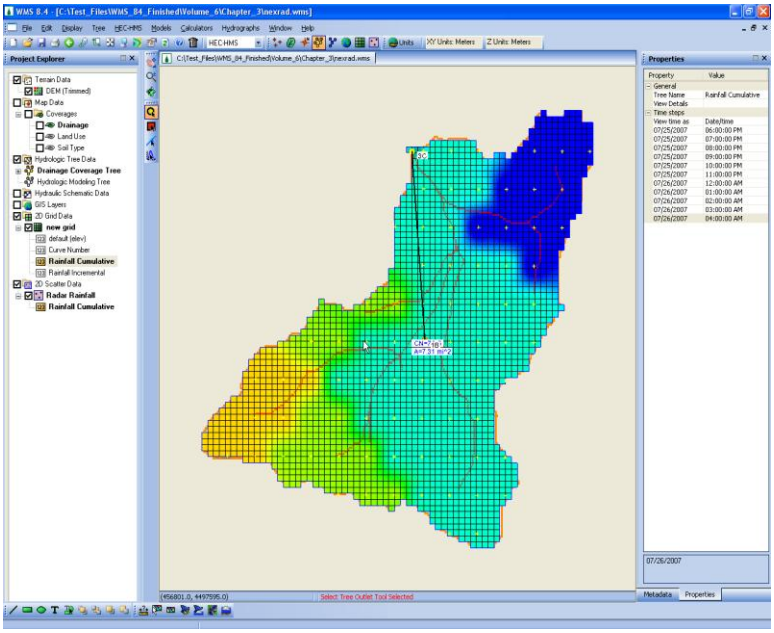
WMS

v. 9.0

WMS 9.0 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 we will see how the NEXRAD rainfall data can be used in an HEC-HMS MODClark model. We will begin with an existing WMS project file with a watershed already delineated and build a MODClark model. Then we will use NEXRAD data for the precipitation. We will 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 your computer.

3 Open an Existing WMS Project

Here we will 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 your tutorial files. If you have used default installation settings in WMS, the tutorial files will be located in ***\My documents\WMS 9.0\Tutorials\.***
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. Make sure that the projection system is correct. Select ***Edit | Current Projection…***

   Horizontal system: *UTM NAD 83*

   Zone: *12 (114 W - 108 W - Northern Hemisphere)*

   Units: *Meters*

   Vertical System: *NAVD 88(US)*

   Units: *Meters*

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6. Click *OK*.
7. Open the Hydrologic Modeling Wizard dialog by clicking the button.
8. On the left side of the wizard dialog, click on the *Select Model* option as we have already performed all other processes.
9. Select your model to be *HEC-HMS MODClark*.
10. Click on *Initialize Model Data*.
11. Click *Next* on the wizard.
12. Enter the cell size of 90.
13. Click on the *Create 2D Grid* button.
14. Click *OK* to interpolate background elevation from DEM.
15. Click *Next* on the wizard.
16. 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.
17. Click on the *Set Job Control Data* button.
18. Click *Next* on the wizard.

4 Creating Landuse and Soil type Coverages

Here we will 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.*** You should now see the land use shape file 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***. You should now see the soil type shape file 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 their respective coverages. You will need to 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.

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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.tbl***.
5. Click *OK* to assign curve numbers to the grid from the land use and soil data defined in this dialog. You should be able to see 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 you have computed a Curve Number grid, you still need 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.

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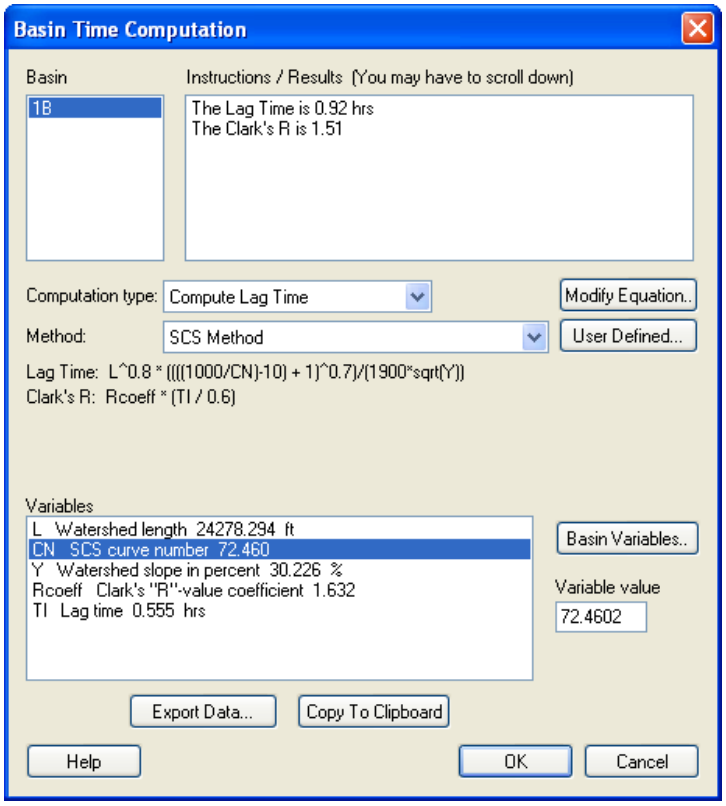

Figure 5-1: Lag Time Variables for Basin Time Computation

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 your models you have been using either uniform intensity rainfall or SCS storm. Here you will use NEXRAD RADAR rainfall data.

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

Since you do not have a DSS file for the precipitation grid, you need to create it. You will 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).

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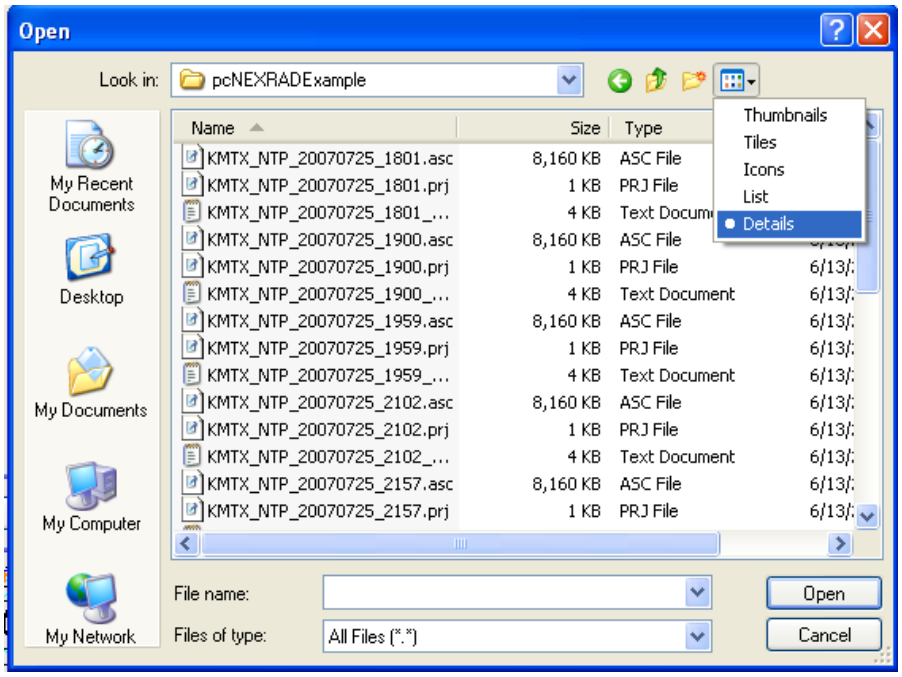

Figure 6-1: Change the view menu to Details

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.

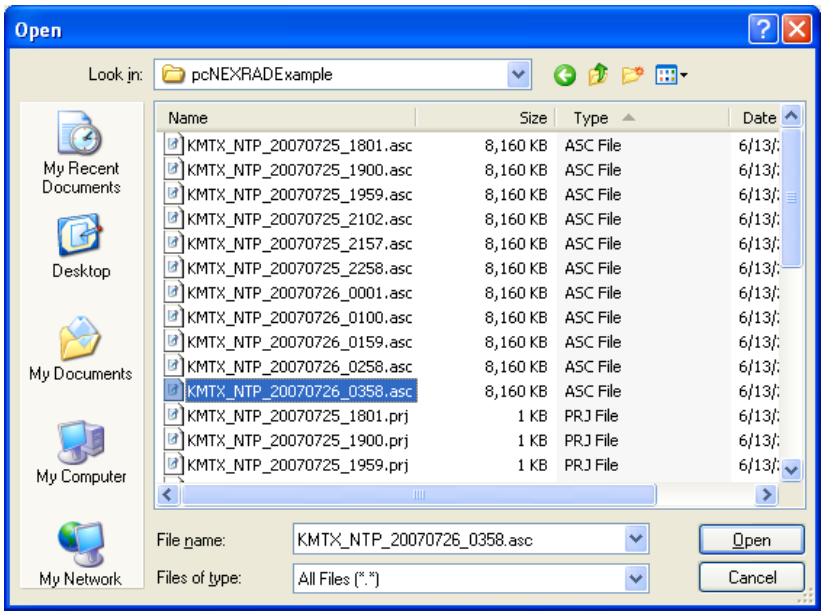

Figure 6-2: Select the last time grid first

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

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

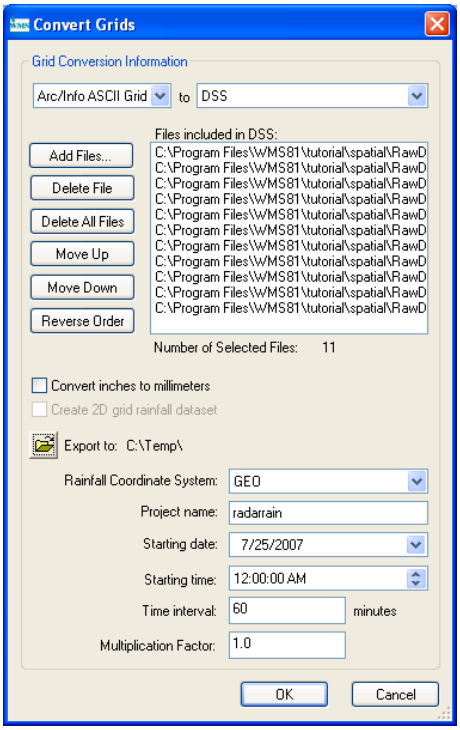

Figure 6-3: Convert Grids dialog

11. Click on the *Browse* button and browse to the folder/file ***spatial\HMS\NEXRAD\radarrain.dss*** (use the folder where you have saved the data used in this tutorial) and click *Save*. It is advisable to select a name that is different than the HMS file you will later save (selecting a different name will separate the gridded precipitation dss file from the project dss file and help keep your 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. You will see a few black DOS windows popping up at the end of the process.

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 completes, a summary file will open up showing the date/time and rainfall depth at each time interval (Figure 6-4). Minimize this file; you will need it later on.

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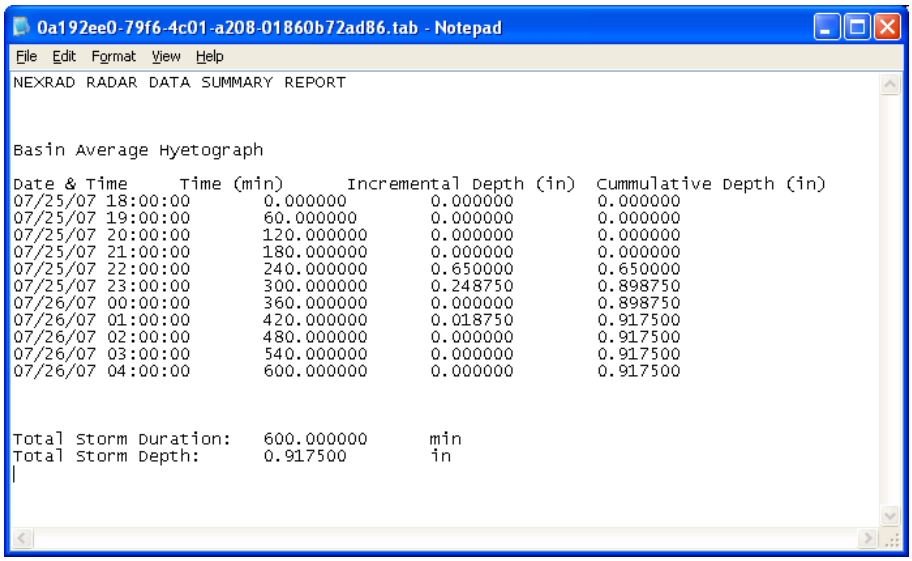

Figure 6-4: NEXRAD Radar Data summary report

15. Click *OK*.

7 Visualizing Meteorological Data

Before continuing, let us 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 you 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 your 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. You may choose to view the incremental rainfall data set in the same way you viewed the cumulative data set. You may choose either dataset for creating the film loop.

6. In the *2D Grid Module* select ***Data | Film Loop…*** Specify the folder where you want to have the animation saved, 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*.

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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. Let us 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

We have successfully created an HMS MODClark file for the Park City Watershed. Now we will 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 you do not have the .hms file saved properly, you may open it from ***\spatial\HMS\NEXRAD\finished \wmsexport.hms.***
3. Run the model (sometimes you must 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.***

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3. Change Precipitation Method to *User Hyetograph* and click on *XY Series* button.
4. Open the summary file which we had 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.

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