Jason Davies'

"Map Projection Transitions"

https://www.jasondavies.com/maps/transition/

Geography 360
October 19, 2016

How GIS understands shapes on the Earth

1. *Questions and announcements*
   - *Reminder:* Extra credit opportunity this weekend!
   - *Reminder:* No lecture or Prof.B. office hours on Friday: Will be at NACIS.
   - *Reminder*: Jason has in-lab office hours Friday 11:30 to 12:20.
2. *A bit more on Quiz I*
3. *Briefly revisiting thematic mapping*
4. *How does GIS represent and present features on the Earth?*
   - Coordinate systems
   - Projections
   - Datums

Quiz I: two weeks from today

- Worth 12.5% of your class grade.
- In lecture, so no computers are involved.
- You have the whole lecture period …but you may well not need all of it.

Format:

- Multiple choice questions
- Choice of short response questions.

- Short response questions:
  - Won't only ask you to recall things, but will also you to apply them to a situation you haven't quite seen before. May ask you to think of examples. May ask you to sketch. May ask you to explain the advantages and disadvantages of one approach compared to another.
  - None of the short response questions should require more than several well-chosen sentences if your responses are concise and effective. Clarity and reason are valued more than the unexplained presence of 'keywords'.

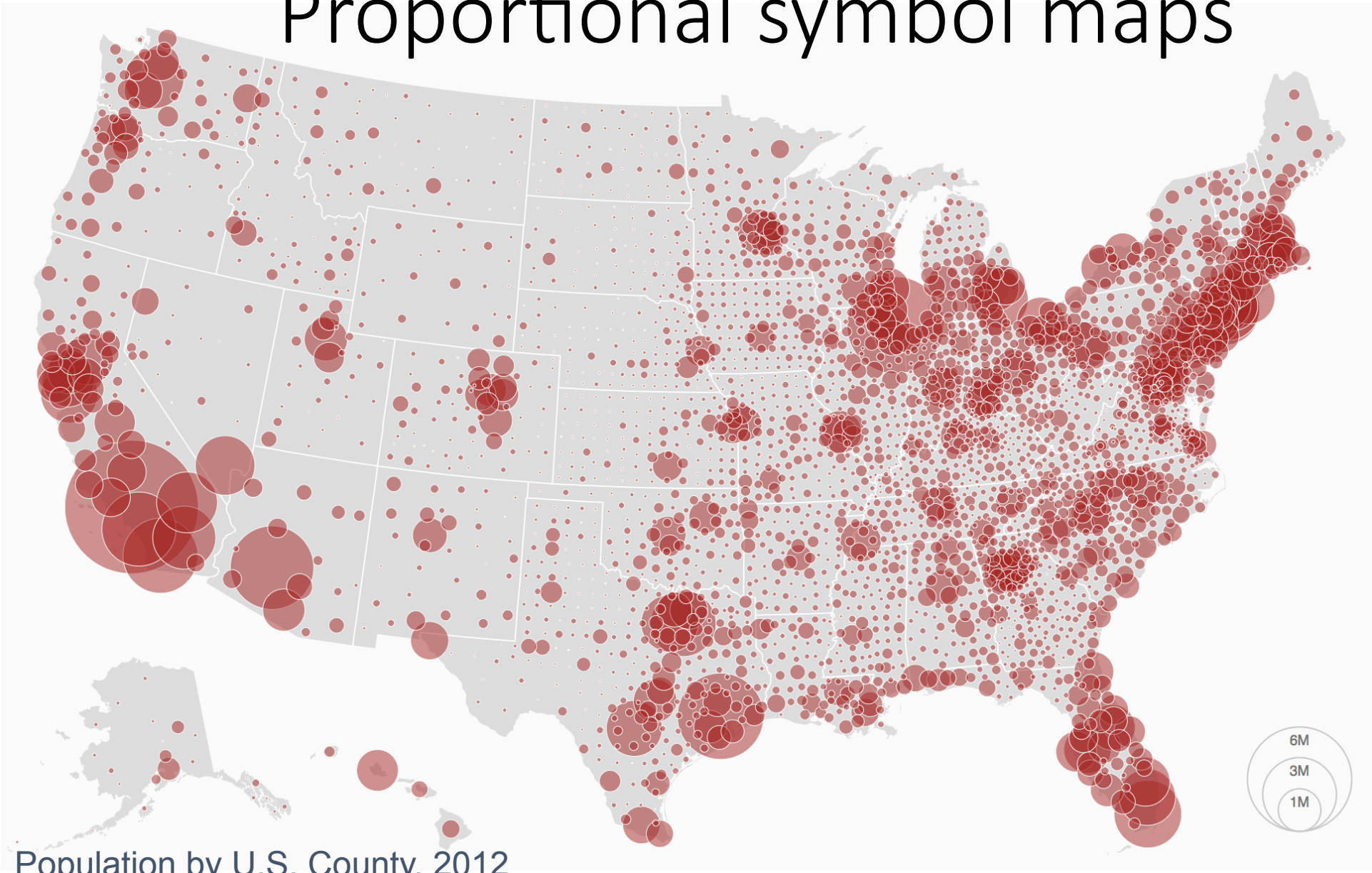
Scope:

- Everything assigned is fair game. That said, focus first on understanding (and thinking about how to creatively apply and evaluate) the material mentioned in lecture and in the labs. Assigned readings (and even supplemental readings) help you do so, especially in those parts of the course that are more distant from your past experiences.

Review:

- We will have time for student-driven review (you bring the questions about material, I discuss them) in one of the lecture periods before the quiz.

Proportional symbol maps



Population by U.S. County, 2012

Source: American Community Survey, 2012 5-Year Estimate
http://bost.ocks.org/mike/bubble-map/

Interested in a critique of this map?
https://cartonerd.blogspot.com/2014/05/hubble-bubble-transparency-and-trouble.html

Proportional symbol map… or choropleth map?

Question:

In each of these cases, would you use proportional symbol or choropleth mapping, and why?

- Data for each U.S. state on what percentage of the state's power generation comes from hydroelectric sources.

- Data for each U.S. state on what percentage of the total national hydroelectric power generation each state provides.

Location

How might we represent location? How could you, or perhaps a GIS, know where things are so you can tell someone else?

Take a minute with a partner to figure out several ways to describe where you are. Your ideas:

- GPS coordinates
- Longitude and Latitude
- Relation to another location (inside CMU)
- Cross-streets
- Address
- Constellations (astronomical measurements)
- In terms of what the vegetation is (and implicitly, how it differs elsewhere)
- Common memory (where you and I saw ___ before)
- Landmarks

Coordinates

‘Coordinates’: are numbers used to describe location.
Example: (*x,y,z,t*)

What is this?

Coordinates

And… *where* is this?

Coordinates are part of a *system*

- GIS can actually use many different kinds of coordinates to describe where a given point is.
  - You can say GEOG 360 meets near (-122.3053, 47.6571)... but you can also say it is at (0,0)...in a different *coordinate system*.
- The *coordinate system* is what makes the coordinates mean something.
  - They have origins (0,0) located at particular places.
  - They tell you how to represent different places by different sets of numbers.
  - Coordinate systems have [code-]names (e.g. EPSG:4326).
- In GIS, coordinates always are defined within one *coordinate system* or another.
  - The *metadata* (e.g. the description page for ArcGIS Online data) should tell you which coordinate system the data is in.

More-than-just-numerical coordinate systems

An example in the news:

- What3Words: http://what3words.com/
  - And a spoof… What3Emojis: http://what3emojis.com/

- Mongolia is licensing What3Words to use instead of traditional addresses!
  - What advantages or pitfalls do you see to that?

Coordinates are part of a *system*

But wait…isn't the Earth three-dimensional?
We are using 2D coordinates (x,y)?

Often, we are. But why?

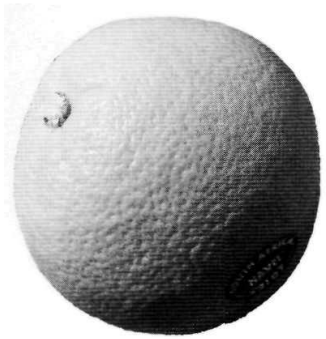
- Our computer displays and maps are usually flat.
- Spatial computation is simplified by using Euclidean geometry, not spherical geometry.
- We are only starting to have good 3D data.

We *can* 'project' the 3D earth onto the 2D space of the plane… but never perfectly and never innocently.

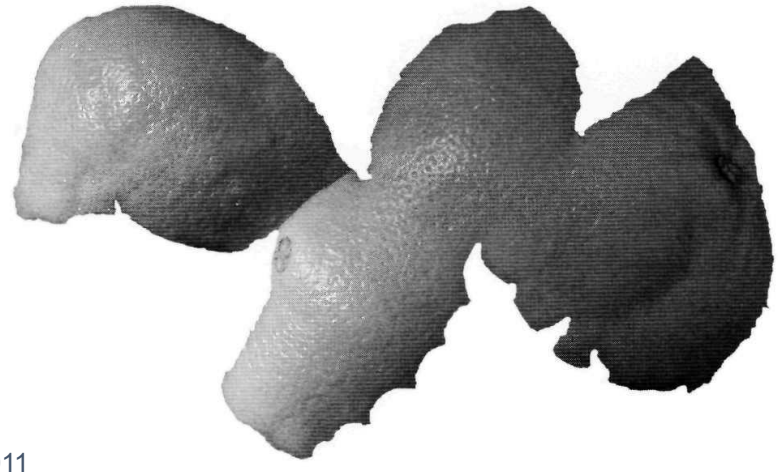
- The different ways of associating points on the 3D earth with points on a 2D plane are called *projections*.
- (We often call the resulting coordinate system by the name of the projection we are using.)

Map Projections.

- They go from 3D to 2D.
  - Transforming points on a curved surface to points on a flat plane.
- None are neutral or the simple truth.

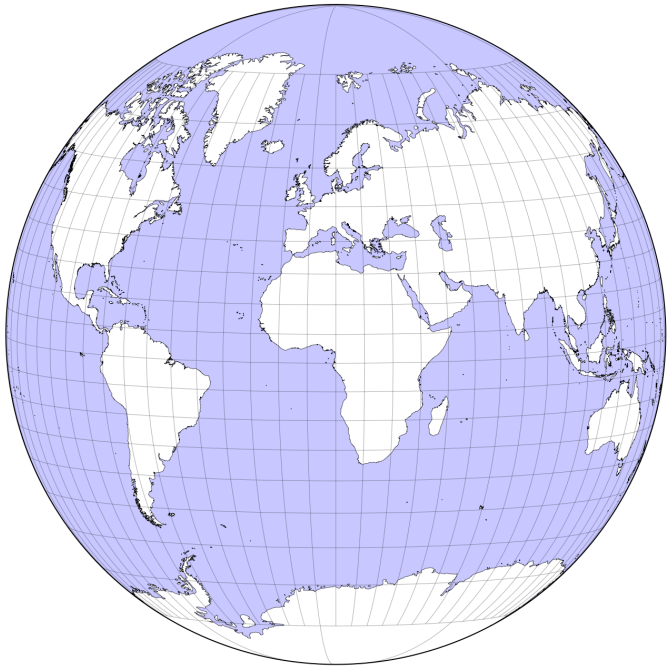


An orange peel *tears* when you peel and flatten it.

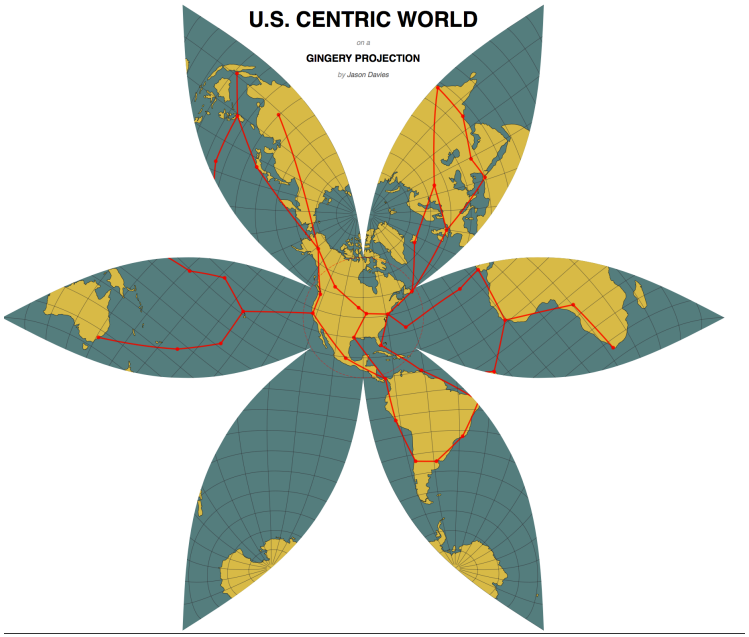


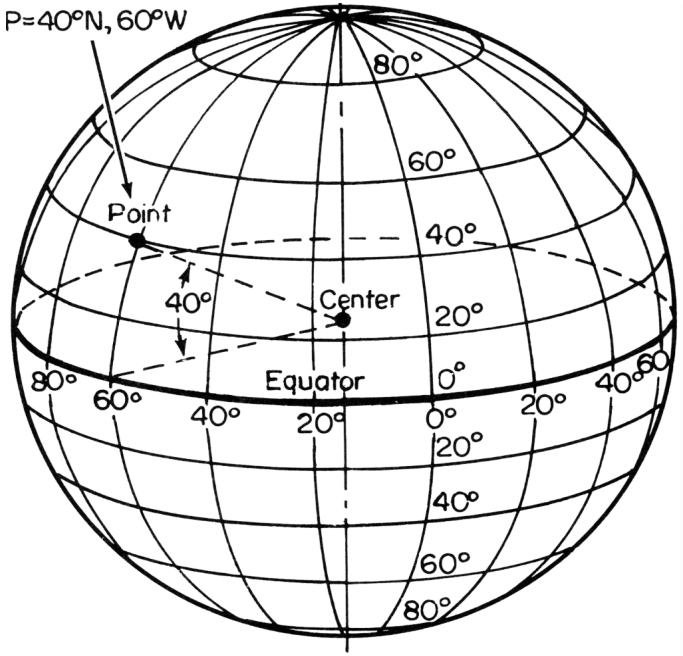
Krygier and Wood 2011

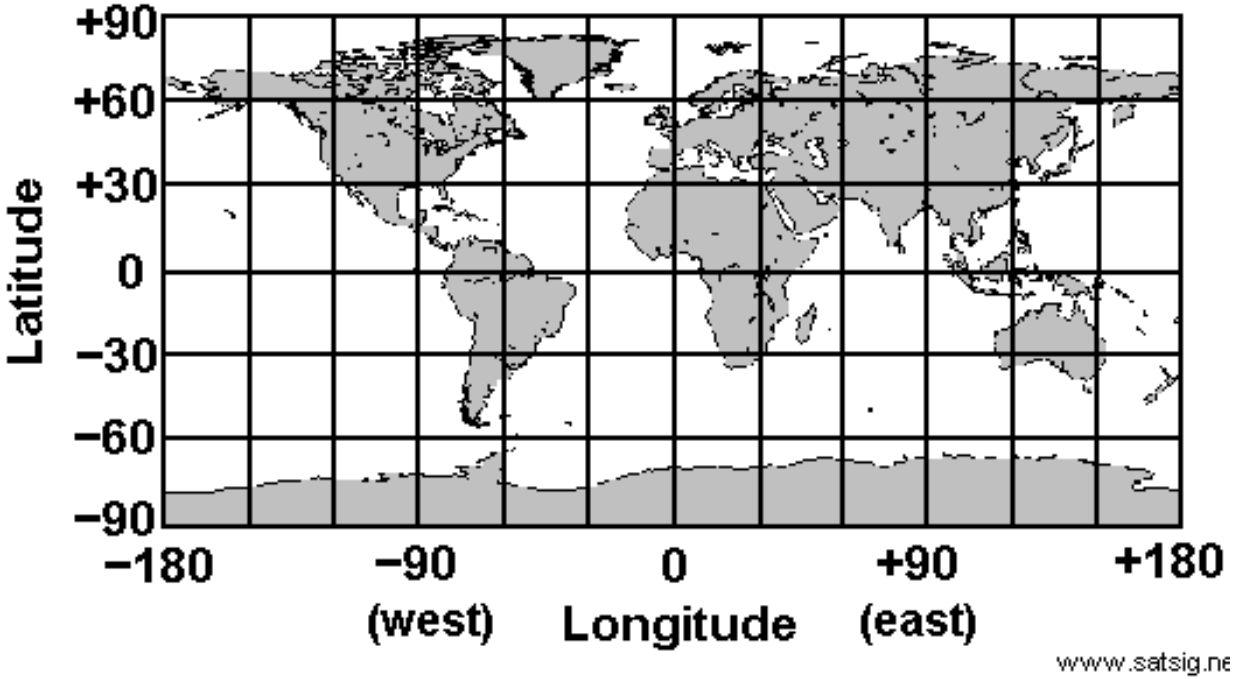
Gilbert's Two-World Perspective



Gilbert's Two-World Perspective Projection, centred at 5°N, 5°E.







Peeling the sphere and stretching it into the *plate carrée* or 'geographical' (!?) projection:

Latitude & Longitude

Also called the 'unprojected' (!?) coordinate system.

Latitude

- Lines of equal latitude are *parallels*
- Equator = 0°
- Extends to 90°N and S

Longitude

- Lines of equal longitude are *meridians*
- Prime Meridian = 0°;
- Extends to 180°E and W.

Note: 1 degree = 60 minutes
1 minute = 60 seconds