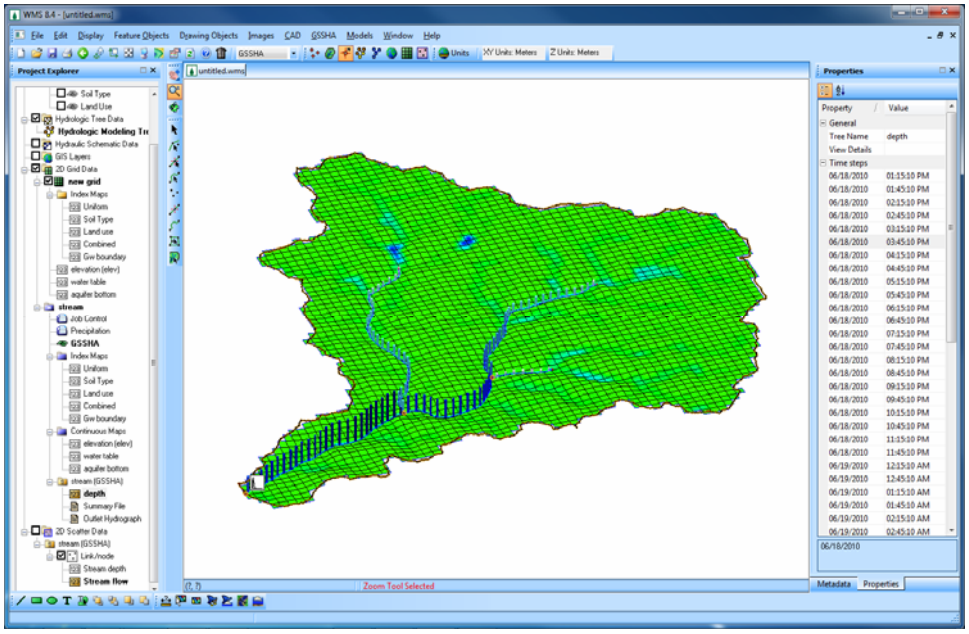
WMS

v. 8.4

WMS 8.4 Tutorial

GSSHA – Modeling Basics – Correcting Overland Flow Problems

Learn how to correct overland flow problems on a GSSHA 2D grid in WMS



Objectives

This tutorial shows you some techniques for displaying and removing pits, also known as "digital dams" in your GSSHA model.

Prerequisite Tutorials

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

Required Components

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

Time

- 30-45 minutes

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1 Contents

2 Introduction

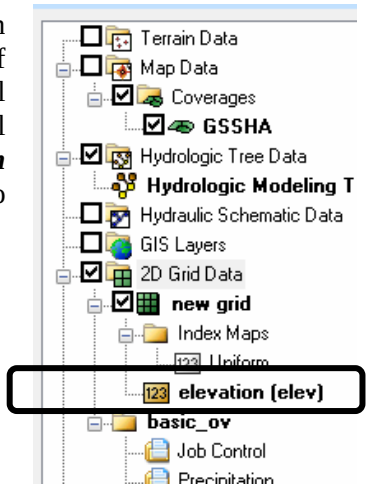
In the previous tutorial, you saw that the presence of digital dams creates problems with surface runoff in your GSSHA model. You will learn how digital dams can be removed from your model.

3 Working with Digital Dams

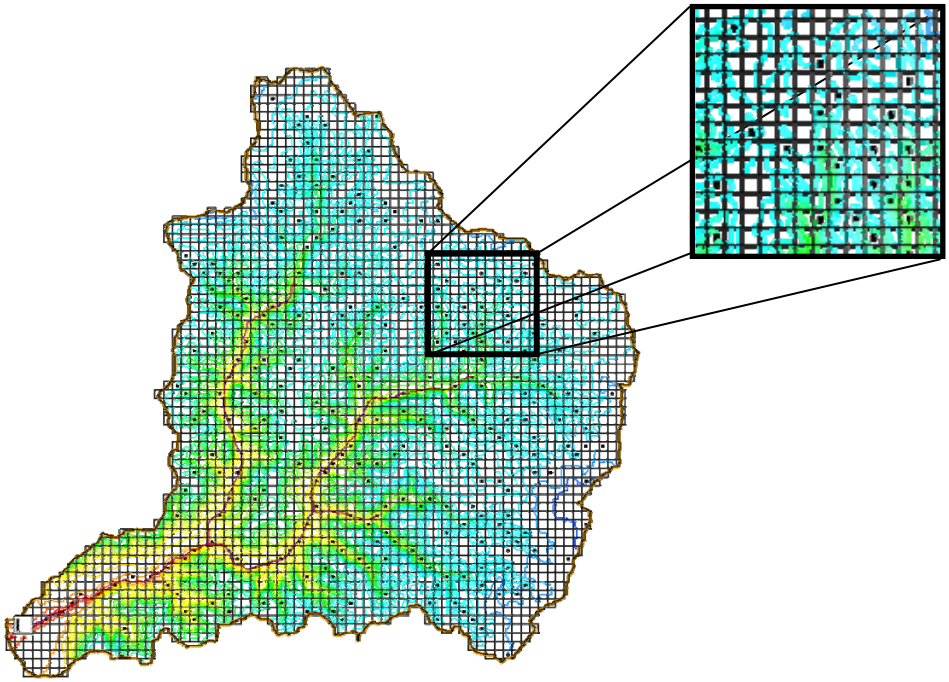
In this tutorial you will continue working with the same model. If you have created the project but have already closed the project, open ***C:\Training\Personal\BasicGSSHA\GSSHA\ basic_ov.prj***. If you do not have a project saved, a backup can be opened from ***C:\Training\BasicGSSHA\ GSSHA\basic_ov.prj.***

You should save this project with a different file name so the original project is unchanged. In the 2D-Grid module, select ***GSSHA | Save Project file***. Save it as ***C:\Training\Personal\DigitalDam\ Clean.prj***.

The problem with digital dams is that the water ponds in artificial depressions that result because of a lack of resolution. There are two methods to fix the digital dams. The first method is to manually adjust the cell elevations and the second method is to use the ***cleandam*** tool to automatically smooth the cell elevations. To quickly identify which cells have digital dams:

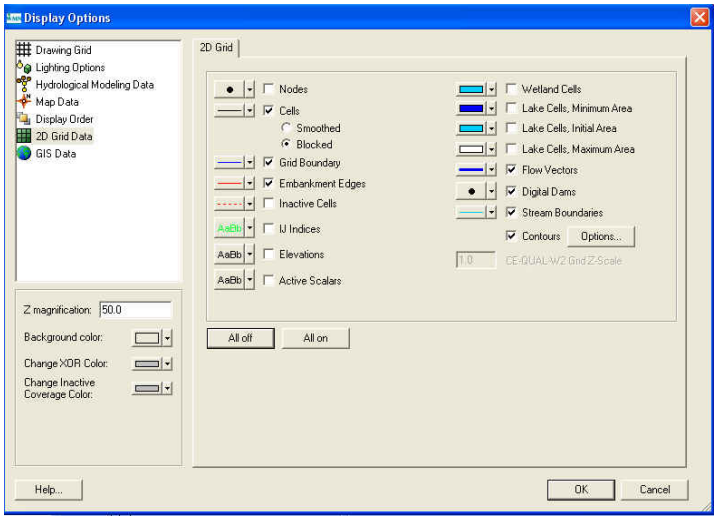


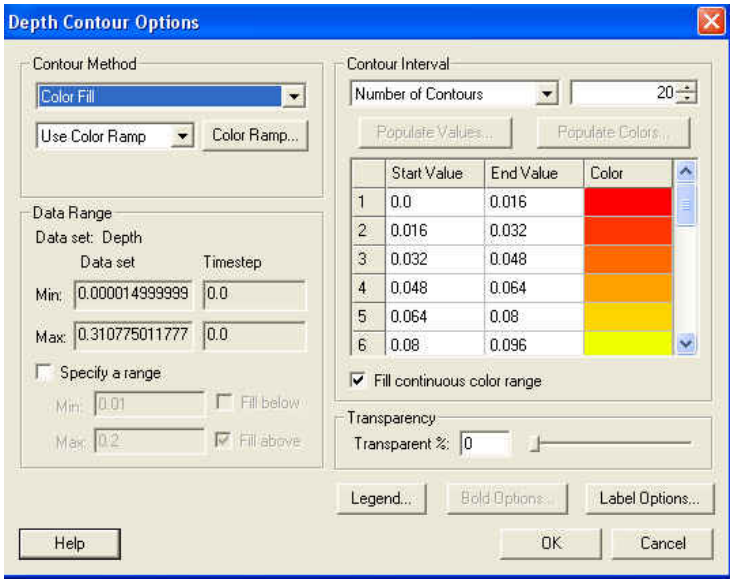
1. Click on the *elevation (elev)* dataset in the project explorer under *2D Grid Data* to select it.
2. Select ***Display | Display Options***.
3. In the *2D Grid* tab, turn on *Digital Dams*.
4. Select *OK*. The Grid will look something like the following figure.



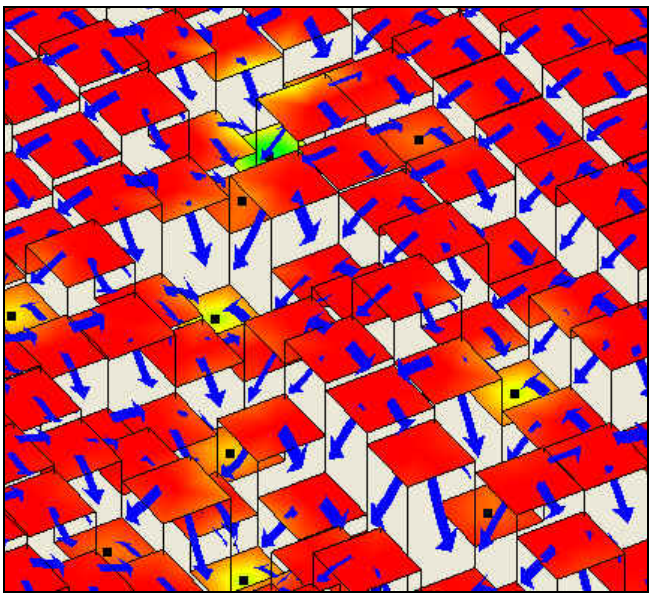
To better visualize why these cells are digital dam cells:

1. Select ***Display | Display Options***.
2. Select the *2D Grid Data* item from the list. Under the *Cells* toggle box, select the *Blocked* cells option.
3. If not already on, turn on the 2D Grid *Contours*.
4. Click on the Contour *Options…* button.
5. Under the *Contour Method*, Choose *Color Fill*.
6. Click *OK*.





7. Turn on the *Flow Vectors*.
8. Click *OK*.
9. Use the Rotate, Pan, and Zoom tools to look at a digital dam cell.



The black dots denote the digital dam cells. The arrows indicate the preferred GSSHA overland flow paths (remember that GSSHA only flows in one of four directions (left, right, up, down from each cell). The cells with all four sides marked as pointing inward are flagged as digital dam cells. The blocked cells display option further helps to illustrate this. You can use the ***Display | View | Z Magnification*** option to enhance the z scale (try adjusting the Z magnification to a value of 10.0). Notice that digital dam locations are at low points in the grid.

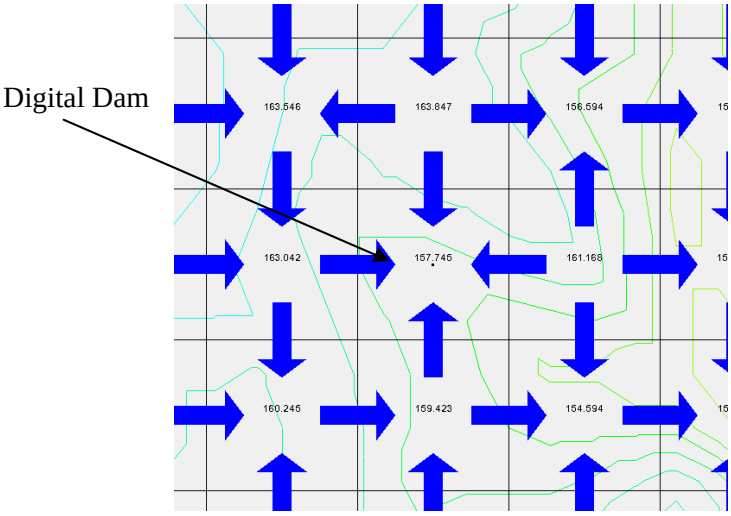
3.1 Manually Adjusting Cell Elevations

You could adjust cell elevations manually to make the water flow in an appropriate direction. However, the number of digital dams in this model is typical and manual adjustment would be tedious. You will edit one or two of these digital dams by hand and then use some automated tools to speed up the process of removing the low points.

Occasionally, only the digital dam cells have to be adjusted, but usually one or more neighboring cells must also be adjusted to remove digital dams.

To adjust the elevation of a cell, click on the cell. In the WMS properties window, there is an edit field with the cell elevation. Let's try a couple.

1. In the display options, change the following so that you can see the elevation of surrounding cells and flow direction in each cell.
   - turn on the display of *Elevations*
   - turn on *Flow Vectors*
   - Change the DEM contour method to *normal linear*
2. Select the *Plan View* button and
3. Select the zoom tool and zoom in to any one of the digital dams so that the cell with digital dam and surrounding cells are clearly visible.



4. Switch to the *2d Grid* Module and select a cell with a digital dam and increase its elevation in such a way that flow occurs from this cell to surrounding cells. It might take few trials. You might end up removing the digital dam from this cell but create a new one up or downstream of it.
5. Once the digital dams are fixed by changing the cell elevations, you will need to right click the ***elevation*** dataset in the *Project Explorer Window* (under the *new grid* 2D grid) and select the ***Set as Elevation*** option. Doing this will permanently update the elevation data.
6. After you have manually fixed a few digital dams, go to the display options and turn off the display of *Elevations* and *Flow Vectors*. Then select the *Frame* tool to zoom to full extent.

3.2 Using Cleandam to Fix Digital Dams

Manually adjusting cell elevations works fine for a small area with a few digital dams or if there are one or two particularly troublesome digital dam cells in a larger watershed model. It quickly becomes tedious, however, when there are hundreds of digital dams. This is why *Cleandam* was created. *Cleandam* uses a stochastic search process to find the best path from the digital dam to a lower elevation. It does this by starting from the digital dam and randomly searching from cell to cell until it finds a lower cell elevation. A cost function is then calculated which is the difference between the current cell elevations along the path and a linear sloping path from the digital dam and the cell with the lower elevation.

To run *Cleandam*:

1. Select ***GSSHA | Clean Digital Dams***
2. You should now see cleandam running in the model wrapper. When it is done select C*lose*.
3. If you still see any digital dams present, you could manually adjust them.

3.3 Save and Run the Model

Once done cleaning the digital dams, save the project as ***C:\Training\Personal\DigitalDam\clean.prj.***

1. Select ***GSSHA | Run GSSHA.*** Turn off the *Suppress screen Printing* option.
2. Select *OK*.
3. You can see the time steps being computed and discharge at each time step in the model wrapper. Click "*Close*" after the computation is complete.

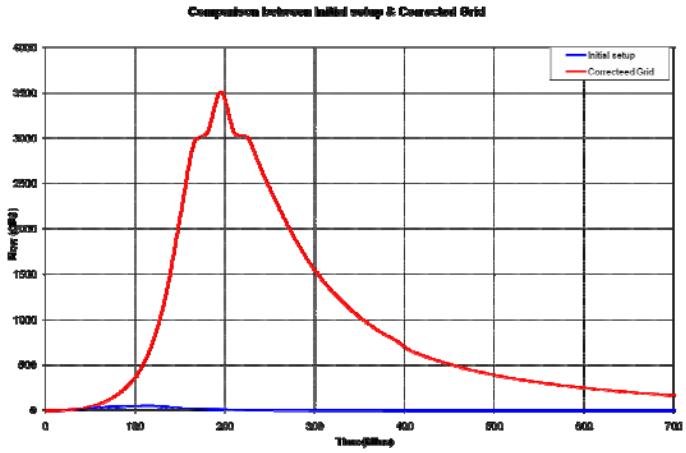
3.4 Visualizing Overland Flow Results

3.5 Visualizing Hydrographs

In the 2-D grid module, click on the "***Select Hydrograph***" tool and double click on the hydrograph icon near the watershed outlet. Since digital dams have been removed, your model should have produced more runoff than the previous model.

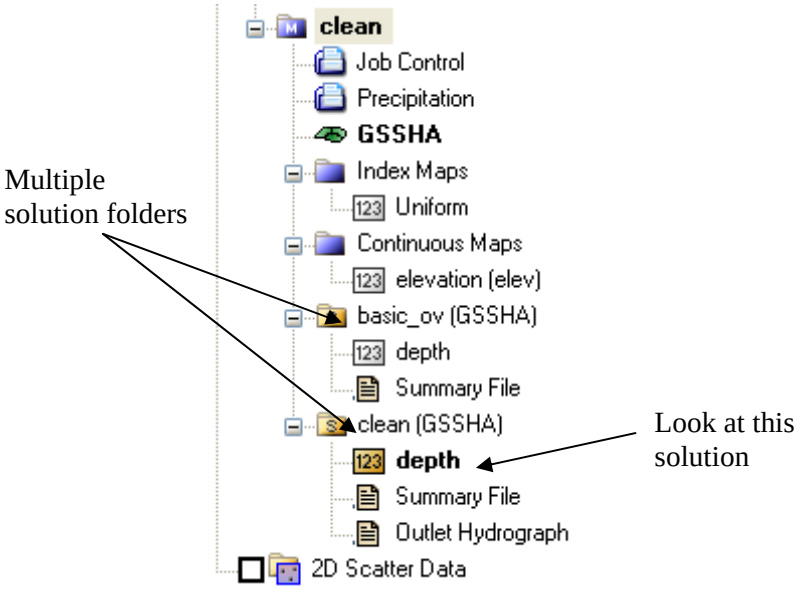
1. Right click on the hydrograph plot and choose *View Values* which will display the hydrograph ordinates and corresponding times.
2. Select the data under *Flow* column, right click and then select *Copy*.
3. Open the spreadsheet ***C:\Training\InitialGSSHAComparison.xls*** and paste the hydrograph ordinates under the column *Corrected Grid*.
4. Paste your data in the white areas of the spreadsheet only and compare the plots before and after correcting the digital dams by selecting the *Initial_Corrected* tab in the spreadsheet.

5. See the following plot which compares the hydrograph before and after fixing the digital dams. Is your plot similar to this (at least of the same magnitude)?
6. In WMS, close the *Hydrograph* plot window after you are done.



Visualizing Summary File

1. Under the GSSHA model folder, you can see one or more solutions. If you have been working with the same model from the previous exercise, you might have two or more solution folders. Go to the solution folder with the name *clean (GSSHA).* See the following figure:



2. Open the summary file and:
   - Compare the amount of water remaining on the surface
   - Volume of discharge

You should have noticed that the volume of water remaining on the surface has significantly reduced as compared to the previous simulation where the digital

dams were not fixed. In the previous simulation, nearly all of the rainfall remained on the surface and there was very little discharge. In this simulation, much of the water was converted to discharge. There is still some water remaining in the overland cells because this model does not have infiltration or streams turned on.

3. When you are done you can close the summary file.

3.6 Visualizing Depth Contours

1. In the 2D Grid module  , select ***Display | Display Options.***
2. Turn on the *2D Grid Contours*. Select *OK*.
3. In the data tree, right-click on ***Depth*** under the solution folder.
4. Select *Contour Options* from the popup menu.
5. Under the *Contour Method*, select *Color Fill*. Select *OK* in the *Contour Options* dialog to save your changes.
6. Now in the project explorer, click on ***Depth*** to select it. In the properties window (to the right side), a set of time steps appear. Click around on a few time steps.
7. Look at the depth contours toward the end of the simulation to see if water is ponding in some part of the watershed. If it is, then you can adjust the elevations manually and try re-running the simulation as described above.

What differences do you see in the results before and after fixing the digital dams?

