Esri International User Conference | San Diego, CA

Technical Workshops | July 2011

Creating Watersheds and Stream Networks

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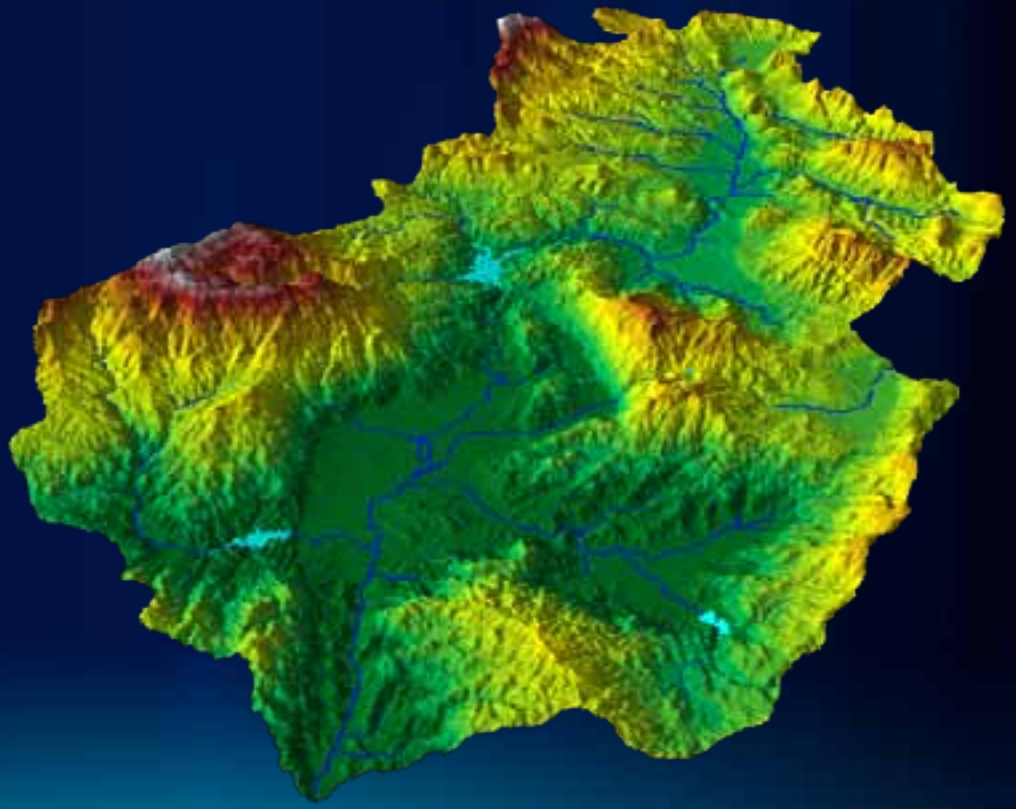
Elevation Data

- Types
  - DEM : Digital Elevation Model “bare Earth”
  - DSM : Digital Surface Model
- Data Structure
  - Raster
  - TIN
  - Terrain



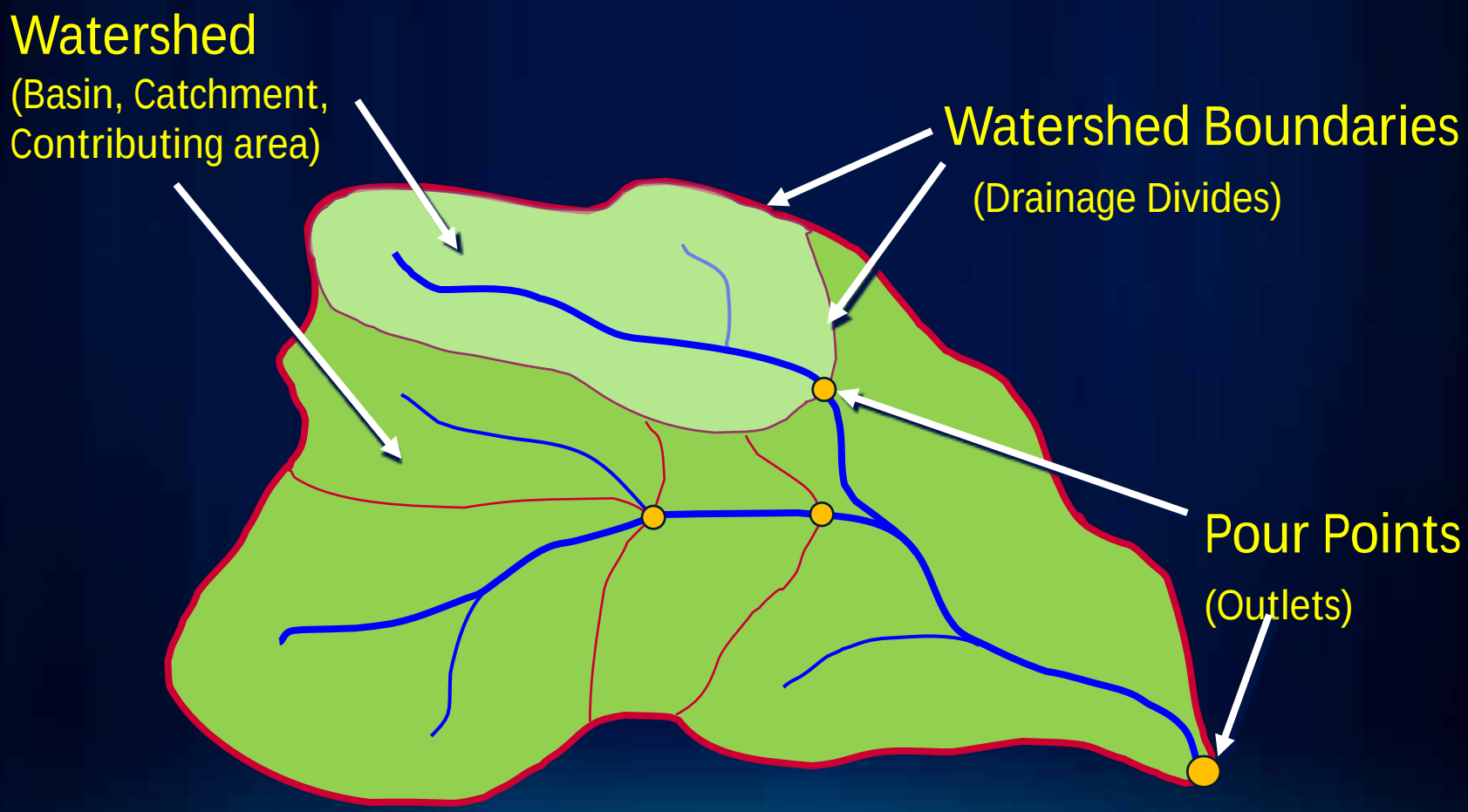
Where do you get DEM data?

- **Sources** http://seamless.usgs.gov/
  - Global
    - GTOPO30 - 1 km
    - SRTM - 90m
    - ASTER - 30m
  - United States NED 30m and 10 m
- LiDAR, IfSAR
- Generated photogrammetrically
- Created with interpolation tools
  - especially TopoToRaster

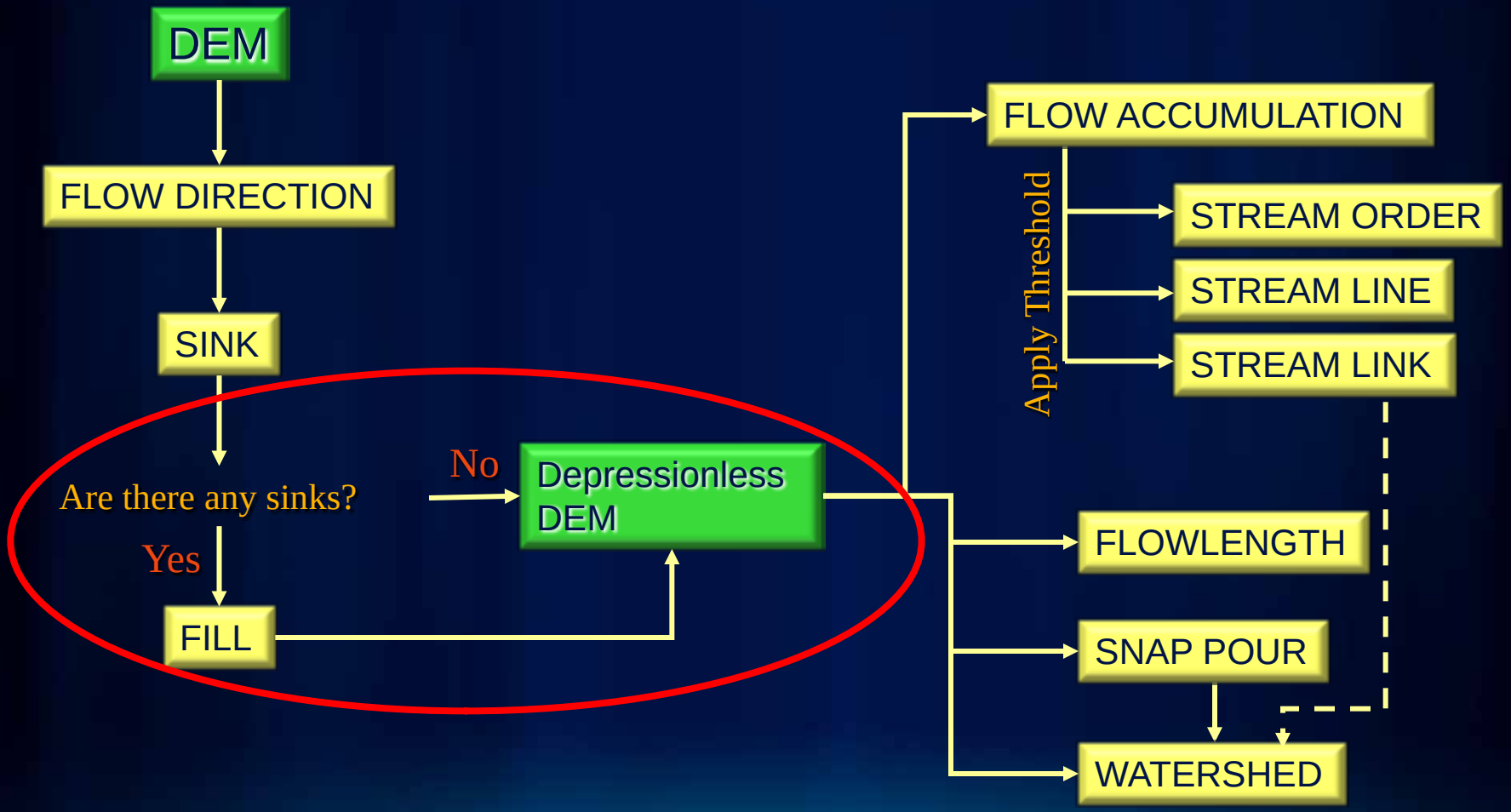
DEM Construction Considerations

- **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**

Drainage System



Function Processing



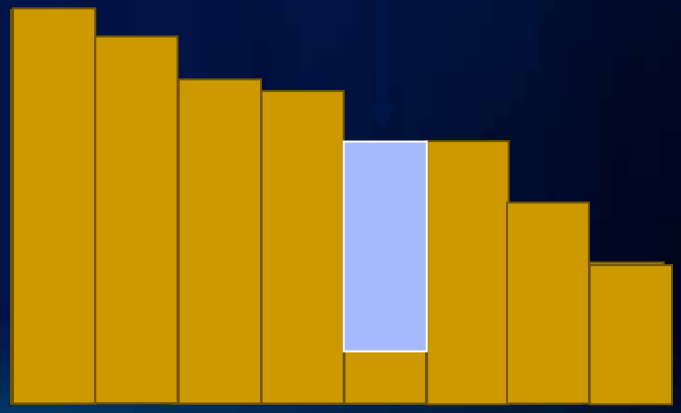
Hydrologically Correct DEM

- 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



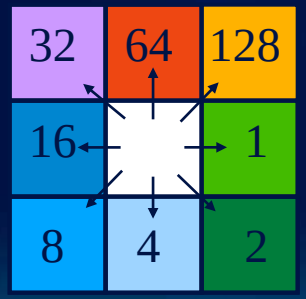
Flow Direction

78	72	69	71	58	49
74	67	56	49	46	50
69	53	44	37	38	48
64	58	55	22	31	24
68	61	47	21	16	19
74	53	34	12	11	12

Elevation

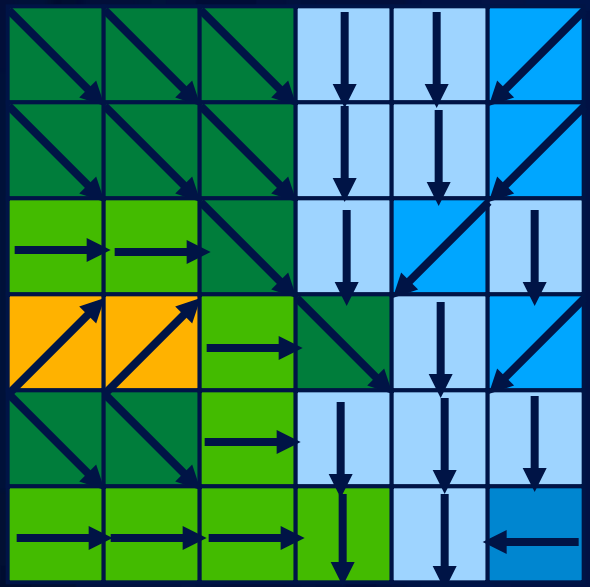
2	2	2	4	4	8
2	2	2	4	4	8
1	1	2	4	8	4
128	128	1	2	4	8
2	2	1	4	4	4
1	1	1	1	4	16

Flow Direction

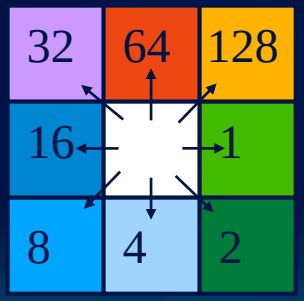


Direction Coding

Flow Accumulation

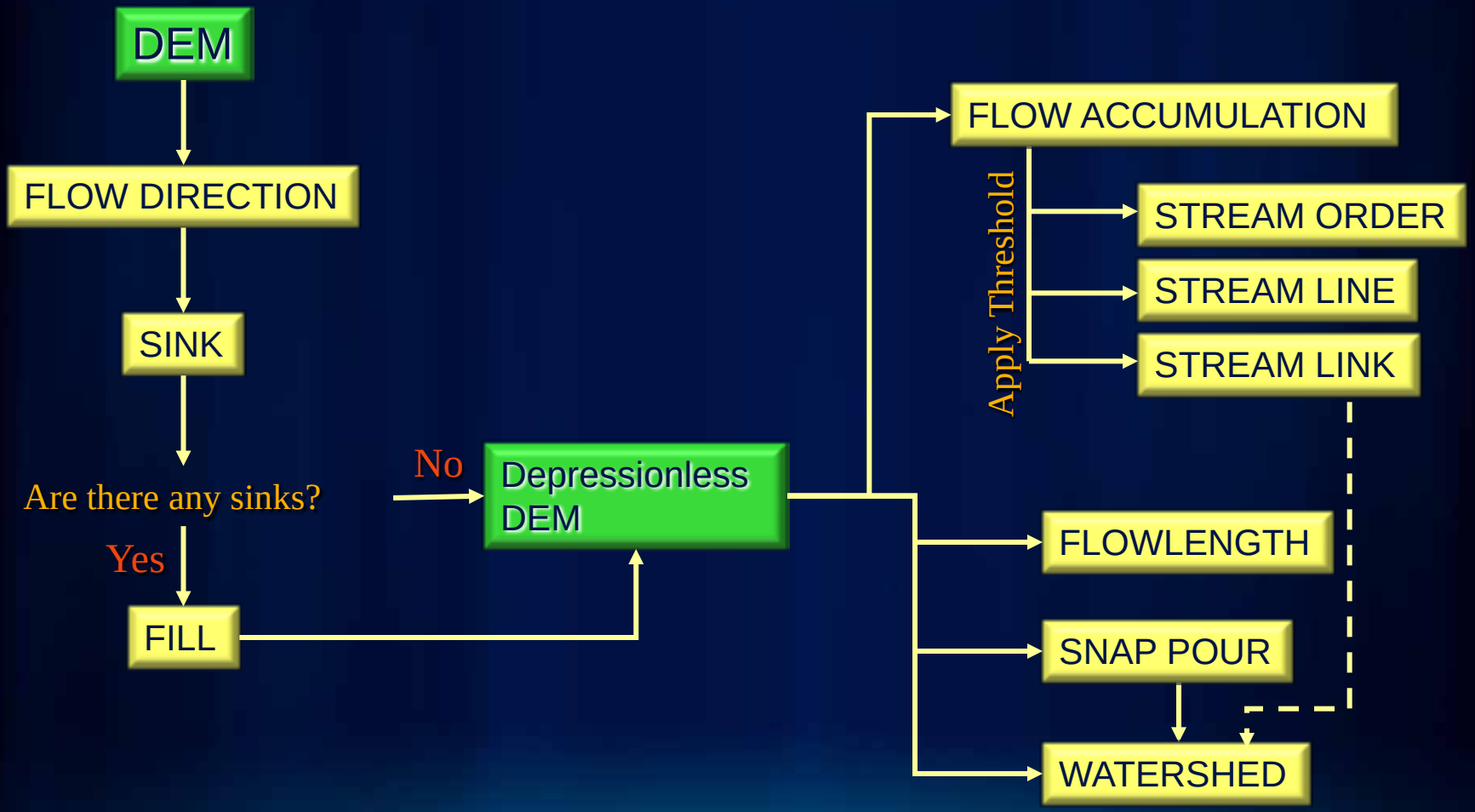


0	0	0	0	0	0
0	1	1	2	2	0
0	3	7	5	4	0
0	0	0	20	0	1
0	0	0	1	24	0
0	2	4	7	35	2



Direction Coding

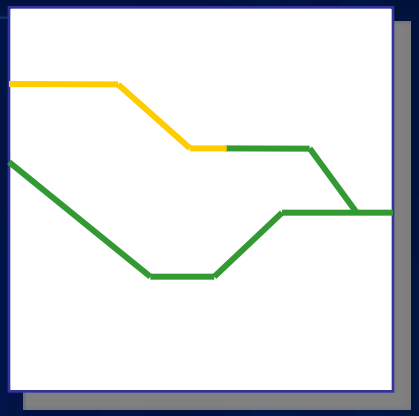
Function Processing



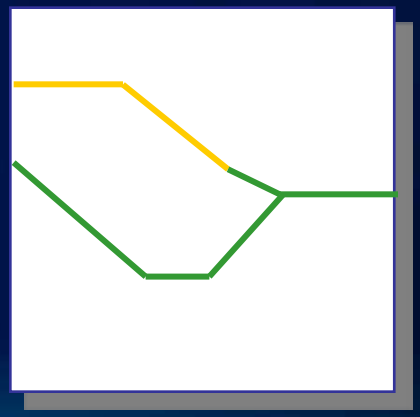
Creating Vector Streams

Value = No Data

1	1				
		1	2	2	
2			2	2	2
	2	2			



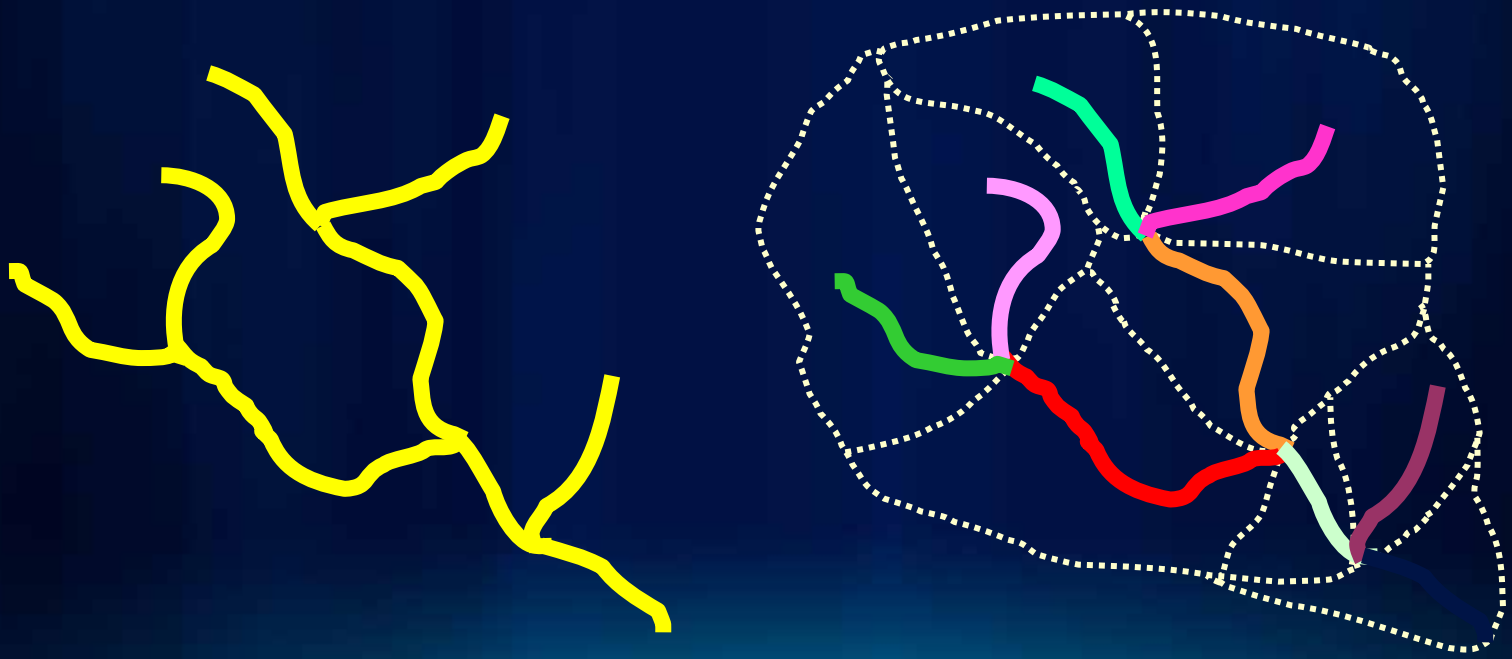
StreamToFeature



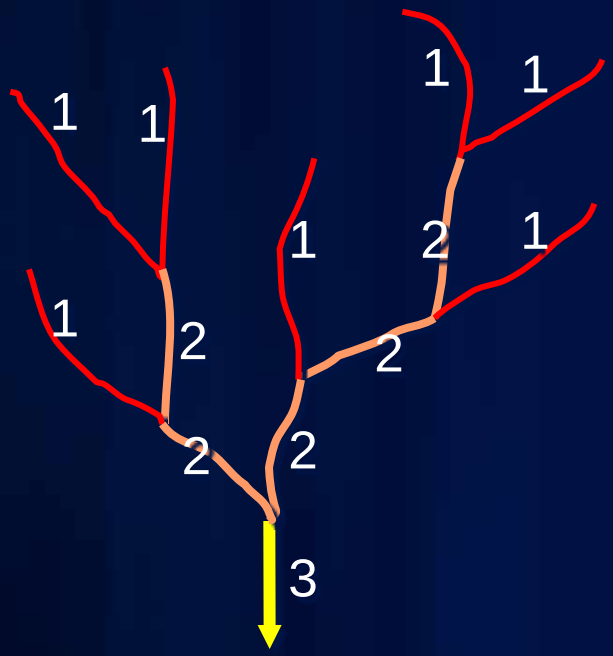
RasterToFeature

Stream Link

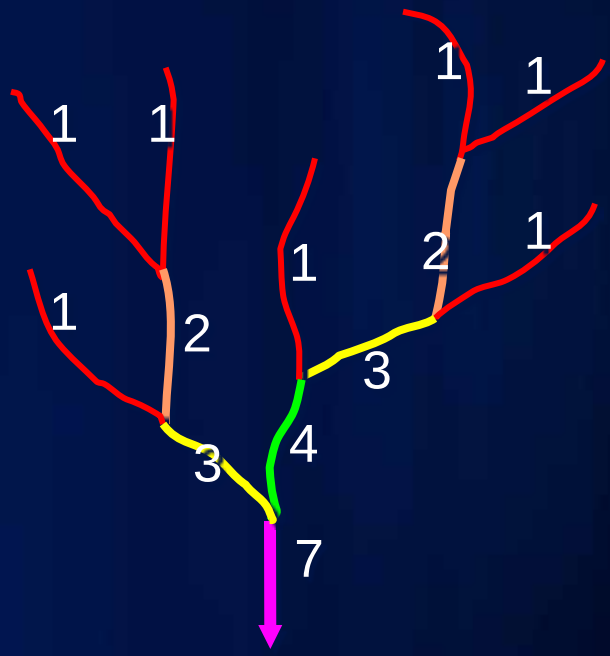
- Assign a unique value to each stream segment.
  - Can be used as input to Watershed tool



Stream Ordering



Strahler



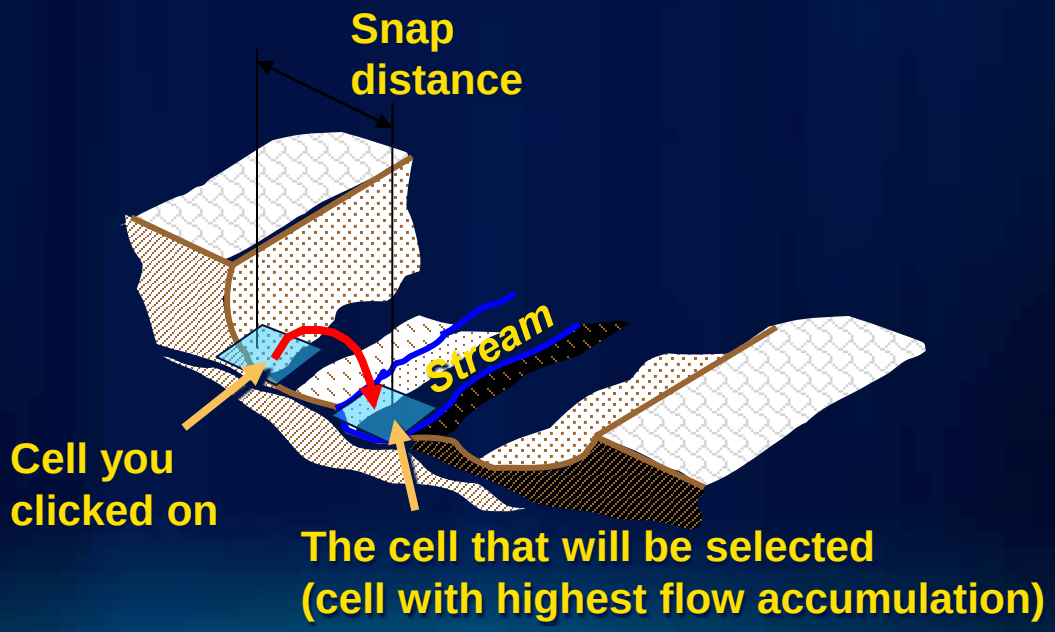
Shreve

Watershed Delineation

- Delineate the contributing area to a cell or group of cells.

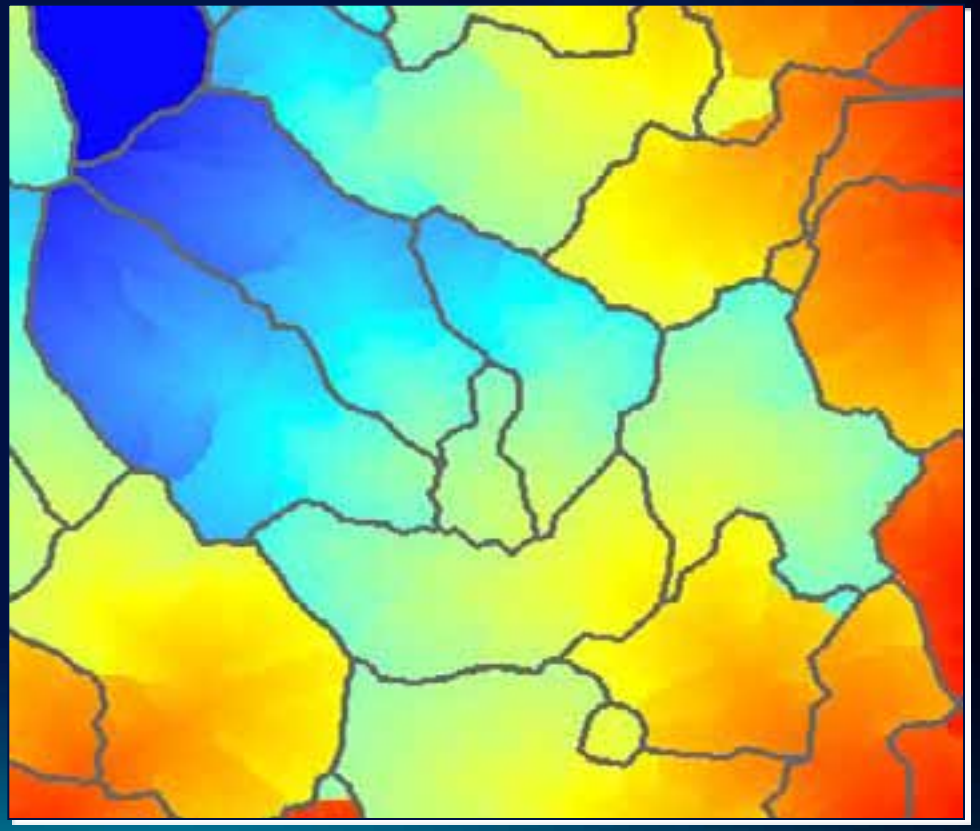
Snapping Pour Points

- Use the SnapPour 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.



Flow Length

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



Where is this functionality?

- Tools in the Spatial Analyst Toolbox
- Sample ModelBuilder model on the Geoprocessing Resource Center
- Arc Hydro data model tools

http://resources.arcgis.com/content/hydro

Questions & Answers

Please fill out the session evaluation forms
www.esri.com/sessionevals

Thank you

Summarizing Watershed Characteristics

- Use the Zonal Statistics tool

- A "*zone*" is all the areas/cells with the same value
- Calculate a statistic within the zones for each cell in a raster

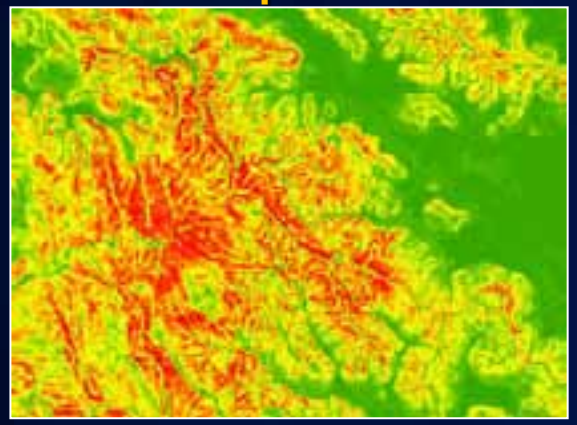
- Input zones can be feature or raster

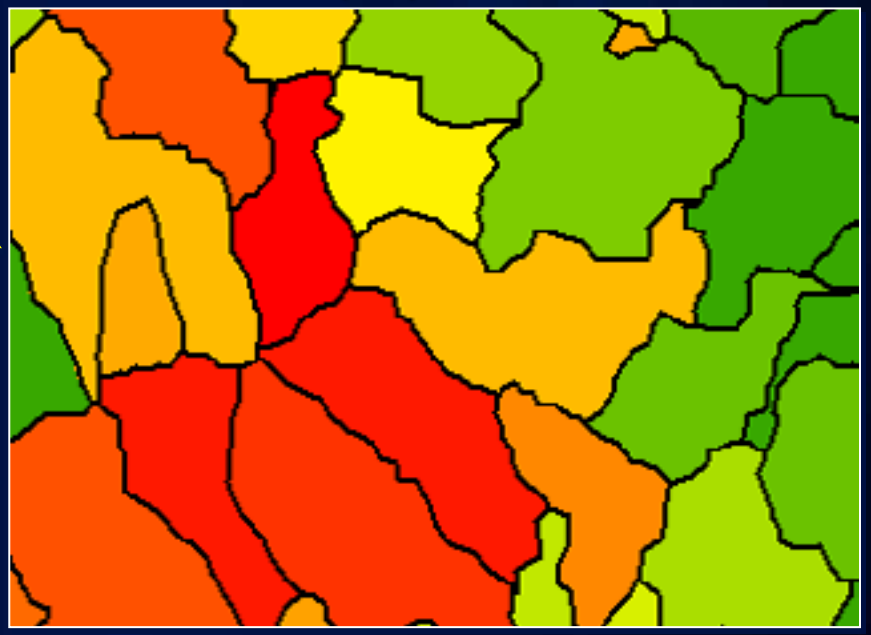
- Output as a raster, summary table, or chart
  - Max flow length per watershed
  - Average slope per watershed
  - Average curve number per watershed

Summarizing Watershed Characteristics

Using the Zonal Statistics tool

Slope



Watersheds

Mean Slope per Watershed