



Creating Watersheds and Stream Networks

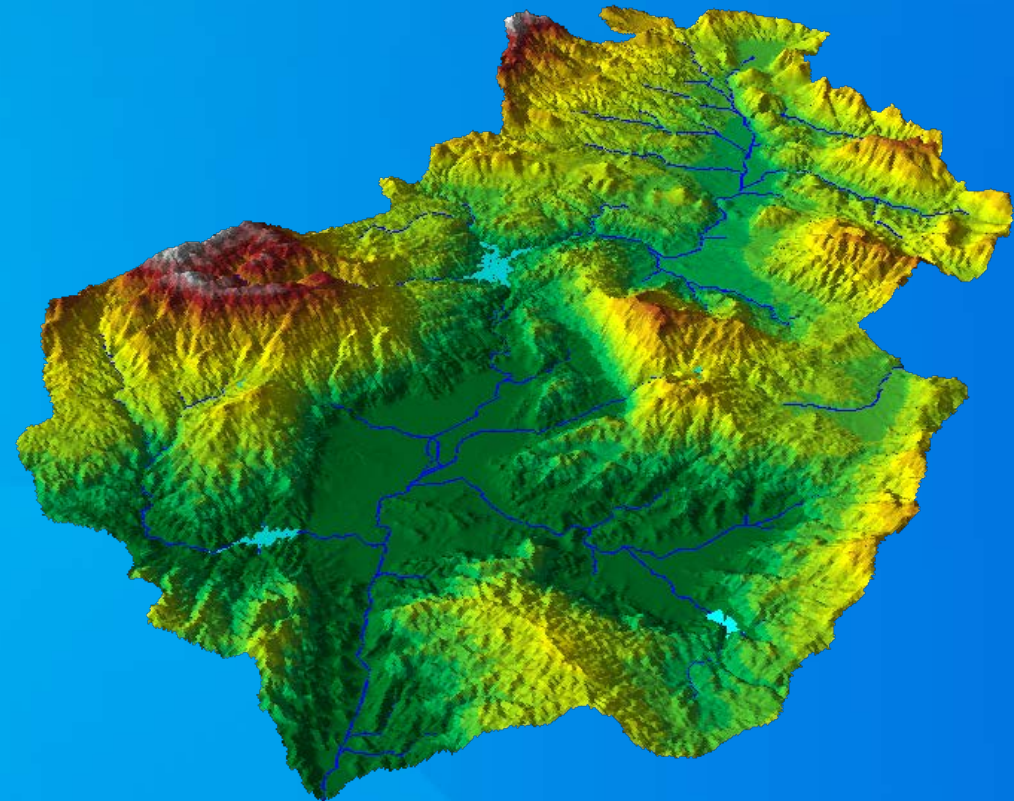
Steve Kopp

Workshop Overview

- Demo
- Data
- Understanding the tools

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 (ArcGIS Online)**
- **LiDAR, IfSAR**
- **Generated photogrammetrically**
- **Created with interpolation tools**
 - **especially TopoToRaster**

DEM Construction Considerations

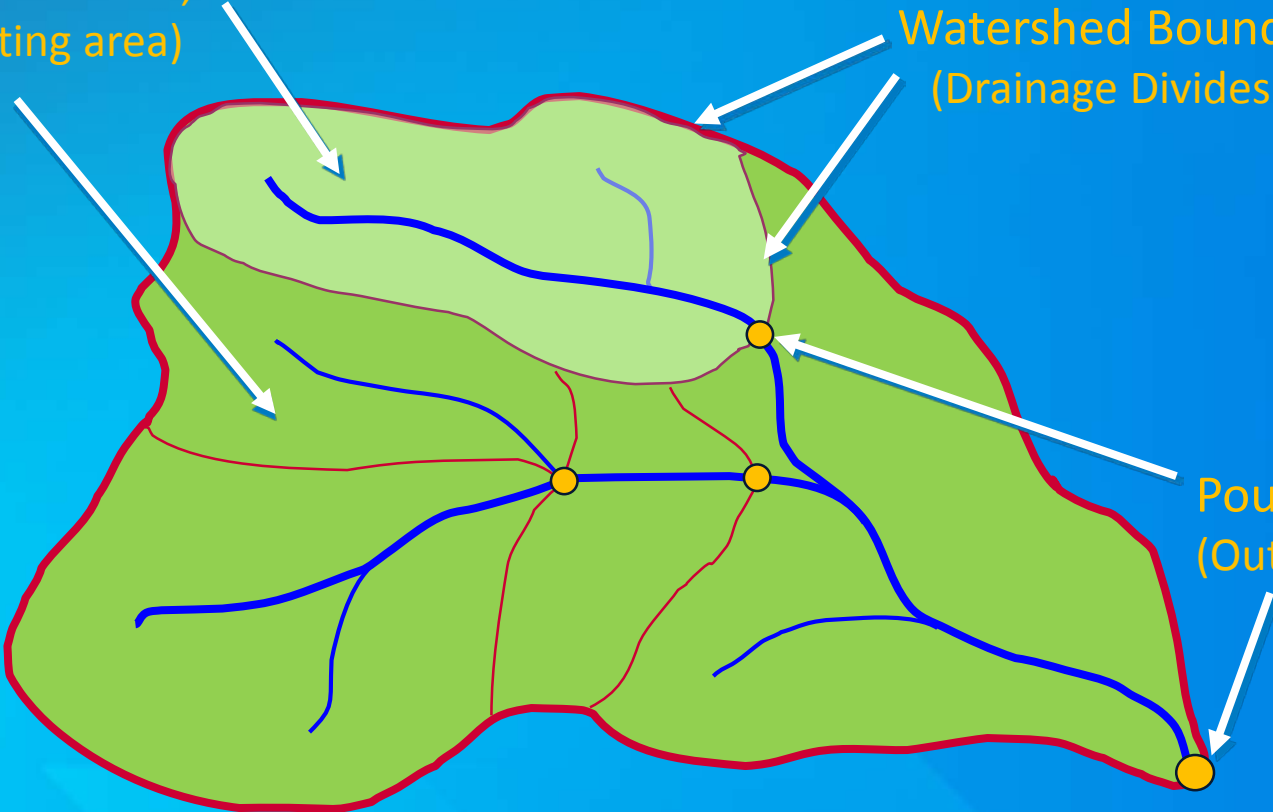
- **Extent**
- **Map Projection (use equal area)**
- **Cell size and Resolution**
 - *Must be appropriate for the landscape and scale being modeled.*
- **Source elevation data (accuracy, density, sampling)**
- **Interpolation techniques (use TopoToRaster)**
- **Special consideration for contour input**
 - TopoToRaster interpolator – works well with contours, creates hydrologically correct DEM

Drainage System

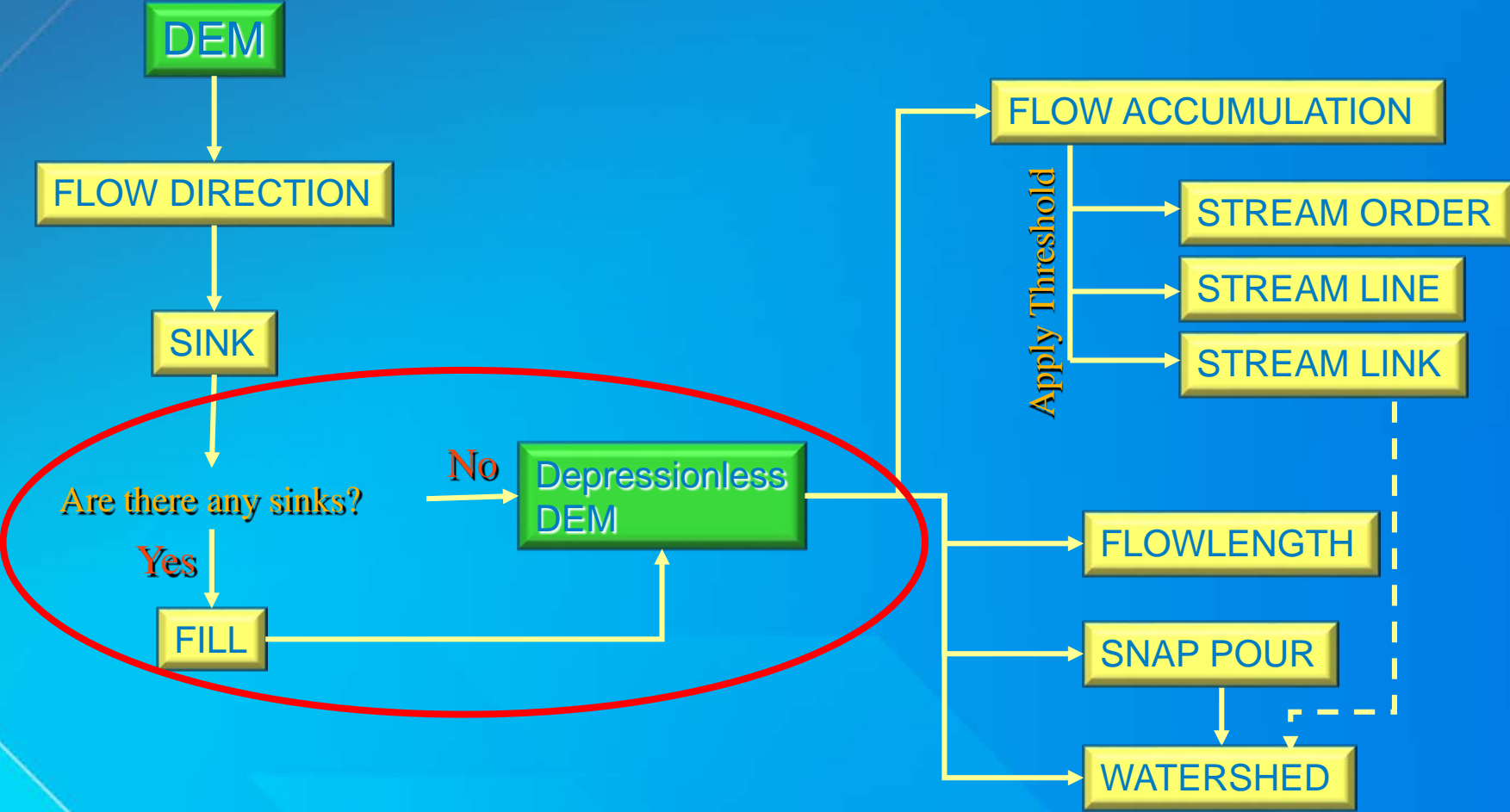
Watershed
(Basin, Catchment,
Contributing area)

Watershed Boundaries
(Drainage Divides)

Pour Points
(Outlets)



Function Processing

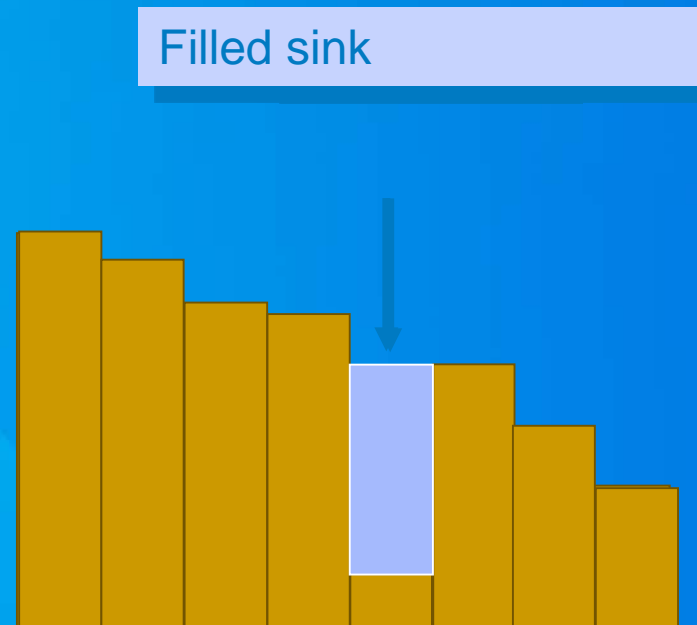


Hydrologically Correct DEM

- **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



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



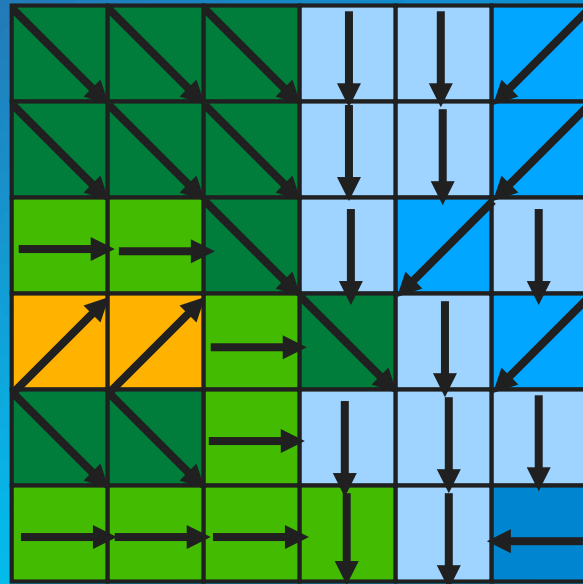
2	2	2	4	4	8
2	2	2	4	4	8
1	1	2	4	8	4
128	128	1	2	4	8
2	2	1	4	4	4
1	1	1	1	4	16

Flow Direction

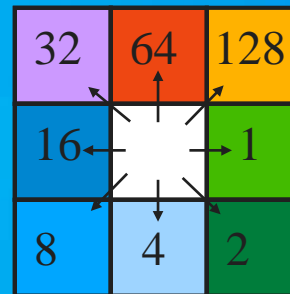
32	64	128
16		1
8	4	2

Direction Coding

Flow Accumulation

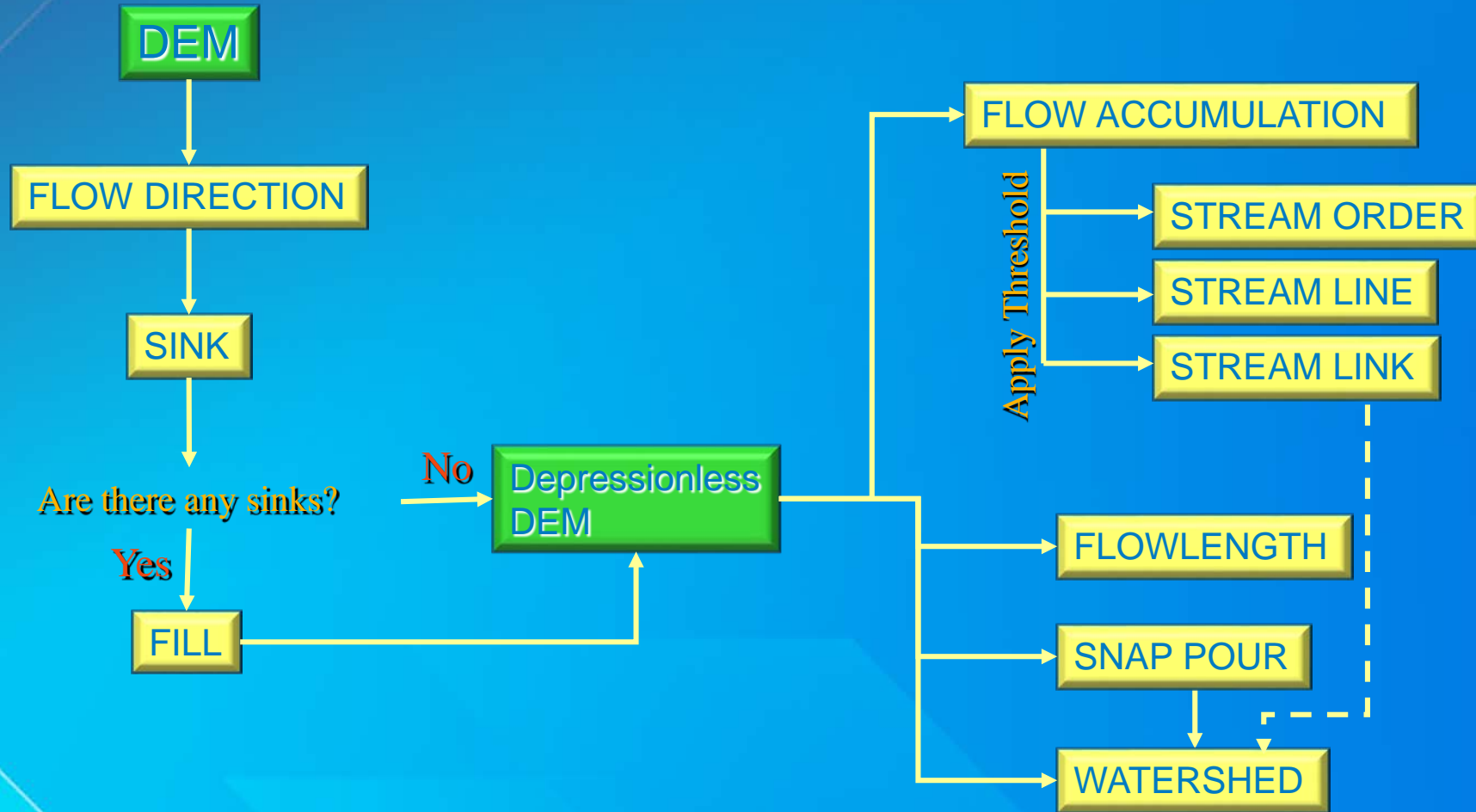


0	0	0	0	0	0
0	1	1	2	2	0
0	3	7	5	4	0
0	0	0	20	0	1
0	0	0	1	24	0
0	2	4	7	35	2



Direction Coding

Function Processing

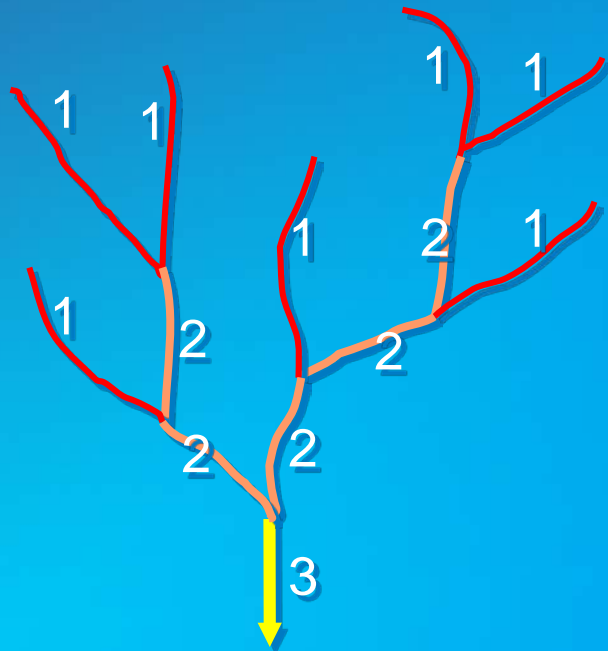


Stream Link

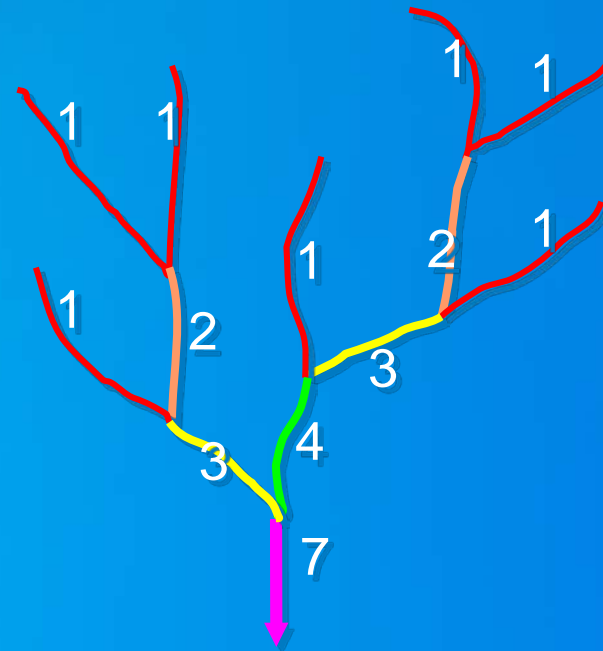
- Assign a unique value to each stream segment.
 - Can be used as input to Watershed tool



Stream Ordering



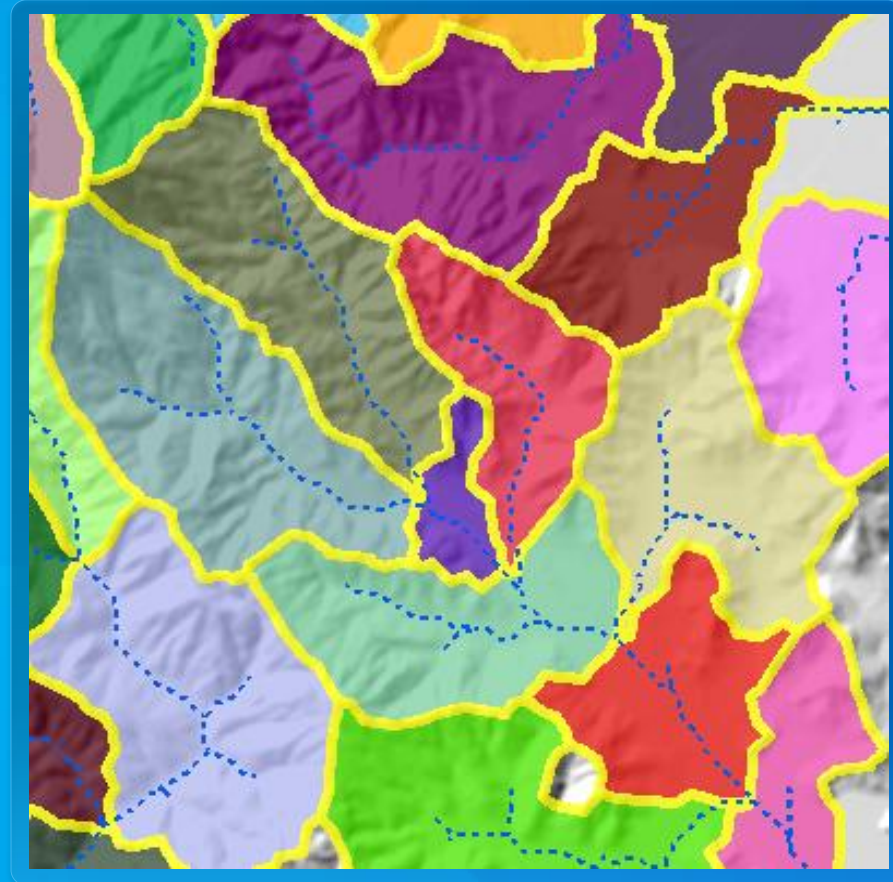
Strahler



Shreve

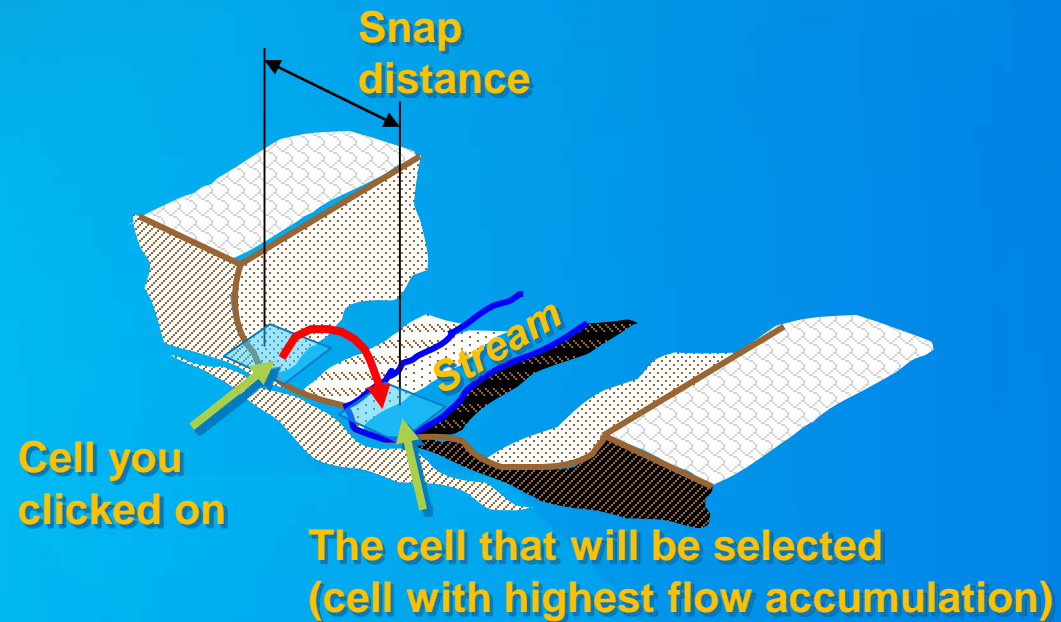
Watershed Delineation

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



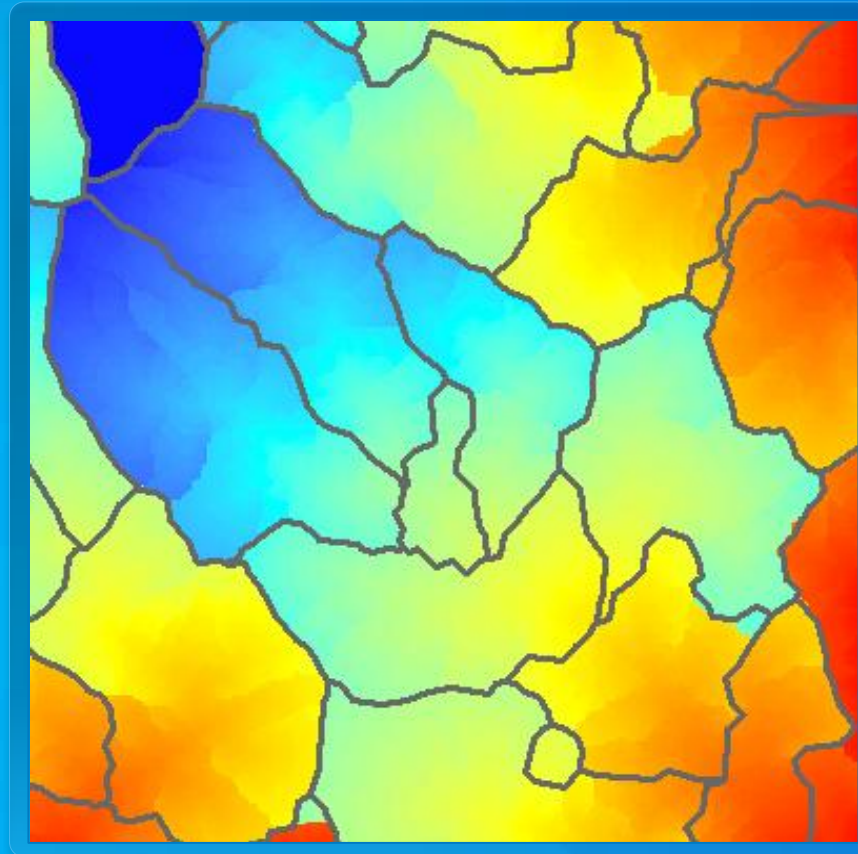
Snapping Pour Points

- 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.

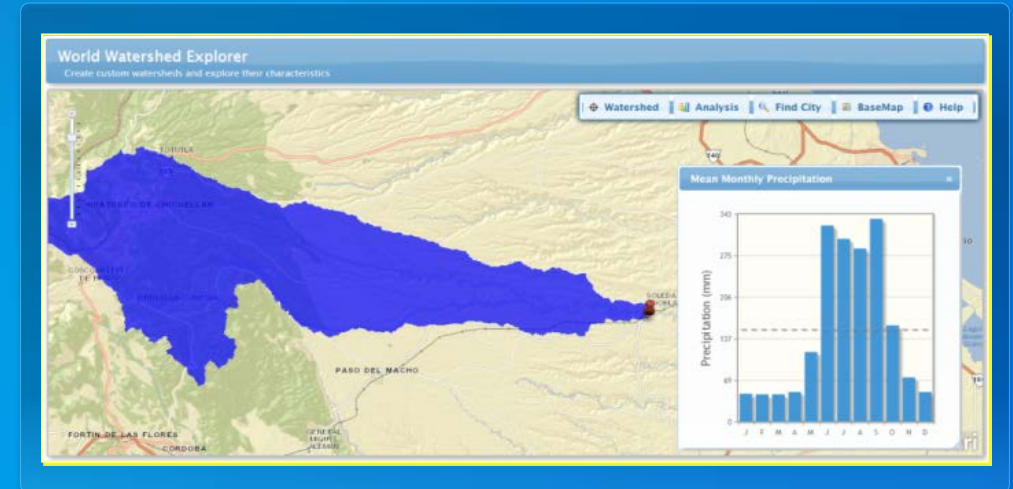


Where is this functionality?

- **Tools in the Spatial Analyst Toolbox**
- **Global Watershed Delineation and Trace Downstream in ArcCatalog Ready to User Services, ArcGIS Online Analytics and Web AppBuilder**
- **Sample tools, models, workflows and Arc Hydro tools) are available in GeoNet, Geoprocessing tool gallery, and Hydro Resource Center**

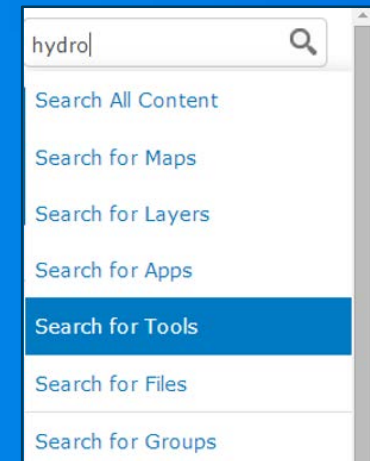
Hosted Hydro Analysis Services

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



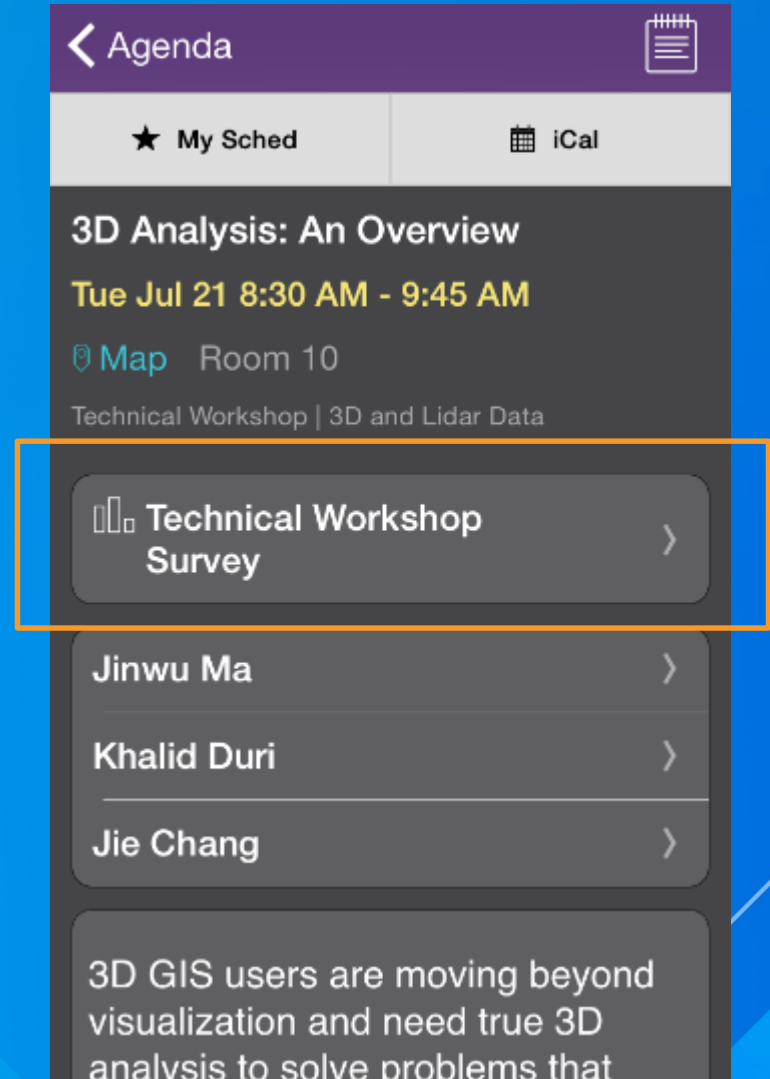
- **Source**

- US – based upon 30 m elevation and vectors derived from NHDPlus V2
- Global – based upon 90 m elevation from HydroSHEDS
- *New contributions welcome...*



Thank you...

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Understanding our world.