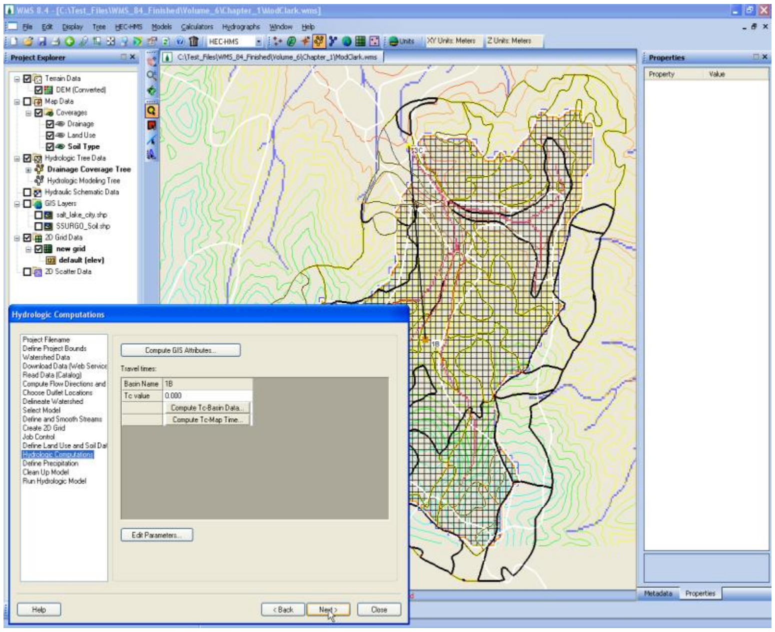
v. 9.0

WMS 9.0 Tutorial

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

Setup a basic distributed MODClark model using the WMS interface



Objectives

In this tutorial, you learn how to setup a MODClark model using the hydrologic modeling wizard. You delineate a watershed, create a grid from the delineated watershed, and compute watershed geometric and hydrologic parameters from geometric, land use, and soil data. Then you run the MODClark model in HMS to obtain a hydrograph.

Prerequisite Tutorials

- Watershed Modeling – DEM Delineation

Required Components

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

Time

- 30-60 minutes

1 Contents

2 Introduction

In this tutorial we will see how a HEC-HMS model with the MODClark transform can be developed using the WMS interface. MODClark is a distributed transform method based on dividing the watershed into small grid cells of equal size and determining runoff from each of the grid cells.

The study site for this tutorial is Park City, Utah. 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 Watershed Delineation using the Hydrologic Modeling Wizard

In the following steps, you will use the *Hydrologic Modeling Wizard* to delineate the watershed. This will make you more familiar and comfortable using the wizard. The steps through the wizard are outlined briefly here.

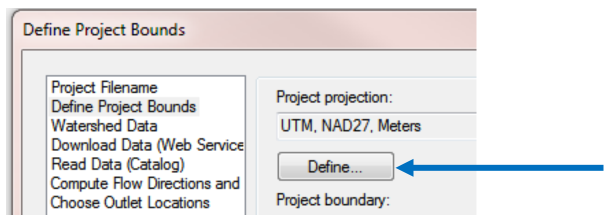
3.1 Project Filename

1. Close all instances of WMS
2. Open WMS

3. Click on the *Hydrologic Modeling Wizard* button at the bottom of the WMS window
4. Click on the *Browse* button to specify the path location and set a file name for the project
5. 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\.***
6. Browse to the ***\spatial\WMS*** directory
7. For the File name enter *"MODClark.wms"* and click *Save*
8. Click on the *Save* button in the Hydrologic Modeling Wizard
9. Click *Next >* to advance to the next step

3.2 Define Project Bounds

1. Under Project projection, select *Define…*



2. Select the *Global Projection* option
3. In the Select Projection dialog set:
   - Projection to *UTM*
   - Datum to *NAD83*
   - Planar Units to *METERS*
   - Zone to *12 (114°W - 108°W – Northern Hemisphere)*
4. Select *OK*
5. Set the Vertical Projection to *NAVD 88 (US)*
6. Set the Vertical Units to *Meters*
7. Select *OK*
8. Click *Next >* to advance to the next step

3.3 Watershed Data by Reading Files

1. Select the *Open file(s) only* option
2. Click on the ***File | Open*** button
3. Locate the folder ***spatial\ RawData\ParkCity*** (all file folders referenced below are relative to this location)
4. In the ***DEM*** file folder open *"ned_35172081.hdr"*

5. Select *OK* to import the NED GridFloat DEM

WMS reads the projection data that comes with the DEM and converts the DEM coordinates to the project projection system specified in section 3.2.

6. Click on the ***File | Open*** button
7. In the ***Luse***\\ file folder open *"salt_lake_city.shp"*
8. Click on the ***File | Open*** button
9. In the ***SSURGO_Soil\Joinedsoil***\\ folder open "*SSURGO_Soil.shp"*
10. Turn off the display of all *GIS Layers* in the Project Explorer

Now you should be able to see the DEM contours behind the modeling wizard in the WMS main window.

11. Make sure the *Use web services* and the *Use a catalog file* options are turned off in the hydrologic modeling wizard.
12. Click *Next* > to advance to the next step.

3.4 Compute Flow Directions and Accumulations

1. Set the computational units for sub-basin areas to *Square Miles*
2. Set the computational units for distances to *Feet*
3. Select *Compute TOPAZ*

TOPAZ uses the DEM data to compute flow directions and accumulations, which are used to infer the stream locations.

4. Click *Close* when TOPAZ terminates
5. Set the Min flow accumulation threshold to 0.2 mi^2
6. Click on the *Apply to Display* button
7. Click *Next* > to advance to the next step

3.5 Choose Outlet Location

1. Choose the *Create Outlet Point* tool in the Hydrologic Modeling Wizard
2. Click on the outlet location in the WMS graphics window as shown in the image to the right as a guide (you can use the middle scroll button of mouse to zoom in or out)

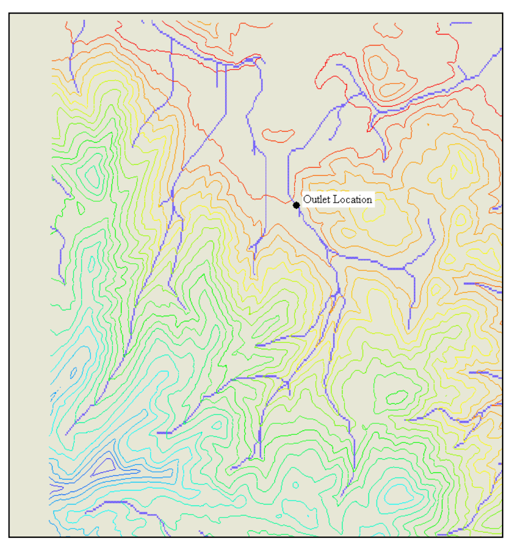


Figure 3-1: Outlet location for Park City watershed

3. Click *Next >* to advance to the next step

3.6 Delineate Watershed

1. Make sure that the Stream threshold value is 0.2 mi^2
2. Click on the *Delineate Watershed* button
3. Save your WMS project by selecting ***File* | *Save*** in the main WMS window
4. Click *Next >* to advance to the next step

4 Setup Gridded HEC-HMS Model

4.1 Select Model

1. Set the model to be *HEC-HMS ModClark*
2. Click on the *Initialize Model Data* button
3. Click *Next >* to advance to the next step

4.2 Create 2D Grid

1. Make sure that the *Enter cell size* option is selected
2. For the X-dimension enter a cell size of 90 meters (the Y-dimension is automatically set to the same value as the X-dimension)
3. Click on the *Create 2D Grid* button
4. Select *OK* to interpolate elevations for each grid cell from the background DEM
5. Click *Next >* to advance to the next step

4.3 Job Control

1. Set the Starting date to 01/01/2008
2. Set the Starting time to 12:00:00 PM
3. Set the Ending date to 01/03/2008
4. Set the Ending time to 12:00:00 PM
5. Set the Time interval to 15 min
6. Click on the *Set Job Control Data* button
7. Click *Next >* to advance to the next step

5 Hydrologic Input Parameters

5.1 Define Land Use and Soil Data

Since you have already read land use and soil shapefiles, you are ready to convert these to feature data that can be used for computing hydrologic model input parameters.

1. Verify that *“salt_lake_city.shp”* is set to a *Land Use* shapefile type.
2. Make sure that *“SSURGO_Soil.shp”* is set to a *Soil Type* shapefile type.
3. Click on the *Create Coverages…* button
4. Select *Next* > in the GIS to Feature Objects Wizard

Notice that WMS automatically set the LUCODE in the shapefile to be mapped to the Land use parameter in WMS.

5. Select *Next >*
6. Select *Finish*
7. Repeat the same mapping process for the soil shapefile

WMS maps HYDGRP to SCS soil type, TEXTURE to Texture, KSAT to Hydraulic conductivity, MOISTURE to Initial moisture, FIELDCAP to Field capacity, and WILTINGPT to Wilting point.

8. Click *Next* > in the Hydrologic Modeling Wizard to advance to the next step

5.2 Hydrologic Computations

1. Click on the *Compute GIS Attributes…* button
2. For Grid Computation choose *SCS Curve Number*
3. Click on the *Import* button to import the mapping table file
4. In the ***spatial\RawData*** folder open *“scsland.tbl”*
5. Select *OK*

A curve number (CN) is computed for each grid cell by overlaying the 2D grid with the land use and soil polygons.

6. Click on the *Edit Parameters…* button to open the HMS Properties dialog
7. In the Display options portion of the dialog, toggle on the following:
    - *Loss Rate Method*
        - *Gridded SCS Curve Number*
    - *Transform*
        - *ModClark*

Turning on these options adds the appropriate fields to the Properties section of the dialog. Some of the properties have already been calculated by WMS.

8. Set/enter values for the following properties (columns):
    - Area (mi^2): Computed by WMS
    - Loss Rate Method: *Gridded SCS Curve Number*
    - Initial abstraction ratio: 0.2
    - Potential Retention Scale Factor: 1.0
    - Transform Method: *ModClark*
9. In the Basin Data column after the Transform Method click on the *Compute…* button
10. In the Basin Time Computation dialog change Computation type to *Compute Lag Time*
11. Set the Method to *SCS Method*
12. In the Variables window at the bottom of the dialog highlight the "CN SCS curve number 0.000" line of text as shown in Figure 5-1

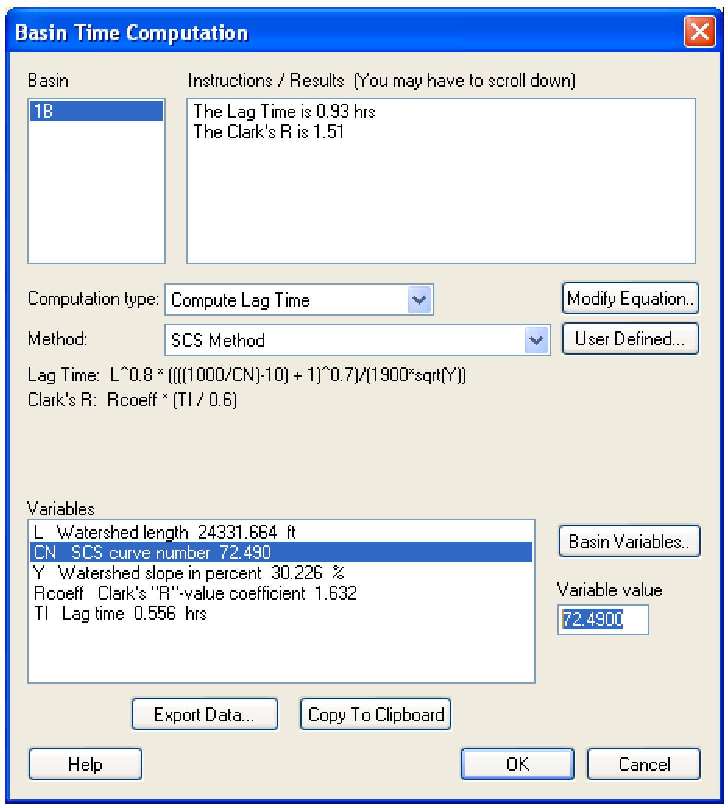


Figure 5-1: Lag time computation

13. For the Variable value enter 72.49
14. Click on another line of text to see the CN value and lag time values updated in the list
15. Select *OK*

Scroll all the way to the right and make sure that the time of concentration and storage coefficient were calculated and entered appropriately.

16. Select *OK* in the HMS Properties dialog
17. Click *Next >* in the Hydrologic Modeling Wizard to advance to the next step

6 Define Precipitation

1. Click on the *Define Precipitation…* button to open the HMS Meteorological Model dialog
2. Set the Precipitation Method to *User Hyetograph*
3. Click on the *XY Series…* button to define the temporal distribution of the rainfall
4. Set the Selected Curve to *TypeI-24hour* as shown in Figure 6-1

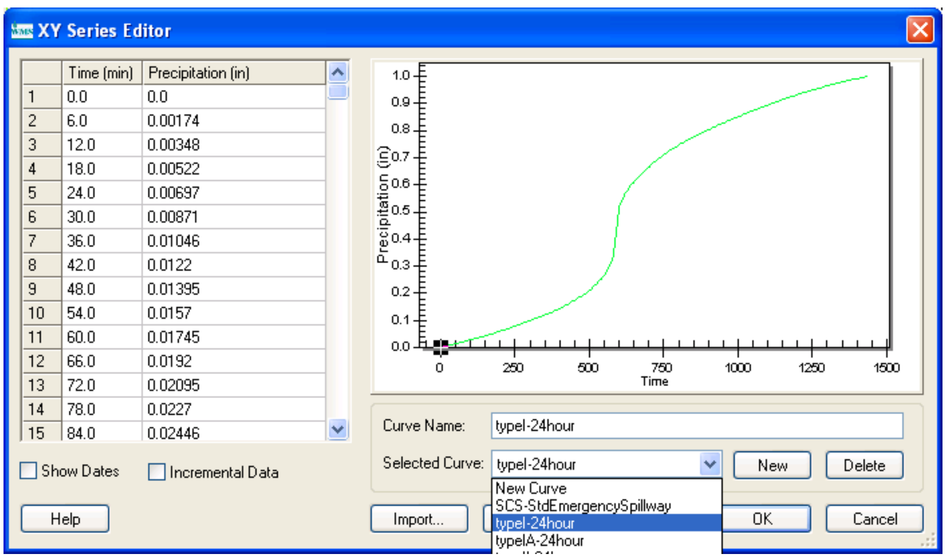


Figure 6-1: XY Series Editor for precipitation

5. Select *OK* to close the XY Series Editor
6. In the Total Depth (in) column enter 3.5 inches
7. Select *OK*
8. Click *Next >* to advance to the next step

7 Clean Up Model

1. Click on the *Clean up Model* button
2. In the Redistribute Vertices dialog that appears, enter a vertex Spacing of 80 meters
3. Toggle ON the option to *Use Cubic Spline*

4. Select *OK*
5. When the model checker appears, fix any errors that appear
6. Select *Done* to close model checker
7. Click the *Save* button to save the WMS project file
8. Select *Close* to close the Hydrologic Modeling Wizard
9. Select ***HEC-HMS | Save HMS File****…*
10. Locate the folder ***spatial\HMS***
11. For File name enter *"MODClark.hms"* and click *Save*

You will see several black DOS windows pop up while saving the HEC-HMS input file. This is part of writing the gridded rainfall and CN DSS files. This is a normal part of saving your HMS project. It may take few minutes to save the project. If you do not see DOS windows popping up, then your HMS file is not saving correctly. Check the input data and make sure you have correctly followed all the steps in this tutorial.

8 Run HEC-HMS

We have successfully created the HEC-HMS input files needed to run a MODClark simulation on the Park City watershed. Now we will run HEC-HMS.

1. Open HEC-HMS 3.1.0 or a later version from the Start Menu
2. Select ***File | Open…***
3. Open the HEC-HMS file you just created (***spatial\HMS\MODClark.hms***)
4. Select ***Compute | Select Run | Run 1***
5. Select ***Compute | Compute Run [Run 1]***
6. Select *Close* when HEC-HMS is finished computing
7. Click on the *Results* tab
8. Expand the Simulation Runs folder
9. Select Run 1 to view results
10. Select basin 1B
11. Select Graph
12. Your outflow hydrograph should look similar to Figure 8-1

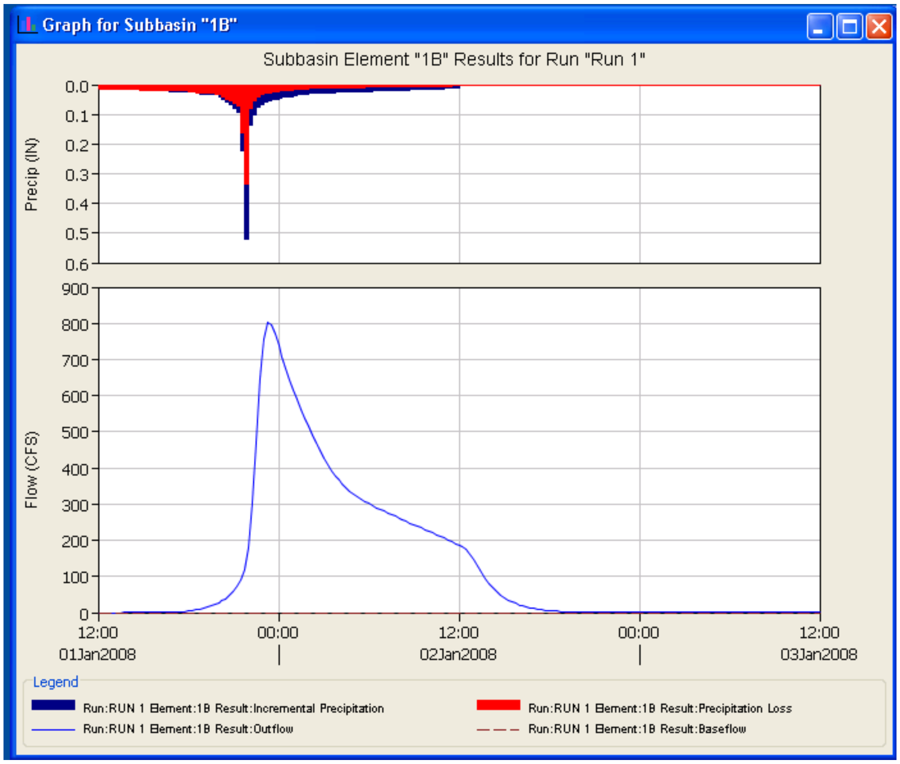


Figure 8-1: HMS Output Window

9 Conclusion

In this exercise you learned how to compute gridded hydrologic model parameters required for a HEC-HMS model with the MODClark transform.