GEOL 452/552 - GIS for Geoscientists I

Lecture 21 - Chapter 8 (Raster Analysis, part2)

- Talk about class project
- (copy follow_along_data\CH8a_class_ex into U:\ArcGIS\ if needed)
- Catch up with lecture 20 (distance functions)
- Digital Elevation Models (DEMs), Topographic functions (surface analysis): slope, aspect hillshade, viewshed, contours, profiles
- (block statistics functions, needed for ch 8 ex. 3)
- Talk about USGS Seamless raster data server
- lab today: Ch 8 Tut 18 - 35

Final project:

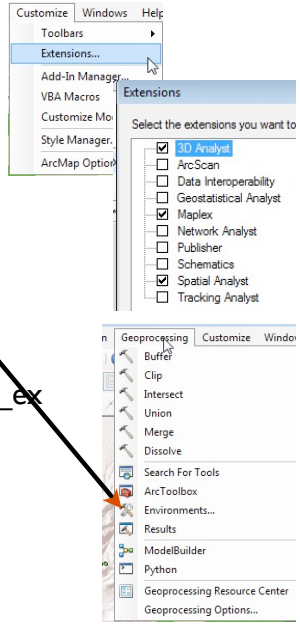
- Geol 552: mandatory, Geol 452: extra credit
- (needed to count as part of GIS certificate)
- Emphasis on **combined** analysis: (spatial) queries, (spatial) join, geoprocessing; and effective result presentation
- Mostly (only) vector data is OK (raster as "background")
- Suggestion: Expand on Miniproj 2 theme
- Don't get too hung up on finding "right" data
- OK to use DNR Iowa data (environmental, people, transport, commercial locations, water) on p-drive

- Preferable: something about your own research
- Fallback (easy to get started): Do a suitability analysis with Iow or US data
- Nov. 17: give me 1 paragraph project description: goal, methods, data
- work on project Nov. 17 - Dec. 8
- Dec. 8, 10 min/10 slide powerpoint **presentation**
- Digital Poster (36" x 27") as 96 dpi jpg, due Friday Dec. 15 (last day of finals week)
- Everybody needs to attend presentations Dec. 8, 9-11 (vote for best presentation)

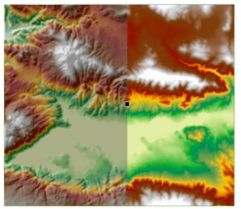
10-Nov	Ch 8 - Raster Analysis	terrain functions
15-Nov	Ch 8 - Raster Analysis	zonal analysis
17-Nov	Ch 8 - Raster Analysis	lidar ex. / suitability analysis
22-Nov	Thanksgiving Break	Thanksgiving break
24-Nov		Thanksgiving break
29-Nov	Work on Class Project (Geol 552)	Work on class project
1-Dec		Work on class project
6-Dec	Review for Final	Work on class project
8-Dec	Project Presentations	
TBA	Final exam	

Class exercise

- Activate **Spatial Analyst** and **3D analyst** extensions
- Keep using dem.img in ch8a_class_ex as DEM
- set Environment extent to extent of dem_float.img
- set Environment Workspace to your U:\ArcGIS\ch8a_class_ex folder
- Always create .img rasters in your ch8a_class_ex folder!
- Now: => lecture 20, last 4 slides (Distance functions)
- (who needs handouts from last class?)

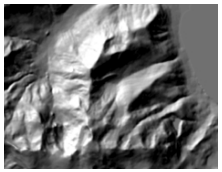


Digital Elevation Model (DEM)

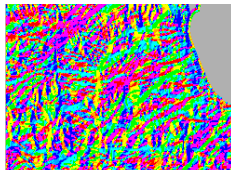


- also: Digital Terrain Model (DTM)
- topography: Elevation (ft. or meter, sometimes: elevation in feet, but horizontal distances in meters!)
- (10 m = 1/9 arc second, 30 m = 1/3 arc sec., 90 m = 1 arc sec.)
- Data (US Geological Survey)
  - National Elevation Dataset (**NED**): 10 m, 30 m, 90 m
  - Shuttle Radar Topography Mission (**SRTM**): 90 m
- LiDAR data (for Iowa in progress): <1 m horizontal, ~ 20 cm vertical
- Elevation (Z-direction) in feet or meters? (important for slope, hillshade, viewshed)

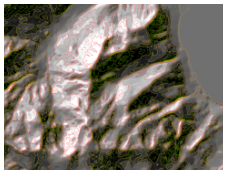
Common surface analysis methods



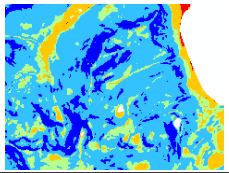
Hillshade - simulates about of light received from the sun



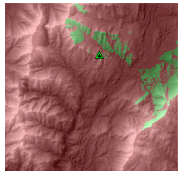
Aspect (which direction does the hill point to?)



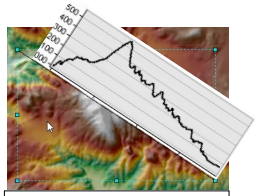
Contour (lines of equal elevation)



Slope (steepness of the hill) degrees or percent)



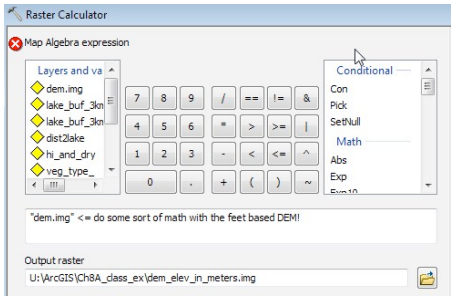
Viewshed (which cells are visible from a viewpoint?)



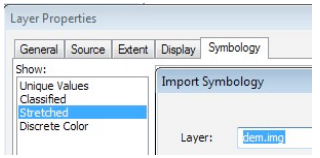
Profile (horizontal cut through DEM along a line)

Convert feet-based DEM to meter

- dem.img: (floats) x/y are already in meters but cell's VALUE are in feet (~2000 to ~ 2500)
- 1 meter = 3.2808399 feet
  1 foot = 0.3048 meters
- how can we use the Raster calulator tool to create a meter-elevation DEM from dem.img
- save as dem_elev_in_meters.img
- use Symbology - Import to color dem_elev_meters with same color as dem.img (ft)

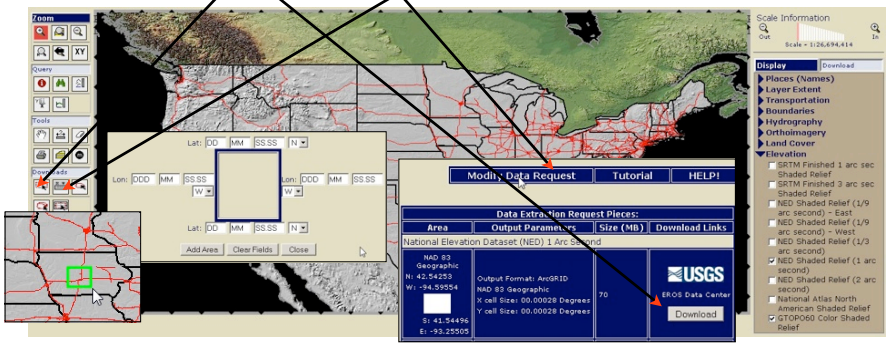


math is:

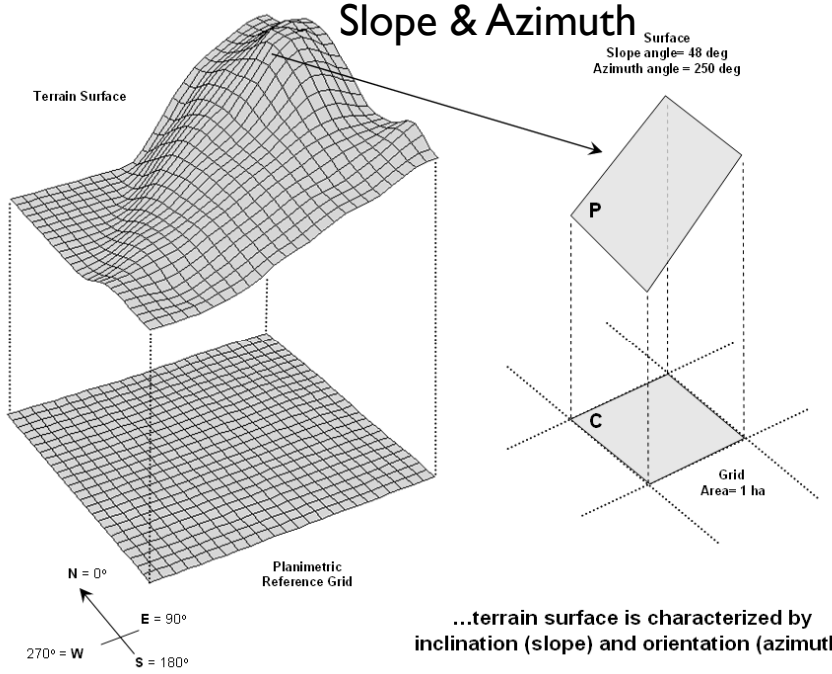


Seamless.usgs.gov

- Web based raster download (lots of good data, interface can be clunky!)
- Display = preview in Browser (not all types of data are available everywhere!)
- Request download area: interactive rectangle or extent (lat/long)
- Download data or modify Data request (wait for refresh)
- If possible get geotifs, warning: data can be large, don't download multiple files!

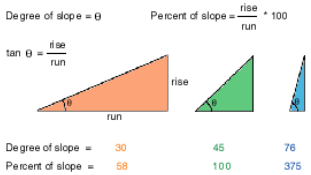


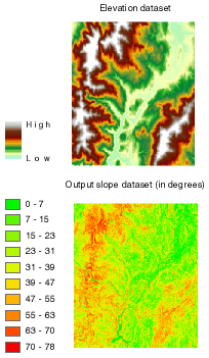
Slope & Azimuth



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

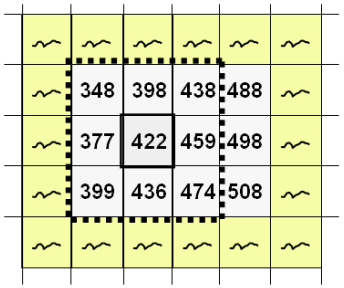
Slope





- Based on elevation difference of cell to elevation of surrounding cells (next slide)
- Gradient at cell (center)
- Perfectly flat: Slope = 0
- Gotcha: X/Y in meters, but elevation (Z) can be in feet
- Solution: multiply elevation by 3.280 (Z-factor)
- Spatial Analyst -> Surface Analysis or ArcToolbox - Spatial Analyst tools (not TIN slope!)

Elevation Data

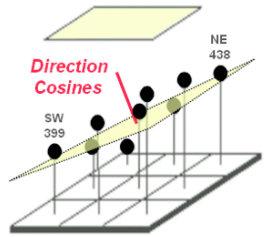


Eight Individual Slopes

N = (398 - 422) / (1.00 *100) = 24%
NE = (438 - 422) / (1.41 *100) = 11%
E = (459 - 422) / (1.00 *100) = 37%
SE = (474 - 422) / (1.41 *100) = 37%
S = (436 - 422) / (1.00 *100) = 14%
SW = (399 - 422) / (1.41 *100) = 16%
W = (377 - 422) / (1.00 *100) = 45%
NW = (348 - 422) / (1.41 *100) = 52%

Maximum = 52% Median = 30%
Minimum = 11% Average = 29%

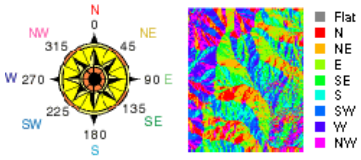
"Fitted" Plane



"Floating" Points

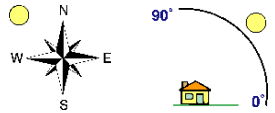
- Simple Slope Method (here slope is in %)
  - Elevation Differences Center to each of the 8 surrounding cell centers (= rise)
  - here: center-center distance (= run) always 100 (m
  - use average of these 8 slope values
- More complex method (used by ArcGIS)
  - fit plane through 9 points
  - calculate "tilt" vs horizontal
  - See Desktop Help "How Slope works"

Aspect

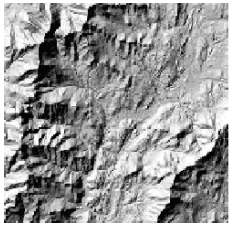


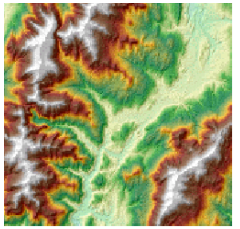
- cell center's **direction**, when looking down towards the maximum slope
- (think: which compass heading would water run?)
- in degrees (0 - 360) from North, *circular* data type
- flat areas (no slope): encoded as -1
- typical: show as 8 directions (colors)
- Looks like "3D" slopes (similar to hill shading)
- Spatial Analyst - Surface Analysis, ArctoolBox - Spatial Analysis Tools(!)- Aspect

Hillshading

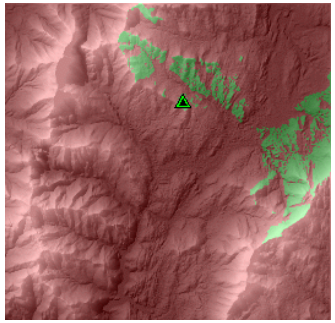


- Trick to fool our eyes to see terrain as 3D relief
- (Think: how do artists draw a 3D sphere with a pencil?)
- Simulate Sun from direction (0-360) and angle (0-90), creates grey scale map
- best color ramp: black = no sunlight, white = max. sunlight,
- Gotcha: Sun must be in the North (270 - 90), otherwise relief looks inverted (human evolution - sun from above?)
- "Smoothing" of grayscale raster: Display - Resample ... - Bilinear or Cubic (Also: Contrast 10% - 30%)
- Similar to Slope (also a "gradient"), good in combination with other layers
- Make10% - 50% transparent, drape over other layer (DEM, slope, etc.) and/or contour lines
- Spatial Analyst - Surface Analysis, ArctoolBox - Spatial Analysis Tools(!)



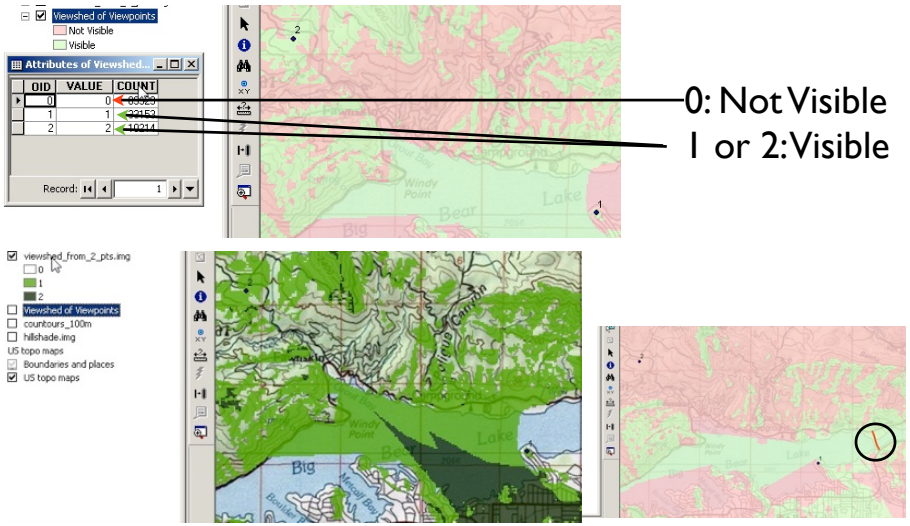


Viewshed



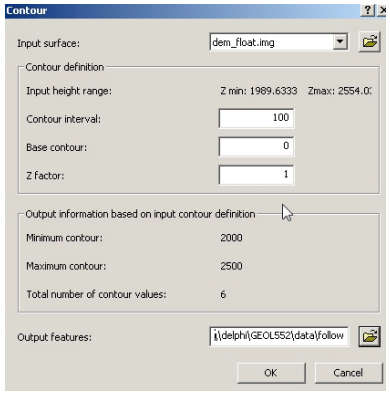
- needs DEM + shapefile with points
- Which cells can be seen from these points? (red = no, green = yes)
- Shoots **rays** from point to each cell, check for intersect with terrain
- Can also use lines (visible from road, river, etc.?)
- Observer points tool: which points can see other points?
- Spatial Analyst - Surface Analysis, ArctoolBox - Spatial Analysis Tools(!)

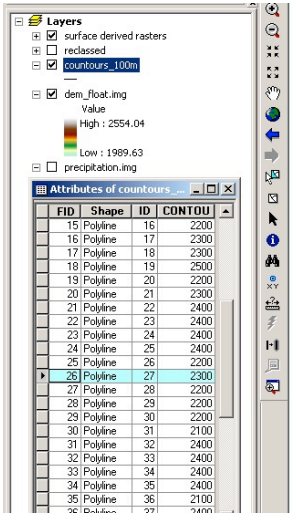
- VALUE attribute: number of viewpoints visible (number of "hits" from rays)
- "Not Visible": means **no** hits, "Visible": mean **one or more** hits
- VALUE: **total** number of hits, but you don't know **which** viewpoints hit a certain cell!
- Also works for line ("can you see point #2 from the bridge?")

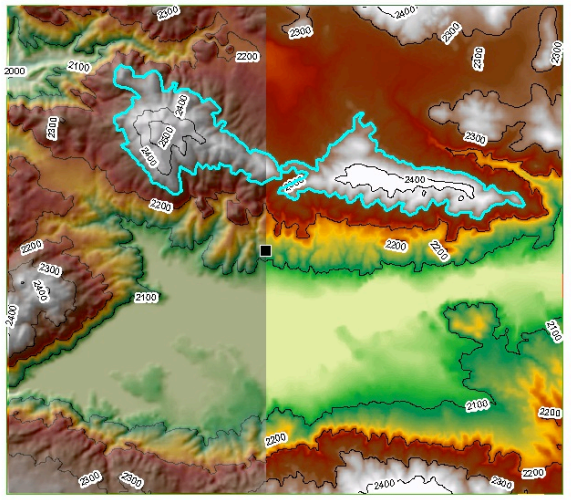


Contours

- Lines of equal Elevation
- traditionally: shown on a "topomap" (USGS)
- Make sure to use the **elevation** data set!
- Let's create 100 m contours (starting at 0, a line every 100 m)
- Save as line features as contours_100m.shp





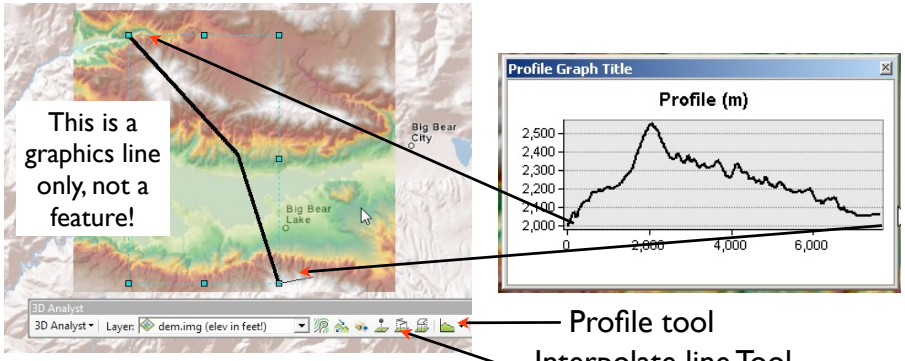


Labels:
- use CONTOUR attribute
- placement properties: Parallel, On line, Halo (?)
- for gaps around labels see WebCT - GIS material - Creating_Advanced_cartographic_effects.pdf

Hill profiles

- Activate 3D Analyst extension and tool
- Set 3D Analyst layer to dem_float.img
- Click on "Interpolate Line tool
- Click first profile point
- 2x click to finish line (2. profile point)

- Click Profile Tool
- Works on selected graphics or line features
- If Profile tool is greyed-out: select graphic (via Black arrow) or line feature first



Wrap up

- Midterms done (hand out multiple choice parts)
- Midterm solutions (practical part) data\old_slides
- Mini proj 2: ~50% done
- Mini proj 3: done
- HW 11 (last!) ch 8 ex. 1,2,3,4
- I'll dig up some old class projects as examples