

# Projection, Scale, and Geodatabase Review

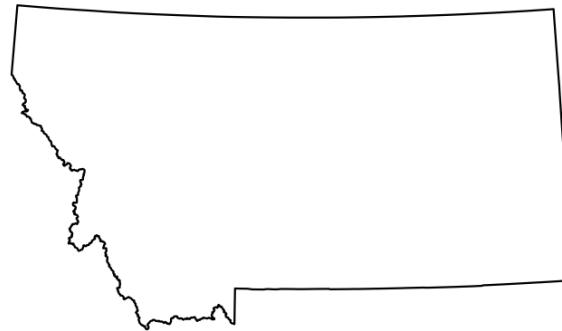
Kyle Bocinsky

FORS350 / GPHY488  
(Forestry) Applications of GIS

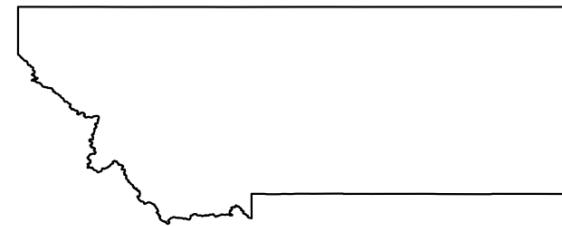
University of Montana  
WA Franke College of Forestry & Conservation



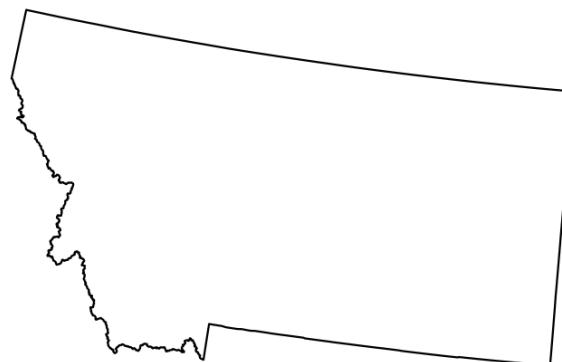
**EPSG 6514**  
**NAD83(2011) / Montana**



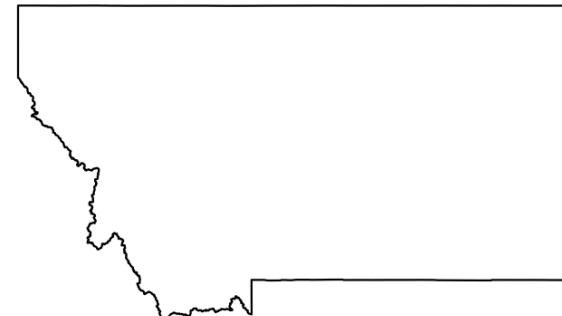
**EPSG 4326**  
**WGS 84**



**EPSG 5070**  
**NAD83 / Conus Albers Equal Area**



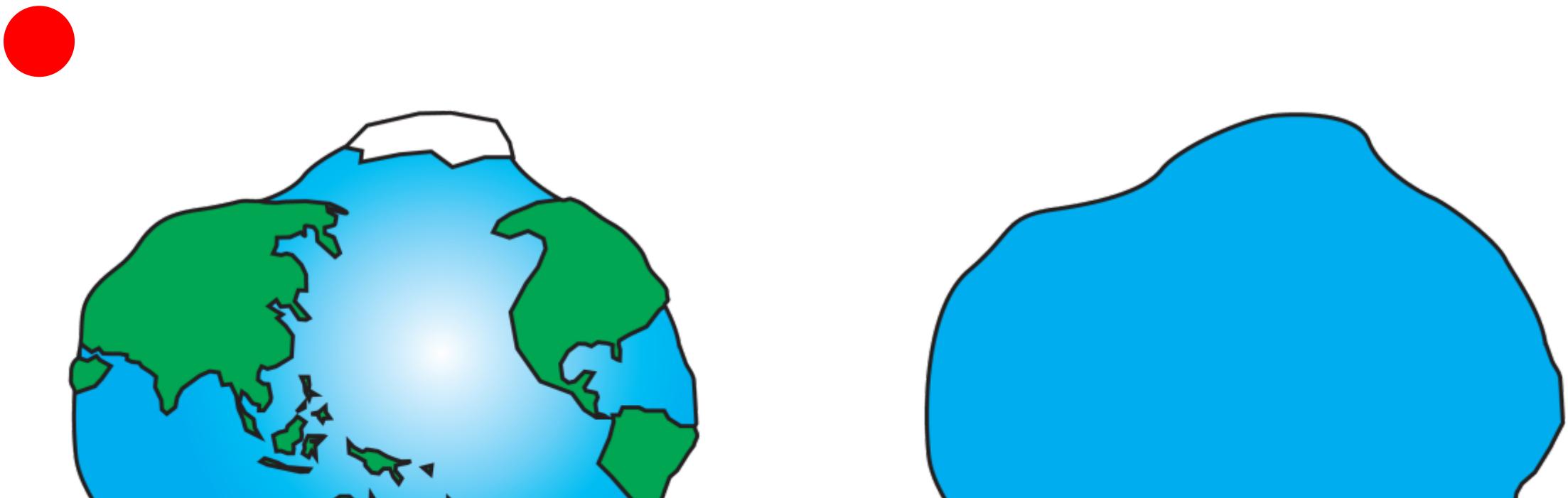
**EPSG 3857**  
**Web Mercator**



# Spheroid, Ellipsoid, Geoid

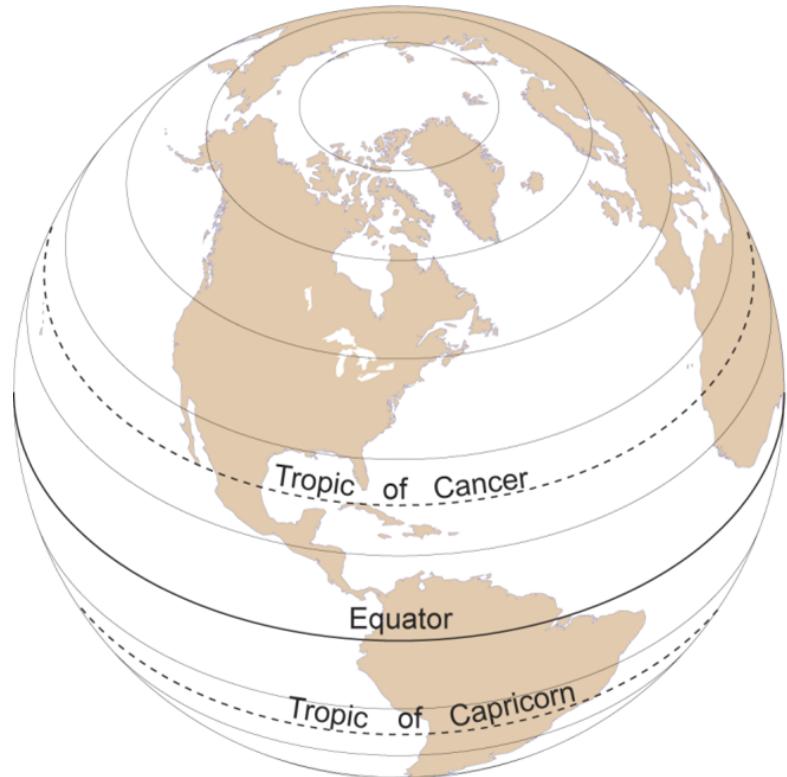
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circle {
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# Coordinate Systems

Parallels

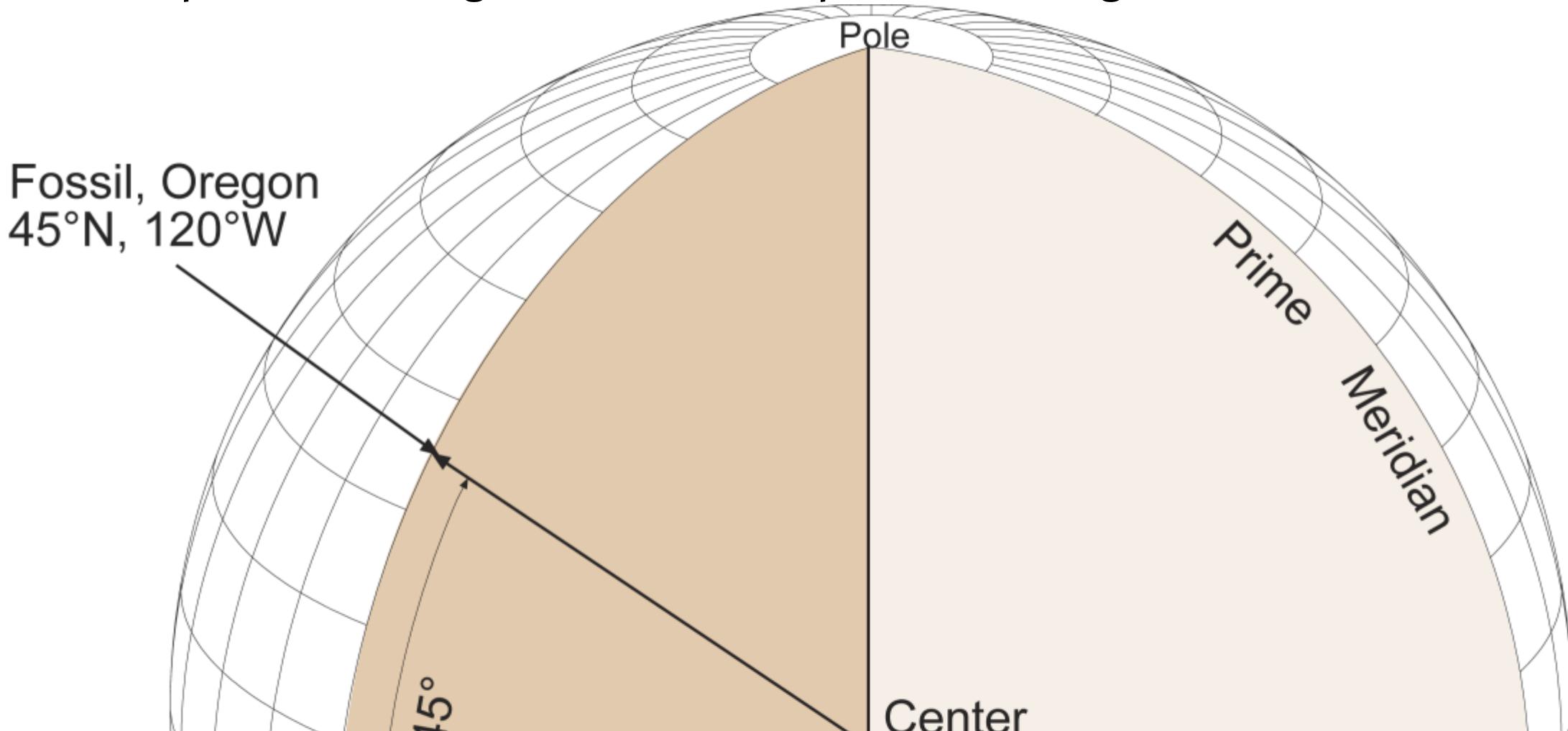


Meridians

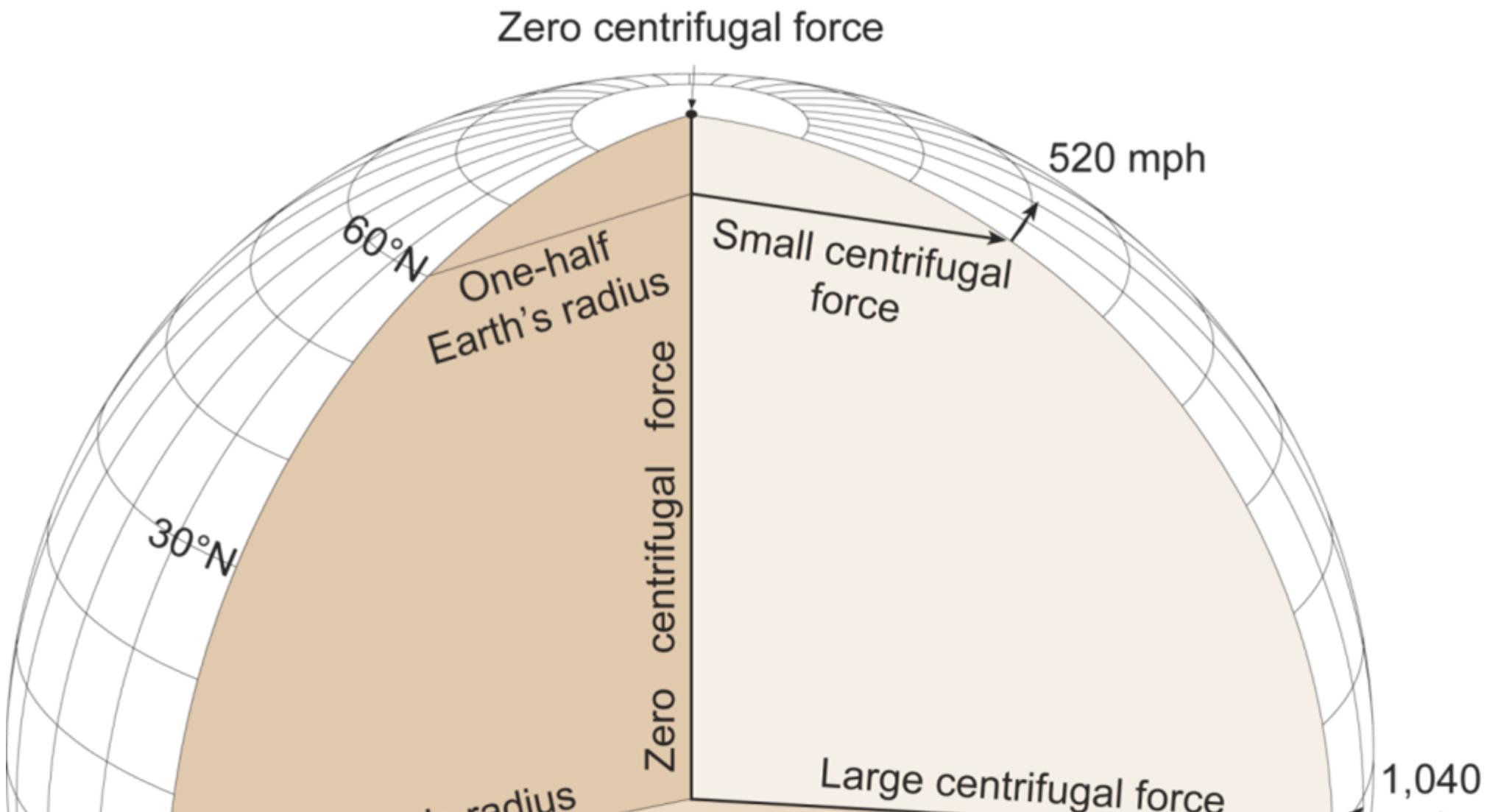


# Coordinate Systems

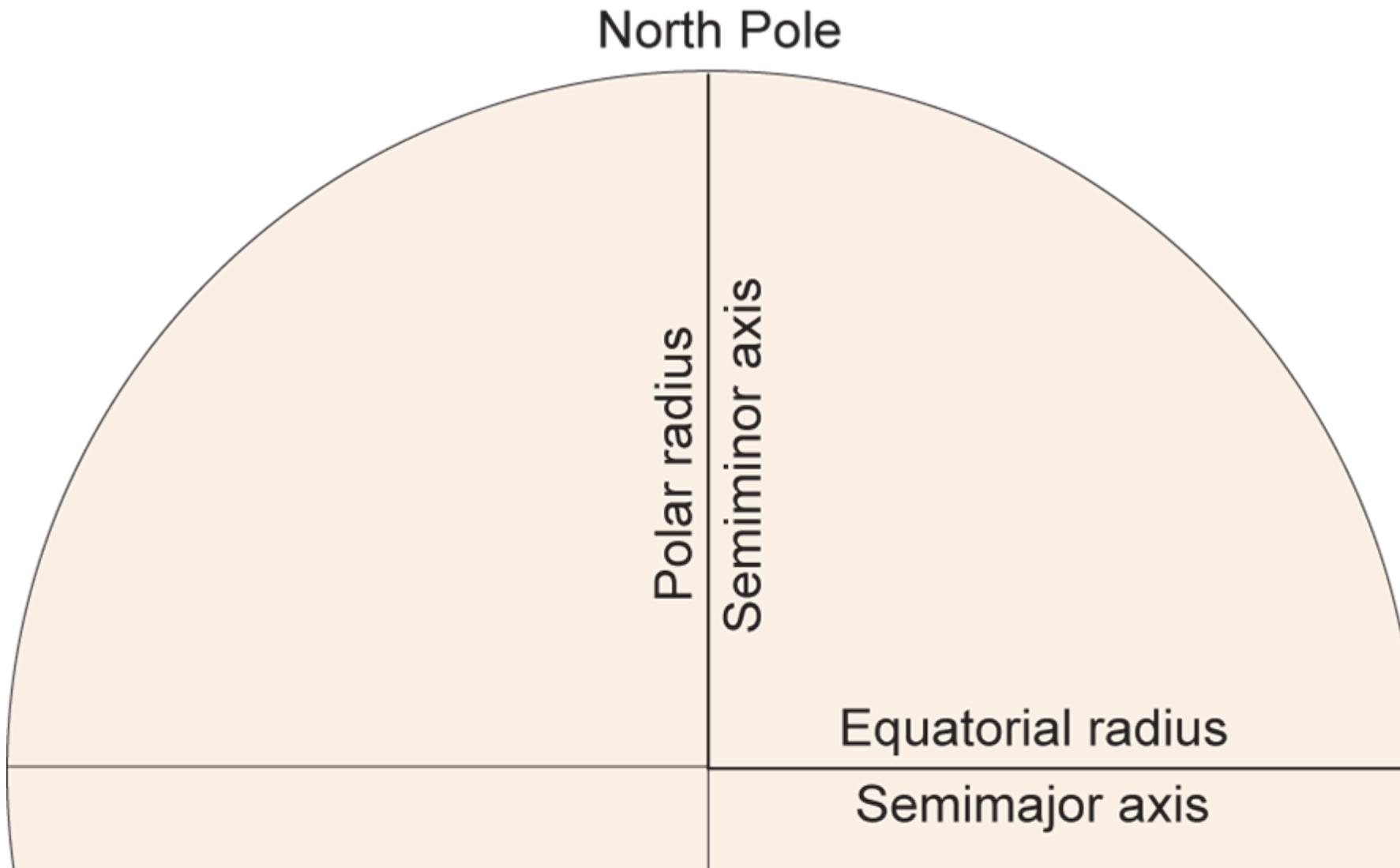
Is  $45^{\circ}\text{N}$  positive or negative? Is  $120^{\circ}\text{W}$  positive or negative?  $45, -120$



# Ellipsoid

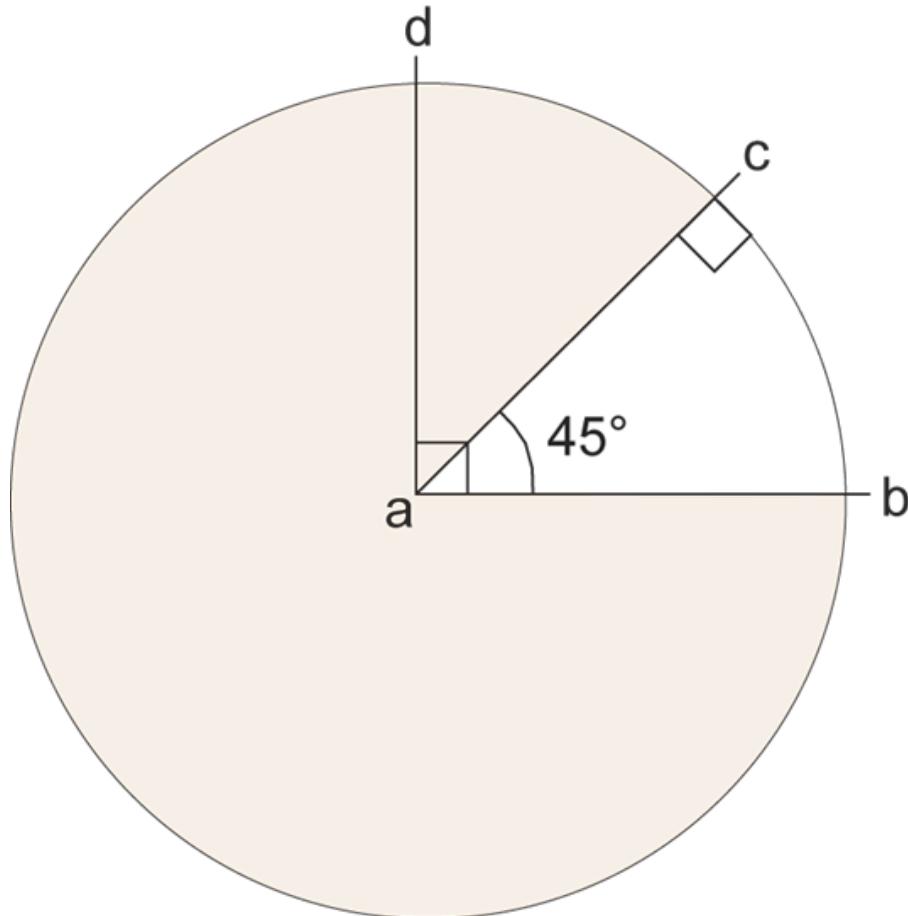


# Ellipsoid

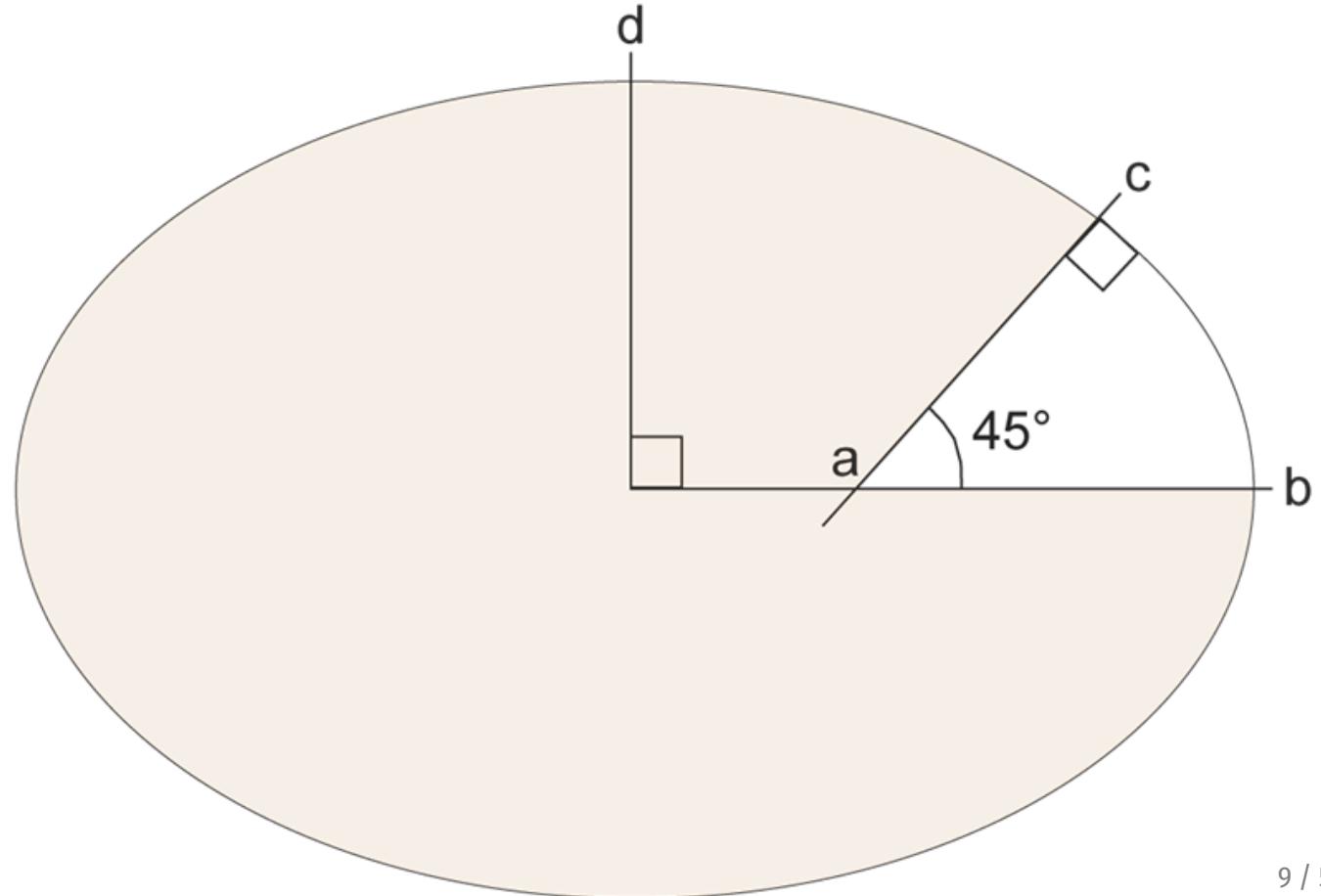


# Ellipsoid

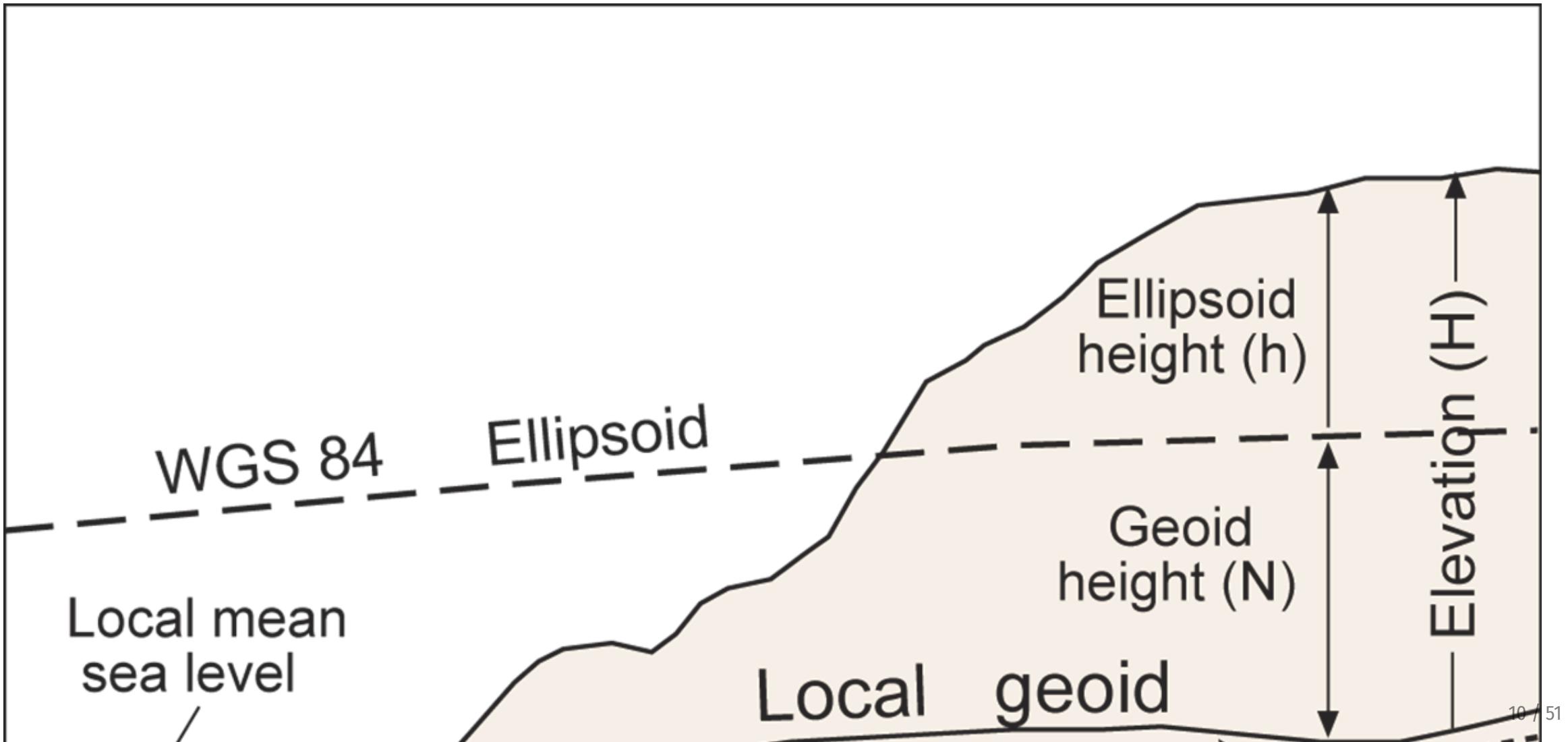
Geocentric latitude  
on a sphere



Geodetic latitude  
on an oblate ellipsoid

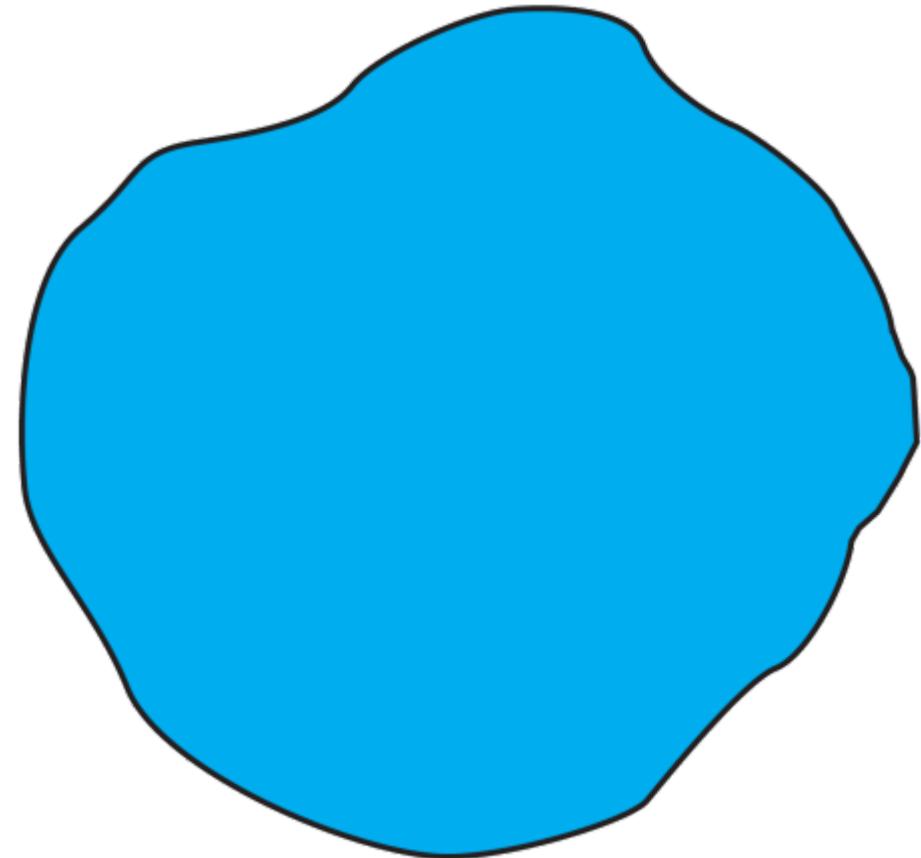


# Geoid



# What the Heck is a Datum?

Geographic Coordinate System Geographic Coordinate System Tie Points Datum



Geoid Ellipsoid + + = (Coordinates) Also called:

# So... Where's the Beef?

The ellipsoid and geoid only matter if you are building\customizing reference systems..... In common use, just know that they are incorporated within the datum (GCS):

- NAD 27 uses the Clarke 1866 Ellipsoid
- NAD 83 uses the GRS 1980 Ellipsoid
- WGS 84 uses the EGM 1996 Ellipsoid Etc.... TAKE HOME: These 3 Datum are what you will use 90% of the time. If you need another, look it up!

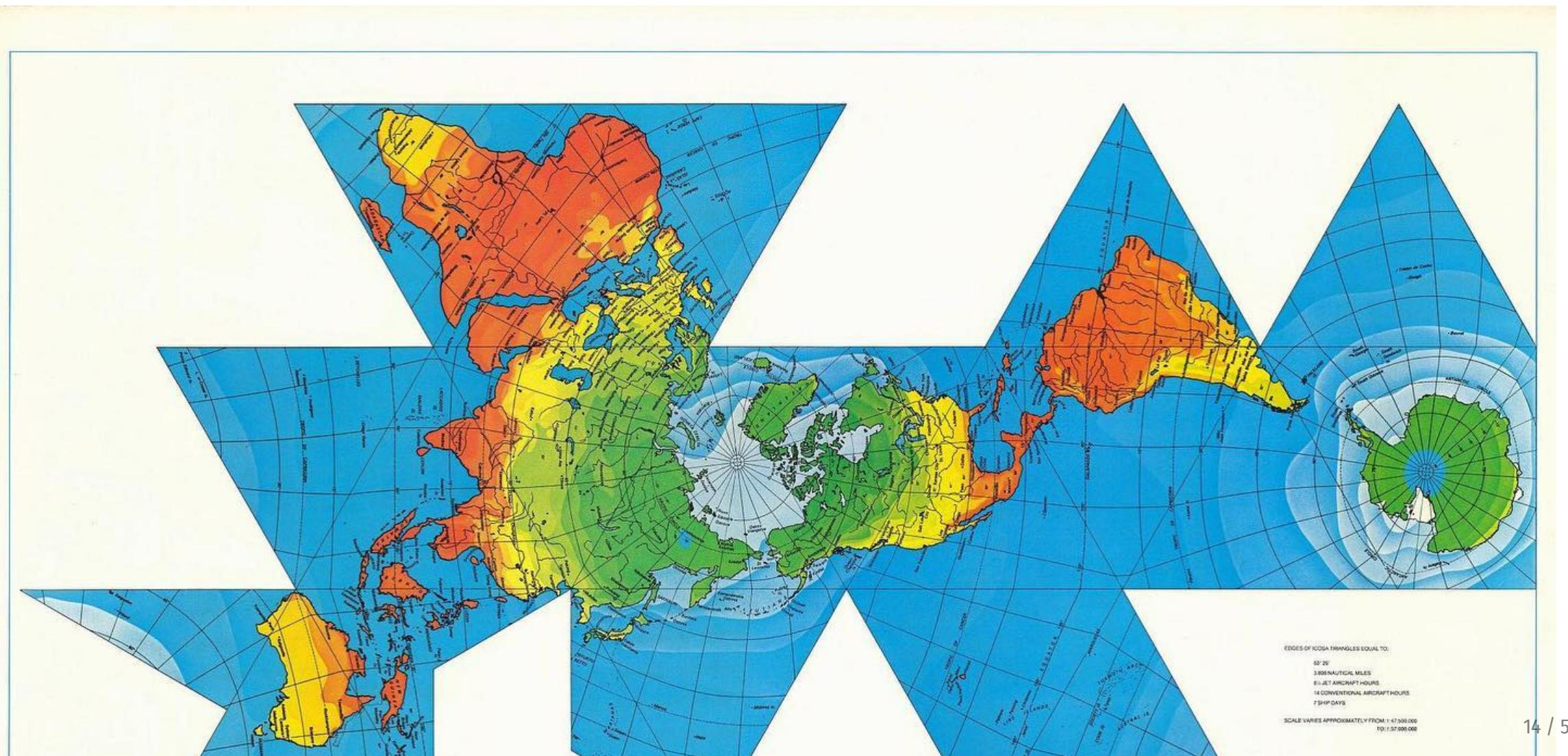
<http://epsg.io/> <http://epsg.io/>

# Side Note: Best Practices for Re-projection

Conversions from NAD 27 to NAD 83 are common and have well established transformation algorithms. However, transformations between lesser known datum can sometimes cause misalignments. So, technically, you must climb down the ladder all the way, and then climb all the way back up! For example, the correct way to transform NAD 27 MT State Plane to NAD 83 Albers Contiguous US is:

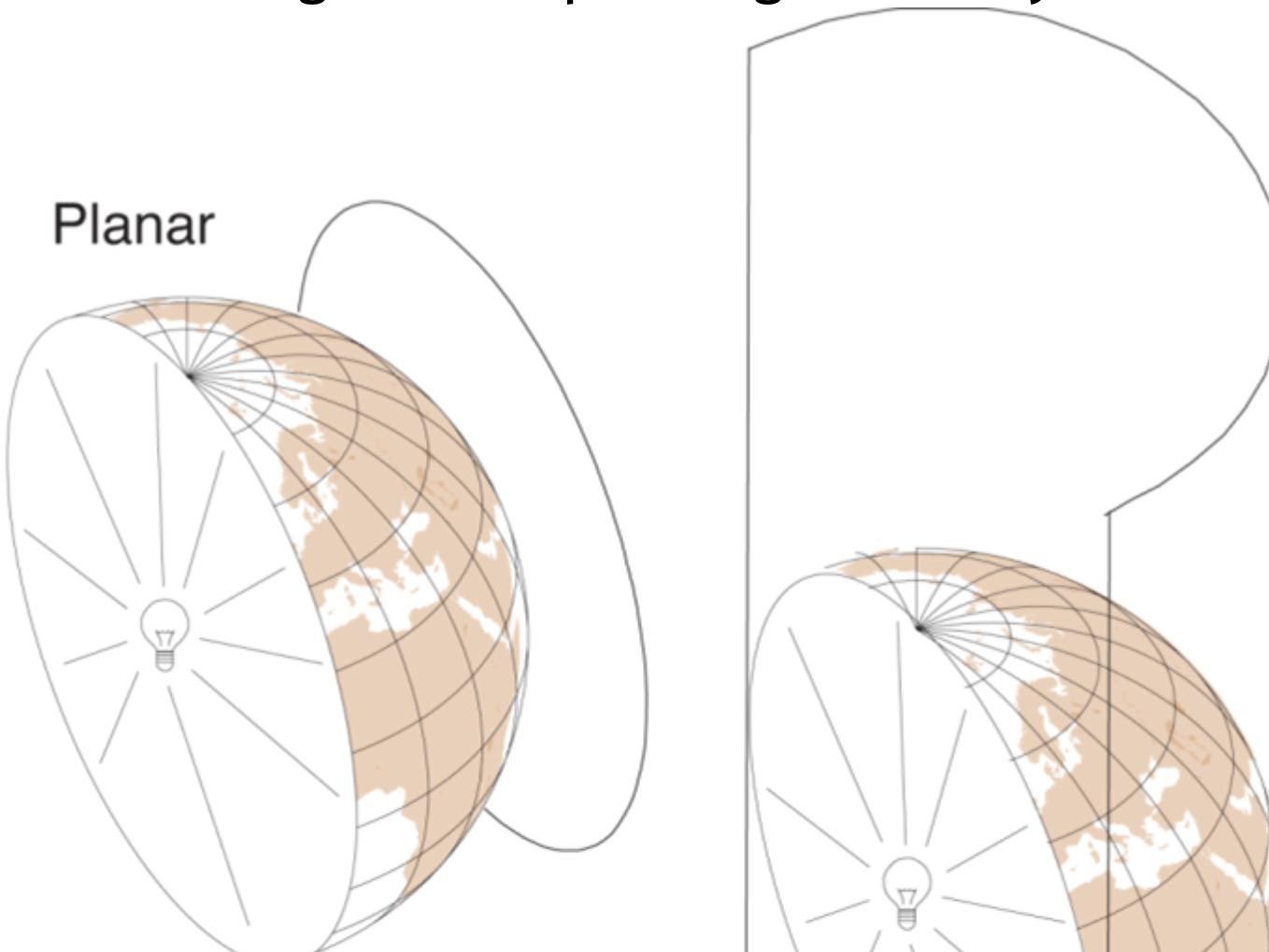
- NAD 27 MT State Plane to NAD 27
- NAD 27 to NAD 83
- NAD 83 to NAD 83 Albers Contiguous US

# Projections – Distilled

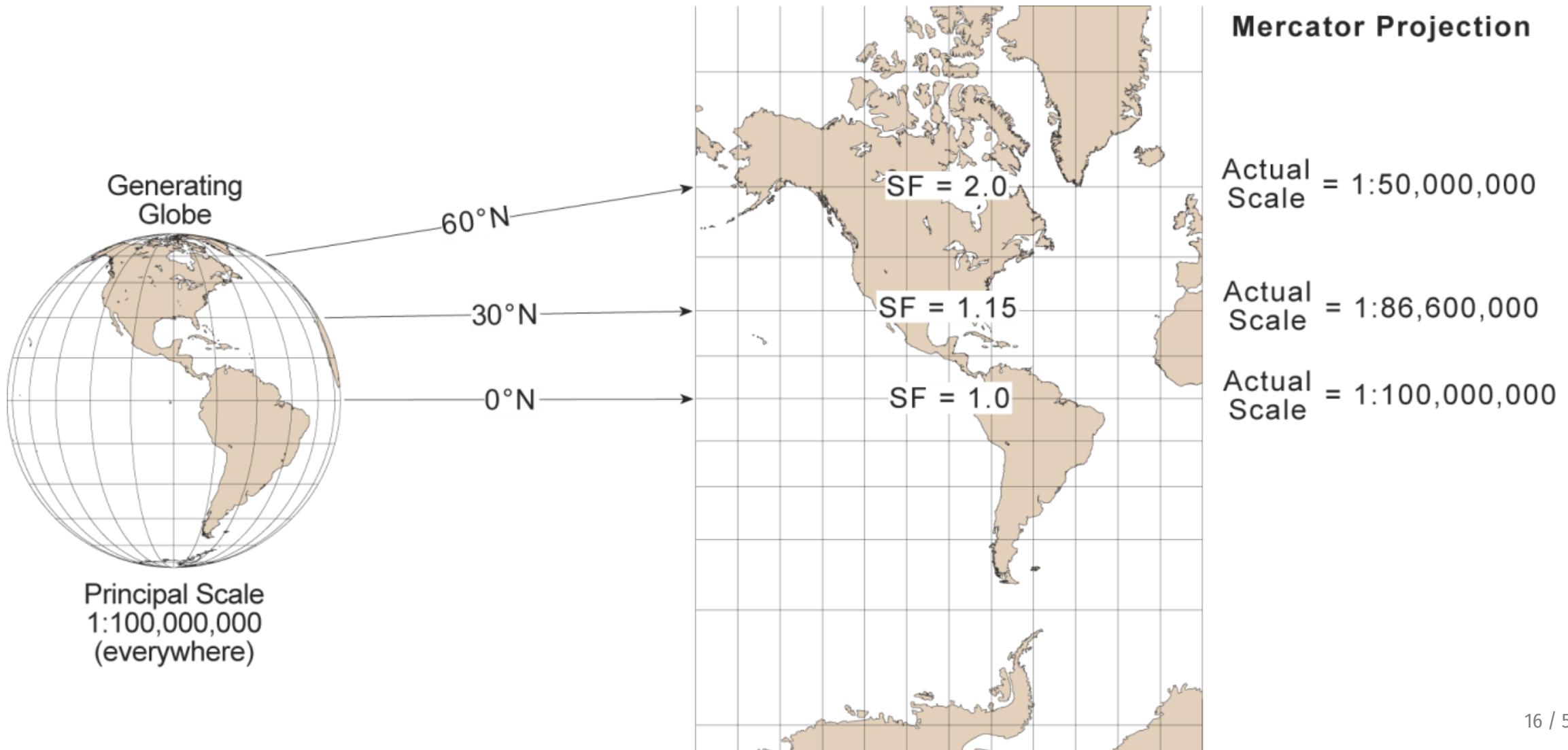


# Projections

Literally “Projected” through a transparent globe. They come in two cases:



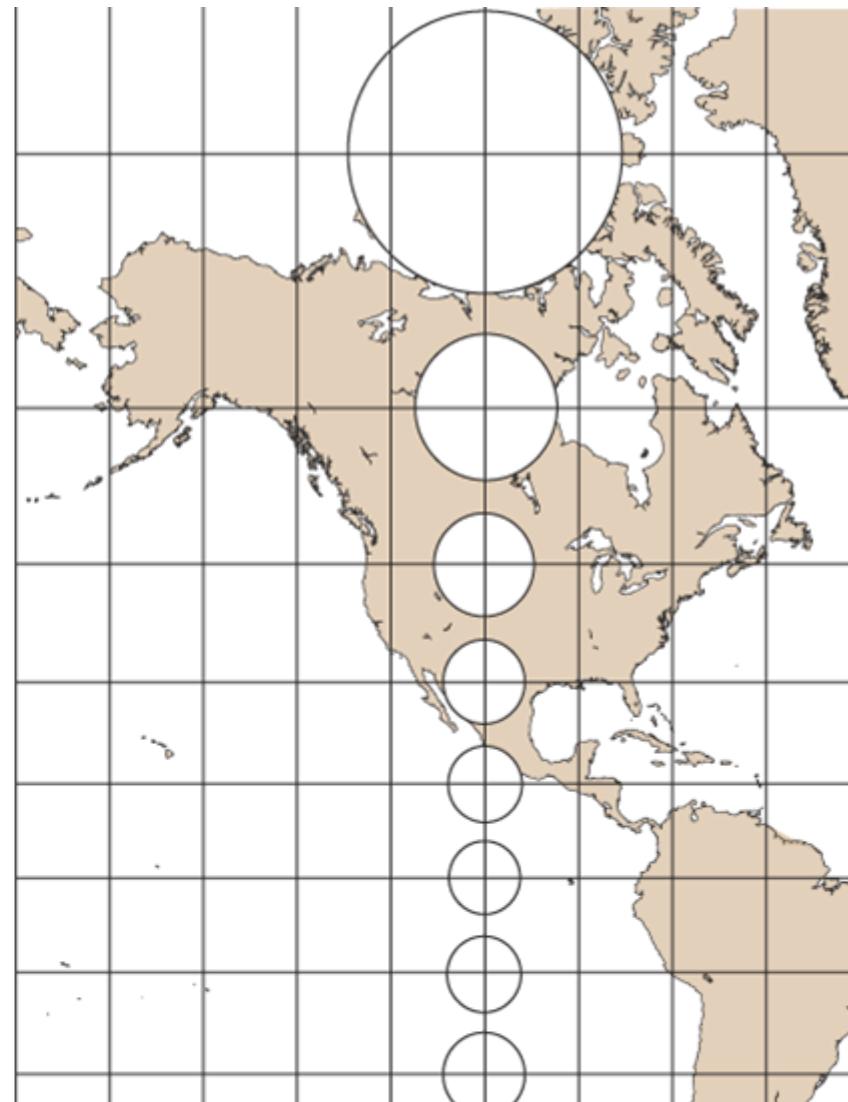
# Projections



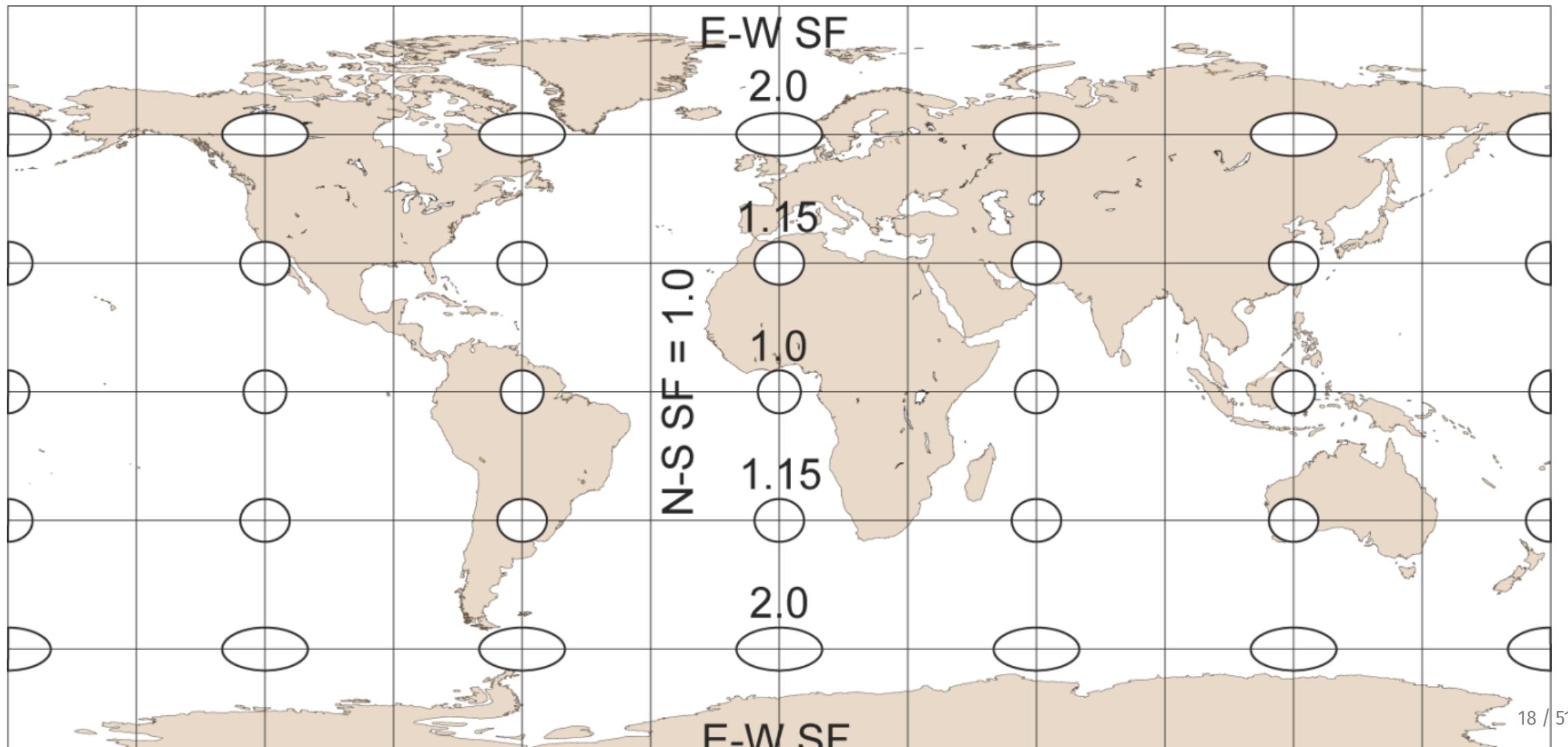
# Projections



Mercator  
Conformal  
Projection



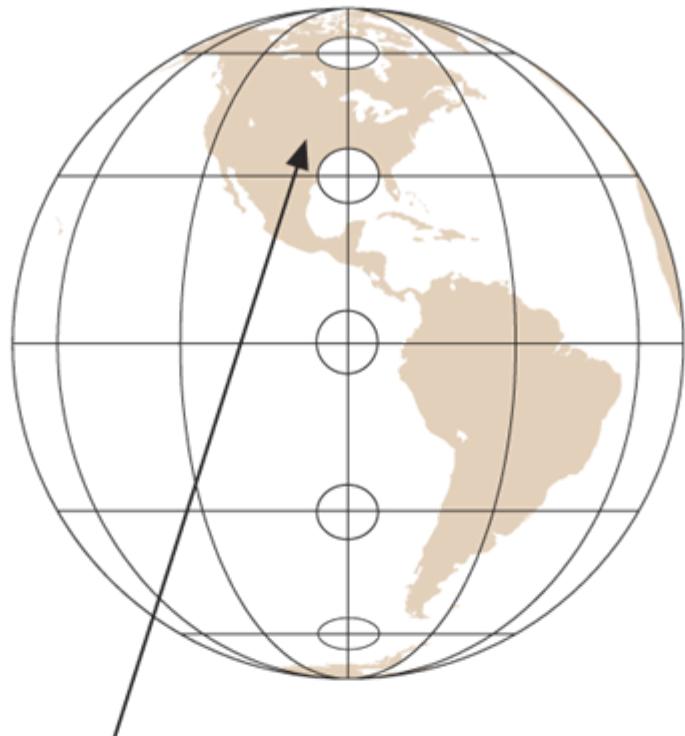
# Projections



# Projections

All Projections are Distortions! All we can do is compromise what gets distorted.

Generating Globe



Skewing and  
shearing of  
quadrilaterals

Tiny circles are  
equal in area  
but different in  
shape

# Projections – Distilled

What is the nature of the phenomena to be analyzed? In other words, do you want to compare: Area, Distance, Shape, or Direction To Choose a Projection Ask...

# Projections – You Have to Choose One

Azimuthal – Direction from a given central point to any other point is shown correctly. Use to evaluate the direction phenomena move from a location.

Conformal – Angles and shapes at each point are preserved. Use to compare the shape of phenomena in relation to one another. Equal-area – All areas have the same relative area as the corresponding part on the Earth. Use to compare phenomena measured in areal units. Equidistant – Shows true distances from a center point or along a special set of lines. Use to measure the spread of phenomena or actual route distance.

# Projections

<https://map-projections.net/index.php>

# Projections – Choose Map Extent

**TABLE 3.2** GUIDE TO THE EMPLOYMENT OF PROJECTIONS FOR WORLD-, CONTINENTAL-, AND COUNTRY-SCALE THEMATIC MAPS

Principal Use	Suitable Projections	Notes
<b>1. Maps of the world</b>		
Equal area	Sinusoidal (Sanson-Flamsteed)	Awkward shape
Equal area	Mollweide	Pleasing shape
Equal area	Hammer	Sometimes called Hammer-Aitoff in software
Compromise	Robinson	Pleasing shape, balances extremes
Compromise	Winkel Tripel	May be most accurate compromise
<b>2. Continental areas</b>		
A. Asia and North America		
Equal area	Bonne*	Considerable distortion in NE and NW corners
Equal area	Lambert Azimuthal	Bearings true from center
	Equal Area	
B. Europe and Australia		
Equal area	Lambert Azimuthal Equal Area*	
	Bonne*	
	Albers Equal Area Conic; ideal for United States	
Conformal	Lambert Conformal Conic	

# Projections – In 3 Easy Steps

TAKE HOME: The Equal-area projection is by far the most popular for thematic mapping. Set the datum in the GDB, and project from the mapframe in GIS. Determine if your data is best analyzed by area, distance, shape, or direction. Choose the best projection compromise for your data type. Select the best projection for the geographic extent being mapped.

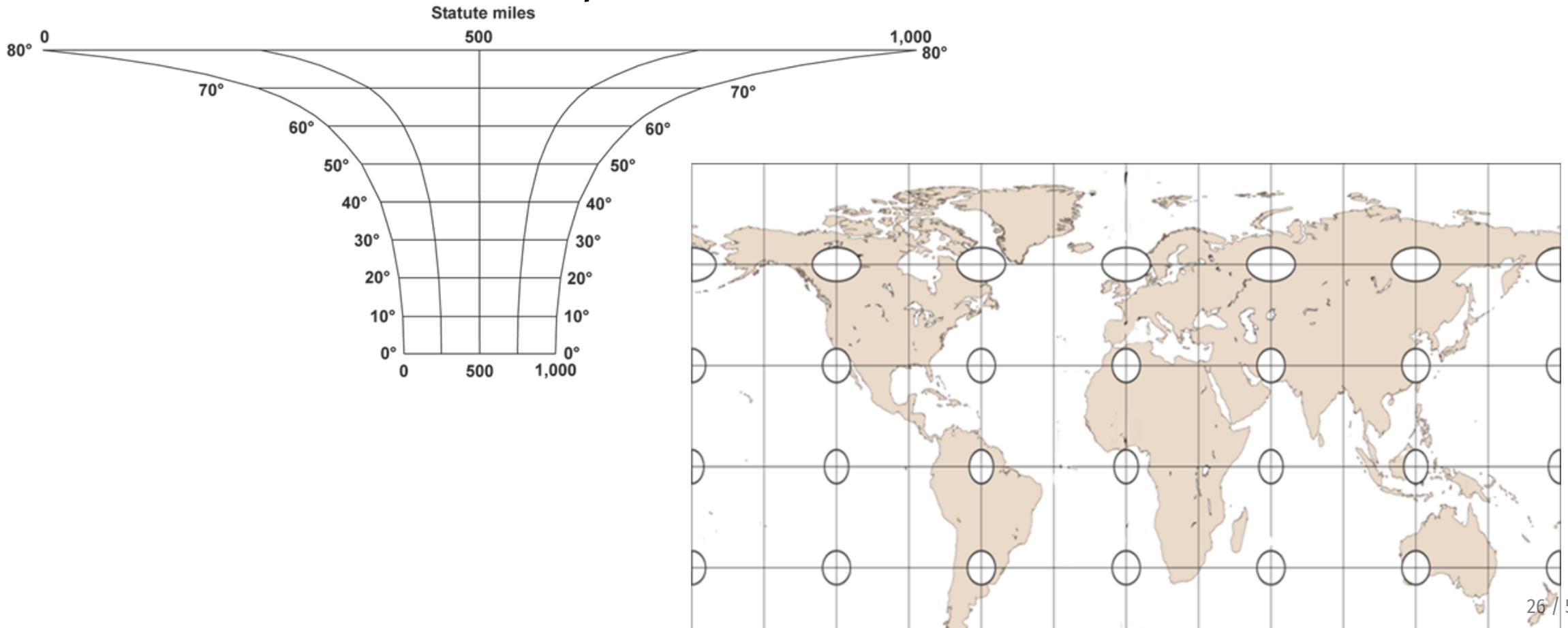
# Scale

Scale—The relationship between a distance on a map and the corresponding distance on the Earth. Three Types Representative Fraction – 1:100,000 Verbal Scale – 1 inch to the Mile Graphic Scale – Scale Bar



# Scale

Scale varies across Small Scale Maps of the World This would be the correct scale on a Mercator World Map.



# Scale

1:250,000 Large Scale 1:25,000 1:25,000,000 Small Scale RELATIVE IT's

# Scale

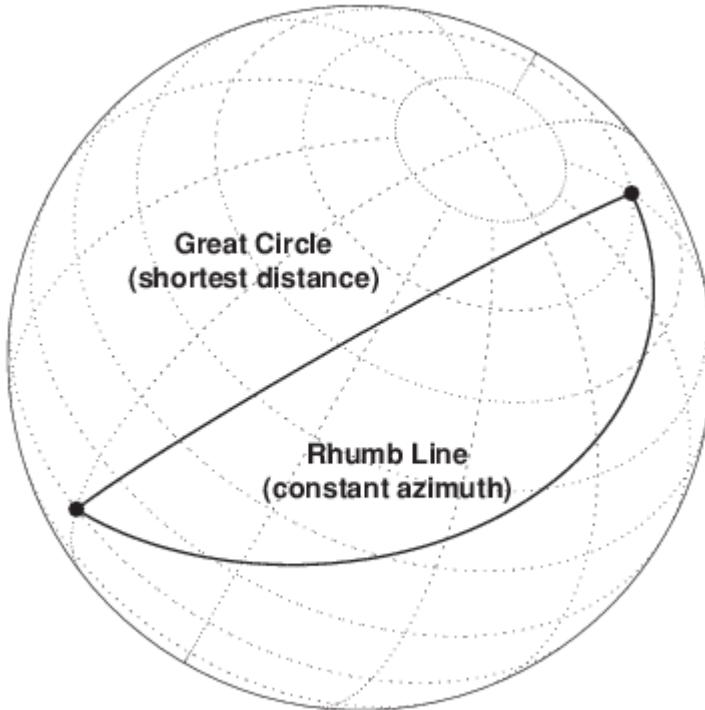
Large Scale Smaller Number Larger Features Smaller Area Small Scale Larger Number Smaller Features Larger Area 1:1,800 1:72,000 11" x 17" 11" x 17"



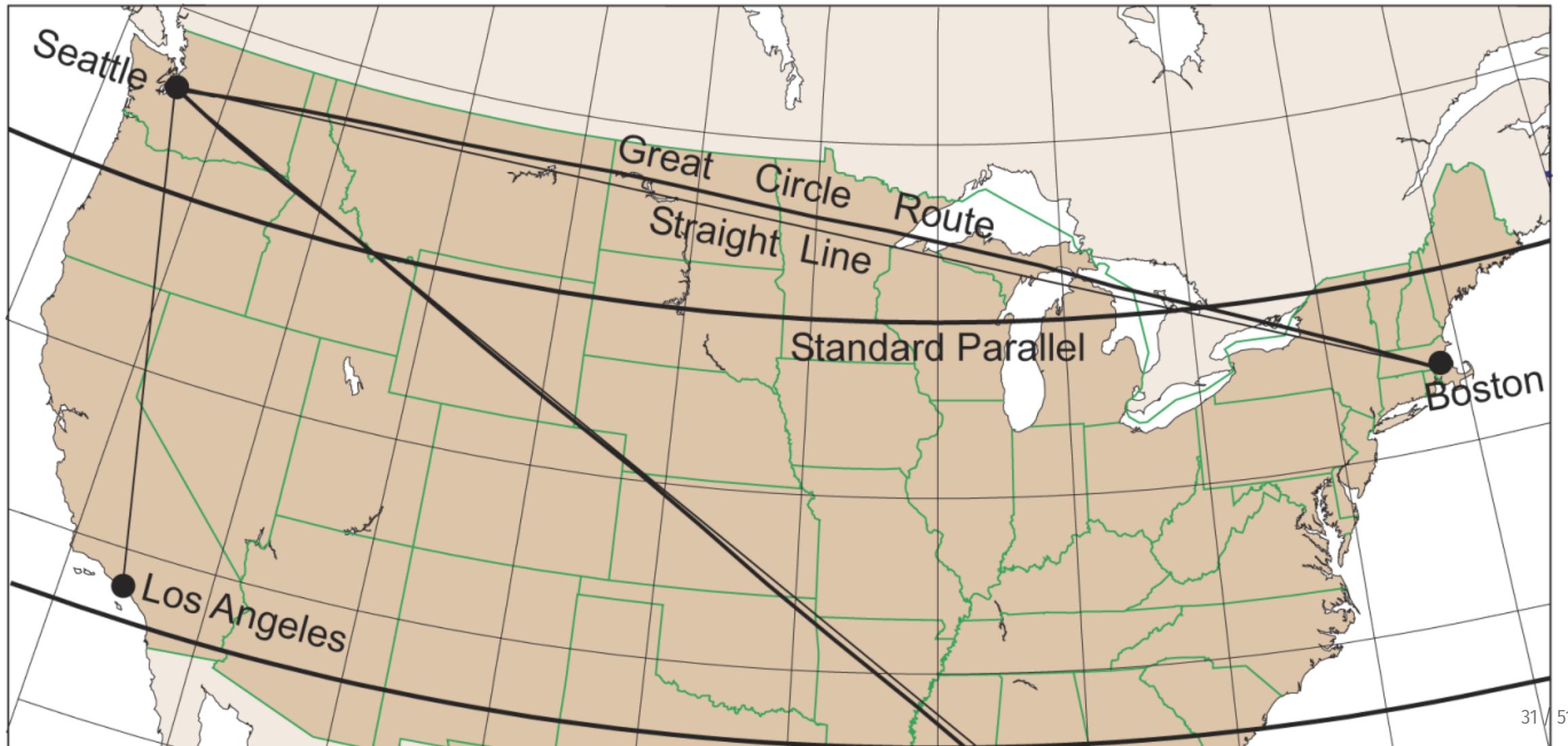
# Scale

TAKE HOME: Scale is not equal across all areas of a small scale projection. On world maps, a static scale bar is virtually useless. A Conic Projection is a good compromise for true scale when mapping mid-latitude continents.

# Great Circles Vs Rhumb Lines

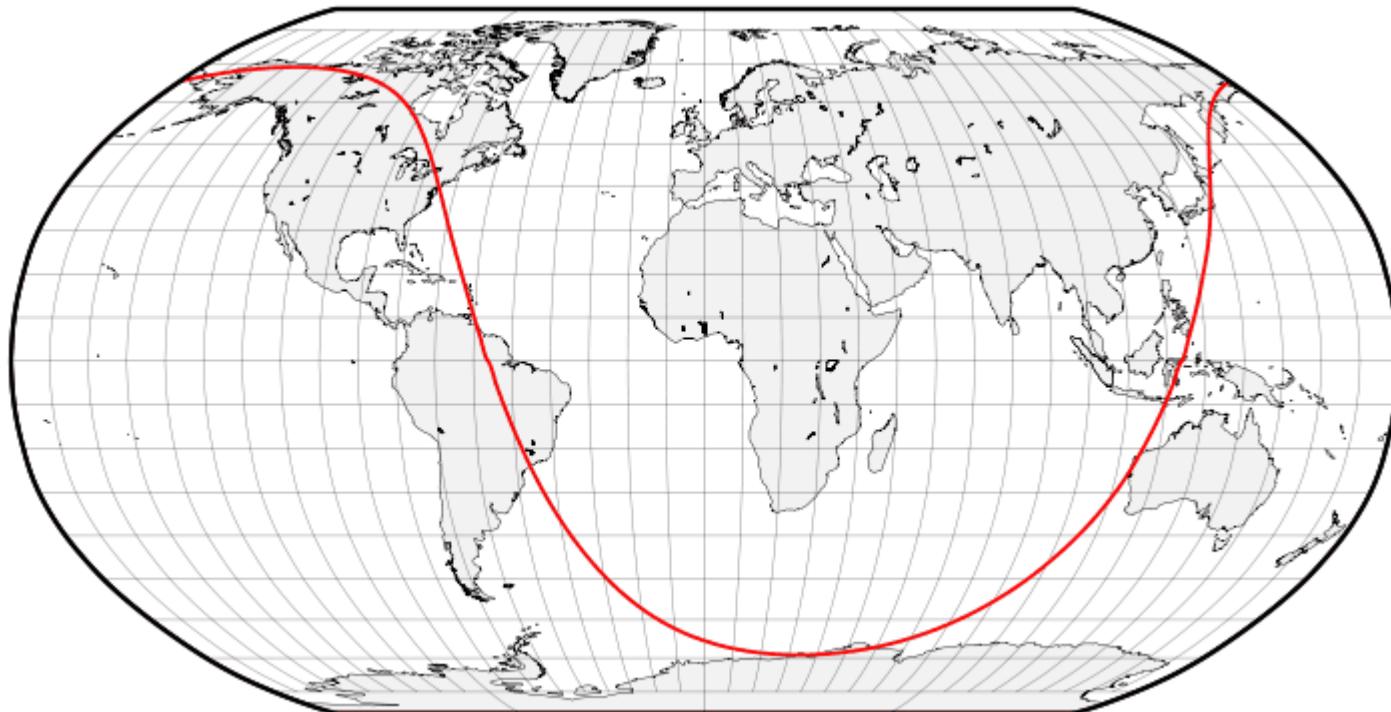


# Great Circles Vs Rhumb Lines



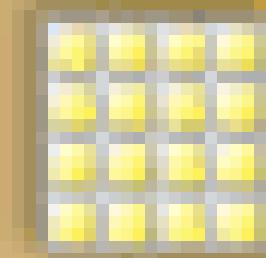
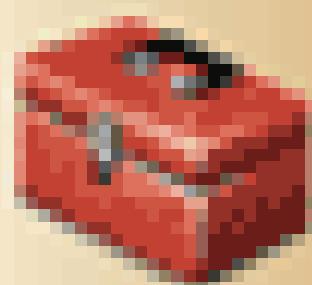
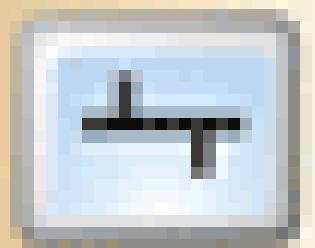
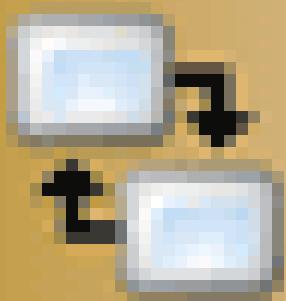
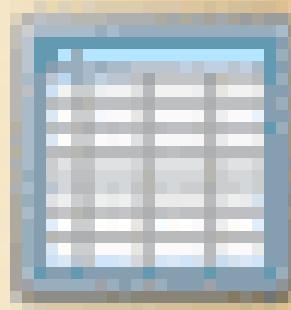
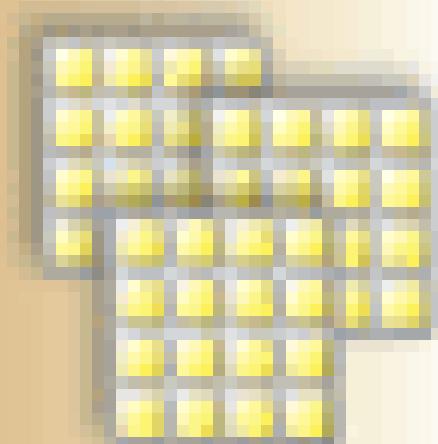
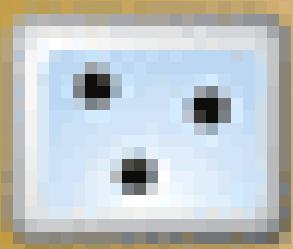
# Great Circles Vs Rhumb Lines

<https://beta.observablehq.com/@jake-low/satellite-ground-track-visualizer>



# The Geodatabase

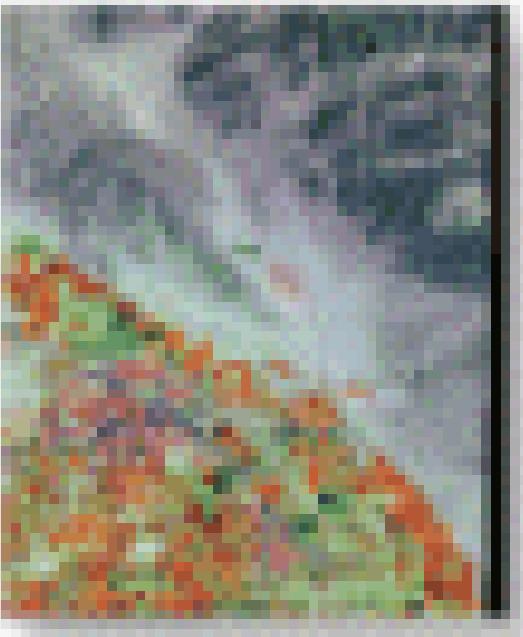
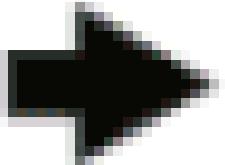
# Geodatabase

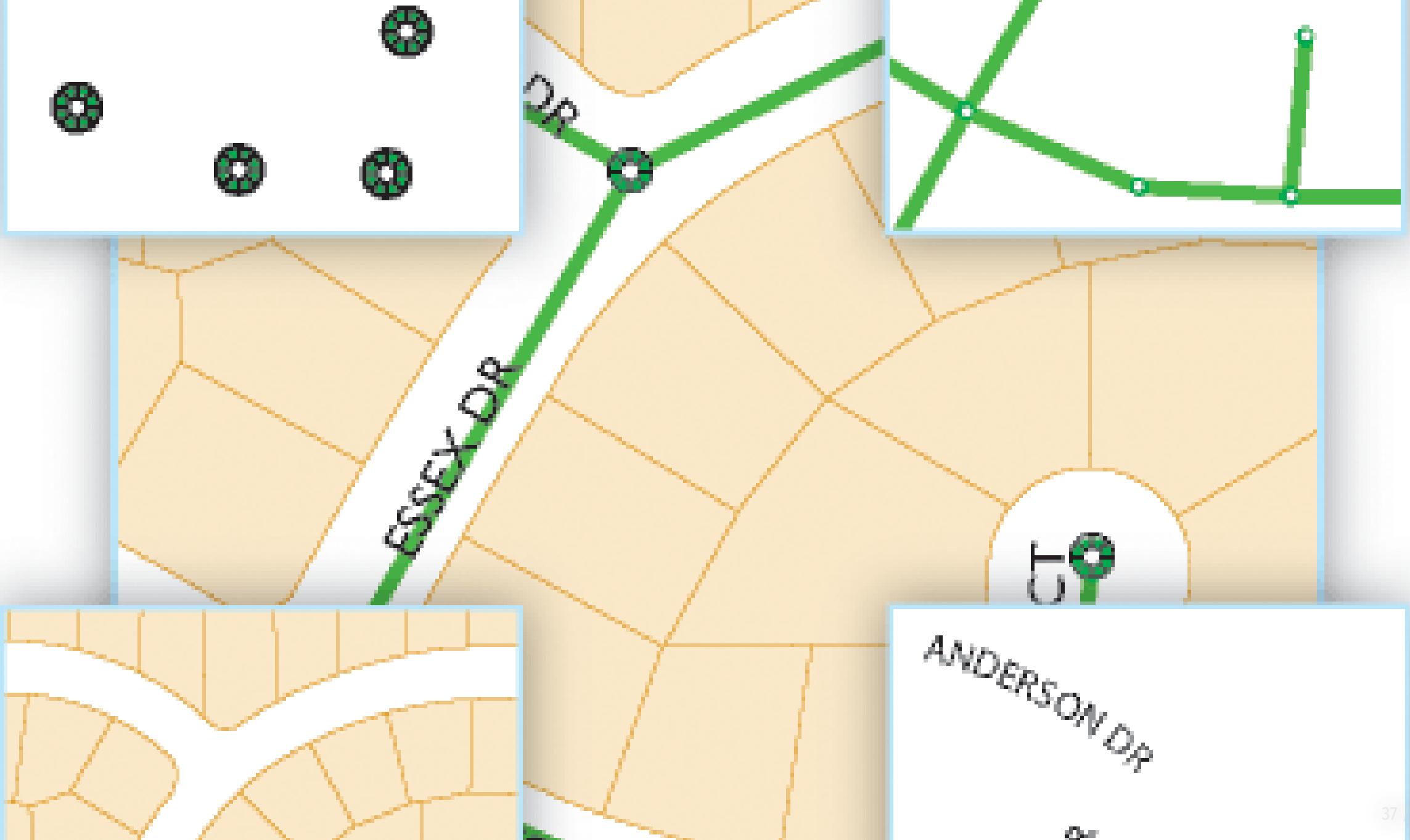




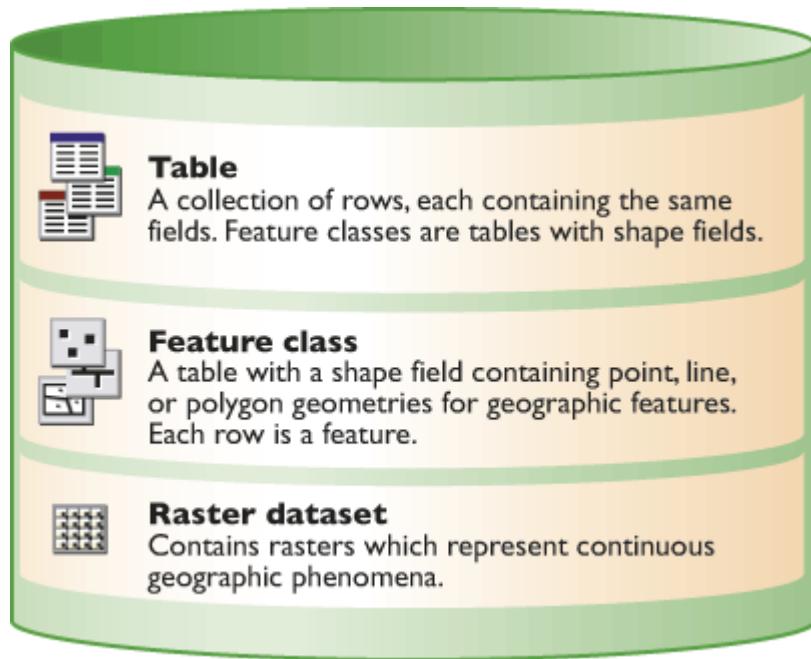


Mosaic





# The Geodatabase



# The Geodatabase

# Staying Organized

# Staying Organized: Graphic





The screenshot shows the Microsoft PowerPoint ribbon at the top with various animation effects like 'Grow & Turn', 'Zoom', 'Swivel', 'Bounce', 'Pulse', and 'Color Pulse'. Below the ribbon is the 'Animation Pane' tab, which is selected. The 'Timing' section shows 'Start' set to 'At Beginning', 'Duration' set to '0', and 'Delay' set to '0'. The 'Animation Pane' list contains 16 items, mostly 'Straight Arrow...' and 'Picture' objects, with some 'TextBox' and 'Image' entries. A red arrow points from the 'Animation Pane' tab to the list of items.

**Animation Pane**

**Timing**

**Animation Pane**

Play

- 1 ★ Straight Arrow... [ ]
- 2 ★ Straight Arrow... [ ]
- 3 ★ Straight Arrow... [ ]
- 4 ★ Straight Arrow... [ ]
- 5 ★ Straight Arrow... [ ]
- 6 ★ Straight Arrow... [ ]
- 7 ★ Picture 3 [ ]
- 8 ★ Picture 3 [ ]
- 9 ★ Picture 2 [ ]
- 10 ★ Elbow Connect... [ ]
- 11 ★ Picture 2 [ ]
- 12 ★ Picture 2 [ ]
- 13 ★ Picture 25 [ ]
- 14 ★ TextBox 9: 4 [ ]
- 15 ★ TextBox 16: M... [ ]
- 16 ★ Picture 3 [ ]

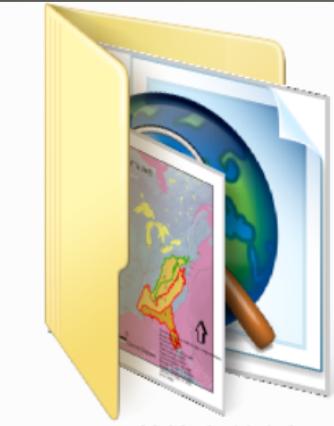
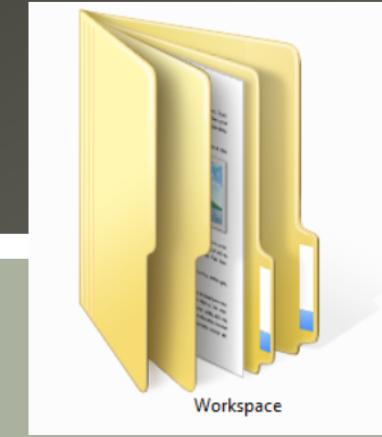
Date modified Type Size

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4/6/2015 4:47 PM	File folder	
10/16/2014 10:13 ...	File folder	
1/12/2015 7:15 PM	File folder	
9/24/2015 9:46 AM	File folder	
8/31/2015 5:29 PM	File folder	
8/31/2015 5:32 PM	File folder	
8/31/2015 5:53 PM	File folder	
9/18/2015 9:03 AM	File folder	
9/17/2015 2:10 PM	Microsoft Excel W...	12 KB
8/27/2015 4:14 PM	JPEG image	735 KB
8/27/2015 4:15 PM	PNG File	2,531 KB
3/6/2015 8:37 PM	Adobe Acrobat D...	204 KB
4/23/2015 10:16 AM	Microsoft Word 9...	61 KB
8/28/2015 10:47 AM	Adobe Acrobat D...	305 KB
8/14/2014 5:13 PM	Microsoft Word D...	14 KB
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8/14/2014 5:36 PM	Microsoft Word D...	721 KB
8/27/2015 4:15 PM	KML	64 KB

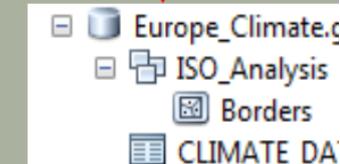
Search IntroGIS\_F15

New folder

# Staying Organized: Graphics

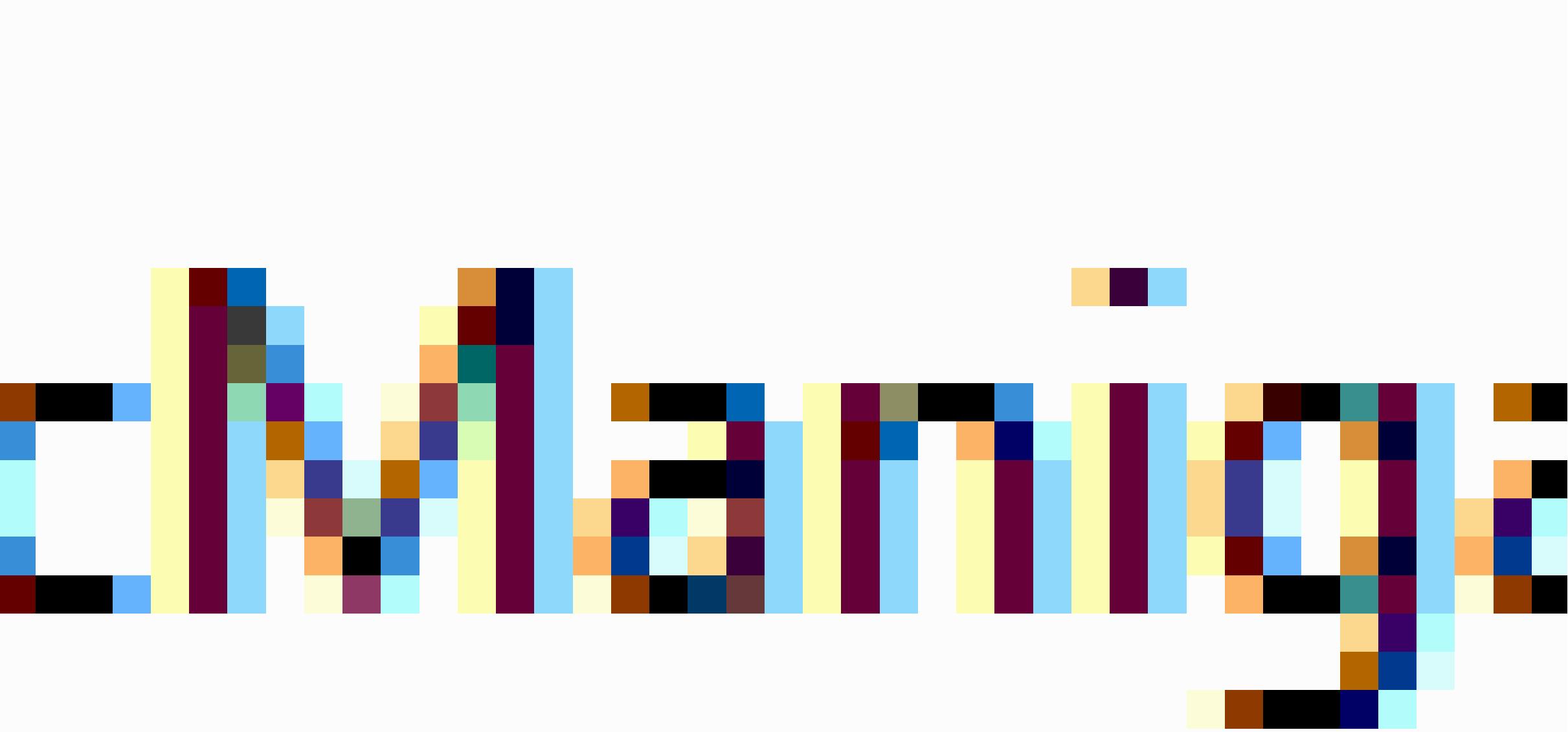


Workspace



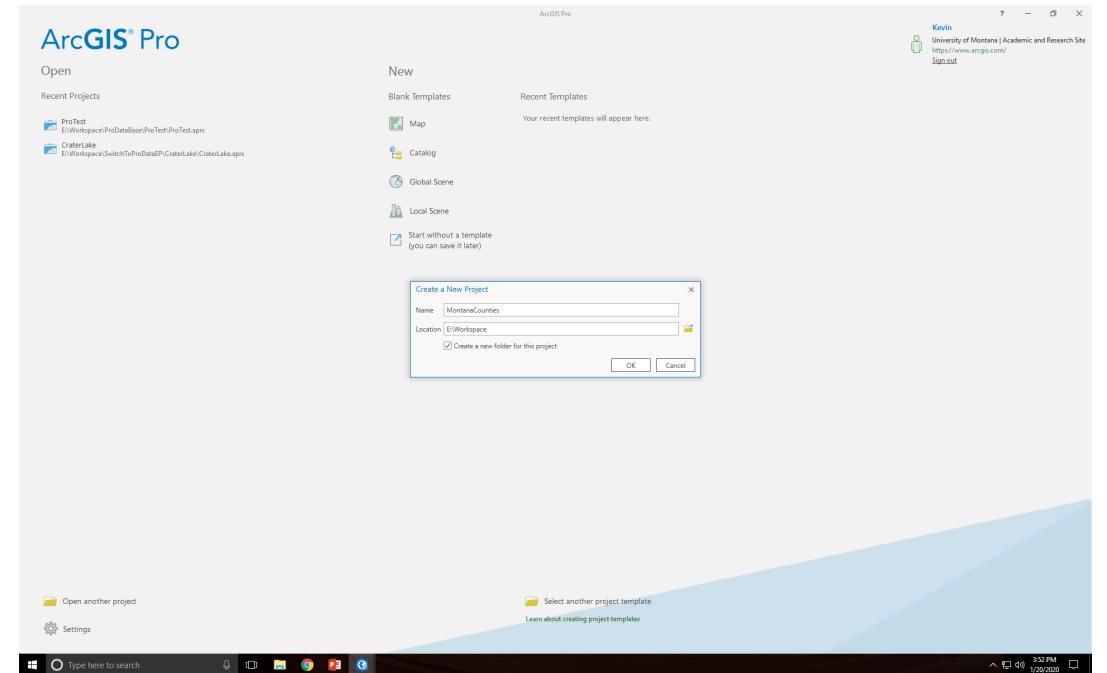
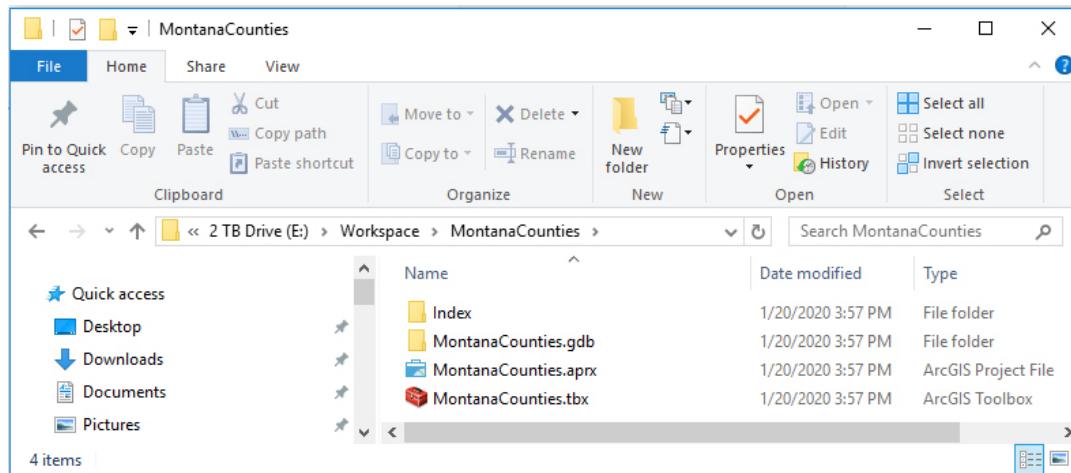
McManigal\_Lab4.docx







# Setting the Default GDB



# Setting the GDB: Option Two

The screenshot shows the ArcGIS Pro application interface. The left sidebar has a blue header with a back arrow and a list of options: New, Open, Save, Save As, Portals, Licensing, Options, Python, Add-In Manager, Help, About, and Exit. The 'New' option is selected. The main area has a blue header 'New' with a 'Recent' button. Below it is a 'Project Templates' section with 'Blank Templates' and 'Recent Templates'. Under 'Blank Templates' are 'Map', 'Catalog', 'Global Scene', and 'Local Scene'. A checkbox 'Start without a template (you can save it later)' is checked. On the right, a 'MontanaCounties - Catalog - ArcGIS Pro' window is open. It shows an 'Options' dialog with a sidebar menu:

- Project
  - Current Settings
  - Units
  - Tasks
- Application
  - General
  - Map and Scene
  - Navigation
  - Selection
  - Editing
  - Geoprocessing
  - Share and Download
  - Raster and Imagery
  - Display
  - Layout
  - CAD

The 'Current Settings' option is highlighted. The main pane shows settings for the current project:

Change settings for the current project.

Name: MontanaCounties

Location: E:\Workspace\MontanaCounties\MontanaCounties.aprx

Home folder: E:\Workspace\MontanaCounties

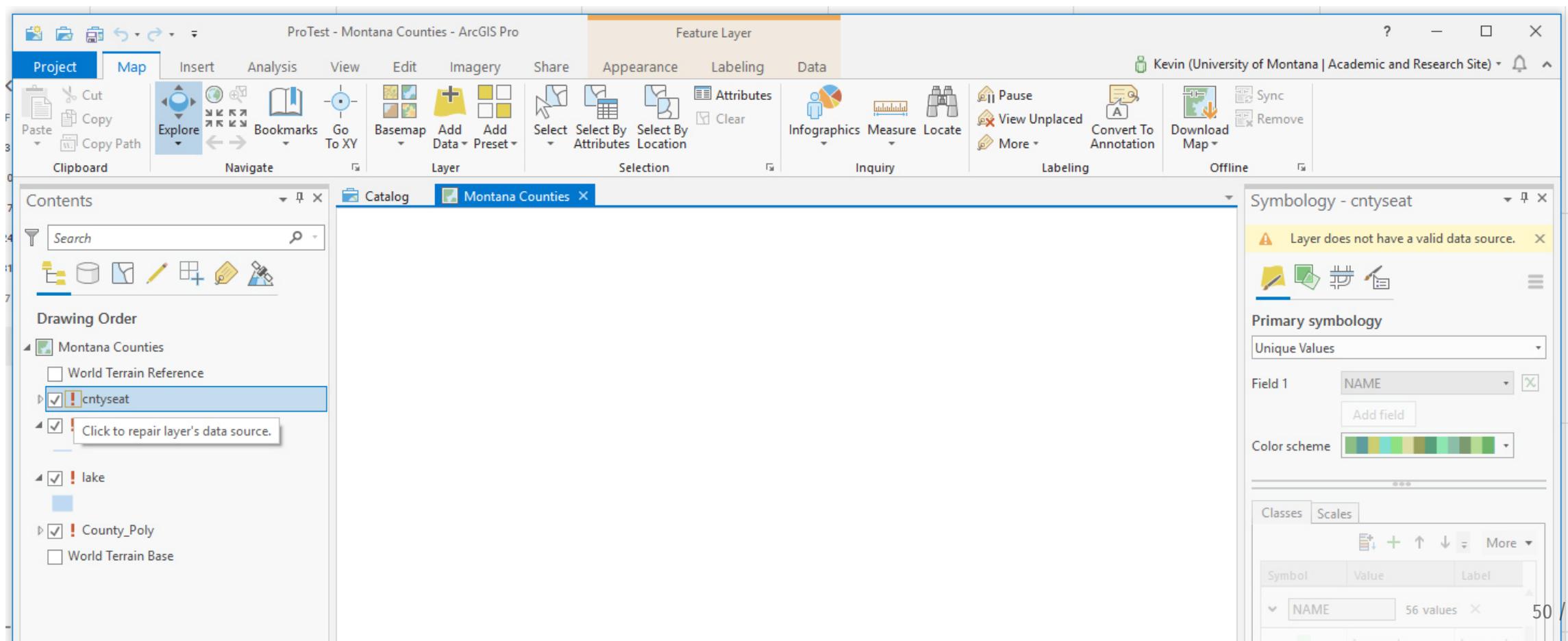
Default geodatabase: E:\Workspace\MontanaCounties\MontanaCounties.gdb

Default toolbox: E:\Workspace\MontanaCounties\MontanaCounties.tbx

Page footer: 49 / 51

# The Red Exclamation Point of Death

Click on Red Exclamation Point → Change Data Source → Find Feature in the GDB and..... MAGIC... All better



# ArcGIS Pro Project Setup