Geol 588

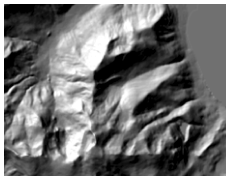
-

GIS for Geoscientists II

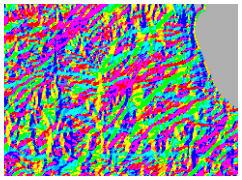
(Feb 15. 2011)

Surface analysis tools and
Neighborhood (focal) tools

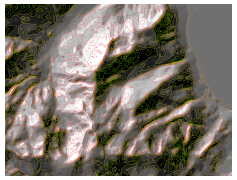
Using surfaces in ArcGIS Spatial Analyst



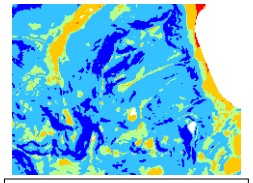
Hillshade (typically as semi transparent overlay)



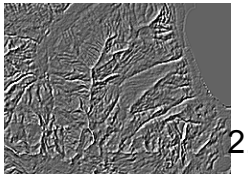
Aspect (8 different directions only)



Contour (lines)



Slope (degrees or percent, may need elevation conversion factor if elev. is in feet)



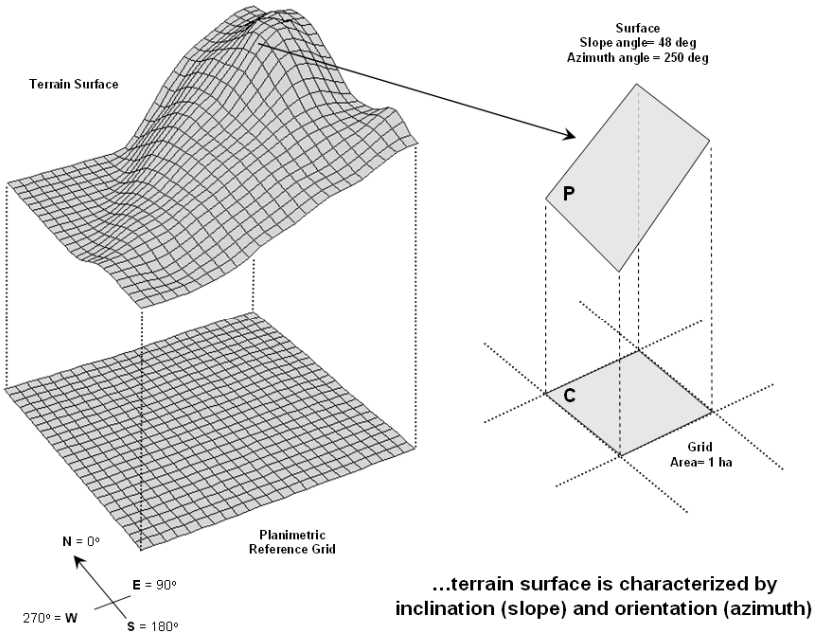
2. order change

Curvature (change of slope i.e. change of change of elevation)

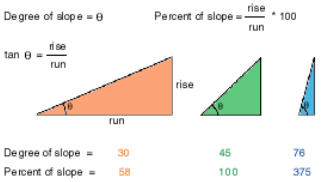
Digital Elevation Model (DEM)

- Digital Terrain Model (DTM)
- topography: Elevation (ft. or meter, sometimes: elevation in feet, horizontal distances in meters!)
- US Geological Survey:
  - 7.5' maps (quads), 10 m, 30 m; 90 m
- National Elevation Dataset (NED): 10 m
- Shuttle Radar Topography Mission (SRTM): 90 m
- raster values: large integers (1243 ft) or float (543.2 m)

Slope & Azimuth



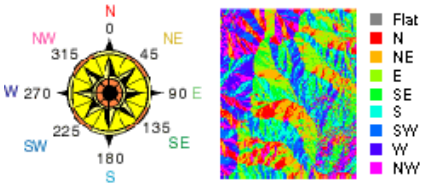
...terrain surface is characterized by inclination (slope) and orientation (azimuth)



Slope

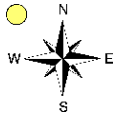
- Based on elevation difference of cell to elevation of surrounding cells
- Gradient at cell (center)
- Problem: if X/Y are in meters, elevation (Z) is in feet
- Solution: multiply elevation by 3.280 (Z-factor)
- Tool: Spatial Analyst tools Surface - Slope

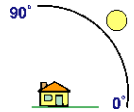
Aspect



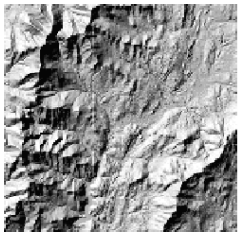
- direction of maximum rate of change at cell's center
- looking down to the maximum slope (geology: dip direction)
- in degrees (0 - 360) from North, *circular* data type
- flat areas (0 slope): encoded as -1
- on floating point DEM, a very small slope (< 0.01) should be filtered to 0
- Default colors (can be changed:
  - visually reduced into the 8 major directions
  - flat areas a shown grey
- Tool: Spatial Analyst tools Surface - Aspect

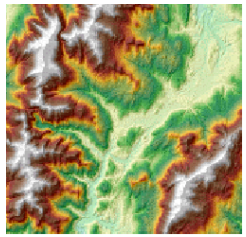
Hillshading



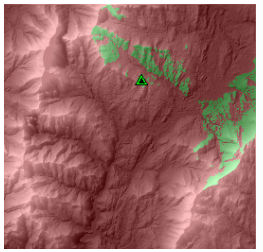


- Trick to fool our eyes to see 3D relief
- Simulate Sun from direction (0-360) and angle (0-90)
- Creates a grey scale raster (0-255, black -> white)
- Gotcha: Sun must be in the North (270 - 90), otherwise relief looks inverted (human evolution: sun from above)
- 10-50% transparent, drape over DEM
- play with contrast and brightness settings
- Tool: Spatial Analyst tools - Surface - Hillshade
- geol588\data\Hillshade Tools - ArcGIS 9.3 special hillshade methods (not sure if they still work in ArcGIS 10 ...)



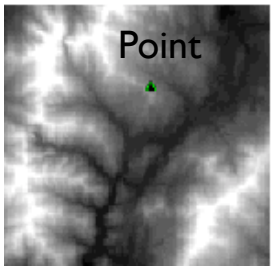


Viewshed

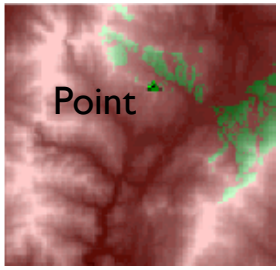


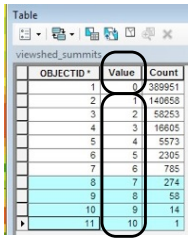
- needs a shapefile with points or lines
- Which cells can be seen from these points?
- Shoots rays from point to each cell, check for intersect with terrain
- Tool: Spatial Analyst tools - Surface - Viewshed
- Observer points tool:
  - which points can see other points? (limit 16 points)
  - can include height of point ("towers"), limit azimuth, ...
  - creates a table only

Elevation raster



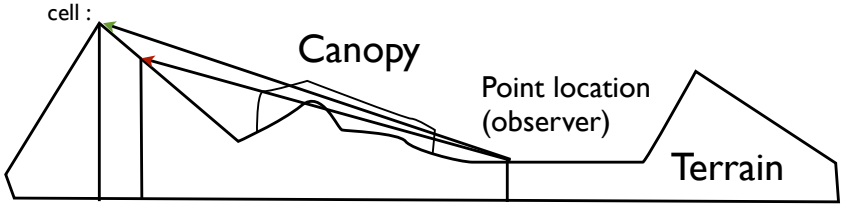
Viewshed raster





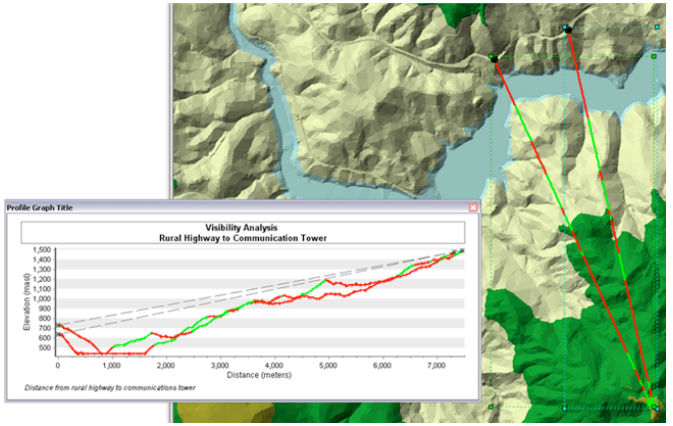
Green cell: can be seen from 1 (or more) point
Red cells: view from point is obstructed (0)

location of a Green cell :



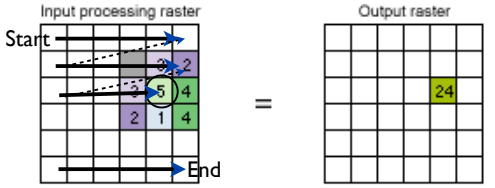
Red cell: Location can NOT be seen

Related Tool: 3D analyst Toolbar - Create Line of Sight



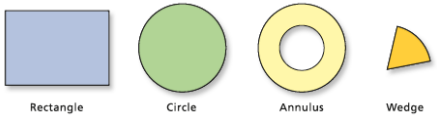
Neighborhood function tools

- go through ALL cells (locations) c input raster one by one
- for each cell, do some sort of math involving it's "neighbors"
- e.g.: calculate the SUM of *all* cells "around" it - write that one value into output raster - go to next cell
- different neighborhood shapes (Geometries)
- use a kernel (3 x 3) to filter raster (mean => low-pass filter)
- Spatial Analyst Tools - Neighborhood



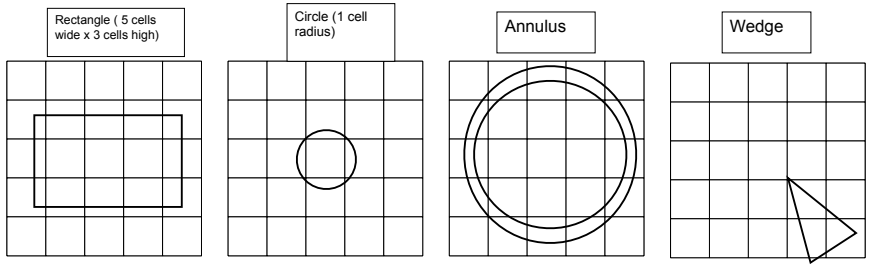
current cell location within input raster

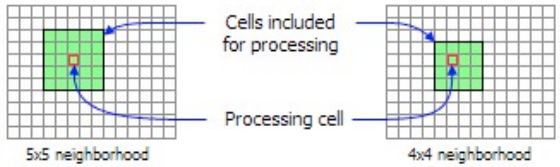
result at that location in output raster



Focal Statistics tool

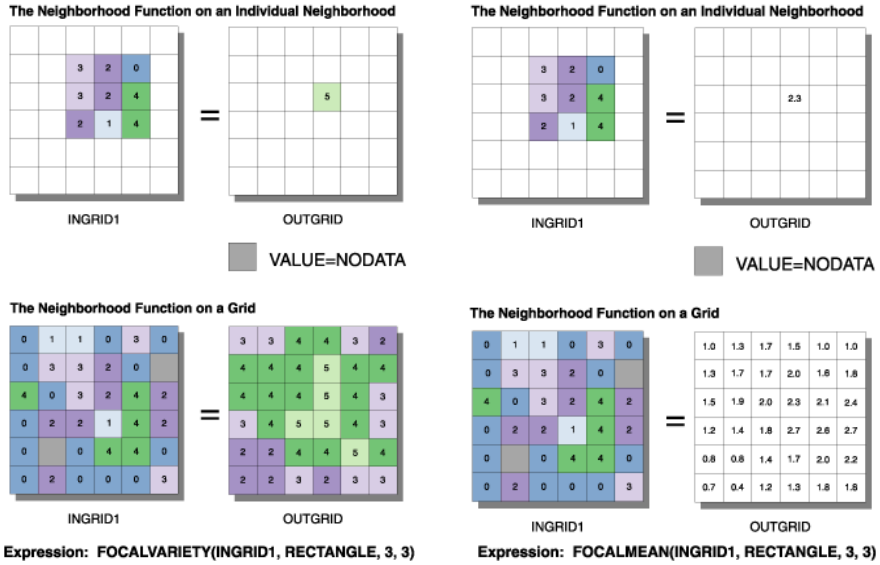
Neighborhood "geometry":
green current cell, yellow: (red) neighbor cells





What type of math (statistics) should be done with the neighborhood cell's values?

Variety: how many different (int) values?



Mean: average of (int, float) values

- Statistics type for Focal Statistics tool:
- MEAN — Calculates the mean (average value) of the cells in the neighborhood.
- MAJORITY — Calculates the majority (value that occurs most often) of the cells in the neighborhood. (INT only)
- MAXIMUM — Calculates the maximum (largest value) of the cells in the neighborhood.
- MEDIAN — Calculates the median of the cells in the neighborhood.
- MINIMUM — Calculates the minimum (smallest value) of the cells in the neighborhood.
- MINORITY — Calculates the minority (value that occurs least often) of the cells in the neighborhood. (INT only)
- RANGE — Calculates the range (difference between largest and smallest value) of the cells in the neighborhood.
- STD — Calculates the standard deviation of the cells in the neighborhood.
- SUM — Calculates the sum (total of all values) of the cells in the neighborhood.
- VARIETY — Calculates the variety (the number of unique values) of the cells in the neighborhood. (INT only)