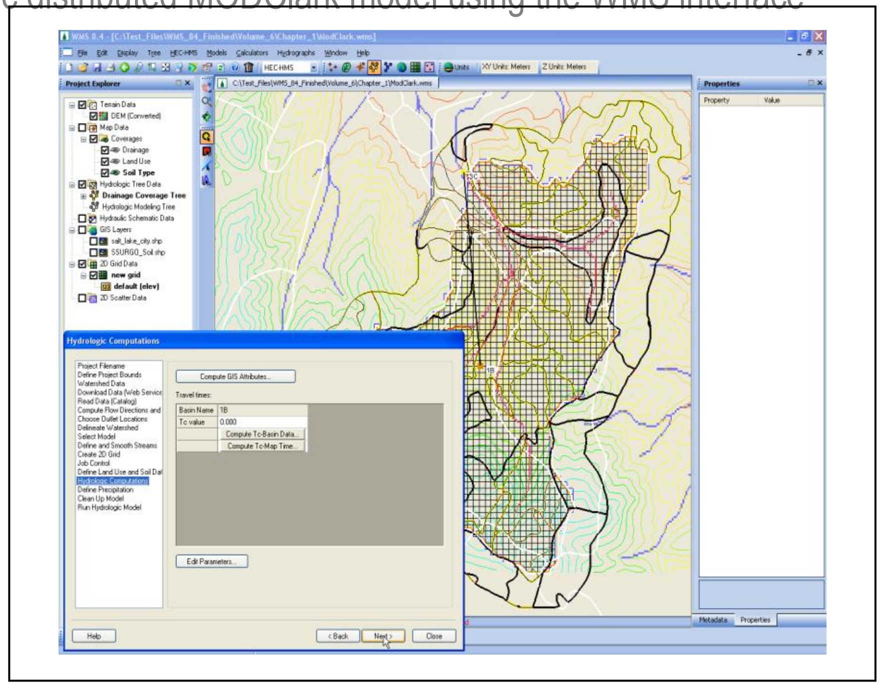
WMS

v. 10.1

WMS 10.1 Tutorial

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

Setup a basic distributed MODClark model using the WMS interface



Objectives

This tutorial covers how to setup a MODClark model using the hydrologic modeling wizard. It start with delineating a watershed, creating a grid from the delineated watershed, and computing watershed geometric and hydrologic parameters from geometric, land use, and soil data. Then it covers running 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

AQUAVEO™

1 Introduction

This tutorial shows 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 the computer.

2 Watershed Delineation using the Hydrologic Modeling Wizard

In the following steps, use the *Hydrologic Modeling Wizard* to delineate the watershed. The steps through the wizard are outlined briefly here.

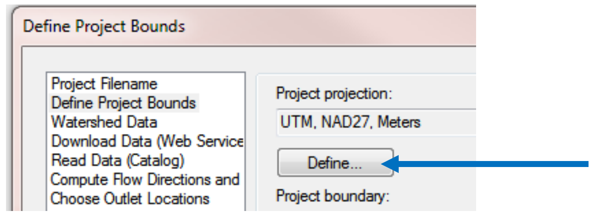
2.1 Project Filename

1. Open WMS. If WMS is already open select *File* **| New** then click **No** if asked to save changes.
2. Click on the **Hydrologic Modeling Wizard** button at the top of the WMS window. The *Project Filename* dialog will open.
3. Click on the **Browse** button to specify the path location and set a file name for the project.
4. Locate the "spatial" folder in the files for this tutorial. If needed, download the tutorial files from www.aquaveo.com.
5. Open the "WMS" folder in the directory.
6. For the *File name* enter "MODClark.wms" and click **Save**.

7. Click on the **Save** button in the *Hydrologic Modeling Wizard*.
8. Click **Next** to advance to the next step.

2.2 Define Project Bounds

1. Under *Project projection*, select **Define…**



2. Select the *Global Projection* option in the *Display Projection* dialog.
3. Click **Set Projection** to open the *Select Projection* dialog.
4. 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)"
5. Select **OK**.
6. Set the *Vertical Projection* to "NAVD 88 (US)".
7. Set the *Vertical Units* to "Meters".
8. Select **OK**.
9. Click **Next** to advance to the next step.

2.3 Watershed Data by Reading Files

1. Click on the **Open file(s)** button to access the *Open* dialog.
2. Locate the folder "spatial\RawData\ParkCity\" (all file folders referenced below are relative to this location).
3. In the "\DEM\" file folder open "ned_35172081.hdr".
4. Select **OK** in the *Importing NED GridFloat File* dialog.

WMS reads the projection data that comes with the DEM and converts the DEM coordinates to the project projection system specified in section 2.2.

5. Click on the *File* | **Open** button in the main WMS window (not the **Open file(s)** button in the Wizard) to access the *Open* dialog.
6. In the "\Luse\" file folder open "salt_lake_city.shp".
7. Click on the *File* | **Open** button to access the *Open* dialog.
8. In the "\SSURGO_Soil\Joinedsoil\" folder open "SSURGO_Soil.shp".
9. Turn off the display of all "GIS Data" in the Project Explorer.

Now the DEM contours should be visible behind the modeling wizard in the WMS main window. Clicking the **Frame** macro will resize and center the contours.

10. Make sure the *Use web services* and the *Use a catalog file* options are turned off in the *Hydrologic Modeling Wizard*.
11. Click **Next** to advance to the next step.

2.4 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 to exit the *Model Wrapper*.
5. Set the *Min flow accumulation* threshold to “0.2” mi^2.
6. Click on the **Apply to Display** button. Streams should appear on the contours behind the window.
7. Click **Next** to advance to the next step.

2.5 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 Figure 1 (use the middle scroll button of mouse to zoom in or out).

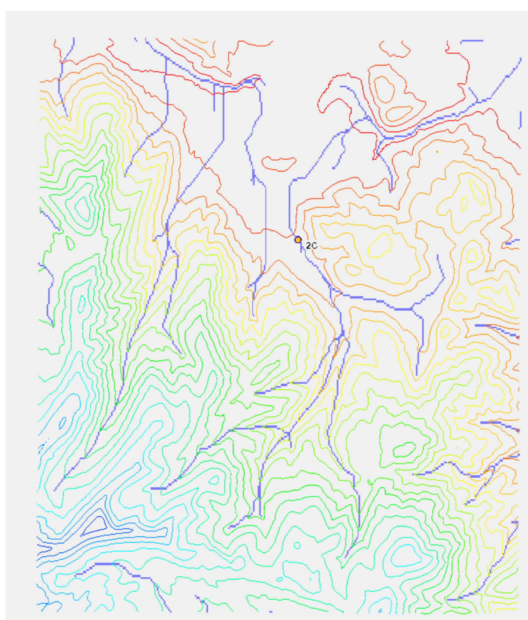


Figure 1 Outlet location (2c)

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

2.6 Delineate Watershed

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

3 Setup Gridded HEC-HMS Model

3.1 Select Model

1. Set the model to be “HEC-HMS ModClark” in the *Hydrologic Modeling Wizard*.
2. Click on the **Initialize Model Data** button.
3. Click **Next** to advance to the next step.

3.2 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 in the *Background Elev Interpolation* dialog.
5. Click **Next** to advance to the next step.

3.3 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.

4 Hydrologic Input Parameters

4.1 Define Land Use and Soil Data

Since land use and soil shapefiles have been imported already, 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 (steps 4-6) 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.

4.2 Hydrologic Computations

1. Click on the **Compute GIS Attributes…** button. The *Compute HMS Loss Method Attributes* dialog will appear.
2. For *Grid Computation* choose "SCS Curve Number".
3. Click on the **Import** button to import the mapping table file, the *Open* dialog will appear.
4. In the "spatial\RawData\" folder open "scsland.txt".
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 (scroll down to see all these options):
    - 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 .

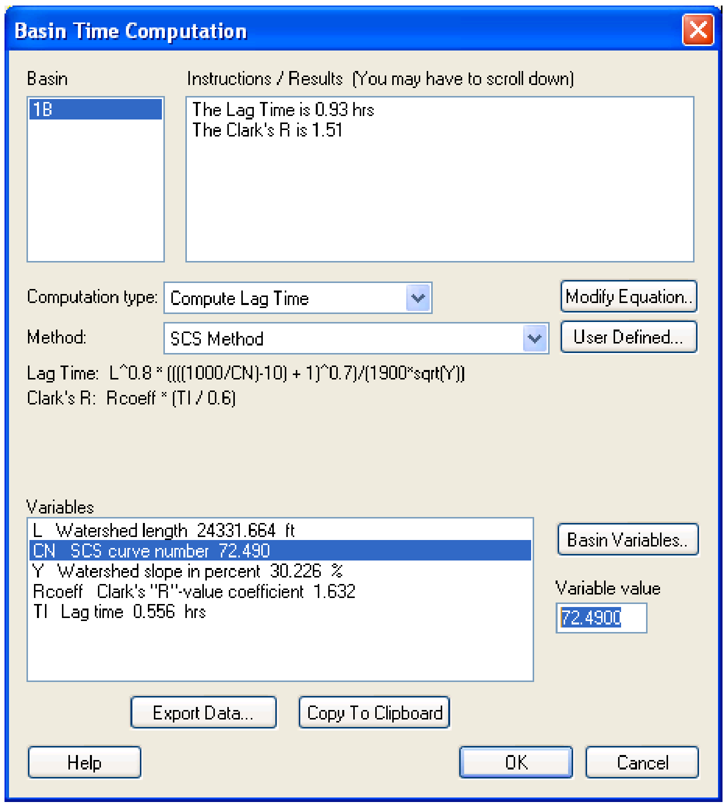


Figure 2 Lag time computation

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.

5 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. The *XY Series Editor* will appear.
4. Set the *Selected Curve* to “TypeI-24hour” as shown in Figure .

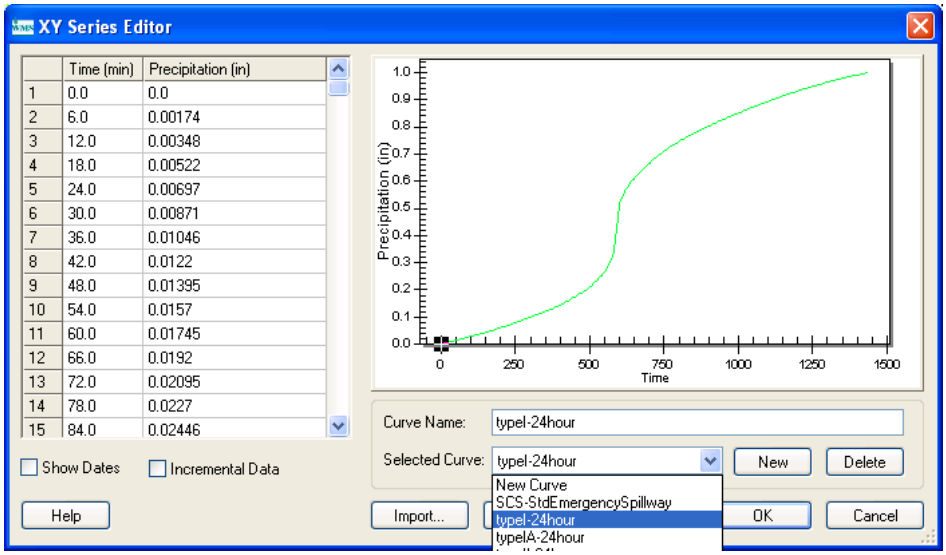


Figure 3 XY Series Editor for precipitation

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.

6 Clean Up Model

1. Click on the **Clean up Model** button.
2. In the *Redistribute Vertices* dialog that appears, enter a vertex *Average Spacing* of “80” meters.
3. Toggle ON the option to *Use Cubic Spline*.
4. Select **OK**.
5. When the *HEC-HMS Model Check* appears, fix any errors that appear.
6. Select **Done** to close *HEC-HMS Model Check*.
7. Click the **Save** button to save the WMS project file.
8. Select **Close** to close the *Hydrologic Modeling Wizard*.
9. In the WMS window, switch to the **Hydrologic Modeling** module
10. Select *HEC-HMS* **| Save HMS File**…
11. In the *Save HMS File* dialog, locate the folder “spatial\HMS”.
12. For File name enter “MODClark.hms” and click **Save**.

WMS will then create the HEC-HMS input files. The progress of writing these files is displayed in the status bar of WMS. It may take a few minutes for the files to be created.

7 Run HEC-HMS

The HEC-HMS input files are now ready to run a MODClark simulation on the Park City watershed. Now run HEC-HMS software outside of WMS.

1. Open HEC-HMS 4.0 or a later version from the Start Menu.
2. Select *File* | **Open…** to access the *Open* dialog.
3. Open the HEC-HMS file 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. The outflow hydrograph should look similar to Figure

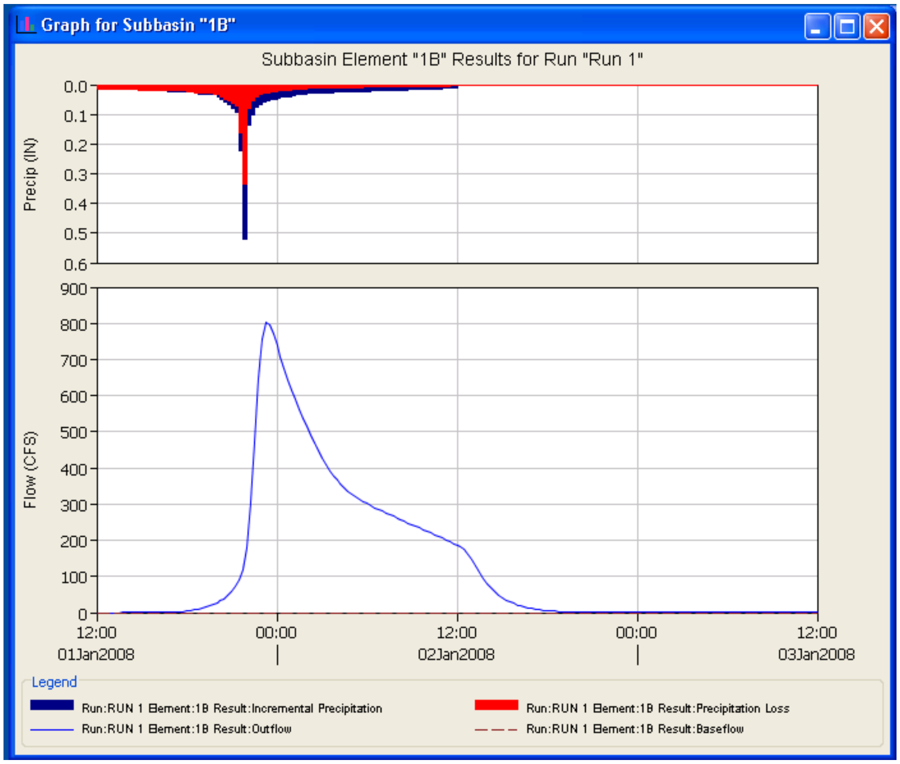


Figure 4 HMS Output Window

8 Conclusion

This exercise showed how to compute gridded hydrologic model parameters required for a HEC-HMS model with the MODClark transform.