# Map Animation

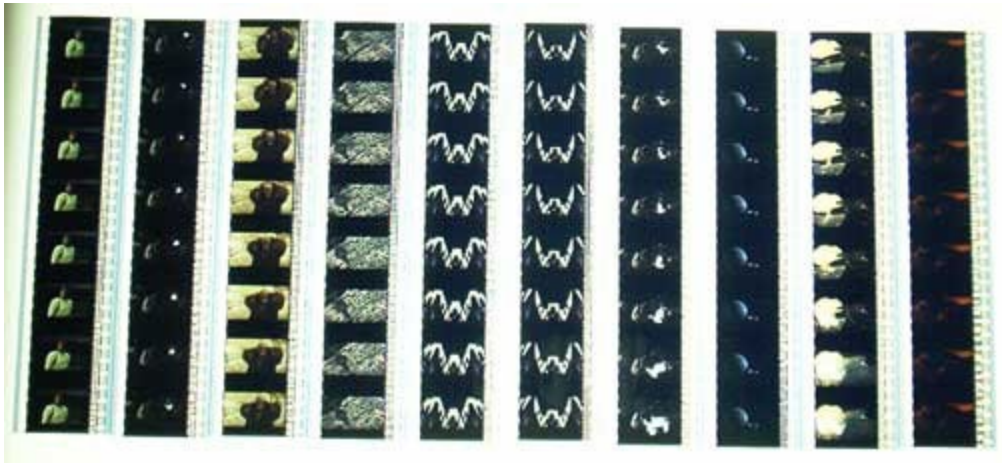
GEOG380 FA2018

# Outline

- Early Developments
- Visual variables revisited
- Animation techniques

# Early Developments

- Norman Thrower (1959) introduces the idea of animation to show "change over time" in maps in The Professional Geographer journal
- Ideas built on the motion picture movies, which are a series of static images put together to form motion

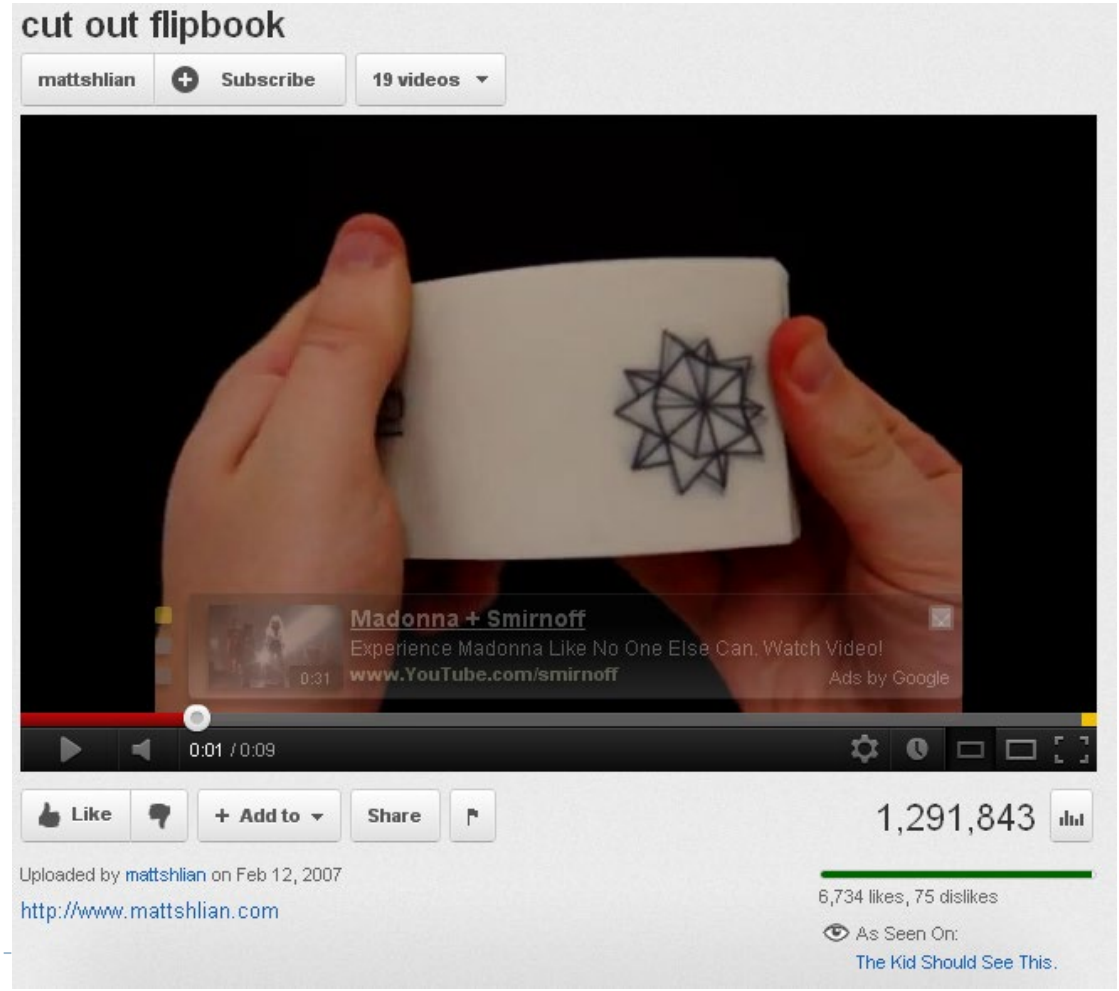


Film Strips of 'Star Wars' movie

(Source: http://marstonia.com/ogs/)

# “Flip-Book” example

- http://www.youtube.com/watch?v=xSrDnIVgVv0



# Some terms in animation

- 1

- 2

- 3

A single frame

A single frame

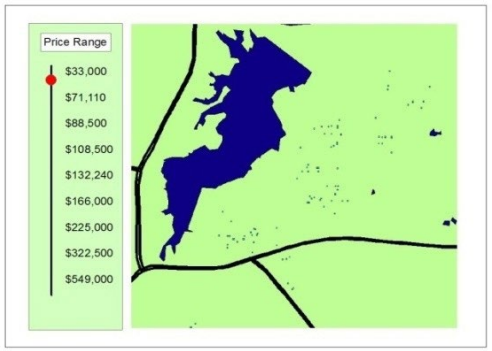
A single frame

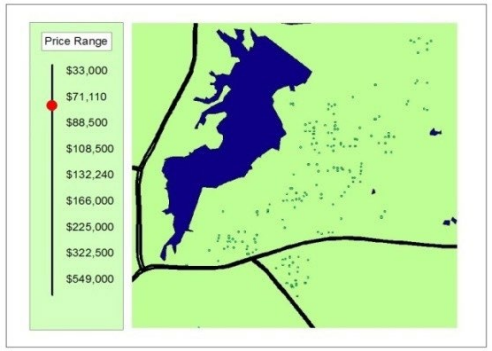
→ A scene

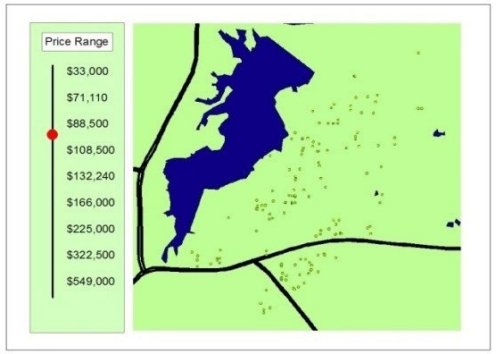
Frame – a single 'shot' or static image

Scene – a series of frames

# Animation in mapping

1. 


2. 


3. 

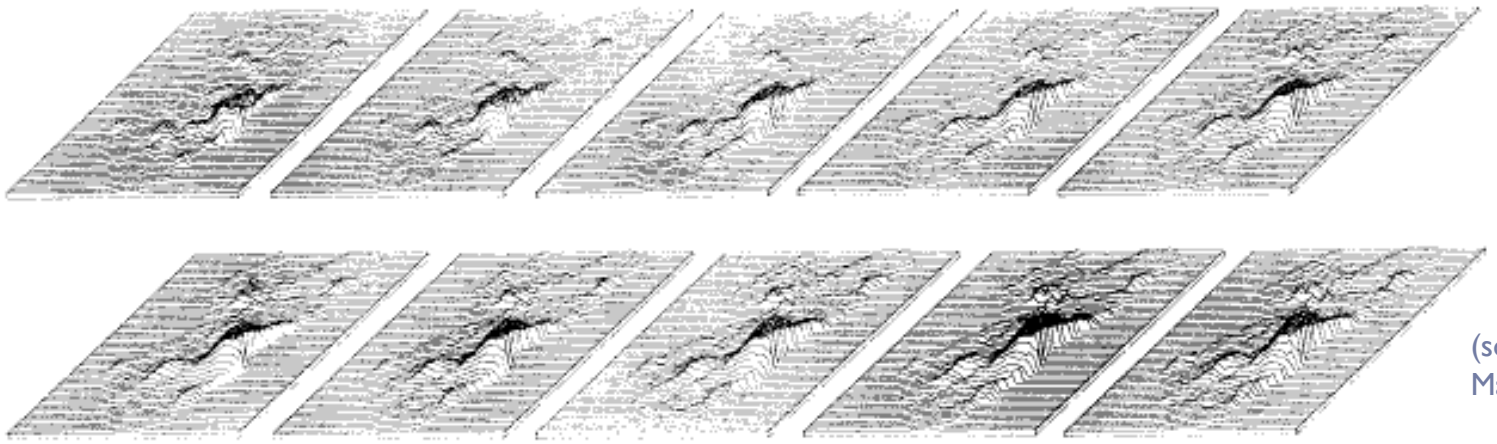

A single map

A single map → A scene of map animation

A single map

# Early developments (cont.)

- Tobler (1970)
  - A 3D population-growth animation of Detroit
- Moellering (1976)
  - Space-and-time patterns of traffic accidents
- MacEachren and DiBiase (1991)
  - Shaded isopleth symbolization for animation



(sources: Tobler, 1970; MacEachren and DiBiase, 1991)

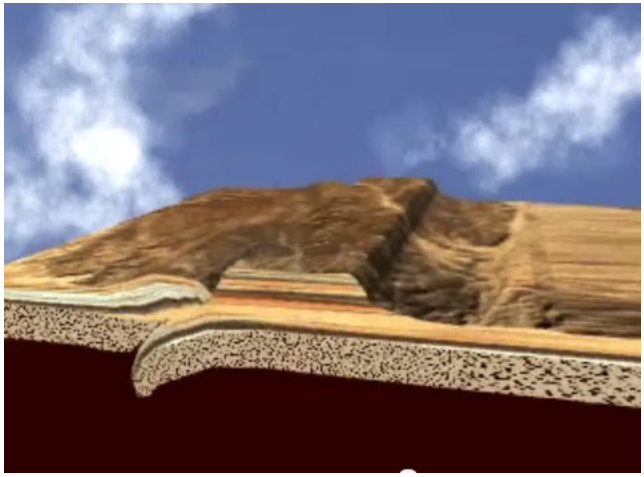
Simulated population growth, Detroit Region. Selection of ten-year interval frames from computer movie. Top row 1910 through 1960, bottom row 1960 through 2000, (non-linear vertical scale).

# Dynamic /animated maps

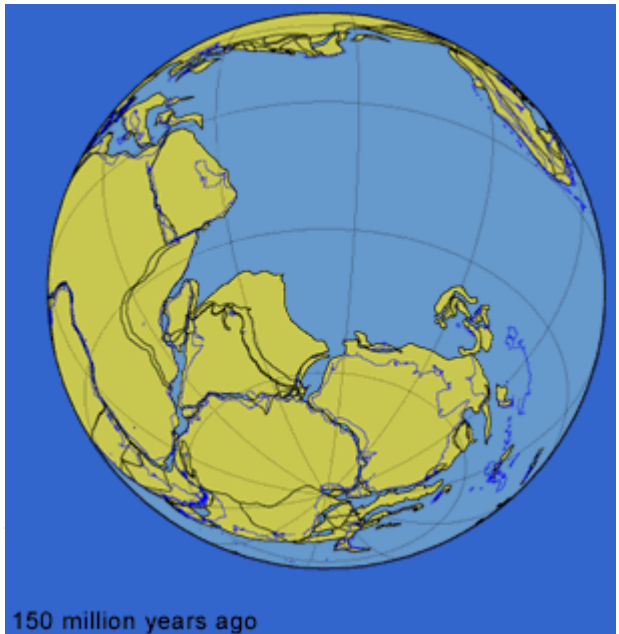
- Dynamically changing phenomena
  - Ex) Plate tectonics
    - http://www.youtube.com/watch?v=6OHRb_ODo-Q&feature=related

    Gondwana (the southernmost of two supercontinents 200-million years ago)

    http://www.pbs.org/wgbh/nova/eden/media/sttnq.html



- Virtual Environment (VE)
  - Interactive contents
    - Ex) modeled worlds such as 3D games and VRML



# Types of animation

- Emphasizing change
  - Time series
    - Buses from Liverpool Street Station (London Quickmap, 2010) http://www.quickmap.com/movie1liv.htm
  - Re-expression: transformation of original data
  - Fly-by (or fly-over)
- Emphasizing location
  - Blinking
    - http://www.youtube.com/watch?v=hehDmwqfhWg
- Emphasizing spatial distribution of an attribute
  - 2004 Indonesia Tsunami
    - http://commons.wikimedia.org/wiki/File:2004_Indonesia_Tsunami.gif (NOAA, 2004)

# Group Activity:
## Examples from Axismaps' works

- http://www.axismaps.com/portfolio/ "View the map"
  - Q. What is the role of animation in the map?

  - Group 1: "Age of Exploration"
  - Group 2: "Diverse Levant"
  - Group 3: "Eruptions, Earthquakes, and Emissions"
  - Group 4: "Rotavirus Visualization"
  - Group 5: "imagineRio"
  - Group 6: "Geography of Jobs"
  - Group 7: "Exploring the Vilnius Ghetto"
  - Group 8: "Mapping Pacific Voyages" (play the movie)

# Visual variables for animation

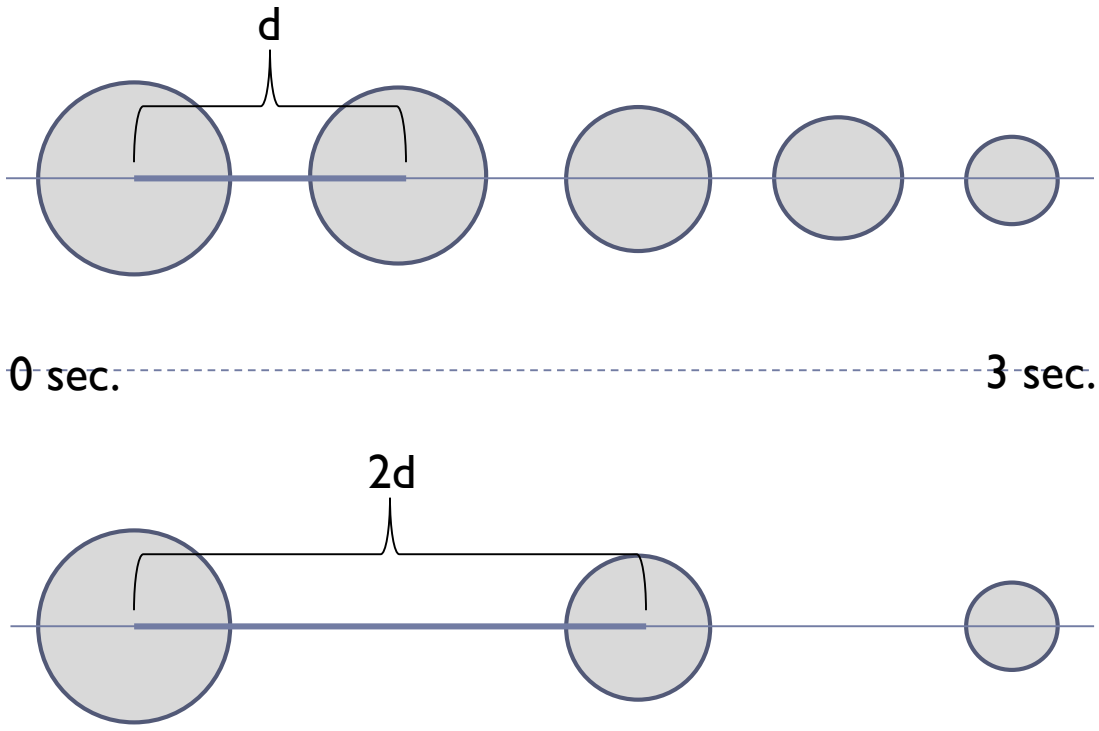
- Duration
  - Length of time a display is shown
- Magnitude of change (rate of change)
  - Difference between an object's positions between displays
- Q. Is *smoothness* a function of duration and magnitude?

  (next slide)

- Order
- Display date
- Synchronization
- Interactivity

# Rate of change

- Q. *Smoothness* as a function of magnitude and duration?
  - At the same duration of about 3 seconds….




Top example changes smoother than the bottom example

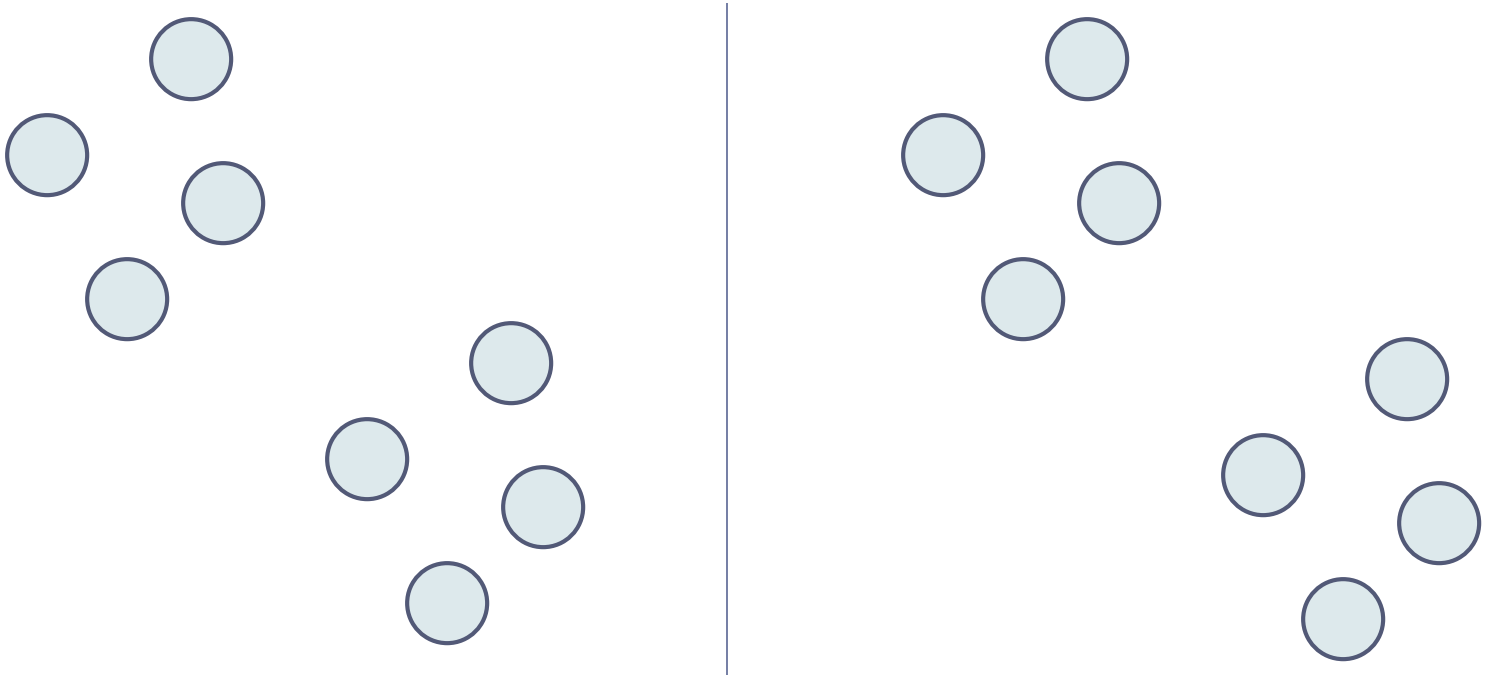
- No, it's about frequency of animation!

# Visual variables for animation

- Duration
  - Length of time a display is shown
- Magnitude of change (Rate of change)
  - Difference in object position, attribute between displays
  - Is smoothness really a function of duration and magnitude?
- Order
- Display date
- Frequency
- Synchronization
- Interactivity

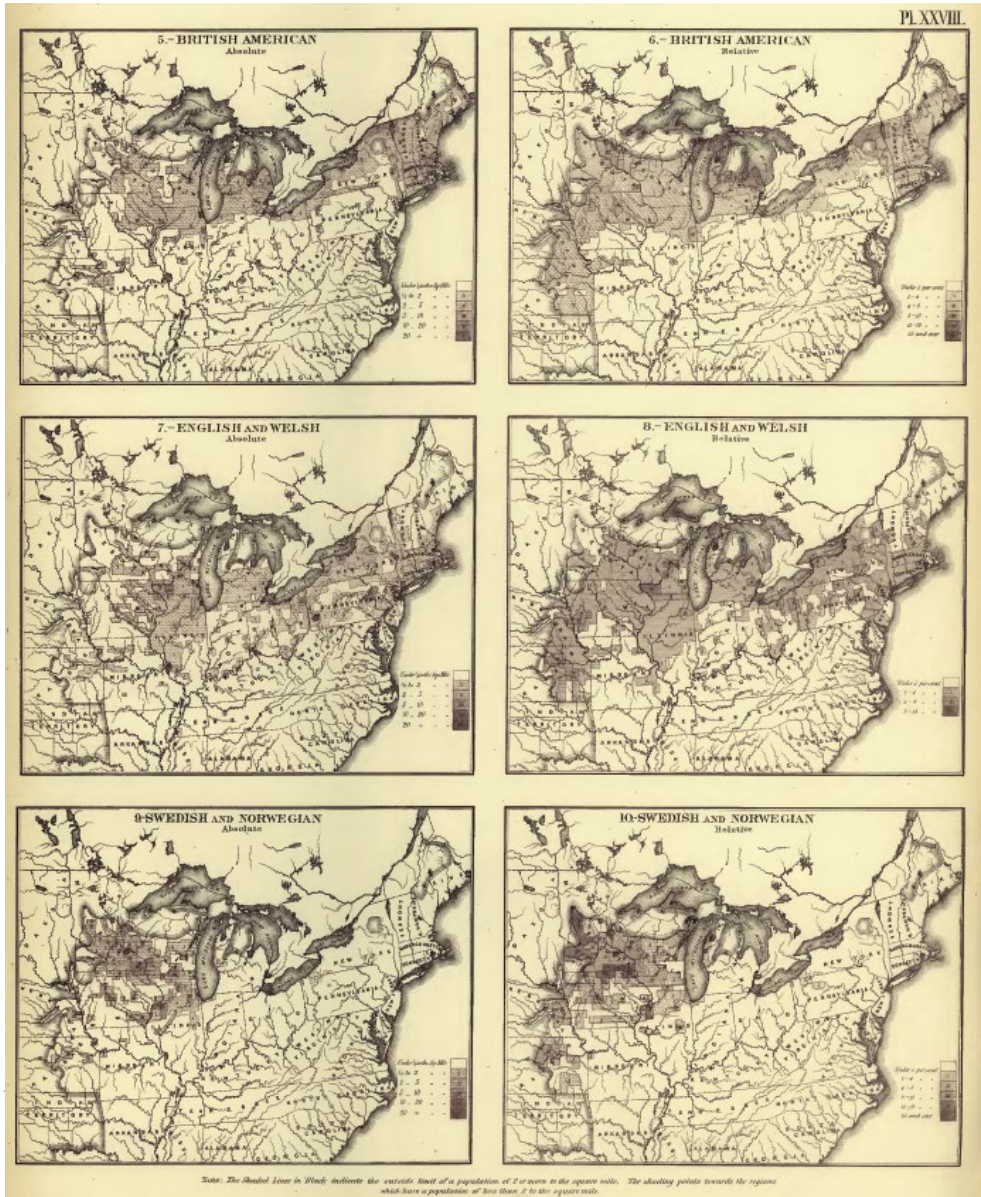
# Order

- Sequence in which frames or scenes are presented
  - Orders other than chronological might emphasize *changes* among given phenomena



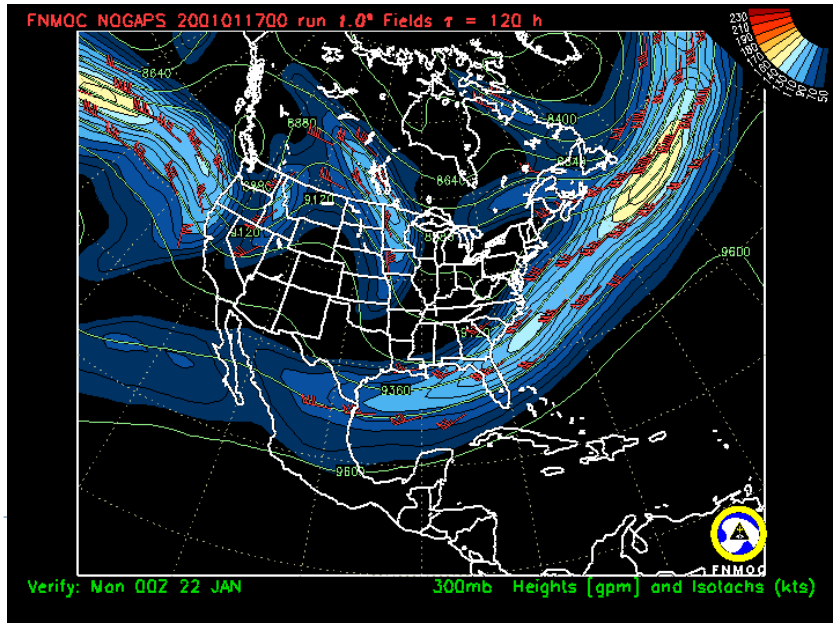
# Display date or moment

- The date, time, or moment of presence and absence
  - As a reference
  - Useful for maps dealing with spatio-temporal change
  - Statistical Atlas of the U.S. Census 1870 (Francis Walker, 1874) →
  - Air Traffic in North America (http://maps.unomaha.edu/animatedflightatlas/FlightTrafficAnimation.html)



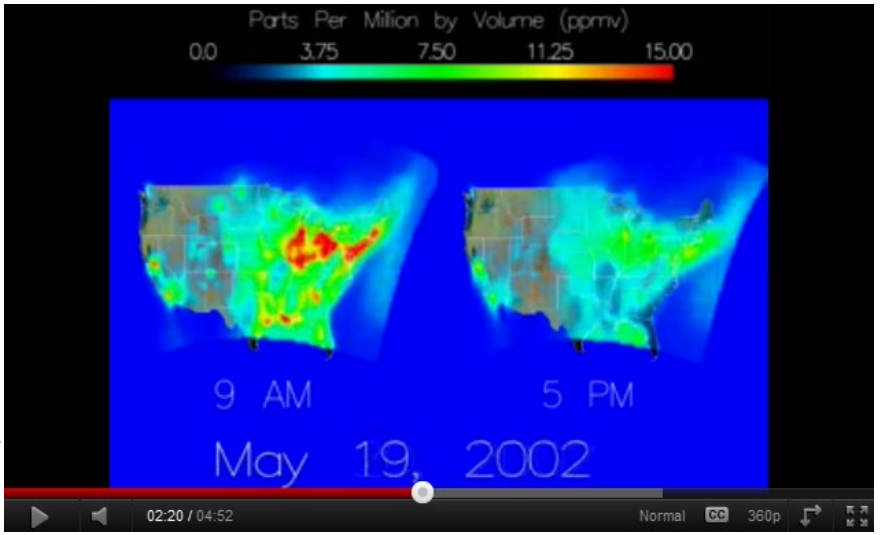
# Frequency

- Number of identifiable states per unit-time
  - 10/sec, 100/sec…
  - Recall the "smoothness"
  - *Typical animated objects 13 fps*
  - *Typical movies 24 fps*
  - *The Hobbit: The Desolation of Smaug (2014) IMAX HD 48 fps*
- "Temporal texture" (MacEachren 1995)
- Symbolization can help
  - E.g., Various colors on cycling
    - → Flows of jet stream on weather maps
      - http://www.pbs.org/wgbh/nova/vanished/jetstr_five.html
      - http://www.glenallenweather.com/links/jetfor.htm



# Synchronization

- Comparison of two or more time-series animations together
  - As one phenomena changes, the other also changes
  - E.g., A map animation of population growth in an area during 20 years side-by-side with another map animation of demand for water in the same area during the same time period
  - E.g., 'Revolutionary' CO2 maps zoom in on greenhouse gas sources
    (http://www.youtube.com/watch?v=eJpj8UUMTaI; 2:18)



# Interactivity

- A bidirectional relationship between information/ service provider and user
- Some tools that can be useful for animated mapping
  - 'VCR'-controls, Looping, Frame-by-frame


(Source: Heim, M. (1998). *Virtual Realism*, Oxford University Press, New York.)

# 3D animations

- 3D animated map could be useful, but should be careful to avoid confusion
  - Need to consider h/w & s/w specification
  - What should be considered for the users?

  - Q: What do you think about the examples below?
    - "Amazing 3D Map (San Francisco)" (pfeiffee, 2006)
      http://www.youtube.com/watch?v=luEjub2liOA&feature=related
    - "Sunfeast World" (Manuheggodu, 2009)
      (http://www.youtube.com/watch?v=g5i375CLm2U)

# Group Activity: Animated maps

- Group 1: https://www.youtube.com/watch?v=9LfdXoL3Xck
- Group 2: https://g.redditmedia.com/GbU9F9GQiO90bFCaPvCH0vZKhtVbHwFGu5wO5GddQO0.gif?w=1024&fm=mp4&mp4-fragmented=false&s=abe6b9e7262bc026c42d681e7d15e6f9
- Group 3: https://gfycat.com/gifs/detail/athleticwellgroomedgalapagostortoise
- Group 4: http://hint.fm/wind/

- Q. What kind of spatio-temporal patterns do you see from the animation maps?

# Is animation useful?

- Difficult to understand!
- "*Animations must be slow and clear enough for observers to perceive movements, changes, and their timing, and to understand the changes in relations between the parts and the sequence of events. This means that animations should lean toward the schematic and away from the realistic, an inclination that does not come naturally to many programmers, who delight in graphic richness and realism.*" (Tversky et al. 2002)

- Griffin et al. (2006)
  - Detection of "space-time cluster"
  - Helped users detect particular type of pattern than using static maps
- Eye-movement method (Fabrikant et al. 2007)

# Challenges and suggestions

- Disappearance (sudden changes)
  - Looping, frame-by-frame, adjustable frame-rate
  - Orientation cues
- Attention (where to look)
  - Simple design, sequenced components
- Complexity (too much information)
  - Generalization of data, smoothing, fewer classes (ex. high, medium, low)

(source: Harrower, 2003)

# Summary – animated maps

- Animation & mapping
- Visual variables for animation
- Types of animation
- Challenges in map animation

# For next time…

- Reading
  - Ch. 1&26
- Lab3 due today
- PM2 due Nov. 27
- Individual project work (digital map making): Nov. 27~Dec. 11
- Final map submission: Dec. 12