Exercise 16: Surfaced Hydrologic Analysis with ModelBuilder

50 Points scaled to 20 Points

Introduction

In this exercise, you will use the ArcGIS ModelBuilder to sequence a series of surface hydrology operations to generate a synthetic stream network and watershed boundaries from an input DEM.

Objectives

- *Remove pits from a DEM to hydrologically correct it*
- *Create flow direction and flow accumulation grids*
- *Create a synthetic stream network and watershed boundaries*
- *Use ArcGIS ModelBuilder to sequence operations and build a tool*

Prerequisite Materials

- Modules: Surface Hydrology
- Videos
  - Lab 16 Intro: https://youtu.be/5TgaXy4BN88
  - ArcGIS ModelBuilder: https://youtu.be/5hl4FT7HXvs

Data

- **dem17N.tif**: digital elevation model (DEM) with a 9.2 m spatial resolution obtained from the National Elevation Dataset (NED). Vertical units are in meters. Data are projected to NAD83 UTM Zone 17N.
- **hs.tif**: hillshade derived from DEM to visualize the terrain. This layer is just for visualization and is not needed in the analysis.

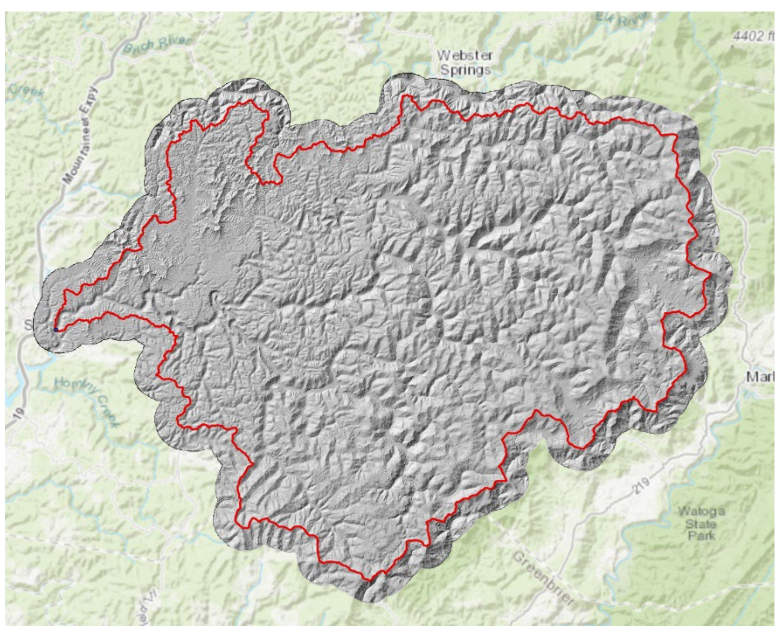

Figure 1. Digital terrain data represented as a hillshade.

Background Questions

Question 1. Why is it necessary to fill a DEM prior to performing hydrologic analysis? (5 Points)

Question 2. Explain the difference between a flow direction and a flow accumulation grid. (5 Points)

Question 3. Explain the difference between the D8 and D-Infinity methods for calculating flow direction. (5 Points)

Question 4. A cell has a flow accumulation value of 952 cells. The size of the grid is 10 by 10 meters. What is the contributing area in square meters? (5 Points)

Question 5. Using the data from the previous question, what is the contribution area in hectares? (5 Points)

Question 6. What are some factors that impact surface water flow that are not considered when using only a DEM to model surface water flow? Please explain. (5 Points)

Tool Creation

You will create a tool from a model that can be run like any other tool in ArcGIS Pro. See our example model in Figure 2 and the resulting tool in Figure 3. The tool will require the following steps.

- ❖ Fill or hydrologically correct a DEM using the Fill Tool in the Hydrology subtoolbox of the Spatial Analyst Toolbox. You can use the default settings for this tool.
- ❖ Create a flow direction grid from the filled DEM using the Flow Direction Tool in the Hydrology subtoolbox of the Spatial Analyst Toolbox. You can use the default settings for this tool. You do not need to output a Drop Raster.
- ❖ Create a flow accumulation grid using the Flow Accumulation Tool in the Hydrology subtoolbox of the Spatial Analyst Toolbox You can use the default settings for this tool.
- ❖ Create a synthetic stream network using a defined flow accumulation threshold. You will first need to use the Greater Than Tool (Spatial Analyst → Math → Logical) to create a binary raster. You will then need to use the Set Null Tool (Spatial Analyst → Conditional) to recode 0 to NoDATA. The input should be the output from the Greater Than Tool, the expression should be VALUE = 0, and the

Input false raster or constant value should also be the output from the Greater Than Tool.

- Create a stream link grid using the Stream Link Tool in the Hydrology subtoolbox of the Spatial Analyst Toolbox. You can use the default settings for this tool.
- Convert the resulting stream link grid to vector polylines using the Raster to Polyline Tool from the Conversion Tools Toolbox. The background value should be set to NoDATA and do not simplify the polylines.
- Create raster watershed boundaries using the Watershed Tool in the Hydrology subtoolbox of the Spatial Analyst Toolbox. You can use the default settings for this tool.
- Convert the resulting watershed grid to vector polygons using the Raster to Polygon Tool from the Conversion Tools Toolbox. Do not simplify the polygons.

The tool should also have the following characteristics.

- Rename inputs and outputs to be more generic and interpretable (see the Figure 2 example).
- Define the input DEM and output stream polylines and watershed polygons as parameters.
- Set the threshold value to delineate streams in the Greater Than Tool to a parameter.

Deliverable 1. Deliver the toolbox containing your model. We will test the tool to make sure it works correctly. It will be judged relative to the criteria specified above and based on whether the correct results are obtained. (20 Points)

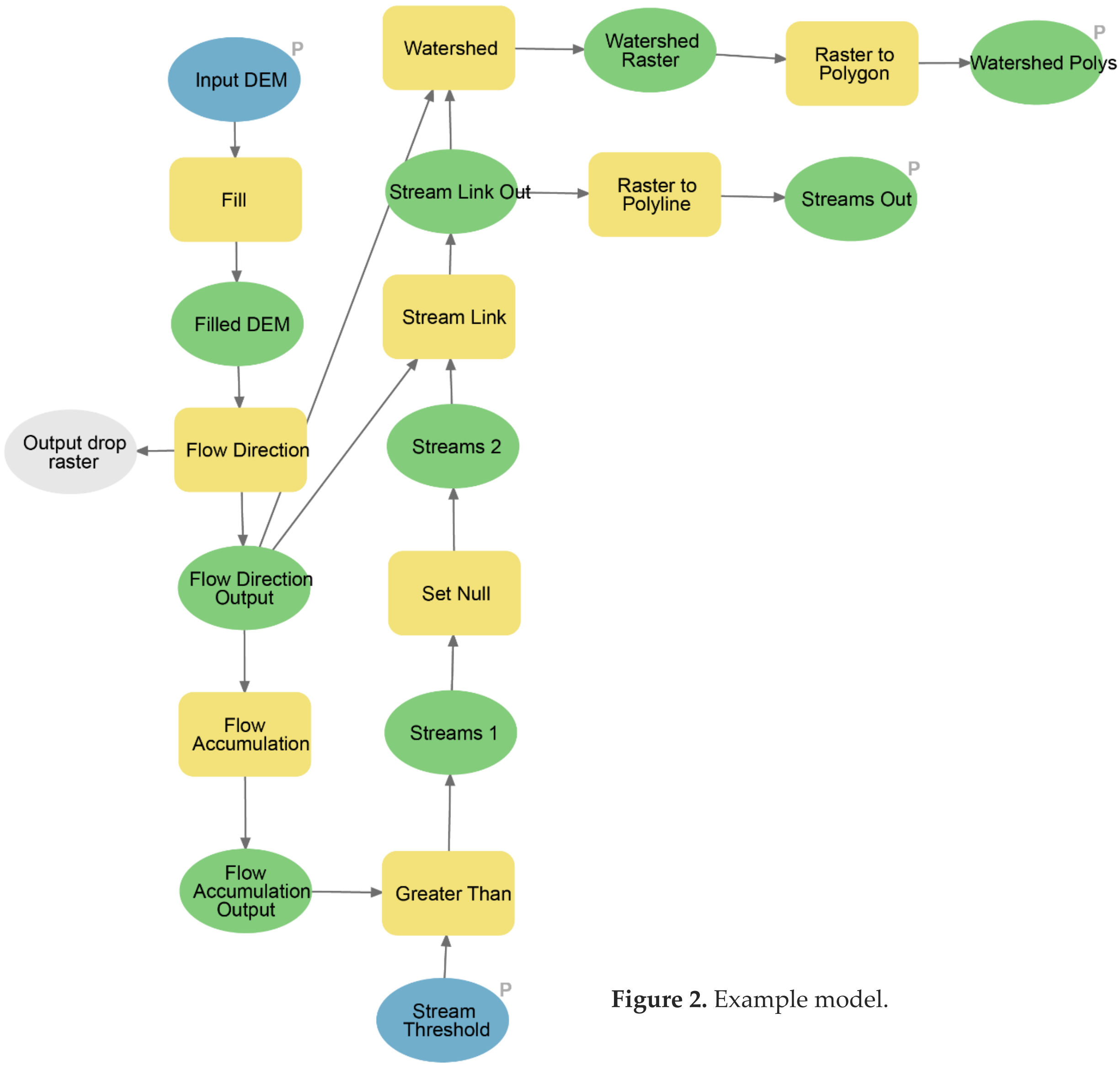

Figure 2. Example model.

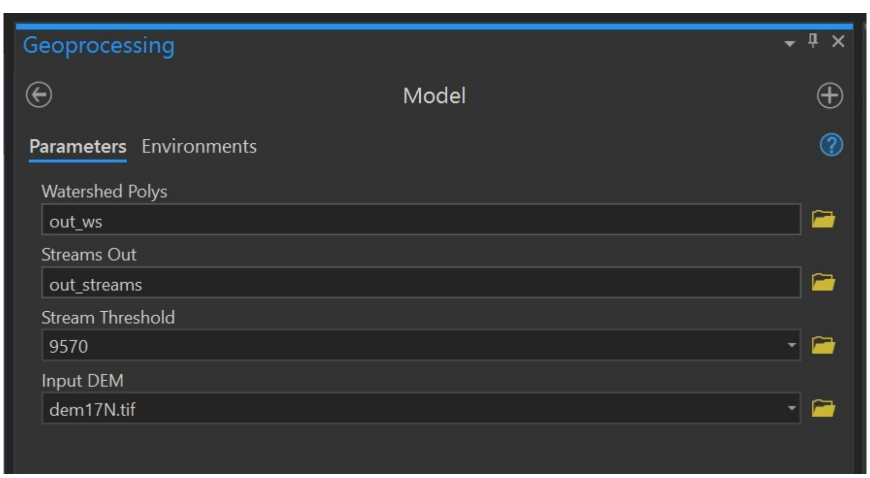

Figure 3. Example tool window.