

# Map Animation

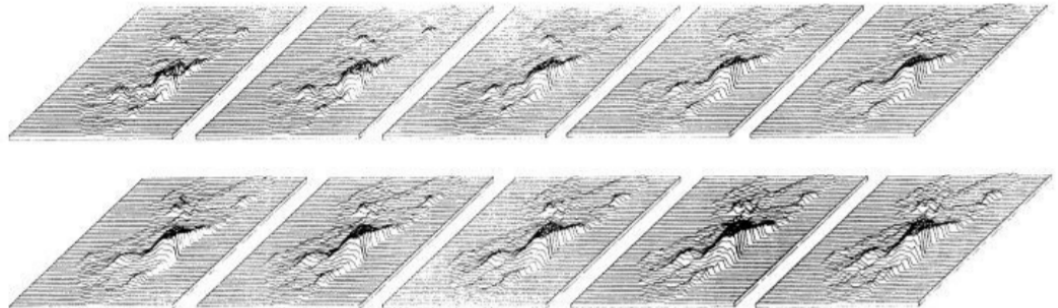
GEOG 5201 – Spring 2022

# Outline

- Definition
- Visual variables
  - Basic
  - Additional
- Categories
  - Temporal
  - Non-temporal

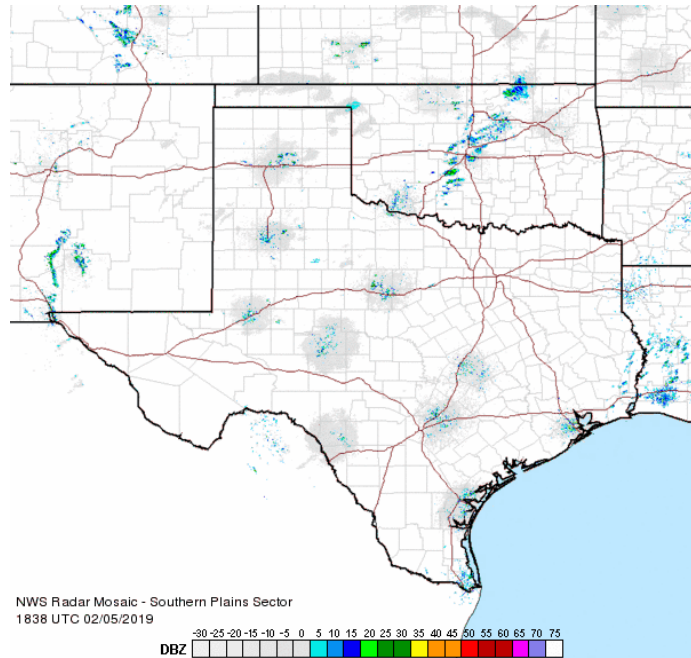
# Definition

- Map animation: the use of different motion techniques (largely devised by the film and cartoon industry over the past 100 years) to display data change on a map
- Tobler created one of the [first computer-based map animations](#) in 1970 to portray population growth over a specified time in Detroit
- Animated maps are used to visualize a wide range of data topics
  - Weather
  - Health
  - Demographic statistics
  - Travel routes

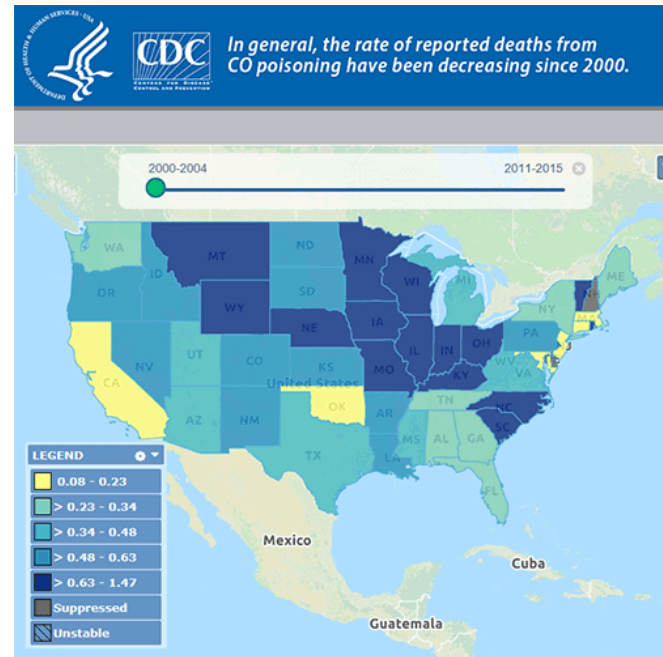


Simulated population growth, Detroit Region. Selection of ten-year interval frames from computer movie. Top row 1910 through 1960, bottom row 1960 through 2000, (non-linear vertical scale).

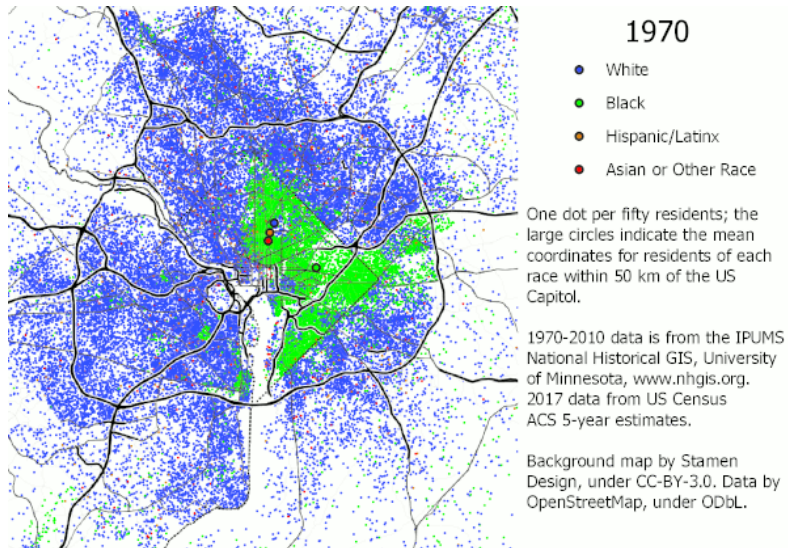
# Weather



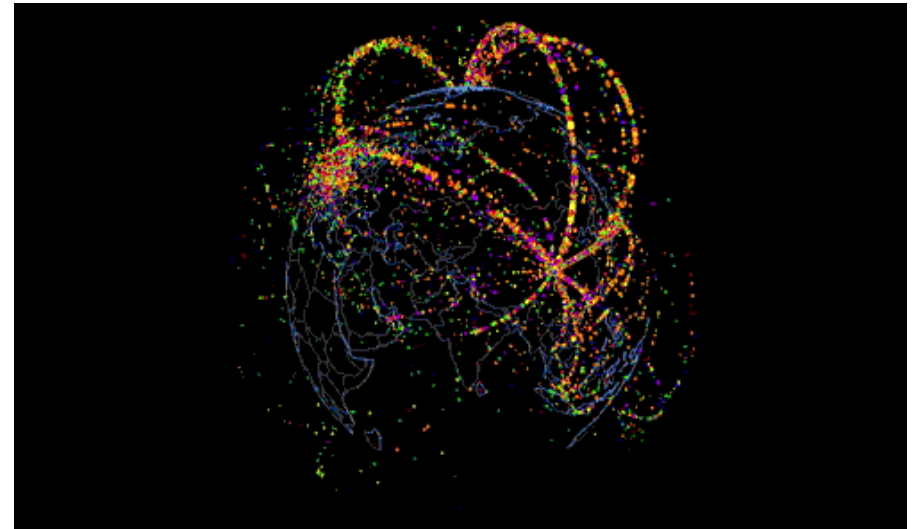
# Health



# Demographics



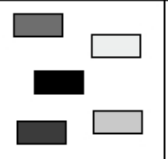
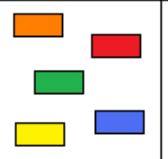
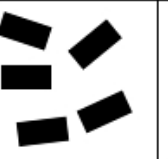
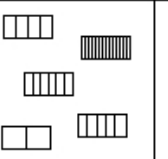
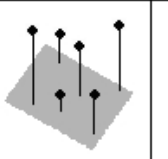
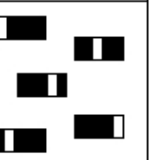




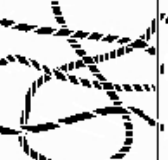




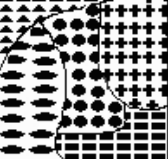




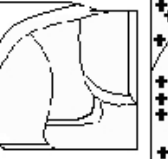



# Global trade



# Basic Visual Variables

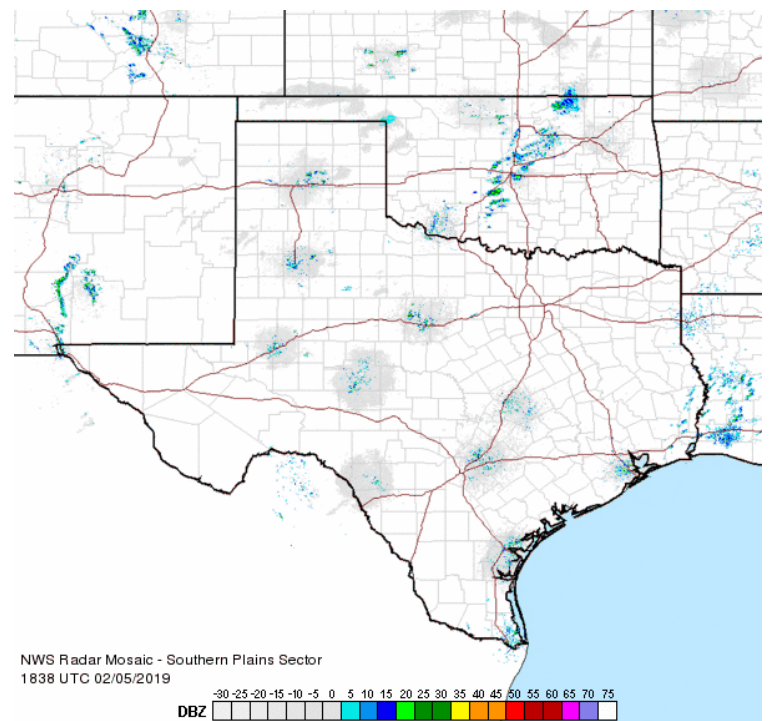
- Any **basic visual variable** can be applied to animated maps

	Size	Shape	Brightness	Color	Orientation	Spacing	Perspective height	Arrangement
Point	 A collection of black rectangles of various sizes, illustrating the visual variable of size.	 A collection of black shapes including a circle, a triangle, a square, and a cross, illustrating the visual variable of shape.	 A collection of gray rectangles of varying shades, illustrating the visual variable of brightness.	 A collection of colored rectangles in orange, green, yellow, red, and blue, illustrating the visual variable of color.	 A collection of black rectangles rotated at various angles, illustrating the visual variable of orientation.	 A collection of white rectangles with varying gaps between them, illustrating the visual variable of spacing.	 A gray square with several black lines of varying heights extending upwards from its top edge, illustrating the visual variable of perspective height.	 A collection of black rectangles arranged in different patterns, illustrating the visual variable of arrangement.
Linear	 A collection of black lines of varying thicknesses, illustrating the visual variable of size.	 A collection of black lines with different end shapes like dots, triangles, and squares, illustrating the visual variable of shape.	 A collection of gray lines of varying shades, illustrating the visual variable of brightness.	 A collection of colored lines in blue, green, yellow, red, and orange, illustrating the visual variable of color.	 A collection of black lines rotated at various angles, illustrating the visual variable of orientation.	 A collection of white lines with varying gaps between them, illustrating the visual variable of spacing.	 A collection of black lines of varying heights extending upwards from a common base, illustrating the visual variable of perspective height.	 A collection of black lines arranged in different patterns, illustrating the visual variable of arrangement.
Areal	 A collection of black crosses of varying sizes, illustrating the visual variable of size.	 A collection of black shapes including a circle, a triangle, and a square, illustrating the visual variable of shape.	 A collection of gray areas of varying shades, illustrating the visual variable of brightness.	 A collection of colored areas in red, yellow, green, and blue, illustrating the visual variable of color.	 A collection of black areas with different orientations of lines, illustrating the visual variable of orientation.	 A collection of white areas with varying gaps between them, illustrating the visual variable of spacing.	 A collection of black areas with varying heights extending upwards, illustrating the visual variable of perspective height.	 A collection of black areas arranged in different patterns, illustrating the visual variable of arrangement.

# Question 5-1-1

Which basic visual variable(s) is/are used in the following animated map?

- i. Color
- ii. Arrangement
- iii. Shape
- iv. Size

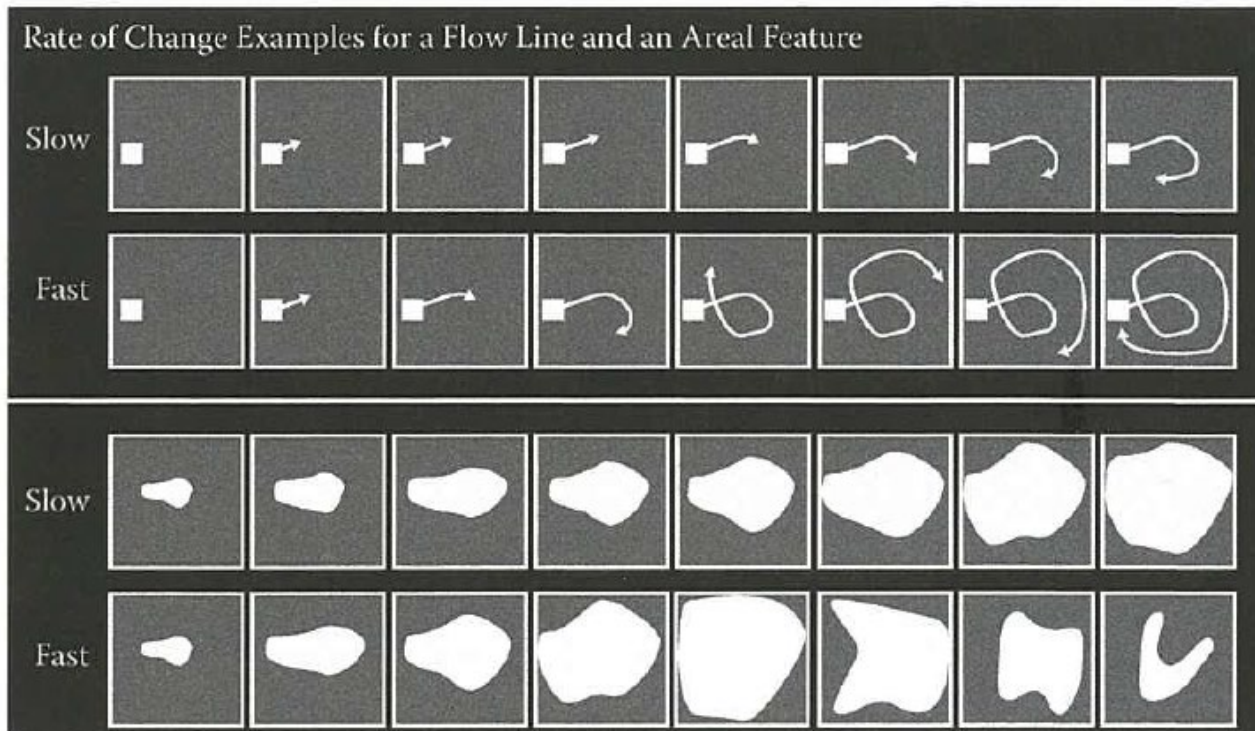


## Additional Visual Variables: Duration

- Duration: the length of time that a scene of an animation is displayed
  - Scene: a static map in the animation; also termed a frame
- Can be used to represent quantitative data
  - Example: animated electoral college votes for president, varying the duration of each scene in direct proportion to the magnitude of the victory in each election

# Additional Visual Variables: Rate of Change

- Rate of change: how much the map changes between each animated frame
  - Defined as  $m/d$ , where  $m$  is the **magnitude of change** (in position and attributes of entities) between scenes, and  $d$  is the **duration** of each scene





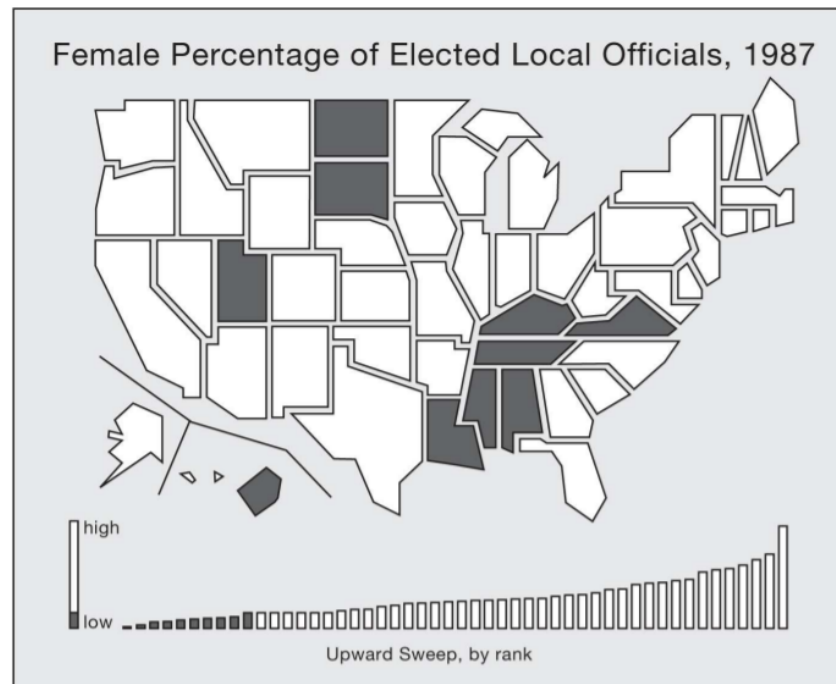
# Question 5-1-2

Which of the following indicates a smoother animation?

- i. Lower duration of scenes
- ii. Lower rate of change
- iii. None of the above
- iv. Both (i) and (ii)

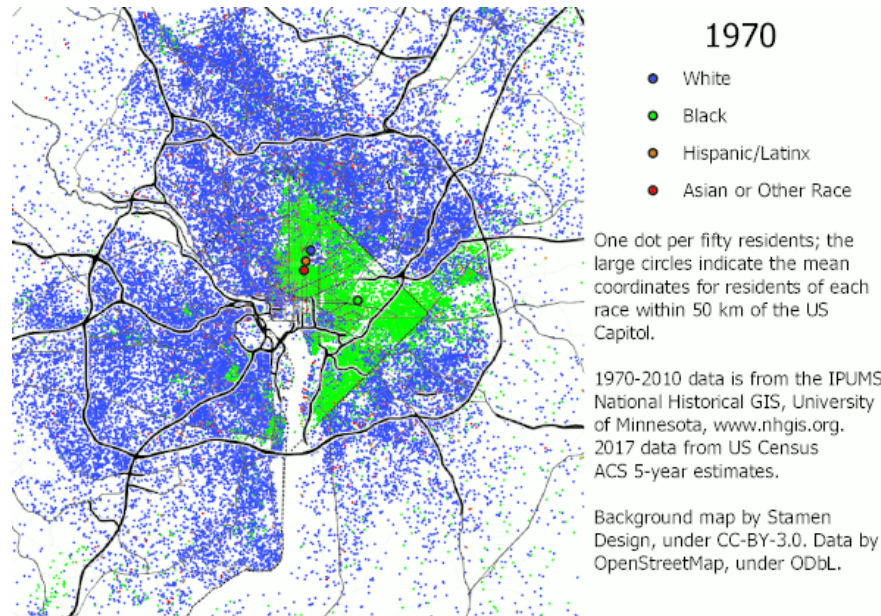
# Additional Visual Variables: Order

- Order: the sequence in which frames or scenes are presented
  - Often presented in chronological order
- Rearrange scenes by **value** can also provide useful information
  - Example: lower female percentages of elected local officials are presented first



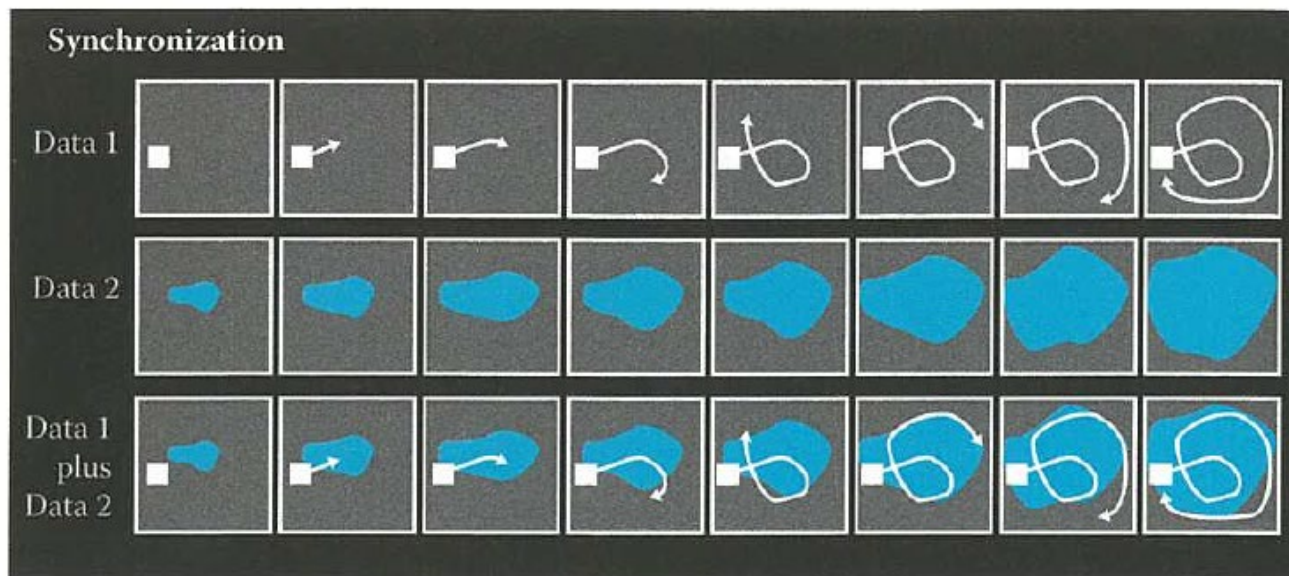
# Additional Visual Variables: Display Date

- Display date: the starting time of a temporal sequence
  - Example: in the animated map below, we might note that the scene first appears in 1970



# Additional Visual Variables: Frequency and Synchronization

- Frequency: the number of scenes per unit time
  - Also termed temporal texture
- Synchronization: the coincidence (or otherwise) of time series when two or more are displayed at once
  - Example: snowfall and school attendance might be displayed out of sync
  - Useful for highlighting temporal correlations and relationships



## Question 5-1-3

- A. What is the relationship between duration and frequency?
- B. Can you think of two time series that are synchronized?

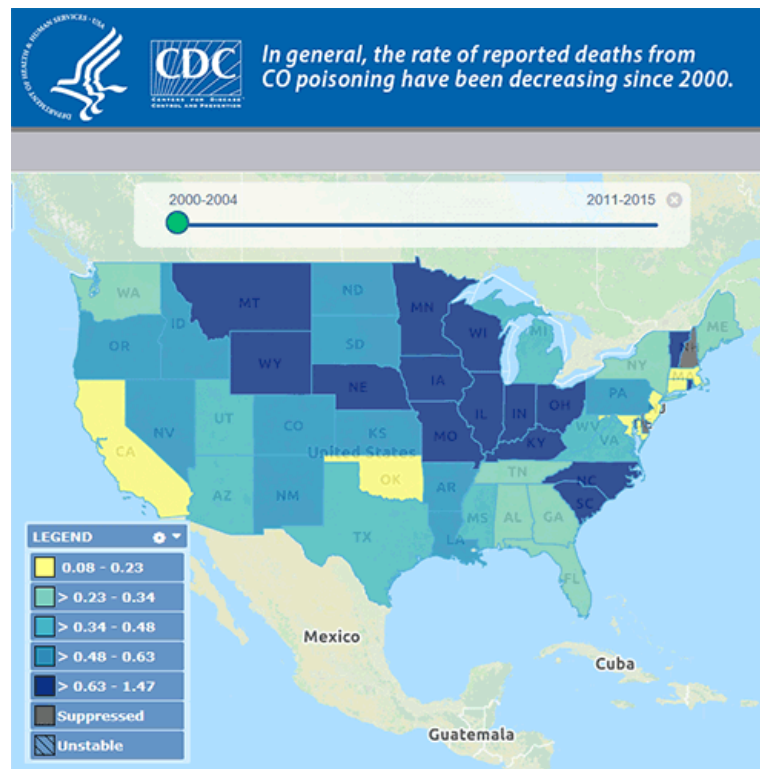
# Types of Map Animations: Temporal

- Animations emphasizing change over time
  - Change in position
    - Example: a moving point of the mean center of the United States population for each decennial census



# Types of Map Animations: Temporal

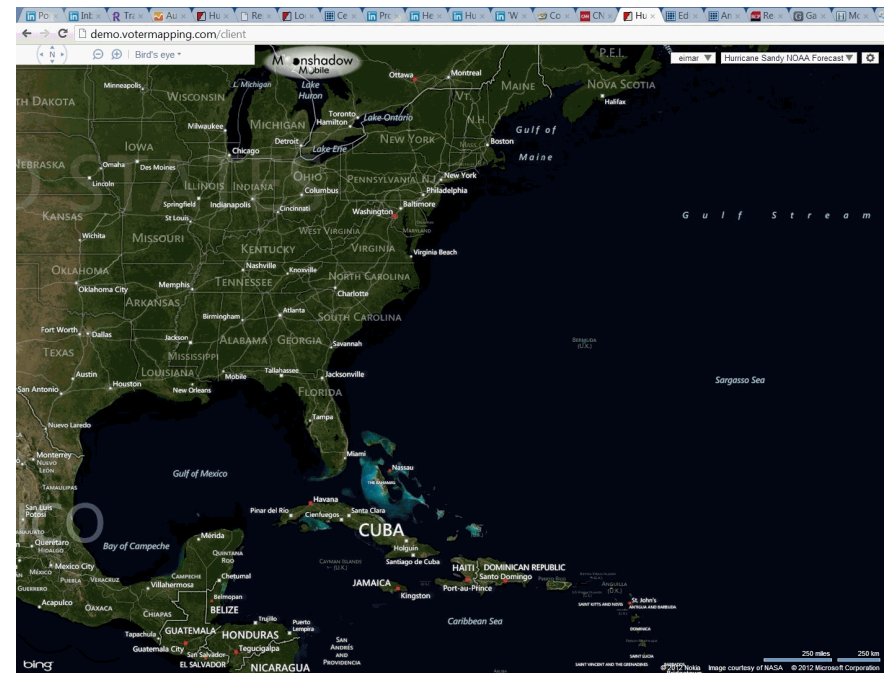
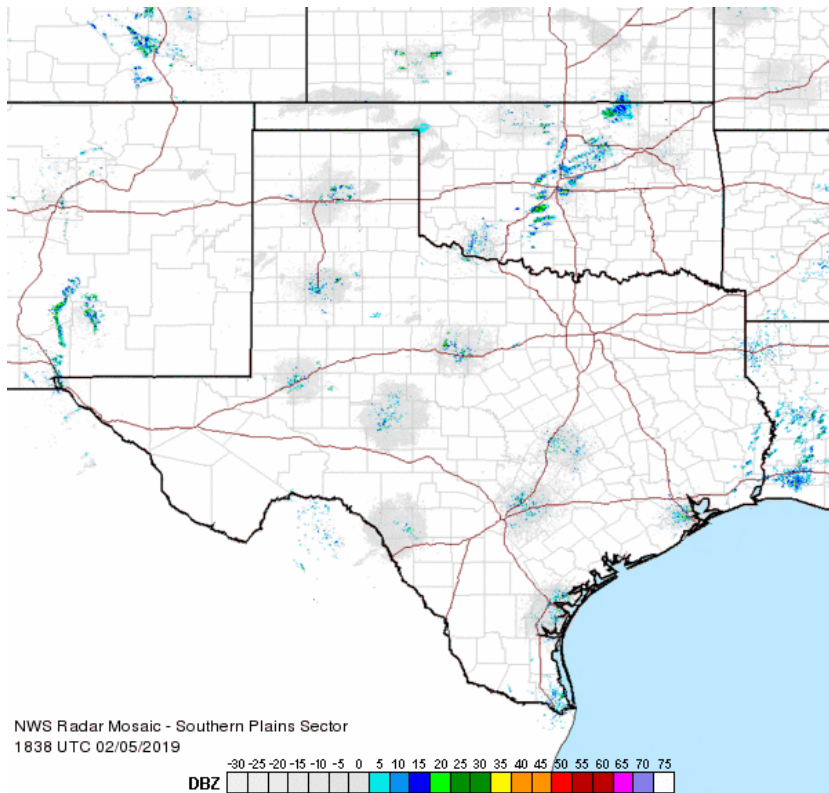
- Animations emphasizing change over time
  - Change in attribute
    - Example: animated choropleth map





# Types of Map Animations: Temporal

- Animations emphasizing change over time
  - Change in shape and size
    - Example: extent of precipitation/hurricanes







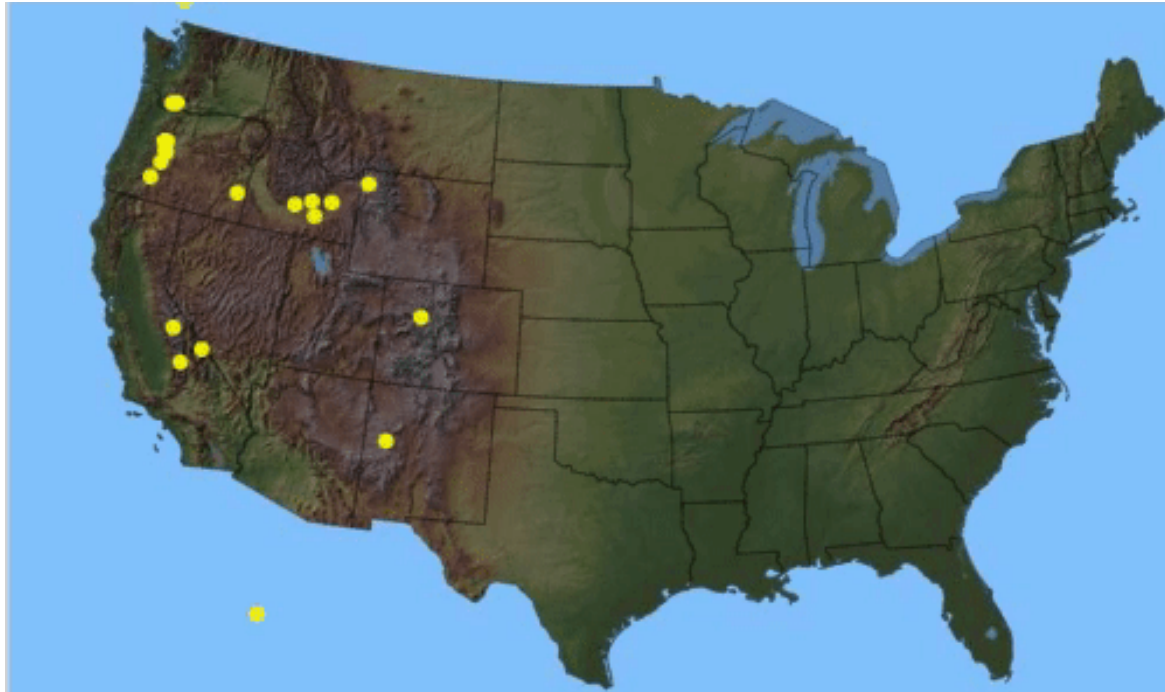
170 Years of America's Evolution In One Animated GIF

## Question 5-1-4

Give another example that uses animation to emphasize change in shape and size. You don't need to attach the source of the animated map.

# Types of Map Animations: Non-temporal

- Animations emphasizing location
  - Example: flashing points to emphasize locations of volcanos



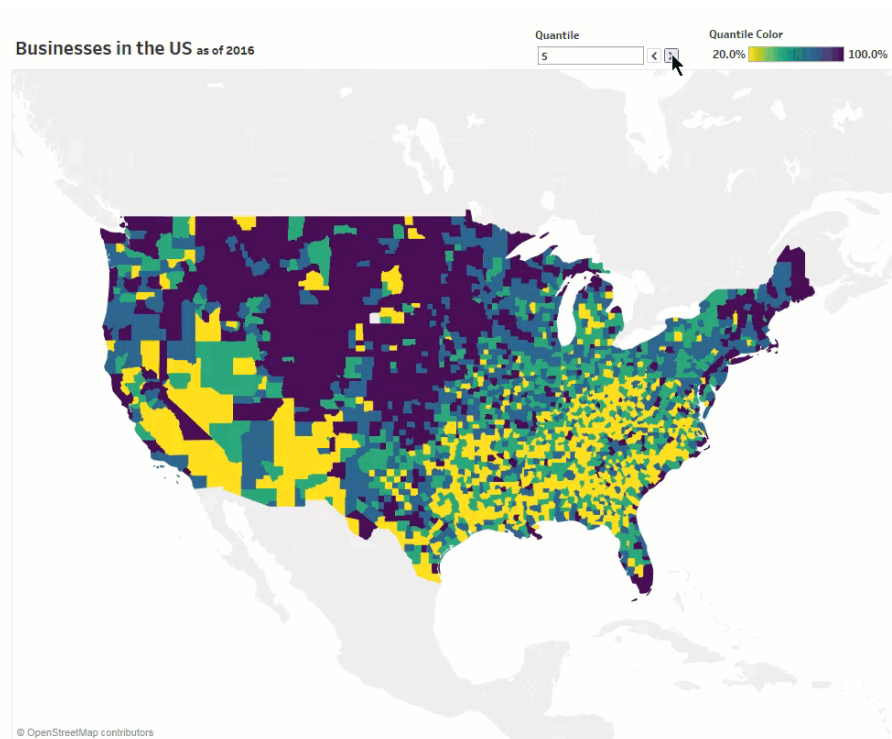
# Types of Map Animations: Non-temporal

- Fly-over animations
  - Give the feeling of flying over a 3D surface
  - Example: a low-speed fly-by over Duke University
  - Recall the advantages and disadvantages of 3D visualization



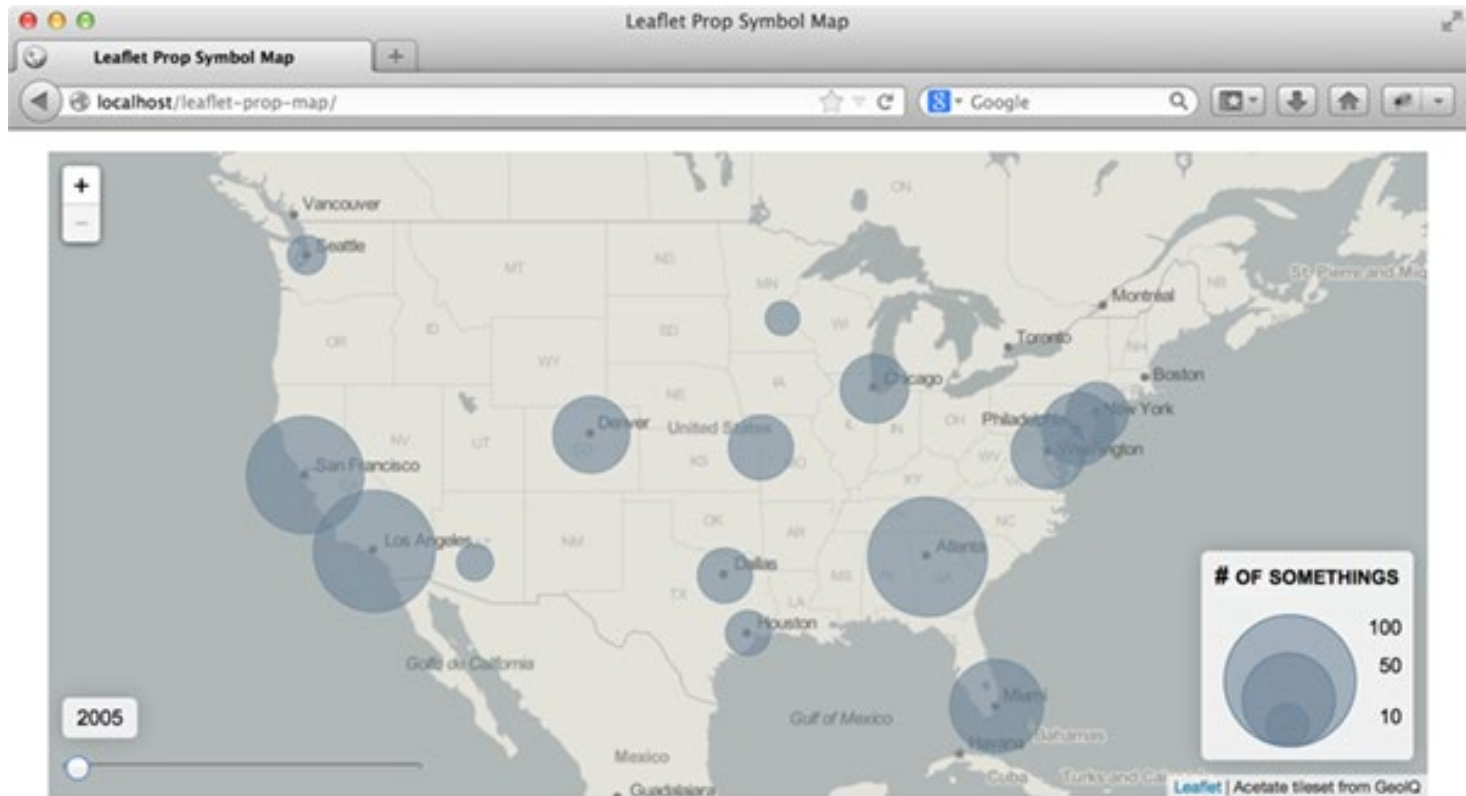
# Types of Map Animations: Non-temporal

- Animation emphasizing the spatial distribution of an attribute
  - Example: present data quantiles from low to high



# Tips for Designing Animations

- Although this may seem like a “no-brainer,” people do not always interpret animated data accurately
- Keep the animations short
  - Animations that are too long overwhelm the viewer’s short-term memory
  - Perhaps 30 seconds to 1 minute (?)
- Simplify the data
  - Do not use animation to communicate an excessively complex message – no matter how cool it looks
  - Humans can only focus on 3-4 things at any single moment
- Give the map user some control
  - It can be frustrating when there is no option to pause or rewind
  - Pairing buttons with a slider give very good flexibility



Time series with Leaflet and Java by slider

# More Map Animation Examples

- [New York Times Web traffic June 25th 2009](#)
- [World history](#)
- [Battle of the Wilderness](#)
- [Flight Aware Real time air traffic](#)
- [Real time Marine traffic](#)