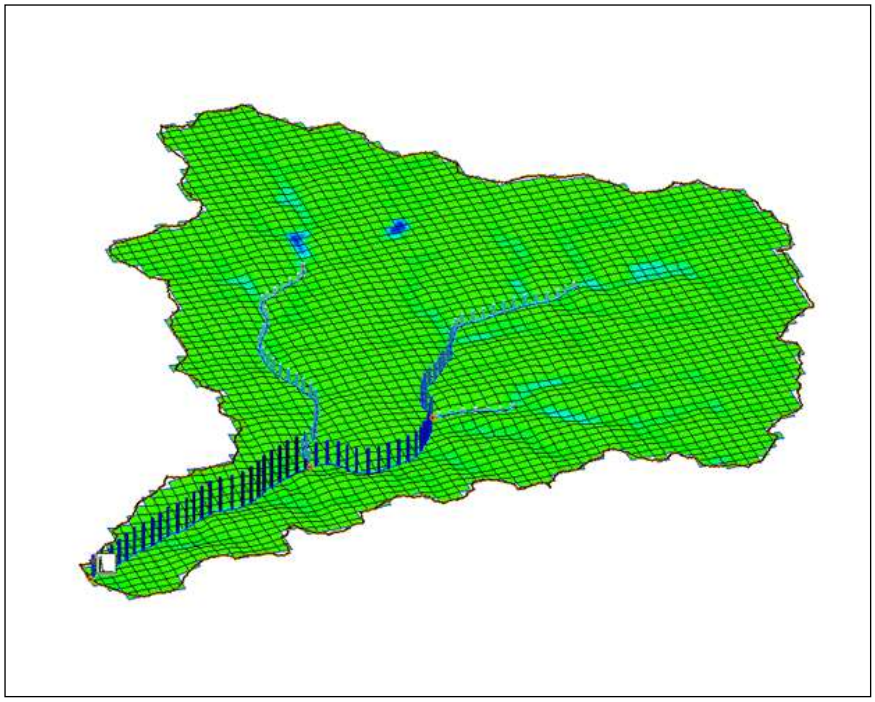
WMS

v. 11.1

WMS 11.1 Tutorial

GSSHA – Roughness

Learn how to add roughness to a GSSHA model



Objectives

Learn how to adjust a previously constructed GSSHA model to account for roughness and compare the results with a model that does not account for roughness.

Prerequisite Tutorials

- GSSHA – Modeling Basics – GSSHA Initial Overland Flow Model Setup
- GSSHA – Correcting Overland Flow
- GSSHA - Infiltration

Required Components

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

Time

- 30–45 minutes

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1 Introduction

Roughness is a key aspect to any GSSHA model as it controls the spacing of the model's hydrograph. When roughness is not accounted for, it will appear as if all the runoff for the area occurs within the first couple hours after a storm. With roughness accounted for, the model results become more accurate displaying a hydrograph that is spaced out over several hours. This tutorial will cover how to account for roughness in a previously constructed GSSHA model.

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 *Roughness*\ and **Open** "Roughness.wms" to close the *Open* dialog and import the project file.
7. Click **OK** to close the dialog asking to read the soil type table.

3 Using Land Use Data

Use a land use GIS file to create an index map that will be used with the roughness mapping table. Using land use data to create an index map for roughness makes the model more closely represent real-world conditions since the model can use both a land use map to describe watershed roughness and a soil type map to describe watershed infiltration. Before the model is complete, consider how land use affects infiltration and adjust the infiltration parameters based on a combined land use/soil index map.

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 "Land Use".

3. Click **OK** to exit the *Properties* dialog.

There should now be three coverages under the "Coverages" folder in the Project Explorer: "GSSHA", "Soil Type" and "Land Use".

4. Right-click on the "GIS Data" folder in the Project Explorer and select **Add Shapefile data…** to open the *Select shapefile* dialog.
5. Browse to the folder *Roughness\Raw Data\JudysBranch\Landuse* and select and **Open** both the "Belleville.shp" and "StLouis.shp" files to open the shapefiles and exit the *Select shapefile* dialog.
6. In the Project Explorer under the "Coverages" folder, right-click on the "GSSHA" coverage and select **Zoom To Layer** to set the current view to the GSSHA model.
7. Click on the "Land Use" coverage under the "Coverages" folder in the Project Explorer to make it the active coverage.
8. In the Project Explorer, select the "GIS Data" folder by clicking on it. This will change the active module to the **GIS Module** .
9. Click the **Select shapes tool** and drag a rectangle around (and a little outside) the watershed to select the soil polygons that overlay the watershed.
10. Select *Mapping* | **Shapes → Feature Objects** to open the *GIS to Feature Objects Wizard* dialog (*Step 1 of 3*).
11. Select **Next** > to proceed to *Step 2 of 3* of the wizard. Make sure *LUCODE* is mapped to "Land Use".
12. Click **Next >** to proceed to *Step 3 of 3* of the wizard.
13. Select **Finish** to exit the *GIS to Feature Objects Wizard* dialog.
14. In the Project Explorer, under "GIS Data", delete "Belleville.shp" and "StLouis.shp" by right-clicking on each and selecting **Delete**.
15. Turn off the display of the "Land Use" coverage by unchecking the box to the left of it, so the WMS display will update faster. If the "Soil Type" coverage is displayed, also turn off the display of this coverage.
16. Select the "GSSHA" coverage to make this the active coverage.

4 Creating an Index Map from Land Use Data

1. Switch to the **2-D Grid Module** .
2. Select *GSSHA* | **Maps…** to open the *GSSHA Maps* dialog.
3. Under the *Index – Grid* tab, for *Input coverage (1)* select "Land Use" from the drop-down menu.
4. Make sure the *Coverage attribute* is set to "Id".
5. Change the *Index map name* to "LandUse".
6. Click on the **Coverages → Index Map** button.

7. Select **Done** to close the *GSSHA Maps* dialog.

Under the "2D Grid Data" folder in the Project Explorer notice that there are now three index maps listed under the "Index Maps" folder: "Uniform", "SoilType" and "LandUse".

5 Creating a Mapping Table from Index Map

When selecting the land use index map, the display should show grid cells colored in several colors representing the different land use IDs of the polygons that were mapped to the grid cells, as shown in Figure 1 below. The next step is to assign the land use index map to the roughness table and set up roughness values for each of the IDs in the land use index map.

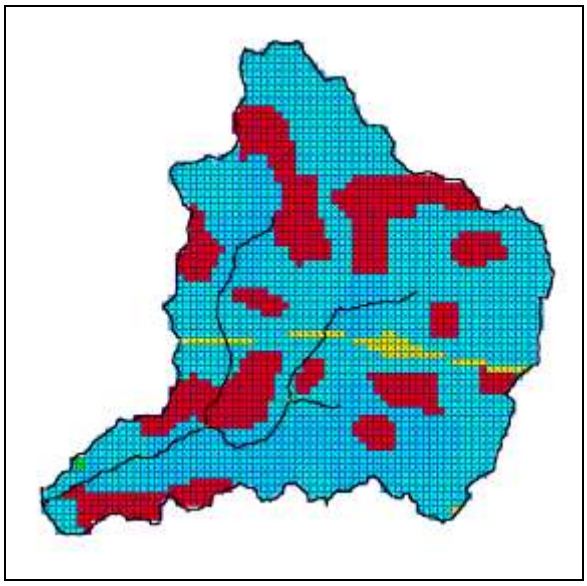

Figure 1 GSSHA model with land use index map.

1. Select *GSSHA* | **Map Tables…** to bring up the *GSSHA Map Table Editor* dialog.
2. Select the *Roughness* tab if it is not already selected.
3. For *Using index map*, use the drop-down menu to select "LandUse".
4. Click on **Generate IDs**. Click **Yes** when asked to delete the selected process' existing IDs.
5. Fill out the *Surface roughness* values according to the table below. To enter a roughness value for an ID, highlight the surface roughness box below the ID, then edit the roughness value.

ID	11	12	14	16	21	41
Surface roughness	0.011	0.012	0.011	0.011	0.035	0.1

6. Once done entering the roughness values, select **Done** to close the *GSSHA Map Table Editor* dialog.

7. Select *GSSHA* | **Save Project File…** to open the *Save GSSHA Project File* dialog.
8. Navigate to *Roughness\Personal*.
9. Enter "roughness.prj" as the *File name*.
10. Click **Save** to save the project and exit the *Save GSSHA Project File* dialog.
11. Select *GSSHA* | **Run GSSHA…** to bring up the *GSSHA Run Options* dialog.
12. Click **OK** to close the *GSSHA Run Options* dialog and open the *Model Wrapper* dialog.
13. Click **Close** when the simulation finishes running to close the *Model Wrapper* dialog.

6 Creating a Combined Index Map

Now adjust the model to take into account the effects of land use on the infiltration parameters. The values being used from Rawls and Brakensiek are for "bare earth" and do not account for the effects of land use. For instance, cropland with sandy soil and the concrete parking lot built on sandy soil will obviously have different "effective" infiltration rates. In this section, see how to determine the effects of land use on infiltration in a GSSHA model.

The first thing is to create a combined index map which will use both the soil and the land use coverages.

1. Select *GSSHA* | **Maps…** to open the *GSSHA Maps* dialog.
2. Set *Input coverage (1)* to "Soil Type".
3. Make sure the *Coverage attribute* is set to "Texture".
4. Turn on *Input coverage (2)* and select "Land Use".
5. Make sure the *Coverage attribute* is set to "Id".
6. Enter "Combined" for the *Index map name*.
7. Click on the **Coverages → Index Map** button. WMS will compute a new index map which specifies a unique ID for each combination of land use and soil type.
8. Click **Done** once the calculation is complete to close the *GSSHA Maps* dialog.

The index map should now look similar to Figure 2 below.

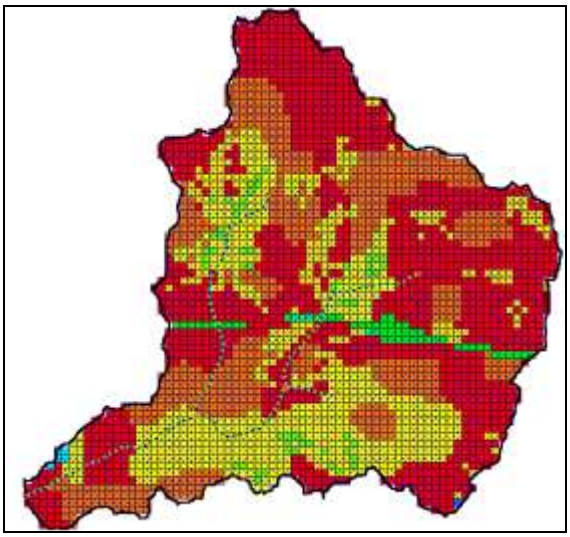

Figure 2 Index map with roughness and infiltration both accounted for.

The next step is to define the infiltration parameters for this combined index map in the infiltration mapping table.

9. Select *GSSHA* | **Map Tables…** to open the *GSSHA Map Table Editor* dialog**.**
10. Switch to the *Infiltration* tab. For the *Using index map* field select "Combined".
11. Click on the **Generate IDs** button. Click **Yes** to delete the existing IDs.

Several fields are added in the table. These fields show all possible combinations of land use and soil type present in the watershed.

The infiltration parameters listed in the Rawls and Brakensiek table represent the bare earth soil infiltration parameters. However, a combined index map was generated that combines the effects of land use and soil cover. The mapping table for this index map should account for the change in infiltration parameters caused by land use changes in a watershed.

The next step would be to import the standard *GSSHA.cmt* file and change the infiltration parameters for each land use type in the mapping table, but for this exercise an updated .cmt file has already been created.

12. Click on the **Import Table…** button to bring up the *Open* dialog.
13. Navigate to *Roughness\Infiltration* and **Open** "UpdatedInfiltrationParams.cmt" to open the file and exit the *Open* dialog.

Notice the values filled in for all the fields.

14. Click **Done** to close the *GSSHA Map Table Editor* dialog.
15. Select *GSSHA* | **Save Project File…** to open the *Save GSSHA Project File* dialog.
16. Navigate to *Roughness\Personal* and **Save** the project as "UpdatedInfil.prj" to save the project and exit the *Save GSSHA Project File* dialog.
17. Select *GSSHA* | **Run GSSHA…** to open the *GSSHA Run Options* dialog.
18. Select **OK** to close the *GSSHA Run Options* dialog and open the *Model Wrapper* dialog.

19. Click **Close** once the model has finished running to close the *Model Wrapper* dialog and import the solution.
20. In an external spreadsheet program, open the spreadsheet "InitialGSSHAComparision.xls" found under *Roughness\tables*.
21. Click on the tab titled "W_WO_Roughness" to view the results of running the model without roughness, with roughness, and with the infiltration modified for the imported land use data. The graph should appear as Figure 3 below.

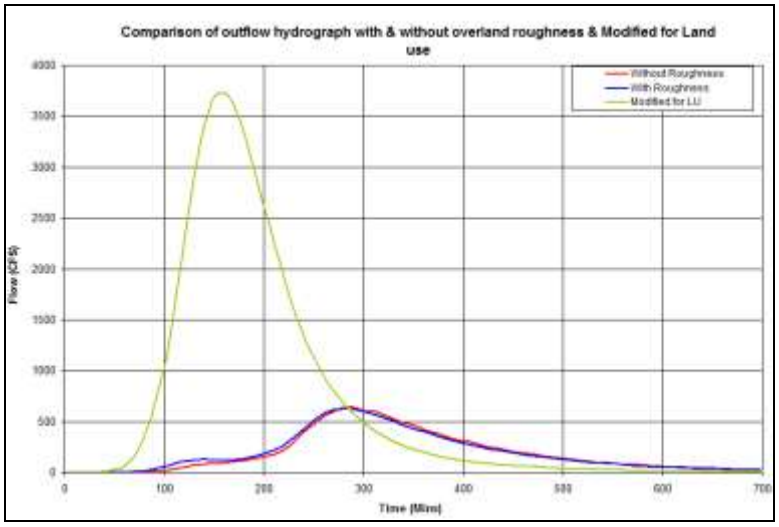

Figure 3 Graph comparing various runs of the GSSHA model with relation to varying roughness parameters.

7 Conclusion

This concludes the "GSSHA – Roughness" tutorial. This tutorial covered how to modify an existing GSSHA model to account for roughness and how to adjust infiltration to merge with the given roughness values.

