Geographic Information Systems (GIS) Methods and Tools

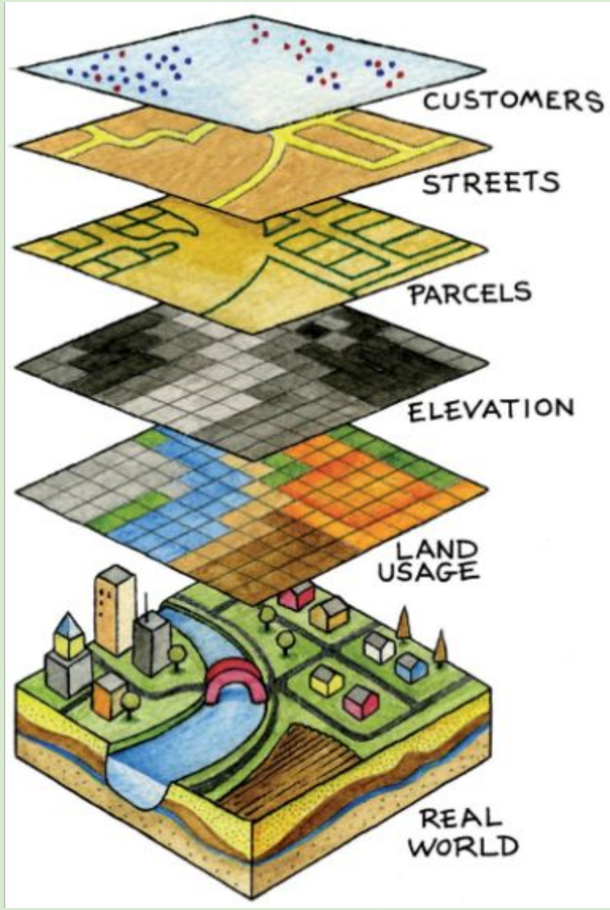
Class Two: Vector Data and Geoprocessing
April 11, 2024

Map Activity

- Reflections on map making process
  - Challenges? Surprises?
- Did your maps reveal any interesting patterns? Did they suggest any novel research questions or puzzles?
- If you had more time, how would you extend or refine the map?

Today…

- Focus on vector data and its applications
- Layering vector datasets on top of each other
- Spatial joins
  - Calculating explicit information through layering process
- Geoprocessing operations
  - Buffer
  - Clip
  - Merge
  - Dissolve
  - Union
  - Erase
- Creating GIS Data: Geocoding
- Distance and area calculations with vector data



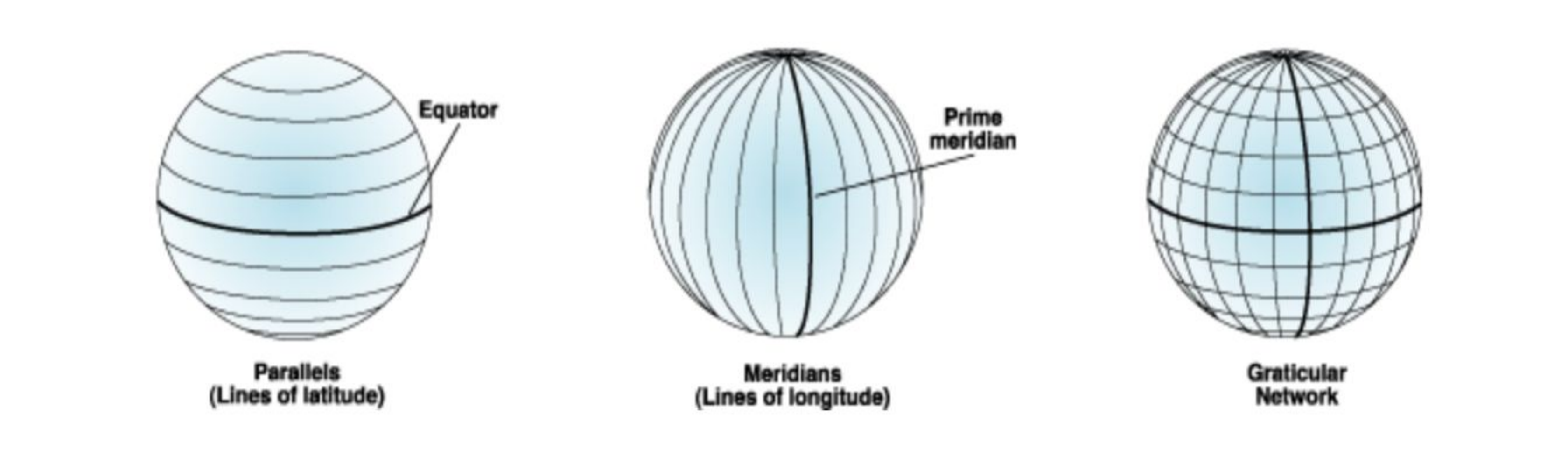
Readings

- For today's class, you had the option of reading one of several articles that involve the use of geospatial vector data to explore some social scientific research question
- Take ~15 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?

Coordinate Reference Systems

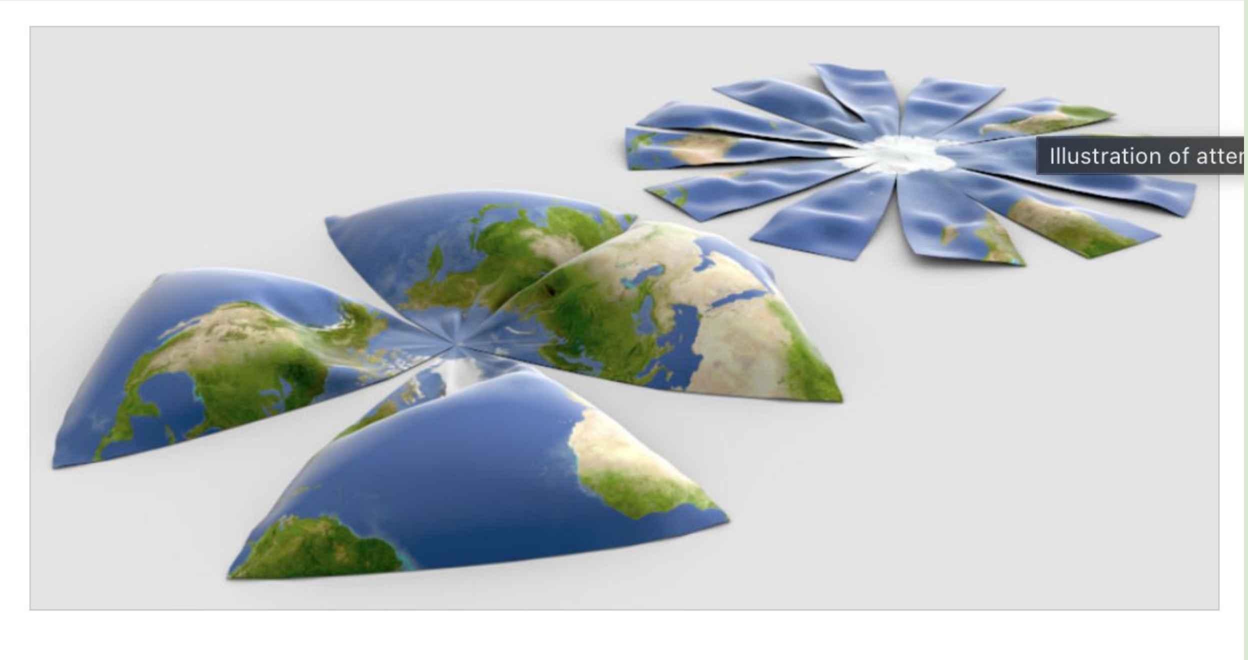
- Geographic Coordinate System (GCS)
  - GCS defines locations on Earth’s surface using latitude and longitude coordinates
  - Uses angular measurements (i.e. degrees, minutes) to represent locations on Earth’s surface; presumes some model of the Earth’s surface
  - GCS can exist independently without necessarily being projected onto a flat surface
- Projected Coordinate System (PCS)
  - Takes a GCS, and applies an algorithm to project the three-dimensional curved surface of the earth onto a two-dimensional flat surface
  - Based on linear measurements (i.e. meters or feet)
  - Allows for distance and area calculations and measurements
  - BUT different projections distort distance, area, shape, and direction to different degrees in different parts of the world; as a researcher, performing a spatial analysis requires you to select a projection that is appropriate for what you’re trying to measure and your geographic domain
- Coordinate Reference System (CRS)
  - A coordinate reference system includes a datum (model of the Earth’s surface), a coordinate system (whether GCS or PCS), and a projection method (if a PCS)
  - Convenient shorthand for various CRS options is the EPSG Code: https://epsg.io/

Geographic Coordinate System



Source:
https://www.esri.com/arcgis-blog/products/arcgis-pro/mapping/gcs_vs_pcs/

Projected Coordinate System



Vox Video:
https://www.youtube.com/watch?v=kIID5FDi2JQ

Source:
https://www.esri.com/arcgis-blog/products/arcgis-pro/mapping/gcs_vs_pcs/

Coordinate Reference Systems: Key Takeaways

- Coordinate Reference System (CRS)
  - A coordinate reference system includes a datum (model of the Earth’s surface), a coordinate system (whether GCS or PCS), and a projection method (if a PCS)
- A Projected Coordinate System (PCS) requires an underlying Geographic Coordinate System (GCS) to which a projection algorithm is applied; however, a Geographic Coordinate System can stand on its own, and does not require a PCS
- When making spatial calculations (such as calculations about distance or area) make sure you choose a projection appropriate for your area of interest, that preserves the spatial property you’re interested in (i.e. that minimizes distortions)
- When working with multiple geographic layers, it’s important that all layers are in the same CRS
- When working with R, you can set the desired CRS by using the corresponding EPSG code
- When something seems “off”, there might be a CRS error; basic knowledge of coordinate reference systems is useful for troubleshooting