Creating Watersheds and Stream Networks

Neeraj Rajasekar
Workshop overview

- Data
- Understanding the tools
- Demo
Elevation Data

- **Types**
  - DEM: Digital Elevation Model “bare Earth”
  - DSM: Digital Surface Model

- **Data Structure**
  - Raster
  - TIN
  - Terrain
Where do you get DEM data?

- **Sources**
  - Global
    - SRTM and HydroSHEDS - 30m and 90m
    - ASTER - 30m *(challenging for surface runoff modeling)*
  - United States NED 30m, 10 m, and higher
  - Available in ArcGIS Online

- **LiDAR, IfSAR**

- Generated photogrammetrically

- Created with interpolation tools
  - especially TopoToRaster
DEM Construction Considerations

- Extent

- Map Projection (use equal area)

- Cell size and Resolution
  - *Must be appropriate for the landscape and scale being modeled.*

- Source elevation data (accuracy, density, sampling)

- Interpolation techniques (use TopoToRaster)

- Special consideration for contour input
  - TopoToRaster interpolator – works well with contours, creates hydrologically correct DEM
Hydrologically Correct DEM

- Sinks
  - Some sinks are real
    - Do not fill in the Great Salt Lake
- Streams in the correct place?
  - To burn or not to burn…
- Watershed boundaries in the correct place?
  - To fence or not to fence…
DEM Errors – Sinks and Spikes

• Sinks: when sinks are (or are not) sinks
• E.g. Lakes, depressions, karst and glacial landscapes
  - Global fill
  - Dealing with internal basins
  - Selective fill
    - Depth
    - Area

Filled sink
Function Processing

Hydrologically conditioned DEM

Flow Direction tool

Flow Accumulation tool

Con tool

Apply flow accumulation threshold.

Streams

Flow Length tool

Stream Link tool

Stream Order tool

Stream to Feature tool

Flow length

Stream link

Stream order

Stream feature

Data

PROCESS
Flow Direction

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Elevation

Flow Direction

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Direction Coding
Flow Accumulation

```
0 0 0 0 0 0
0 1 1 2 2 0
0 3 7 5 4 0
0 0 0 20 0 1
0 0 0 1 24 0
0 2 4 7 35 2
```
Stream Link

- Assign a unique value to each stream segment.
- Can be used as input to Watershed tool
Creating Vector Streams

Value = No Data

StreamToFeature

RasterToFeature
Stream Ordering

Strahler

Shreve
Flow Length

- Calculate the length of the upstream or downstream flow path from each cell.
Function Processing

1. Hydrologically conditioned DEM → Flow Direction tool → Watershed tool → Watershed
2. Pour point:
   - Want to snap pour point?
     - Yes → Flow Accumulation tool
     - No → Snap Pour Point tool
Snapping Pour Points

- Use the Snap Pour Point tool to snap the “pour point” of a watershed to the cell of highest flow accumulation within a neighborhood.
  - Prevents accidental creation of tiny watersheds on channel side slopes.
Watershed Delineation

- Identify the contributing area to a cell or group of cells.
Where is this functionality?

- Tools in the Spatial Analyst Toolbox
- Sample tools, models, workflows and Arc Hydro tools are available in GeoNet and Geoprocessing tool gallery
- Web hosted Watershed Delineation and Trace Downstream in:
  - ArcMap and Pro as Ready to User Services
  - ArcGIS Online Analytics
  - Web AppBuilder
Hosted Hydro Analysis Services

- Watershed Delineation Service
- Trace Downstream Service
- Profile Service
- Elevation Summary Statistics

Source
US – based upon 30 m elevation and vectors derived from NHDPlus V2
Global – based upon 90 m elevation from HydroSHEDS
New contributions welcome through Community Maps…

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   - Download the Esri Events app and find your event.
2. **Select the session you attended**
   - Select the session you attended.
3. **Scroll down to find the survey**
   - Scroll down to find the survey.
4. **Complete Answers and Select “Submit”**
   - Complete Answers and Select “Submit”.