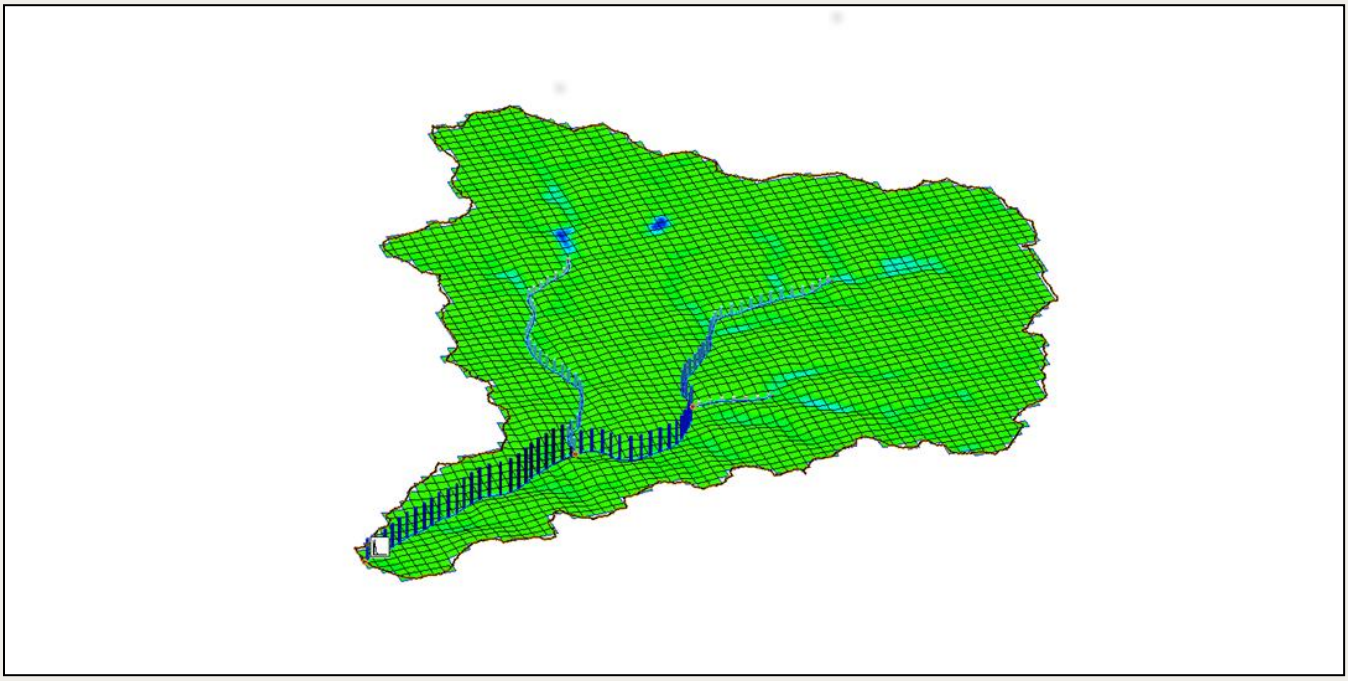
WMS 11.2 Tutorial

GSSHA – Correcting Overland Flow

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



Objectives

This tutorial shows some techniques for displaying and removing pits, also known as “digital dams”, in a GSSHA model.

Prerequisite Tutorials

- GSSHA Initial Model Setup

Required Components

- WMS Core
- GSSHA Model

Time

- 15–30 minutes

1 Introduction

The presence of digital dams creates problems with surface runoff when modeling with GSSHA. This tutorial instructs how digital dams can be removed from the 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 *GSSHAModeling2*\ and **Open** "Clean.wms" to close the *Open* dialog and import the project file.

3 Working with Digital Dams

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. In the Project Explorer, under "2D Grid Data" > "new grid", select "elevation (elev)".
2. Select *Display* | **Display Options…** to open the *Display Options* dialog.
3. In the *2D Grid* tab, turn on *Digital Dams*.
4. Click on the black circle, directly to the left of *Digital Dams*, to open the *Point Properties* dialog.
5. Enter a value of "10" for the *Radius*.
6. Click **OK** to close the *Point Properties* dialog.

7. Select **OK** to close the *Display Options* dialog. The grid should appear similar to Figure 1. Note that the cells with digital dams are blacked out.

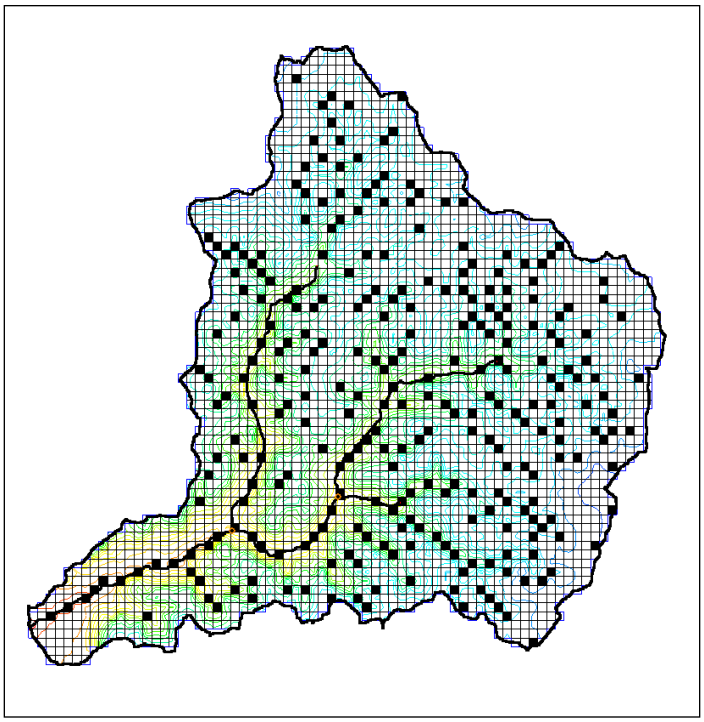


Figure 1 Grid with digital dams displayed

To better visualize why these cells are digital dam cells:

8. Select *Display* | **Display Options…** to open the *Display Options* dialog.
9. Under the *2D Grid* tab, make sure *Cells* is turned on, and select the *Blocked* cells option.
10. Turn on *Contours*.
11. Click on the **Options…** button to the right of *Contours*, to open the *elevation (elev) Contour Options* dialog.
12. Under *Contour Method*, choose “Color Fill” from the drop-down menu.
13. Click **OK** to close the *elevation (elev) Contour Options* dialog and return to the *Display Options* dialog.
14. Turn on Flow Vectors.
15. Click **OK** to close the *Display Options* dialog.
16. Use the **Rotate**, **Pan**, and **Zoom** tools to look at a digital dam cell. The digital dam will have indications of ponding as shown in Figure 2.

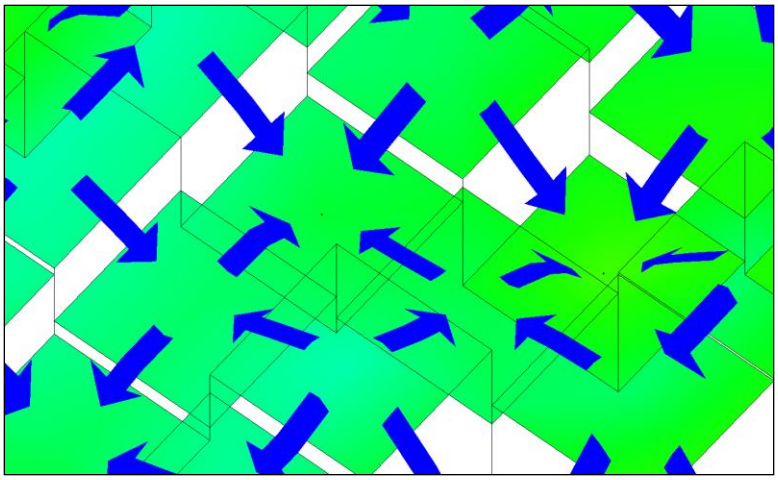


Figure 2 Digital dam cells where ponding occurs

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, or 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. 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

It is possible to 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. 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:

1. Select the **Plan View** button.
2. In the 2-D Grid Module, select the **Select grid cell** tool.
3. Select a cell that has a digital dam. This will bring up the *Properties* window for that cell, on the right-hand side of the screen.
4. Adjust the “S” value, which is the elevation of the cell, to enable outflow to other cells.

After adjusting the elevation of the dammed cell, make sure another one was not created by this change in the surrounding area. If another dammed cell was created, simply adjust the elevation of that cell. Continue with this process until there are no more dammed cells in the grid.

5. Once the digital dams have been fixed by changing the cell elevations, right-click “ elevation (elev)” under “ new grid” in the Project Explorer and select the **Set as Elevations…** option. Doing this will permanently update the elevation data.
6. Click **Display Options** to open the *Display Options* dialog.

7. Turn off *Flow Vectors*, then click **OK** to close the *Display Options* dialog.
8. Click on **Frame** to frame the project.

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…** to bring up the *Model Wrapper* dialog.
2. Notice Cleandam running in the model wrapper. When it is done select **Close** to exit the *Model Wrapper* dialog.

4 Save and Run the Model

1. Once all digital dams have been cleared from the project, click *File* | **Save As…** to bring up the *Save As* dialog.
2. Navigate to GSSHAModeling2\Personal\DigitalDam.
3. In the *File name* field, enter “clean”.
4. Click **Save** to save the project and exit the *Save As* dialog.
5. Select *GSSHA* **| Run GSSHA…** to open the *GSSHA Run Options* dialog.
6. Turn off the *Suppress screen printing* option.
7. Select **OK** to close the *GSSHA Run Options* dialog and open the *Model Wrapper* dialog.
8. Notice the time steps being computed and discharge at each time step in the *Model Wrapper* dialog. Click **Close** after the computation is complete to close the *Model Wrapper* dialog.

5 Visualizing Overland Flow Results

5.1 Visualizing Depth Contours

1. In the **2-D Grid Module** , select *Display* **|** **Display Options…** to open the *Display Options* dialog.
2. Turn on *Contours*, then select **OK** to close the *Display Options* dialog.
3. In the Project Explorer, under “ clean (GSSHA)”, right-click on “ depth” and select **Contour Options…** to open the *depth Contour Options* dialog.

4. Under *Contour Method*, select “Color Fill”.
5. Select **OK** to close the *depth Contour Options* dialog.
6. In the Project Explorer, under “ clean (GSSHA)”, 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 adjust the elevations manually and try re-running the simulation as described above.

Note differences that can be seen in the results before and after fixing the digital dams.

6 Conclusion

This tutorial covered:

- Displaying and removing digital dams
- Running an improved GSSHA model
- Visualizing and comparing overland flow results