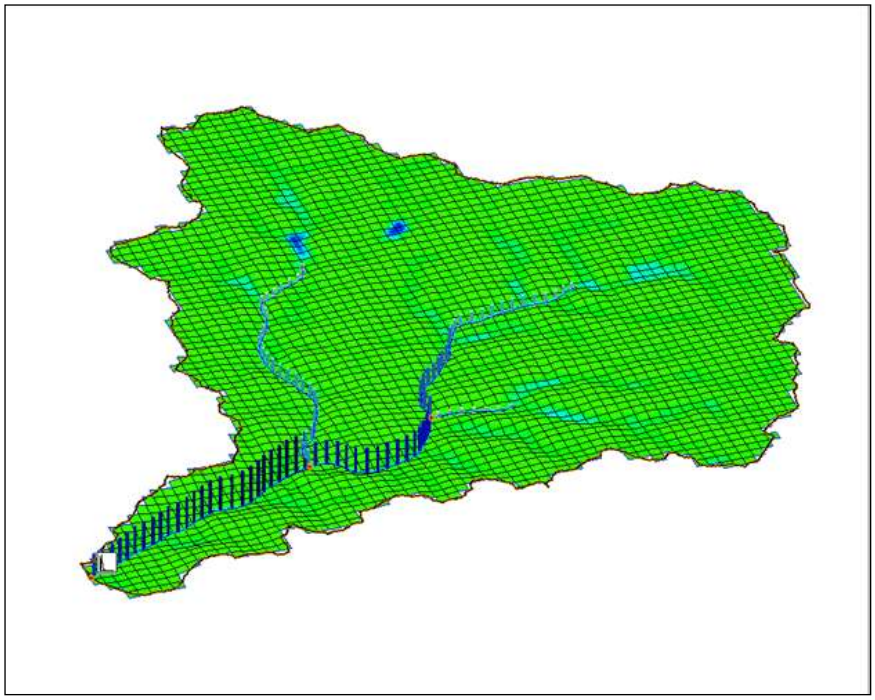
WMS

v. 11.1

WMS 11.1 Tutorial

GSSHA – Infiltration

Learn how to add infiltration to a GSSHA model



Objectives

This tutorial shows how to add Green & Ampt infiltration with soil moisture redistribution to an existing model.

Prerequisite Tutorials

- GSSHA Initial Model Setup
- GSSHA – Correcting Overland Flow

Required Components

- Data
- Drainage
- Map
- Hydrology
- 2D Grid
- GSSHA

Time

- 30–45 minutes

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1 Introduction

Infiltration is a key process in a rainfall runoff model. Without including infiltration in a model, the results will show all of the precipitation resulting in runoff, giving a much higher value for runoff than can be reasonably expected, unless an area is completely impervious. During this tutorial, the inputs needed for the *Green & Ampt with soil moisture redistribution* model will be set up in order to account for infiltration.

2 Getting Started

Starting WMS new at the beginning of each tutorial is recommended. This resets the data, display options, and other WMS settings to their defaults. To do this:

1. If necessary, launch WMS.
2. If WMS is already running, press *Ctrl-N* or select *File* | **New…** to ensure that the program settings are restored to their default state.
3. A dialog may appear asking to save changes. Click **Don't Save** to clear all data.

The graphics window of WMS should refresh to show an empty space.

4. Click **Open** to bring up the *Open* dialog.
5. Change the *Files of type* to "WMS XMDF Project File (*.wms)".
6. Navigate to *GSSHAModeling3* and select "GSSHAinfiltration.wms" then click **Open** to close the *Open* dialog and import the project file.

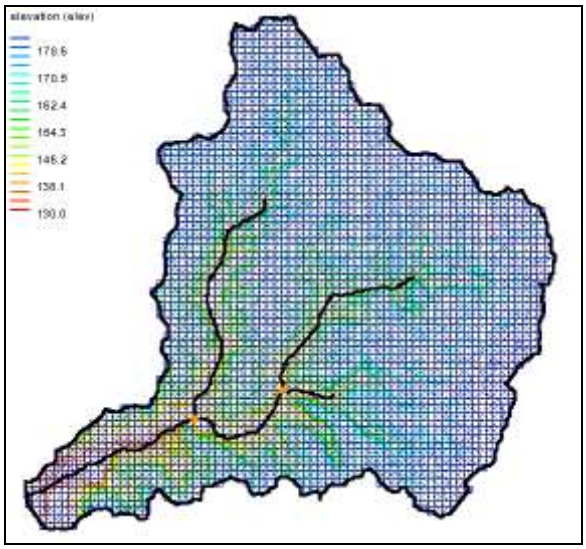

Figure 1 Initial project

3 Index Map Setup

Describing the spatial variability of almost all parameters is done by setting up an index map and then assigning parameter values to a mapping table. An index map is a grid of ID numbers. Parameter values can be assigned to each index map ID number in the project mapping tables. Index maps are generic and may apply to any number of mapping tables. Each table lists the name of the index map associated with the table and all the IDs that the index map (should or could) have, along with parameters for the IDs.

In this tutorial, use a soil type shape file from the NRCS SSURGO soil database to create a soil type index map. Perform necessary join operations to derive infiltration parameters from SSURGO soil data.

3.1 Create Soil Type Coverage

1. Right-click on the "Coverages" folder in the Project Explorer and select **New Coverage** to open the *Properties* dialog.
2. Change the *Coverage type* to "Soil Type".
3. Select **OK** to close the *Properties* dialog and create the coverage.

3.2 Import and Prepare the Soil Data

1. Right-click on "GIS Data" in the Project Explorer and select **Add Shapefile Data…** to open the *Select shapefile* dialog.
2. Browse to *GSSHAModeling3\Raw Data\JudysBranch\SSURGOSoil\Raw\spatial* and **Open** "soilmu_a_il119.shp" to close the *Select shapefile* dialog and open the shapefile.
3. Right-click on "soilmu_a_il119.shp" in the Project Explorer and select **Join NRCS Data…** to open the *Join NRCS data* dialog.

4. Turn on the *Fill blank values* and *Compute hydraulic conductivity using equivalent conductance equation* options.
5. Click **OK** to close the *Join NRCS data* dialog.

The next step is to convert the shape file to a coverage.

6. In the Project Explorer under "Coverages", right-click on the "GSSHA" coverage and select **Zoom To Layer** to set the current view to zoom to the GSSHA model.
7. Click on the "Soil Type" coverage under "Coverages" to make it the active coverage.
8. Select the "soilmu_a_il119.shp" layer by clicking on it. This will change the active module to the **GIS Module**.
9. With the **Select shapes tool** selected, drag a rectangle around (and a little outside) the watershed to select the soil polygons that overlay the watershed. Drag a rectangle by clicking and holding down the left mouse button.
10. Select *Mapping* | **Shapes** → **Feature Objects** to open the *GIS to Feature Objects Wizard* dialog (*Step 1 of 3*).
11. Select **Next >** to move to *Step 2 of 3* in the wizard.
12. Select **Next >** to move to *Step 3 of 3* in the wizard.
13. Select **Finish** to close the *GIS to Feature Objects Wizard* dialog.
14. Right-click on "soilmu_a_il119.shp" under "GIS Data" in the Project Explorer and select **Delete**.
15. In the Project Explorer, under "Coverages", turn off the "Soil Type" layer by unchecking the box next to it.

4 Creating an Index Map from Soil Data

1. Switch to the **2D Grid Module**.
2. Select *GSSHA* | **Maps…** to open the *GSSHA Maps* dialog.
3. For the *Input coverage (1)*, use the "Soil Type" coverage.
4. Make sure the *Coverage attribute* is set to "Texture".
5. Change the *Index map name* to "SoilType".
6. Click on the **Coverages** → **Index Map** button.
7. Select **Done** to close the *GSSHA Maps* dialog.

5 Creating a Mapping Table from the Index Map

The next step is to define IDs based on the "SoilType" map in the infiltration mapping table and assign infiltration parameters to each ID.

1. Select *GSSHA* | **Map Tables…** to open the *GSSHA Map Table Editor* dialog.

2. Select the *Infiltration* tab. Click **Yes** in the dialog that appears asking to open the Job Control window. This will bring up the *GSSHA Job Control Parameters* dialog.
3. Under the *Infiltration* section, select the *Green + Ampt with soil moisture redistribution* option.
4. Select **OK** to close the *GSSHA Job Control Parameters* dialog.
5. In the *Using index map* drop down box, choose "SoilType".
6. Click on the **Generate IDs** button.

The Generate IDs button should have created some IDs. Notice the soil texture name in the *Description1* field below each ID. Now define infiltration properties for each of these soil textures.

7. Using the following table, enter the values for each soil type.

Parameter	clay loam	silty clay loam	silt loam
Hydraulic Conductivity (cm\hr)	0.2	0.2	0.68
Capillary Head (cm)	20.88	27.3	16.68
Porosity ($m^3\m^3$)	0.464	0.471	0.501
Pore distribution index (cm\cm)	0.242	0.177	0.234
Residual Saturation ($m^3\m^3$)	0.075	0.04	0.015
Field Capacity ($m^3\m^3$)	0.318	0.366	0.33
Wilting Point ($m^3\m^3$)	0.148	0.212	0.141

8. Switch to the *Initial Moisture* tab.
9. In the *Using index map* drop down box, select "SoilType".
10. Click on the **Generate IDs** button.
11. Enter the following values for the *Initial Moisture* parameter.

clay loam	silty clay loam	silt loam
0.15	0.2	0.1

The initial moisture value must always be less than porosity.

12. Click **Done** to close the *GSSHA Map Table Editor* dialog.

6 Running the Model

1. Select *GSSHA* | **Save Project File…** to open the *Save GSSHA Project File* dialog.

2. Navigate to *GSSHAModeling3\Personal\Infiltration.*
3. **Save** the project as "Infiltration.prj" to exit the *Save GSSHA Project File* dialog.
4. Select *GSSHA* | **Run GSSHA…** to open the *GSSHA Run Options* dialog.
5. Click **OK** to exit the *GSSHA Run Options* dialog and bring up the *Model Wrapper* dialog.
6. Select **Close** once the simulation has finished running to exit the *Model Wrapper* dialog and read in the solution.

To compare the results of the model with infiltration accounted for to the model without infiltration:

7. In an external spreadsheet program, open *GSSHAModeling3\tables\InitialGSSHAComparison.xls.*
8. Switch to the tab titled "W_WO_Infiltration" to view the graph which displays the runoff value results from a model without infiltration and a model with infiltration. The graph should look similar to Figure 2 below.

Notice that the peak flow and the runoff volume have significantly decreased. Some of the rainfall should have infiltrated into the soil with the infiltration option turned on.

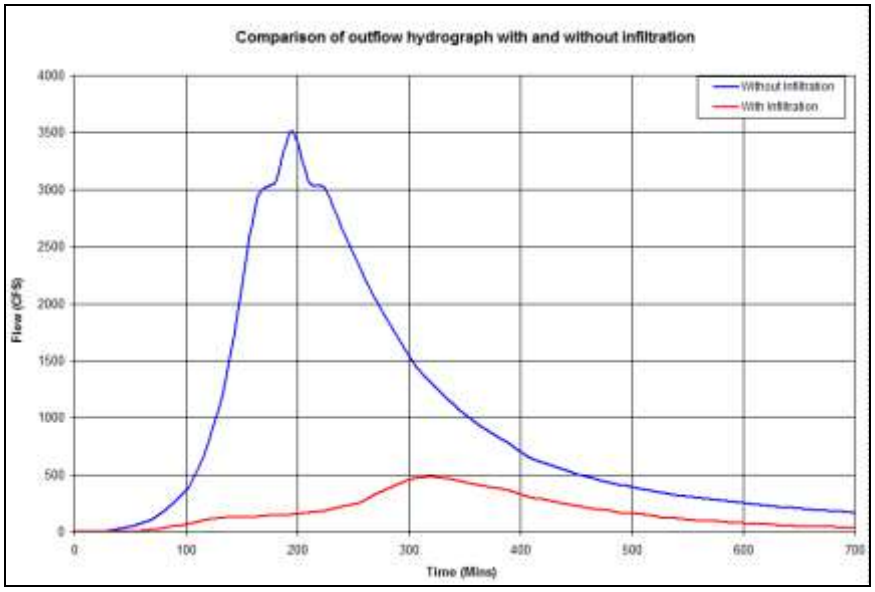

Figure 2 Comparison of outflow hydrograph with and without infiltration.

7 Conclusion

This concludes the "GSSHA – Infiltration" tutorial. This tutorial covered how to:

- Add Green & Ampt infiltration with soil moisture redistribution to an existing model.
- Run a GSSHA simulation which accounts for the effects of infiltration.