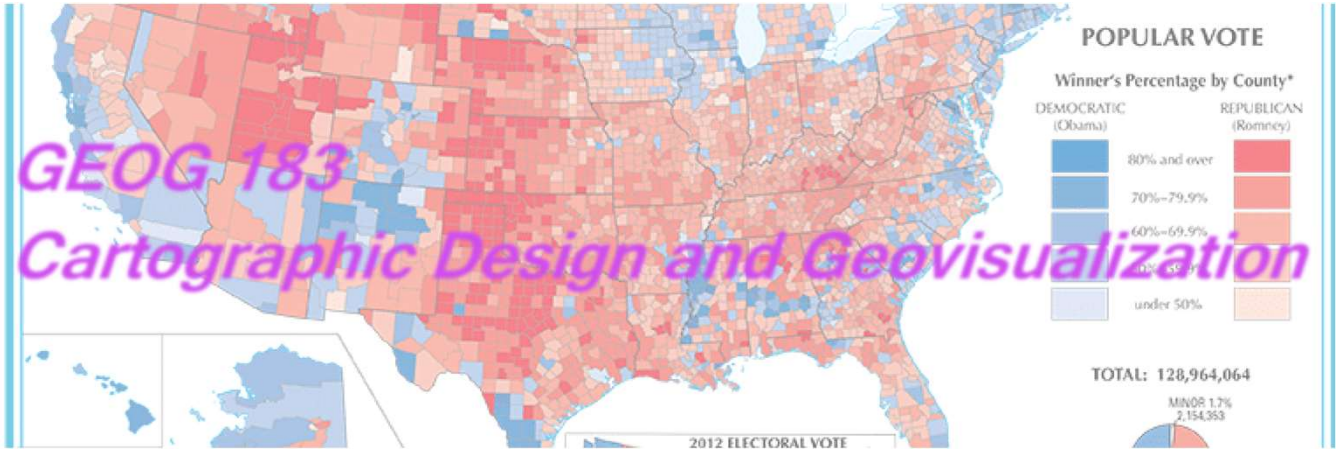
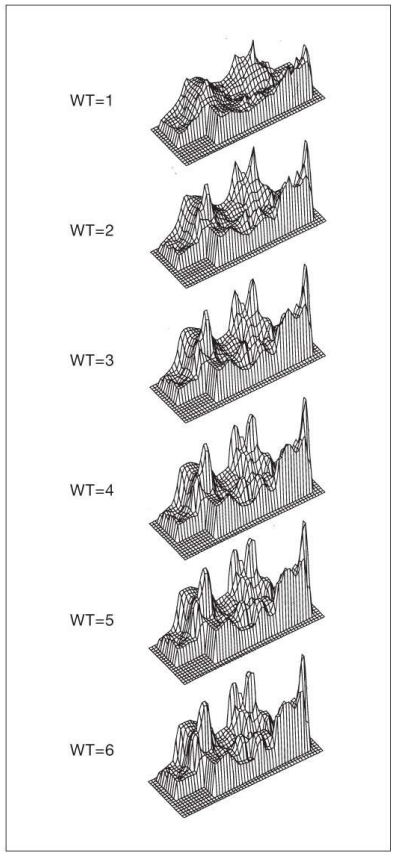


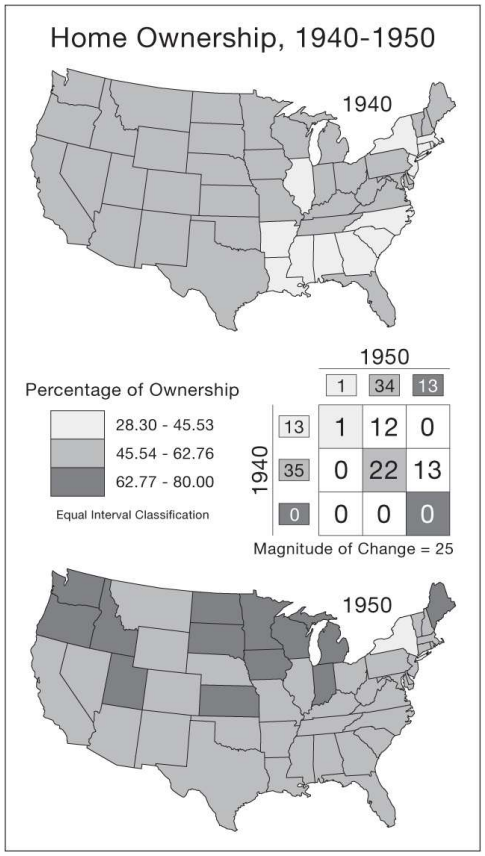
Geog183: Cartographic Design and Geovisualization Spring Quarter 2020

Lecture 13: Map animation

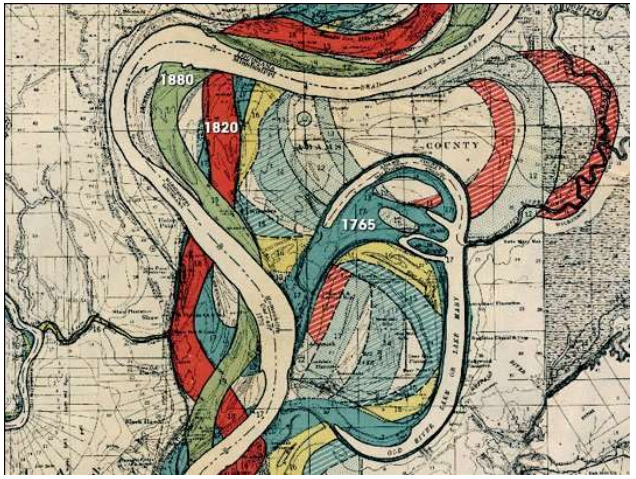
Static ways of showing change

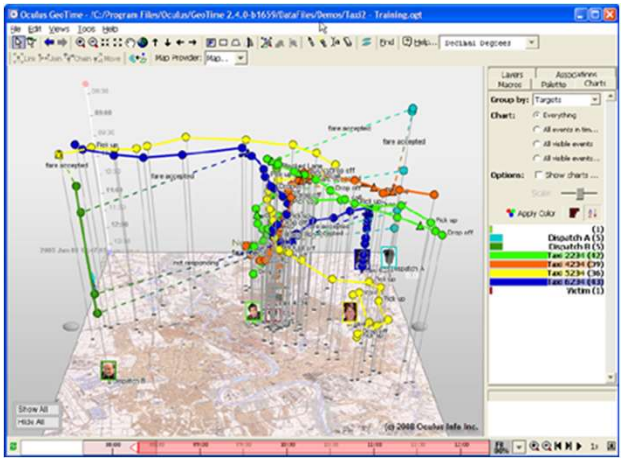


Copyright © 2009 Pearson Prentice Hall, Inc.



Copyright © 2009 Pearson Prentice Hall, Inc.

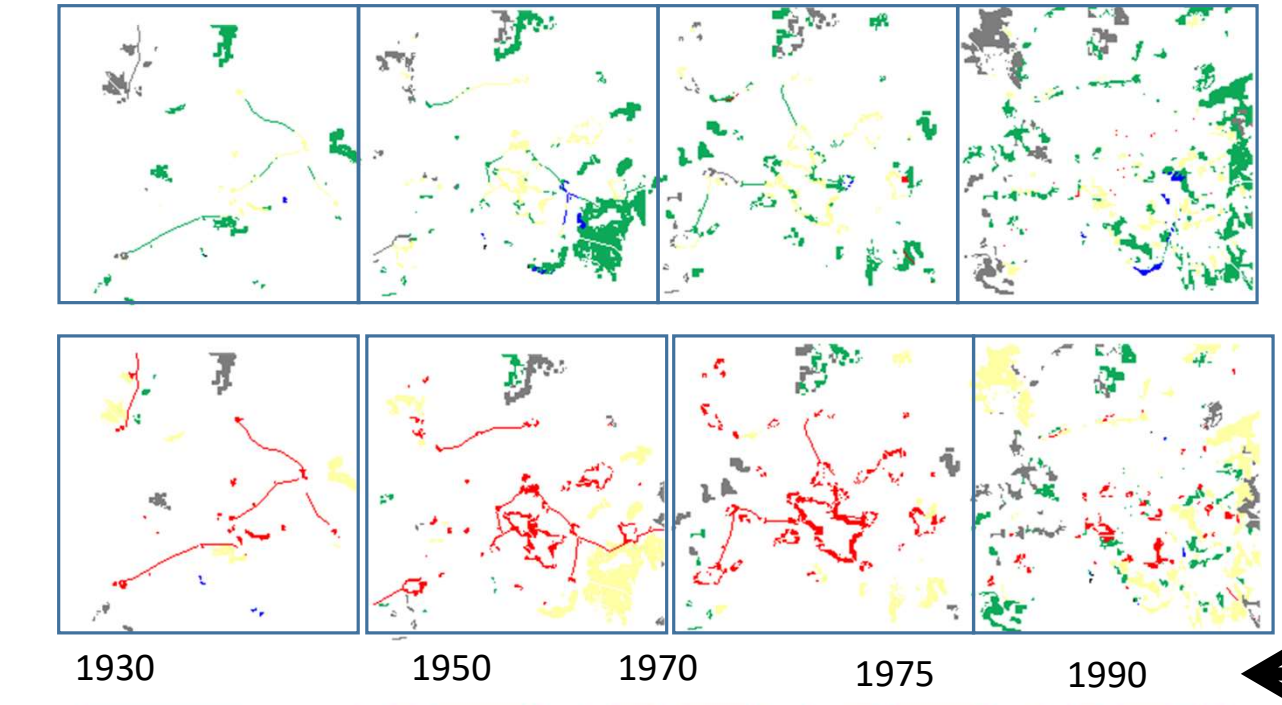




Showing ONLY change

From

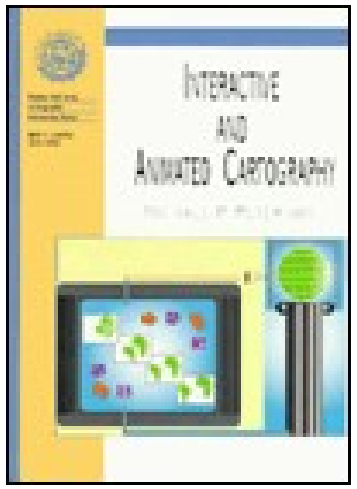
To

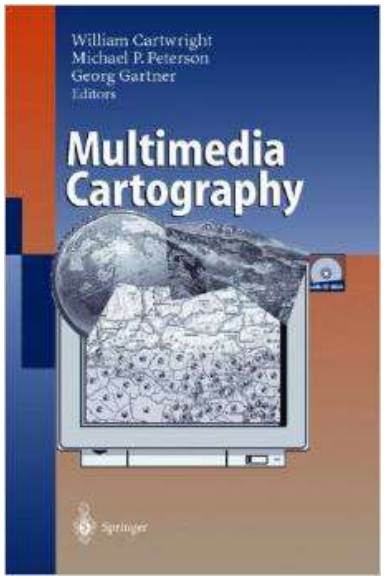


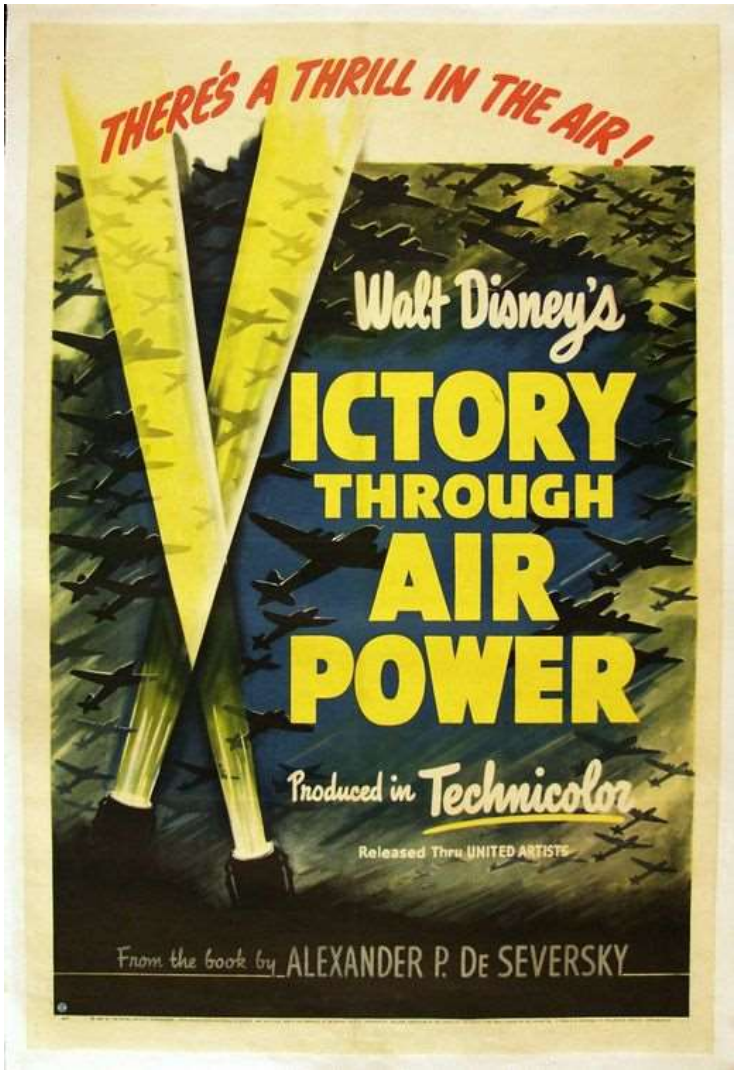
Temporal Resolution/ Granularity

Animation

- Rare in cartography prior to the Internet
- First case probably Disney WW2
- Thrower 1959 *Animated Cartography*
- Tobler's Detroit movie 1970
- Dutton's animated hologram 1979
- LA the Movie (1987) https://www.youtube.com/watch?v=6RsXCbpJG54
- Peterson *Interactive and Animated Cartography* 1995
- By 1999 become *Multimedia Cartography*
- Animation really begins with Web Cartography







Victory through Air Power (1942) Disney

Victory Through Air Power

- https://archive.org/details/VictoryThroughAirPower

- Start at 36:20

- Projections
- Animated line symbols
- Flow maps
- Trajectories
- Spreading polygons
- Animated icons/3D models

Tobler 1970

- Created fishnet perspective views of population density from census
- Shot frame-by-frame with lag onto film

A COMPUTER MOVIE SIMULATING URBAN GROWTH IN THE DETROIT REGION

W. R. TOBLER

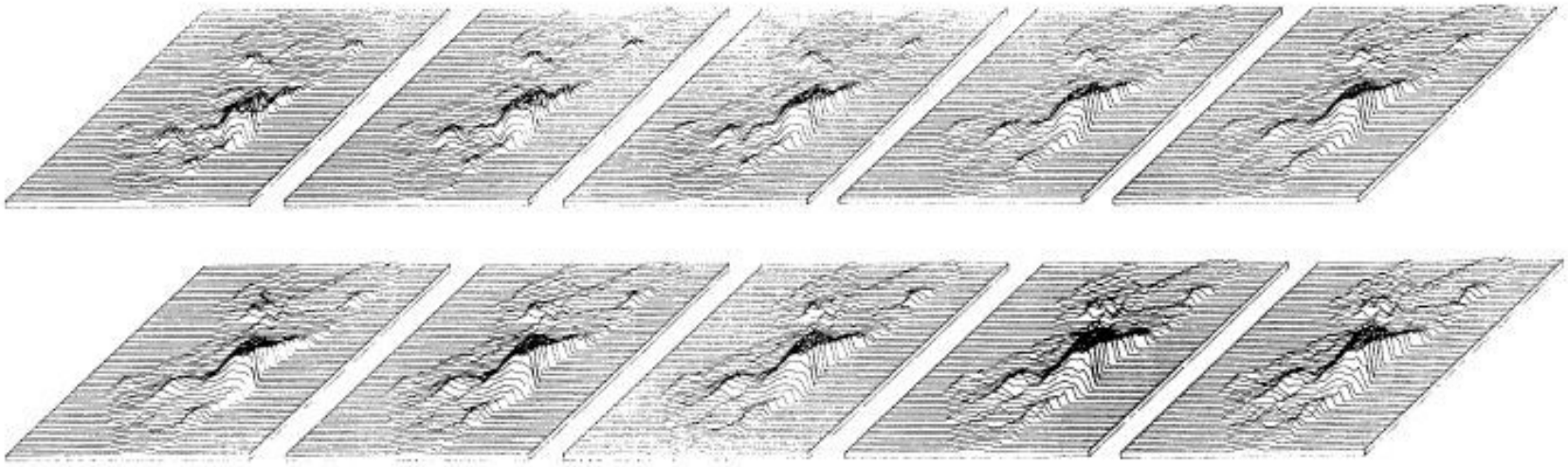
University of Michigan

In one classification of models [*16*] the simulation to be described would be considered a demographic model whose primary objectives are instructional.[1] The model developed here may be used for forecasting, but was not constructed for this specific purpose, and it is a demographic model since it describes only population growth, with particular emphasis on the geographical distribution of this growth.

As a premise, I make the assumption that everything is related to everything else. Superficially considered this would plicated rules, examples are: the game of chess, the motion of the planets before Copernicus; evolution before Darwin and the double helix, geology before Hutton, mechanics before Newton, geography before Christaller, and so on [*5*]. The plausibility of models also varies, but this is known to be an incomplete guide to the scientific usefulness of a model. The model I describe, for example, recognizes that people die, are born, and migrate. It does not explain why people die, are born, and migrate. Some would insist that I should incorporate

Tweening One frame/month at 16 fps using numerical approximation

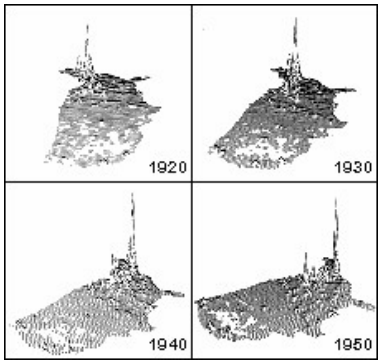
https://www.youtube.com/watch?v=kRsF9S8JqBI



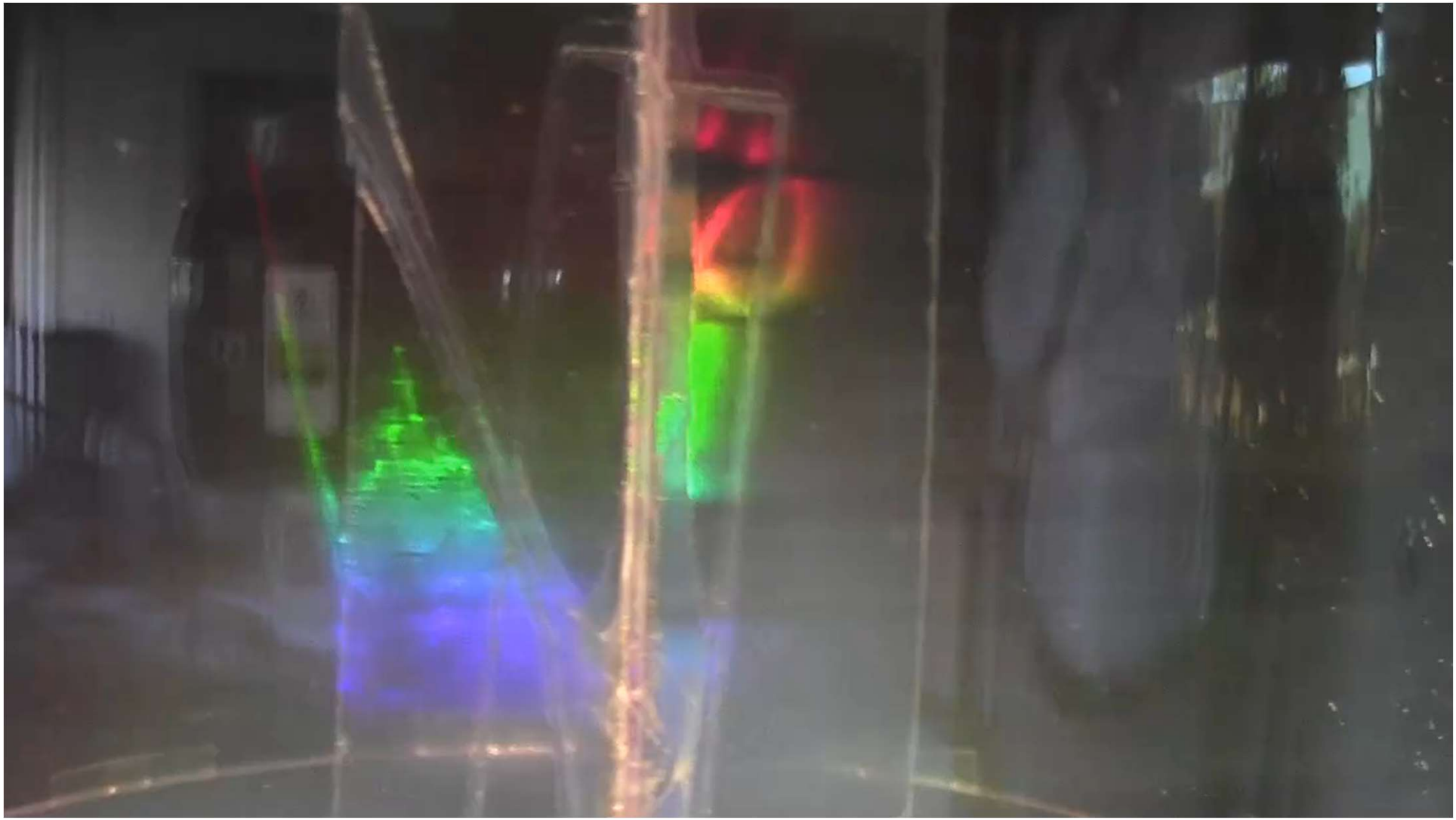
Simulated population growth, Detroit Region. Selection of ten-year interval frames from computer movie. Top row 1910 through 1960, bottom row 1960 through 2000, (non-linear vertical scale).

Dutton et al. 1970 American Graph Fleeting

- The first (and perhaps only) animated thematic map to be produced as an integral hologram
- Rotating celluloid cylinder within which a 3D demographic map of the United States hovers
- US Census counts of population by county from 1790 to 1970 were uniformly interpolated to an equal-area grid and displayed as statistical surfaces
- Interpolated to one-year intervals, yielding 181 maps
- Filmed in sequence along with titles and the 16-mm animation
- Transferred in three batches to integral holograms, which are wrapped around a plexiglass cylinder 18 inches across
- A clear light bulb below the cylinder provides illumination for reconstructing the images, which rotate and change in time as the display revolves
- Produced for the 1979 Harvard Computer Graphics Week Conference
- Displayed at The Computer Museum in Boston, Place Pompidou in Paris and on public television

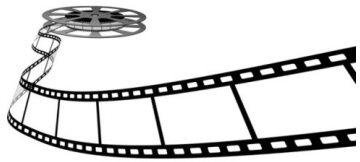


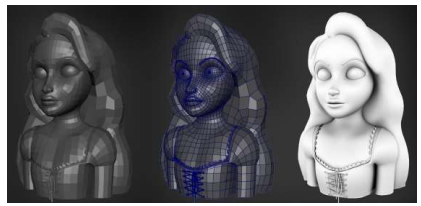
American Graph Fleeting (http://youtu.be/tl160bBcmbA)



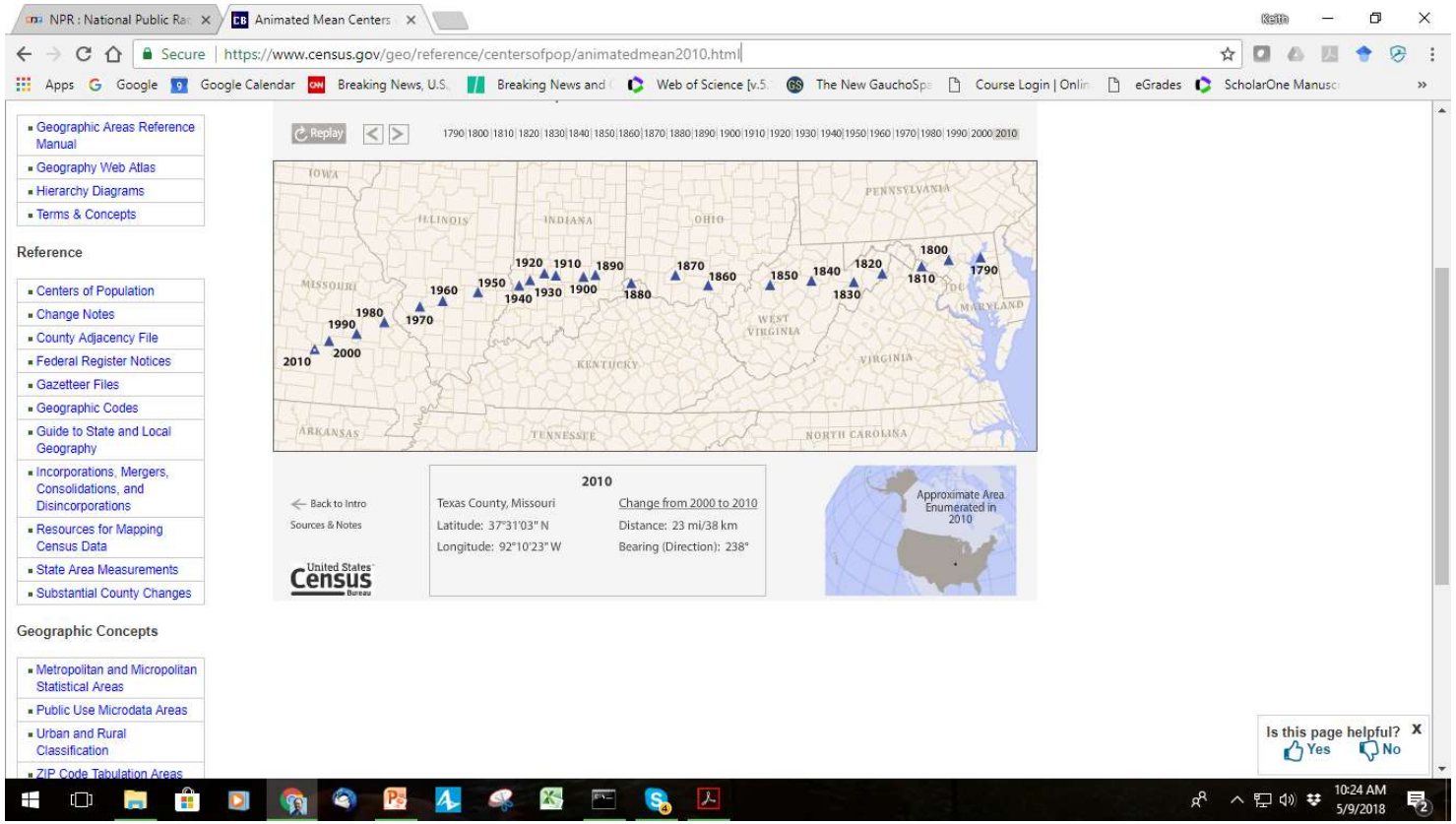
Two models for animation

- Frame by frame
  - Related to small multiples
  - Frame rate important
  - Tweening by interpolation
- By model
  - Tweening by modeling
  - 2D and 3D, makes it 4D
  - Needs full descriptive geometry and object specification
  - Movement by trajectory

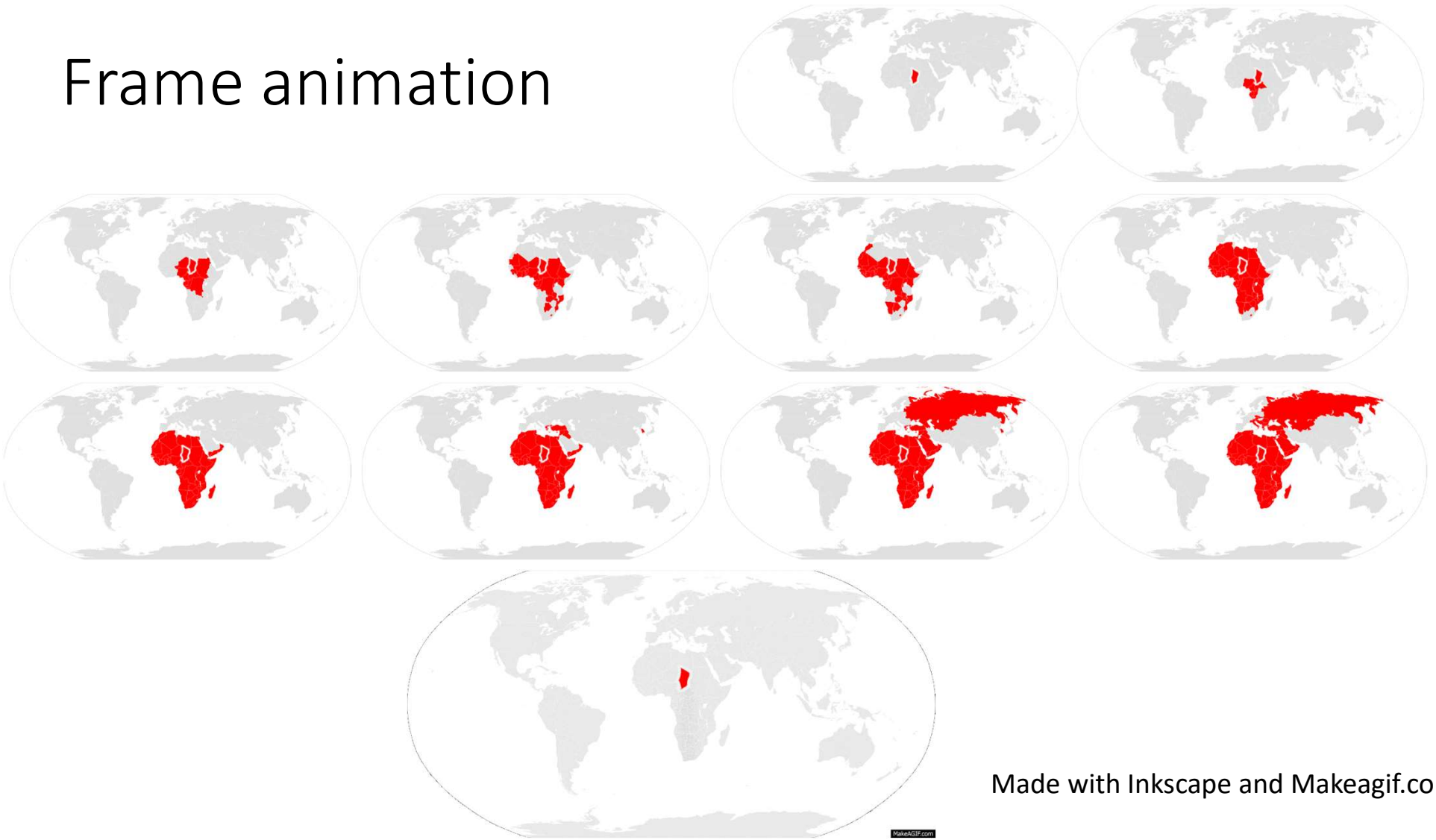




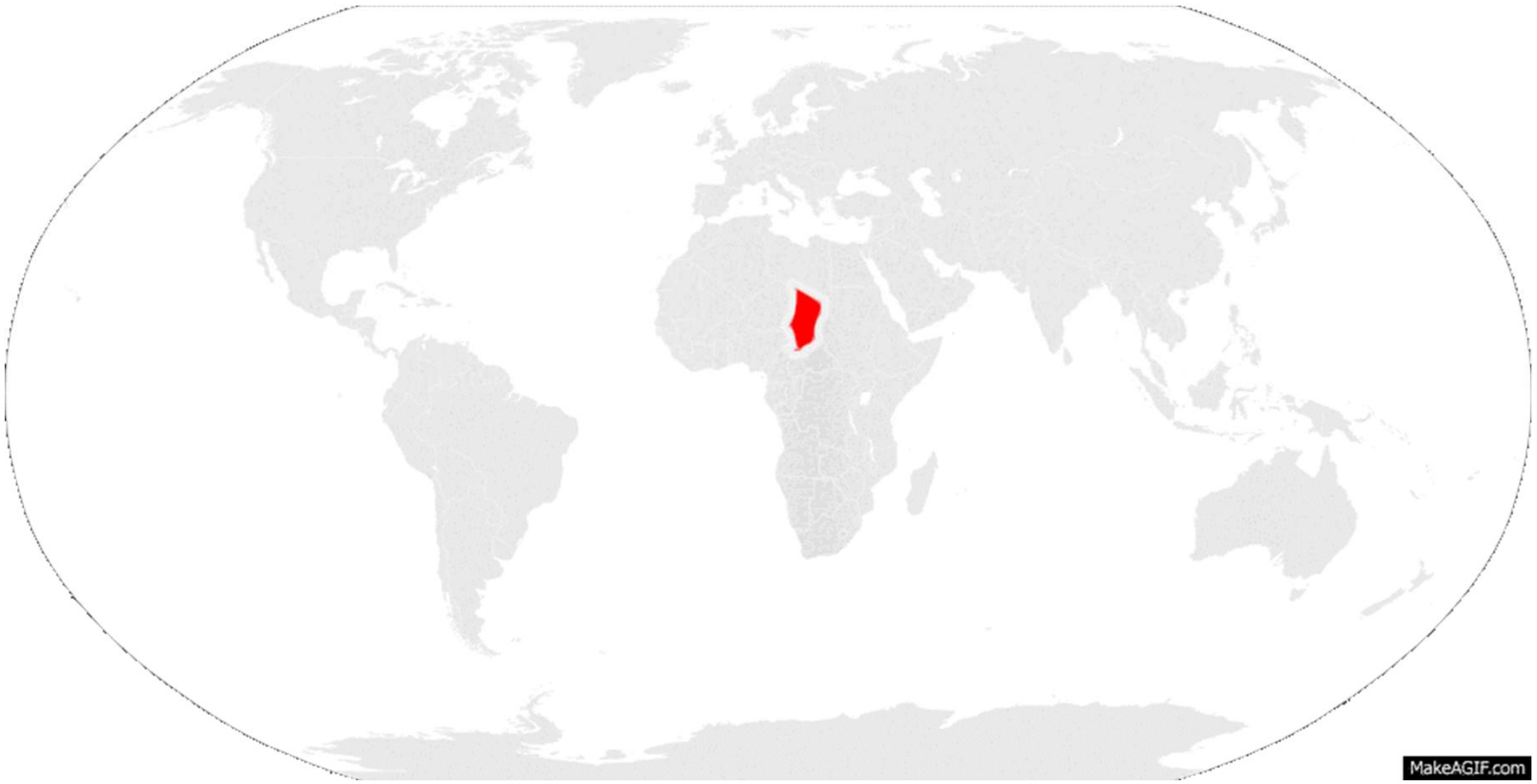
https://www.census.gov/dataviz/visualizations/050/

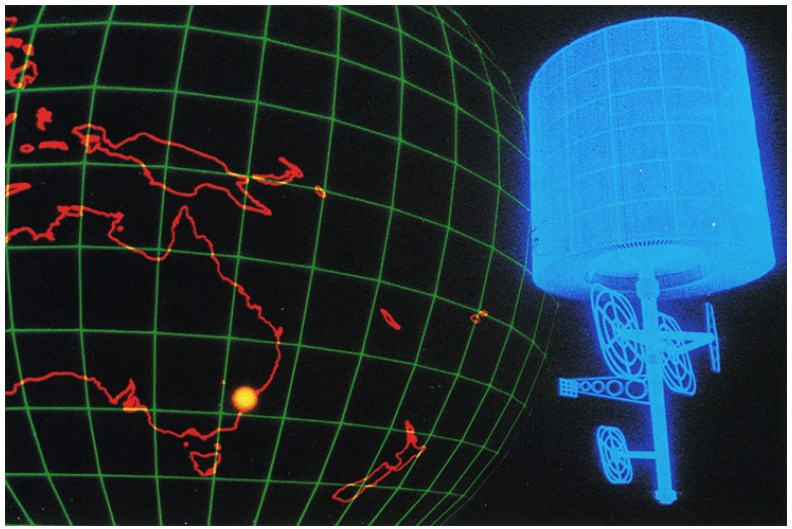


Frame animation



Made with Inkscape and Makeagif.com


MakeAGIF.com



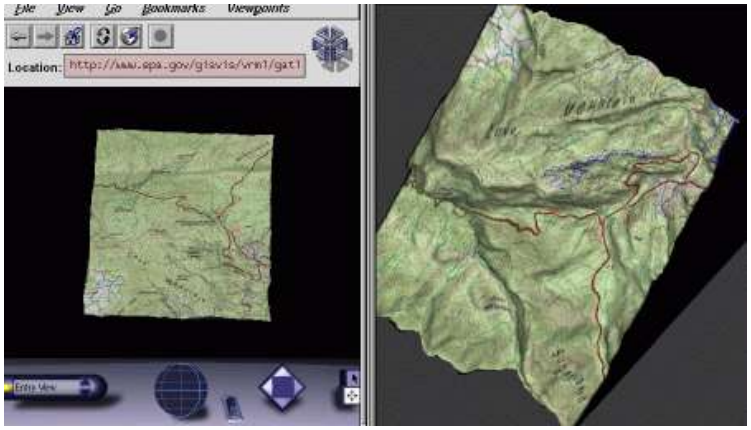
Models and motion

New visual variables

- DiBiase et al. (1991): duration, rate of change and order
- Duration is the unit of time a frame or scene is displayed, affecting the smoothness of the animation. The shorter a frame is displayed, the smoother the animation will appear
- Smoothness of animation is also a function of the rate of change
- Order refers to the time sequence in which animation is played out, usually presented in chronological
- MacEachren (1995) added display date (time at which change is initiated), frequency (number of times identifiable forms are displayed) and synchronization (correspondence of 2 or more time series)

Viewpoint and figure

- Static 2D map with time as sequence
- http://cimss.ssec.wisc.edu/goes/blog/wp-content/uploads/2016/01/1999_01_01-04_goes08_water_vapor_blizzard_anim.mp4
- Moving focus with trace https://www.youtube.com/watch?v=x67WP7IayJY
- Moving viewpoint
- Moving viewpoint and image
- Zoom and pan
- Full interaction (e.g. X3D, GeoVRML)

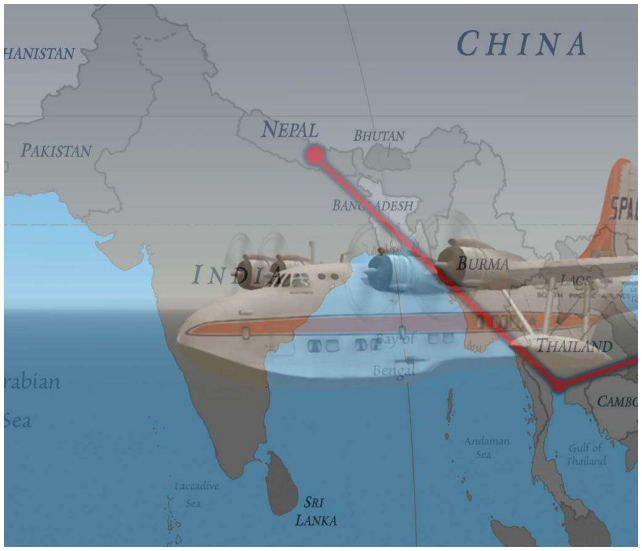


Moving focus and trace

Aftereffects
Tripline

Raiders of the Lost Ark (1981)

https://www.youtube.com/watch?v=5TY5Fp6O5iM



Types of animation

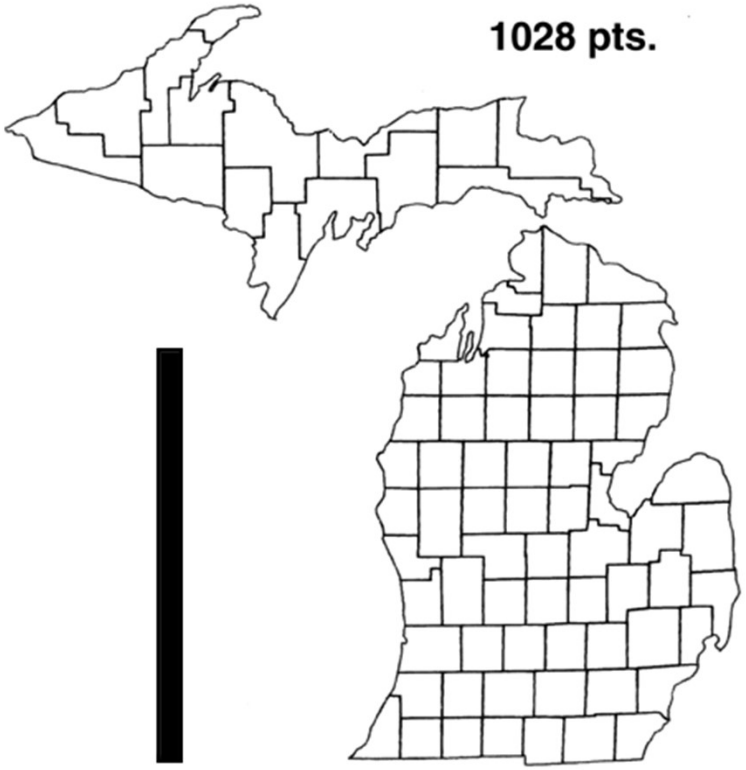
- Temporal Animation: needs legend
- Non-Temporal Animation: shows changes against some other variables other than time. The variable might be place, position, generalization level etc.
- Non-temporal animation types

1. Fly through/fly over (e.g. Google Earth tour) https://www.youtube.com/watch?v=0IbVgGdj8cA&index=10&list=PLSFfIfMDqwu5KhTQlHN3g9uGXgzSOWds1
2. Cartographic zoom
3. Classification animation
4. Generalization animation

Historical growth of Santa Barbara: Tweening using SLEUTH model

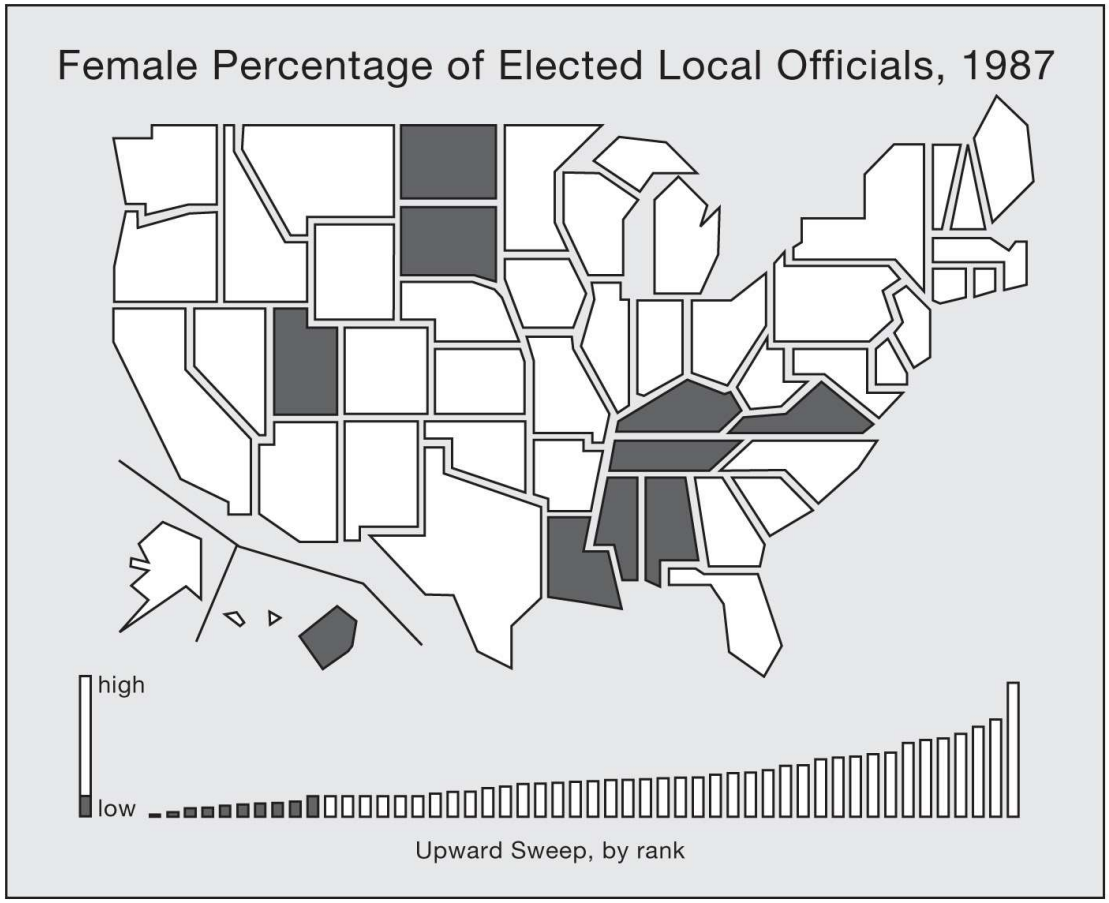
gifmerge, GIFmaker.me, GIMP with animation plug-in

Douglas-Peucker for Michigan Counties



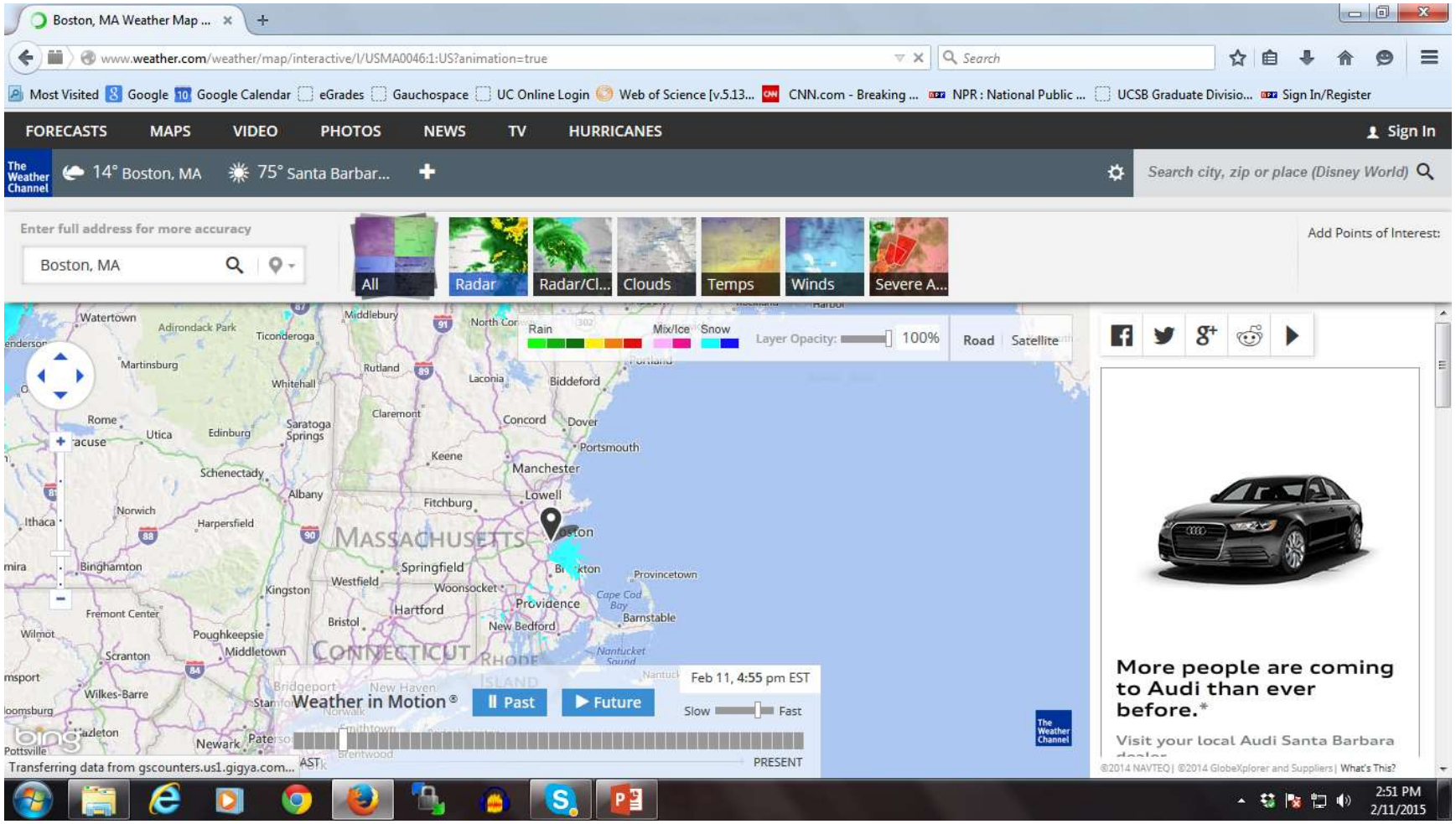
Example (Using Animation) Courtesy of Brad Allen and Waldo Tobler.

Sweep by attribute

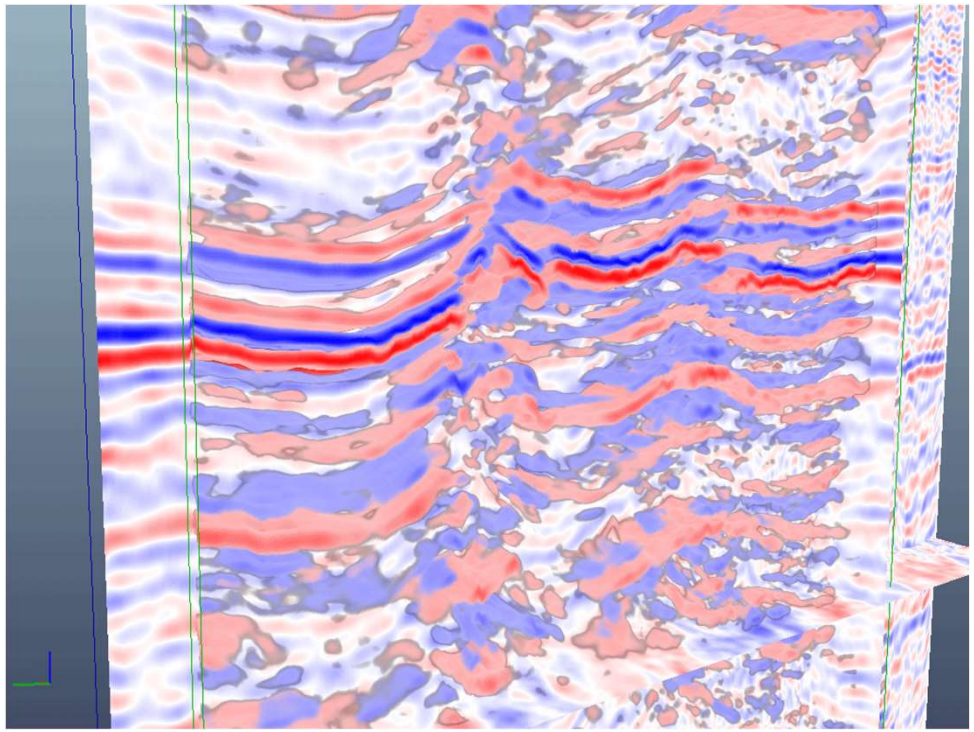


Interactive animation control (weather.com)

https://weather.com/weather/radar/interactive/l/USCA1017:1:US

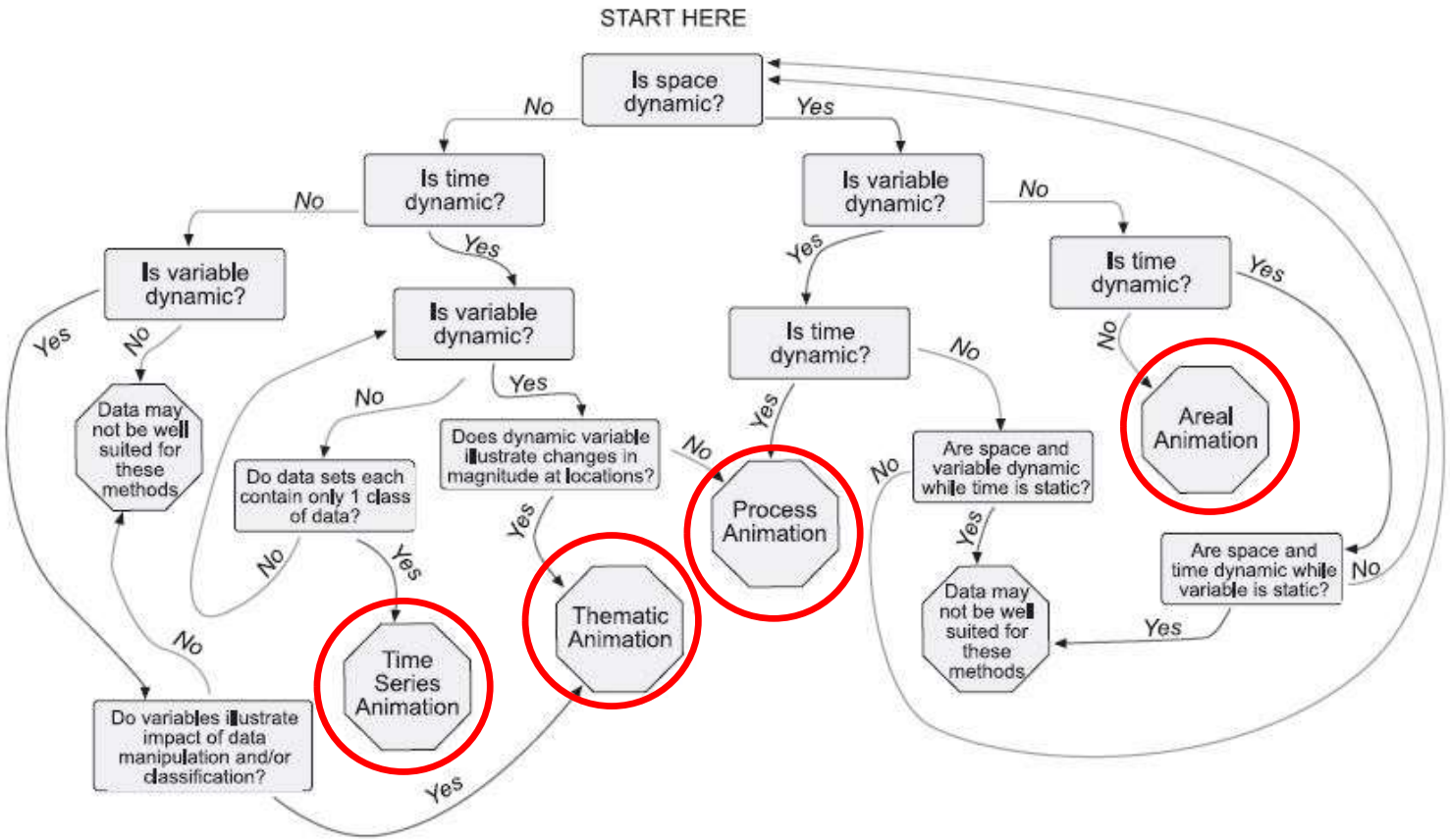


Visualization of Uncertainty



Prof. Dr. Bernd Fröhlich
Visualization of Uncertainty: Visualizing Errors and Uncertainties in Geo-Scientific Data
http://www.uni-weimar.de/cms/medien/vr/research/visualization/scivis/uncvis.html

Lobben 2008


START HERE
Is space dynamic?
No
Yes
Is time dynamic?
Is variable dynamic?
No
Yes
Is variable dynamic?
Is time dynamic?
No
Yes
Is time dynamic?
Yes
No
Yes
No
Yes
No
Data may not be well suited for these methods
Is variable dynamic?
Do data sets each contain only 1 class of data?
Does dynamic variable illustrate changes in magnitude at locations?
Process Animation
Are space and variable dynamic while time is static?
Areal Animation
Yes
No
Yes
No
Yes
No
Yes
No
Time Series Animation
Thematic Animation
Data may not be well suited for these methods
Are space and time dynamic while variable is static?
Yes
No
Do variables illustrate impact of data manipulation and/or classification?
Yes
No
Yes

Donohue, Sack, Roth 2013 Cartographic Perspectives

http://www.cartographicperspectives.org/carto/index.php/journal/article/view/cp76-donohue-et-al/1307

Time series with Leaflet and Java by slider

Andrienko et al 2000

	Existence		Spatial location	Shape and size	Thematic data
	Instant events	Durable objects			
Single moment *t*	What events occurred and where?	What objects existed and where?	Where was each object at *t*?	What shapes/sizes had the objects at *t*?	What were values of an attribute at *t*? How were they spatially distributed?
Two moments *t1* and *t2*	What is the difference in number, kind, or spatial distribution of events between *t1* and *t2*?	What objects remained, appeared, died? How did the spatial distribution change?	Where/ how far did each object move?	What is the difference between shapes/sizes at *t1* and *t2*?	What is the difference between values/ spatial variations of the attribute at *t1* and at *t2*?
Interval [*t1*,*t2*] (summary)	What events occurred during [*t1*,*t2*]?	What objects existed, appeared, died during [*t1*, *t2*]?	How did the objects move? (trajectory)	How often did the objects change? How much?	What are average (minimum, maximum, dominant) values on [*t1*, *t2*]?
Interval [*t1*,*t2*] (progress)	How did the number, kind, spatial distribution pattern of events/objects change in time?		How fast did the objects move? Did they meet? How did the speed change?	How did the shapes/sizes develop with the time?	How did the values and their spatial distribution develop in time?
	When did maximum changes occur? Were there still periods? Is there any temporal trend? Was (where was) the development monotonous /periodic?				

Table 1. Classification of analysis tasks emerging in the course of exploration of spatio-temporal data

Animation examples

- New York Times Web traffic June 25th 2009 http://vimeo.com/8225945
- World history https://vimeo.com/88625055
- Battle of the Wilderness https://www.youtube.com/watch?v=YsGiz6M5iFc
- Flight Aware Real time air traffic http://flightaware.com/live/
- Real time Marine traffic http://www.marinetraffic.com/

Motion capture

Lidar movie set capture

Green screen (greenscreenstudio.multimediamktg.com)

Summary

- Map animation has a history dating to the 1940s, and perhaps earlier
- Early work was tied to film-making
- Web and internet made animation simpler
- Many mapping tools now support animation
- Animation involves additional visual variables, movement cognition
- Types listed by multiple scholars, no agreement as yet
- Lots of great examples on the web, often linked to user interaction
- New tools emerging from the digital movie industry