Geographic Information Systems (GIS) Methods and Tools

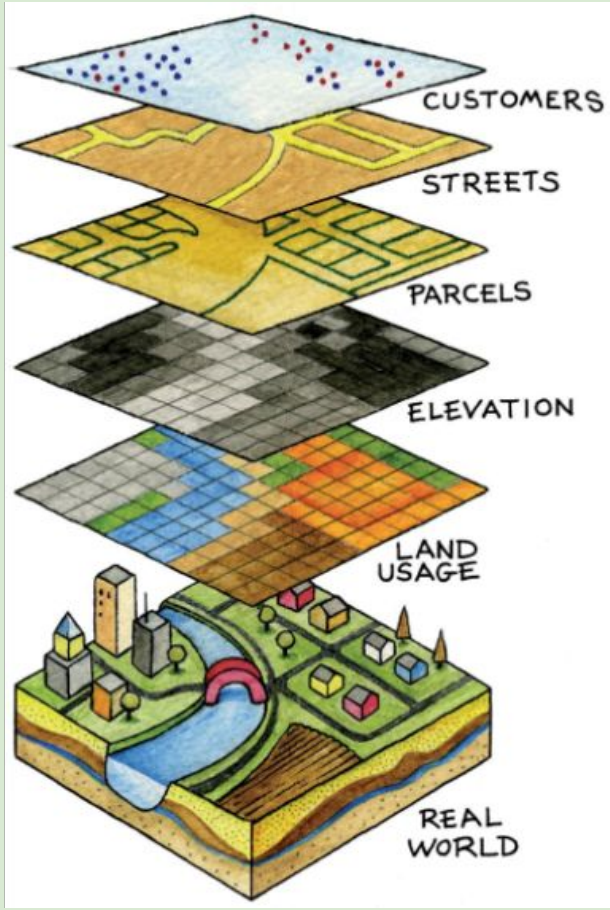
Class Three: Raster Analysis and Vector/Raster Integration
April 17, 2024

Homework Assignments

- What did you do?
  - Challenges? Surprises?

Today…

- Focus on raster data and its applications
- Layering vector datasets and raster datasets on top of each other for Visualization and analysis

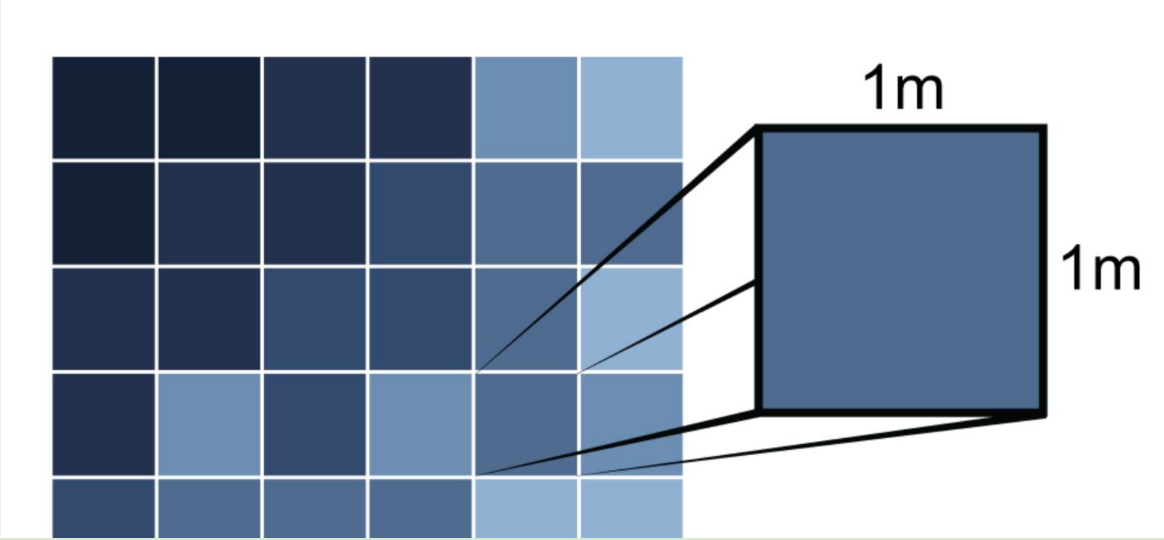


Readings

- For today’s class, you had the option of reading one of several articles that involve the use of raster data to explore some social scientific research question
- Take ~10 minutes to prepare a “share-out” of your article in which you address the following questions:
    - What was the research question?
    - What were the main finding(s)?
    - What geospatial vector data did the author(s) use? How was the data used to answer their question? What geoprocessing (if any) operations did the author(s) carry out on their vector data?
    - Did reading the article stimulate any ideas for your own research?

The Grid Structure of Raster Data

- Raster data essentially consists of a georeferenced grid, where individual grid cells (stored as pixels) take on various values depending on what's being measured
  - For example, if you have a population raster, the value of a given grid cell represents the population in the area covered by that grid cell



Source: https://www.neonscience.org/raster-res-extent-pixels-r

Raster Data: Key Terms

- Resolution
  - Refers to size of grid cells (for instance 1 km x 1 km grid cells. As grid cells become smaller, resolution increases
- Spatial extent
  - Refers to geographic coverage (i.e. what’s the surface area covered by a given raster)

Raster vs Vector Data

- One data format is not “better” than another, and indeed, it is straightforward to convert between data types in modern GIS software
- As a general rule, if you want to capture how a phenomenon varies (whether continuously or discretely) across space, it is preferable to do so with a raster dataset; if you are less interested in how a given phenomenon varies across space, or it is especially important to capture precise details in a an object’s geometry, vector data is a better bet.
- Data storage issues: It’s worth noting that high-resolution rasters can often become very large, and so you may have to think systematically about storage and preservation options.
- Often, workflows integrate both raster and vector data; we’ll see this in practice in the demonstration.

Examples of phenomena often represented by raster data

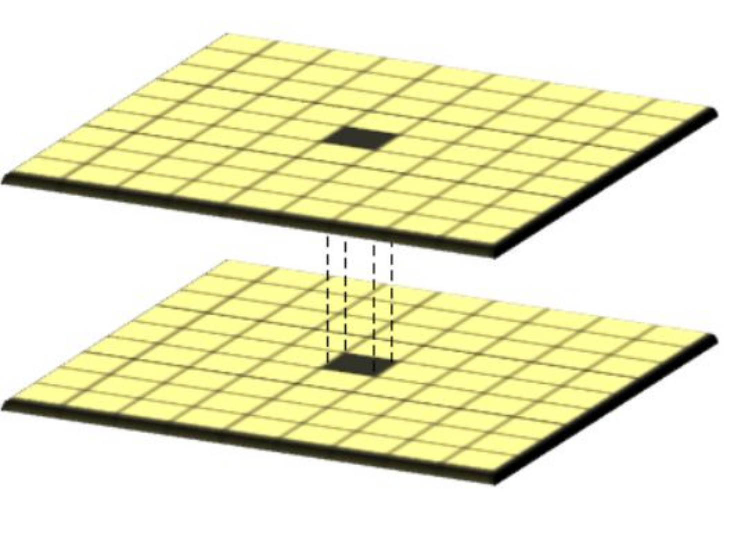
- Soil type
- Population
- Elevation
- Air pollution measures
- Ocean depth
- Temperature
- Precipitation

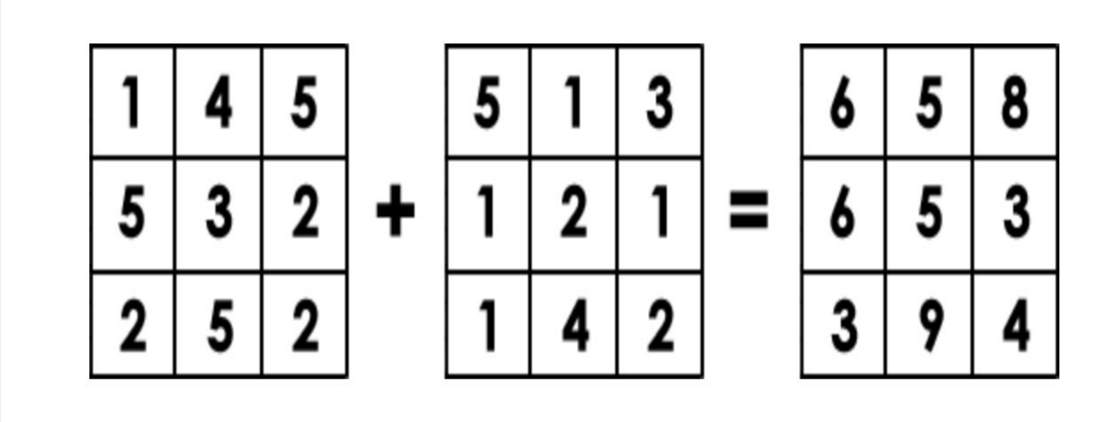
Raster File Formats

- TIFF
- JPEG
- CMP
- BMP
- And many more!
- Note: Rasters may not always be georeferenced at the outset; in order to do spatial analysis on a raster, you must ensure that the grid cells have been georeferenced (i.e. pegged to a location on the earth’s surface). If a raster has not been georeferenced, you must take additional steps before beginning your spatial analysis.

Map Algebra/Raster Math

- Performing calculations on rasters to derive new rasters

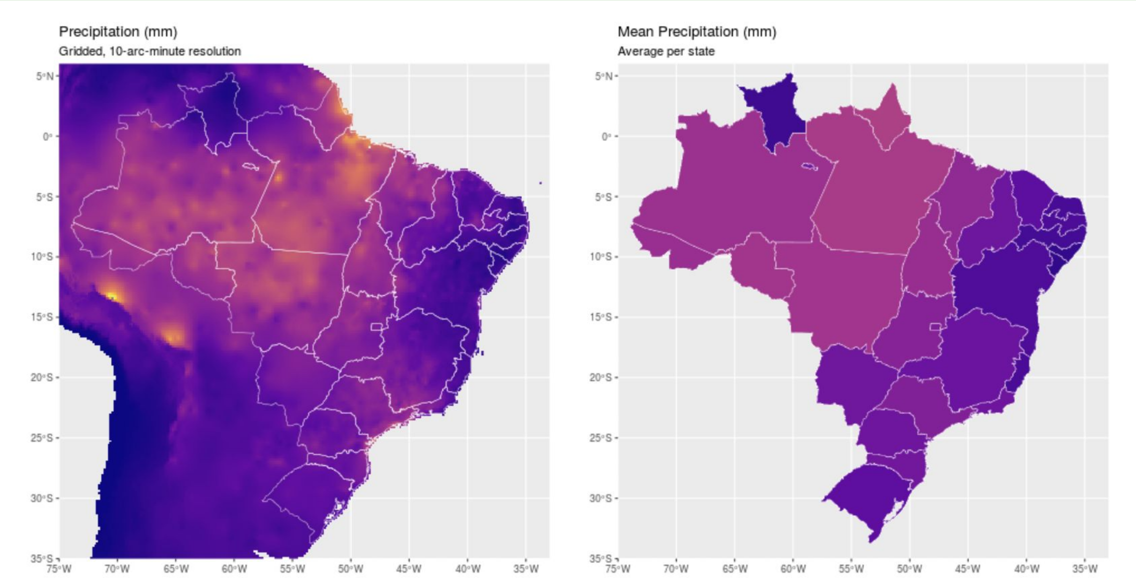




Source:
https://gisgeography.com/map-algebra-global-zonal-focal-local/

Zonal Statistics

- Calculates statistics using raster's grid cell values within a "zone" defined by another spatial datasets (vector or raster)



Today’s Tutorial

- Reading in raster datasets into R and extracting metadata
- Visualizing rasters in tmap
- Raster projections
- Map algebra/raster math practice
- Zonal statistics
- Integrating raster data and vector geoprocessing to answer research questions