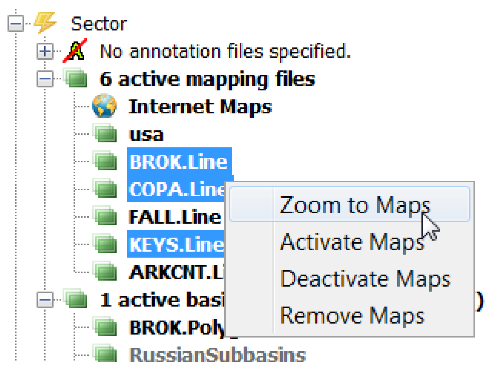


Figure 127 - Project Explorer window Zoom to Maps selection

- Right click on the map and select 'Encompass Data' and then select 'Maps', 'TIN' or 'Both' (Figure 128).

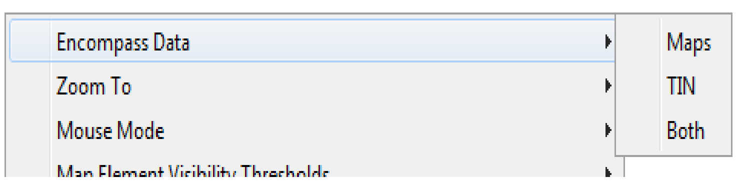


Figure 128 - Map Window Encompass Data selection

- Right click on the map and select 'Zoom To' and select 'Map' or 'Basin' dependent on whether the map is defined in the mapping files or basin averages category in the Project Explorer. A menu list of the active maps is displayed to choose from (Figure 129).

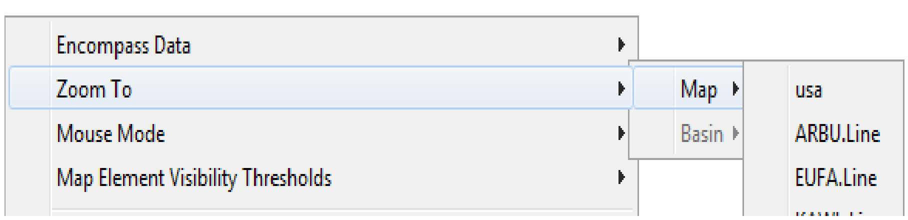


Figure 129 - Map Window Zoom To selection

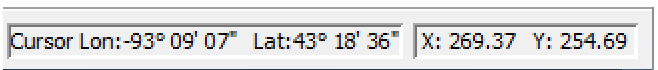
Panning

Use the left mouse button when the mouse mode is set to 'Pan'. Simply hold down on the mouse button and drag the mouse. Release the mouse button when done.

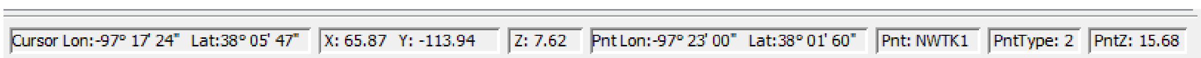
12.4 Tracking the Mouse Cursor

This option is used to give feedback on the status bar of the current location of the mouse. It is set to either be on or off and it is a global setting for every map panel.

If the mouse is outside of the defined area where measurement data exists, it will show both the current position in lon/lat and in the coordinates of the currently selected projection. Note that the format of the lon/lat can be controlled via a setting on the Global settings tab of the Properties window.



If the cursor is within the defined area of the measurement data, the cursor message box will display additional information. In addition to what is shown above, the cursor message box also displays the interpolated measurement value at the cursor location, the nearest measurement point location lon/lat, the name of the measurement point (not shown for gridded images), the measurement point type and the measurement value of the nearest point.



12.5 Cursor Mimicking

Similar to the tracking option, cursor mimicking is either on or off and its setting is also a global one affecting all map windows. Although the setting is global, the cursor mimicking itself is restricted to map windows within the same session. When this option is enabled, a small 'x' is drawn in the other map panels in the session to reflect the lat/lon position of the mouse cursor in these other panels.

12.6 Setting Visibility Thresholds

Maps can become cluttered with excessive amount of map data. HEC-MetVue allows the visibility of map attributes to be controlled based on the geographic extents of the data being displayed in the map window. Visibility thresholds are best set from the context menu of the map panel although they can also be set using the attribute schema dialog. Visibility thresholds are always defined by attribute type.

For example, suppose that the maps being viewed contain map data for Interstates, U.S. Highways, State Highways, Primary roads, and Secondary roads. At a very wide view perhaps only interstates are visible. As the view is zoomed in, perhaps U.S. highways become visible (high view threshold) and symbols show where major cities are located. Zoom in even more and other roads become visible, the symbol showing where the city is located is removed (low view threshold) and replaced with an outline of the incorporated limits. Zoom in further and streets in subdivisions and flood zones become visible.

Since the zoom thresholds are associated it the attributes of a particular schema, once defined, they are defined for all map panels. (Remember that attribute schemas, palettes, and scales are global objects.)

To define upper visibility threshold for an attribute as illustrated in Figure 130:

1. Zoom on the map to the maximum extent where attribute should begin to display.

2. Right click on the map panel to bring up the map panel context menu.

3. Select 'Map Element Visibility Thresholds'.

4. Select the desired attribute to set the upper threshold for and select 'Set High View Threshold'.

To define the lower visibility threshold for an attribute, do the same as above for the upper threshold except select 'Set Low View Threshold' instead for the final step.

If neither of the thresholds have been defined then the 'Remove View Thresholds' menu item will be grayed out.

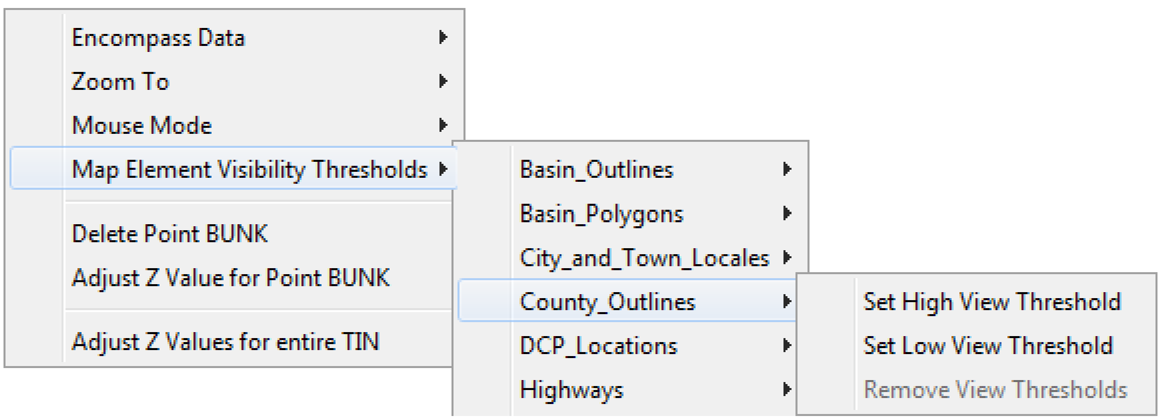


Figure 130 - Map Element Visibility Thresholds menu options

12.7 Dynamic Map Window Toolbar

The dynamic map window toolbar, shown in Figure 132 appears at the bottom of every map window. By default, the toolbar is hidden. When you position the mouse pointer close to the bottom of the map window, the dynamic map window toolbar will appear. The small thumbtack icon on the left side of the toolbar can be used to prevent the toolbar from disappearing if the mouse pointer is not in proximity. Figure 131 shows a typical data selection dialog common to most I/O plugins. The red oval highlighted options are required for the dynamic toolbar to function. If these options are not selected the toolbar will have a message stating that it is disabled. Table 45 provides a description of the symbols and features of the Dynamic Map Window.

Using the toolbar to change the time window will create an aggregate TIN for the map panel that reflects the available data for the defined time window. This view of the data is temporary. It will not change the settings that were set with the data selection editor (Figure 131). If the program is restarted, the "Refresh TIN(s) from datastore" option from the context menu is selected, or the data selection editor is redisplayed and the OK button pressed, the time window will revert to the original settings.

The toolbar has controls for increasing or decreasing the timespan from either the beginning or end or moving the timespan forward or backward in time.

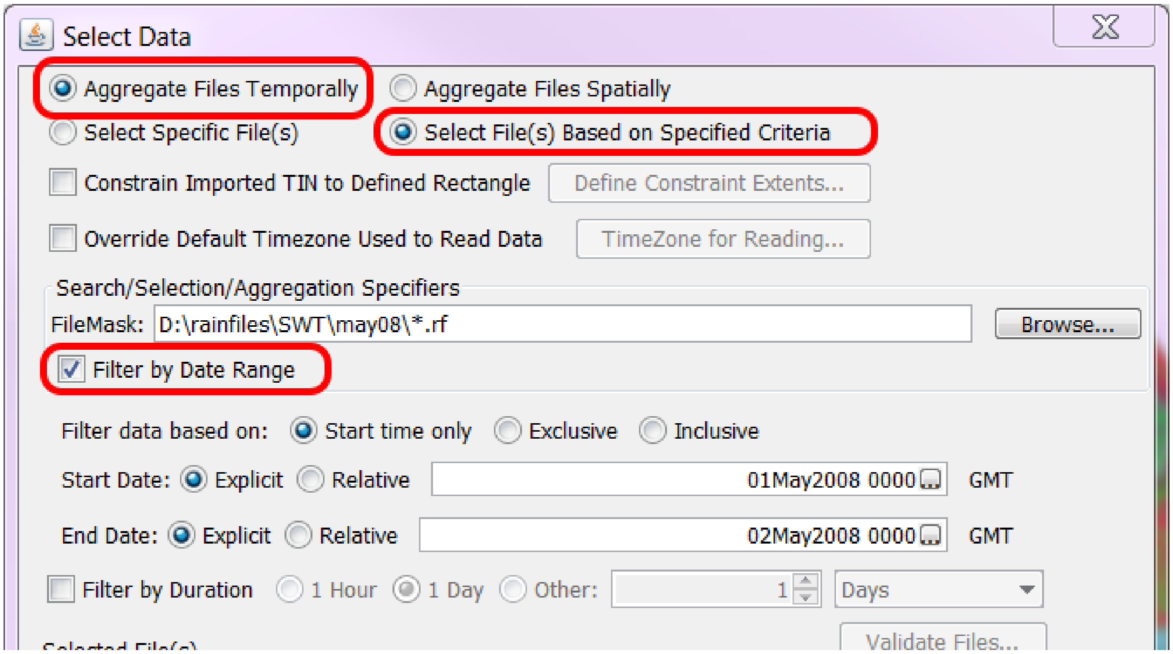


Figure 131 - Required options for enabling the Dynamic Map Window toolbar

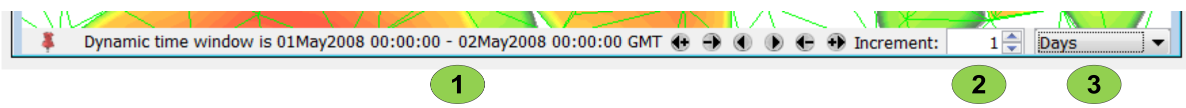
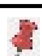


Figure 132 - Dynamic Map Window toolbar

Table 45 - Dynamic Map Window toolbar description

Item	Description
 or 	The thumbtack icon is used to fix the toolbar at the bottom of map panel. If the thumbtack is pointing down it indicates the toolbar is fixed. If the thumbtack is at an angle, the toolbar will disappear when the mouse pointer moves away from the bottom of the map panel and reappear when the mouse pointer is in proximity.
1	This displays the time current time window used to aggregate the TINs. If the time window encompasses more time than the available data, it may differ from the timespan shown in the map window title bar.
	Pressing this button will increase the timespan by adding the time increment defined by items 2 and 3 to the beginning of the current timespan.
	Pressing this button will decrease the timespan by trimming the time increment defined by items 2 and 3 from the beginning of the current timespan.

	Pressing this button will shift the displayed timespan to an earlier start time by the time increment defined by items 2 and 3.
	Pressing this button will shift the displayed timespan to a later start time by the time increment defined by items 2 and 3.
	Pressing this button will decrease the timespan by trimming the time increment defined by items 2 and 3 from the end of the current timespan.
	Pressing this button will increase the timespan by adding the time increment defined by items 2 and 3 to the end of the current timespan.
2	This is used to define the number of increments to adjust the timespan by whenever one of the timespan adjustment controls is pressed.
3	This is used to define the duration of the increment used to adjust the timespan by whenever one of the timespan adjustment controls is pressed.

Chapter 13

13. Editing TIN Data

13.1 Deleting a Point

Deleting a point is most often done with an irregular TIN than it is with a grid but it can be done to both. To delete a point, simply get as close to the point with the mouse cursor as possible and right click to bring up the context menu and delete the point (Figure 133).[10]

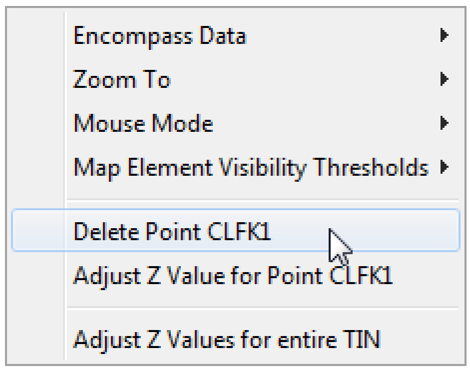
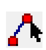


Figure 133 - Delete Point in TIN

13.2 Creating a Polygon With the Define Polygon Tool

The 'Define Polygon' tool  is used to form a polygon. This polygon is used for a variety of editing purposes as described below. In addition, once a polygon is defined on a map window, it can be used in I/O operations to set the extents of TIN data to read, write, or project.

To create a polygon, either press and hold the left mouse button while moving the mouse on the map panel, press and release the left mouse button to input individual points, or use a combination of both techniques. To remove one or more points, use the backspace key. To remove all the points, use the escape key. Once satisfied with the polygon, press the right mouse key. This will automatically connect the first and last polygon points and redraw the polygon using a thicker line. The polygon can be removed by pressing the escape key. If a new polygon is created once the original polygon is completed, the original polygon will remain in the map view but the program will not use it. Only the most recent polygon is tracked in the map window.

13.3 Deleting a Group of Points

Make sure all the measurements that are to be deleted are visible on the screen. Set the mouse mode to 'Define Polygon'  and create a polygon with the points to delete in the

[10] Deleting points from gridded data marks the data as deleted or missing but does not actually delete the point location from the dataset. To do so would make the data into an irregular TIN. This is unnecessary.

polygon. Right click to bring up the map panel context menu and select the appropriate option as shown in Figure 134.

Note that once the polygon is formed there is also an option to delete points that fall outside of the polygon. This option would typically be used to 'trim' the extents of a storm prior to performing a depth-area-duration analysis by encompassing the portion of the storm to retain.

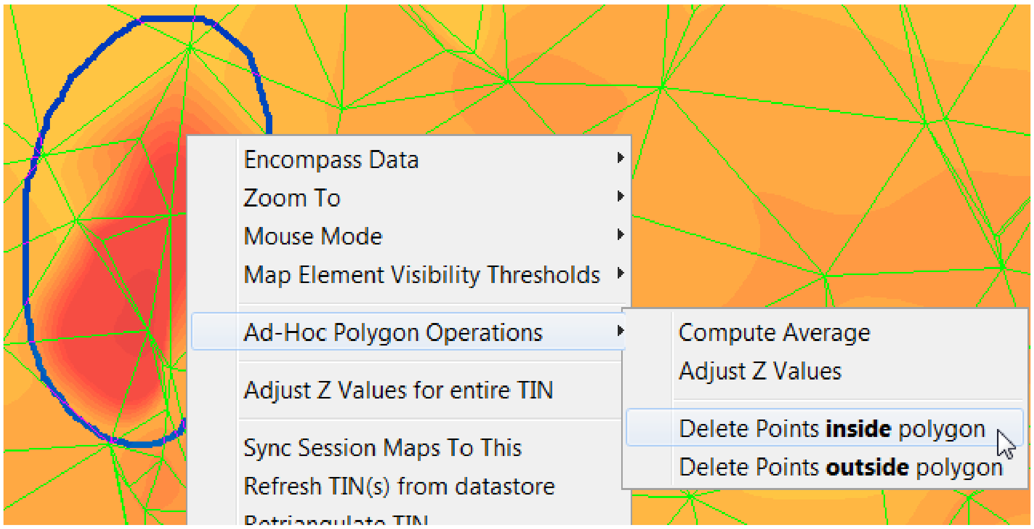


Figure 134 - Delete measurements defined in polygon

13.4 Adding a Point

Adding a point is most often done with an irregular TIN than it is with a grid but it can be done to a gridded dataset as well. Note however that adding a point to a grid means it is no longer a grid and will be processed as an irregular TIN. Any added point modifies the totals in the aggregate image. When saving discrete images for the dataset, the individual images will be modified using their temporal distribution weights and the modified aggregate value.

To add a point, simply position the mouse where the point is to be added and select the 'Add Point…'option. This will bring up the dialog shown in Figure 135. The X and Y coordinates of the point are in the display coordinates of the map projection selected and at the point that the mouse was pressed. Adjust the locations, measurement and name of the point as desired.

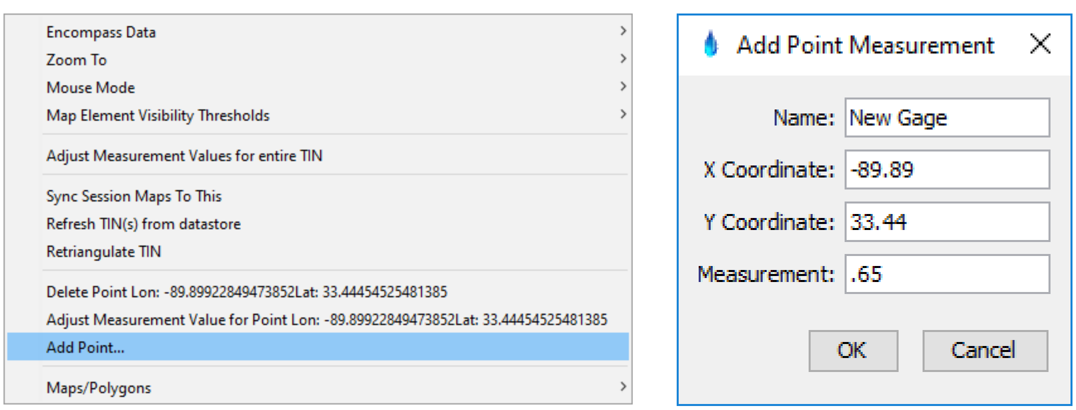


Figure 135 - Add point in TIN

13.5 Adjusting Measurement Value for a Point

Adjusting the measurement value for a point most often done with an irregular TIN than it is with a grid but it can be done to both. To modify a point, simply get as close to the point with the mouse cursor as possible and right click to bring up the context menu and select 'Adjust Measurement Value for Point…' A new dialog will be displayed as shown in Figure 136. The selected value can either be a ratio or a constant value can be added to it.

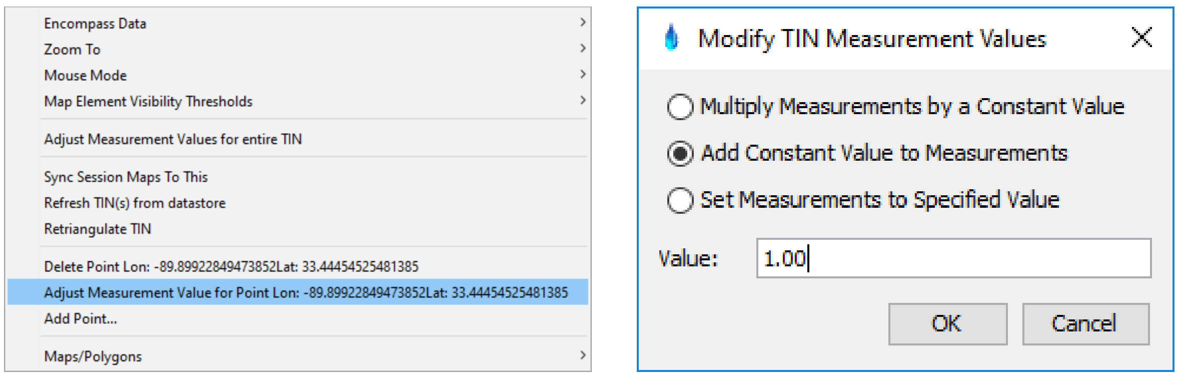


Figure 136 - Adjust measurement value for a point in a TIN

13.6 Adjusting Measurement Value for all Points

To adjust all the measurement data for the entire dataset, right click on the map panel context menu and select 'Adjust Measurement Values for entire TIN' (Figure 137). Again, the dialog shown in Figure 136 will be displayed. Note: This is much more efficient than surrounding the entire dataset with a polygon and adjusting it.

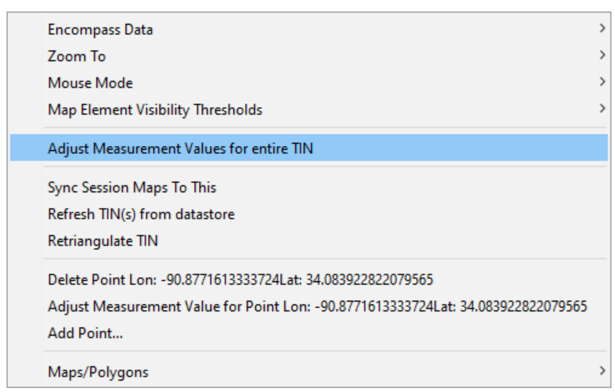


Figure 137 - Adjust Measurement Values for entire TIN

13.7 Adjusting Measurement Value for a Group of Points

Make sure that all the measurements to be modified are visible on the screen. Set the mouse mode to 'Define Polygon' and create a polygon with the points to modify in the polygon. This is similar to Figure 134 except that the menu selection 'Adjust Measurement Values' is selected instead. This then displays the dialog as shown in Figure 136.

13.8 Rotating, Translating and Scaling TINs

Many features in HEC-MetVue are designed for use in operational settings. However, there are some features that are beneficial for performing studies. Rotation, Translation, and Scaling of the TIN layer are three features designed to help with storm studies and other applications. Using these features, it is possible to move a storm over a basin and re-orient it to model what would happen should the storm occur at a different location. Since HEC-MetVue's storm rotation, translation, and scaling features provide simple TIN manipulations without regard to atmospheric dynamics, users should make practical decisions on manipulating the image placement and scale to provide reasonable what-if scenarios.

Currently, there are two ways to perform these options. The visual way is to use the mouse and directly drag/orient the storm to the desired location. The second method is to the use the studies toolbar and input the values directly.

Note: Gridded data that have been scaled, translated, or rotated cannot be saved by any of the current I/O providers without projecting the results onto a new grid. HEC-MetVue has built in support for it. However, none of the current I/O providers support saving without re-projection.

Method 1 – Manual TIN positioning

Rotating a TIN

To rotate a TIN, select the appropriate mouse mode and then depress the left mouse button and drag the mouse. The TIN will be rotated around the center of the window. There is currently no way to set the rotation center point other than to set the desired rotation location to the center of the map window. When the left mouse button is released the image is redrawn. Any basins average files that are active will have their basin computations redone for the new TIN alignment.

It is sometimes convenient to be able to position a TIN by a combination of translation and rotation. When Rotation mode is selected, Translation mode becomes the secondary mode. With the left mouse button still depressed, press the right mouse button. While both buttons are depressed simultaneously, the edit action will be Translation. Release one button and the mode goes back to Rotation mode. So long as at least one button is depressed, switching between the two can be done many times.

Translating a TIN

To translate a TIN, select the appropriate mouse mode either from the toolbar or context menu and then depress the left mouse button and drag the mouse. The TIN will be moved along with the mouse cursor. When the left mouse button is released, the image is redrawn. Any basin average files that are active will have their basin computations redone for the new TIN alignment.

It is sometimes convenient to be able to position a TIN by a combination of translation and rotation. When Translation mode is selected, Rotation mode becomes the secondary mode. With the left mouse button still depressed, press the right mouse button. While both buttons are depressed simultaneously, the edit action will be Rotation. Release one button and the mode goes back to Translation mode. So long as at least one button is depressed, switching between the two can be done many times.

Scaling a TIN

To scale a TIN, select the appropriate mouse mode either from the toolbar or context menu and then depress the left mouse button at a location about halfway between the center and edge of the map panel and drag the mouse. A rectangular box will appear on the screen where the dragging began and another in the current location giving an indication of the scaling amount. By making the rectangle smaller, the TIN will be scaled to a smaller size. Likewise, making the rectangle larger increases the TIN coverage.

Method 2 – Positioning TIN using the Positioning toolbar

Figure 138 shows the Positioning toolbar used to control the TIN placement. Using this toolbar, one can input the rotation, x and y displacement (translation), and scaling for a TIN. The controls on the toolbar move the TIN to the desired location. Table 46 provides a description of the features available in the toolbar.

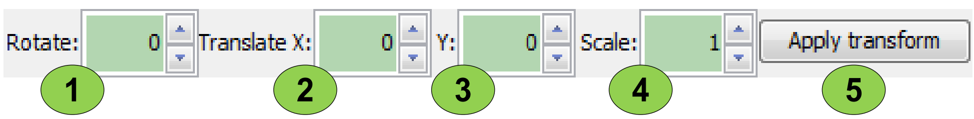


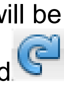
Figure 138 - TIN positioning toolbar

Table 46 – TIN positioning toolbar description

Item	Description
1	This is the entry field for the angle of rotation of the image. The angle of rotation is always in degrees. The spinner control moves the angle one degree at a time. Positive rotations are counterclockwise.
2	This is used to input the distance to move the TIN in the X direction. If the spinner is used, it moves the image one unit to at a time. What defines a unit varies based on the coordinate transform picked. If the display units are miles, every click of the spinner moves the image one mile. If the coordinate transform selected uses feet, every click of the spinner moves the TIN one foot.
3	This is used to input the distance to move the TIN in the Y direction. If the spinner is used, it moves the image one unit to at a time. What defines a unit varies based on the coordinate transform picked. If the display units are miles, every click of the spinner moves the image one mile. If the coordinate transform selected uses feet, every click of the spinner moves the TIN one foot.
4	This control is used to scale the image. The spinner scales the image using a variable factor in an exponential fashion.
5	After the factors are set in the various entry fields/spinners, this button must be pressed to apply the transform just input. Until this is pressed, no computations or actual recordable edit actions take place.

13.9 Undoing and Redoing Editing Changes

Analogous to a text editor, this program supports being able to undo and redo edits. For example, suppose a measurement was accidentally deleted. The undo action could be executed to restore the deleted measurement. All the edits that are performed are stored in series. If 25 edits have been made, the undo action could be performed 25 times in a row. If however, 14 edits were undone and then a new edit performed then the edit chain would only have 15 transactions in it; the original 14 that were not undone plus the one new transaction. The addition of the new transaction had the effect of removing all the undone transactions that occurred after transaction 14.

If there are no edits that can be undone, the undo indicator on the toolbar will be grayed out . If there are edits that can be undone, the undo indicator will be enabled . If there are no edits that can be redone, the redo indicator will be grayed out . If there are edits that can be redone, the redo indicator will be enabled .

Chapter 14

14. TIN Calibration

This section describes utilities that can be used to process TIN data that go beyond simple editing of images as described earlier.

14.1 Image Adjustment and Calibration

Using one TIN image to adjust another is referred to as image calibration. Typically this methodology is used to adjust a radar TIN using a rainfall TIN as the control grid (Figure 139).

This is typically done because radar TINs (Figure 140) have very good spatial resolution but lack precision, whereas rainfall TINs are precise at the gage locations but lack the spatial resolution of the radar. The best features of each TIN type are combined in the hope that it will result in a better final product.

For example, if a radar grid cell indicates that the heavier rainfall in one grid cell than another then there is a good chance this is correct if the grid cells are somewhat close to each other. This can be greatly affected by anomalous propagation, orographic effects, cold fronts, hail, and many other factors. Given all this, calibrating radar can still significantly improve results.

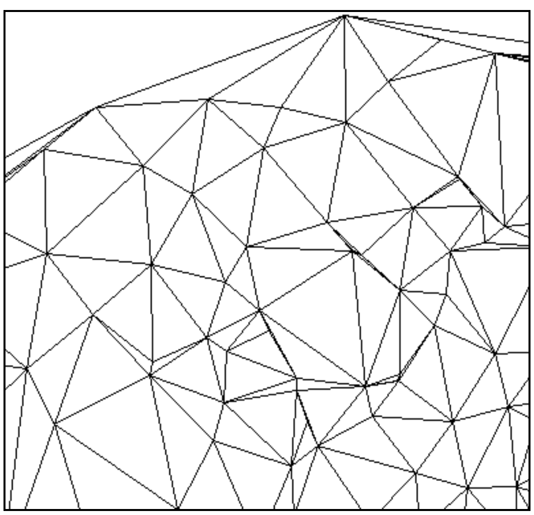


Figure 139 - Typical rain gage TIN

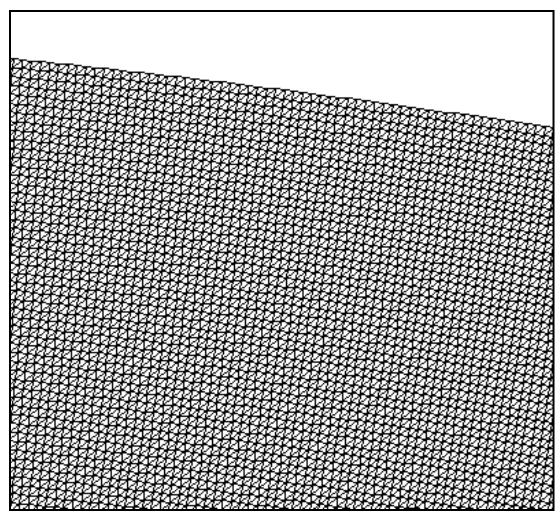


Figure 140- Typical radar TIN for same area

How the Calibration Works

HEC-MetVue uses a geometric algorithm as opposed to most methods that rely on statistical methods to attempt a radar calibration. First, the program determines which radar grid cell center points reside in each of the triangles formed by the rain gage TIN. It then uses the measurement values of the rainfall TIN, which are defined at the triangle vertexes, to adjust all the radar grid cells within that triangle using a double interpolation technique. Not only does this give a calibrated radar image that matches the TIN of the rainfall data at known points, it also preserves the relative, albeit adjusted, intensity values of the radar where no gage exists. Unlike statistical means which tend to diminish the radar measurement values from their highs and lows, this method does not either blur the image or become unstable.

There are limitations the application of HEC-MetVue geometric algorithms. First, hail which confuses the radar and shows a very high return and thus very high rainfall, may not be accurate since the radar image no longer is representative of the rainfall itself and now represents a non-linear relation between the radar return and actual rainfall. Secondly, rain events with supercell storms may not calibrate well due to the fact that storms can completely miss the gages and no bias can be applied. For example, there is no meaningful way a radar image that has reported zero rainfall at the gage and in the radar bin above the gage can be adjusted since no difference is apparent. Although this may be a problem from a mathematical perspective, supercell storms are usually so localized that they do not cause problems on larger reservoirs. Also, at the worst, no bias is applied and the supercell is the same size as before. Third, the algorithms have not been tested where orographic effects from mountains influence precipitation, but the expectation is that it will perform very well as long as the rain gages are well distributed with respect to elevation.

There are some issues with a rain gage TIN having a rainfall value of zero at a gage location while the radar value at that vertex is non-zero and vice versa. When this happens, there is a point where the computation method must switch from one technique to another. Whenever the ratio of the radar to the rainfall exceeds 3.0, the algorithms switch to an additive approach as opposed to a ratio approach to adjust the radar image. This algorithm determination evaluation occurs independently for each of the rainfall TIN gage location/radar estimation combinations in the dataset.

Figure 141 is an example of the calibration. To simplify the computations, consider the 5 grid cells evenly spaced along a line between A and B where the points A and B make up two of the corner points of a triangle of the precipitation TIN. The simplification comes from the fact that since the grid cells are precisely on a line between A and B, the third point of the triangle, Point C, has no weight.

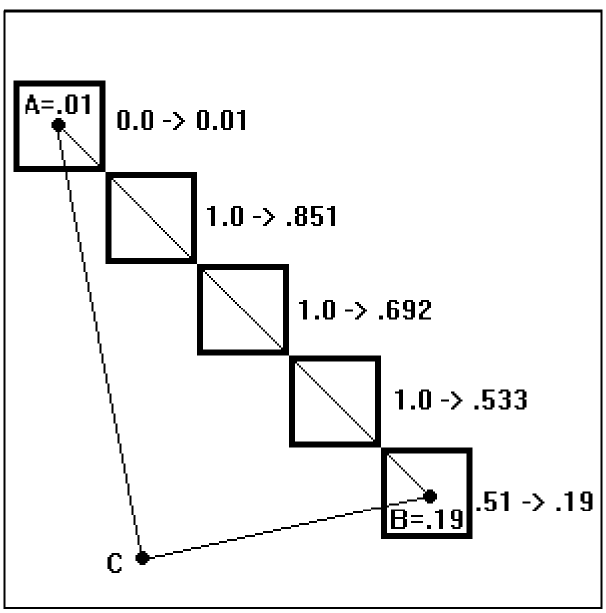


Figure 141 - Radar bins along a rainfall grid

Table 47 - Rain/Radar differences and ratios

Point	**Rain**	**Radar Estimate**	**Delta**	**Ratio**
A	0.01	0.00	0.01	∞
B	0.19	0.51	-0.32	0.3725

Weighting a point based on how far it is from Point A and B respectively with point 1 being the center of the radar bin on top of point A and point 5 being the radar bin on top of point B:

Table 48 - Radar bin point weights

Point weight	**1**	**2**	**3**	**4**	**5**
Weight A	1.00	0.75	0.50	0.25	0.00
Weight B	0.00	0.25	0.50	0.75	1.00

From Table 47, the ratio of Point A (.01 / 0) is greater than 3. Additive weighting will be used from this point. The ratio of Point B (.3725) is less than 3. The ratio method will be used from this point.

When additive weighting for a point is used, its ratio is 1. When ratio weighting for a point is used its difference is 0. Given this and the generalized equation shown below and ignoring point C yields:

```
adjZ = origRadarZ * (ratioA * weightA + ratioB * weightB) + diffA * weightA
+ diffB * weight
```

From Table 48, `ratioA=1`, `ratioB=0.3725`, `diffA=0.01` and `diffB=0.00`. Again, from the above rules, ratioA was set 1 for additive weighting and diffB was set to 0 for ratio weighting (Table 49).

Table 49 - Adjusted radar bins

Radar Bin	**Original rain**	**Original Radar**	**Adjusted Radar**
1	0.01	0.00	0.01
2		1.00	0.851
3		1.00	0.692
4		1.00	0.533
5	0.19	0.51	0.19

Specifying the Calibration

The calibration tool is available on the program toolbar by pressing the ⚙ icon. The icon may be greyed out if no map window has been selected. Once pressed, the dialog shown in Figure 142 is displayed. Table 50 provides a description for the features of the calibration tool.

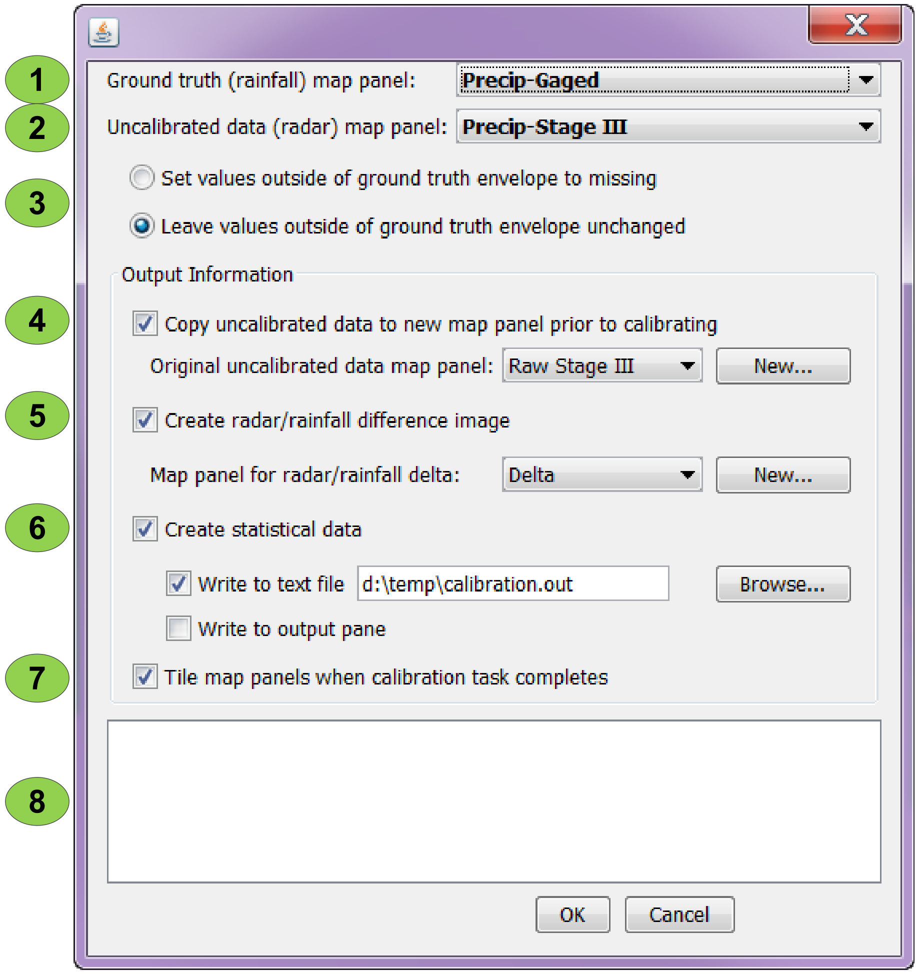


Figure 142 - Calibration Tool dialog

Table 50 - Calibration Tool dialog description

Item	Description
1	This dropdown is used to set the map panel that contains the control TIN to use in the calibration. It is usually a TIN type that is identified internally as a gaged precipitation type of image. Images that are of this type are in bold text in the dropdown to help in the selection; however, any valid map panel may be selected for the control, even another radar image.
2	This dropdown is used to set the map panel that contains the target TIN to use in the calibration. It is usually a TIN type that is identified internally as an uncalibrated radar image type. Images that are of this type are in bold text in the dropdown to help in the selection however any valid map panel may be selected for the target.
3	This control defines whether the resultant TIN created should be trimmed outside the area defined by the control TIN. The algorithms which calibrate the image only do so within the perimeter of the control TIN.

4	Enable this option to copy the original uncalibrated TIN prior to calibration. This option makes it straightforward to compare the calibrated and uncalibrated TIN. The 'New…' button can be used to create a new map panel in the session window. If a new map panel is created, it copies the map panel defined in 2 above to obtain its shapefiles and basin average files. If the map panel already exists it uses the current settings without copying them.
5	Enable this option to create a radar/rainfall difference TIN and place it in the specified map panel. The 'New…' button can be used to create a new map panel in the session window. If a new map panel is created, it copies the map panel defined in 1 above to obtain its shapefile and basin average files. If the map panel already exists, it uses the current settings without copying them. Because the scale used to display differences may be different than the normal scaling it may be better at times to specify an existing map panel with a specialized scale just for displaying differences. This map can be invaluable in visually spotting errant control gages.
6	These controls are used to create the statistical data. The statistical data is a listing of the control gages ranked by the fit with the radar TIN. This file can be invaluable in locating errant control gages. Although HEC-MetVue cannot determine which gages are in error versus those that simply have a poorer fit, the gages that are errant tend to have a higher ranking.
7	This is used to tile the map panels after the calibration computations have completed.
8	This is the location where any errors or warnings are shown which will result in the calibration failing. If there are any errors, pressing the 'OK' button will not dismiss the dialog.

Chapter 15

15. TIN Disaggregation

TIN disaggregation is the process of taking a single TIN in conjunction with temporal controls to generate a series of shorter timespan TINs that have the same aggregate total as the original TIN and also incorporate the temporal information from the given temporal controls. The temporal controls may be either one or more georeferenced hyetographs or a temporal pattern. When multiple hyetographs are used, the temporal pattern differs within the TIN based on the location of any particular location in the TIN with respect to the locations of the supplied hyetographs.

One example of where TIN disaggregation is useful is in the modeling of historical storms where no radar information is available. It is not unusual for storm hyetographs to have durations of 15 minutes, 1 hour, 6 hours and 24 hours for a single event. Some hyetographs may even be irregular interval time series, recording the time and date when each .01 inches of rainfall accumulate. A storm total TIN is simple to generate using all the data available (refer to the TriangulateTin command line utility). What if a series of 1-hour TINs is required? The 15 minute and 1 hour hyetograph data would be simple to utilize but to incorporate the longer time span data becomes a bigger challenge. In addition, the 24 hour reports may be a combination of midnight to midnight, 7am-7am, or 8am-8am readings. Using all the available data and attempting to accomplish this process manually can be a very time consuming task. By creating a single aggregate TIN representing the storm total and then using the more resolute reports for temporal distribution, a series of short duration TINs can be created which can then be used to generate subbasin average hyetographs or projected onto a set of gridded TINs for use by other programs.

Although the disaggregation technique processes a single TIN to create the shorter duration TINs, it can be inconvenient to specify a single TIN for perhaps a 24-hour timespan, load another TIN for the following day, and repeat the disaggregation process for a precipitation event that covers several days or weeks. Processing the entire storm as a single aggregate is not feasible in this situation because it would not respect the boundary conditions of the discrete TINs, allowing the temporal pattern for the entire timespan to possibly shift precipitation from one discrete TIN timespan to another if there was some variance between the distribution for the hyetographs and the TINs. HEC-MetVue allows the aggregate TIN that is referenced to be optionally processed by applying the disaggregation process independently to each TIN that comprises the aggregate TIN. When operating in this fashion, each TIN is independently disaggregated. In addition, the set of shorter duration TINs that are created will have exactly the same aggregate total as the original individual discrete TINs from which they were created, while at the same time creating a set of TINs that span the entire aggregate TIN timespan.

15.1 Creating the resultant TIN Datasets

Several options are available for creating the resultant TIN datasets. As mentioned above, one or more hyetographs or a temporal pattern can be used. The hyetographs can be georeferenced by using a combination of DSS record metadata and name matching or a GageInterp control file, as specified in the GageInterp User's Manual (HEC, 2016). The hyetograph based TIN disaggregation tool 1:N is available on the main HEC-MetVue tool bar and it provides access to the editor shown in Figure 143, Figure 144, and Figure 145. A description of the features available in the editor are provided in Table 51, Table 52, and Table 53.

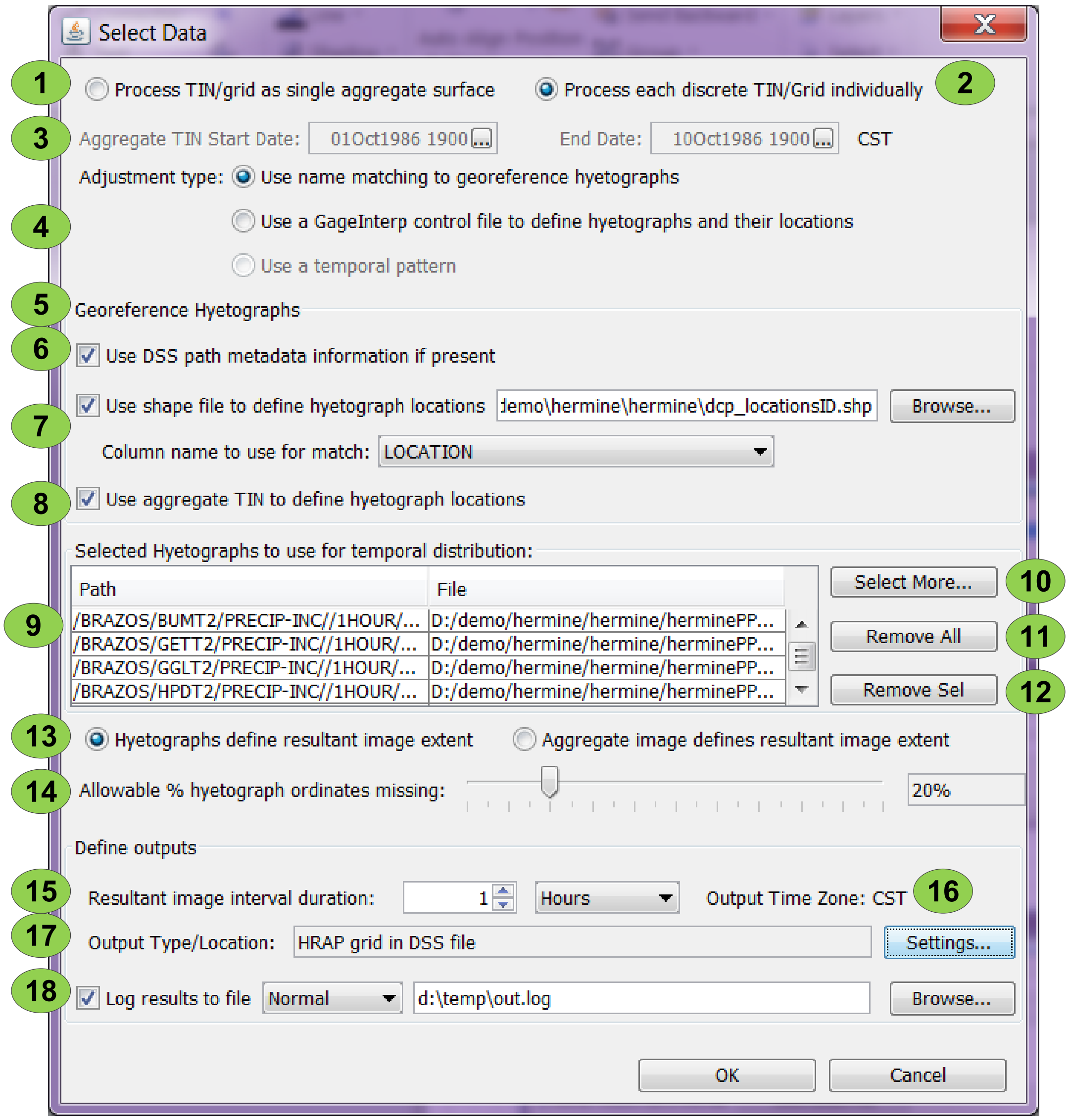


Figure 143 - TIN Disaggregation using name matching dialog

Table 51 - TIN Disaggregation using name matching dialog description

Item	Description
1	This option is used to process the aggregate TIN as a single surface and disregard any discrete TINs that were used to create it.
2	This option is used to process the discrete TINs that the aggregate is comprised of one at a time as described above. When this option is selected, the ability to override the timespans as described in item 3 and the option to specify a temporal pattern are both disabled. When processing each discrete TIN the program uses the actual timespan information associated with the selected TINs.
3	This can be used to modify the starting and ending date of the aggregate TIN.

4 This is the methodology to use to define the temporal pattern. Depending on the option selected, certain portions of the remainder of the dialog will differ. The name matching option shown here allows the use of a combination of methods to georeference the list of hyetographs.

5 Hyetographs need to be georeferenced to be used. Knowing the longitude and latitude is essential. The program supports three options for defining the location as shown in items 6-8 below.

If more than one option is selected, the process will attempt to resolve the hyetograph location using the above methods in the order they are listed in the dialog.

6 Use DSS path metadata. DSS supports storing the longitude and latitude in the time series records. One caution: every DSS path must hold its own metadata and a storm may cross multiple time series records in the data store.

7 Use a shapefile with hyetograph locations. This shapefile must be a POINT type of shapefile and a NAME, ID, or DSSB column must be present within the .DBF file.

8 Use aggregate TIN for hyetograph locations. If the aggregate TIN was constructed using the hyetographs/gages specified the process can match the name to the DSS B pathname part. Note that if the aggregate image is a radar image or some other image not based on the original hyetographs directly, this option will not resolve anything.

9 This gives a listing of the hyetograph paths and the DSS file they reside in that will be used for the analysis. Note that if there are any hyetographs that are specified that cannot be georeferenced, the process will fail.

10 This button will bring up a dialog (the same dialog used by DSSVue) to select hyetographs to use for the temporal distribution.

11 This button will clear the list of hyetographs used for temporal distribution.

12 This button will remove the highlighted hyetographs from the list of hyetographs used for temporal distribution.

13 This defines the geographic extent of the resultant images. The georeferenced hyetographs are converted to a resultant TIN (this TIN can vary over time if there is missing data) and this forms the basis for the boundary of valid data if the option to have the hyetographs define the boundary is used. If the aggregate image defines the extent, points on the aggregate image that fall outside the perimeter of the hyetograph generated TIN(s) use a weighted extrapolation technique of nearby hyetograph TIN locations to determine the temporal distribution.

14 This specifies what percentage of the hyetograph timespan can be missing and still be used. By default this is set to 20% which lets the program use any hyetographs where 80% of the timespan has valid data.

15 This defines the resultant image interval duration. In essence, the program generates a mass curve at every required location which is then time sliced as required to generate the resultant TINs.

16 The output time zone is display here. It can be changed by modifying the settings for the TIN output type and location below.

17 This defines the output type and location for the newly created TINs. The associated settings button displays the standard 'Save TIN' dialogs as shown in Figure 106. Refer to the section 'Saving TIN Datasets' for more information on these settings.

18 This logs the results of the process to a file for analysis. Output is also displayed in the output panel of the program. The log file is overwritten every time the process is run. The dropdown gives some control over the level of detail present in the log.

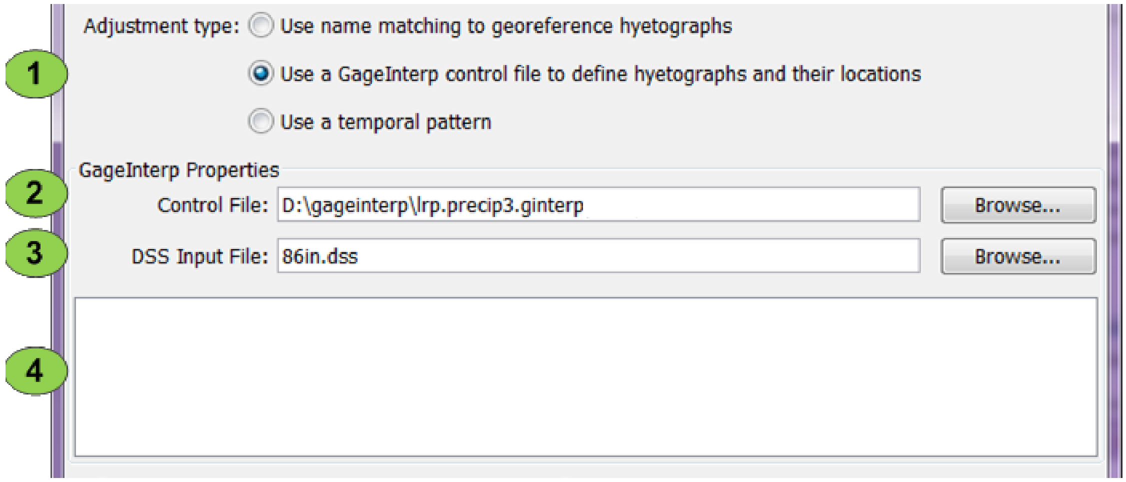


Figure 144 - TIN Disaggregation using GageInterp control file (partial dialog shown)

Table 52 - TIN Disaggregation using GageInterp control file dialog description

Item	Description
1	Select this to use a GageInterp file for the definition of the hyetograph records as well as the hyetograph georeferencing.
2	This is used to specify the GageInterp control file. The associated Browse… button can be used to bring up a file system browser to locate the file. Note: Only the hyetograph locations, the hyetograph pathnames, and optionally, the DSS file containing them is used from the GageInterp file.
3	This overrides the file to use for the DSS input file. If left blank the DSS file specified by the GageInterp control file will be used.
4	This area will display any errors or warnings that were encountered when processing the GageInterp control file.

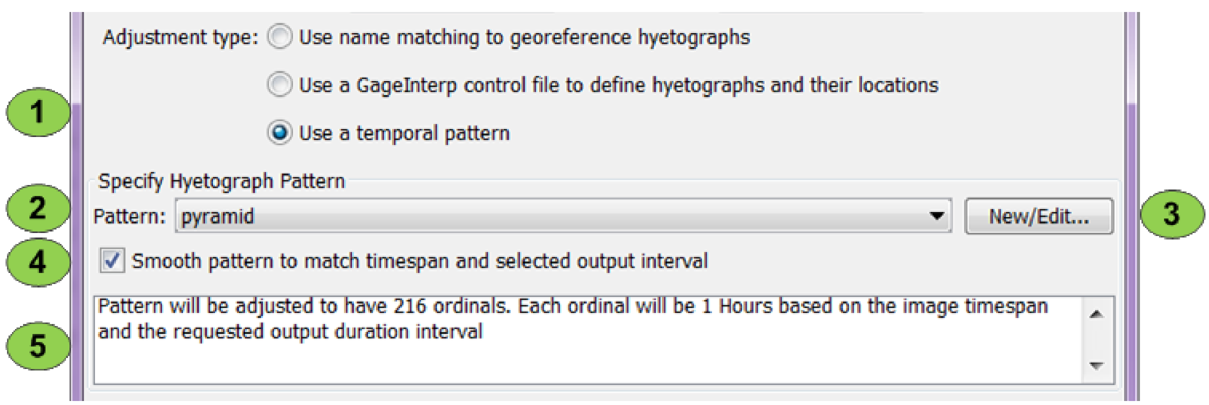


Figure 145 - Tin Disaggregation using a temporal pattern (partial dialog shown)

Table 53 - TIN Disaggregation using a temporal pattern dialog description

Item	Description
1	Select this to use a temporal pattern for the disaggregation.
2	This dropdown control specifies the pattern to use to disaggregate the TIN.
3	This button is used to access the Pattern Editor, Figure 146, which is used to edit existing patterns and create new ones. Note that any pattern defined is normalized when used so that a pattern with ordinals of [1, 2, 3] will give the same results as a pattern of [100, 200, 300].
4	When this is unchecked, the program will use the pattern ordinal count, along with the timespan defined for the aggregate TIN to determine the timespan of each of the newly created TINs. When the selection is checked, the selected pattern will be resampled to create a valid pattern with the appropriate number of ordinals.
5	This area will display information on the resultant pattern and ordinal count that will be used when disaggregating the TIN.

The Temporal Pattern Editor shown in Figure 146 is similar to the Custom Scale Editor shown in Figure 22 with features such as clicking the right mouse button to insert or delete a value. To help with paste operations, several values can be entered in a single cell and the editor will format them into individual cells automatically.

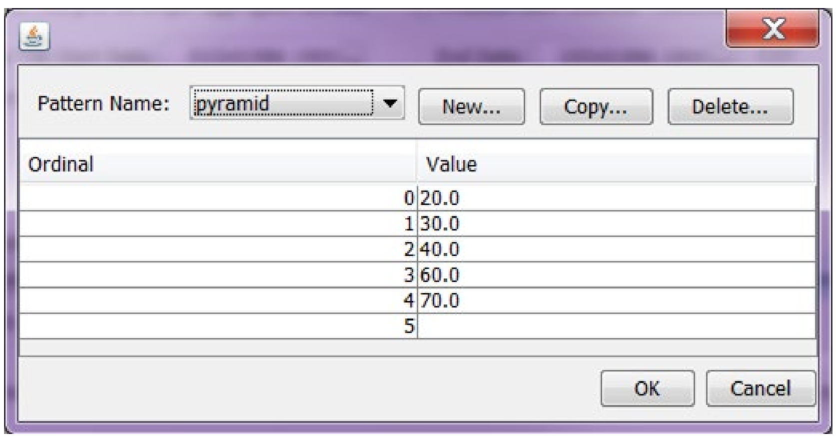


Figure 146 – Temporal Pattern editor

Chapter 16

16. Depth-Area-Duration Computation Tool

The Depth-Area-Duration (DAD) tool  uses the set of TINs contained in a map panel and performs an analysis of the data (Figure 147). The TINs selected should all have the same time duration without containing missing time spans. HEC-MetVue currently outputs the data to the output window in a format that can easily be copied and pasted into a spreadsheet for further analysis or writes the paired data to DSS, one curve per record, in a variety of choices for defining the axis and series. The 'Output Details' section allows the definition of the rows and columns of the output data so that pivoting in the spreadsheet is not necessary. The selection of the rows and columns also controls the choice for writing to DSS. Table 54 provides a description of the features available in the DAD tool.

When working with gridded data, the tool has the option to process TINs as grid cell averages or discrete point values. Non-gridded TINs are always processed as discrete point value datasets.

16.1 DAD Example

To better understand how the HEC-MetVue program computes the DAD information, consider a precipitation event spanning 72 hours from 01May2000 0000-03May2000 2400 created from a set of 72 1-hour radar grids. A depth-area curve will be generated for each duration, 1-hr, 2-hr...72-hr. and the shorter durations will not be constrained to occur within the time span of a longer duration. For instance, the 6 hour duration may occur from 01May2000 0400-01May2000 1000 and the 12 hour duration may occur from 03May2000 0100-03May2000 1300.

First, the program computes the depth-area curve for the 72-hr TIN.

There are two choices for the 71-hr TIN:

- 01May2000 0000-03May2000 2300
- 01May2000 0100-03May2000 2400

There are 3 choices for the 70-hr TIN:

- 01May2000 0000-03May2000 2200
- 01May2000 0100-03May2000 2300
- 01May2000 0200-03May2000 2400

.
.
.

There are 72 choices for the 1-hr TIN

- 01May2000 0000-01May2000 0100
- 01May2000 0100-01May2000 0200
- ...
- 03May2000 2200-03May2000 2300
- 03May2000 2300-03May2000 2400

For this 72-hour storm example, the program evaluates 2,592 different TIN combinations to determine the answer (1+2+3…+71+72=2592). If the shorter durations would have been constrained within the longer durations the program would have evaluated 143 different TIN combinations; 1 for the 72-hr value and then 2 each for the remaining 71 durations.
The evaluation of the 72 1-hr duration possibilities results in a single depth-area curve which is selected based on the TIN containing the maximum volume. Note that this may not be the TIN that has the maximum point precipitation value. In order to maximize depth and volume, the program would have to form an envelope curve for each duration by using the maximum depth-area values from whichever curve in the duration set contained it. The program does not currently do this.

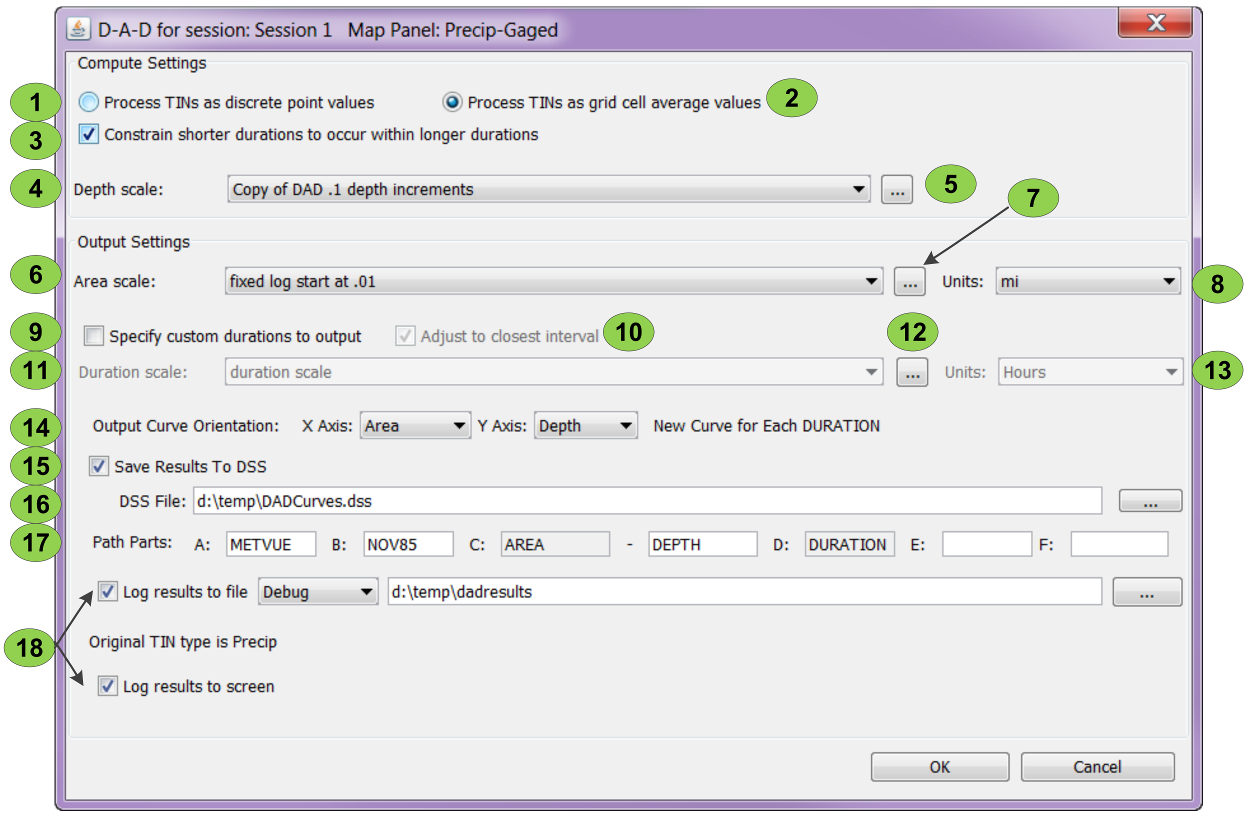


Figure 147 - Depth-Area-Duration editor

Table 54 - Depth-Area-Duration editor description

Item	Description
1	This option will process the TIN as discrete point values. It is applicable to TINs created from observer or gages.
2	This option processes the TIN as grid cell averages. It will be disabled if the aggregate TIN is not gridded.
3	It is possible for the maximum depth-area curve for a shorter duration to occur outside of the timespan than that of the maximum depth-area curve for a longer time interval. For example given a set of TINs that went from 04Jan 0100 through 07Jan 0100 the depth-area curve for the 1 hour duration may occur from 05Jan 0100-05Jan 0200 and the 6 hour curve may occur from 06Jan 0400 – 06Jan 1000. If this box is selected ONLY the 6-1 hour durations between 06Jan 0400 – 06Jan 1000 will be checked. If this

box is not selected, all the possible 1 hour time intervals from 04Jan 0100 through 07Jan 0100 will be checked for the maximum depth-area. Because checking the box constrains the range of possibilities considerably, it is much quicker to perform a depth-area–duration analysis.

4	This is used to select the depth scale to use from any scale object that has been defined.
5	This is used to bring up the editor used to define or edit the scale to use for depth values. Output depth values will always be in the same units that are being displayed in the map panel. Normally a linear scale is selected for the depths
6	This is used to select the area scale to use from any scale object that has been defined.
7	This is used to bring up the editor used to define or edit the scale to use for area values. Note that a log scale or custom scale is normally more appropriate for this than a linear scale.
8	This defines the distance units to associate with the values from the selected area scale. The list of available units is constrained by the unit system being used. For example, if using SI units, only the metric options are available. Change unit systems using the global properties setting for the program.
9	Select this option to pick custom durations to compute and output. Normally the program inspects the durations of the discrete TINs that were used to create the aggregate and uses multiples of this for the durations.
10	Select this to make sure that scales that conflict with the actual durations of the data still work by allowing the program to pick the appropriate duration value closest to an allowable timespan. It is straightforward to define a linear scale that matches the data but using a log scale for the duration values will likely not work unless this box is checked.
11	This is used to select specific durations to use from any scale object that has been defined when item 9 is selected
12	This is used to bring up the editor used to define or edit the scale to use for duration values.
13	This defines the time units to associate with the values from the selected duration scale.
14	This section controls the format of the curves written to DSS. The curve orientation defined here also controls the format of the output text (CSV) as well.
15	Select this to save the results of the analysis to DSS. To aid in determining how the data will appear in HEC-DSSVue, the program displays the X axis, Y axis, and curve type that will be generated. These values can be modified based on the options selected for item 14.
16	This is used to specify the output DSS file where the paired data curves are to be saved.
17	This is used to specify the path parts when writing the paired data curves to DSS. The second half of the C part and the D part are generated by the program and is dependent on the options set for item 14 above. The first half of the C part is specified by the program but can be overridden.
18	These options are used to specify where to log the results. Several log messages relating to the processing of the data as well as the text version of the results are shown here.

Chapter 17

17. Editing the Annotation Layer

Annotation editing is done in its own layer, which allows for separation of the annotation objects from all of the data and map display layers. In this layer, there are two modes, Absolute and Relative editing. When one of these modes is selected, several other menu items will be disabled. For example, it is not possible to perform some of the TIN editing operations, such as rotation/scaling/translating of images, when either of the annotation modes is selected.

17.1 Selecting the Annotation Mode

In order to edit the annotations or add new ones, the program must be in one of the two annotation edit modes. The following icons should be visible on the program toolbar. 
If these icons are not visible, right click on the toolbar and select the 'Annotation Layer' toolbar option.

17.2 Creating New Annotation Objects on the Map Panel

Once either of these options is selected, the program will display a palette control as shown in Figure 148. Using this palette, new items can be added to the map panel by selecting it with the mouse, dragging it to the location on the map panel where it should be displayed, and releasing the mouse button.

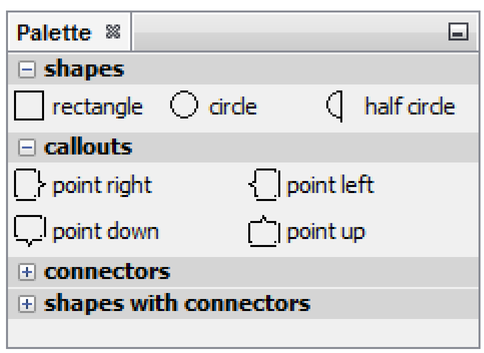


Figure 148 - Annotation layer palette control

When operating in absolute mode (), any new annotations added from the palette are placed in the map panel in the absolute position selected, with reference to the view window. For example, an annotation placed in the upper left corner of the map panel stays in the upper left corner, regardless of the map scale and positioning. When operating in relative mode (), any new annotation added from the palette are placed in the map panel in the relative position selected. Relatively positioned items are attached to the map and not the map panel. As the map is panned, the annotation would follow the map. For example, if a relative annotation was placed on a lake, as the map was zoomed and panned, the annotation would stay pointed at the lake.

All annotations have hotspots. This is the point on the annotation that is actually attached to the map panel or the map. The program by default supplies a rectangle, circle. The hotspot for these is in the center of the object. Also supplied are callouts that point to the left, right, up, and down. For these objects, the hotspot is at the end of the arrow point of the callout.

17.3 Annotation File Options

The annotation layer stores the annotations that are created into files. The program supports having multiple annotation files, and are activated in the same fashion as the mapping files. Referring to Figure 149, the annotation map panel has four separate annotation files specified. The 'flood57.xml' file is inactive and will not appear on the map panel.

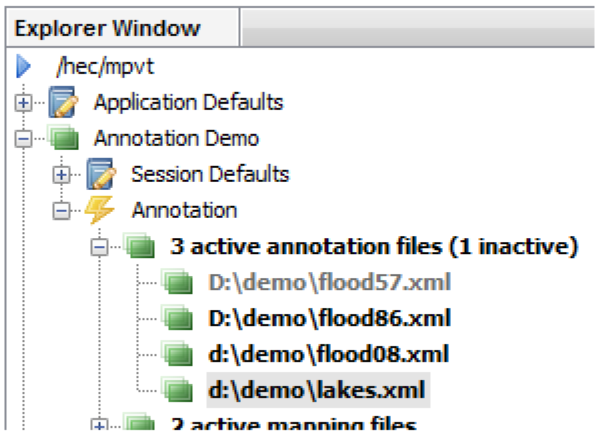


Figure 149 - Sample annotation files

In the above example, there are multiple annotation files specified and active. As new annotations are added to the map panel, the program must attach these to one of the active files. To select which of the files accepts the dropped annotations, right click on the desired file and set it to the drop target as shown in Figure 150. If no annotation file is active, the program will create an entry named 'default file', which is where new annotations will be placed. The user will have to specify a file to replace this default file before saving can take place. If no annotation file is the designated drop target, but there are annotation files active, the program will use the last active file listed in the Project Explorer window for that map panel.

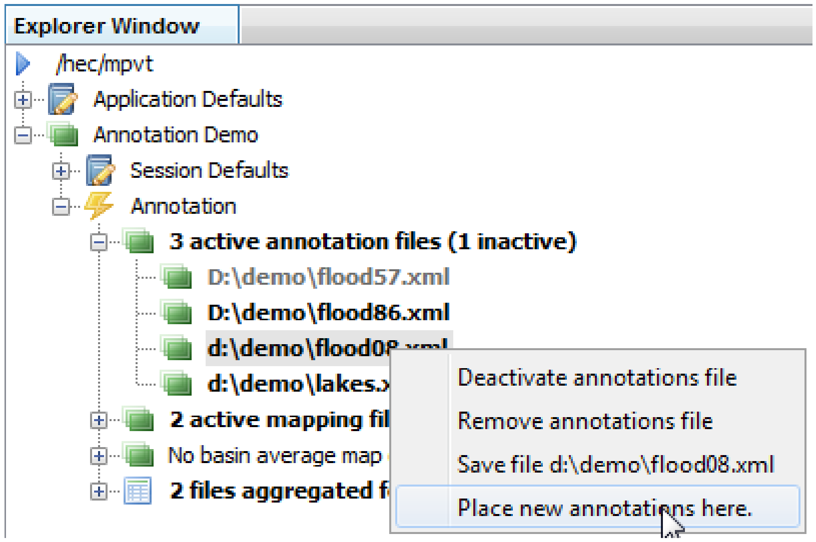


Figure 150 - Annotation drop target

Referring to Figure 150, the other options listed are as follows:

- Deactivate annotation file – Selecting this option deactivates the annotation file within the map panel, and greys out the entry in the Project Explorer window to indicate the file is inactive.
- Activate annotation file (not shown) – Selecting this activates a currently deactivated annotation file.
- Remove annotations file – Selecting this option removes the annotation file from the map panel. It DOES NOT delete the file.
- Save file … - this option saves the annotations file. It will be disabled if no changes have been made to the annotations within the file.

Note that there is an option to automatically save annotations edits as they are performed (see the Layer Settings Option Tab section of Chapter 11).

Annotations, like map files, are drawn in the order within their defined layer, as shown in the Project Explorer panel. In order to control the annotations file ordering, as well as being able to quickly enable and disable multiple annotation files, select the 'Annotation file ordering/enabling' option, as shown in Figure 151. This will display the dialog shown in Figure 152.

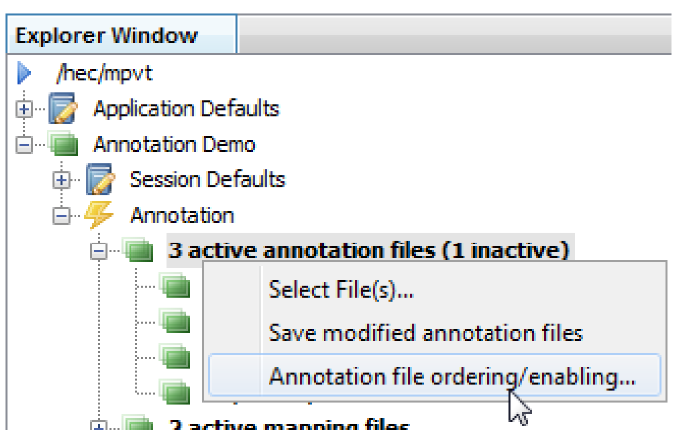


Figure 151 - Annotation file ordering/enabling

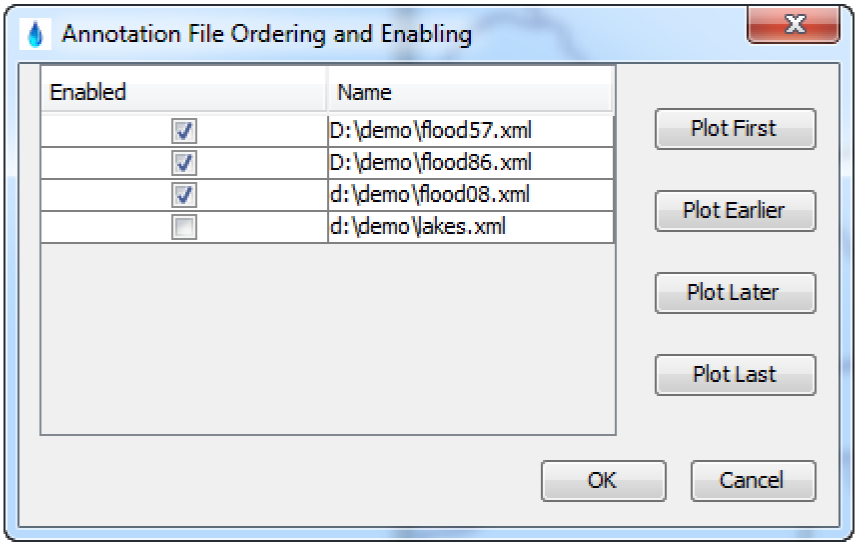


Figure 152 - Annotation file ordering and enabling dialog

17.4 Editing Annotations

Once the desired annotation file has been selected, and an annotation has been dropped on the map panel from the annotation palette control, it will look similar to what is shown in Figure 153. The annotation can be selected after it is on the map panel by clicking on it with the mouse. In addition, multiple annotations may be selected simultaneously by holding the ctrl key and left clicking on subsequent annotation objects. When selected, the annotation will be displayed with a sizing border as shown in Figure 154. The small squares on the sizing border can be used to change the size of the object visually.

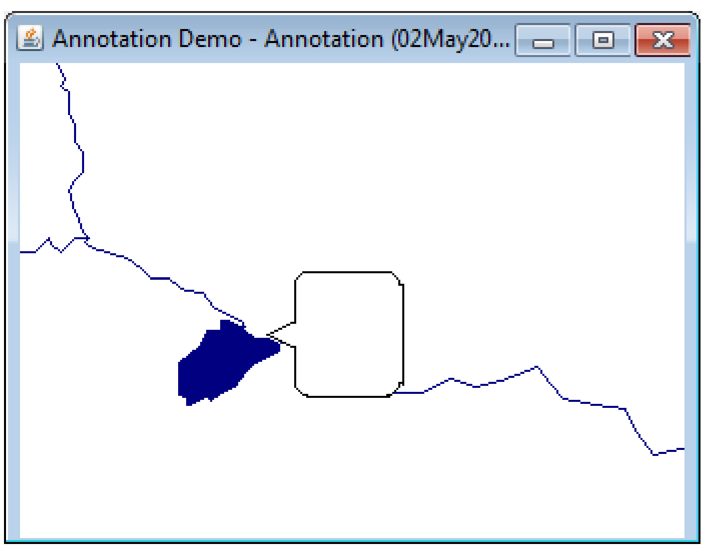


Figure 153 - Callout annotation dropped onto map window

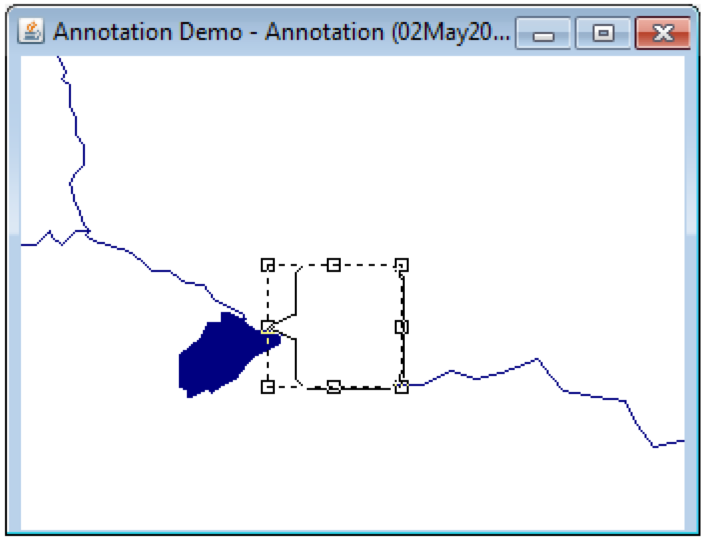


Figure 154 - Callout annotation with sizing border

While the object is selected, right clicking will bring up the context menu shown in Figure 155. From this menu, the following actions are possible:

- Hide Palette – Hides the annotation editor palette.
- Show Palette (not shown) – Displays the annotation editor palette.
- Z Order – moves the selected annotation higher or lower in the plot order within the annotation file it resides.
- View Thresholds – Sets the view thresholds for the annotation. View thresholds control the visibility of the object as the map panel zoom level changes.
    - Set High View Threshold (not shown) – Sets the maximum zoom level at which a particular annotation will appear. Once the view is wider than the specified level, the annotation will not be rendered on the plot.
    - Set Low View Threshold (not shown) – Sets the minimum zoom level at which a particular annotation will appear. Once the view is narrower than the specified level, the annotation will not be rendered on the plot.
    - Remove High View Threshold (not shown) – Removes the upper view threshold from the annotation. For an annotation without an upper threshold, once the object appears on the plot, it will be displayed on the plot at any wider view selected.
    - Remove Low View Threshold (not shown) – Removes the lower view threshold from the annotation. For an annotation without a lower threshold, once the object appears on the plot, it will be displayed on the plot at any narrower view selected.
- Delete – Deletes the selected annotation.
- Duplicate – Duplicates the selected annotation. Once an annotation has been customized, it is convenient to duplicate the annotation, then only requiring minor changes to the new annotation. This is typically easier than manually adding all of the desired settings into a new annotation from the annotation palette.
- Customize – This displays the dialog shown in Figure 156, which allows the modification of the attributes of the selected annotations. Table 55 provides a description of the features available in the Annotation Attribute editor.

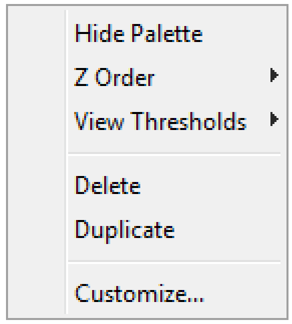


Figure 155 - Annotation context menu

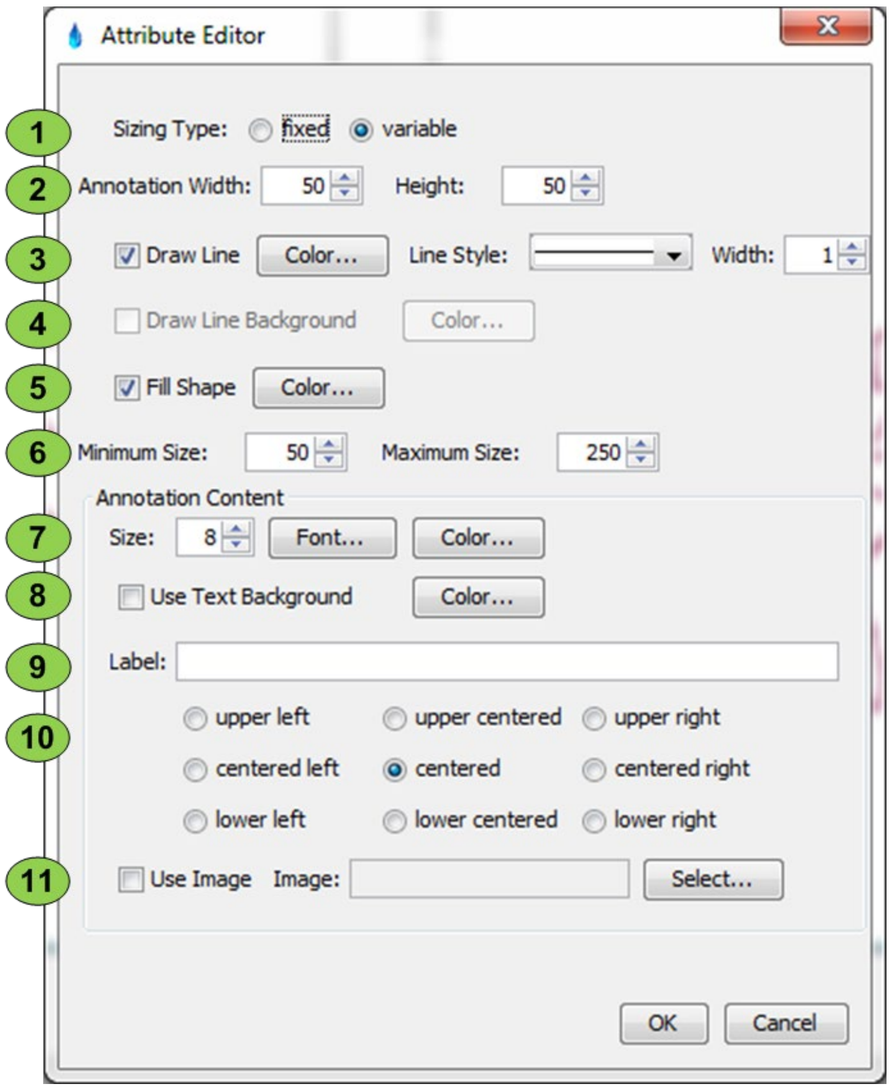


Figure 156 - Annotation Attribute editor

Table 55 - Annotation Attribute editor description

Item	Description
1	This sets the sizing type to either fixed or variable. • Fixed sizing makes the object have a fixed size in the map panel. Regardless of the zoom level, the annotation size will not change. • Variable sizing makes the object size change as the map panel zoom level changes.
2	This is annotation width and height. Note that if the annotation is using variable sizing, the values entered into these width and height controls will change as the map panel size and the zoom level changes.
3	These controls are used to define visibility, color, line style and line thickness of the line defining the annotation.
4	This control defines the line background. It is disabled if the line style chose for the annotation is a solid line.
5	These controls specify whether the shape should be filled with color or not. If left unchecked, the annotation area will be transparent.
6	This allows the user to select a minimum and maximum size (in this case the object can be no smaller than 50 by 50), which keeps a relative object from becoming too large or small when zooming in or out, respectively. This limit will also prevent the user from sizing the object outside these limits.
7	These controls define the font used for the annotation label. Note that the font size for annotations, with variable sizing selected above, will change as the zoom level changes.
8	This specifies the visibility and background color behind text.
9	This is the textual information that is displayed in the annotation.
10	This specifies the alignment of the information within the text box of the annotation.
11	This allows the user to put an image inside of an annotation object. Supported formats are jpg, gif and png.

Chapter 18

18. Batch File Processing Utilities

In addition to the main HEC-MetVue program, the deployment package also contains a number of useful utilities that are meant to aid in mass and automated data processing using batch files (Table 56). These utilities are also referred to as 'entry points' since they are not actually different programs but simply an alternative method to access the exact same methods that the HEC-MetVue program uses.

All of the utility batch files are located in the `metvue/utilities` folder of the HEC-MetVue deployment package. All are actually template batch files that are meant to be copied and modified. For example the `addtin.cmd` batch file contains the following single line command:

```
"..\jre\bin\java.exe"  -Xmx1024m -cp
"..\metvue\modules\*;..\metvue\modules\ext\*"
org/mcbsystems/mpvtbase/tin/spatialUtil/AddTin -?
```

A couple of important things should be noted about this batch file. First, the `"..\jre\bin\java.exe"` is a relative path. This batch file will only work when executed from the `metvue/utilities` folder. To execute the batch file from some other location, the same `java.exe` executable, which is deployed as part of the HEC-MetVue package, should be used. Second, the '-?' at the end of the string will print out the command line options that the entry point supports and then exit. To view the output it should be executed from a command prompt window and not by clicking on it from a file explorer. The '-?' is meant to be replaced by one or more of the command line options that the entry point supports.

Table 56 - Batch File Description

Batch File	Description
addtin.cmd	Used to aggregate multiple TINs into a single TIN. This utility can be used to combine images temporally or spatially. The spatial combining is useful to take two or more TINs that cover different geographic areas and combine them into a single TIN that covers the total geographic area of the individual TINs.
basincomps.cmd	Used to compute basin averages, usually precipitation, using the given shapefiles and TINs for each polygon or zone defined in the shapefile. The output is either to a text file or DSS as a hyetograph.
calrad.cmd	Used to calibrate a radar TIN using a ground truth control TIN. Although developed for radar calibration, this utility is a generalized adjustment utility which could be used for elevation corrections and possibly other uses as well.
deptharea2tin.cmd	Utility developed for the Ft. Worth district as an aid for creating elliptical storms based on depth-area data. The process took the resultant storm and then used the HEC-MetVue disaggregation capability to create a design storm.
gage2tin.cmd	Utility to convert a gage set into a TIN or grid. This process in analogous to using GageInterp.

projectTinToGrid.cmd	Used to take an input TIN, optionally translate and rotate the TIN to a new geographic position, and write the resultant TIN to an ASCII GRID file. This was developed for a specific study and may be removed or superseded in the future with a more flexible entry.
rfcgridreader.cmd	Utility to take radar images in XMRG, NetCDF, and GRIB formats and convert to a native HEC-MetVue format which can be saved to a file or DSS.
triangulatetin.cmd	Used to convert a text file containing georeferenced measurement data, such as gaged precipitation, for a time span and converting the data to a TIN.

18.1 AddTin

The AddTin utility (Table 57) is used to merge/aggregate together multiple TINs/grids into a single resultant TIN. It can be used to combine images together either temporally or spatially. Currently, the utility can combine TINs either temporally or spatially during a single invocation but not both. To combine TINs in both time and space, the utility would have to be executed twice.

Usage:

```
AddTin arg1 arg2...argn –o outputfile [–n title] [-g] [-s] [-t] [–m
mergetype] ]-p] [-u] [-i] [-z units]
```

Notes:

- Arguments shown in brackets are optional.
- This program may utilize a significant amount of memory depending on datasets specified. The JVM may require the option -Xmx512m or -Xmx1024m to operate.

Table 57 - AddTin Utility description

Argument	Description
arg1 arg2…argn	The filenames or file masks of the TIN files to merge. The list can be one or more filenames or file masks. For example: **201605*.nc , 201606*.nc** might be used to aggregate together 2 months of radar data into a single TIN.
-n title	This option is used to specify a title for the output file. If none is specified the program will attempt to generate one from the available times and existing title of one. A title that has blanks should be enclosed in double quotes (")
-o outputfile	The output filename for the TIN. Note: If the resultant TIN is an HRAP or SHG grid, it can be stored in DSS by using the syntax "DSSPath|DSSFIle". For example: "/SHG3///27MAY2007:1900/27MAY2007:2000//|D:\radar\MyRadar.DSS" A file name that has blanks should be enclosed in double quotes (")
-g	Specifies the allowable distance to use for edge triangle creation. This is meant to reduce the problem of long slender triangles around the edges of the data set.
-s	Add data together spatially as opposed to a temporally. The default is to let the program scan the files and attempt to determine whether to add spatially or temporally. Spatial addition is used to combine images for the same time and different locations. If the image times vary any, the program will choose to add the images temporally.
-t	Add data together temporally as opposed to spatially. The default is to let the program scan the files and attempt to determine whether to add spatially or temporally. Temporal addition is used to combine images for the same general area and different timespans.
-p	Specifies that when merging TINs and TRNs (gridded tins) that the actual TIN points be added together. By default when at least one of the images is a grid, then TINs are projected onto a 'master' grid. Using this option can be time consuming and the resultant object will be a TIN that is not a grid.

-u	Use the union of images when merging. If not specified spatial image addition will use this method. This option is only applicable if one or more of the images being added is a gridded image and -p is not specified.
-i	Use only the intersection of images when merging. If not specified temporal image addition will use this method. This option is only applicable if one or more of the images being added is a gridded image and -p is not specified.
-m mergetype	Merge type specifies the spatial method to use to merge overlapped image sets together. The possible values are 'min', 'max', 'avg', 'avgx0'. If not defined the default is avgx0. • min - uses the minimum value from all datasets for the overlapped areas. • max - uses the minimum value from all datasets for the overlapped areas. • avg - uses the average of the overlapped areas for computing the surface. • avgx0 - uses the average of the overlapped areas for computing the surface but excludes measurement values of zero from the averaging. This is the default method for spatial surface addition because certain images, especially gridded data, may be clipped with areas of the grid set to 0 instead of undefined.
-z units	Sets the output units to specified type. The default is to the set the output units to be the same as the input units. The output units must be convertible from the input units for this to work. For example, conversion of 'mm' to 'inches' is possible but conversion of 'mm' to 'ft/sec' is not.

18.2 BasinComps

This utility (Table 58) is used to compute the basin average precipitation for one or more shapefiles and a single TIN file. The results can be written to either an output file or to DSS. When written to DSS the results are written as a regular time series record, one record per polygon/subbasin and the TIN timespan determines the time series timespan. Optional arguments are also available to move the input TIN prior to performing any computations.

Usage:

```
BasinComps arg1 arg2...argn -r rainfallFile [-o outputFile] [-d
dssFile][-p] [-x] [-t] [-um][-z] [-c centerpoint] [-m move] [-s
saveType]
```

Notes:

- Arguments shown in brackets are optional.
- This program may utilize a significant amount of memory depending on datasets specified. The JVM may require the option -Xmx512m or -Xmx1024m to operate.

Table 58 - BasinComps Utility description

Argument	Description
arg1 arg2…argn	The filenames or file masks of the shapefiles (e.g. *.shp) of the files to compute averages for.
-r TIN file	The TIN/grid file to use.
-o outputfile	The text output filename for the results. This is optional and output will go to the console screen if not specified.
-p	Include polyline data and use it as polygons. The default is to exclude non-polygon data.
-x	Exclude units validation of the input TIN. The default is to require standard measurement units such as FEET, INCHES, METERS, MM, etc.
-t type	Defines the DSS C path part. The default is PRECIP-INC if nothing is specified.
-um	Output depths in mm, area in km^2, and volume in meters^3. The default is English units (-ue) with output in in, mi^2, and ac-ft respectively.
-z	Compute and output any defined zone data. All zone hyetographs written to DSS will have a DSS A path part of ZONE.
-d dssfile	Specifies the DSS output filename. If not specified no data will be written to DSS.
-c centerpoint	The center point in decimal degrees to use to perform any storm rotations. e.g. '-c -95.9264:36.0426'.

-m move	-m lon:lat:rot OR x:y:rot:units specifies how to move the TIN prior to making any computation. Leaving a value blank will set it to zero. For example:. • -m ::30 will rotate the TIN 30 degrees CCW. • -m 2:1:0 will move the TIN 2 degrees east and 1 degree north. • -m -22:-18:30:miles will rotate the TIN 30 degrees CCW and then translate the TIN 22 miles west and 18 miles south. If both a translation and rotation is specified, the rotation will occur prior to the translation. If a non-zero translation is specified the -c argument must be used to specify the rotation center point.
-s saveType	Save type which can be either 'intersection' or 'total'. The default is 'total' if not defined. If set to 'intersection', then only the polygon areas that are covered by a defined TIN are used. If set to 'total', then the entire polygon area will be used for average computation regardless of TIN coverage.

18.3 CalRad

This utility (Table 59) is used to calibrate radar TINs using rainfall observer TINs. It may be used for other purposes which could use a control TIN which has accurate measurements but is spatially sparse to adjust a target TIN which has a dense spatial set of measurements but less accurate values.

Usage:

```
CalRad -r controlFile -n uncalibratedRadarFile -c
calibratedRadarFile [-d deltaFile] [-t title] [-s statFile] [-m] [-f
number]
```

Notes:

- Arguments shown in brackets are optional.
- This program may utilize a significant amount of memory depending on datasets specified. The JVM may require the option -Xmx512m or -Xmx1024m to operate.

Sample execution line:

```
CalRad-r 08may09.rf -n 08mar09.rad -c 08may09.cal -d 08may09.dif -s
08may09.stat.txt -f 3.5
```

Table 59 - CalRad Utility description

Argument	Description
-r controlFile	The control file to use for calibration. This is typically a rainfall file that contains observer or other point data.
-n uncalibratedFile	The TIN file to adjust the measurement value for. This is typically a radar file containing gridded data.
-c calibratedFile	The primary output file. In general this is a radar file that has been adjusted.
-d deltaFile	This is an optional output file. When specified, a secondary TIN is created which has the same point locations as the control file with the measurement values being the difference at those points between the control and uncalibrated files. Note: This TIN can be used to help visually identify erroneous measurement values from the control file.
-s statisticsFile	The file used to hold an ordered list representing the statistical 'fit' between the control and uncalibrated TIN datasets. It can be used to help identify erroneous measurement values from the control file TIN (e.g. suspect rainfall gages).
-t title	The title for the calibrated image. Use quotes around title. For example, -t "My new Title"
-m	Specifies that the points that are part of the unadjusted image that are outside of the perimeter of the control image should be set to missing. Normally the values outside of the calibration perimeter are left unadjusted.

-f number	This is maximum ratio to be used between rainfall and radar measurement values before switching to an additive weighting method. The default is 3.0. For example, if the measurement value for a point from the control image is .15 and the measurement value for the coincident unadjusted point is .03, this would give a ratio of 5.0. If the default max ratio is used then this exceeds the 3.0 maximum so the adjustment becomes additive and the difference between the two measurement values (.12) becomes the control for adjustment instead of the ratio.

18.4 DepthAreaCurve2Tin

This utility (Table 60) is used to create an elliptical storm pattern from a point precipitation value, a set of areas, and a set of accompanying indexed precipitation values or ratios. If values are used instead of ratios, the first value should match the value given by the –m argument.

Usage:

```
DepthAreaCurve2Tin -m pointPrecip -a areaArray -p indexedPrecipArray
[-o outputfile] [-b time] [-e time] [-d timespan] [-t title] [-u
areaArrayOut] [-s] [-g] [-r ellipseRatio] [-c points] [-v distance]
[-x "lon,lat,angle"] [-l logfile]
```

Notes:

- The timespan of the TIN can be defined using exactly two of the '-b', '-e', and '-d' arguments. Defining 0, 1, or 3 of the options will not work.
- The options -m, -a, and -p MUST be specified.
- Arguments shown in brackets are optional.

Table 60 - DepthAreaCurve2Tin Utility description

Argument	Description
-o outputfile	The data file to place the triangulated TIN data into. Defaults to DepthAreaCurve2Tin.rf if not specified.
-b time	Beginning date & time of data. The format of the data can be one of the following: • yy/mm/dd,hh:mm:ss • yyyy/mm/dd,hh:mm:ss • ddmmmyy,hhmmss • ddmmmyyyy,hhmmss
-e time	Ending date & time of data. The format of the data is the same as the beginning time.
-d timespan	The amount of time from either the start or end time expressed in one of 2 formats: • nnX where nn is the number of intervals of the given interval X. e.g. -d 10days or -d3600seconds • ddd.hh:mm:ss where days is optional but the hours minutes and seconds are required. e.g. -d 4.8:11:00
-t title	The title for the output file. If none is specified the program will generate one. The title MUST be enclosed double quotes ("). For example, -t "this is my title"
-m pointPrecip	The value for the maximum precipitation used in all computations.
-a areaArray	A comma separated array of input areas. MUST be enclosed double quotes. e.g. -a "1, 10, 1000, 5000"

-p indexedPrecipArray	A comma separated array of input indexed precipitation values. MUST be enclosed double quotes (e.g. -p "1, .969, .858, .444"). The number of items in the list MUST match the items in the list specified by –a argument.
-u areaArrayOut	A comma separated array of output areas to generate ellipses for. MUST be enclosed double quotes (") and be encompassed within the bounds of the area Array specified above (e.g. -o "1, 2, 5, 10, 100, 500, 1000, 2000, 5000"). If no array is specified then the array specified using the -a argument is used.
-s	Smooth the input arrays specified using the -a and -p option using a spline fit. The default is to use the raw curve.
-g	Use log interpolation of the input curve for the areas. The default is to use linear interpolation.
-r ellipseRatio	The ellipse ratio to use (major/minor axis ratio). If not specified, a value of 2.5 is used. Value should be 1.0 or greater.
-c points	The number of points per ellipse. If not specified the default of 72 is used (5 degree angle between points). This must be a whole number. There may be fewer points if the -v argument is specified also.
-v distance	The minimum distance along an ellipse between points. Default is 0 so that the -c option controls point placement. If -v is specified the points along the ellipse are guaranteed to be no closer than what is specified.
-x "lon,lat,angle"	The center point and rotation of the resultant TIN. MUST be enclosed double quotes ("), for example: -x "-95.25,33.50". The angle defaults to 0 CCW from the X axis if not specified.
-l logfile	The output file for results/error review. If not specified it defaults to DepthAreaCurve2Tin.log

18.5 Gage2Tin

This utility (Table 61) is used to compute a gridded dataset from a control file and a set of gage hyetographs stored in DSS. The control file is identical to the control file used by the GageInterp program (HEC, 2016). In addition to computing a gridded dataset, this utility can also write out the TINs for the time spans created from the hyetographs and write these TINs to a set of files.

Usage:

```
Gage2Tin -control gageInterpFile [-dssIn dssInputFile] [[-dssOut
dssOutputFile] | [-outFileMask fileMask]] [-bTime time1] [-eTime
time2] [-dTime timespan] [-noExtrapolate] [-aggregate] [-logFile
logfile]
```

Notes:

- The timespan of the TIN can be defined using exactly two of the '-bTime', '-eTime', and '-dTime' arguments. Defining 0, 1, or 3 of the options will not work.
- Arguments shown in brackets are optional.
- This program may utilize a significant amount of memory depending on datasets specified. The JVM may require the option -Xmx512m or -Xmx1024m to operate.

Table 61 - Gage2Tin Utility description

Argument	Description
-control gageInterpFile	The file that specifies how to convert gage data into a gridded dataset. It has a similar format to the GageInterp program's control file.
-dssIn dssInputFile	Overrides the DSS input file specified in the control file if present.
-dssOut dssOutputFile	Overrides the DSS output file specified in the control file if present. Cannot be used with the outFile option.
-outFileMask fileMask	Overrides the output file specified in the control file if present. Cannot be used with the dssOut option. Refer to the section on File Masks and Naming Templates in Chapter 9.
-gridType	The type of TIN to generate. It can be either 'TIN', 'HRAP', or 'SHG'. The correct grid origin must be specified in the control file for the related option override to succeed.
-b time	Beginning date & time of data. The format of the data can be one of the following: • yy/mm/dd,hh:mm:ss • yyyy/mm/dd,hh:mm:ss • ddmmmyy,hhmmss • ddmmmyyyy,hhmmss
-e time	Ending date & time of data. The format of the data is the same as the beginning time.

-d timespan	The amount of time from either the start or end time expressed in one of 2 formats: • nnX where nn is the number of intervals of the given interval X, for example: -d 10days or -d3600seconds • ddd.hh:mm:ss where days is optional but the hours minutes and seconds are required, for example: -d 4.8:11:00
-noExtrapolate	By default, the program extends data onto the entire grid that is specified in the control file. If this is specified the output grid will have the values outside of the convex hull formed by the TIN comprised of the gages set to 'out of bounds'.
-logFile	The file to log the output to. Output also goes to the console which can be redirected to a file if desired also.
-dialog	Show the configuration dialog to make setting adjustments.
-aggregate	Add all the images together into an aggregate image and store that also.

18.6 ProjectTinToGrid

This utility (Table 62) is used to read a TIN dataset and convert it to a gridded dataset. Prior to converting it, the program can translate and rotate the source TIN to a new location. The arguments to specify a timespan are useful for TIN formats that do not have a timespan defined which is common with many ASCII files. This utility was designed for a specific purpose and is limited to outputting target grids to ASCII files in a longitude/latitude projection with a 0.01 degree cell spacing.

Usage:

```
ProjectTinToGrid -i inputfile -o outputFile [-u units] [-c lon:lat]
[-m lon:lat:rot[:units]] [-b time] [-e time] [-d timespan] [-n
[distance]]
```

Notes:

- The timespan of the TIN can be defined using exactly two of the '-b', '-e', and '-d' arguments. Defining 0, 1, or 3 of the options will not work.
- Arguments shown in brackets are optional.
- This program may utilize a significant amount of memory depening on datasets specified. The JVM may require the option -Xmx512m or -Xmx1024m to operate.

Table 62 - ProjectTinToGrid Utility description

Argument	Description
-i filename	The filename for the source TIN.
-o filename	The filename for the target TIN (ASCII grid).
-u units	The measurement units of the input file. This overrides the units defined if any.
-c lon:lat	The center point in decimal degrees to use to perform any storm rotations. For example: '-c -95.9264:36.0426'.
-m lon:lat:rot:units	The new position to place the source TIN prior to making any computations. Leaving a value blank will set it to zero. • -m ::30 will rotate the TIN 30 degrees CCW. • -m 2:1:0 will move the TIN 2 degrees east and 1 degree north. • -m -22:-18:30:miles will rotate the TIN 30 degrees CCW and then translate the TIN 22 miles west and 18 miles south. If both a translation and rotation is specified, the rotation will occur prior to the translation. If a non-zero translation is specified, the -c argument must be used to specify the rotation center point.

-n distance	Specifies to use the 'nearest neighbor' point on the source TIN when setting the value for the grid cell on the target TIN instead of surface interpolation. The 'distance' portion of the argument is optional (defaults to 1.0) and specifies the distance in grid cells of the output TIN that the nearest neighbor point must be in range of to be used. If no point is found within range the interpolated surface value will be used. For example, '-n' would use the closest point found if it was within +/- 1/2 cell distance in each direction. '-n 3' would use any point that was within the area of the current grid cell and the 8 adjoining grid cells (1 1/2 cells in each direction). Values less than 1 are supported. For example, '-n .5' would use the nearest point if it was within +/- 1/4 grid cell of the target TIN point.
-b time	Beginning date & time of data. The format of the data can be one of the following: • yy/mm/dd,hh:mm:ss • yyyy/mm/dd,hh:mm:ss • ddmmmyy,hhmmss • ddmmmyyyy,hhmmss
-e time	Ending date & time of data. The format of the data is the same as the beginning time.
-d timespan	The amount of time from either the start or end time expressed in one of 2 formats: • nnX where nn is the number of intervals of the given interval X (e.g. -d 10days or -d3600seconds). • ddd.hh:mm:ss where days is optional but the hours minutes and seconds are required (e.g. -d 4.8:11:00).

18.7 RfcGridReader

This utility (Table 63) is used to take radar images in XMRG, NetCDF, or GRIB formats and convert to a format which can be saved to a HEC-MetVue native file or DSS.
Usage:

```
RfcGridReader -in inputFile [-fmt inputFormat] [-dir outputDirectory
| -out outputFile] [-dssa dssApart] [-dssb dssBpart] [-dssC
dssCpart] [-dssf dssFpart] [-type type] [-inUnits units] [-outUnits
units] [-shg] [-bTime time] [-eTime time] [-dTime timespan] [-shift
timespan] [-title "my title"]
```

Notes:

- The timespan of the TIN can be defined using exactly two of the '-bTime', '-eTime', and '-dTime' arguments. Defining 0, 1, or 3 of the options will not work.
- Arguments shown in brackets are optional.
- This program may utilize a significant amount of memory depending on datasets specified. The JVM may require the option -Xmx512m or -Xmx1024m to operate.

Table 63 - RfcGridReader Utility description

Argument	Description
-in inputFile	The input TIN to process.
-fmt inputFormat	The input format of the TIN file. If not specified all possibilities will be attempted. • 1 for netCDF files • 2 for XMRG files • 3 for Nexrad Grib files.
-dir outputDirectory	Optional argument. If specified the output will be to a file with a name based on the input filename. This cannot be combined with –out option.
-out outputFile	The output file to use. If the output file is a DSS file or has a DSS extension, the images will be stored in DSS. If the file does not exist or is not a DSS file, the images will be stored on the file system. This cannot be combined with -dir option.
-dssA, -dssB, -dssC, -dssF	Used to specify pathname parts for the DSS path when DSS is used.
-type label	Label of data. Default is 'Rainfall'.
-inUnits units	The data units that the input file units are in. Default is 'mm' if not specified and cannot be determined from the input file directly.
-outUnits units	The data units that the output file units are in. Default is 'mm'
-shg	Specifies to output a standard hydrologic grid DSS image. By default an HRAP image will be generated. This option is only compatible with DSS image storage and will not work with file based image storage.

-bTime time	Beginning date & time of data. The format of the data can be one of the following: • yy/mm/dd,hh:mm:ss • yyyy/mm/dd,hh:mm:ss • ddmmmyy,hhmmss • ddmmmyyyy,hhmmss
-eTime time	Ending date & time of data. The format of the data is the same as the beginning time.
-dTime timespan	The amount of time from either the start or end time expressed in one of 2 formats: • nnX where nn is the number of intervals of the given interval X (e.g. -d 10days or -d3600seconds) • ddd.hh:mm:ss where days is optional but the hours minutes and seconds are required (e.g. -d 4.8:11:00)
-shift timespan	The amount of time to shift the image from its encoded time. It cannot be used if either '-bTime, '-eTime', -dTime or '-localTime' are used. The formats are the same as for the -d option with the additional specification that the timespan can be negative (e.g. -06:00:00).
-localTime	Shifts the data to local time. It cannot be combined with '-bTime', '-eTime', '-dTime', or '-shift' options.
-title	The title for the output file. If none is specified the program will attempt to generate one from available information. A title that has blanks should be enclosed in double quotes (").

18.8 TriangulateTin

This utility (Table 64) is used to convert a text file containing georeferenced measurement data, such as gaged precipitation, for a time span and converting the data to a TIN.

Usage:

```
TrinagulateTin -i inputFile -o outputFile  -b time –e time -d
timespan [-r] [-g ratio][-l label] [-u units][-p delimiter] [-c]
```

Notes:

- The timespan of the TIN can be defined using exactly two of the '-b', '-e', and '-d' arguments. Defining 0, 1, or 3 of the options will not work.
- Arguments shown in brackets are optional.
- This program may utilize a significant amount of memory depending on datasets specified. The JVM may require the option -Xmx512m or -Xmx1024m to operate.

Table 64 - TriangulateTin Utility description

Argument	Description
-i inputfile	The data file containing the raw data to be processed.
-o outputfile	The data file to place the TIN data into.
-b time	Beginning date & time of data. The format of the data can be one of the following: • yy/mm/dd,hh:mm:ss • yyyy/mm/dd,hh:mm:ss • ddmmmyy,hhmmss • ddmmmyyyy,hhmmss
-e time	Ending date & time of data. The format of the data is the same as the beginning time.
-d timespan	The amount of time from either the start or end time expressed in one of 2 formats: • nnX where nn is the number of intervals of the given interval X (e.g. -d 10days or -d3600seconds). • ddd.hh:mm:ss where days is optional but the hours minutes and seconds are required (e.g. -d 4.8:11:00).
-r	Randomizes or 'shuffles' the data points. Triangulation actually performs more efficiently with randomly ordered data so ordered data such as radar data can be triangulated more efficiently. Note that this routine is not optimal for processing row/column type or gridded data.
-g ratio	The ratio of long to short triangle side lengths defines a 'slender' triangle. Slender triangles that exist on the perimeter of the dataset will be removed if they meet this criteria. A typical value would be around 4 or greater but must be greater than 1 to be meaningful.
-l label	Label of data. Default is 'Rainfall'.
-u units	The data units. Default is 'INCHES' if not specified.

-p 'delimiter'	Used to specify a different parsing delimiter to use for splitting a line of text into the point definition parts. The default is a space. Options include-p ',' to specify a comma or -p | to specify a pipe character. If the argument following the -p starts with 0x, the character is interpreted as a hex value representing the character. For example, -p 0x0020 would be a space delimiter.
-c	Check grid consistency. Warns about duplicate locations and duplicate point labels.

```
Gaged precipitation 0700 30Apr08 to 0700 01May08
# lines that begin with a # or ; are ignored
#column 2 is latitude. Can be dddmmss or dd.dddd
#column 3 is longitude. Can be dddmmss or dd.dddd
#column 4 is the measurement amount.
#column 5 is a gage type. It optional.
FULT         333627    934849      0.00         1
HUDS         361354    951136      0.00         1
HALL         361305    963838      0.00         1
ARLI         375344    981117      0.00         1
HASK         354923    953839      0.00         1
DURC         383036    971753      0.00         1
PANA         350947    943850      0.00         1
BCED         343818    943645      0.00         1
IDAB         335628    944530      0.00         1
CARE         350960    993000      0.00         1
GSAL         364440    980808      0.00         1
PENS         362817    950219      0.00         1
HULA         365544    960518      0.00         1
FGIB         355216    951343      0.00         1
TENK         353548    950257      0.00         1
ROBE         352057    944643      0.00         1
WEBB         353512    951006      0.00         1
LEWS         330409    965751      0.00         1
ELGI         370013    961854      0.00         1
JOHN         381412    954606      0.00         1
LANA         363557    942658      0.00         1
COOL         380134   1020041      0.00         1
DEKA         334115    944139      0.00         1
FLOR         381410    965237      0.00         1
CEDP         381155    964922      0.00         1
CLIM         374230    961330      0.00         1
WHEE         352560   1001560      0.00         1
MIAT         365360    945205      0.00         1
CLRK         352806    932746      0.00         1
MUSK         354550    951750      0.00         1
SWEE         352520    995808      0.00         1
INDX         333307    940228      0.01         1
VANB         352542    942137      0.00         1
ELKA         352460    992500      0.00         1
RSVT         344953    990727      0.00         1
PATM         335110    953238      0.00         1
.
.
.
REDO         345445    950920      0.00         1
AVAN         362911    960345      0.00         1
CANC         370035    955713      0.00         1
THRA         375619    961822      0.00         1
BATE         333720   1001234      0.00         1
TAHL         355517    945515      0.00         1
```

Figure 157 - Sample Input File for the TriangulateTin Utility

APPENDIX A

References

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APPENDIX B

Abbreviations

TIN - Triangulated Irregular Network is a network of points interconnected which conforms to the rules of a Delaunay Triangulation.

LFM - Limited Fine Mesh grid on which the National Weather Service's HRAP grid is based.

HRAP - Hydrologic Rainfall Analysis Project is a grid coordinate system used within the National Weather Service for defining the location of Stage III radar grid cells.

SHG – Standard Hydrologic Grid is a projection used by many HEC programs. It is a specifically defined Albers Equal Area projection with a defined grid size and location.

PRJ file – A file that usually accompanies another file with the same name and different extension that contains the coordinate reference system definition for the related data source.

WKT – Well known text. This is a specific format used to define a coordinate reference system. WKT strings are usually most evident in PRJ files but are used by nearly all data sources.

DAD – Depth-Area-Duration.

APPENDIX C

HMR52 Overview

The HEC-MetVue HMR52 plugin is an extension to the HEC-MetVue program. It is designed to allow the development of design storms, Probable Maximum Storms (PMPs), that conform to the NOAA Hydrometeorological Reports 51[11] and 52[12] (HMR 51/52). The results produced by this software have been compared against the original HEC-HMR52[13] and HEC-HMS computer programs on multiple basins to verify its correctness.

Currently, for U.S. Army Corps of Engineers (USACE) Probable Maximum Flood (PMF) determinations and studies, HEC-HMS is the required software for developing the PMP and resulting PMF. HEC-HMS contains an HMR 52 precipitation method that allows the modeler to enter the storm characteristics. During a simulation in HEC-HMS, the program will intersect the elliptical PMP storm with the subbasin polygons to compute basin average hyetographs. HEC-HMS also contains an option to "optimize" the HMR 52 storm characteristics, area, orientation, and centroid coordinates, to maximize peak flow, volume, and reservoir stage at any point of interest in a basin model.

The HEC-MetVue HMR52 plugin can be useful to assist the modeler in visualizing the PMP storm and in estimating initial storm characteristics to be used in an HEC-HMS model. The HMR 52 storm characteristics from HEC-MetVue can be defined in the HEC-HMS meteorologic model. Using HEC-MetVue and HEC-HMS would require several interactive trials by manually varying the storm center's location and storm orientation in HEC-MetVue and then testing the resulting PMP variations in HEC-HMS (HEC, 2018) in order to yield maximized peak flow and reservoir stage for the site of interest. Trial PMP computations are very fast in HEC-MetVue, which also provides very convenient and visual tools for moving the center of the storm center and changing its orientation. Most often, for fairly symmetric basins, the optimal storm center placement is pretty close to the basin centroid. Typical storm placement trials to be executed in HEC-MetVue range between the basin centroid and location of the site of interest, such as a reservoir or basin outlet.

The HMR52 plugin is an optional component of the HEC-MetVue program. Designing the HMR52 feature as a plugin means that individuals that are not developing HMR52 design storms will not have to deal with the added menus, toolbar icons, and other HMR52 specific actions that the plugin adds to HEC-MetVue. The HEC-MetVue architecture also enables the addition of other plugins to provide other design storm facilities such as HMR58 and TP40. The ability to load only the required plugin(s) also minimizes the memory required to run HEC-MetVue.

Prerequisites

In order for this program extension to work it requires a shapefile with one or more polygons (subbasins) defined in a coordinate system that HEC-MetVue supports. All nomographs and tables necessary to perform an analysis are supplied by the plugin. In addition, all the location information such as the point depth-area-duration data, optimal storm orientation and

[11] http://www.nws.noaa.gov/oh/hdsc/PMP_documents/HMR51.pdf
[12] http://www.nws.noaa.gov/oh/hdsc/PMP_documents/HMR52.pdf
[13] http://www.hec.usace.army.mil/publications/ComputerProgramDocumentation/HMR52_UsersManual_(CPD-46).pdf

the 1:6 hour hyetograph ratios are supplied from a set of digital maps included with the plugin[14].

Enabling the HMR52 plugin

The HMR52 plugin is currently included in the deployment package as a plugin for HEC-MetVue to simplify installation. The HMR52 plugin is optional and can be enabled by following the procedure outlined in section 9.5.

Using the HMR52 plugin

HMR52 Tools

The HMR52 tool is part of the **Image Edit** toolbar. The Image Edit tools must be enabled by right clicking on an empty portion of the HEC-MetVue toolbar area and assuring that that the tool is selected as shown in Figure 158.

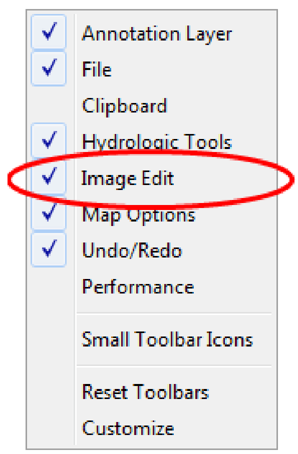


Figure 158 - Toolbar menu

When the HMR52 plugin has been loaded, the toolbar should look as shown in Figure 159.

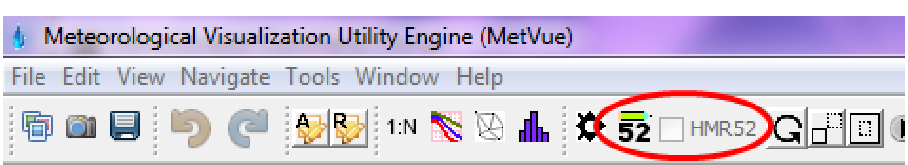


Figure 159 - HMR52 plugin toolbar tools

[14] Figures 18-47 from the NOAA HMR51 document and figures 8 and 39 from the NOAA HMR52 document have been digitized.

There are two HMR52 tools in the toolbar.

- The HMR configuration tool is accessed by pressing the button on the toolbar. Like many tools in the HEC-MetVue program, the configuration tool is context sensitive and will be disabled (grayed out) when the current focus of HEC-MetVue is not a map panel.

- The other tool is the toolbar HMR52, which is used to enable or disable the plugin. This tool is also context sensitive and will only be enabled when the current focus of HEC-MetVue is a map panel with a valid HMR52 elliptical grid defined for the map panel. When enabled and selected, it indicates that there is a valid HMR52 elliptical grid in the map panel and the HMR 52 analysis will be performed when the storm is repositioned.

Caution: When working with an HMR52 elliptical grid, the only image edit tools that should be used are the translate and rotate tools. Avoid using the scaling tool or modifying the measurement values of the TIN directly.

The HMR52 Configuration Tool

Configuring an HEC-MetVue project for an HMR52 analysis is straightforward. Clicking on the configuration tool when the selected map panel does not contain a valid HMR52 elliptical TIN will display the warning in Figure 160. Select 'Yes' to display the configuration dialog. The elliptical grid will replace any current TIN/Grid definitions present for the map panel.

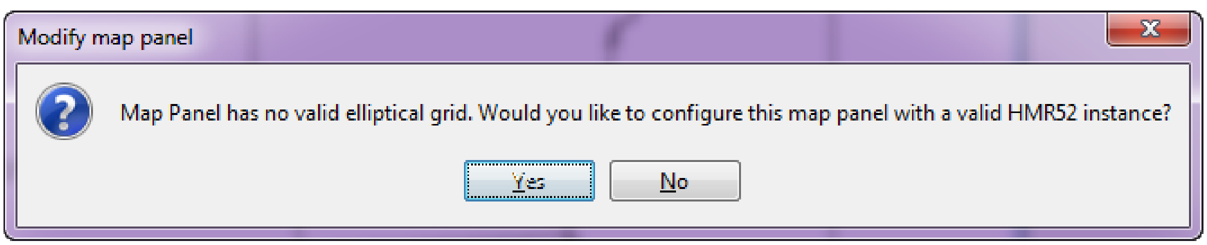


Figure 160 - HMR52 configuration tool's modify map panel option message

The configuration dialog has three setup tabs for setting options; 'Computation Options', 'Run Options' and 'Output Options' as shown in Figure 161, Figure 163, Figure 164, and Figure 165, respectively. Table 65 provides a description of the Computation Options tab, Table 66 provides a description of the Run Options tab, and Table 67 provides a description of the Output Options tab.

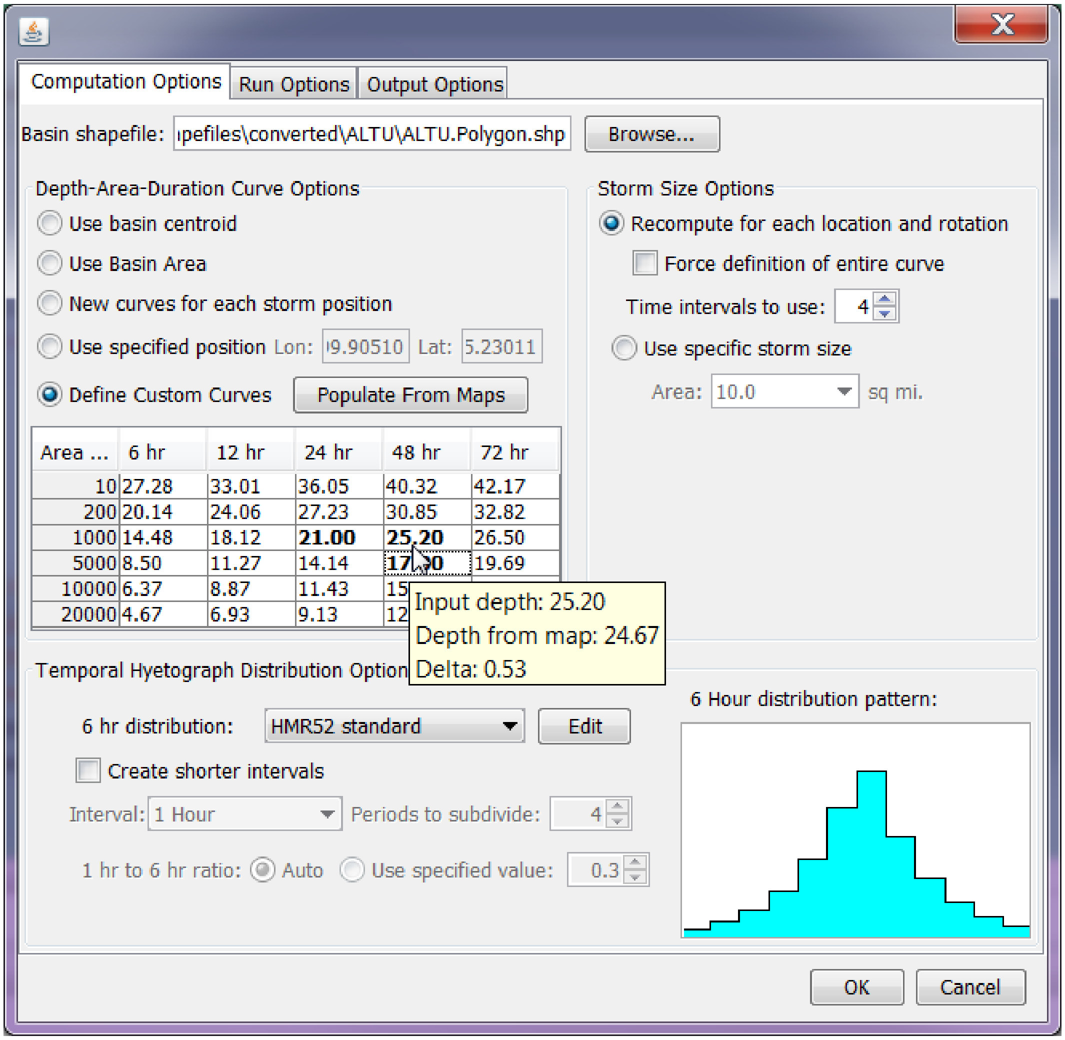


Figure 161 - Computation options tab

Table 65 - Computation options tab description

Computation Options		
Section Name	**Control Name**	**Value**
	Basin shapefile	This is the name of the shapefile that is used to optimize the HMR52 storm size, location, and rotation. The shapefile should contain only the required subbasin polygons. All of the individual polygons in the shapefile will be automatically aggregated together for computations. For a USACE site-specific PMP analysis, the shapefile specified here should only include the subbasins that are upstream of the reservoir. To compute average precipitation for additional basins, add their shapefile(s) to the list of shapefiles in the Project Explorer window for the map panel. The additional shapefiles will not affect the storm computations, but the computed storm precipitation will be applied to the additional polygons to determine their basin averages.

	Browse…	Displays a standard file selection dialog to find a shapefile. When a new shapefile is selected the message shown in Figure 162 is displayed to make sure it is ok to reset some of the information in the dialog to the defaults for the new shapefile.
Depth-Area-Duration Curve Options	Use Basin Centroid	HMR52 studies typically use a single set of Depth-Area-Duration (DAD) curves for a study area based on the centroid of the basin. When the HMR52 procedure was released in 1982, this was the standard due to the amount of time, effort, and complexity involved in using the basin area and its intersection with the multiple area-duration maps.
	Use Basin Area	This is the default option to use for extracting the depth values from the area-duration maps.
	New curves for each storm position	This will harvest a new set of DAD curves every time the storm is moved to a new position. This may be advantageous for a large basin in which the DAD relationship is considerably different from one side of the basin to the other. Because HEC-MetVue resamples the digital maps for this data, the program will become less responsive.
	Use specified position	Using this option, the location for the DAD curves can be selected to be somewhere other than the centroid.
	Longitude	The longitude for the manual positioning. This must be a negative value for correct positioning within the western hemisphere.
	Latitude	The latitude for the manual positioning. This must be a positive value for correct positioning within the northern hemisphere.
	Define Custom Curves	Select this to input DAD data manually. The area-duration maps from HMR52 have not been updated since 1982 when the original report was published.
	Populate From Maps	This populates the depth values from the area-duration maps as a starting point. Doing this makes it easy to observe the differences between the manually input curves and the ones for the maps.
	Area-Duration Table	This is where custom depth values are entered. Any values that are different than what is read from the maps using the entire basin area has a bolded font. Placing the cursor over the cell will show the original basin average computed depth value.
Temporal Hyetograph Distribution Options	6 hr. distribution	This is the name of the 6 hour hyetograph distribution to use. A sample of the distribution is shown.
	Edit	Used to open the Hyetograph Pattern editor to define an alternate distribution to use for hyetograph creation. The hyetograph pattern editor is described below.
	Create shorter intervals	Select this to create hyetographs with intervals shorter than 6 hours.
	Interval	The hyetograph interval to create. This performs computations using the HMR52 rules to define the shorter intervals using the defined 1:6 hr. ratio along with the generated depth-duration curves.
	Periods to subdivide	This defines the number of 6 hours periods to subdivide to the shorter interval. Typically HMR52 requires that only the 4 largest 6 hour periods be subdivided. This was likely due to the computational effort that was involved in using more periods. Subdividing more periods makes little difference in the results and will increase computation times somewhat as more temporal TIN images must be generated.

	1 hr. to 6 hr. ratio: auto	This is the ratio used to adjust the lower portion of the generated depth-duration curves and is usually obtained from the digital maps automatically at the same location used for the DAD curves. It sets a point on the depth-duration curve at the 1 hour mark. For example, if the depth-duration curve had 15 inches of precipitation in the first 6 hour period with a ratio of .30, the depth for the first hour would be 4.5 inches.
	1 hr. to 6 hr. ratio: use specified value	Select this to manually enter the 1:6 hr. ratio.
	Specified value	The value for the 1:6 hr. ratio. HMR52 specifies to use values between .27 and .35.
Storm Size Options	Re-compute for each location and rotation	Select this to have the plugin optimize the storm size based on each individual placement and orientation of the storm. This is the default for HMR52 analysis and is the critical part of what the plugin is designed to do. If the storm size/intensity optimization was not a requirement then a standard, static elliptical storm pattern could be used by HEC-MetVue.
	Use specific storm size	Select this to force the HEC-MetVue to generate a specific storm size for all computations. This may be used if a specific location/rotation/storm size computation needs to be reproduced for historic purposes.
	Force definition of entire curve	If the storm size is being optimized, the plugin actually needs only a few points on each side of the optimal storm size to compute a valid curve. However, the plugin does produce an output table (refer to Figure 178 - Sample Output 2) and if it is necessary to compute the entire curve it can be done even though the plugin does not require it. Note that this will increase computation time significantly.
	Time intervals to use	An HMR52 storm consists of 12-6 hour periods. Computing the optimal storm size can be laborious, so by convention only the largest 4 periods were used to determine the optimal storm size. A more accurate optimization computation can be done using all the periods if desired. The difference in computation time is negligible.
	Storm area	Select from the standard storm sizes or enter a new one if necessary.

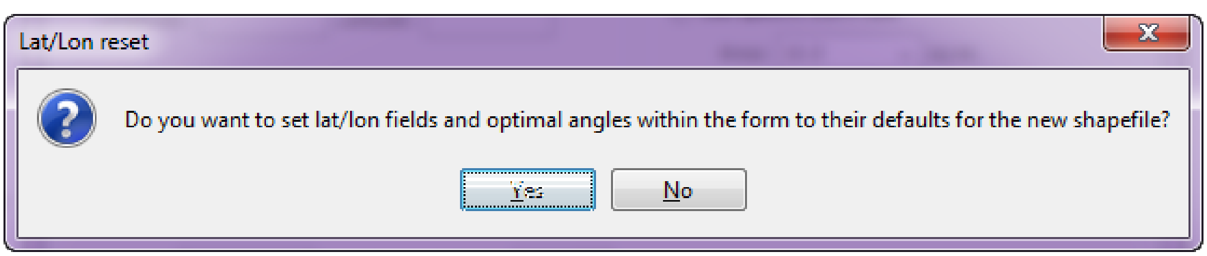


Figure 162 - Input values reset warning message

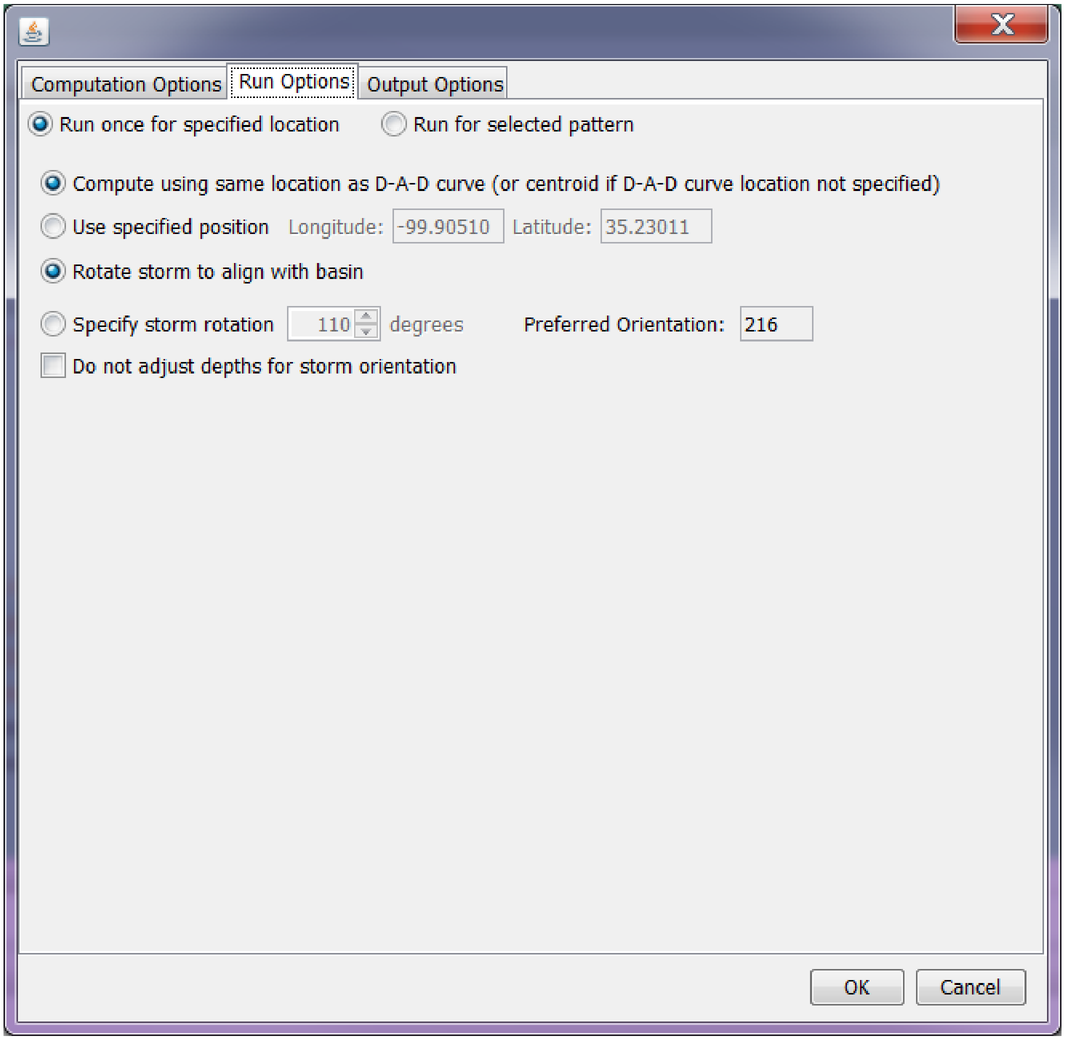


Figure 163 – HMR52 Run Options tab ("Run once for specified location" selection)

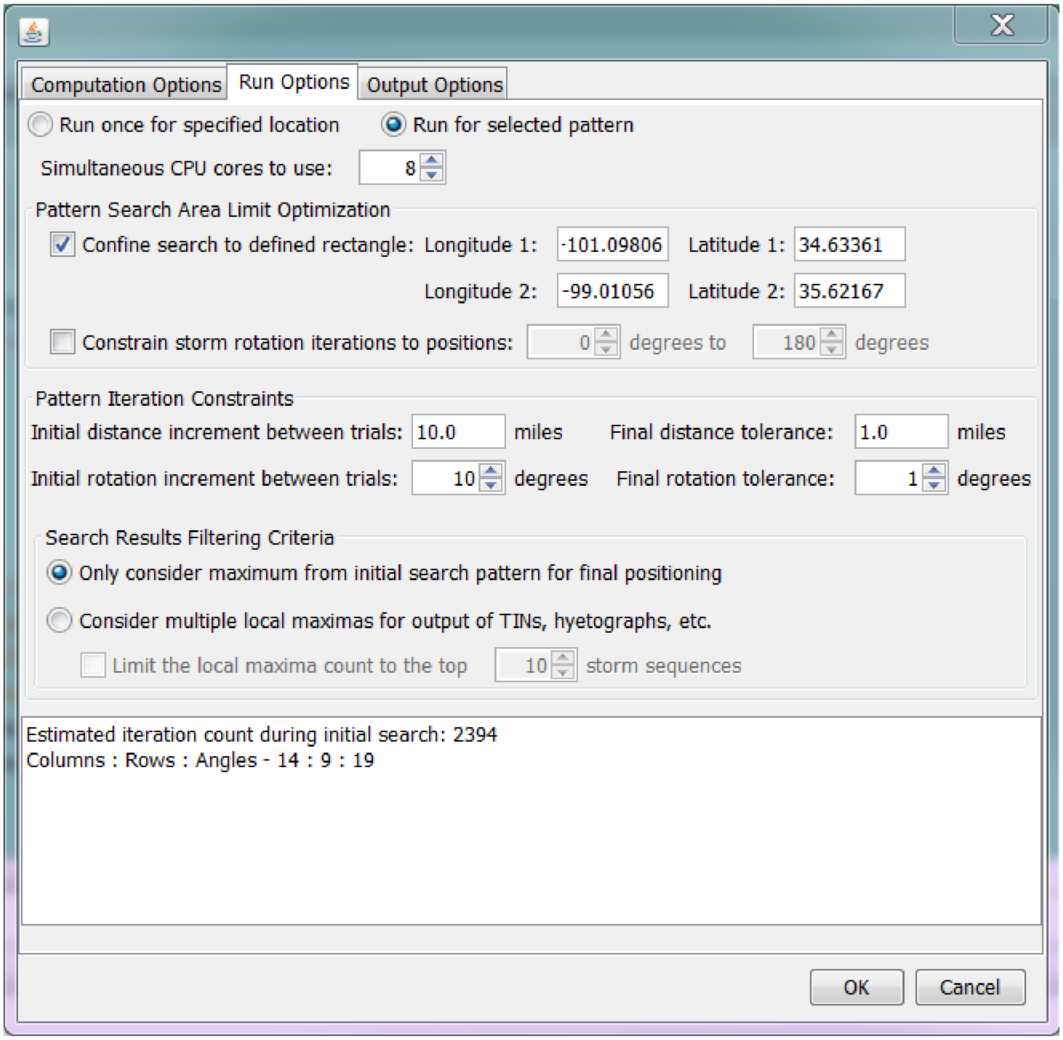


Figure 164 – HMR52 Output Options tab ("Run for selected pattern Selection)

Table 66 - Run Options tab description

Run Options		
Section Name	**Control Name**	**Value**
	Run once for specified location	Place the storm center at the same location used to establish the DAD curve. If the DAD selection is based on the basin area, the storm center will be set at the basin centroid.
	Run for selected pattern	Use an iterative search for the location that results in maximum precipitation volume. The initial search iterates through a grid and tests multiple rotations to find one or more local maxima. Next, the program performs a refined search of these local maxima to obtain results at the required precision. **The optimization for maximum volume is different than optimizing for peak flow at a defined location which requires the use of HEC-HMS.**
Run Once Options	Compute using same location as DAD curve	If this is selected, the location the storm is placed at the same location used to compute the DAD curves. This is normally the basin centroid. Note that once the storm is positioned at this location it can be moved easily using the normal HEC-MetVue storm repositioning tools.
	Use specified position	Select this to place the storm center at a location other than the basin centroid or the selected DAD curve sampling option.
	Rotate storm to align with basin	The default is to align the storm with the basin based on the axis computed by minimizing the 2nd moment of area about the centroid of the basin. Note that the basin centroid is used for the moment computation regardless of the location that the storm is to be placed. Note that once the storm is rotated to this position, it can be rotated easily using the HEC-MetVue storm repositioning tools.
	Specify storm rotation	Select this to manually input a specific storm rotation.
	Storm rotation	This is the azimuth in degrees, measured clockwise from north, of the minimum moment axis (longest radial through the center of the elliptical storm).
	Do not adjust depth for storm orientation	Normally HMR52 requires that the storm intensity be adjusted for storm rotational alignments that differ from the optimal storm alignment. This optimal storm alignment is retrieved from the digital maps[15] at the same location from which the DAD curves are acquired. If the DAD curves are recomputed for a location, the optimal storm alignment will be also.
Run For Selected Pattern Options	Simultaneous CPU cores to use	The default the setting is to use all available CPU cores on a computer to speed the analysis. A CPU usage setting lower than the default will constrain HEC-MetVue to use fewer CPU resources and better allow other task to run on the computer at the same time.

[15] Digitized from figure 8 in the original NOAA HMR52 document.

	Confine search to defined rectangle	The search pattern the program uses begins with the iteration of a gridded pattern. The default extents are computed as a rectangle encompassing the shapefile. Making the constraint rectangle smaller will speed the search since less grid points have to be searched.
	Constrain storm rotation iterations to positions	The default is to allow all possible storm alignments. This can be used to constrain the major axis of the elliptical storm to the range defined. The degrees are azimuths measured clockwise from north.
	Initial distance increment between trials	This should be set so that there are an adequate number of trials so that a local maxima isn't completely missed. An easy general rule would be to use the forth root of the total area of the shapefile polygons as an upper limit. For example, for a 625 square mile drainage basin would have a distance increment of 5 miles between the initial trial locations.
	Final distance tolerance	This sets the acceptable tolerance for convergence on a final solution for the optimal center of the storm. Once the local maxima locations and alignments for the grid search are complete, a binary search technique is used to locate a location within the acceptable tolerance.
	Initial rotation increment between trials	For every position on the search grid, the program will iterate through all the rotations possible using this increment interval.
	Final rotation tolerance	Once the best initial rotation value is found for a particular grid point, the rotation will be further refined to the acceptable final tolerance using a binary search approach.
	Only consider maximum from initial search pattern for final positioning	This will only refine the location and rotational alignment for the single grid point where the maximum occurred. On most normally shaped basins, there is usually a single maximum.
	Consider multiple local maxima for output of TINs, hyetographs, etc.	On some basin shapes, there can be more than a single local maximum storm position. This option should especially be used for basins that are oddly shaped such as a horseshoe or boomerang shaped basins, where the centroid of the basin is near or outside of its boundaries. Also, if this option is selected, consider reducing the 'Initial distance increment between trials.
	Limit the local maxima count to the top [count] sequences	The default is 10. The likely number of local maxima in normal situations is 1 or 2.

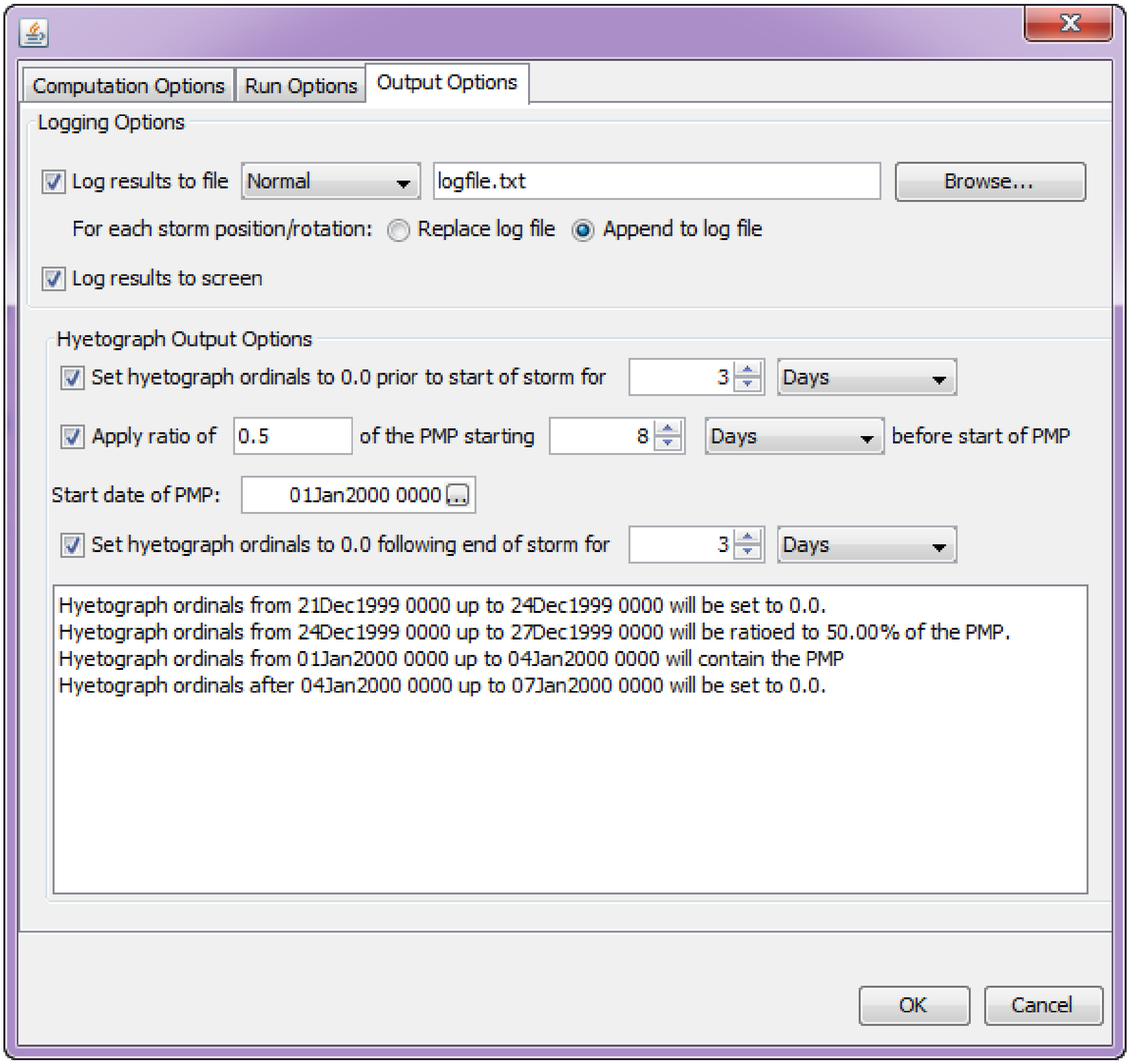


Figure 165 - Output Options tab

Table 67 - Output Options tab description

Output Options		
Section Name	**Control Name**	**Value**
Logging Options	Log results to file	Select this to set a log file for the output of the HMR52 data.
	Logging level	Sets the level to log the output at. Options are **Normal**, **Detailed** and **Debug** for increasing levels of detail.
	Logging file	The file to write the output to.
	Browse…	Brings up a file selection dialog to pick an output file.
	Replace log file	If this is selected, every iteration or storm movement resets the log file.
	Append to log file	If this is selected, every iteration or storm movement appends more results to the log file.
	Log results to screen	If this is selected the output is written to the screen.

Hyetograph Output Options		These options are designed to make the hyetographs generated more immediately useful to other applications. They allow the definition of extended time series and the inclusion of a PMP ratio.
	Set hyetograph ordinals to 0.0 prior to start of PMP or PMP ratio	When selected, it allows for the definition of a certain number of time series intervals to be set to 0.0 prior to definition of the PMP ratio, or PMP if a PMP ratio is not selected. The intention of this is to make sure that as PMP ratios are moved along the time scale, there will not be any remnants of previous hyetographs within the critical portion of the DSS time series records.
	Amount of time to set hyetograph ordinals to 0.0 for.	This sets the amount of time prior to the PMP ratio or PMP that the time series is set to 0.0 for.
	Time units to use.	The units of time for the time amount defined above.
	Apply PMP ratio	Select this to generate a PMP ratio that occurs prior to the PMP.
	PMP ratio	This is the ratio of the PMP ordinals to create. For example to apply 50% of the PMP prior to the PMP, set this to 0.5.
	Amount of time before start of PMP to start of ratio	This is the amount of time between the start of the PMP ratio to the start of the PMP. Since a PMP, and hence the PMP ratio, are 72 hours long, to get a gap of 5 days without precipitation between the end of the PMP ratio and the start of the PMP, this would be set to 8 days. Note that the ordinals between the end of the PMP ratio and the start of the PMP are always set to 0.0. If the PMP ratio and the PMP overlap a warning will be displayed in the information area but will not be prevented from occurring. If the values do overlap, the PMP ratio and the PMP will be summed for the overlapping intervals. Note that this makes it possible to scale the PMP by setting this time to 0. If this was done and the ratio was 0.5 it would make have the effect of scaling the original computed PMP to 150%. **<u>Caution:</u> For USACE PMF studies, this option should not be used to create an antecedent conditions. USACE PMF guidance requires 0.5 the PMF (NOT 0.5 of the PMP) to be routed as the antecedent condition in HEC-HMS. The antecedent storm is used to determine a starting reservoir stage for the PMF simulation, and should not impact initial baseflow and soil moisture for the PMF simulation.**
	Time units to use	The units of time for the time amount defined above.
	Start date of PMP	This sets the start time for the original PMP. All hyetograph data generated is with respect to this time. All the other times defined for PMP ratios are relative to this time.
	Set hyetograph ordinals to 0.0 following the PMP	When selected, it allows for the definition of a certain number of time series intervals to be set to 0.0 following the end f the PMP. The intention of this is to make sure that if the PMP start time is moved, there will not be any remnants of previous hyetographs within the critical portion of the DSS time series records.
	Amount of time following the PMP to set hyetograph ordinals to 0.0 for	This sets the amount of time following the end of the PMP that the time series is set to 0.0 for.
	Time units to use	The units of time for the time amount defined above.

The Hyetograph Pattern Editor

The hyetograph pattern editor is used to edit existing or create new hyetograph patterns. The hyetograph pattern is used to transform the computed depth-duration curves for each of the isohyets into the pattern desired for a hyetograph. HMR52 defines a standard pattern and this pattern is used by default. The plugin comes with the standard pattern which arranges the 12-6 hour values from the depth-duration curves as shown in Figure 166. The HMR52 standard pattern cannot be edited but new patterns can be added which can be edited. When a pattern can be edited, the buttons, shown grayed out in Figure 166 are enabled and the ordinals can be moved around by selecting one or more and using the buttons to change their positions. Another sample with the resultant hyetograph skewed right is shown in Figure 167. Table 68 provides a description of the features available in the Hyetograph pattern editor.

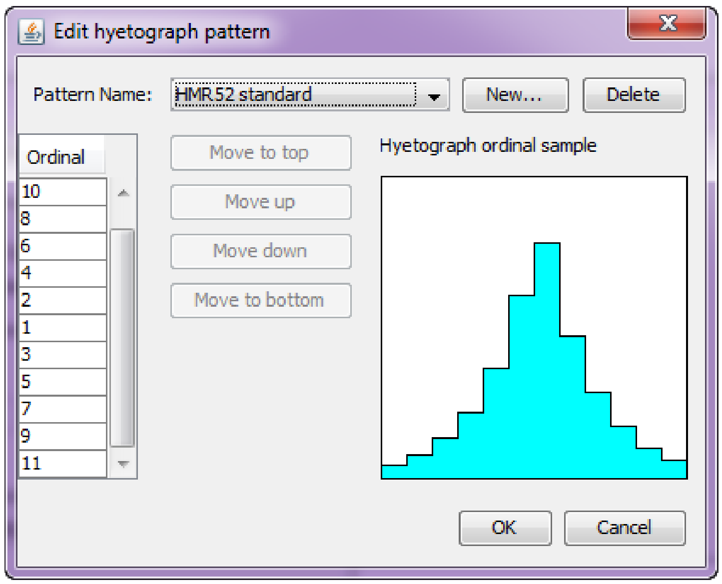


Figure 166 - Hyetograph pattern editor

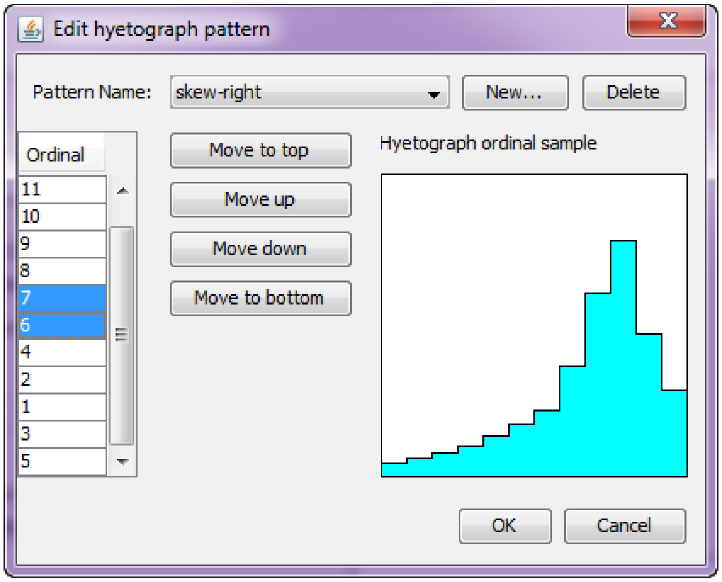
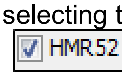


Figure 167 - Hyetograph pattern editor with editable pattern

Table 68 - Hyetograph Pattern editor description

Edit Hyetograph Pattern	
Control Name	**Value**
Pattern name	This shows the currently selected pattern. All the available patterns are contained within the dropdown. The standard HMR52 pattern is always in the list.
New… button	Use this to create a new pattern to edit. It will bring up an input dialog to enter the name for the new pattern.
Delete button	Delete the active pattern. The standard HMR52 pattern cannot be deleted.
Ordinal table	This is the table that contains the 12-6 hour ordinals that HMR52 defines. Highlight the ordinals to move using the standard mouse selection options for grids; click to select, shift-click for range, and control-click to add an item to existing selection.
Move to top	Moves the highlighted ordinals to the top of the list. The standard HMR52 pattern cannot be edited.
Move up	Moves the highlighted ordinals up one position.
Move down	Moves the highlighted ordinals down one position.
Move to bottom	Moves the highlighted ordinals to the bottom of the list.
Hyetograph sample	This shows a sample of what the hyetograph ordinal output would look like. The proportionality of the individual ordinals are approximate.

Working With the Selected Configuration

After the HMR52 configuration dialog is dismissed by selecting the 'OK' button, a panel similar to what is shown in Figure 168 and the control 

on the toolbar is enabled and selected. This particular storm is shown over Altus Reservoir which straddles the Oklahoma-Texas border. **Note: If this button is de-selected, any movement of the storm**

to a new position does not use the HMR52 plugin to optimize storm size or adjust for the new angle. The first time this is done after starting HEC-MetVue can take several seconds as the plugin extracts and decompresses the digitized map information to the computer temporary working directory. From this point, there are some possible choices:

- Move the storm to a new position
- Add other basins to the list.
- Generate hyetographs for the current storm position

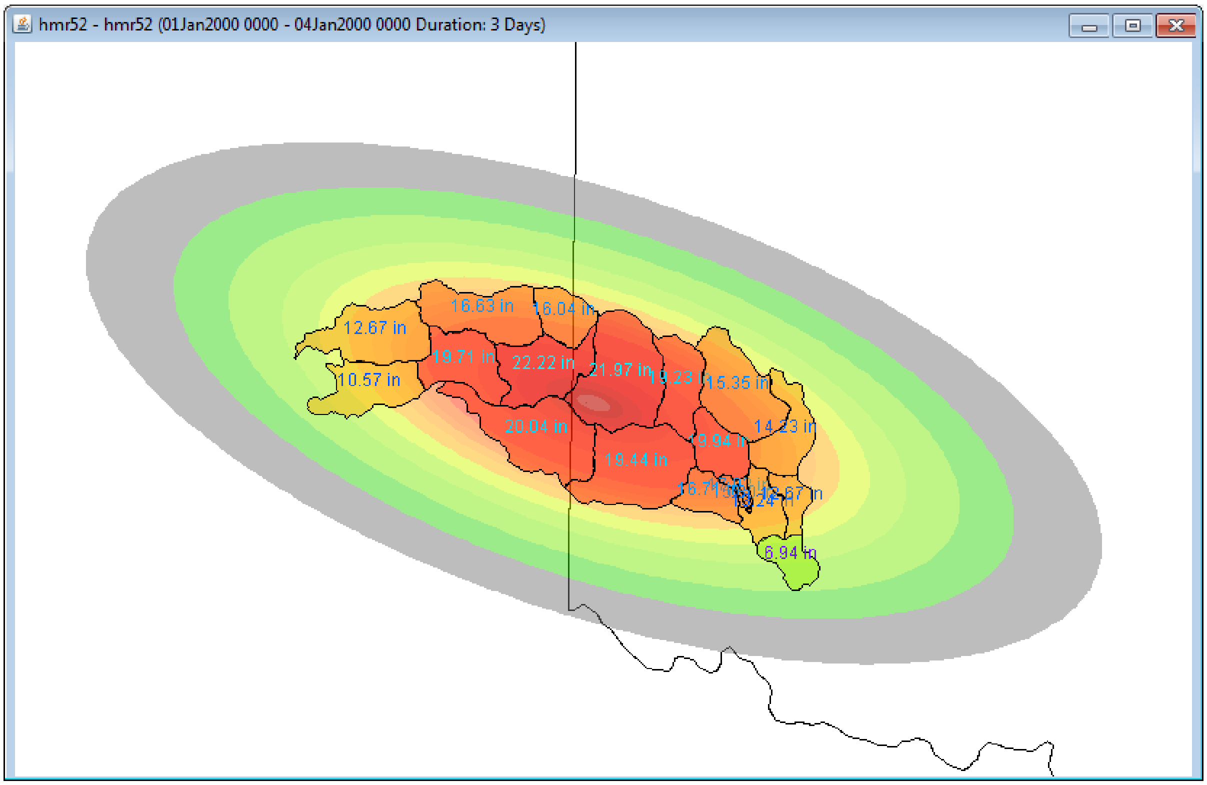


Figure 168 - Sample HMR52 design storm in default position.

Moving the storm to a new position

The storm can be moved to a new position in several ways. The positioning controls are part of the general HEC-MetVue program, which has a section that should be referenced for the various options. HEC-MetVue allows many editing actions. But for the HMR52 analysis, only the tools that translate or rotate the TIN should be used. Do not use the scaling tool or adjust the TIN measurements manually. Do not add or remove points from the TIN.

Usage tip: The HEC-MetVue rotate storm tool is not used just for rotating perfectly elliptical storms. When HEC-MetVue rotates a storm it uses the center of the map panel for the pivot point of the storm. To rotate the elliptical storm about the center, it is necessary to move the center of the storm to the center of the map panel. Right clicking on the map panel to bring up the context menu and selecting Encompass Data->TIN will do this.

Figure 169 shows an example after the storm had been moved to a new position. Although not evident from the plot, the computed optimal storm size for the new alignment was 10,190 square miles. The storm size for the original default alignment for this particular basin shown in Figure 168 was 3,065 square miles.

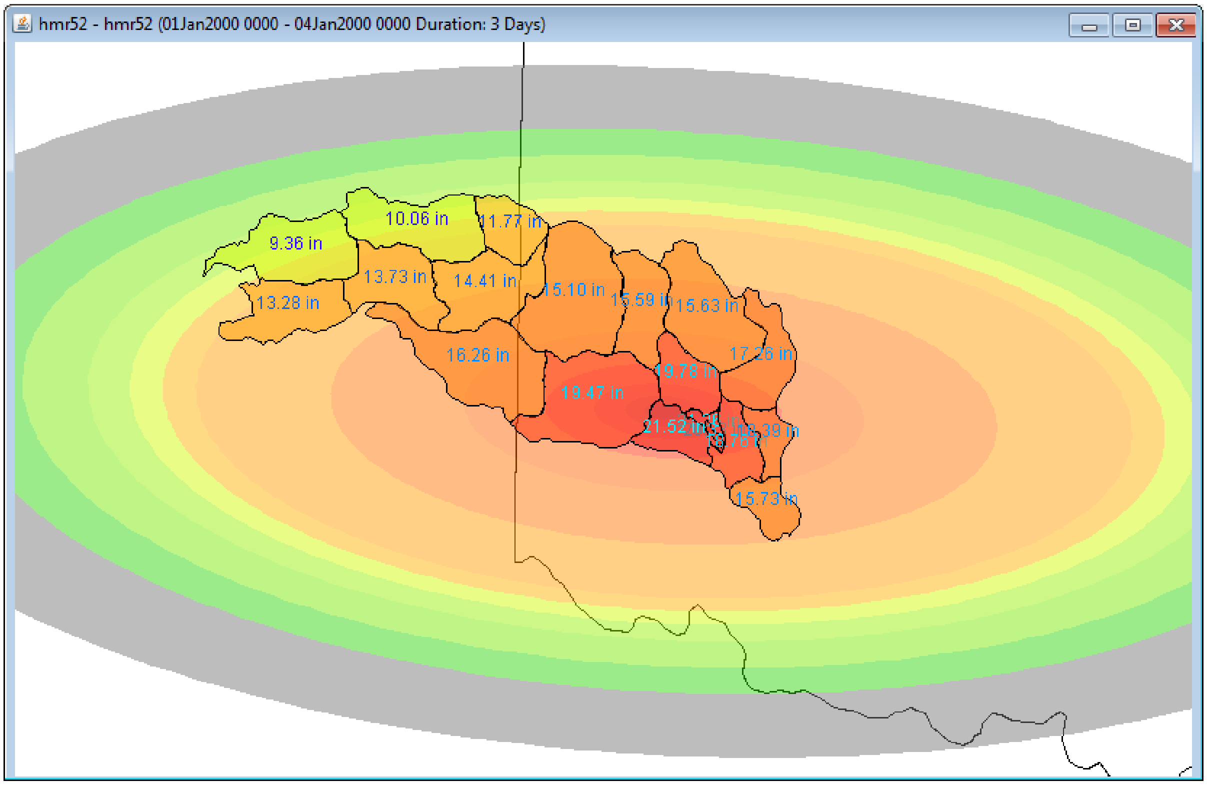


Figure 169 - Storm translated/rotated to a new position

Adding other basins to the list

In the example above, Altus Reservoir releases flow into the Denison Basin. Some storm analysis may require that for a particular storm orientation, the Denison basin hyetographs are also necessary. This is a simple task. In the HEC-MetVue Project Explorer window, simply add in the shapefiles that contain the Denison Basin subbasins. HEC-MetVue will compute subarea precipitation and is able to generate hyetographs for all the active shapefiles as shown in Figure 170. Note that the storm size optimization is with respect to the shapefile that was specified in the HMR52 configuration panel only. If it was critical to have the Denison subbasins contribute to the HMR52 storm optimization computations and then those subbasins would need to be included in the single shapefile that was specified in the HMR52 configuration dialog.

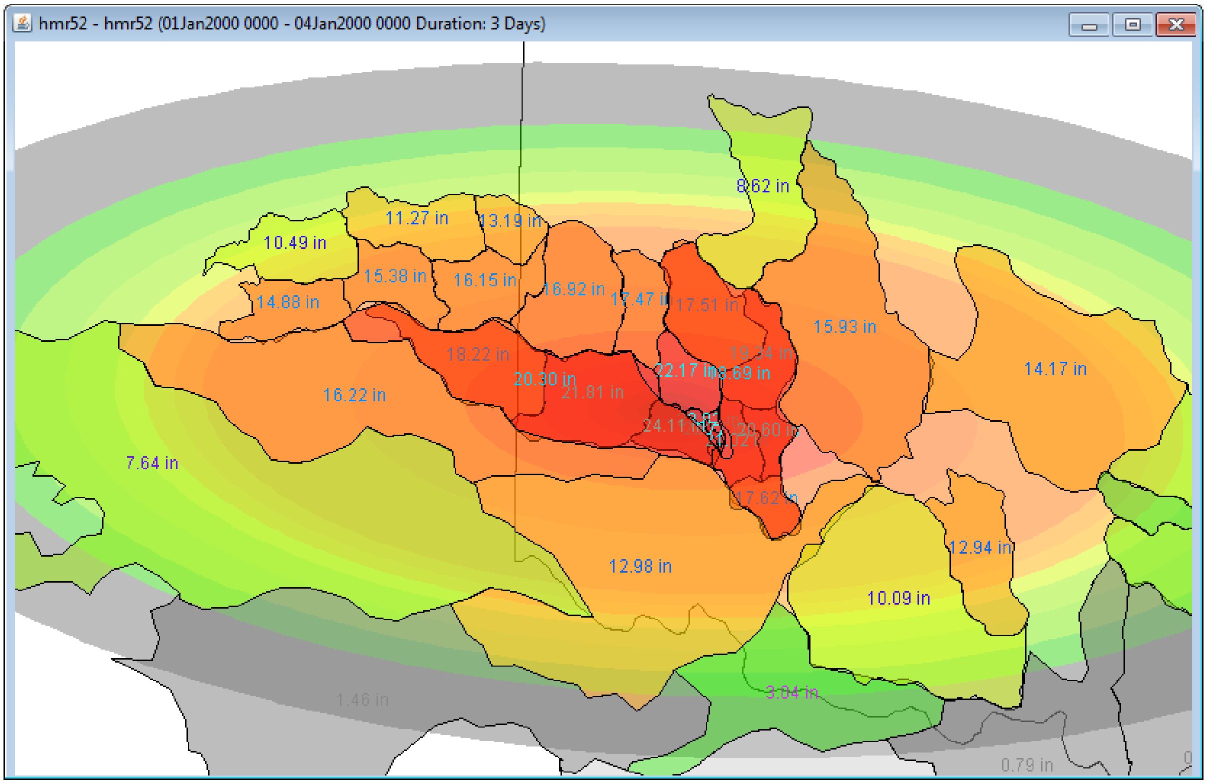


Figure 170 - Sample Map window with additional basin shapefile added

Generating hyetographs for the current storm position

Once a storm position is selected, the next step is to generate the hyetographs that some other program such as HEC-HMS can use. This is done using the standard HEC-MetVue options for saving hyetographs to DSS or to a text file. There are two things worth noting when saving the hyetographs to DSS.

First, the option within HEC-MetVue to either 'Save entire timespan' or 'Missing timespan only' must be set to 'Save entire timespan' if the same set of DSS records is continually re-used for a new storm position/orientation (Figure 171). If this is not done, HEC-MetVue will inspect the existing hyetograph records, note that there are no missing periods, and skip the computations for those time periods.

The second thing to note is the hyetograph duration interval size to save. The HMR52 plugin has an option on the setup dialog to select the interval also. On the HMR52 setup, selecting an interval of less than 6 hours uses the 1:6 hour hyetograph ratio to extend the shorter duration portion of the depth-duration curves for the appropriate isohyets. Subsequently, the ordinals generated for the selected number of intervals are actually distinct values. Refer to Figure 172 and Figure 173 which denotes the distinction between the two methods.

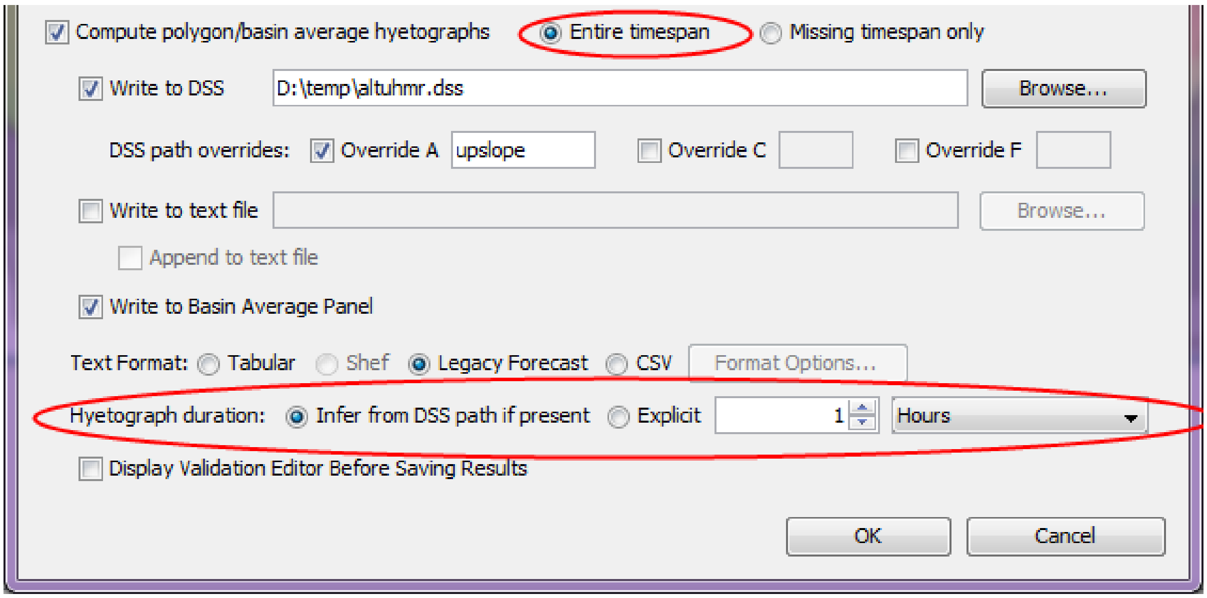


Figure 171 - Bottom portion of the standard HEC-MetVue 'Save' dialog.

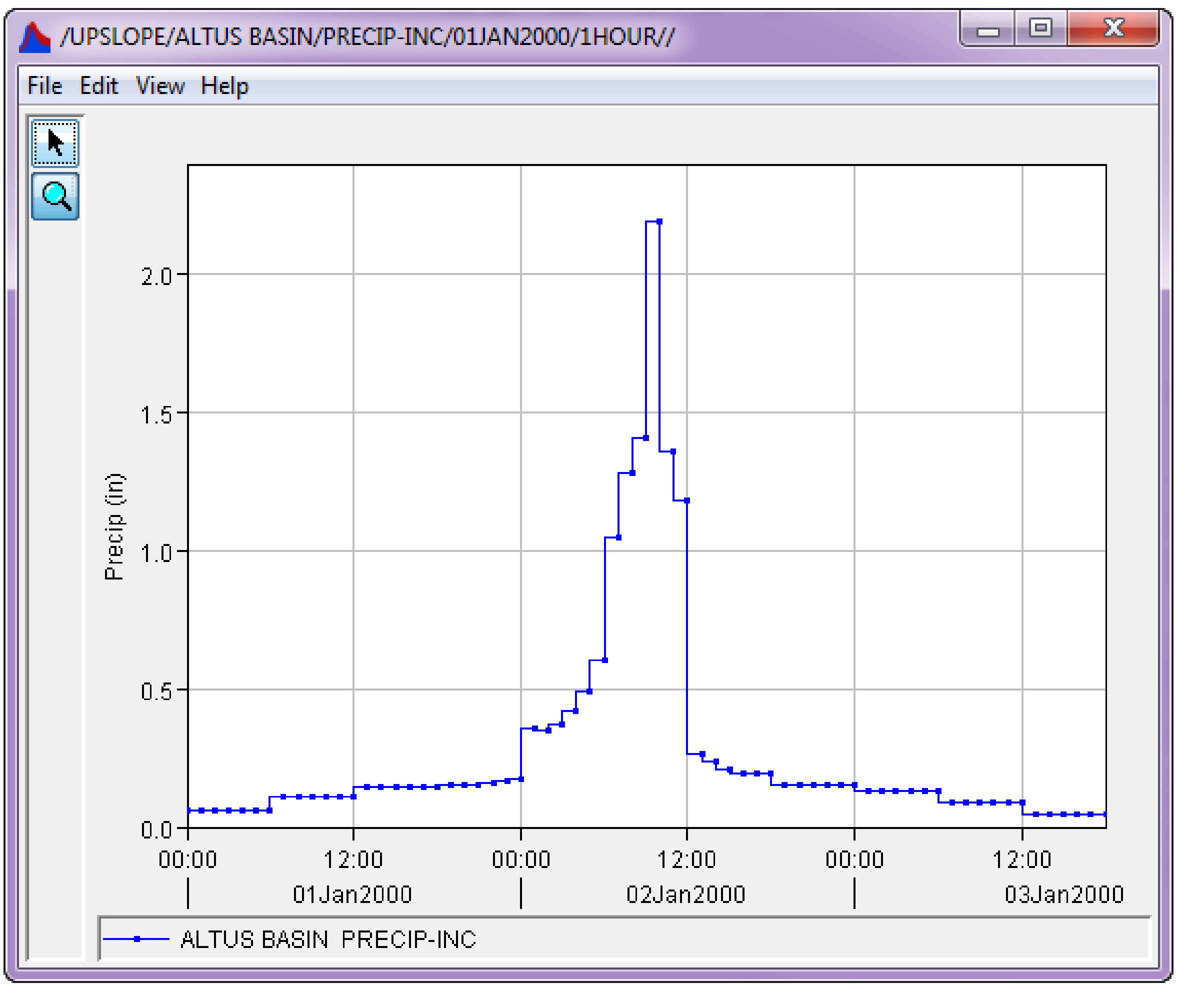


Figure 172 - 1-hour interval over 4- 6-hour time periods set using the HMR52 configuration dialog (plot from DSSVue).

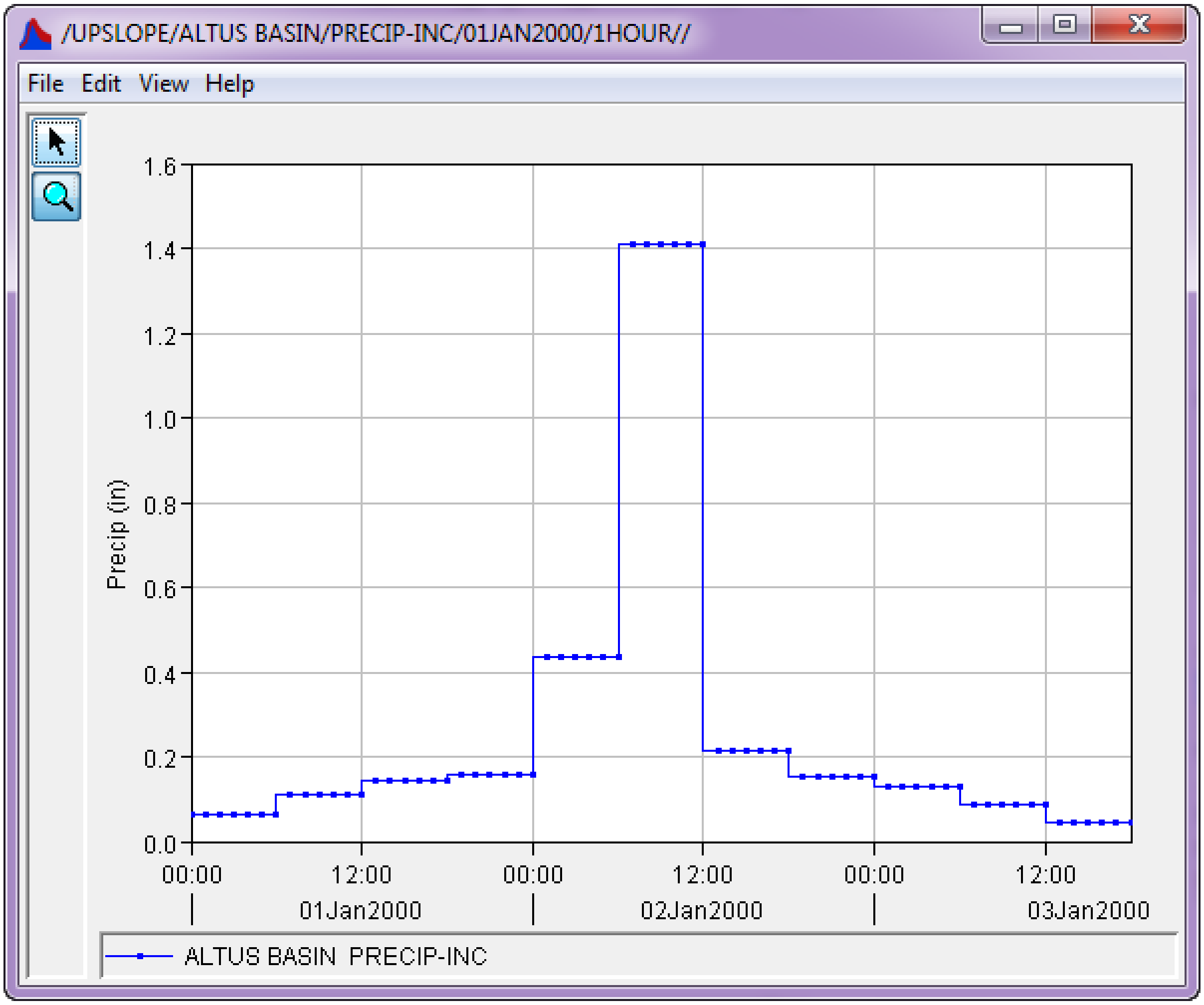


Figure 173 - 1-hour interval set using the standard HEC-MetVue save options with the HMR52 configuration dialog set to save a 6-hour interval hyetograph (plot from DSSVue).

HMR52 Plugin Output

The output information supplied from the HMR52 plugin is modeled after the original HMR52 program (HEC, 1984). This ability should make comparisons with the original HMR52 program more straightforward. However, due to the differences in how the plugin performs its computations, the output information will differ. For example, the Sample Output 4 in Figure 180, the basin area intersected by a particular isohyet is not computed since the plugin does not consider each isohyet separately but rather processes all the isohyets as a single storm pattern.

Sample Output 1 – Starting conditions for analysis

This output (Figure 174) appears at the beginning of the output file and is repeated for every storm repositioning that is performed. It reflects the initial conditions that were used for the computations. The information for the shapefile being processed is the first item listed. The area should be validated to assure that issues relating to overlapping areas as discussed earlier. Refer to the shapefile discussion in Table 65 for more information on this subject. The location used to determine the depth-area-duration curves, optimal storm angle, and 1:6 hour hyetograph ratio are displayed along with the associated information obtained for those parameters[16]. The point PMP depth-area-duration curves from the digital maps are then smoothed as shown in Figure 175.

```
Shapefile in use: D:\temp\ALTU.Polygon.shp
        Area :   7581.70 sq. miles
        Centroid : Lon: -99.91   Lat: 35.23
        Rotational alignment to minimum inertial axis: 110.30 degrees CW from north.


Location to use for Depth-Area_Duration curves, optimal storm angle, and 1:6 hour hyetograph ratio: Lon: -
99.91   Lat: 35.23

Storm center for this computation: Lon: -99.91   Lat: 35.23

1:6 hour hyetograph ratio: 0.3152

Optimal storm angle for this location: 216.0000 degrees (measured CW from north)

Angle for this computation: 110.2971 degrees (measured CW from north)

Hyetograph ordinal order to be applied: HMR52 standard.  Values: [12, 10, 8, 6, 4, 2, 1, 3, 5, 7, 9, 11]

                           PMP DEPTHS FROM HMR 51

       AREA                           DURATION
     (SQ. MI.)         6-HR     12-HR     24-HR     48-HR     72-HR
         10           27.20     32.96     35.95     40.12     42.04
        200           20.11     23.99     27.21     30.80     32.73
       1000           14.42     18.00     20.81     24.55     26.39
       5000            8.44     11.22     13.97     18.00     19.56
      10000            6.38      8.82     11.35     15.06     16.50
      20000            4.64      6.88      9.04     12.41     14.19
```

Figure 174 - Sample Output 1 (Starting conditions for analysis)

[16] Depth-area-duration curves from figures 18-49 of the NOAA HMR51 document. Optimal storm angle and the 1:6 hour hyetograph ratio from figure 8 and 39 respectively of the original NOAA HMR52 document.

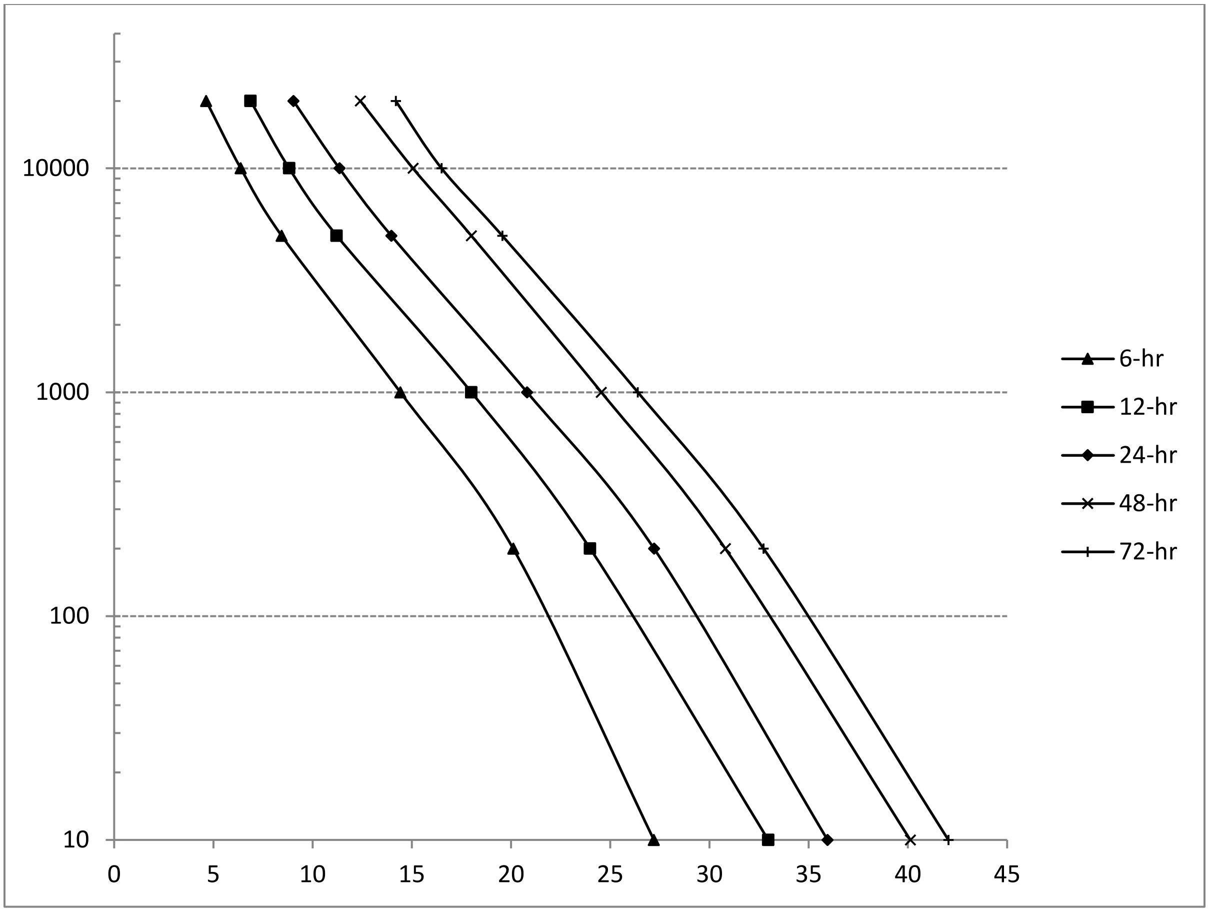


Figure 175 - Depth Area Duration Curves from Digital Maps

Sample Output 2 – Storm size optimization

This output appears following the starting conditions when the storm optimization option is selected. It shows the computations that are performed for determining the optimal storm size for the selected location and orientation. The sample output was set to compute all the storm sizes for the purposes of illustration. Normally the plugin will only compute enough size alternatives to define an adequate curve for determination of the optimal storm size which requires at least three trials on each side of the computed maximum similar to what is shown in Figure 176.

To compute the optimal storm size, a depth-duration curve is created for a specific storm size using the curves from Figure 175. Next, the depth-duration curves for each of the isohyets, A through S, are adjusted using the nomographs in Table 70 through Table 73 along with the appropriate storm orientation adjustment factor. This storm is then applied to the polygons in the shapefile to compute a total basin precipitation volume. This results in a single trial point on the curve shown in Figure 176. Several storm size versus precipitation volume computations are performed to create the curve shown in Figure 176.

Using the curve points from the standard storm sizes described above, the optimal storm size is determined by constructing a curve using a Catmull-Rom spline curve fitting algorithm. In the example in Figure 176, this results in a storm size of 2109 square miles. Referring to

Sample Output 2 in Figure 178, the row with the asterisk in the leftmost column denotes the optimal storm size. Many times the optimal storm size is one of the computed storm sizes but in this case it is not[17]. Since the optimal storm size falls between the standard storm sizes from the nomograph tables, a final computation is performed by interpolating between the standard storm sizes to adjust the isohyets proportionally.

The angle reduction coefficient shown in the table is computed from the storm orientation adjustment factor nomograph as shown in Figure 177.

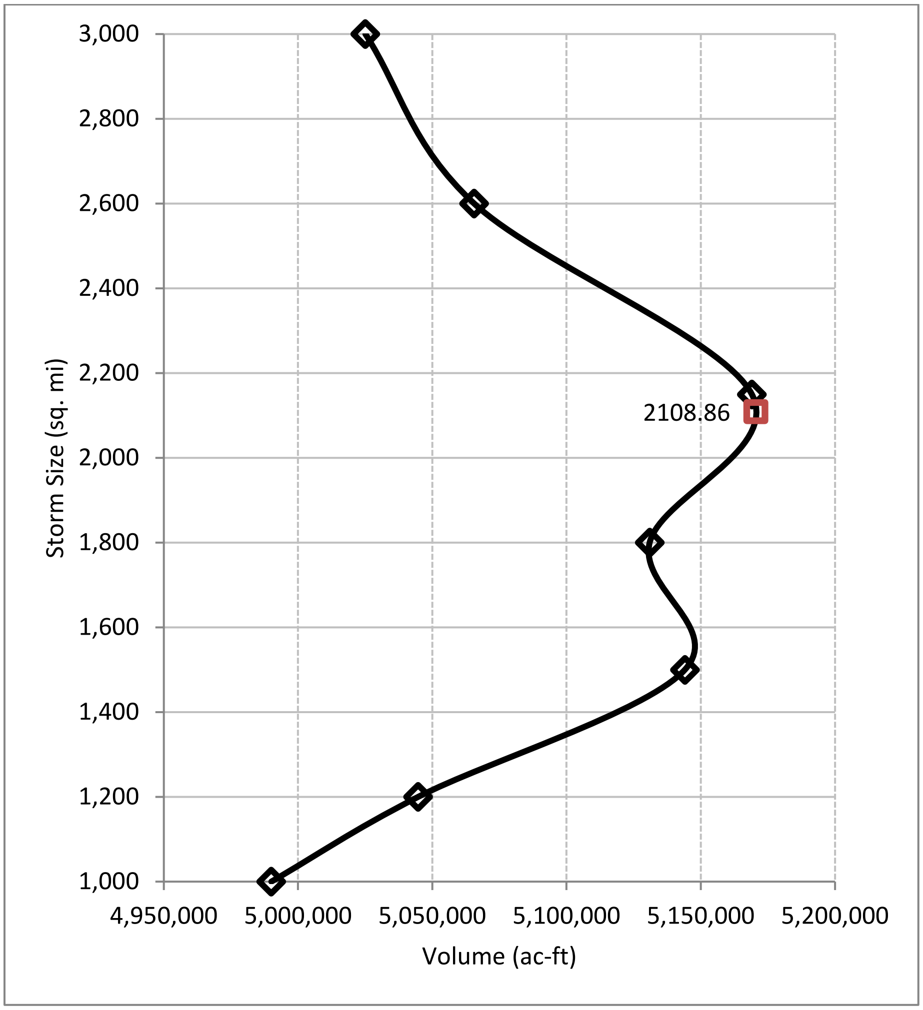


Figure 176 - Relevant portion of the smoothed curve for Sample Output 2.

[17] Refer to figure 47 in the original NOAA HMR52 document and the related discussion for more information.

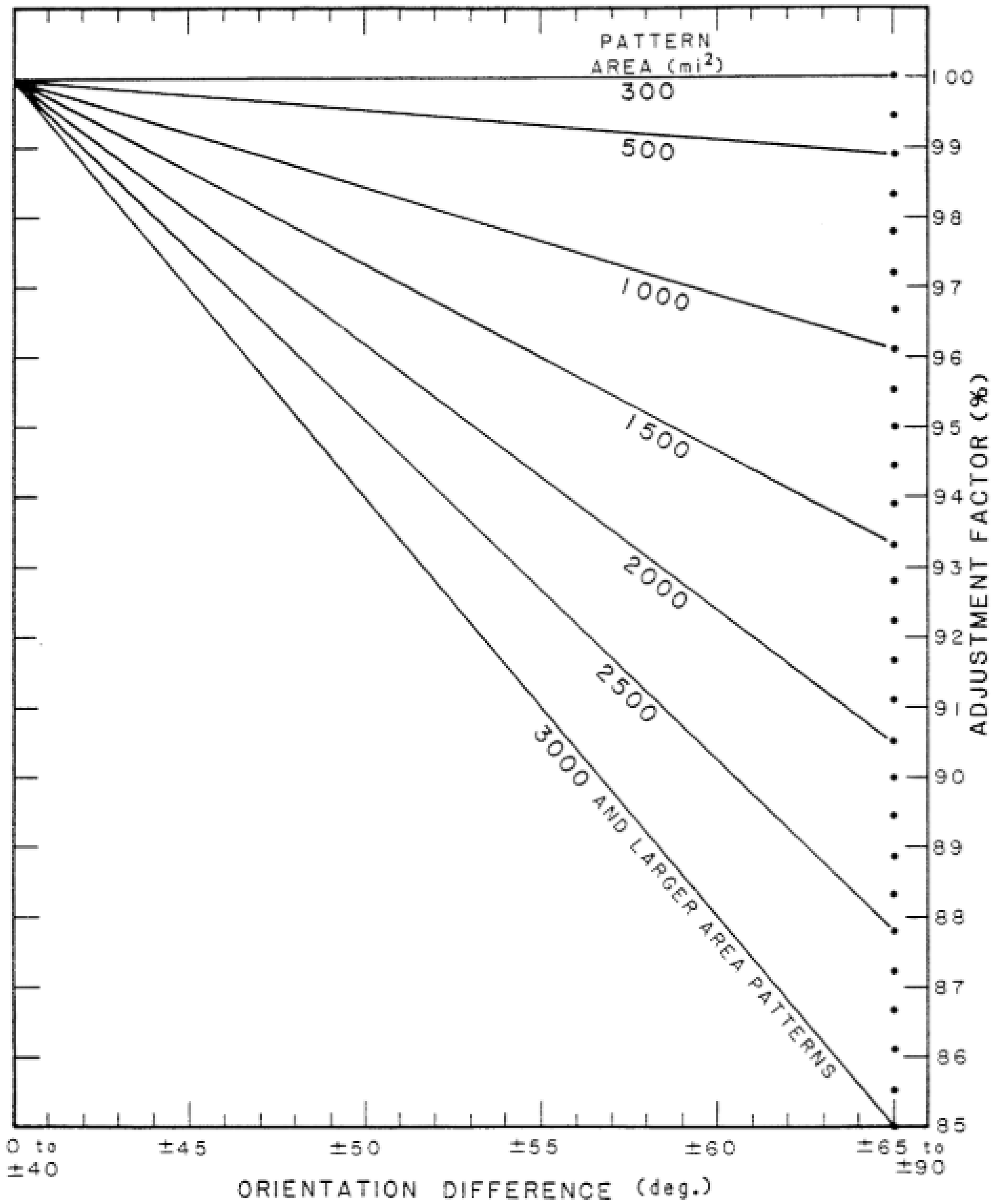


Figure 177 - Reprinted from Figure 10 in the NOAA HMR 52 document. Nomograph for determining the adjustment factor to apply to isohyet values as a result of the difference in the angle of the elliptical storm and the optimal storm angle for the location.

```
                                         ISOHYETAL STORM TOTAL PRECIP FOR STORM SIZE WITH ROTA
                                                      ORIENTATION = 110.30,   PREFERRED ORIENT
                                                              STORM CENTER COORDINATES LON: -


    STORM     ANGLE       TOTAL
     SIZE   REDUCTION    VOLUME                                            ISOHYETAL STORM TOTAL
   (SQ MI)    COEFF      (AC-FT)              A       B       C       D       E       F       G
     10.00    1.000      1150695  :       35.95   23.04   17.26   13.75   10.78    8.63    6.92
     17.00    1.000      1557298  :       34.84   27.24   20.30   16.21   13.00   10.54    8.55
     25.00    1.000      1899158  :       34.05   32.00   22.85   17.98   14.78   11.79    9.76
     35.00    1.000      2189856  :       33.62   31.63   25.48   19.80   16.11   13.14   10.87
     50.00    1.000      2506584  :       33.10   31.18   29.32   21.59   17.64   14.44   11.74
     75.00    1.000      2857542  :       32.60   30.77   28.98   24.08   19.54   15.90   12.95
    100.00    1.000      3108022  :       32.38   30.60   28.87   26.94   20.87   16.99   13.87
    140.00    1.000      3389183  :       32.12   30.20   28.56   26.70   22.95   18.27   14.96
    175.00    1.000      3600363  :       31.97   30.11   28.31   26.70   25.16   19.30   15.76
    220.00    1.000      3803125  :       31.72   29.92   28.18   26.62   25.13   20.60   16.74
    300.00    1.000      4092199  :       31.22   29.52   27.85   26.38   24.95   23.34   18.01
    360.00    0.997      4254464  :       30.86   29.23   27.60   26.01   24.63   23.07   19.32
    450.00    0.992      4455733  :       30.17   28.61   27.05   25.53   24.22   22.73   21.43
    560.00    0.986      4609368  :       29.53   28.03   26.56   24.94   23.70   22.12   21.05
    700.00    0.978      4760978  :       28.67   27.25   25.89   24.37   23.01   21.54   20.54
    850.00    0.969      4874058  :       28.04   26.57   25.25   23.82   22.41   21.02   19.92
   1000.00    0.961      4990040  :       27.41   26.01   24.62   23.24   21.91   20.59   19.55
   1200.00    0.950      5044723  :       26.79   25.34   24.03   22.62   21.24   19.99   18.99
   1500.00    0.933      5144052  :       25.83   24.48   23.17   21.86   20.58   19.32   18.39
   1800.00    0.917      5130938  :       25.05   23.69   22.34   21.13   19.82   18.77   17.68
*  2108.06               5170525        COMPUTED OPTIMAL STORM SIZE
   2150.00    0.897      5169009  :       24.15   22.89   21.64   20.31   19.11   18.12   17.11
   2600.00    0.872      5065600  :       23.07   21.82   20.59   19.37   18.26   17.27   16.35
   3000.00    0.850      5025085  :       22.20   21.05   19.81   18.69   17.58   16.65   15.72
   3800.00    0.850      4986113  :       21.67   20.45   19.31   18.19   17.09   16.23   15.38
   4500.00    0.850      4971697  :       21.22   20.06   18.93   17.82   16.77   15.91   15.02
   5500.00    0.850      4870491  :       20.62   19.55   18.43   17.40   16.37   15.42   14.61
   6500.00    0.850      4802092  :       20.10   19.06   18.00   16.91   16.01   15.06   14.24
   8000.00    0.850      4678690  :       19.55   18.47   17.44   16.43   15.49   14.62   13.86
  10000.00    0.850      4559668  :       19.01   17.90   16.95   15.92   15.05   14.14   13.44
  12000.00    0.850      4450670  :       18.48   17.44   16.51   15.50   14.64   13.74   13.09
  15000.00    0.850      4286014  :       17.74   16.81   15.92   14.91   14.03   13.17   12.53
  18000.00    0.850      4142227  :       17.07   16.12   15.26   14.30   13.50   12.65   12.08
  20000.00    0.850      4044054  :       16.61   15.72   14.87   13.91   13.11   12.32   11.76
```

Figure 178 - Sample Output 2 (Storm optimization determination, part 1 of 2)

```
TION AND NOMOGRAPH ADJUSTMENTS FOR ALTU.Polygon
ATION = 216.00 DEGREES CW FROM NORTH
99.91   LAT: 35.23



PRECIP FOR STORM SIZE WITH ROTATION AND NOMOGRAPH ADJUSTMENTS
     H       I       J       K       L       M       N       O       P       Q       R       S
   5.03    3.59    2.23    0.81    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
   6.69    4.98    3.36    1.91    0.38    0.00    0.00    0.00    0.00    0.00    0.00    0.00
   7.70    5.97    4.34    2.66    1.17    0.00    0.00    0.00    0.00    0.00    0.00    0.00
   8.60    6.63    5.00    3.33    1.85    0.32    0.00    0.00    0.00    0.00    0.00    0.00
   9.47    7.54    5.67    4.00    2.54    1.02    0.00    0.00    0.00    0.00    0.00    0.00
  10.50    8.59    6.51    4.87    3.20    1.71    0.00    0.00    0.00    0.00    0.00    0.00
  11.24    9.12    7.06    5.42    3.77    2.07    0.29    0.00    0.00    0.00    0.00    0.00
  12.12   10.04    7.77    5.95    4.34    2.66    0.70    0.00    0.00    0.00    0.00    0.00
  12.73   10.46    8.26    6.41    4.83    2.99    1.04    0.00    0.00    0.00    0.00    0.00
  13.52   11.07    8.69    6.87    5.31    3.29    1.40    0.00    0.00    0.00    0.00    0.00
  14.45   12.04    9.49    7.49    5.78    3.81    1.95    0.29    0.00    0.00    0.00    0.00
  15.27   12.51    9.97    7.85    6.17    4.06    2.22    0.60    0.00    0.00    0.00    0.00
  16.32   13.25   10.41    8.35    6.53    4.45    2.48    0.90    0.00    0.00    0.00    0.00
  17.60   14.08   11.14    8.78    6.82    4.63    2.75    1.10    0.00    0.00    0.00    0.00
  19.22   14.95   11.77    9.16    7.08    4.98    2.97    1.31    0.00    0.00    0.00    0.00
  18.82   16.03   12.49    9.61    7.46    5.11    3.16    1.46    0.00    0.00    0.00    0.00
  18.36   17.32   13.16   10.07    7.65    5.38    3.33    1.60    0.00    0.00    0.00    0.00
  17.88   16.91   13.98   10.56    7.94    5.60    3.62    1.80    0.00    0.00    0.00    0.00
  17.26   16.23   15.22   11.22    8.54    5.89    3.89    2.00    0.00    0.00    0.00    0.00
  16.61   15.67   14.71   11.93    8.98    6.17    4.10    2.17    0.22    0.00    0.00    0.00

  16.02   15.16   14.17   13.21    9.48    6.49    4.31    2.32    0.46    0.00    0.00    0.00
  15.35   14.46   13.47   12.58   10.29    6.90    4.46    2.55    0.69    0.00    0.00    0.00
  14.79   13.87   12.96   12.11   11.30    7.37    4.69    2.76    0.87    0.00    0.00    0.00
  14.44   13.53   12.68   11.91   11.08    8.58    5.36    3.07    1.21    0.00    0.00    0.00
  14.14   13.28   12.49   11.70   10.91    9.97    5.98    3.51    1.50    0.00    0.00    0.00
  13.80   12.94   12.14   11.41   10.68    9.82    7.05    3.98    1.84    0.00    0.00    0.00
  13.48   12.69   11.87   11.19   10.51    9.70    8.94    4.54    2.25    0.11    0.00    0.00
  13.05   12.30   11.56   10.93   10.25    9.50    8.73    5.56    2.86    0.49    0.00    0.00
  12.63   11.95   11.26   10.63   10.05    9.25    8.60    7.80    3.72    1.06    0.00    0.00
  12.29   11.65   11.01   10.36    9.83    9.08    8.43    7.68    4.69    1.54    0.00    0.00
  11.80   11.21   10.59   10.00    9.47    8.80    8.20    7.52    6.80    2.32    0.11    0.00
  11.37   10.83   10.21    9.68    9.18    8.57    8.01    7.34    6.69    3.10    0.47    0.00
  11.09   10.55    9.96    9.45    8.99    8.40    7.84    7.20    6.59    3.68    0.67    0.00
```

Figure 179 - Sample Output 3 (Storm optimization determination, part 2 of 2)

Sample Output 4 – Probable Maximum Storm for 6-Hour Intervals

The Sample Output 4 in Figure 180 displays the computed incremental depth-duration curves for each of the 6-hour time intervals for the selected storm area, orientations, and location. This is the detailed information for the storm isohyets for the optimal storm size computed above.

PROBABLE MAXIMUM STORM FOR ALTU.Polygon

STORM AREA = 2108 SQ. MI., ORIENTATION = 110.30, PREFERRED ORIENTATION = 216.00

STORM CENTER COORDINATES LON: -99.91 LAT: 35.23

ISOHYET	AREA (SQ.MI.)	DEPTHS (INCHES) FOR 6-HOURS INCREMENTS OF PMS											
		1	2	3	4	5	6	7	8	9	10	11	12
A	10	18.22	3.49	1.49	1.05	1.00	0.94	0.85	0.73	0.56	0.42	0.31	0.25
B	25	17.07	3.37	1.48	1.05	1.00	0.94	0.85	0.73	0.56	0.42	0.31	0.25
C	50	15.93	3.27	1.46	1.05	1.00	0.94	0.85	0.73	0.56	0.42	0.31	0.25
D	100	14.71	3.20	1.45	1.05	1.00	0.94	0.85	0.73	0.56	0.42	0.31	0.25
E	175	13.56	3.13	1.44	1.05	1.00	0.94	0.85	0.73	0.56	0.42	0.31	0.25
F	300	12.63	3.08	1.43	1.05	1.00	0.94	0.85	0.73	0.56	0.42	0.31	0.25
G	450	11.69	3.00	1.43	1.05	1.00	0.94	0.85	0.73	0.56	0.42	0.31	0.25
H	700	10.66	2.94	1.42	1.05	1.00	0.94	0.85	0.73	0.56	0.42	0.31	0.25
I	1000	9.83	2.91	1.42	1.05	1.00	0.94	0.85	0.73	0.56	0.42	0.31	0.25
J	1500	8.91	2.85	1.41	1.05	1.00	0.94	0.85	0.73	0.56	0.42	0.31	0.25
K	2150	7.85	2.78	1.39	1.04	0.99	0.93	0.84	0.72	0.56	0.42	0.30	0.25
L	3000	5.33	2.13	1.13	0.84	0.80	0.75	0.68	0.58	0.45	0.33	0.25	0.20
M	4500	3.38	1.58	0.86	0.64	0.60	0.57	0.51	0.44	0.34	0.25	0.19	0.15
N	6500	2.06	1.09	0.65	0.48	0.46	0.43	0.39	0.34	0.26	0.19	0.14	0.12
O	10000	0.92	0.64	0.43	0.32	0.30	0.28	0.26	0.22	0.17	0.13	0.09	0.08
P	15000	0.20	0.11	0.07	0.05	0.05	0.05	0.04	0.04	0.03	0.02	0.02	0.01
Q	25000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
R	40000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
S	60000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Figure 180 - Sample Output 4 (PMP Depth-Area-Duration curves for HMR52 standard isohyets A through S.)

Sample Output 5 – Sub 6-Hour Interval Curve

The Sample Output 5 in Figure 181 displays the cumulative depth-duration curves for each isohyet. This table is only generated when intervals less than 6 hours are required. The first 6-hour interval from each curve in Sample Output 4 in Figure 180 is multiplied by the 1:6 hour ratio to obtain the precipitation value for the first hour. This new time-depth value along with a time-depth value of [0, 0] and the original curve are used to generate the points for the cumulative curve. The 1:6 hour ratio is used for all isohyets that are equal to or smaller than the computed optimal storm size. In the example shown, isohyets A through J use the ratio whereas the outer isohyets do not since they are considered residual precipitation. For residual precipitation, the 1-hour precipitation is simply 1/6 of the 6-hour precipitation. The curves are then smoothed. From these smoothed cumulative curves (shown below), each curve is converted back to incremental for the time interval requested. The hyetograph pattern specified in the Computation Options panel is then used to rearrange the ordinals to the requested hyetograph pattern. By convention the intervals from the first 6-hour duration are staggered around the midpoint of the 6 hour interval and the other intervals are placed in declining order moving out from the center.

For the purposes of illustration, assume that 1-hour hyetographs are required from the analysis. As Sample Output 5 in Figure 181 shows, the isohyets A through J are within the optimal storm size of 2109 sq. mi. meaning that the 1:6 hour ratio will be applied resulting in the general pattern as shown in Figure 182, Isohyets K though S fall outside the optimal storm size and do not use the 1:6 hour ratio for distributing precipitation and will result in a pattern similar to what is shown in Figure 184. For isohyets A through J the 1-hour value is approximately the 1:6 ratio, adjusted using the appropriate ratio adjustment value from Table 69, multiplied by the 6-hour value. However, since the curve has been smoothed, the 1-hour values will not be exact. The 1-hour values for isohyets K through S are 1/6 of the 6-hour values.

Table 69 - 1:6 hour isohyet hyetograph adjustment factors for given storm size

Storm Area	Isohyet															
(sq mi)	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
10	0.2555															
17	0.247															
25	0.237	0.2355														
35	0.2255	0.224														
50	0.2115	0.21	0.2085													
75	0.1935	0.192	0.1905													
100	0.18	0.1785	0.177	0.175												
140	0.1625	0.161	0.1595	0.1575												
175	0.15	0.1485	0.147	0.145	0.1435											
220	0.1375	0.1355	0.134	0.132	0.1305											
300	0.1185	0.117	0.1155	0.1135	0.112	0.11										
360	0.107	0.1055	0.104	0.102	0.1005	0.0985										
450	0.0935	0.0915	0.09	0.088	0.086	0.084	0.0825									
560	0.079	0.0775	0.076	0.0735	0.0715	0.07	0.069									
700	0.064	0.062	0.0605	0.0585	0.057	0.0545	0.053	0.051								
850	0.0515	0.049	0.0475	0.0455	0.044	0.042	0.0405	0.0385								
1000	0.0405	0.038	0.0365	0.034	0.032	0.0305	0.029	0.027	0.0255							
1200	0.028	0.0255	0.024	0.0215	0.0195	0.018	0.0165	0.0145	0.0125							
1500	0.0135	0.011	0.009	0.0075	0.006	0.0035	0.002	0	-0.002	-0.007						
1800	0.003	0.0005	-0.001	-0.003	-0.0045	-0.006	-0.0075	-0.0095	-0.0115	-0.0165						
2150	-0.0055	-0.0075	-0.009	-0.011	-0.0125	-0.0145	-0.016	-0.018	-0.0195	-0.0235	-0.028					
2600	-0.013	-0.015	-0.0165	-0.018	-0.0195	-0.0215	-0.023	-0.025	-0.027	-0.0305	-0.0345					
3000	-0.0185	-0.02	-0.0215	-0.023	-0.0245	-0.026	-0.0275	-0.0295	-0.0315	-0.035	-0.0385	-0.0425				
3800	-0.0245	-0.026	-0.0275	-0.029	-0.0305	-0.032	-0.0335	-0.0355	-0.037	-0.0405	-0.044	-0.0465				
4500	-0.0275	-0.029	-0.0305	-0.032	-0.0335	-0.035	-0.0365	-0.0385	-0.04	-0.0435	-0.0465	-0.049	-0.054			
5500	-0.0295	-0.031	-0.0325	-0.034	-0.0355	-0.037	-0.0385	-0.0405	-0.042	-0.0455	-0.0485	-0.0505	-0.0555			
6500	-0.03	-0.0315	-0.033	-0.0345	-0.036	-0.0375	-0.039	-0.0405	-0.042	-0.0455	-0.0485	-0.051	-0.0555	-0.061		
8000	-0.0295	-0.031	-0.0325	-0.034	-0.0355	-0.037	-0.0385	-0.04	-0.0415	-0.0445	-0.0475	-0.0505	-0.055	-0.0605		
10000	-0.0275	-0.029	-0.03	-0.0315	-0.0325	-0.034	-0.0355	-0.037	-0.0385	-0.0415	-0.045	-0.048	-0.0525	-0.0575	-0.064	
12000	-0.024	-0.0255	-0.0265	-0.028	-0.029	-0.0305	-0.032	-0.034	-0.0355	-0.0385	-0.0415	-0.0445	-0.049	-0.0535	-0.0605	
15000	-0.0155	-0.017	-0.018	-0.02	-0.0215	-0.023	-0.0245	-0.0265	-0.028	-0.031	-0.035	-0.038	-0.0425	-0.0475	-0.055	-0.063
18000	-0.0065	-0.008	-0.0095	-0.011	-0.0125	-0.014	-0.0155	-0.0175	-0.0195	-0.0235	-0.027	-0.0305	-0.0345	-0.041	-0.0475	-0.0555
20000	0	-0.0015	-0.003	-0.0045	-0.006	-0.008	-0.0095	-0.0115	-0.0135	-0.0175	-0.021	-0.0245	-0.029	-0.0355	-0.0415	-0.0505

TIME INTERVAL = 1 HOURS																			
1-HR TO 6-HR RATIO FOR ISOHYET A AT 20000 SQ. MI. = 0.3152																			
	DEPTH VS. DURATION																		
ISOHYET	5MIN	10MIN	15MIN	30MIN	1HR	2HR	3HR	6HR	12HR	18HR	1DAY	30HR	36HR	42HR	2DAY	54HR	60HR	66HR	3DAY
A	0.82	1.84	2.52	3.87	5.66	8.69	11.55	18.22	21.71	23.2	24.25	25.25	26.19	27.05	27.78	28.34	28.76	29.07	29.32
B	0.76	1.7	2.34	3.59	5.27	8.11	10.8	17.07	20.44	21.92	22.98	23.98	24.92	25.77	26.5	27.07	27.49	27.8	28.05
C	0.71	1.58	2.17	3.33	4.89	7.54	10.06	15.93	19.2	20.66	21.72	22.72	23.65	24.51	25.24	25.8	26.22	26.53	26.79
D	0.64	1.44	1.98	3.05	4.49	6.93	9.26	14.71	17.9	19.35	20.4	21.4	22.34	23.2	23.93	24.49	24.91	25.22	25.47
E	0.59	1.32	1.81	2.79	4.12	6.37	8.51	13.56	16.7	18.13	19.19	20.19	21.13	21.98	22.71	23.28	23.7	24.01	24.26
F	0.54	1.21	1.67	2.58	3.81	5.91	7.9	12.63	15.7	17.14	18.19	19.19	20.13	20.98	21.71	22.28	22.7	23.01	23.26
G	0.5	1.12	1.54	2.37	3.51	5.45	7.3	11.69	14.69	16.12	17.17	18.17	19.11	19.97	20.7	21.26	21.68	21.99	22.24
H	0.45	1.01	1.39	2.14	3.18	4.95	6.63	10.66	13.61	15.03	16.08	17.08	18.02	18.88	19.61	20.17	20.59	20.9	21.15
I	0.41	0.92	1.27	1.96	2.92	4.54	6.09	9.83	12.74	14.16	15.22	16.22	17.16	18.01	18.74	19.3	19.73	20.03	20.29
J	0.37	0.82	1.12	1.75	2.61	4.08	5.48	8.91	11.76	13.18	14.23	15.23	16.17	17.02	17.75	18.32	18.74	19.05	19.3
K	0.11	0.22	0.33	0.65	1.31	2.62	3.92	7.85	10.63	12.02	13.06	14.05	14.98	15.82	16.54	17.1	17.51	17.82	18.07
L	0.07	0.15	0.22	0.44	0.89	1.78	2.67	5.33	7.46	8.59	9.43	10.22	10.97	11.65	12.23	12.68	13.01	13.26	13.46
M	0.05	0.09	0.14	0.28	0.56	1.13	1.69	3.38	4.96	5.82	6.45	7.06	7.62	8.14	8.58	8.92	9.18	9.36	9.51
N	0.03	0.06	0.09	0.17	0.34	0.69	1.03	2.06	3.15	3.8	4.28	4.74	5.17	5.56	5.9	6.16	6.35	6.5	6.61
O	0.01	0.03	0.04	0.08	0.15	0.31	0.46	0.92	1.56	1.99	2.31	2.61	2.89	3.14	3.36	3.53	3.66	3.75	3.83
P	0	0.01	0.01	0.02	0.03	0.07	0.1	0.2	0.3	0.38	0.43	0.48	0.53	0.58	0.61	0.64	0.66	0.68	0.69
Q	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Figure 181 - Sample Output 5 (Sample cumulative depth-duration curves developed using the 1:6 hour ratio)

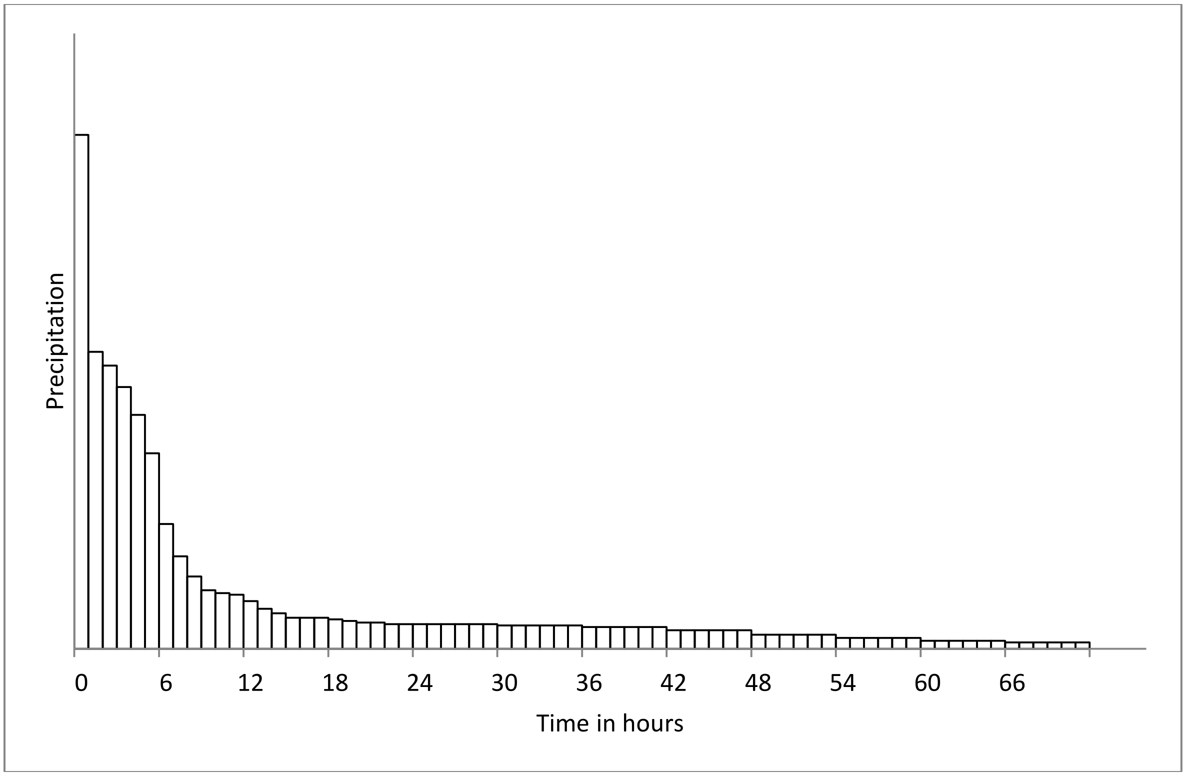


Figure 182 - Sample depth-duration curve for isohyets within the optimal storm size

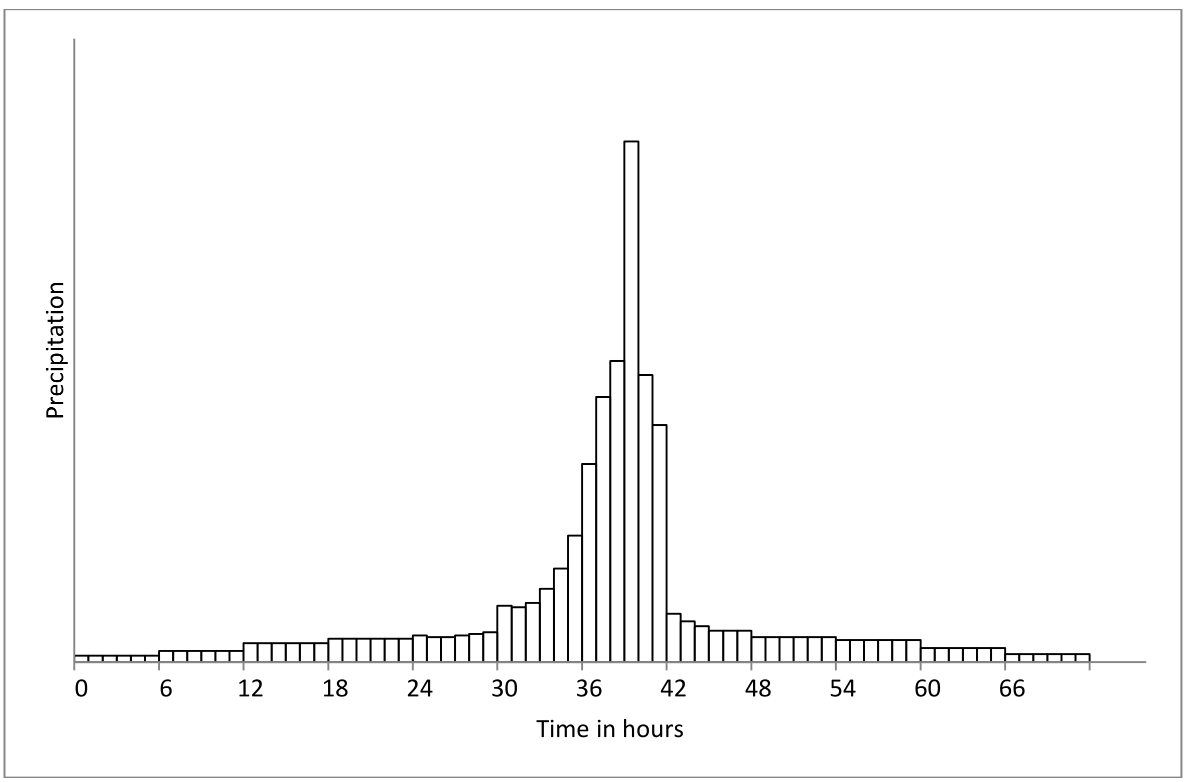


Figure 183 - Sample hyetograph derived from depth-duration curve for isohyets within the optimal storm size

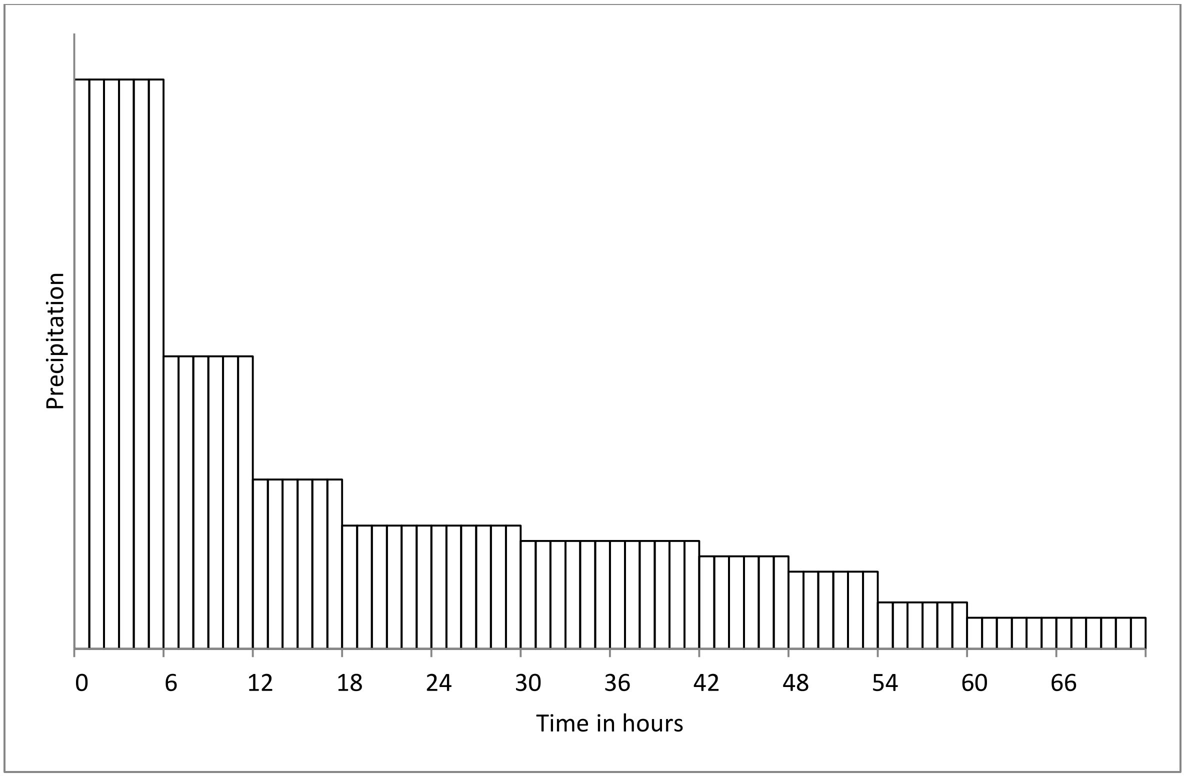


Figure 184 - Sample depth-duration curve for isohyets outside the optimal storm size

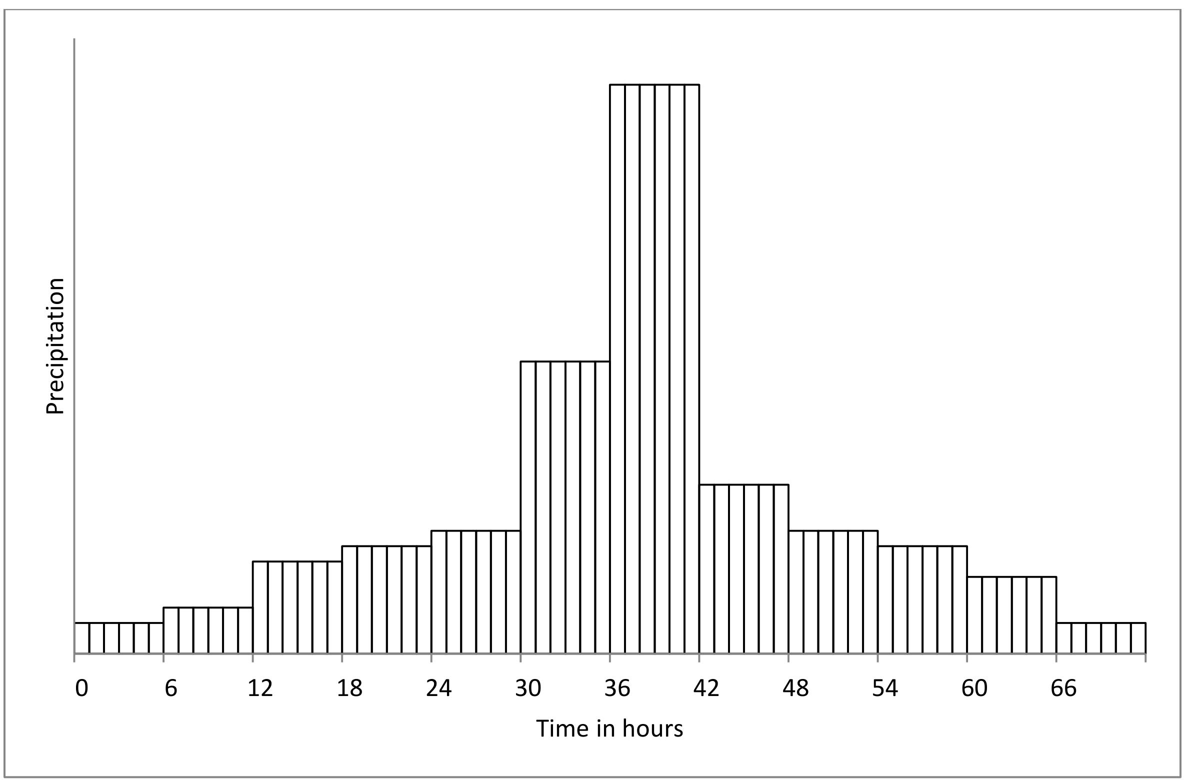


Figure 185 - Sample hyetograph derived from depth-duration curve for isohyets outside the optimal storm size

Table 70 - Spatial variation in PMP for largest 6-hour increment

	Isohyet																		
Storm Size	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
10	100	64	48	38	30	24	19	14	10	6	2	0							
17	101	78	58	46	37	30	24	19	14	9	5	1	0						
25	102	95	67	52	43	34	28	22	17	12	7	3	0						
35	104	97	77	59	48	39	32	25	19	14	9	5	1	0					
50	106	99	92	66	54	44	35	28	22	16	11	7	3	0					
75	109	102	95	77	62	50	40	32	26	19	14	9	5	0					
100	112	105	98	90	68	55	44	35	28	21	16	11	6	1	0				
140	116	108	101	93	78	61	49	39	32	24	18	13	8	2	0				
175	119	111	103	96	89	66	53	42	34	26	20	15	9	3	0				
220	122	114	106	99	92	73	58	46	37	28	22	17	10	4	0				
300	126	118	110	103	96	88	65	51	42	32	25	19	12	6	1	0			
360	129	121	113	105	98	90	73	56	45	35	27	21	13	7	2	0			
450	132	124	116	108	101	93	86	63	50	38	30	23	15	8	3	0			
560	136	128	120	111	104	95	89	72	56	43	33	25	16	9	3.5	0			
700	140	132	124	115	107	98	92	84	63	48	36	27	18	10	4	0			
850	145	136	128	119	110	101	94	87	72	54	40	30	19	11	4.5	0			
1000	149	140	131	122	113	104	97	89	82	60	44	32	21	12	5	0			
1200	155	145	136	126	116	107	100	92	85	68	49	35	23	14	6	0			
1500	162	152	142	132	122	112	105	96	88	80	56	41	26	16	7	0			
1800	169	158	147	137	126	117	108	99	91	83	64	46	29	18	8	1	0		
2150	176	165	154	142	131	122	113	103	95	86	77	52	33	20	9	2	0		
2600	184	172	160	148	137	127	118	108	99	89	80	62	38	22	11	3	0		
3000	191	179	166	154	142	132	122	112	102	92	83	74	44	25	13	4	0		
3800	203	189	176	163	150	140	130	119	108	98	89	79	56	31	15	6	0		
4500	212	198	184	170	157	146	135	124	113	103	93	83	71	37	19	8	0		
5500	223	209	194	180	166	153	142	131	119	108	98	88	76	48	23	10	0		
6500	233	218	203	187	174	160	148	137	125	113	103	93	81	70	29	13	1	0	
8000	247	230	214	198	183	169	157	144	132	120	110	99	87	75	40	18	3	0	
10000	262	243	227	209	194	178	166	152	140	128	117	107	93	82	68	26	7	0	
12000	274	255	238	219	203	186	174	159	147	135	123	113	99	87	73	38	11	0	
15000	290	271	253	232	214	196	183	168	156	143	131	120	106	94	80	65	18	2	0
18000	304	283	264	242	224	205	192	176	164	150	138	127	113	101	86	71	28	6	0
20000	312	291	271	248	229	210	197	181	168	154	142	131	117	104	89	74	36	8	0

Table 71 - Spatial variation in PMP for 2nd largest 6-hour increment

	Isohyet																		
Storm Size	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
10	100	64	48	39	30	24	20	14	10	7	3	0							
17	102	81.5	61	50	40	32	27	20.5	15.5	12	7	1.5	0						
25	103	98	72	59	48	39	32.5	26	20	15.5	10.5	5	0						
35	104	99	82	66.5	54.5	44.5	37.5	30.5	24	19	13.5	7.5	1	0					
50	105.5	100.5	96.5	76	62.5	51	43.5	36	29	23	17	11	4	0					
75	107	102	98	86	72	59.5	50	42	34.5	27.5	21	14.5	7	0					
100	108	103	99	95	79	65	55	47	38.5	31	24	17	9	1	0				
140	109	104	100.5	96.5	88	73	62	52.5	43.5	35	27.5	20.5	12	3.5	0				
175	110	105	101.5	97.5	95	79	66.5	56.5	47	38.5	30	23	14.5	5	0				
220	110.5	106	102.5	98.5	96	85	72	61	51	42	33	26	17	7.5	0				
300	111.2	107	103.5	100	97.5	95	80	67.5	57	47	37.5	30	20.5	10	1	0			
360	112	108	104	101	98.5	96	85	72	61	50	40.5	33	23	12	3	0			
450	113	109	105	102	99.5	97	95	77.5	66	54.5	44.5	36.5	25.5	14	4.5	0			
560	114	109.5	106	102.5	100.5	98	96	85	71.5	60	49	40	28.5	17	6.5	0			
700	114.5	110	107	104	101	99	97	95	78	65.5	54	44	32	19.5	9	0			
850	115	111	107.5	104.5	102	100	98	96	85	71	58.5	48	35	22	11	0			
1000	116	112	108.5	105	103	101	99	97	95	76	63	51	38	24	12.5	0			
1200	116.5	112.5	109	106	104	102	99.5	97.5	96	82.5	68	55	41	27	14.5	0			
1500	117	113	110	107	105	103	100.5	99	97	95.5	75.5	60.5	45	31	17	0			
1800	118	114	110.5	108	105.5	104	101.5	99.5	98	96	83	66	49.5	34	19.5	1.5	0		
2150	118.5	114.5	111	108.5	106.5	104.5	102	100	99	97	96	73	54	37.5	22	4	0		
2600	119	115.5	112	109.5	107	105.5	103	101	99.5	98	96.5	83	60.5	41.5	25.5	7	0		
3000	119.5	116	112.5	110	108	106	104	102	100.5	99	97	96	67	45	28.5	9	0		
3800	120.5	117	113.5	111	109	107	105	103	101.5	100	98	97	81	52.5	34	13.5	0		
4500	121	117	114	112	109.5	108	105.5	103.5	102	100.5	99	97.5	96	59	39	17	0		
5500	122	118	115	112.5	110.5	108.5	106.5	104.5	103	101.5	100	98.5	97	72.5	46	22	0		
6500	122	119	115.5	113	111	109	107	105	104	102	100.5	99	97.5	95.5	52.5	27.5	1	0	
8000	123	120	116.5	114	112	110	108	106	104.5	103	101.5	100	98.5	96	66	37	6	0	
10000	124	120.5	117	115	113	111	109	107	105.5	104	102.5	101	99	97	95	50	14	0	
12000	124.5	121	118	116	114	112	110	108	106.5	105	103	102	100	98	96	64	21	0	
15000	125	122	119	117	115	113	111	109	107	106	104	102.5	101	99	97	96	34	0	
18000	126	122.5	119.5	118	116	113.5	112	110	108	106.5	105	103.5	102	99.5	97.5	96.5	47	4.5	
20000	126	123	120	118	116	114	112	110	108.5	107	105	104	102	100	98	97	55	7	0

Table 72 - Spatial variation in PMP for 3rd largest 6-hour increment

	Isohyet																		
Storm Size	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
10	100	65	48	39	30	24	20	14	10	6.5	3	0							
17	100.6	83.5	63	51	40	33	28	21	16.5	12.5	7.5	1.5	0						
25	101	99	74.5	60.5	48.5	40	34	27	21.5	17	11.5	5	0						
35	101.3	99.4	85.5	69	55.5	46.5	39.5	32.5	26.5	21	15	8.5	1	0					
50	101.6	99.8	98.5	78.5	63	53.5	46	37.5	31.5	26	19.5	12	4	0					
75	102	100.3	99	90	73.5	61.5	53	44	37.5	31.5	24.5	16.5	8.5	0					
100	102.3	100.7	99.3	98.6	81.5	68	59	49	42	35.5	28	20	11.5	1	0				
140	102.6	101	99.7	99	92	76.5	66	55	47.5	40.5	32.5	24	15	4.5	0				
175	102.8	101.3	100	99.2	98.8	83	71	59.5	51	44	35	26.5	18	7	0				
220	103.1	101.5	100.3	99.5	99	89	77	64	55.5	47.5	38.5	29.5	20.5	10	0				
300	103.4	101.9	100.7	99.8	99.3	99	86	72	62	53	43	33.5	24.5	14	2	0			
360	103.6	102.1	100.9	100.1	99.5	99.2	92	76.5	66	56	46	36	27	16	4	0			
450	103.8	102.4	101.2	100.3	99.8	99.5	99.2	84	71	60	50	39.5	30	19	7	0			
560	104	102.7	101.5	100.6	100	99.7	99.4	91	77.5	64.5	54	43	33	22.5	10	0			
700	104.2	102.9	101.7	100.8	100.2	99.9	99.6	99.2	85	70.5	58.5	47	37	25.5	13	0			
850	104.4	103.2	102	101.1	100.4	100.1	99.7	99.4	92	76.5	62.5	50.5	40	28.5	15.5	0			
1000	104.6	103.3	102.3	101.3	100.6	100.3	99.9	99.6	99.3	82.5	67	54	43	31	17.5	0			
1200	104.7	103.5	102.5	101.5	100.8	100.4	100	99.7	99.5	89.5	72.5	58.5	46.5	34	20.5	0			
1500	105	103.8	102.7	101.7	101	100.7	100.3	100	99.7	99.4	81	65.5	51.5	38	24	0			
1800	105.2	104	102.9	102	101.2	100.8	100.4	100.1	99.8	99.5	89	72.5	56.5	42	27	2.5	0		
2150	105.3	104.2	103.2	102.2	101.3	101	100.6	100.3	100	99.7	99.5	80.5	61	46.5	30.5	5.5	0		
2600	105.5	104.4	103.4	102.4	101.5	101.2	100.7	100.4	100.1	99.8	99.5	90.5	69	52	34	9	0		
3000	105.7	104.6	103.5	102.5	101.7	101.3	100.9	100.5	100.2	99.9	99.6	99.3	76	57	37.5	12	0		
3800	105.8	104.8	103.8	102.8	101.9	101.5	101.1	100.7	100.5	100.1	99.8	99.5	88.5	67	43.5	16.5	0		
4500	106	105	104	103.1	102.1	101.7	101.2	100.9	100.6	100.2	99.9	99.6	99.3	76	49	21	0		
5500	106.2	105.3	104.3	103.2	102.3	101.8	101.4	101.1	100.8	100.4	100	99.7	99.4	88	57	27.5	0		
6500	106.4	105.5	104.5	103.5	102.5	102	101.5	101.2	100.9	100.5	100.2	99.8	99.5	98.9	65	34.5	1	0	
8000	106.6	105.7	104.8	103.7	102.7	102.2	101.7	101.4	101.1	100.7	100.3	100	99.6	99	79	44.5	8	0	
10000	106.8	106	105	104	102.8	102.4	101.9	101.6	101.3	100.9	100.5	100.2	99.8	99.2	98.7	59	18	0	
12000	107	106.2	105.3	104.2	103	102.6	102.1	101.8	101.5	101	100.7	100.3	99.9	99.3	98.8	71.5	27.5	0	
15000	107.2	106.5	105.5	104.4	103.3	102.8	102.3	102	101.7	101.2	100.8	100.5	100.1	99.5	99	98	42	1	0
18000	107.4	106.7	105.8	104.6	103.5	103	102.4	102.2	101.8	101.3	101	100.6	100.2	99.6	99.1	98.7	54.5	7.5	0
20000	107.5	106.8	105.9	104.7	103.6	103	102.5	102.2	101.9	101.4	101.1	100.7	100.2	99.7	99.2	98.8	66	12	0

Table 73 - Spatial variation in PMP for 4th-12th 6-hour increment

	Isohyet																		
Storm Size	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
10	100	65	48	39	30	24	20	14	10	6.5	3	0							
17		83.5	62.5	50.5	40	33	27.5	21	16	12	7.5	0.5	0						
25		100	74.5	60.5	48.5	40	34	27	21.5	17	11.5	5	0						
35			86	68.5	55	46	39	31.5	26	21	15	8.5	0.5	0					
50			100	78.5	63	53.5	46	37.5	31.5	26	19.5	12	4	0					
75				89.5	73	61.5	53	44	37	31	24	16	8.5	0					
100				100	81.5	68	59	49	42	35.5	28	20	11.5	1	0				
140					91	76.5	65.5	55	47.5	40	32	23.5	15	4	0				
175					100	83	71	58.5	51	44	35	26.5	18	7	0				
220						89	77	64	55	47	38.5	29	20.5	9.5	0				
300						100	86	72	62	53	43	33.5	24.5	14	2	0			
360							91.5	77	65.5	55.5	46	36	27	16	4	0			
450							100	84	71	60	50	39.5	30	19	7	0			
560								91	77.5	64.5	53.5	43	33	22	9.5	0			
700								100	85	70.5	58.5	47	37	25.5	13	0			
850									92	77	62	50.5	40	28	15	0			
1000									100	82.5	67	54	43	31	17.5	0			
1200										89.5	72	58.5	46.5	33.5	20	0			
1500										100	81	65.5	51.5	38	24	0			
1800											89	72.5	56	41.5	26.5	2.5	0		
2150											100	80.5	61	46.5	30.5	5.5	0		
2600												90	69	51.5	33.5	9	0		
3000												100	76	57	37.5	12	0		
3800													88.5	67	43.5	17	0		
4500													100	76	49	21	0		
5500														88	56.5	27	0		
6500														100	65	34.5	1	0	
8000															79	44	8	0	
10000															100	59	18	0	
12000																71	27	0	
15000																100	42	1	0
18000																	54	7	0
20000																	66	12	0

APPENDIX D

Transitioning from ViewRain to HEC-MetVue

HEC-MetVue supports using the original real time measurement files (typically files with the extensions RF, RAD and CAL) without modification. However, the original overlay files which contain mapping information such as basin delineations are not supported directly and must be converted to shapefiles in order to be used. A program (Overlay2Shapefile.exe) is available to help with the transition. This program requires the Microsoft .net framework v 3.5 or later be installed on the PC that does the conversion. Once the original overlay files are processed by this program the HEC-MetVue program can be used to accomplish most of the same tasks that the ViewRain program provided. In addition, Table 74 contains information regarding program entry points that can be used to replace several of the other ViewRain programs.

Table 74 - Utilities for transitioning from ViewRain to HEC-MetVue

Original Utility	Replacement	Comments
Make_overlay.exe	Overlay2shapefile.exe.	Not a direct replacement. Provides a transition to shapefiles where commonly available utilities can be used to maintain
Print_overlay.exe	None.	Not required. Use commonly available shapefile utilities.
Print_rain.exe	No replacement to tabulate TIN files.	Original utility is still viable.
Pre_rain.exe	Sample entry point in sample directory in the file TriangulateTin.cmd.	Java command line sample
Ncgetprecip.exe	No replacement yet.	Original is still viable. Can also use HEC utilities gridLoadNetCDF and gridLoadXMRG to import images into DSS instead.
Basinrf.exe	Sample entry point in sample directory in the file Basincomps.cmd.	Java command line sample
Add_rad.exe	Sample entry point in sample directory in the file AddTin.cmd.	Java command line sample
Add_rain.exe	Sample entry point in sample directory in the file AddTin.cmd.	Java command line sample
Cal_rad.exe	Sample entry point in sample in the file CalRad.cmd	Java command line sample
ViewRain.exe	metvue.exe	

Figure 186 illustrates the Overlay files conversion utility dialog, while Table 75 provides a description of the features of the dialog.

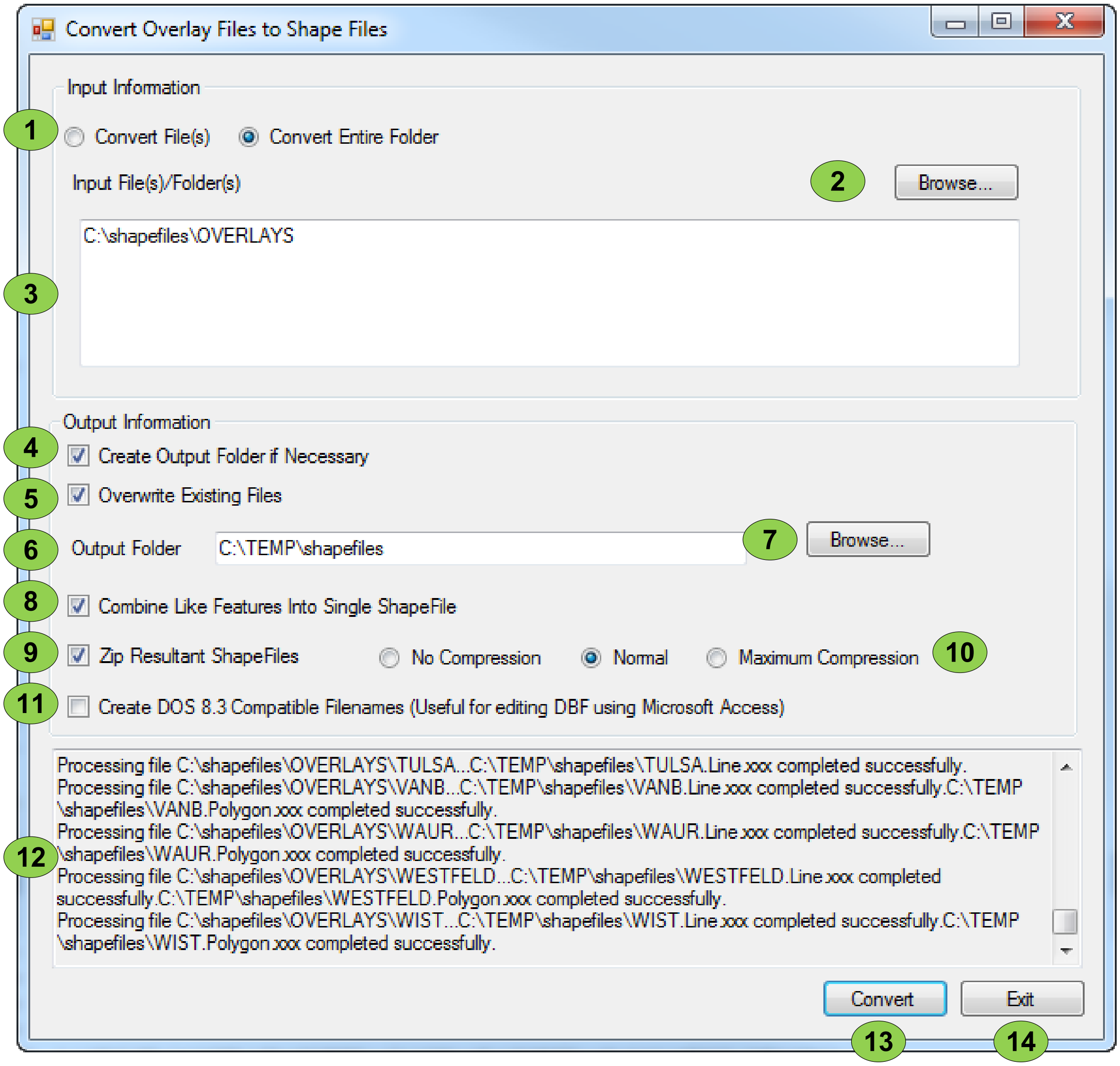


Figure 186 - Overlay files conversion utility dialog

Table 75 - Overlay files conversion utility dialog description

Item	Description
1	Select whether to convert individual overlay files or an entire directory of them. Do not worry if there are some files in the directory that are not overlays. A warning message will be issued but no harm done.
2	Brings up a standard file or directory browser depending on if files or folders are being selected.
3	The list of files or folders to process. Multiple entries are ok. All the resultant files will be written to the single output location though.
4	If the folder does not exist, it will be created.
5	If there are files in the output folder that match the ones this program has created they can either be left alone or replaced with the new files.
6	The location for the output files.
7	Find an appropriate folder for the output files.
8	If this box is selected, only 3 base shapefiles are created. One for Point types, one for Line types and one for Polygon types. If it is not selected, a different base shapefile is created for each attribute in the files, for example: a shapefile for reservoirs and another for rivers.
9	Zip the contents of the shapefiles. Especially if item 8 is not selected, one overlay file can result in dozens of shapefiles. HEC-MetVue can use the zip files directly so if these shapefiles are just being used by HEC-MetVue then they can be managed easier by zipping. A small amount of overhead occurs when HEC-MetVue is opened to unzip the files it needs.
10	The compression level to zip the files. Depending on the speed of the CPU and disk subsystems, the performance of these may be able to be improved.
11	By default this program does not care about the filename length. This is only an issue if one wishes to edit the resultant dbf files (part of a shapefile set) Programs like Microsoft Access cannot edit a DBF file that does not comply with the DOS 8,3 file format.
12	Output information regarding the conversion.
13	Convert the input files.
14	Exit.