GEOG 176 A: Intro to GIS
2015 Fall

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Lab 2:
Field

DUE:
2 p.m. Oct. 21st 2015
Objectives

• To gain a deeper understanding of the concept of a field by experimenting with and producing field data.
Overview

• How raster data is stored → GeoTIFF

• Digital Terrain Model (Raster, DEM…) → Metadata; how does this terrain data represent locations?

• Operations on the terrain data

  1. Basics:
     • Summary Statistics
     • Select some specific unit pixels and identify their attributes

  2. Conversion:
     • Convert the raster to vector (Polygon, Polyline, Points) → attribute table
     • Convert vector to raster
Overview (cont.)

3. Spatial Statistics:
   • Autocorrelation among unit pixels (Spatial Statistics → Moran I)
   • Interpolation (i.e. limited points → field)

4. Map Algebra:
   • Transformation (e.g. transform the elevation to slope)
   • Zonal statistics (e.g. mean slope per elevation zone)
   • Raster Calculator (e.g. Arithmetic, Boolean, and Relational)
Raster VS. Vector

- **Raster**: A raster data type is, in essence, any type of digital image represented by reducible and enlargeable grids.

- **Vector**: Geographical features are expressed as vector data by considering those features as geometrical shapes (points, lines, polygons).
QGIS:

Why **QGIS**?
- free (you can install it on your machine)
- open source
- cross platform (Mac, Windows, Linux)
- always being updated
- lots of resources for learning If you haven’t already
QGIS-Plugins

- open your plugins window
  Plugins > Manage and Install
- activate (check) the following plugins:
  - Coordinate Capture
  - Gdal Tools
  - Interpolation Plugin
  - Raster Terrain Analysis Plugin
  - Zonal statistics Plugin
Installed Plugins

Here you only see plugins installed on your QGIS.

Click on the name to see details.

Click the checkbox or doubleclick the name to activate or deactivate the plugin.

You can change the sorting via the context menu (right click).
QGIS-Where to find the installed plugins?

- Main Toolbar on top of the interface
QGIS—Where to find the installed plugins?

Open the panel for the toolbox
Processing > Toolbox

You can type names of tools into the search bar to retrieve; if you don’t see it, you didn’t “add the plugin”
QGIS-How to add data?
QGIS-How to check the coordinate systems

When your mouse is on the map, here will show you the coordinates

Check your coordinate systems here
QGIS-How to change the coordinate systems

[Image of QGIS interface showing coordinate reference systems]

Selected CRS: WCS 84
+proj=longlat +datum=WGS84 +no_defs
Data-OpenTopography
Raster

For the datasets listed below, pre-computed raster data are available from OpenTopography. These data include digital elevation model (DEM) layers computed from aerial LiDAR surveys and raster data from the Satellite Radar Topography Mission (SRTM) global dataset. DEMs from aerial LiDAR surveys are available as bare earth (ground), highest hit (first or all return), or intensity (strength of laser pulse) tiles. Some datasets also have orthophotographs available. All raster data can be output into common GIS formats and are compressed to reduce their size.

Airborne LiDAR Datasets:

1. Mayapan, Mexico [Private Dataset]
2. Surprise Valley, CA
3. State of Utah Acquired LiDAR Data - Wasatch Front
4. UMD-NASA Carbon Mapping / Sonoma County Vegetation Mapping and LiDAR Program
5. Hyak, WA: Cedar River Municipal Watershed Snow Modeling
6. Southwest Flank of Mt. Rainier, WA
7. Raleigh Peak, Colorado: May 2010
8. 2010 CU-Boulder Campus and Flatirons
9. White Mountain Fault Zone, Owens Valley, CA
10. Survey of Sheepscot, Narragagus and Pleasant Rivers, Maine
11. Southern Sierra Nevada Critical Zone Observatory: Snow On
12. Southern Sierra Nevada Critical Zone Observatory: Snow Off
13. Susquehanna Shale Hills Critical Zone Observatory: Leaf On Survey
14. Susquehanna Shale Hills Critical Zone Observatory: Leaf Off Survey
15. St. Elias Mountains and Gulf of Alaska
17. Northern California Coast: Slope Failure in Low and High Uplift Regions
18. PG&E Diablo Canyon Power Plant (DCPP): San Simeon, CA Central Coast
19. PG&E Diablo Canyon Power Plant (DCPP): Los Osos, CA Central Coast
Thank you for using the OpenTopography Raster System.

The results of your job (id `raster1443816834118734729292`) with job title: `my order` are available at

http://opentopo.sdsc.edu/result.jsp?id=raster1443816834118734729292

Metadata about your job are available at

http://opentopo.sdsc.edu/result.jsp?id=raster1443816834118734729292&metadata=1

If you are a registered user of the OpenTopography Portal, you can also access the results of your job via the "myRaster Jobs" link under the myOpenTopo Workbench section of myOpenTopo. Please note that the results will expire after 2 weeks.

----- The OpenTopography Team -----
Task 3: Query

Data: your own data from OpenTopography

• Panels:
  1. Coordinate capture
  2. Identify results

• Tools:
  1. Raster Layer Statistics
  2. Polygonize (Raster to Vector)
Task 4: Test Tobler’s First Law

• Tobler’s First Law:
Everything is related to everything else, but near things are more related than distant things.

Spatial Correlation!
Task 4: Test Tobler’s First Law

• Data:
  1. Your own data from OpenTopography
  2. Downloaded data from GauchoSpace:
     • Question 4 - Checkered Image.gif
     • Question 4 - Noisy Image.png

• Tools:
  Global Moran’s I for Grids
- The most common measure of Spatial Autocorrelation
- Use for points or polygons
  - Join Count statistic only for polygons
- Use for a continuous variable (any value)
  - Join Count statistic only for binary variable (1,0)
- Varies on a scale between $-1$ through $0^*$ to $+1$

*technically it is: $-1/(n-1)$

- high negative spatial autocorrelation
- no spatial autocorrelation*
- high positive spatial autocorrelation

Can also use it as an index for dispersion/random/cluster patterns.

Dispersed Pattern | Random Pattern | Clustered Pattern

Briggs Henan University 2010
Task 5: Transformation

• Data:
Your own data from OpenTopography

• Tools:
1. Polygonize (Raster to Vector)
2. Terrain analysis (Slope)
3. Zonal statistics
Task 5: Transformation

5a: Raster $\rightarrow$ Conversion $\rightarrow$ Polygonize
Task 5: Transformation

5b: Raster → Terrain Analysis → Slope
Task 5: Transformation

5c: Raster $\rightarrow$ Zonal Statistics

- results are added to your vector layer’s attribute table as new columns

- open the attribute table and sort by area in ascending order to find the largest area
Task 5: Transformation

Tips: 5c. Zonal Statistics (original raster data → raster slope data, vector elevation data)

• It will take long time to process:

• Solutions:
  1. You can wait till the end
  2. Download a smaller datasets
  3. Clippers
Task 6: Slope of “noisy image”

what would slope of an image with random elevation values (discontinuous) look like?

slope is maximum rate of change between each cell and its neighbors.

try it out! run slope calculation on “noisy image”
Task 7: Interpolation

• Data:
Downloaded Air Quality Point Data from GauchoSpace

• Tools:
Interpolation
Task 7: Interpolation

- **Interpolation**: Use the value of defined areas to assign values to undefined areas (IDW, Kriging, Natural Neighbor, etc.).

- **IDW (Inverse Distance Weighting)**:
  - The assigned values to unknown points are calculated with a *weighted average* of the values available at the known points.
  - *weighted average*: inverse of the distance to each known point
Task 8: Raster Calculator

- Data:
Your own data from OpenTopography (DEM) & Slope data calculated in Task 5
Task 8: Raster Calculator (cont.)

• Process
1. Convert the unit from meters to feet
   Arithmetic Operation: "rasters_sdem.tar@1" * 3.2808
2. Determine the mean and std of the DEM data
Refer to Task 3 (Raster Layer Statistics)

  e.g.
  Mean: 1238.43225933
  Std: 25.4342832499
Task 8: Raster Calculator (cont.)

3. Do the query based on the two requirements Boolean and Relational Operations:

   e.g.

   ("slope@1" < 45) AND
   ("output_be@1" < (1238.43225933+25.4342832499)) AND
   ("output_be@1" > (1238.43225933-25.4342832499))