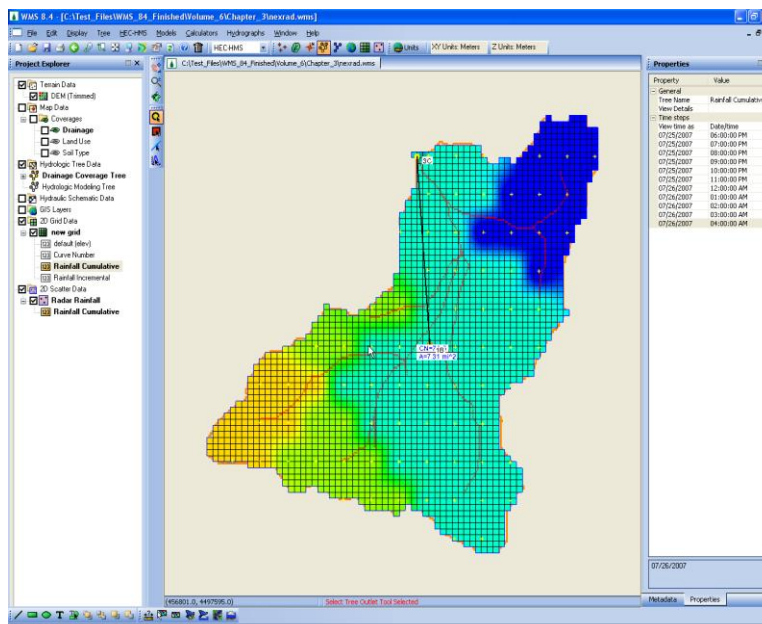


WMS 11.0 Tutorial Using NEXRAD Rainfall Data in an HEC-HMS (MODClark) Model

Learn how to setup a MODClark model using distributed rainfall data



Objectives

Using an existing WMS watershed model, this tutorial will cover using NEXRAD (distributed radar rainfall) data for the model's precipitation. The results from the NEXRAD precipitation will be compared with a non-distributed precipitation method.

Prerequisite Tutorials

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

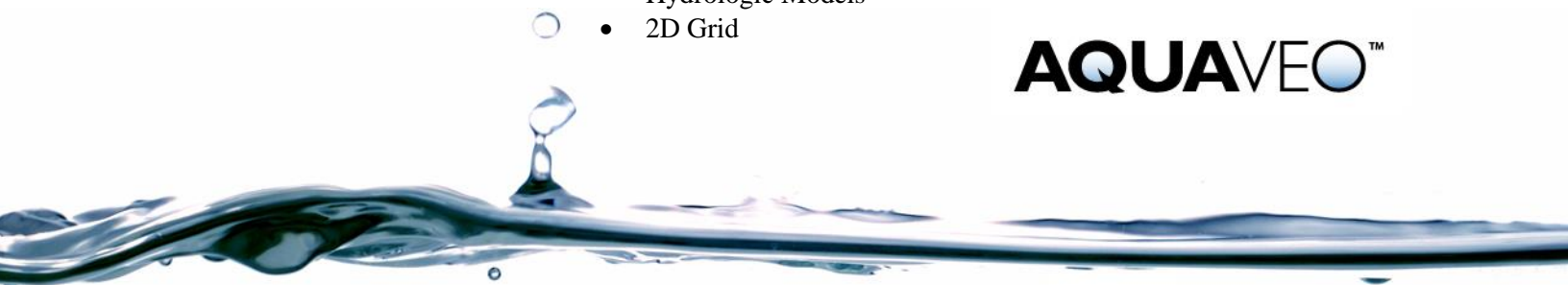
Required Components

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

Time

- 15–30 minutes

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|-----|--|---|
| 1 | Introduction | 2 |
| 2 | Open an Existing WMS Project | 2 |
| 3 | Using the Hydrologic Modeling Wizard | 3 |
| 3.1 | Creating Landuse and Soil type Coverages | 3 |
| 3.2 | Defining Model Parameters | 4 |
| 4 | Defining Meteorological Data | 5 |
| 5 | Visualizing Meteorological Data | 7 |
| 6 | Saving the Model | 8 |
| 7 | Running the Model | 8 |
| 8 | Using a Rainfall Hyetograph | 9 |
| 9 | Conclusion | 9 |

1 Introduction

In this tutorial NEXRAD rainfall data will be used in an HEC-HMS MODClark model. It starts with an existing WMS project file with a watershed already delineated. A MODClark model will be built. Then NEXRAD data will be added for the precipitation.

The data used for this tutorial can be downloaded from the WMS learning center on the Aquaveo web site.

2 Open an Existing WMS Project

Start with opening a WMS project file for the Park City watershed.

1. Select *File / Open* to bring up the *Open* dialog.
2. Locate the *data files* folder for this tutorial, and select the “BaseProj.wms” file.
3. Click **Open** to import the project.

Save the project with a new name so that the original project remains unchanged.

4. Select *File / Save As* to open the *Save As* dialog.
5. For the *File name* enter “nexrad.wms” and select **Save**.

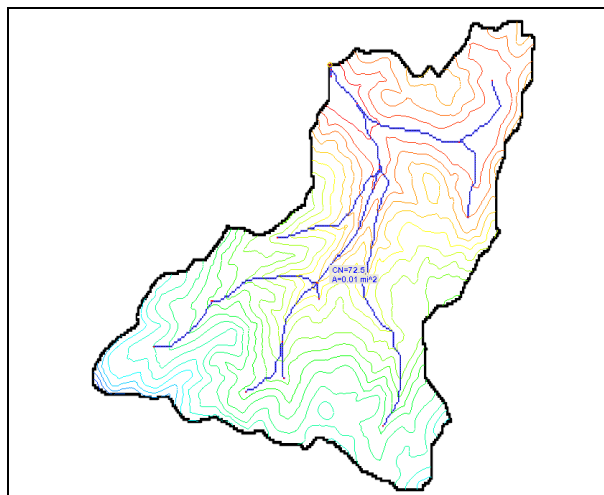



Figure 1 Initial project


3 Using the Hydrologic Modeling Wizard


Additions need to be made to the project before including the NEXRAD data.


1. Click the  macro, to open the *Hydrologic Modeling Wizard* dialog.
2. On the left side of the wizard dialog, click on the *Select Model* option as all other processes have been performed.
3. Set *Select the desired model* to “HEC-HMS MODClark”.
4. Click on **Initialize Model Data**.
5. Click **Next** to go to the *Create 2D Grid* section of the wizard.
6. Enter the *Cell size* of “90”.
7. Click on **Create 2D Grid** to open the *Background Elev Interpolation* dialog.
8. Click **OK** to interpolate background elevation from DEM.
9. Click **Next** to go to the *Job Control* section of the wizard.
10. Set the job control options to be:
 - a. *Starting date* to “07/25/2007”
 - b. *Starting time* to “6:00:00 PM”
 - c. *Ending date* to “07/26/2007”
 - d. *Ending time* to “6:00:00 PM”
 - e. *Time interval* to “15” min.
11. Click on **Set Job Control Data**.
12. Click **Next** to go to the *Define Land Use and Soil Data* section of the wizard.


3.1 Creating Landuse and Soil type Coverages

Now to 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* to bring up the *Select shapefile* dialog.
2. Select the file “salt_lake_city.shp”.
3. Click **Open** to close the *Select shapefile* dialog.

The land use shape file has now been added to the “ GIS Data” in the Project Explorer. Now to add the soil data:

1. Click on the **Open**  button next to *Add shapefile* to bring up the *Select shapefile* dialog.
2. Select the file “SSURGO_Soil.shp”.
3. Click **Open** to close the *Select shapefile* dialog.



The soil type shape file has now been added to the “ GIS Data” in the Project Explorer.

4. Click **Create Coverages** to open the *GIS to Feature Objects Wizard*.
5. Make certain the *Select a coverage for mapping* option is set to “Land Use” and that “salt_lake_city.shp” is selected under *Select shapfiles to map*.
6. Click **Next** to go to the Step 2 of the *GIS to Feature Objects Wizard*.
7. Click **Finish** to close and restart the *GIS to Feature Objects Wizard*.
8. Make certain the *Select a coverage for mapping* option is set to “Soil Type” and that “SSURGO.Soil.shp” is selected under *Select shapfiles to map*.
9. Click **Next** to go to the Step 2 of the *GIS to Feature Objects Wizard*.
10. Click **Finish** to close the *GIS to Feature Objects Wizard*.
11. Click **Next** to go to the *Hydrologic Computations* section of the wizard.

3.2 Defining Model Parameters

The model parameters will now be defined.

1. Click **Compute GIS Attributes** to open the *Compute HMS Loss Method Attributes* dialog.
2. Set *Grid Computation* to “SCS Curve Number”.
3. Make sure that the soil type and land use coverages are mapped correctly in the central section.
4. Click on **Import** to bring up an *Open* dialog. .
5. Select the file “scsland.txt” and click **Open**.
6. Click **OK** to close the *HMS Loss Method* dialog and assign curve numbers to the grid from the land use and soil data defined in this dialog.

Notice that a “ Curve Number” dataset has been added to the Project Explorer under “ 2D Grid Data”.

7. Click **Edit Parameters** to open the *HMS Properties* dialog.
8. In the *Display options* portion of the dialog, select the following:
 - a. *Loss Rate Method*
 - i. *Gridded SCS Curve Number*
 - b. *Transform*
 - i. *MODClark*

Turning on these options will add fields to the *Properties* area. Set and/or fill in the following values in the rest of the fields:

9. Make sure that the *Loss Rate Method* is “Gridded SCS Curve Number”.
10. *Initial Abstraction Ratio* is “0.2”.
11. *Potential Retention Scale Factor* is “1.0”.
12. *Transform Method* is “MODClark”.
13. Click **Compute** under *Basin Data* to open the *Basin Time Computation* dialog.

14. 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

15. Check to make sure the *CN* variable in the *Variables* window is not “0.0”.
 - a. 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.
16. Check to make sure there are no zero values among the lag time variables and click **OK** to close the *Basin Time Computation* dialog.
17. 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.

18. Click **OK** to close the *HMS Properties* dialog.
19. Click **Next** to go to the *Define Precipitation* section of the wizard.

4 Defining Meteorological Data

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

1. Click **Define Precipitation** to open the *HMS Meteorological Model* dialog.
2. For the *Precipitation Method*, select “Gridded Precipitation”.

Since there is not a DSS file for the precipitation grid it needs to be created. This will be done by opening the NEXRAD files and converting them to DSS.

3. Click **Convert ASCII or XMRG files to DSS** to open the *Convert Grids* dialog.
4. Make sure that the *Grid Conversion Information* option is set to “Arc/Info ASCII Grid” to “DSS”.
5. Click **Add Files** to open the *Select File(s)* dialog.
6. Browse to the *NEXRAD* folder in the *data files* folder for this tutorial.
7. Change the *View* menu to “Details” (Figure 4-1).

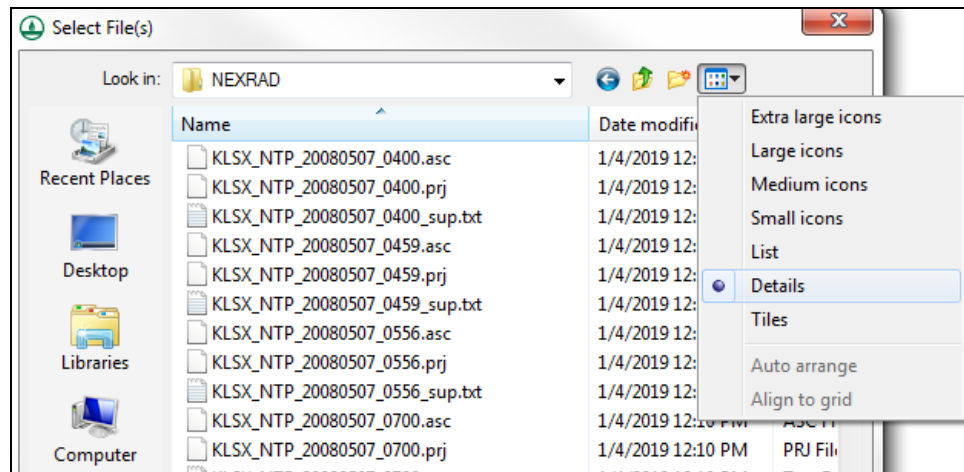



Figure 4-1: Change the view menu to Details

8. Click on the *Type* column label to sort the files by file type.
9. Select the last time grid which is “KMTX_NTP_20070726_0358.asc”.
10. Hold the *Shift* key and select starting time grid which is “KMTX_NTP_20070725_1801.asc”. All the files in between should be selected.
11. Click **Open** to close the *Select File(s)* dialog.
12. In the *Convert Grids* dialog, make sure the *Convert inches to millimeters* option is turned off.
13. Click the **Browse**  to open the *DSS Export File* dialog.
14. Enter “WMSexport.dss” for the *File Name* 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.

15. Change the *Starting date* to “07/25/2007” and the *Starting time* to “6:00:00 PM”.
16. Make sure that the time interval is “60” minutes (1 hour).
17. Click **OK** to close the *Convert Grids* dialog and save the grid file.

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

18. If the *View Data File* dialog appears, select a text editor and select **OK**.
19. View summary file showing the date/time and rainfall depth at each time interval (Figure 4-2).
20. Minimize this file—it is needed later on.

e4ba0edc-8ea8-4199-8542-e2ed506bb4fc.tab - Notepad

File Edit Format View Help

NEXRAD RADAR DATA SUMMARY REPORT

Basin Average Hyetograph

| Date & Time | Time (min) | Incremental Depth (in) | Cumulative Depth (in) |
|-------------------|------------|------------------------|-----------------------|
| 07/25/07 18:00:00 | 0.000000 | 0.000000 | 0.000000 |
| 07/25/07 19:00:00 | 60.000000 | 0.200000 | 0.200000 |
| 07/25/07 20:00:00 | 120.000000 | 0.153846 | 0.353846 |
| 07/25/07 21:00:00 | 180.000000 | 0.030769 | 0.384615 |
| 07/25/07 22:00:00 | 240.000000 | 0.629487 | 1.014103 |
| 07/25/07 23:00:00 | 300.000000 | 0.920513 | 1.934615 |
| 07/26/07 00:00:00 | 360.000000 | 0.920513 | 2.855128 |
| 07/26/07 01:00:00 | 420.000000 | 0.943590 | 3.798718 |
| 07/26/07 02:00:00 | 480.000000 | 0.943590 | 4.742308 |
| 07/26/07 03:00:00 | 540.000000 | 0.943590 | 5.685897 |
| 07/26/07 04:00:00 | 600.000000 | 0.943590 | 6.629487 |

Total Storm Duration: 600.000000 min
Total Storm Depth: 6.629487 in

Figure 4-2: NEXRAD Radar Data summary report

20. Click **OK** to close the *HMS Meteorologic Model* dialog.

5 Visualizing Meteorological Data

Before continuing, visualize the gridded rainfall data.

1. Select **Close** to exit the *Hydrologic Modeling Wizard* dialog.
2. In the Project Explorer, turn off the display of the “ Soil Type” and “ Land Use” coverages, as well as the “ GIS Data” folder.
3. **Zoom** into the watershed area for better visualization.
4. Right-click on “ Rainfall Cumulative” in the Project Explorer under “ 2D Grid Data” and select **Contour Options** to open the *Rainfall Cumulative Contour Options* dialog.
5. Select “Color Fill” for the *Contour Method*.
6. Click **OK** to close the *Rainfall Cumulative Contour Options* dialog.
7. 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.

8. Repeat step 4–7 to view “ Rainfall Incremental” dataset in the same way the cumulative dataset was viewed.
9. Make either “ Rainfall Cumulative” or “ Rainfall Incremental” active to create the film loop.
10. Make the **2D Grid Module** active.
11. Select *Data / Film Loop* to start the *Film Loop Setup* wizard.

12. Specify the folder where to save the animation, check off the option to *Export to KMZ (Google Earth)*.
13. Click **Next** to go to the *Time Step Options* section of the wizard.
14. 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.
15. Turn off the option to *Write the 2D Scattered Dataset to a KMZ File*.
16. Click **Next** to go to the *Display Options* section of the wizard.
17. Click **Finish** to close the *Film Loop Setup* wizard and generate the animation.



It 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.

18. When done viewing the animation, close the *Play AVI Application*.

Now continue working with the model.

6 Saving the Model

Now to clean up and save the model with the NEXRAD rainfall data.

1. Open the *Hydrologic Modeling Wizard* dialog again by clicking the  macro.
2. Click *Clean Up Model* on the left side of the dialog.
3. Click **Clean Up Model** to run the operations that are turned on and bring up the *Redistribute Vertices* dialog.
4. Accept the default values for stream redistribution and click OK to close the *Redistribute Vertices* dialog and open the *HEC-HMS Model Check* dialog.
5. Fix any errors that may be listed, then click **Done** to close the *HEC-HMS Model Check* dialog.
6. Select **Close** to exit the *Hydrologic Modeling Wizard* dialog.
7. Switch to the **Hydrologic Modeling Module** .
8. Select *HEC-HMS / Save HMS File* to open the *Save HMS File* dialog.
9. Enter “wmsexport.hms” as the *File name* and click **Save** to finish saving the project.

7 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 3.5 or later.
2. In HEC-HMS, select *File / Open* to bring up the *Open an Existing Project* dialog.
3. Select **Browse** to bring up the *Select Project File* dialog.

4. Locate the “wmsexport.hms” that was created in WMS and click **Select** to import the project.
5. In the HEC-HMS Project Explorer, select to the *Compute* tab.
6. Expand the folders and select the “Run 1” item.
7. Select *Compute* | **Compute Run1**.
8. Click **Close** when the model finishes running.
9. If desired, review the results in HEC-HMS.

8 Using a Rainfall Hyetograph

1. Return to WMS.
2. Select *HEC-HMS / Meteorologic Parameters* to open the *HMS Meteorological Model* dialog.
3. Change the *Precipitation Method* to “User Hyetograph”.
4. Click on the **XY Series** button to open the *XY Series Editor*.
5. Open the summary file which was previously minimized and copy the distribution from the summary file to Excel or another spreadsheet program.
6. Make sure that the incremental/cumulative depths are in inches (if not use conversion factor or 1 inch = 25.4mm to convert).
7. 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.

8. Select **OK** to close the *XY Series Editor*.
9. For the rainfall *Total Depth* enter “0.92” inches.
10. Select **OK** to close the *HMS Meteorological Model* dialog.
11. Select *HEC-HMS / Save HMS File* to open the *Save HMS File* dialog.
12. Enter “wmsexport2.hms” as the *File name* and click **Save** to finish saving the project.
13. Return to HEC-HMS to run the model and review the results.

9 Conclusion

This concludes the “Using NEXRAD Rainfall Data in an HEC-HMS (MODClark) Model” tutorial.