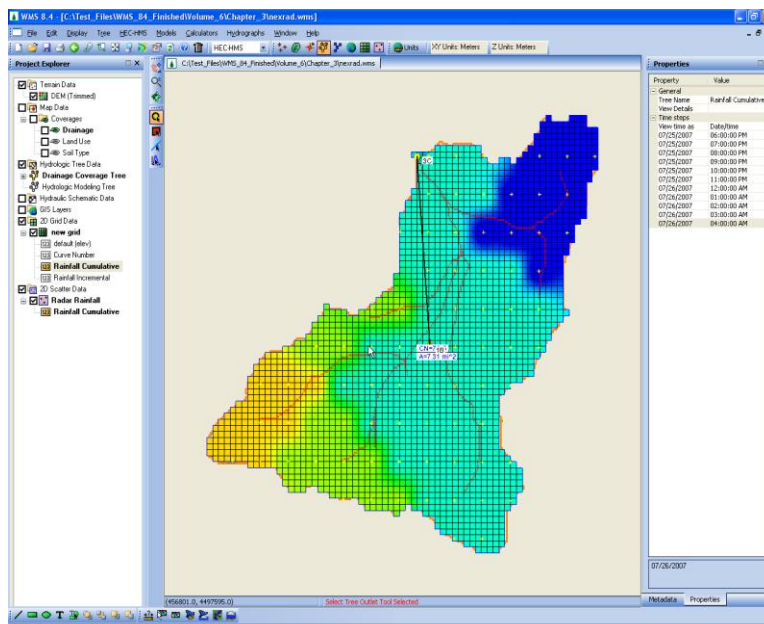


WMS 10.1 Tutorial

Spatial Hydrologic Modeling – Using NEXRAD Rainfall Data in an HEC-HMS (MODClark) Model

Learn how to setup a MODClark model using distributed rainfall data



Objectives

Read an existing WMS watershed model. Finish defining the model input parameters, then use NEXRAD (distributed radar rainfall) data for the model's precipitation. Compare the results from the NEXRAD precipitation with a non-distributed precipitation method.

Prerequisite Tutorials

- Spatial Hydrologic Modeling – HEC-HMS Distributed Parameter Modeling with the MODClark Transform

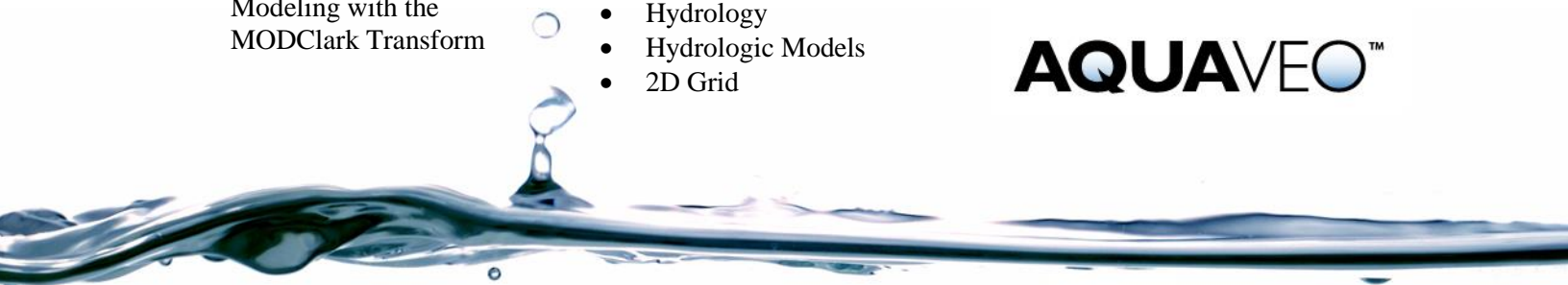
Required Components

- Data
- Drainage
- Map
- Hydrology
- Hydrologic Models
- 2D Grid

Time

- 30-60 minutes

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2 Introduction

In this tutorial see how the NEXRAD rainfall data can be used in an HEC-HMS MODClark model. Begin with an existing WMS project file with a watershed already delineated and build a MODClark model. Then use NEXRAD data for the precipitation. Also compare the results from NEXRAD gridded precipitation method and user hyetograph precipitation methods.

The data used for this tutorial can be downloaded from the WMS learning center of the Aquaveo web site and can be unzipped to a folder called *spatial* on the computer.

3 Open an Existing WMS Project



Open a WMS project file for Park City watershed and keep building on it.

1. Select **File / Open**.
2. Locate the **Hydrologic Models** folder in the files for this tutorial. If needed, download the tutorial files from www.aquaveo.com.
3. Browse and open the following file: `\spatial\HMS\NEXRAD BaseProj.wms`.
4. Save the project with a new name so that the original project remains unchanged. Select **File | Save As...** and save the file as `spatial\HMS\NEXRAD\nexrad.wms`.
5. Open the Hydrologic Modeling Wizard dialog by clicking the  button.
6. On the left side of the wizard dialog, click on the *Select Model* option as all other processes have been performed.
7. Select the model to be *HEC-HMS MODClark*.
8. Click on *Initialize Model Data*.
9. Click *Next* on the wizard.

10. Enter the cell size of 90.
11. Click on the *Create 2D Grid* button.
12. Click *OK* to interpolate background elevation from DEM.
13. Click *Next* on the wizard.
14. Set the job control data (07/25/2007, 6:00:00 PM to 07/26/2007, 6:00:00 PM). Set the time interval to be 15 min.
15. Click on the *Set Job Control Data* button.
16. Click *Next* on the wizard.

4 Creating Landuse and Soil type Coverages

Here create two coverages, read in soil and land use data, and map these data to WMS coverages.

1. Click on the *Open* button  next to *Add shapefile:* and open the file *spatial\RawData\ParkCity\Luse\salt_lake_city.shp*. The land use shape file is now added to the GIS Layers in the WMS Project Explorer.
2. Likewise, click on the *Open* button  next to *Add shapefile:* and open the file *spatial\RawData\ParkCity\SSURGO_Soil\Joinedsoil\ SSURGO_Soil.shp*. The soil type shape file is now added to the GIS Layers in the WMS Project Explorer.
3. In the wizard, click on the *Create Coverages...* button to create land use and soil coverages and map the corresponding shape file polygons to the respective coverages. Navigate through the attribute mapping dialogs by selecting *Next*, *Next*, and *Finish* in each dialog when prompted.
4. Click on *Next* in the modeling wizard.

5 Defining Model Parameters

1. Click the *Compute GIS Attributes* button which will open the Compute HMS Loss Method Attributes dialog.
2. Toggle on *SCS Curve Number*.
3. Make sure that the soil type and land use coverages are mapped correctly.
4. Click on the *Import* button. Browse and open the file *spatial\RawData\scsland.txt*.
5. Click *OK* to assign curve numbers to the grid from the land use and soil data defined in this dialog. Notice that the Curve Number grid has been added to the data tree under 2D Grid Data.

6. Click on the *Edit Parameters* button.
7. In the HMS Properties dialog, in the *Display options* portion of the dialog, select the following
 - Loss Rate Method
 - Gridded SCS Curve Number
 - Transform
 - MODClark
- Turning these options will add fields to the *Properties* area.
8. Set and/or fill in the following values in the rest of the fields:
 - Basin Area is computed by WMS
 - Make sure that the *Loss Rate Method* is *Gridded SCS Curve Number*
 - Initial Abstraction Ratio = 0.2
 - Potential Retention Scale Factor = 1.0
 - Transform Method = *MODClark*
9. Click on the *Compute...* button under basin data. In the Basin Time Computation dialog change *Computation type* to *Compute Lag Time* and *Method* to *SCS Method*.

Notice the variables required for the SCS lag time equation listed in the box at the bottom of the dialog. Although having computed a Curve Number grid, it's still necessary to enter a composite curve number value in the lag time equation

10. Check to make sure the *CN* variable in the Variables window is not 0.0. If it is, click on the *CN* variable in the Variables window, enter a CN value of 72.46 in the Variable value edit field to the right of the window, then click on any other variable in the Variables window so that the CN value gets updated.
11. Check to make sure there are no zero values among the Lag Time variables and click *OK*. See Figure 5-1.

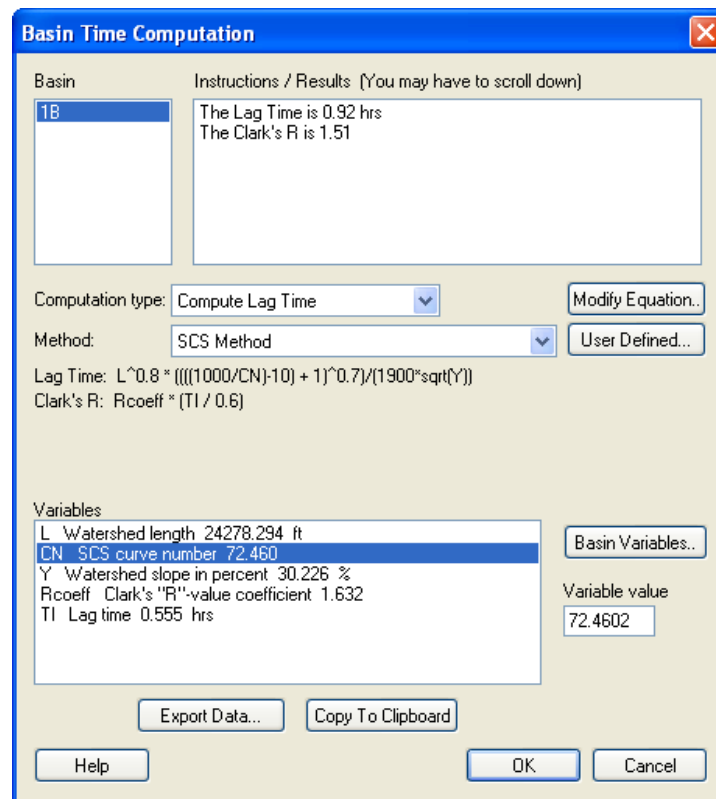


Figure 5-1: Lag Time Variables for Basin Time Computation

12. Scroll all the way to the right and make sure that the *Time of Concentration (hr)* and *Storage Coefficient (hr)* are calculated. WMS converts the lag time to a time of concentration using the SCS equation.
13. Click *OK*.
14. Click *Next*.

6 Defining Meteorological Data

So far in all of the models being used either uniform intensity rainfall or SCS storm. Here use NEXRAD RADAR rainfall data.

1. Click on the *Define Precipitation* button.
2. Select *Gridded Precipitation* for *Precipitation Method*.

Since there is not a DSS file for the precipitation grid, create it. First open the NEXRAD files and convert them to DSS.

3. Click on *Convert ASCII or XMRG files to DSS....*
4. In the Convert Grids dialog that opens, make sure that the conversion option is set to *Arc/Info ASCII Grid to DSS*.
5. Click the *Add Files...* button. Browse to *spatial\RawData\ParkCity\NEXRAD*.
6. In the Open file browser, change the view menu to *Details* (Figure 6-1).

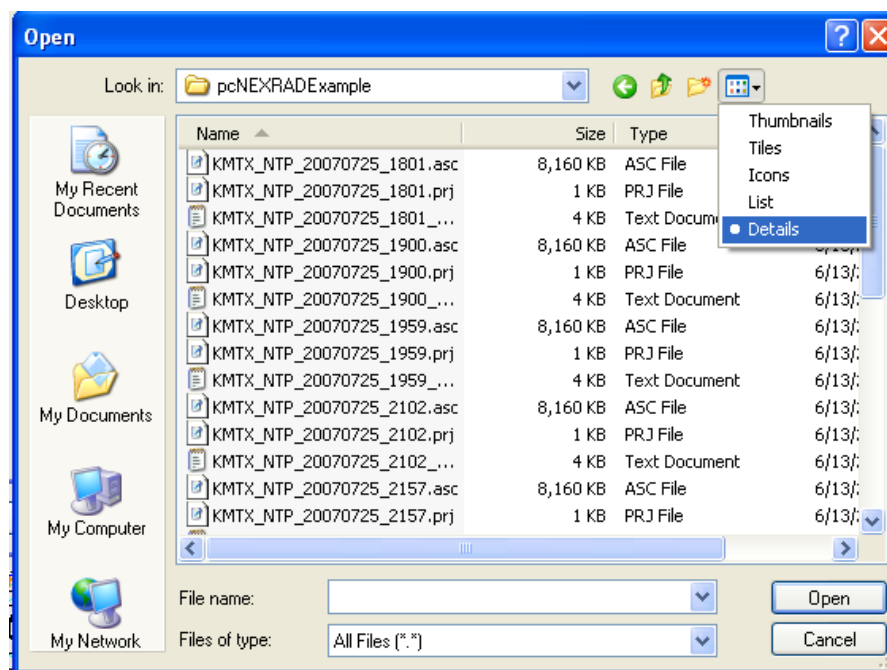


Figure 6-1: Change the view menu to Details

7. Click on the *Type* column label to sort the files by type.
8. Select the last time grid which is *KMTX_NTP_20070726_0358.asc* as shown in Figure 6-2.

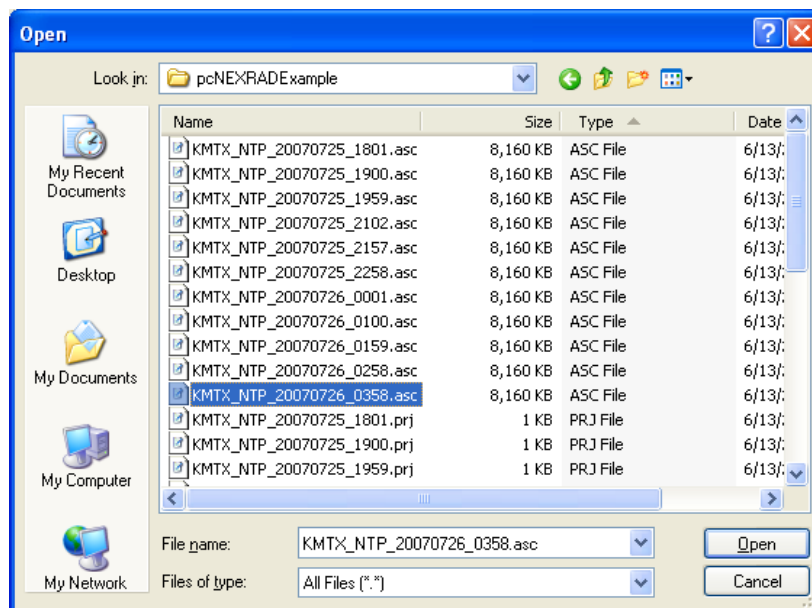


Figure 6-2: Select the last time grid first

9. Hold shift key and select first time grid which is *KMTX_NTP_20070725_1801.asc*. Click *Open*.

10. In the Convert Grids dialog, make sure the *Convert inches to millimeters* option is toggled *off* (Figure 6-3).

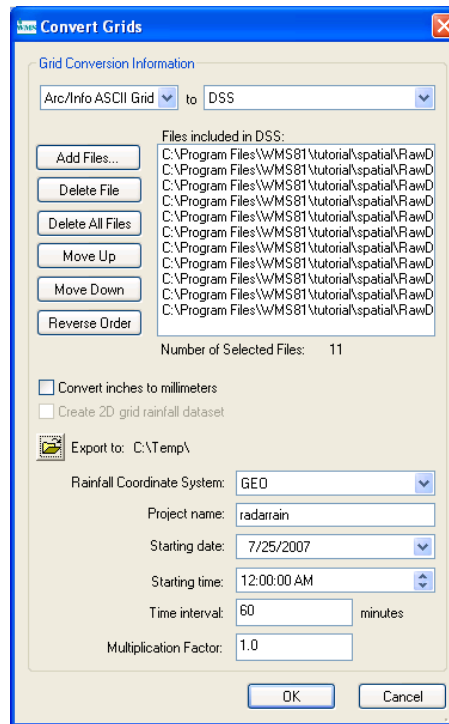



Figure 6-3: Convert Grids dialog

11. Click on the *Browse* button  and browse to the folder/file *spatial\HMS\NEXRAD\radarrain.dss* (use the folder where the data used in this tutorial is saved) and click *Save*. It is advisable to select a name that is different than the HMS file (selecting a different name will separate the gridded precipitation dss file from the project dss file and help keep the files organized).
12. Set the *Starting date* to 7/25/2007 and the *Starting time* to 6:00 PM. Make sure the time interval is set to 1 hour (60 min) and click *OK*.
13. After selecting *OK*, it will take some time to read and process the precipitation files and save the gridded DSS file.

For more information on how this process is carried out, see http://www.xmswiki.com/index.php?title=WMS:Radar_Rainfall

14. As soon as the saving process finishes, a prompt will appear to select a program to view a summary showing the date/time and rainfall depth at each time interval (Figure 6-4). Minimize this file—it is needed later on.

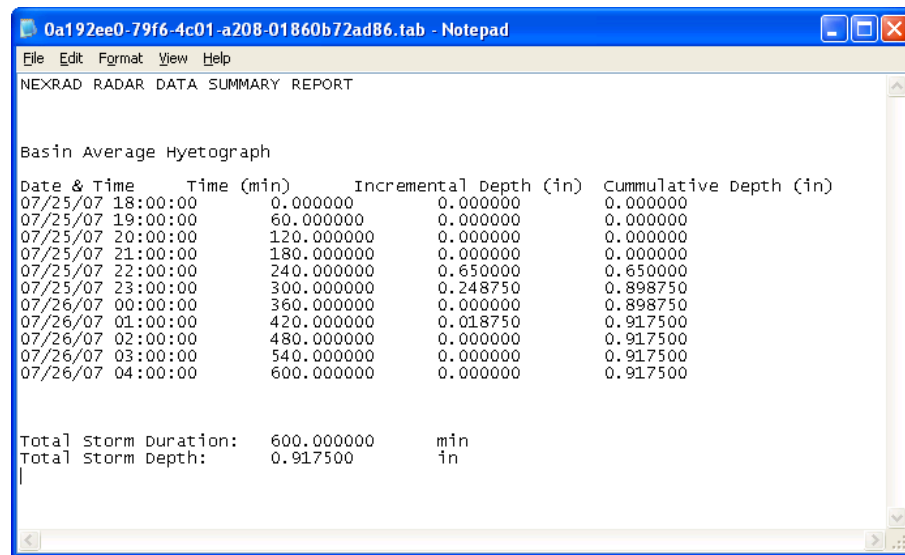


Figure 6-4: NEXRAD Radar Data summary report


15. Click *OK*.

7 Visualizing Meteorological Data

Before continuing, visualize the gridded rainfall data.

1. Select *Close* to close the wizard dialog.
2. Turn off the display of soil type and land use coverages as well as the GIS layers by un-checking them in the data tree. This will help zoom into the watershed area for better visualization.
3. Right-click on *Rainfall Cumulative* on the data tree under *2D Grid Data* and select *Contour Options...* Select *Color Fill* for the Contour Method. Click *OK*.
4. Click on *Rainfall Cumulative* on the data tree under *2D Grid Data* to make sure that it is active.
5. Select the first time step in the properties window and with the down arrow key on the keyboard, step through the time steps to see how the precipitation varies.



There are two rainfall datasets, one is incremental and the other is cumulative. View the incremental rainfall dataset in the same way the cumulative dataset was viewed. Choose either dataset for creating the film loop.

6. In the *2D Grid Module*  select **Data | Film Loop...** Specify the folder where to save the animation, toggle *off* the option to *Export to KMZ* (*Google Earth*) and click *Next*.
7. Under the option to *Write to AVI file*, make sure *Rainfall Cumulative* is checked and that the option to write to a KMZ file is turned off for all datasets. Turn *off* the option to *Write the 2D Scattered Dataset to a KMZ File*.

8. Click *Next*
9. Click *Finish*

WMS may take a few moments to create and save the animation file. The animation will start playing as soon as the saving process is complete. Try to visualize how rainfall is changing over the watershed over time. Now continue working with the model.

8 Saving the Model


1. Open the Hydrologic Modeling Wizard dialog again by clicking the  button.
2. Click *Clean Up Model* on the left side of the dialog.
3. Click on the *Clean Up Model* button. This button runs the operations that are toggled on.
4. Click *OK* to accept the default values for stream redistribution.
5. In the model checker, fix any errors that may be listed, then click *Done* to close the model checker.
6. Click *Close* to close the modeling wizard dialog.
7. Switch to the *Hydrologic Modeling Module*  and select **HEC-HMS / Save HMS file**.
8. Save the HMS file as *spatial\HMS\NEXRAD\wmsexport.hms*.

9 Running the Model

An HMS MODClark file has been successfully created for the Park City Watershed. Now work inside the HMS interface.

1. Minimize the WMS window and open HEC-HMS 3.1 or later.
2. Select **File / Open**. Browse and open *spatial\HMS\NEXRAD\wmsexport.hms*. If the .hms file is not saved properly, open it from *spatial\HMS\NEXRAD\finished\wmsexport.hms*.
3. Run the model (sometimes run the model twice for the results to be active).
4. View the results.

10 Using Rainfall Hyetograph and Running the Model Again

1. Return to WMS.
2. In *Hydrologic Modeling Module*  select **HEC-HMS / Meteorologic Parameters**.

3. Change Precipitation Method to *User Hyetograph* and click on *XY Series* button.
4. Open the summary file which was previously minimized and copy the distribution from the summary file to Excel.
5. Make sure that the incremental/cumulative depths are in inches (if not use conversion factor or 1 inch = 25.4mm to convert).
6. Copy and paste the time in minutes and the cumulative distribution into the XY series editor (NOTE: WMS will accept a temporal rainfall distribution that is either dimensional or dimensionless. If a dimensional distribution is entered, WMS will normalize the curve and make it dimensionless before applying the total rainfall depth to the distribution). Select *OK*.
7. Enter total rainfall depth (0.92 in. in this case).
8. Select *OK*.
9. Save the HMS project file.
10. Run HMS.
11. View the results and compare with the previous run.