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CHANGE THE WORLD FROM HERE

Dimensionality

2D, 2.5D, and 3D

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2D VISUALIZATION

Basics

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2D Visualization

- Only two dimensions for position
  - *Can gain additional dimensions by encoding data using other pre-attentive attributes*
- Includes many charts and graphs
- Can have issues with occlusion and overplotting
  - *Especially an issue with high-dimensional data*
  - *Especially an issue with dense data*

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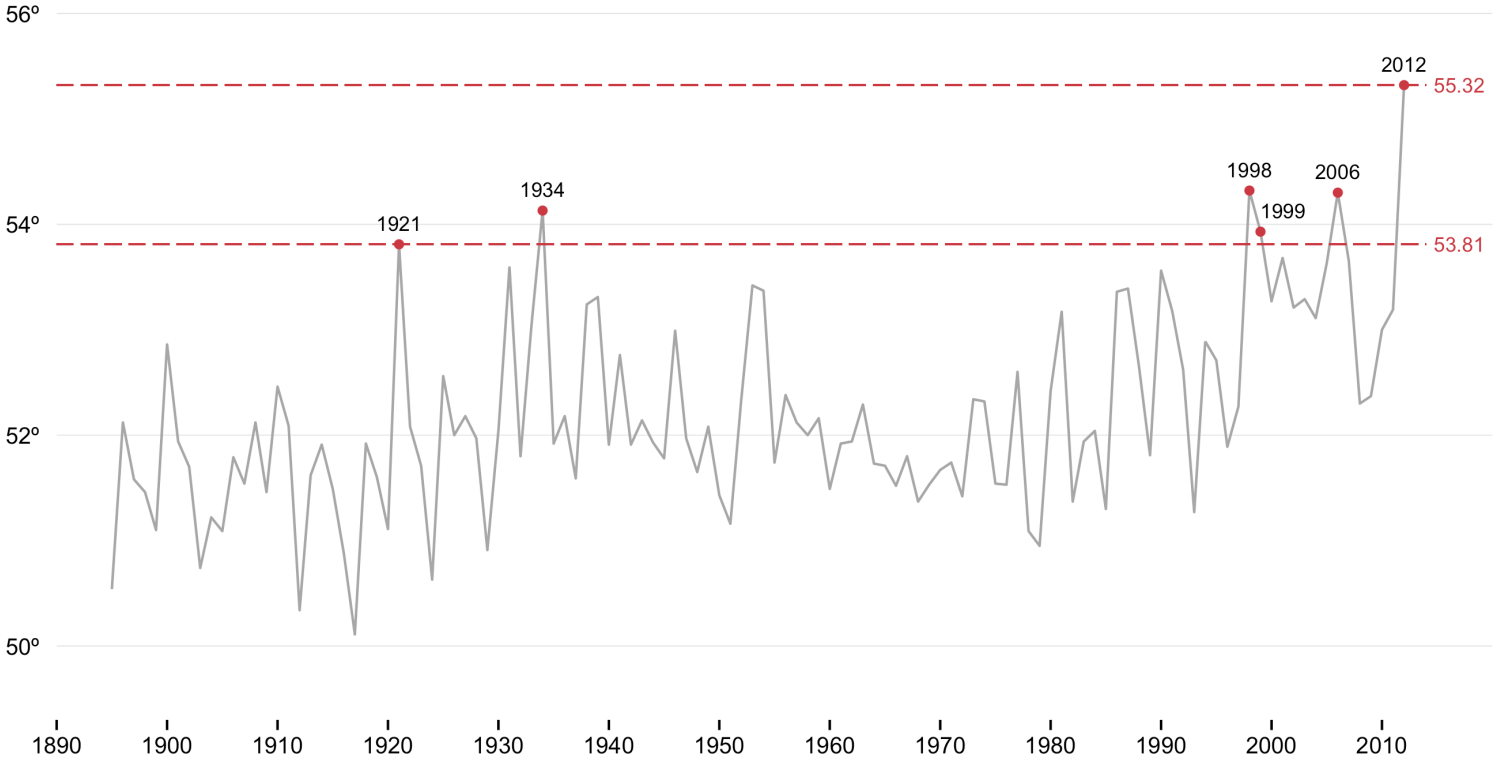
Warmest Years on Record (Contiguous US)



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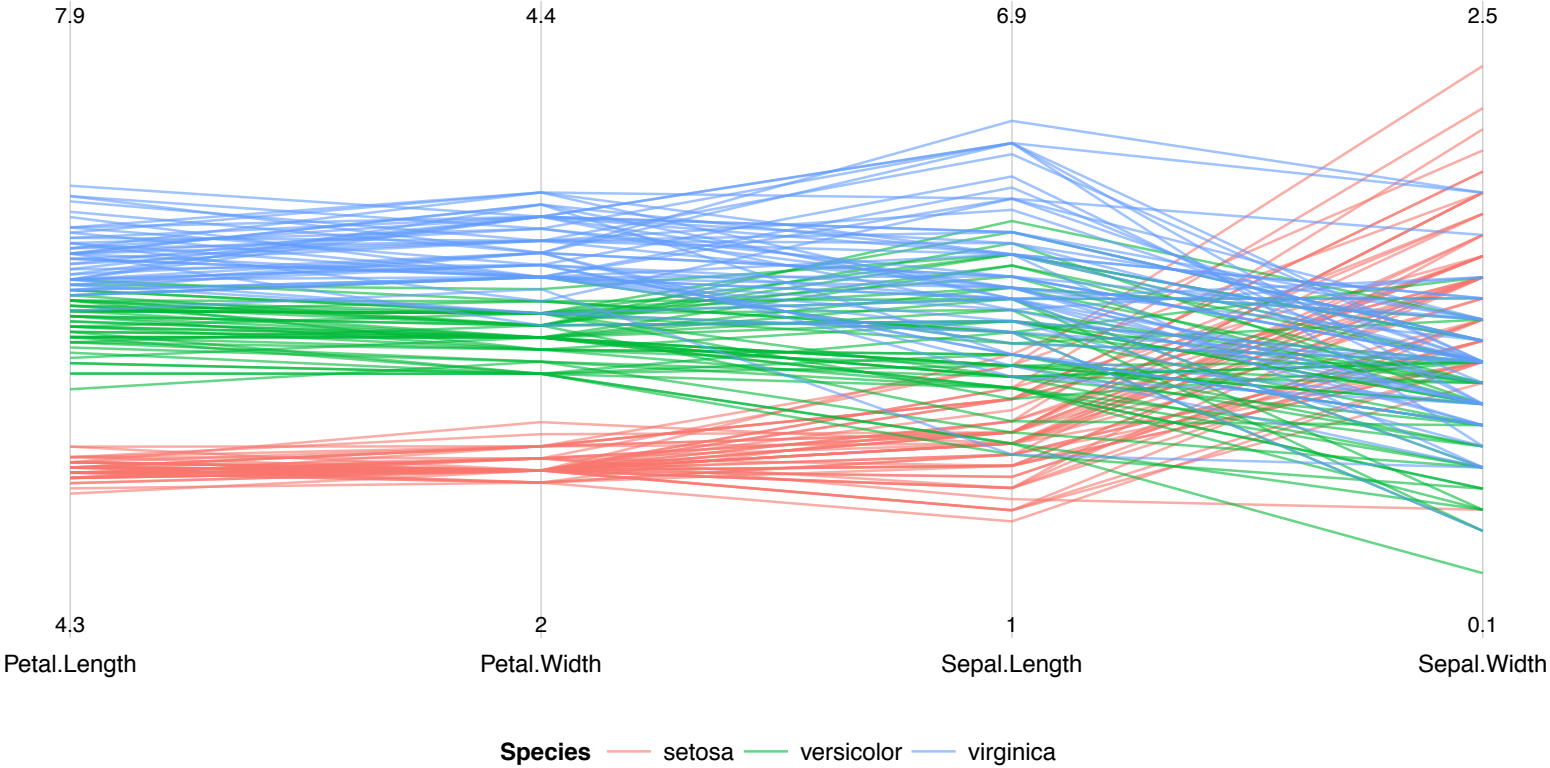

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2D VISUALIZATION

Overplotting

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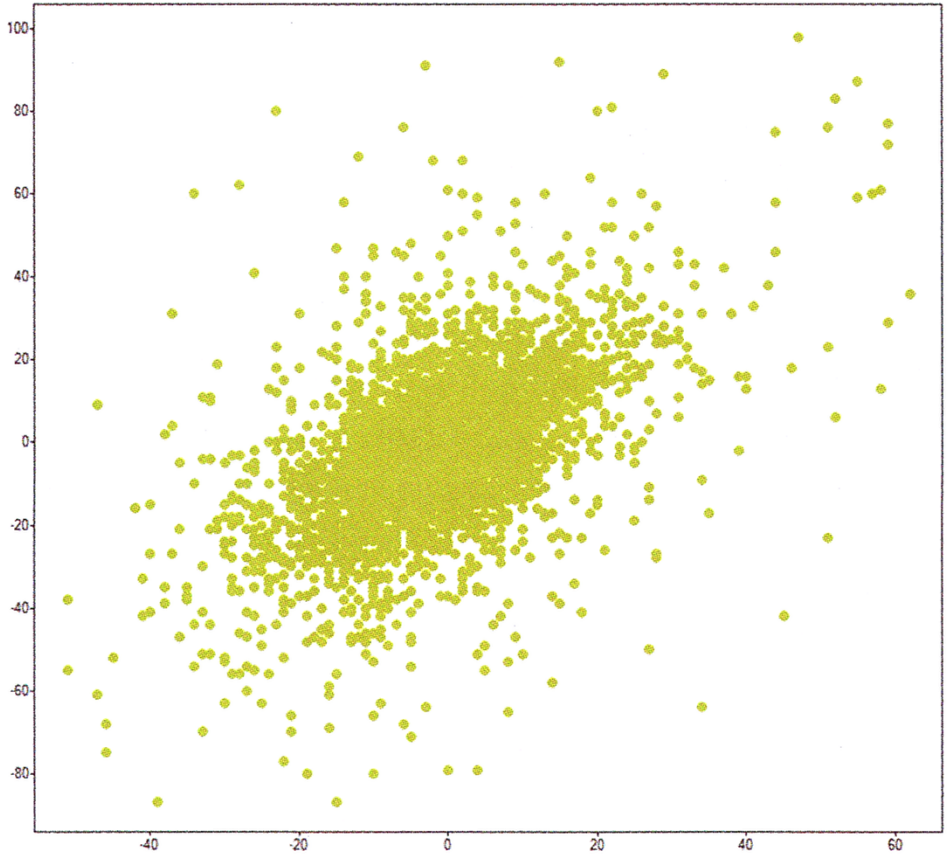

Now You See It, by Stephen Few, Analytics Press, 2009, p118.

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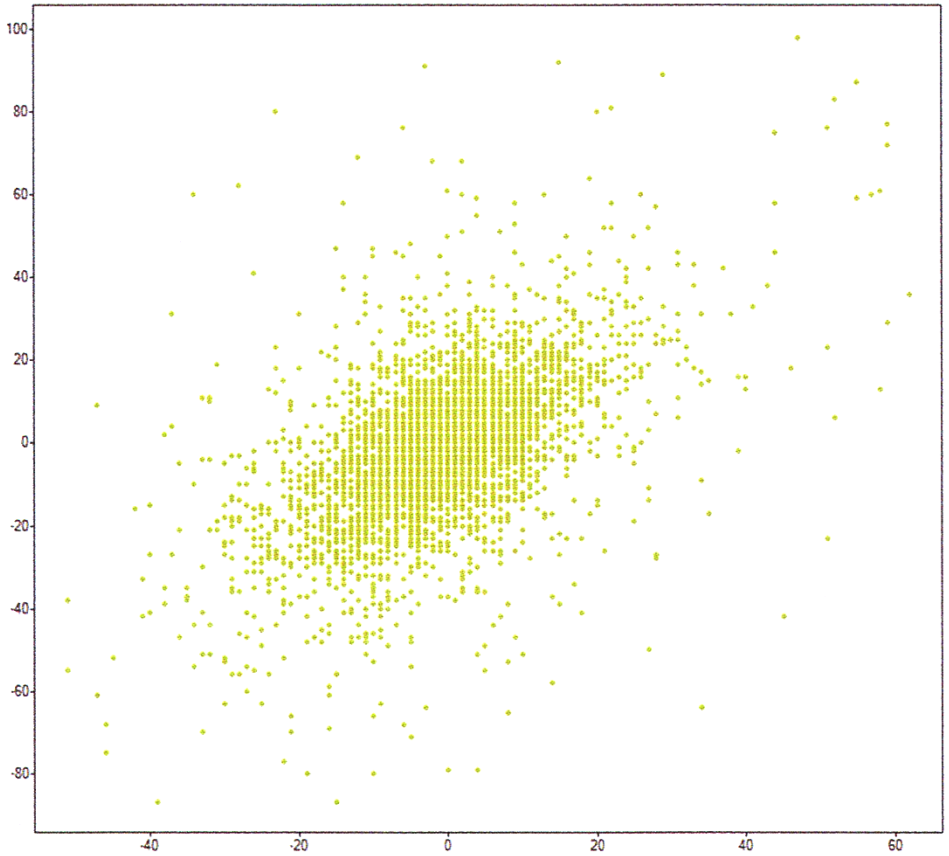

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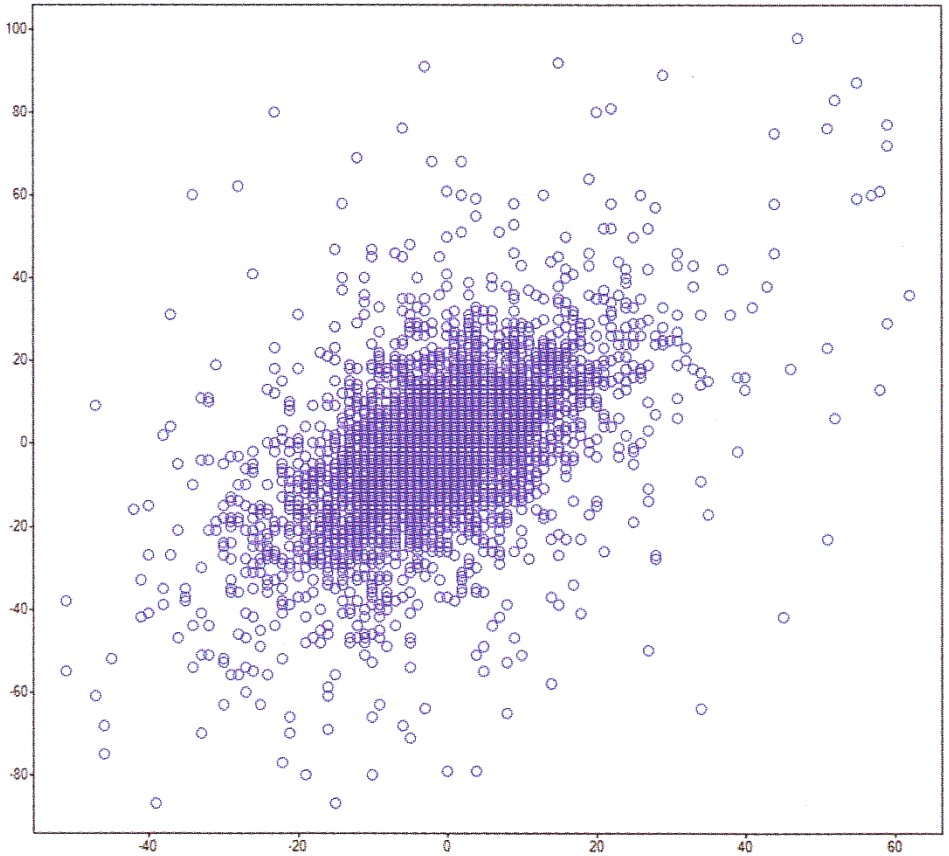

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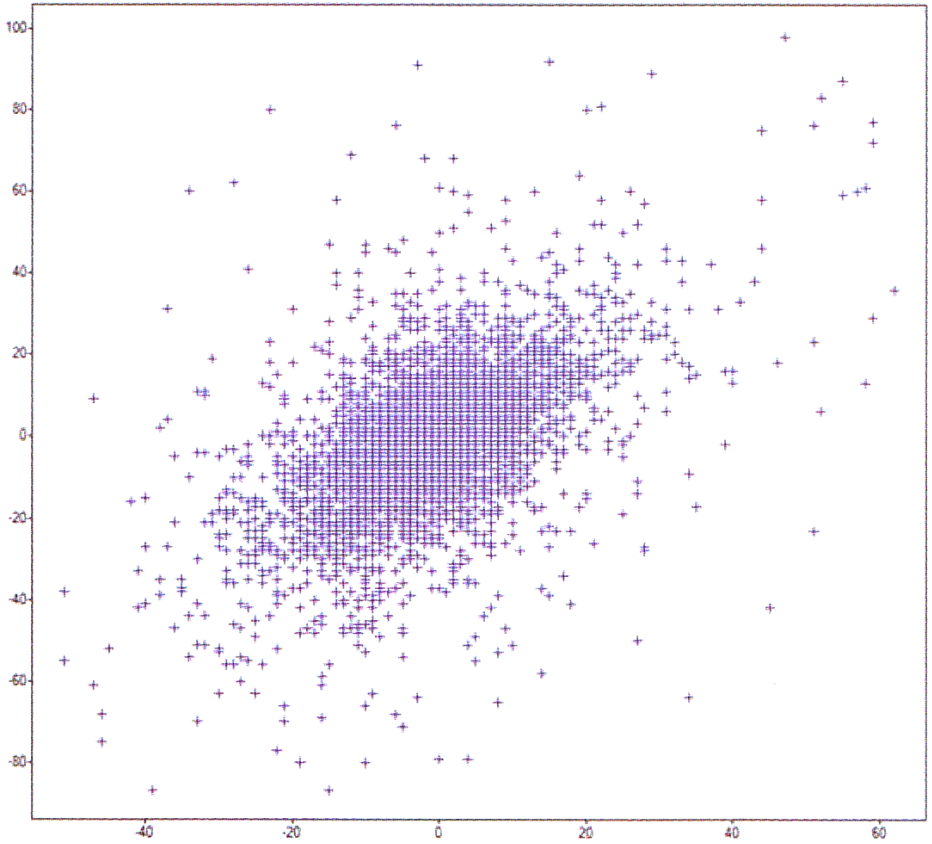

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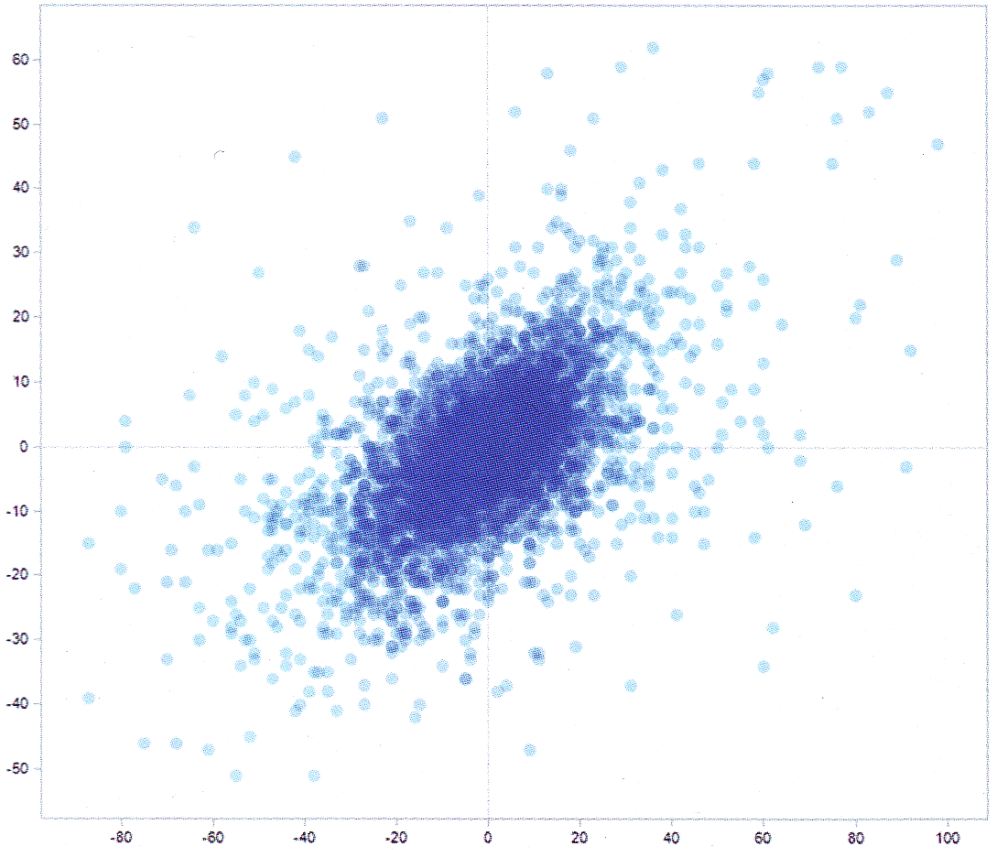

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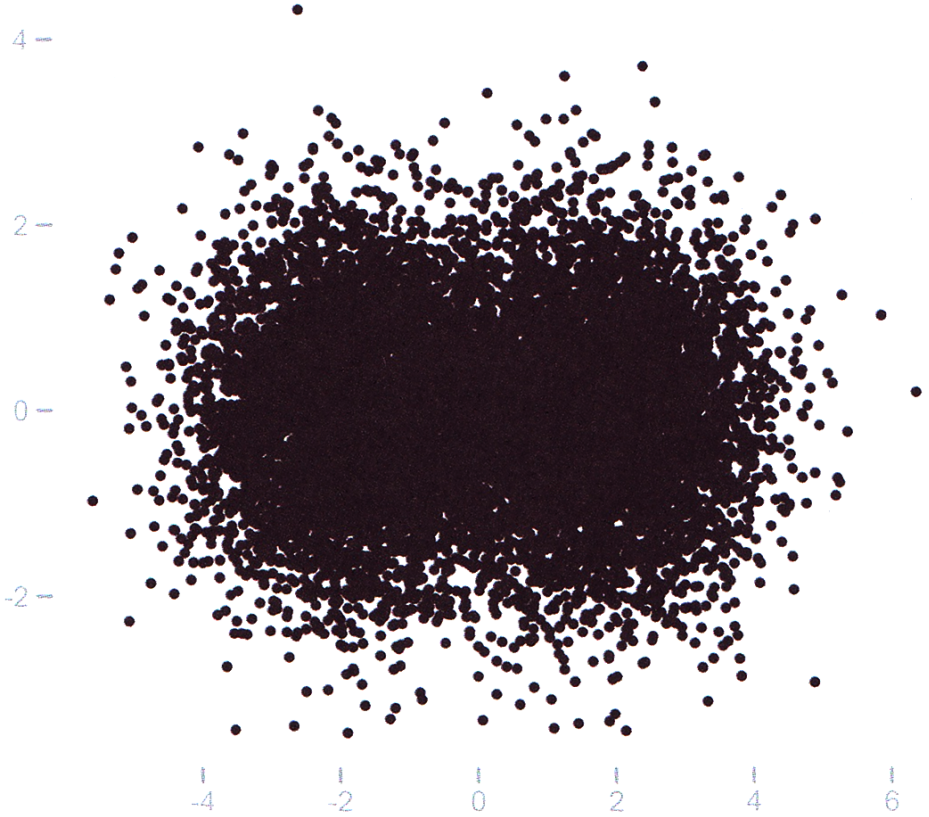

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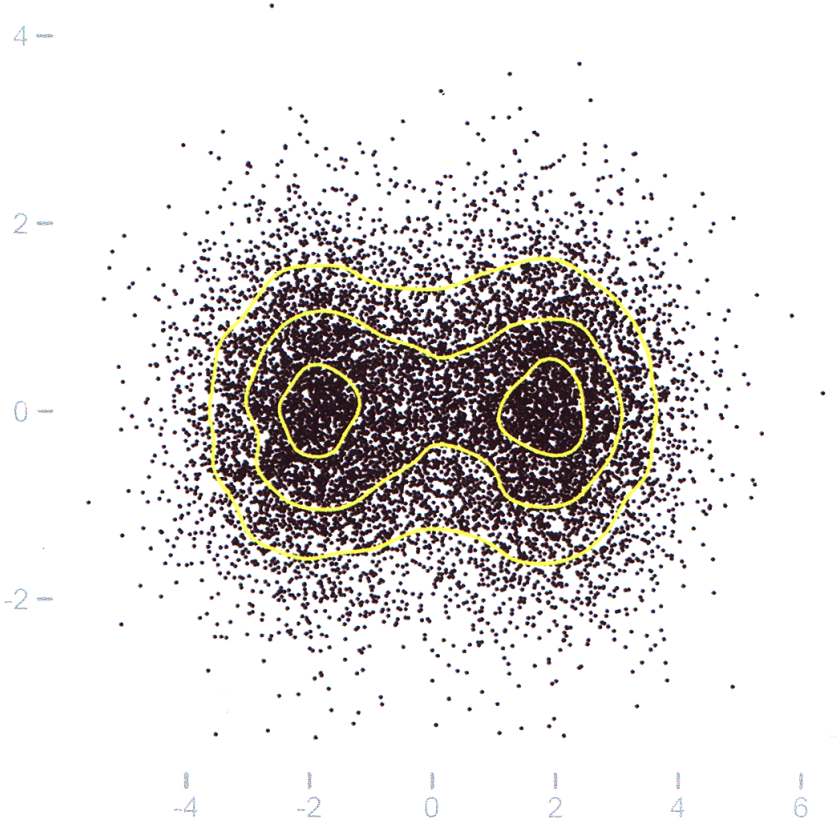

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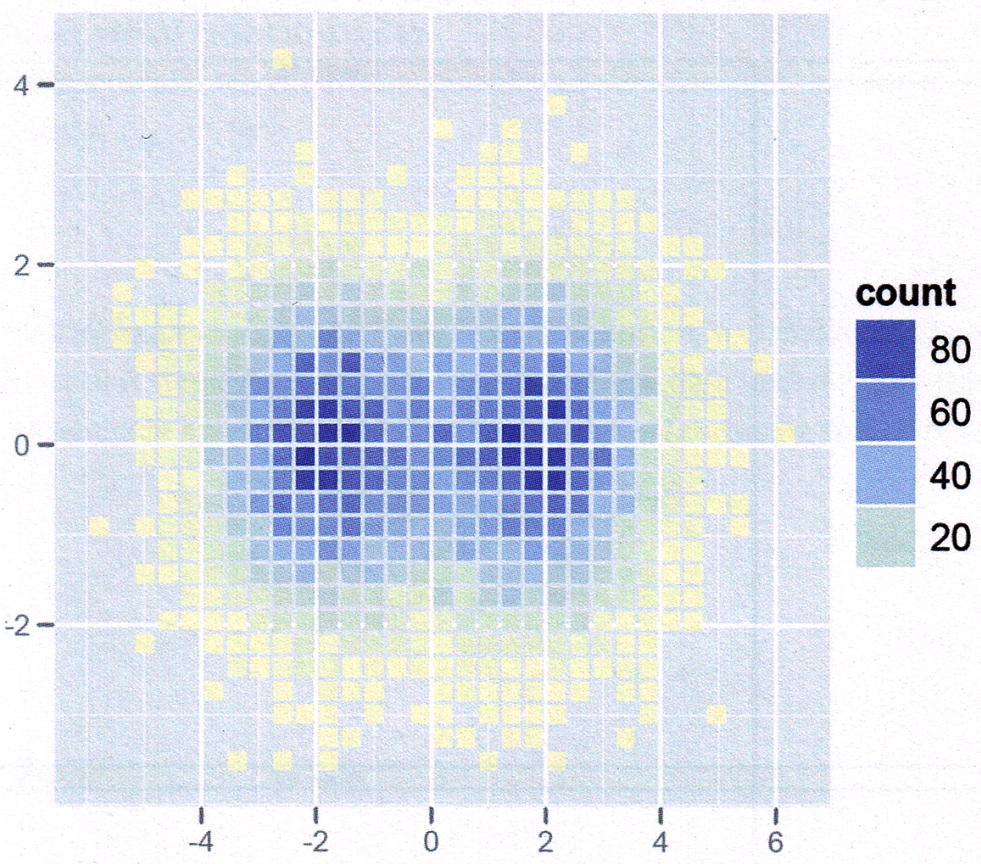

Now You See It, by Stephen Few, Analytics Press, 2009, p118.

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Overplotting in D3

- Change opacity, stroke, and shape
  - https://github.com/mbostock/d3/wiki/SVG-Shapes#_symbol
- Use D3 plugins
  - https://github.com/d3/d3-plugins/tree/master/geom/contour
  - https://github.com/d3/d3-plugins/tree/master/hexbin

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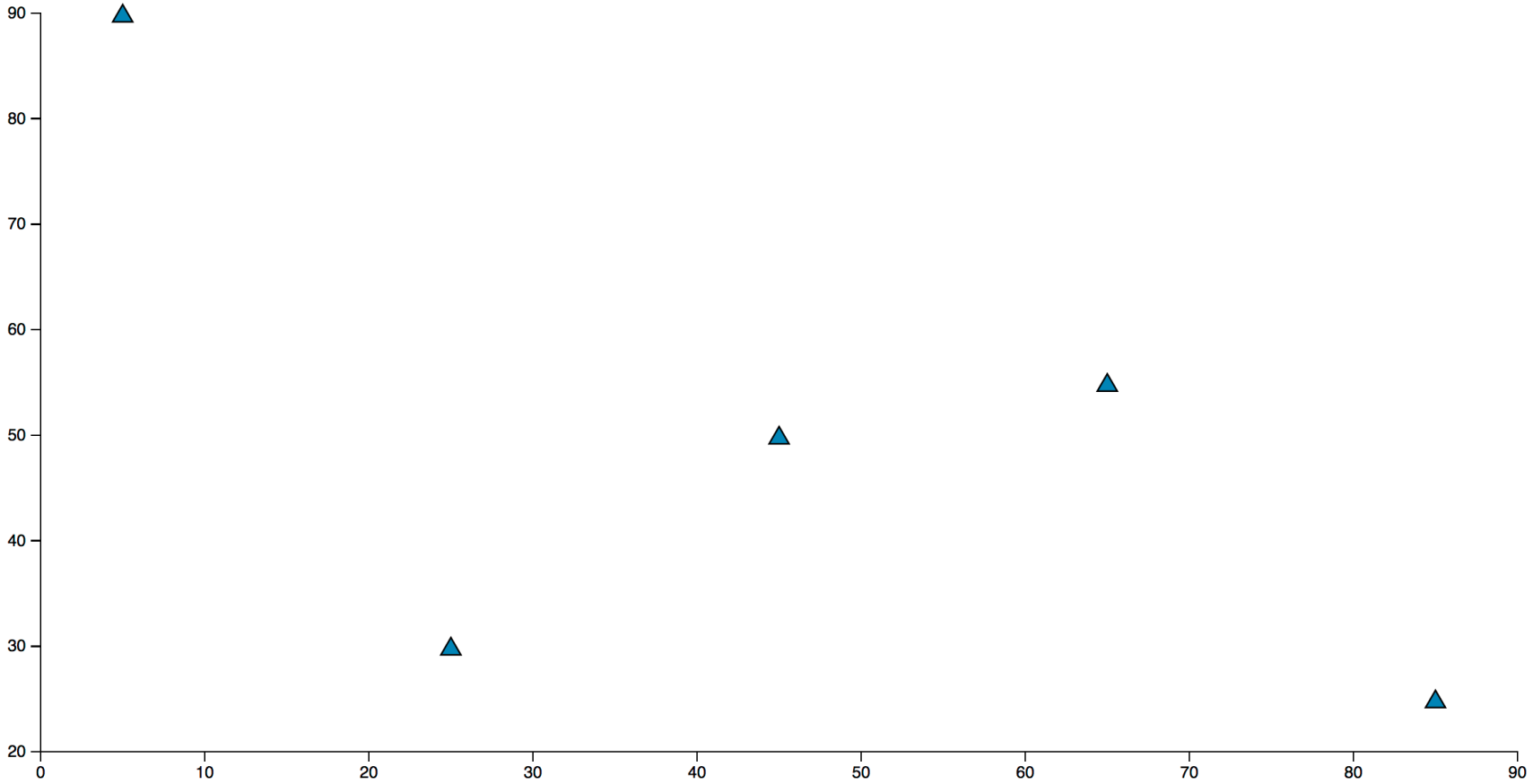

http://bl.ocks.org/mbostock/3244058

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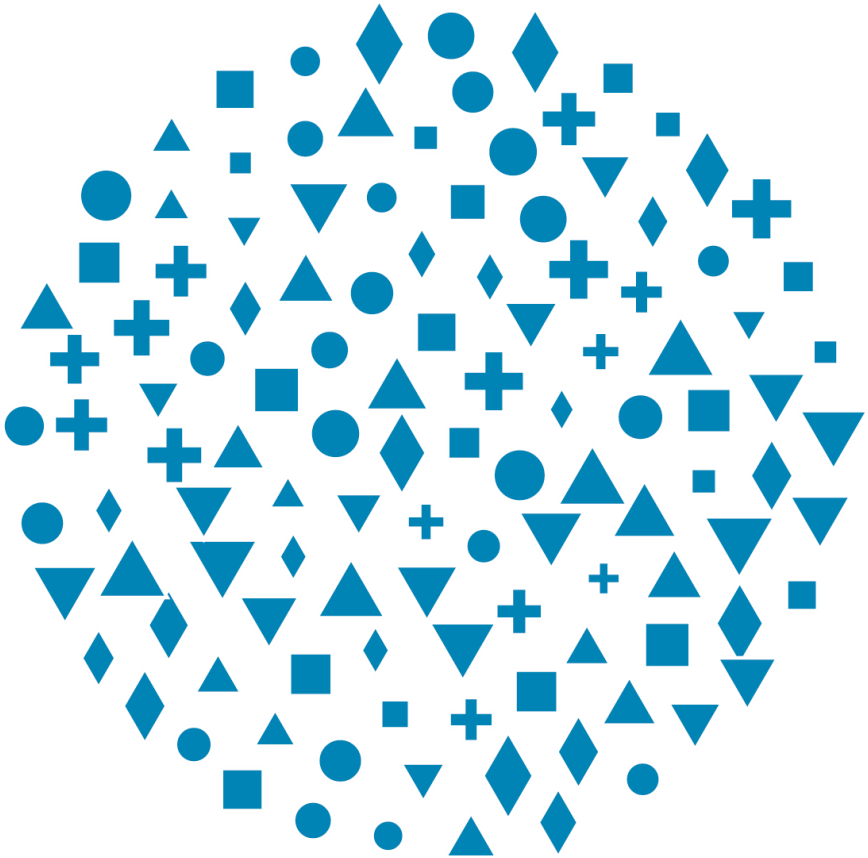

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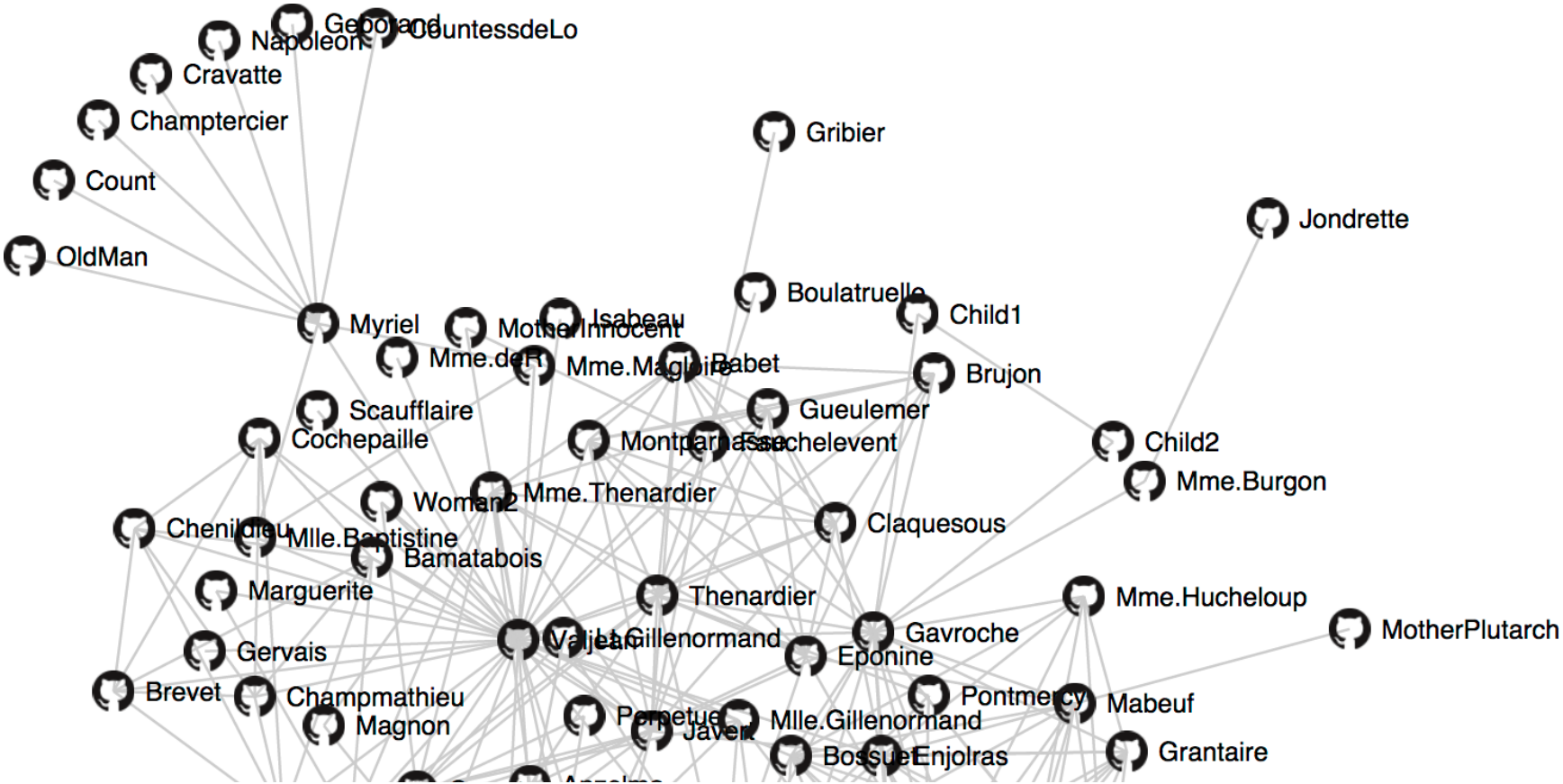

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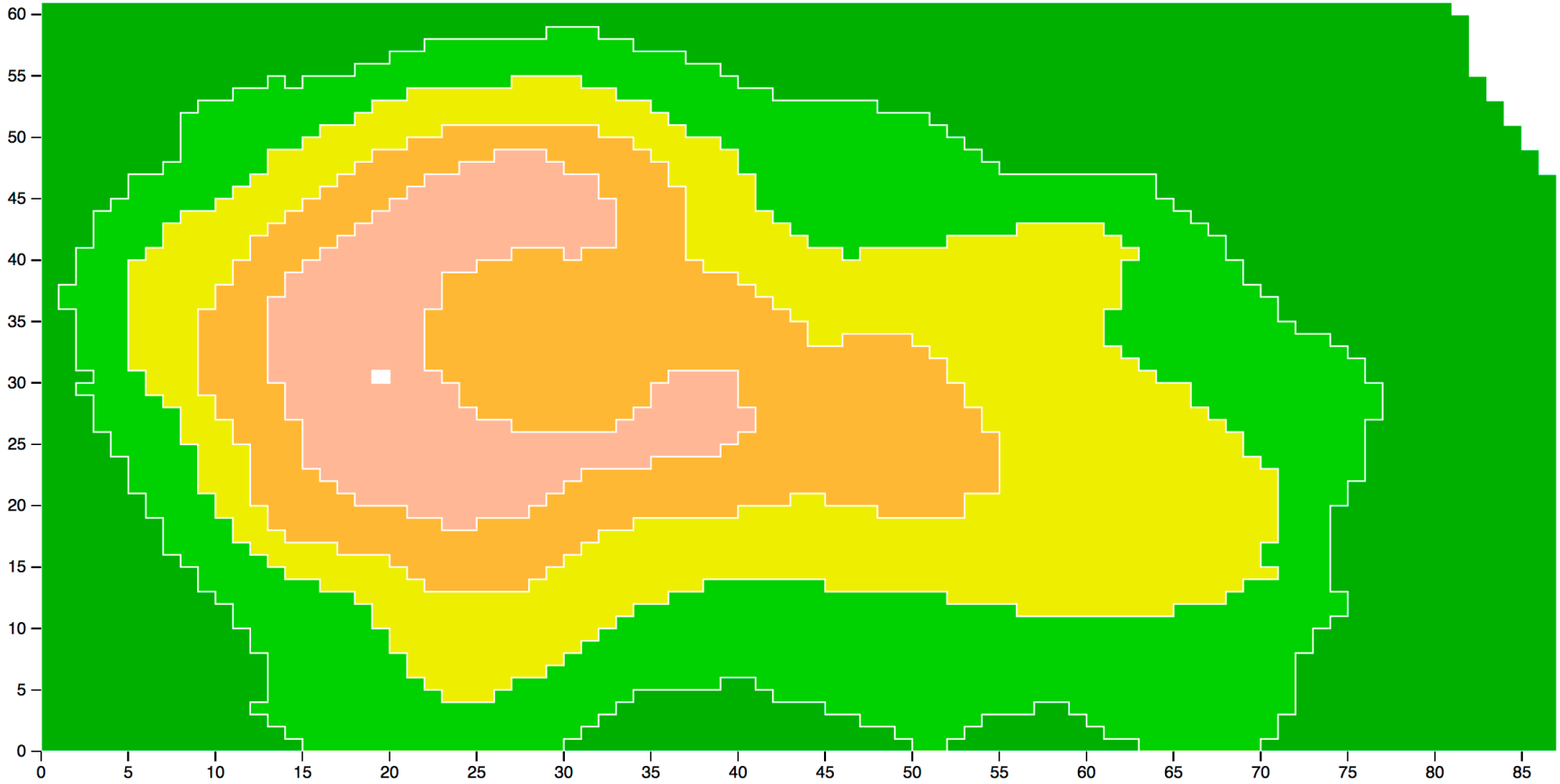

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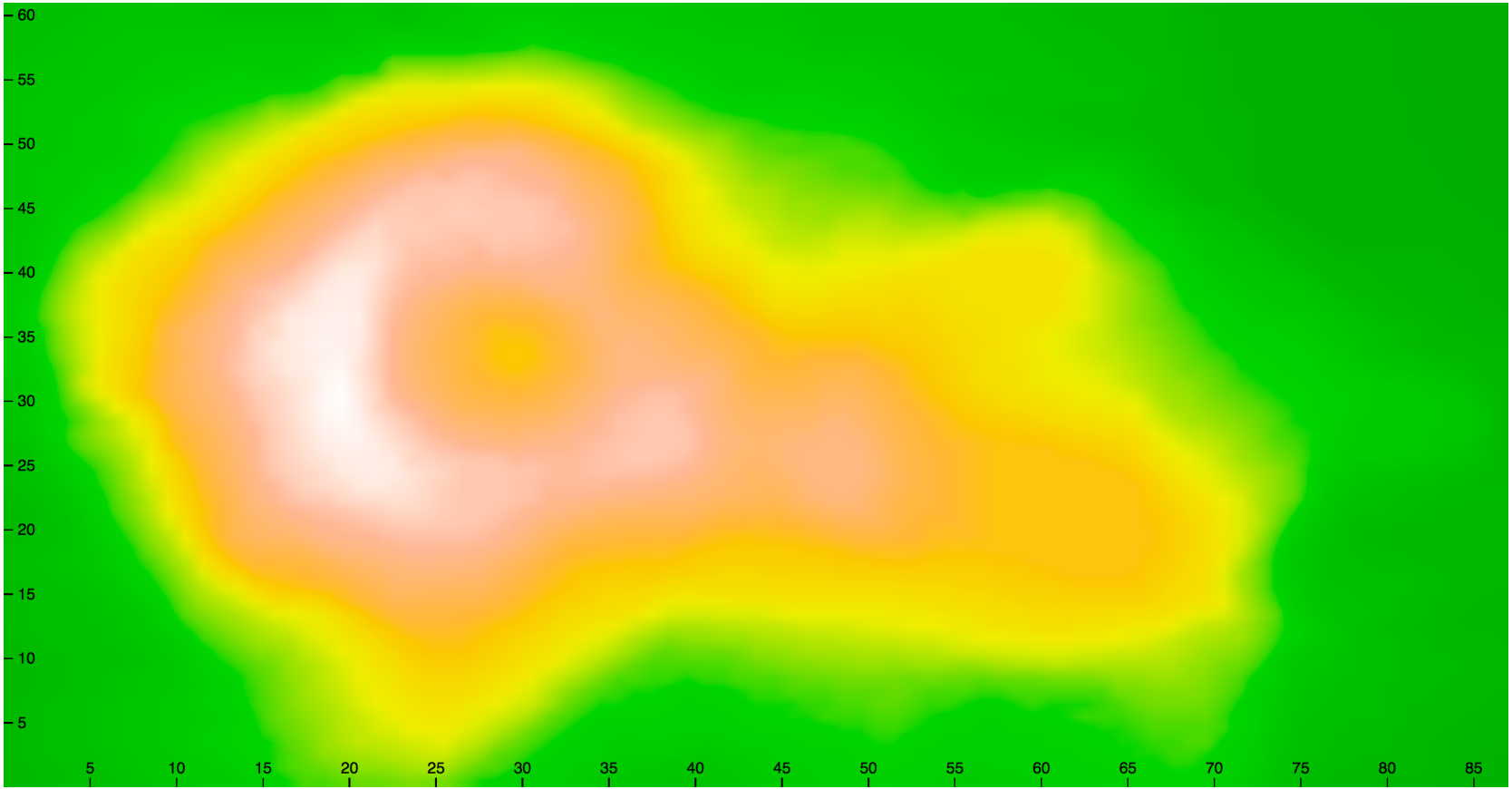

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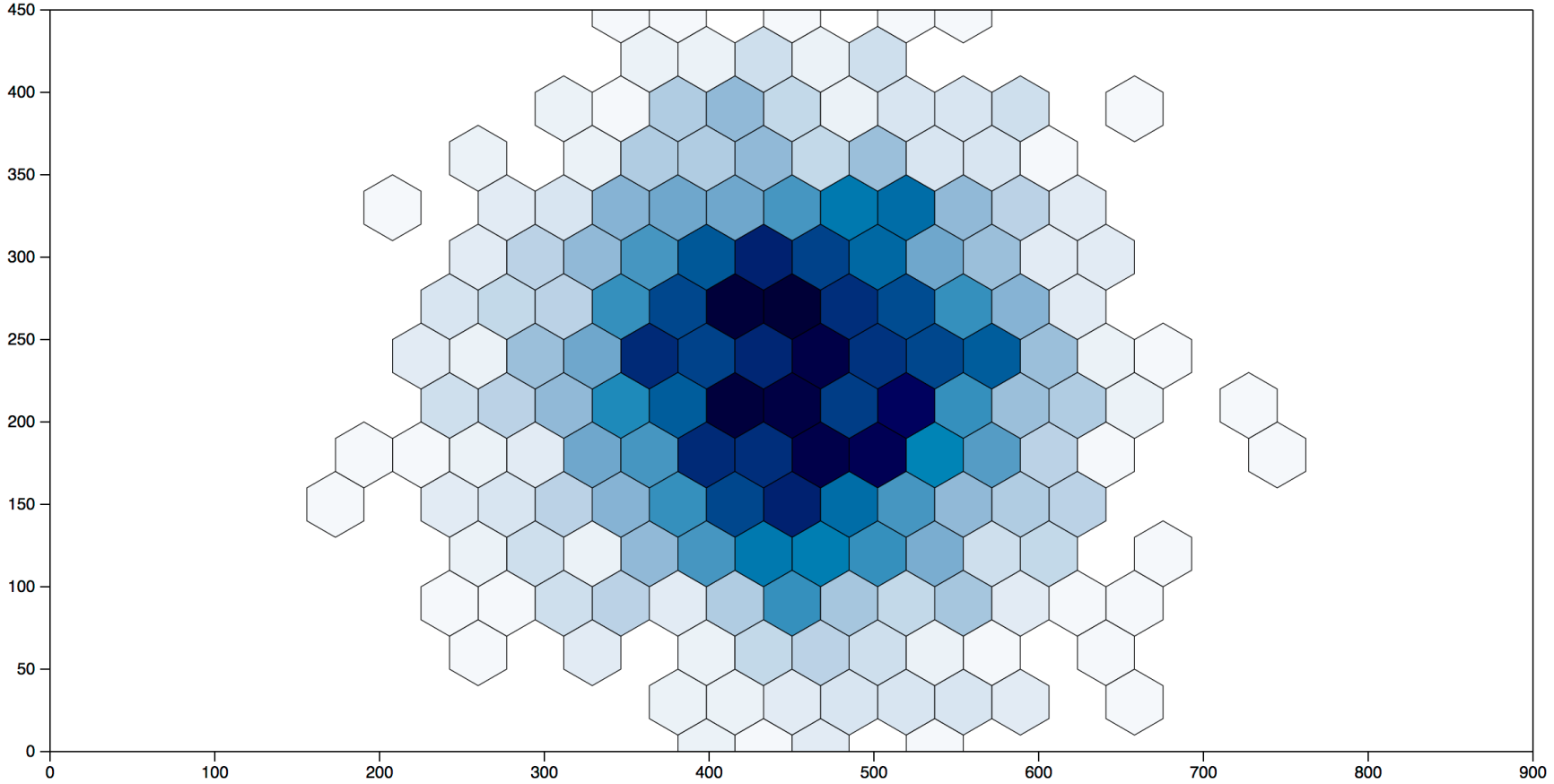

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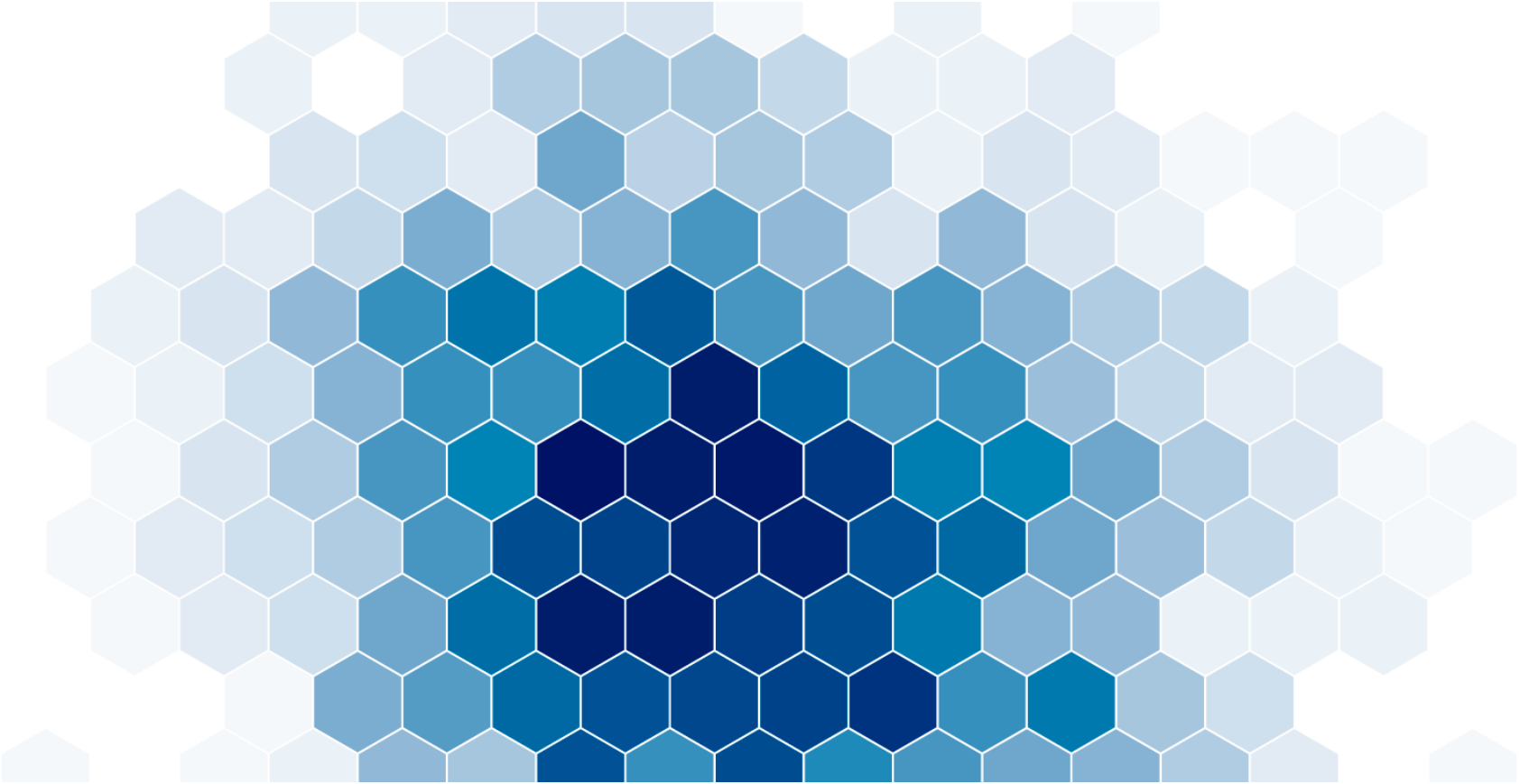

http://bl.ocks.org/mbostock/7833311

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Overplotting Remedies

- Modify marker display
  - *Reduce marker size*
  - *Change marker shape*
  - *Increase transparency*
- Indicate density of regions
  - *Use contour lines to indicate density*
  - *Use heatmap coloring to indicate density*
- Move to more dimensions?

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UK Temperature History

Explore the temperature in the United Kingdom since 1910 by scrolling the page **up** and **down**. Visit years marked in red or blue that have significant weather events. You can also sort by **year**, **maximum**, **minimum** or **mean** temperature

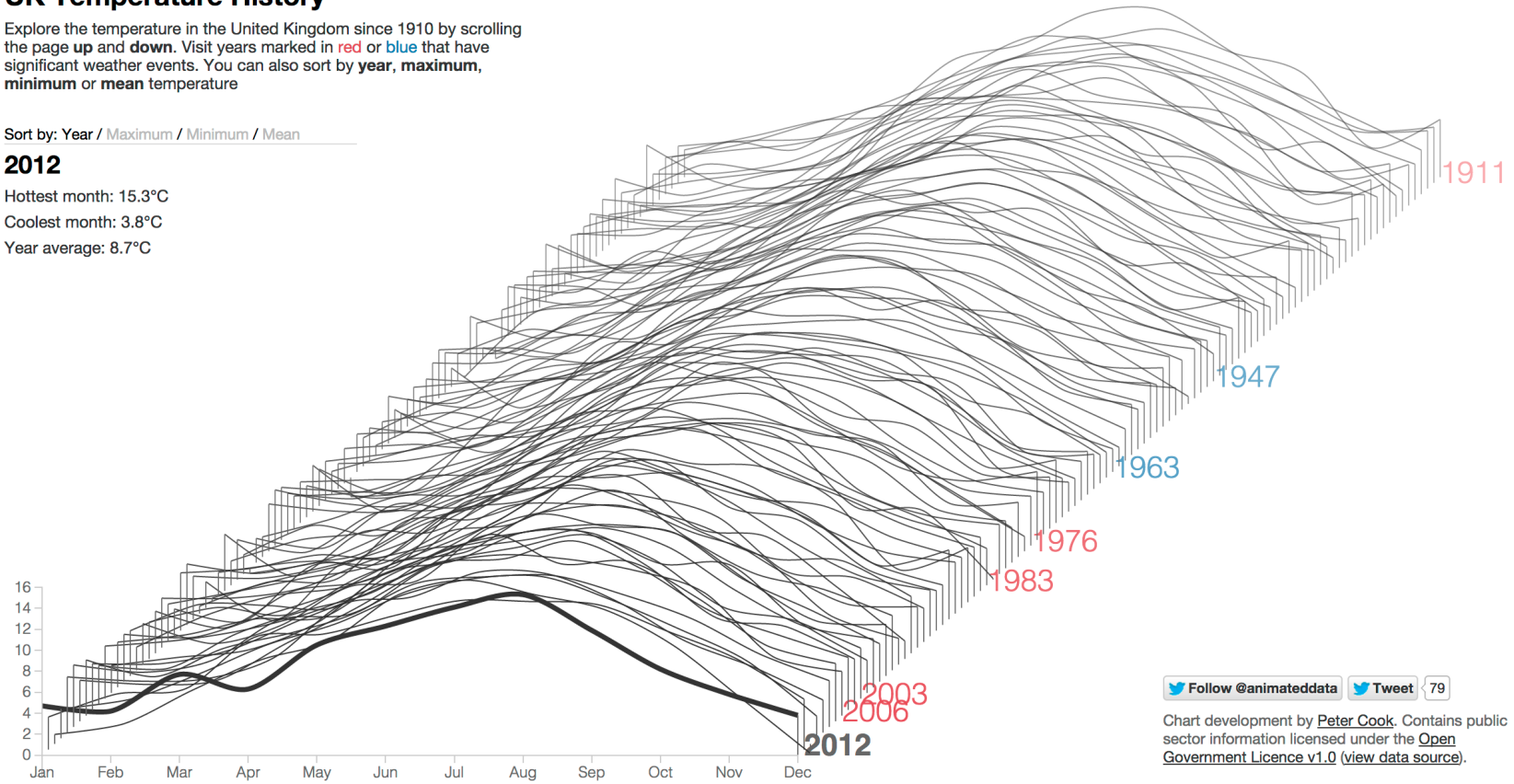
Sort by: Year / Maximum / Minimum / Mean

2012

Hottest month: 15.3°C

Coolest month: 3.8°C

Year average: 8.7°C



Follow @animateddata Tweet 79

Chart development by Peter Cook. Contains public sector information licensed under the Open Government Licence v1.0 (view data source).

http://charts.animateddata.co.uk/uktemperaturelines/

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3D VISUALIZATION

Examples

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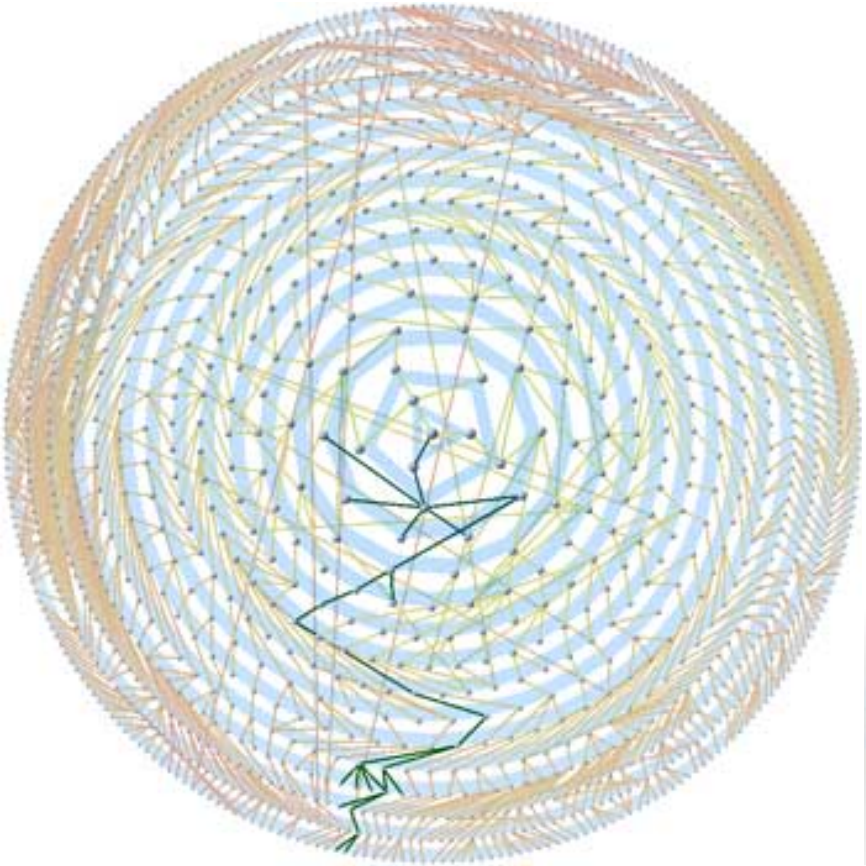

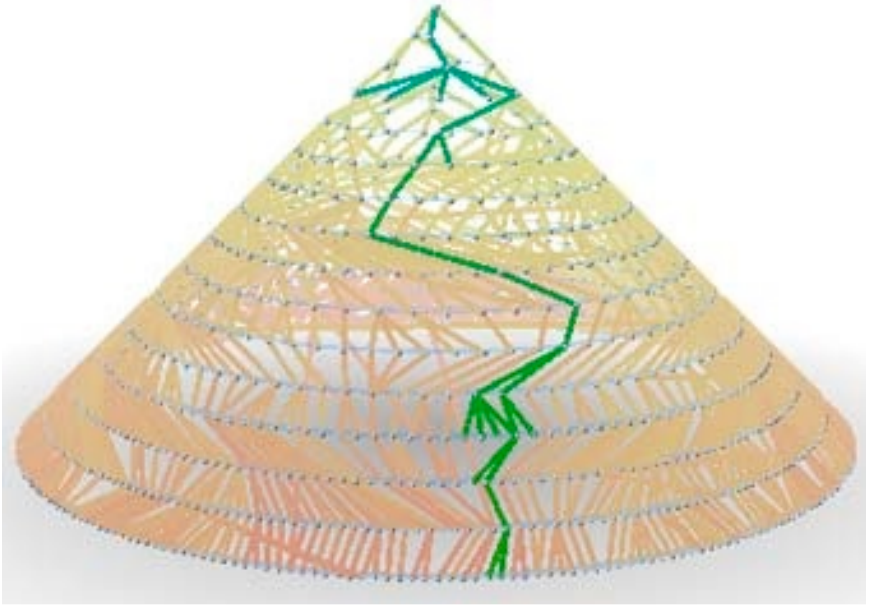

http://nadeausoftware.com/node/83

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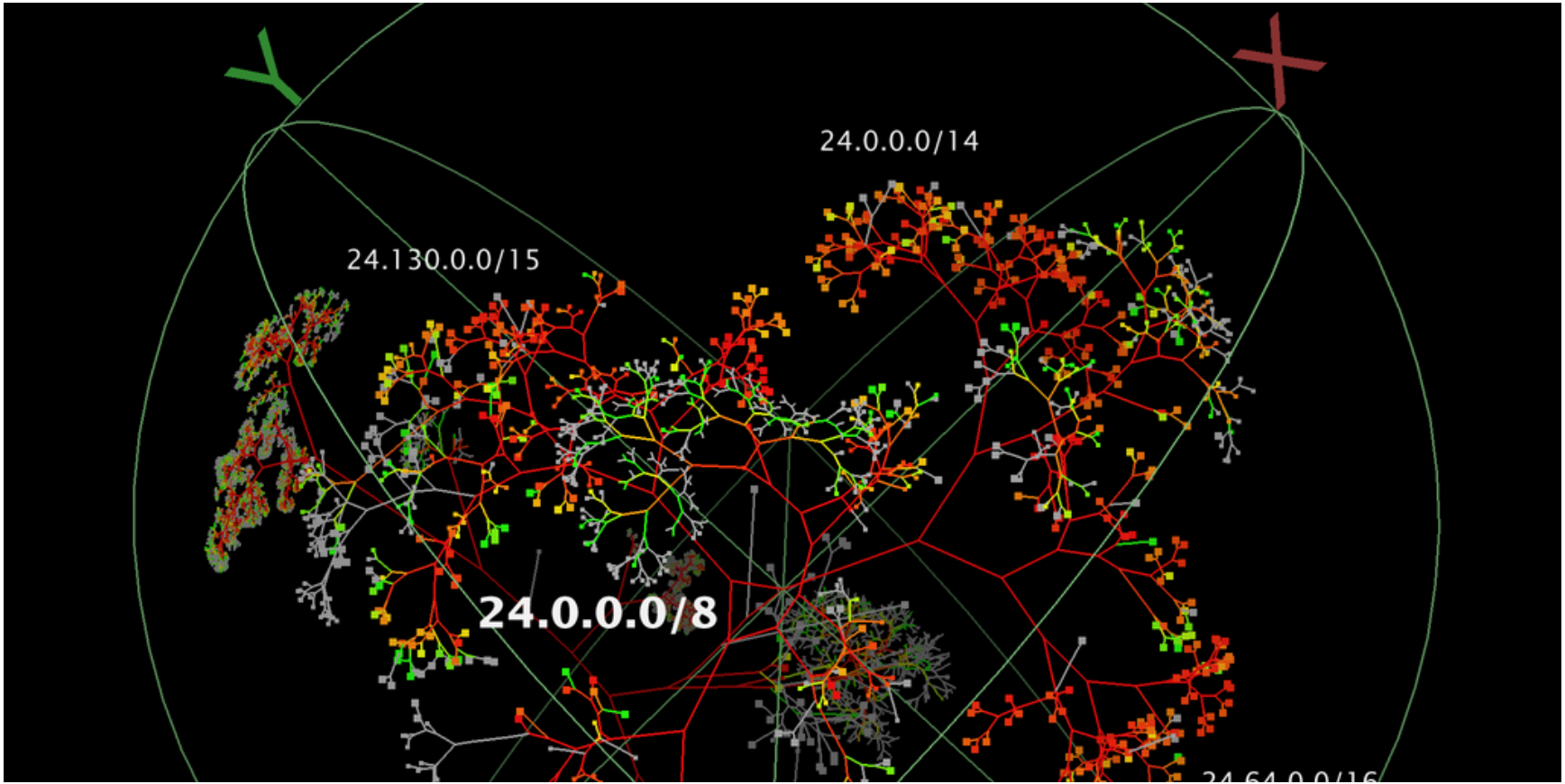

http://www.caida.org/tools/visualization/walrus/gallery1/

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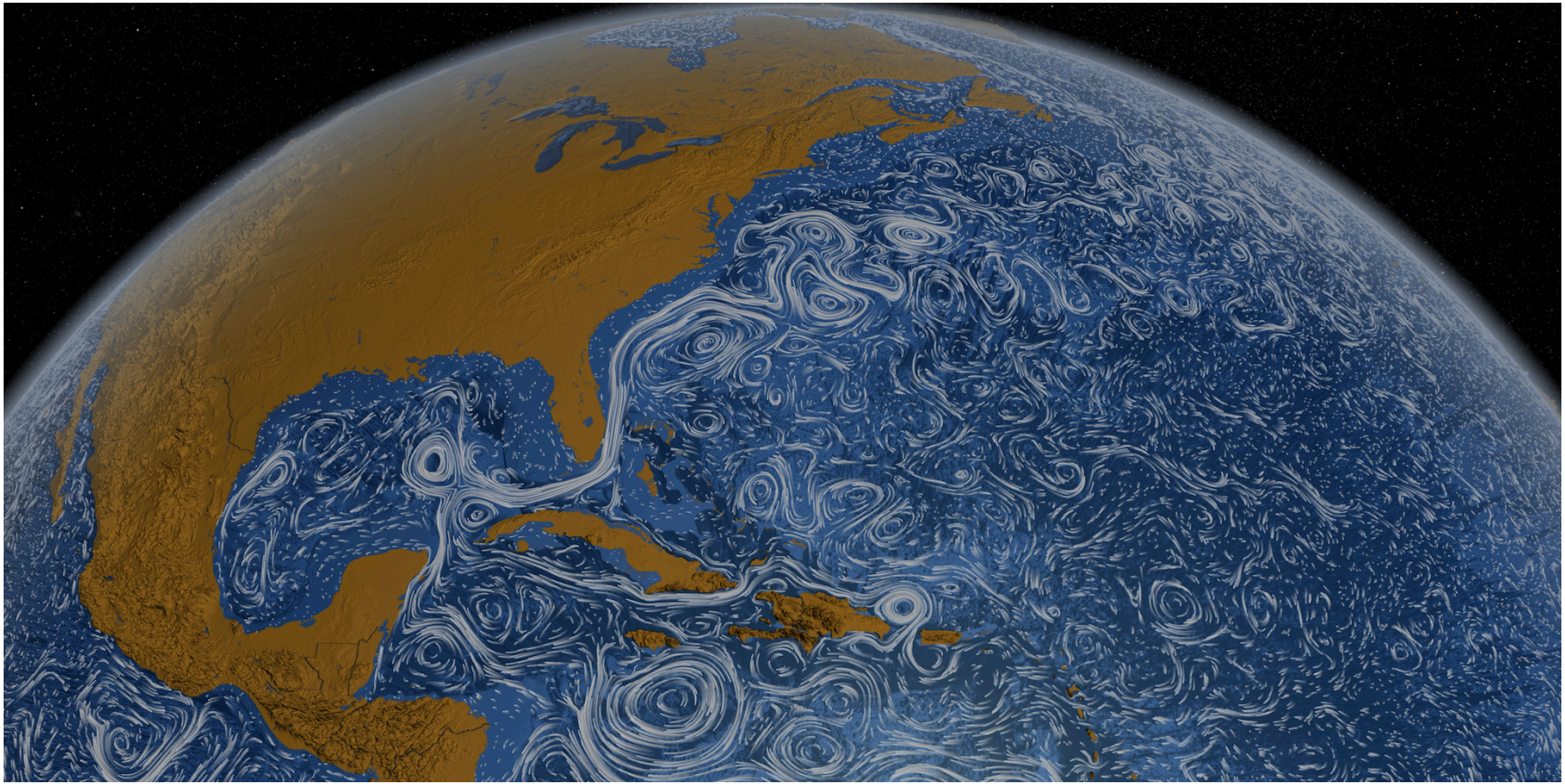

Perpetual Ocean • http://svs.gsfc.nasa.gov/vis/a000000/a003800/a003827/

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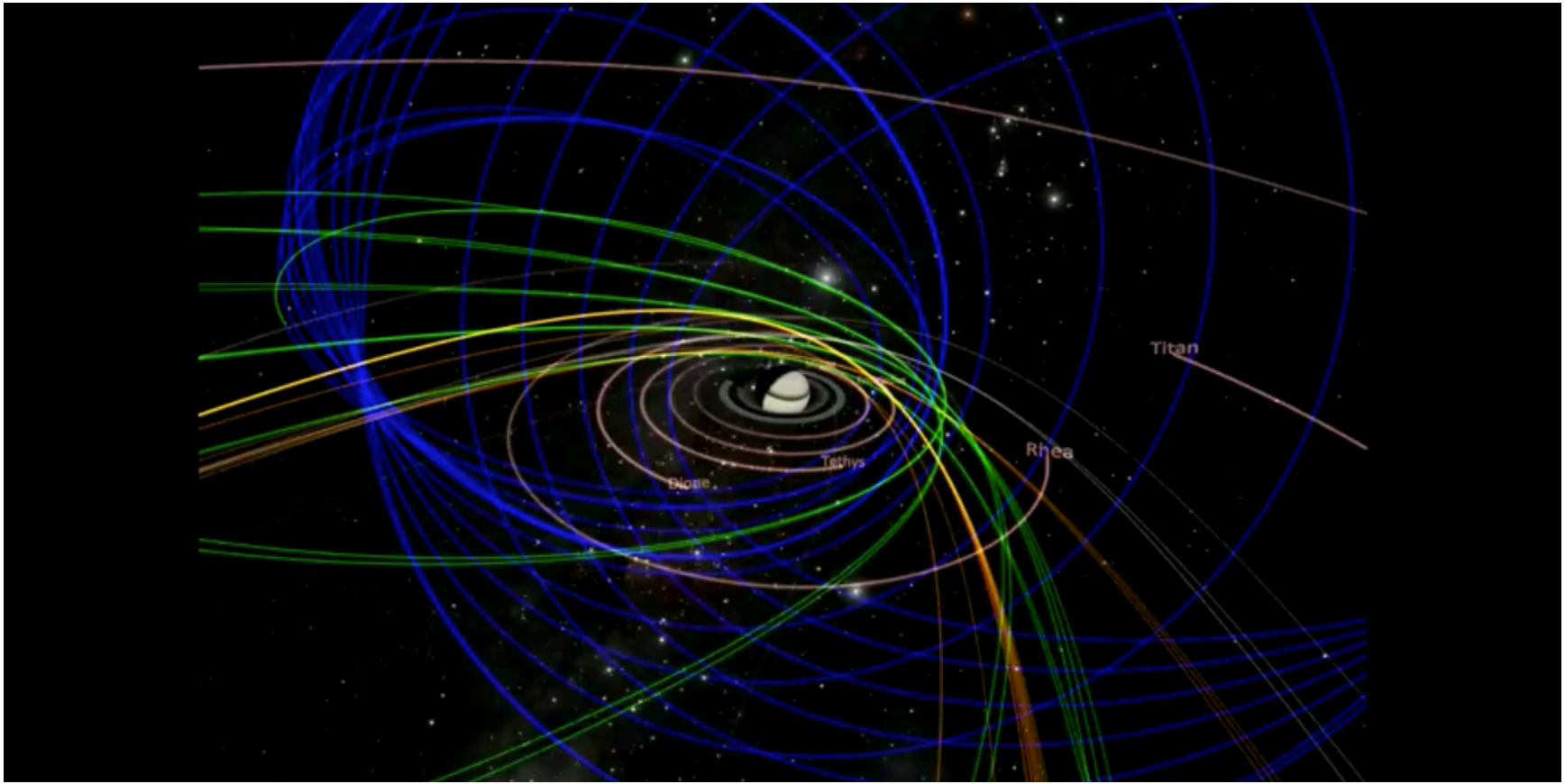

http://www.ted.com/talks/carter_emmart_demos_a_3d_atlas_of_the_universe.html

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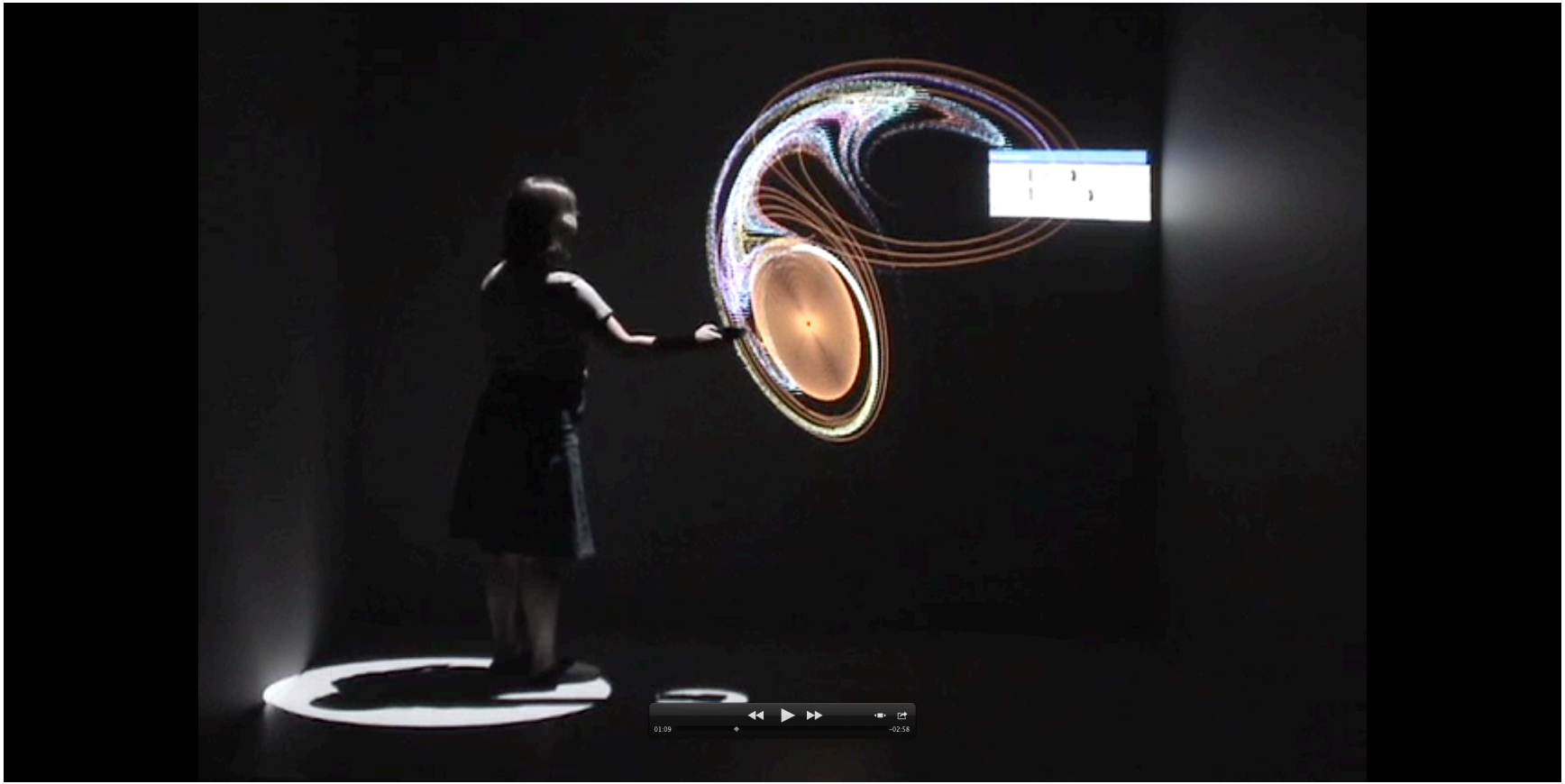

KECK Cave • http://csc.ucdavis.edu/~chaos/chaos/pubs/esa.htm

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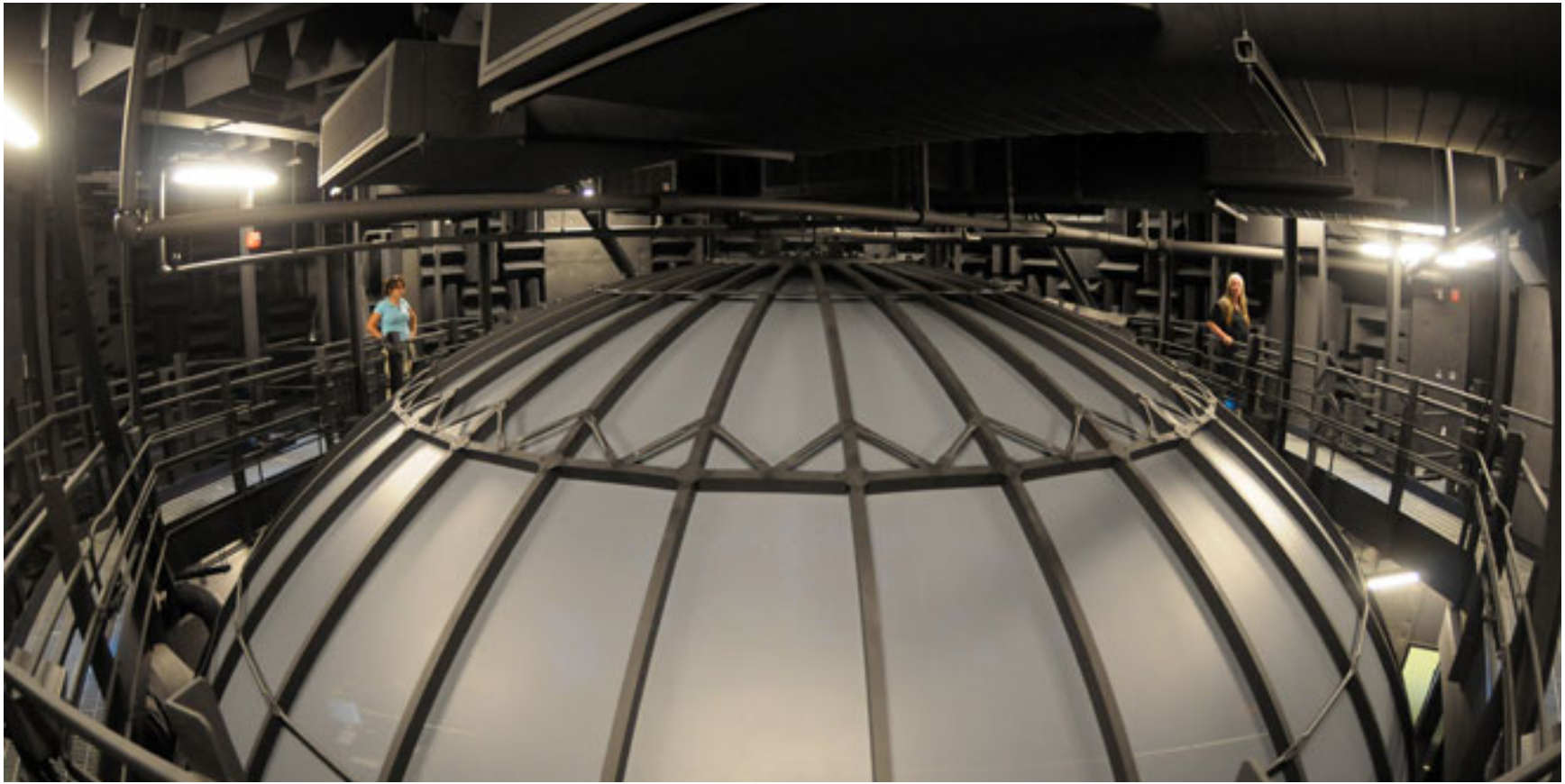

Allosphere • http://www.allosphere.ucsb.edu/

3D VISUALIZATION

Issues

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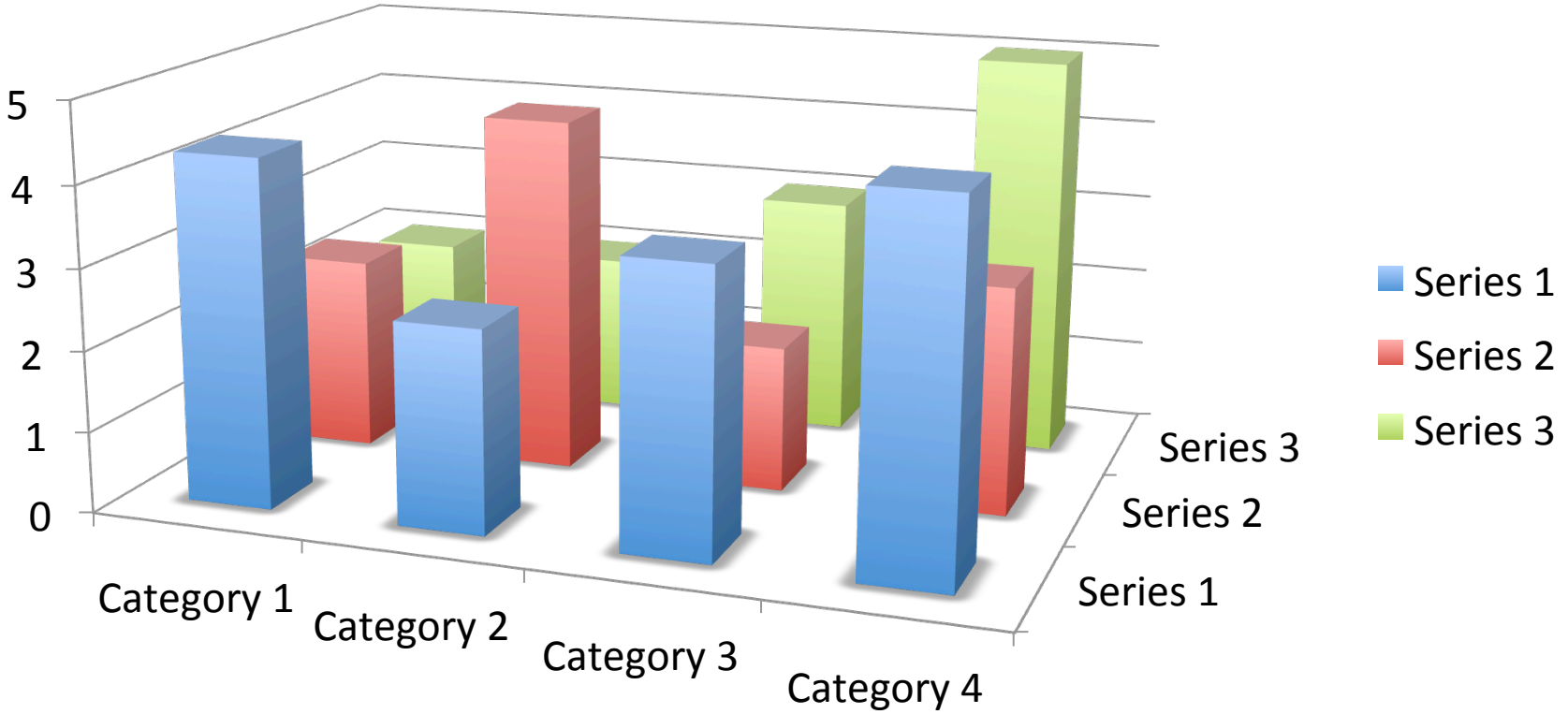

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Problems

- Ambiguity
  - Position and orientation is ambiguous
- Occlusion
  - Unable to see data in the “back” of visualization
- Perception
  - Trying to “trick” mind into thinking image is 3D using lighting, shading, perspective, etc.

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Problems

- Interactivity
  - Required to deal with ambiguity and occlusion
- Devices
  - Input and output devices usually 2D
- Text is 2D
  - How display alongside 3 dimensional objects?

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Information Gain

- Moving from 1D to 2D
  - Can see all of x and y dimensions
  - Maximum possible information gain
- Moving from 2D to 3D
  - Can only see some of z dimension (occlusion)
  - Limited information gain
  - Possible to reduce information conveyed!

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http://www.flickr.com/photos/teflon/2864666161/

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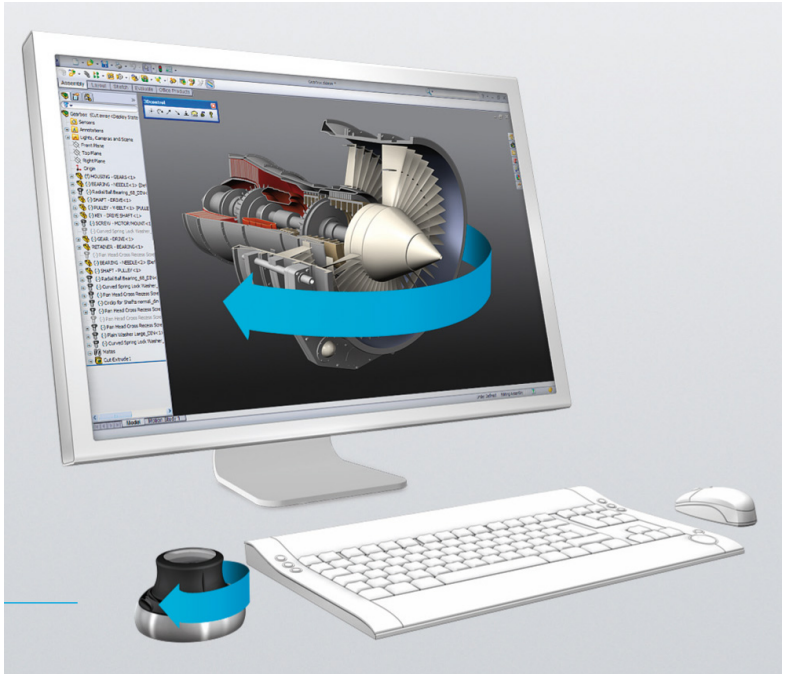
3D Input Devices



http://www.3dconnexion.com/

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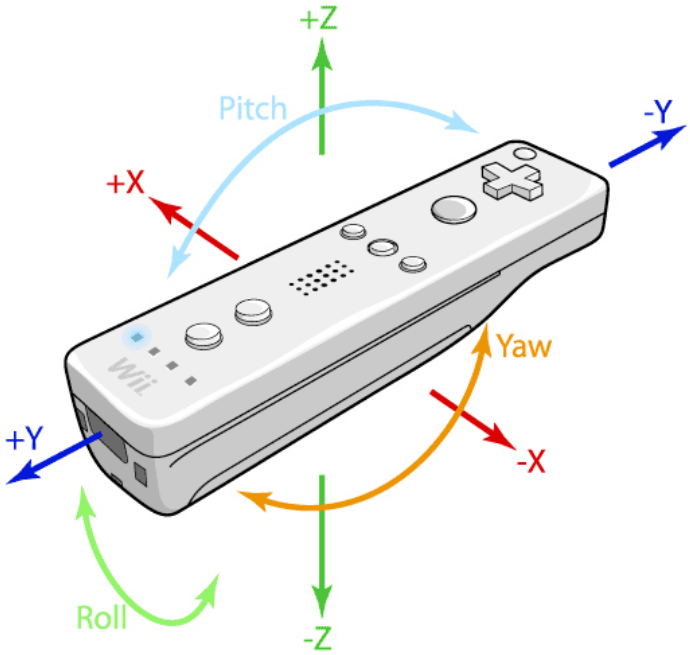
3D Input Devices



3D Input Devices from Nintendo and Sony

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3D Output Devices: KECK Cave

- Four seamless “walls” and projectors
- Six high-end systems driving the projectors
  - One main system, one system per projector, one system for audio processing
- Several 3D input devices
  - Wireless 3D head tracking system, 3D “wand” as input controller, shuttered glasses for stereographic 3D

http://keckcaves.org/

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http://gizmodo.com/5520526/panasonics-3dtv-sales-so-strong-theyre-producing-30-more

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3D VISUALIZATION

Evaluation

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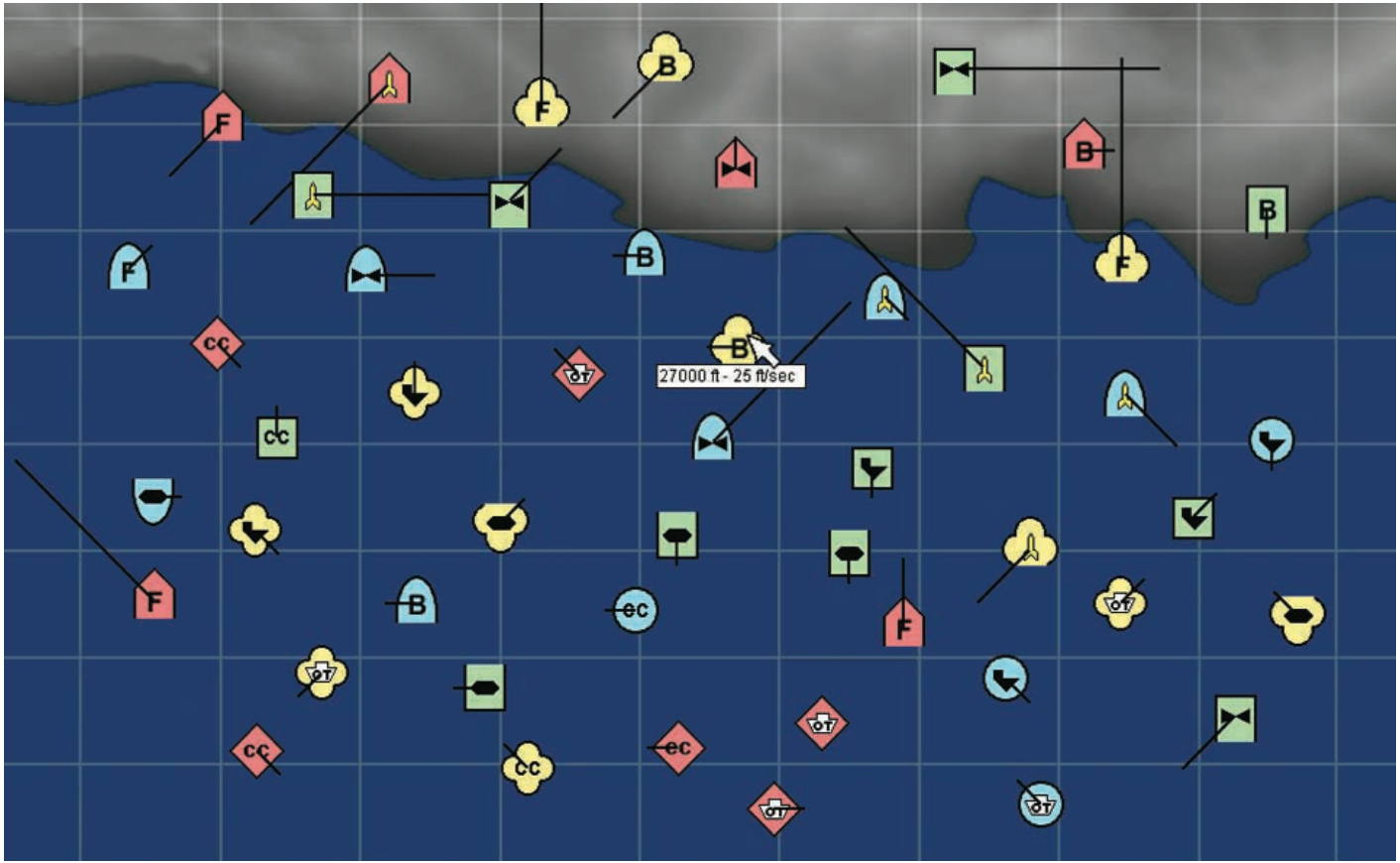

"Information Availability in 2D and 3D Displays" by H. S. Smallman, et al.

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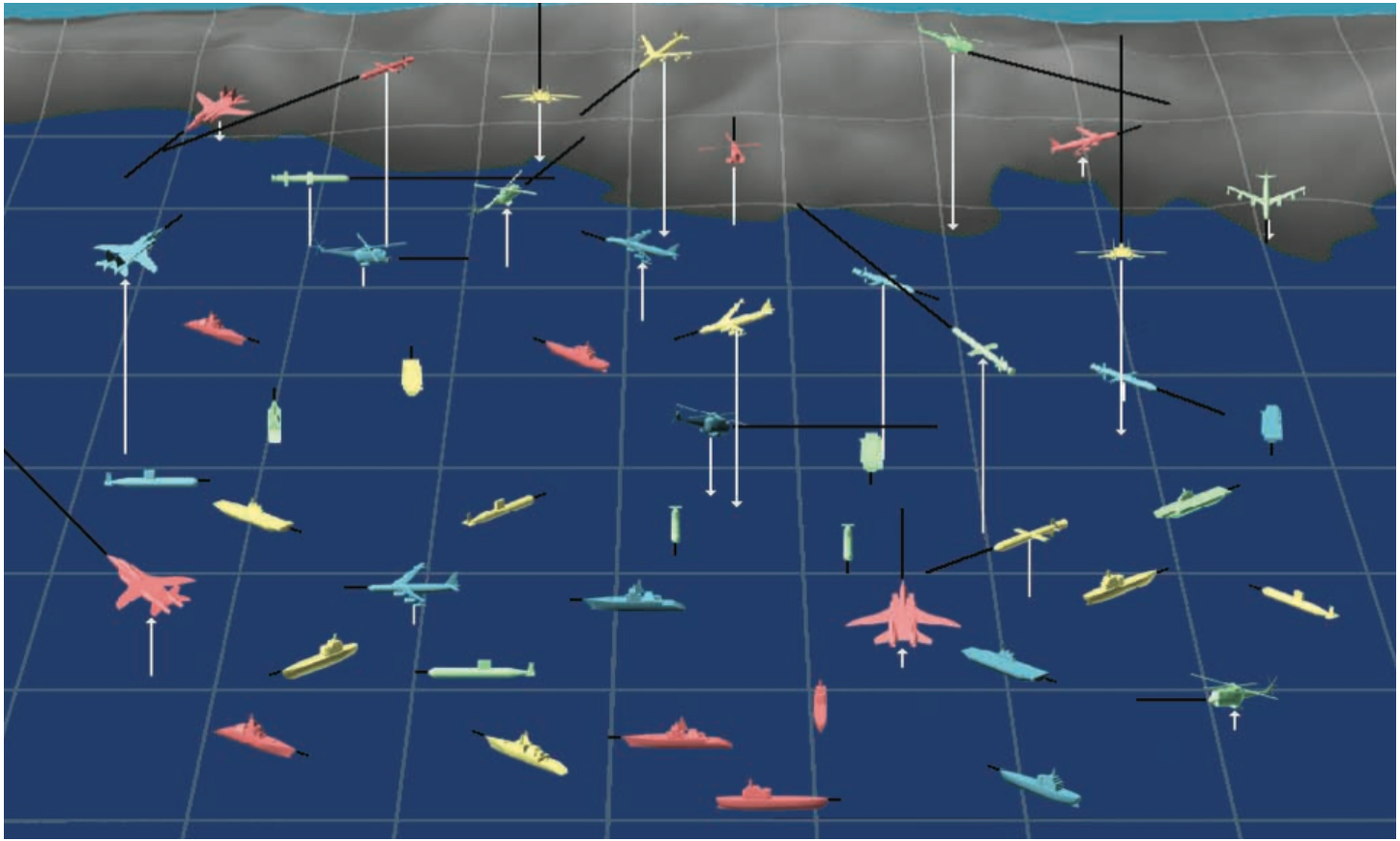

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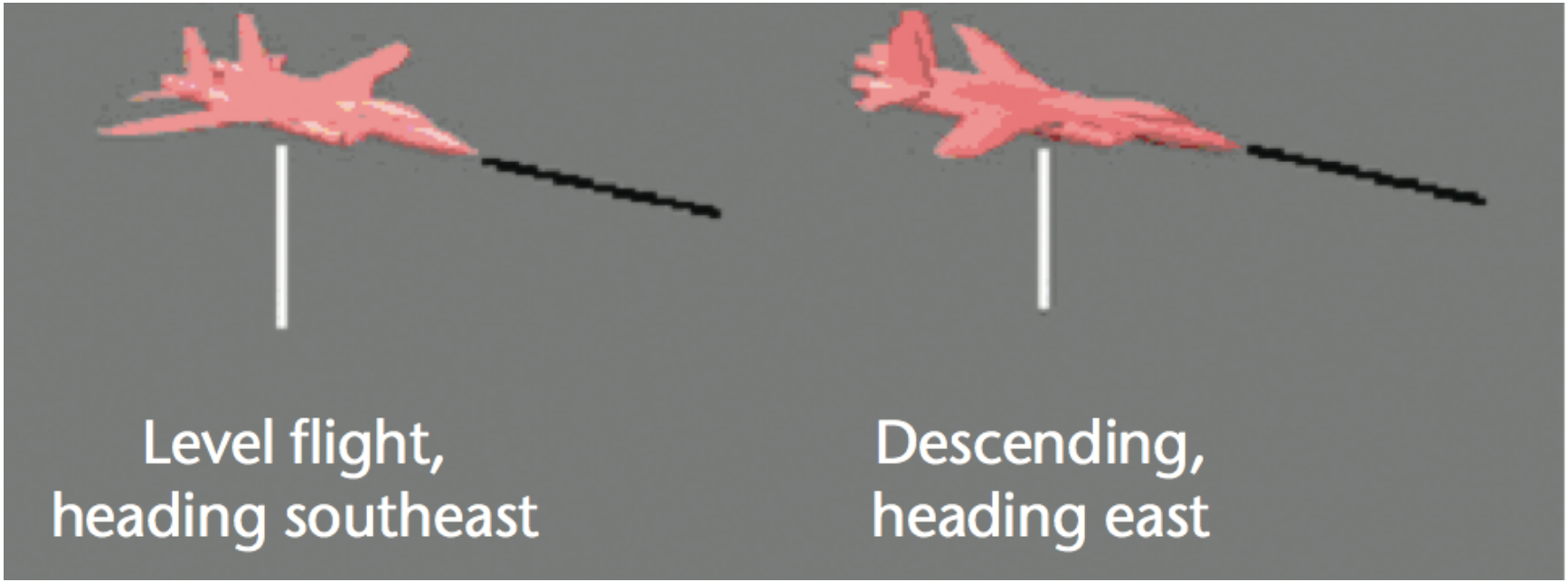

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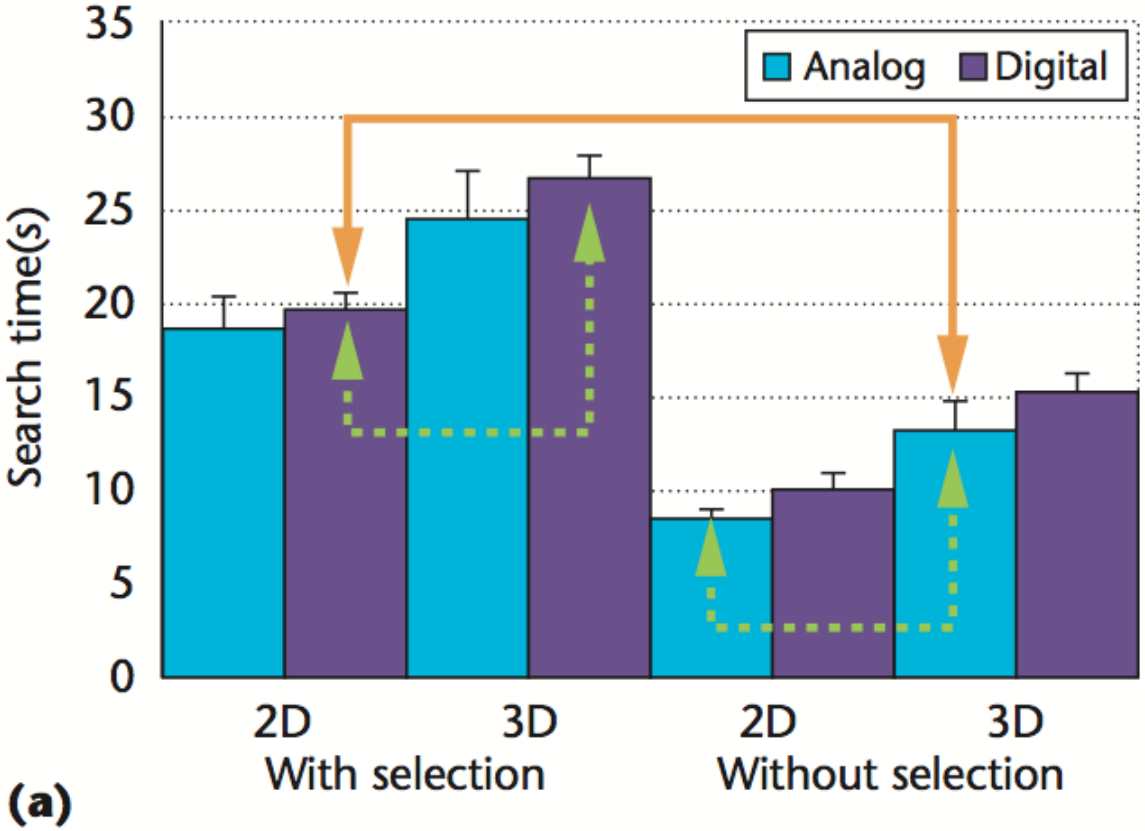

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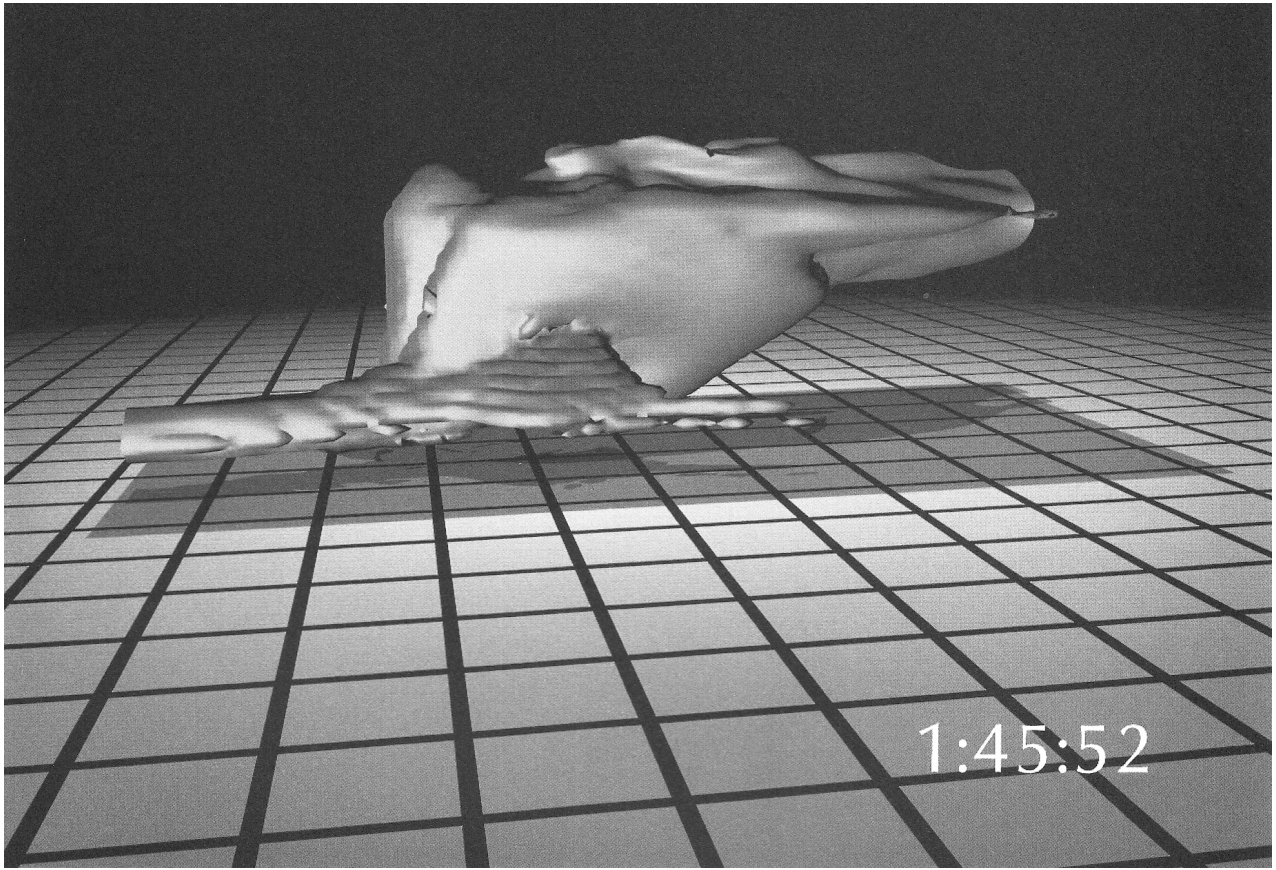

Visual Explanations, by Edward R. Tufte, Graphics Press, 1997, p20.

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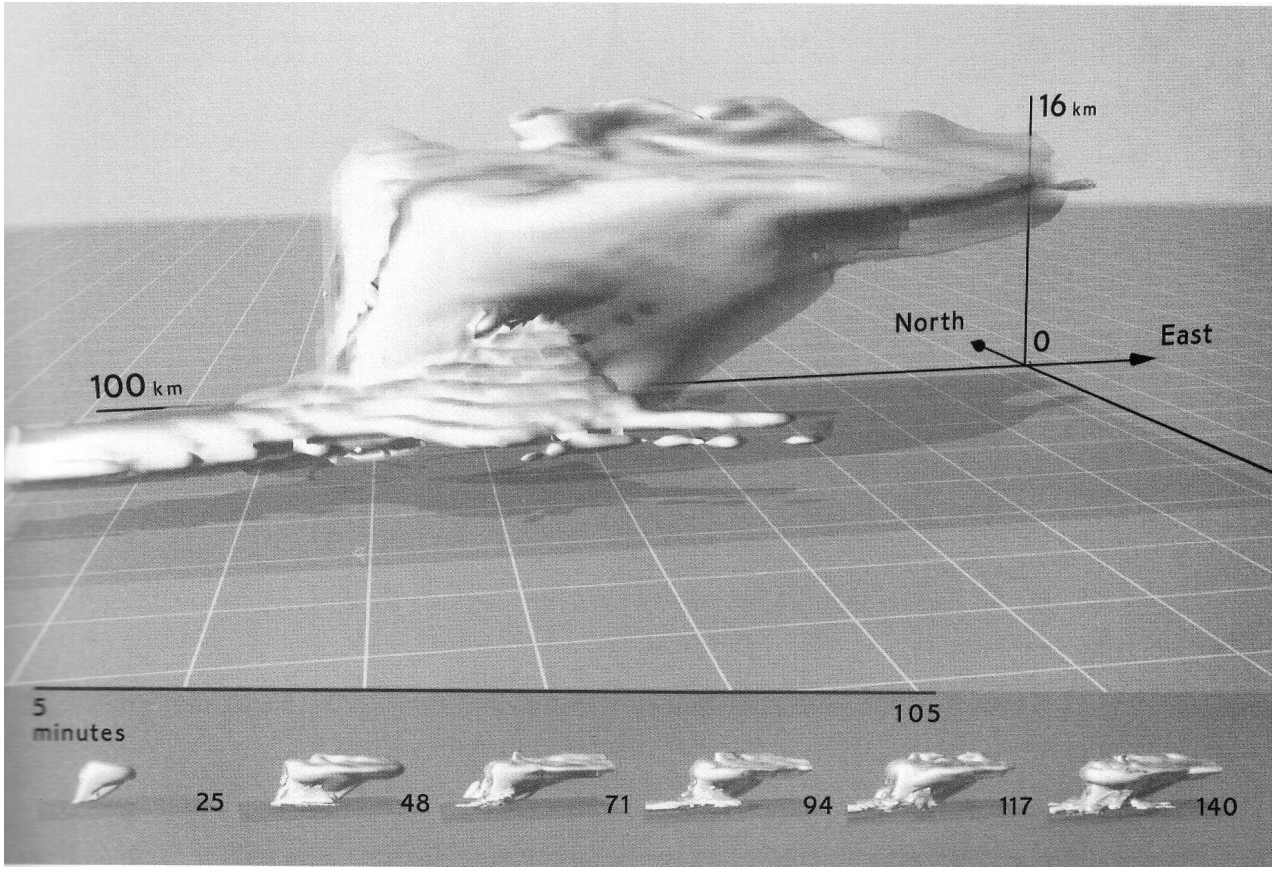

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2.5D VISUALIZATION

Basics

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2.5D Visualization

- Primarily 2D visualization
  – *2D layout, 2D interaction*
- Adds some 3D cues
  – *Shadow, gradients, and more…*
- Provide some additional “hints” without causing many of the problems with 3D visualization

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Depth Cues

- Shadows
- Shading
- Texture
- Occlusion
- Depth of Focus
- Position
- Size
- Linear Perspective

Information Visualization: Perception for Design, Chapter 7: Space Perception, Colin Ware,.

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Linear Perspective

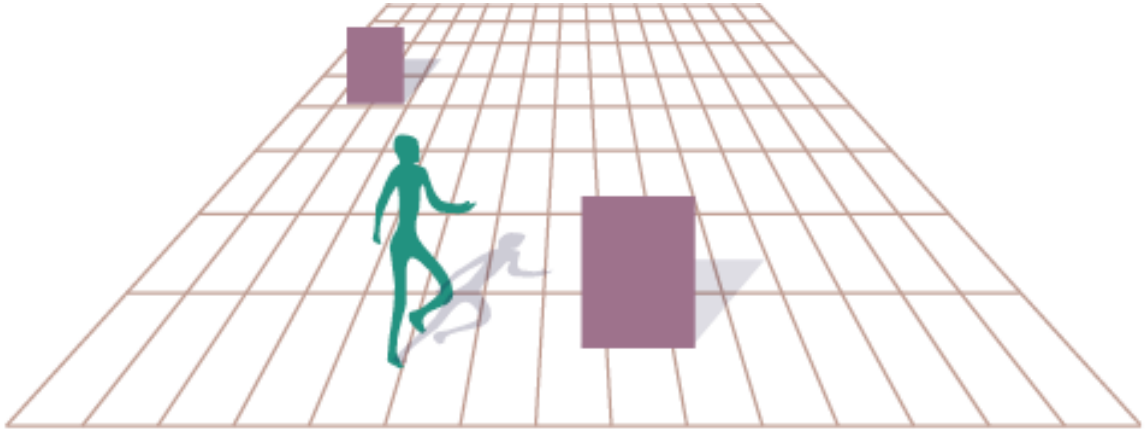
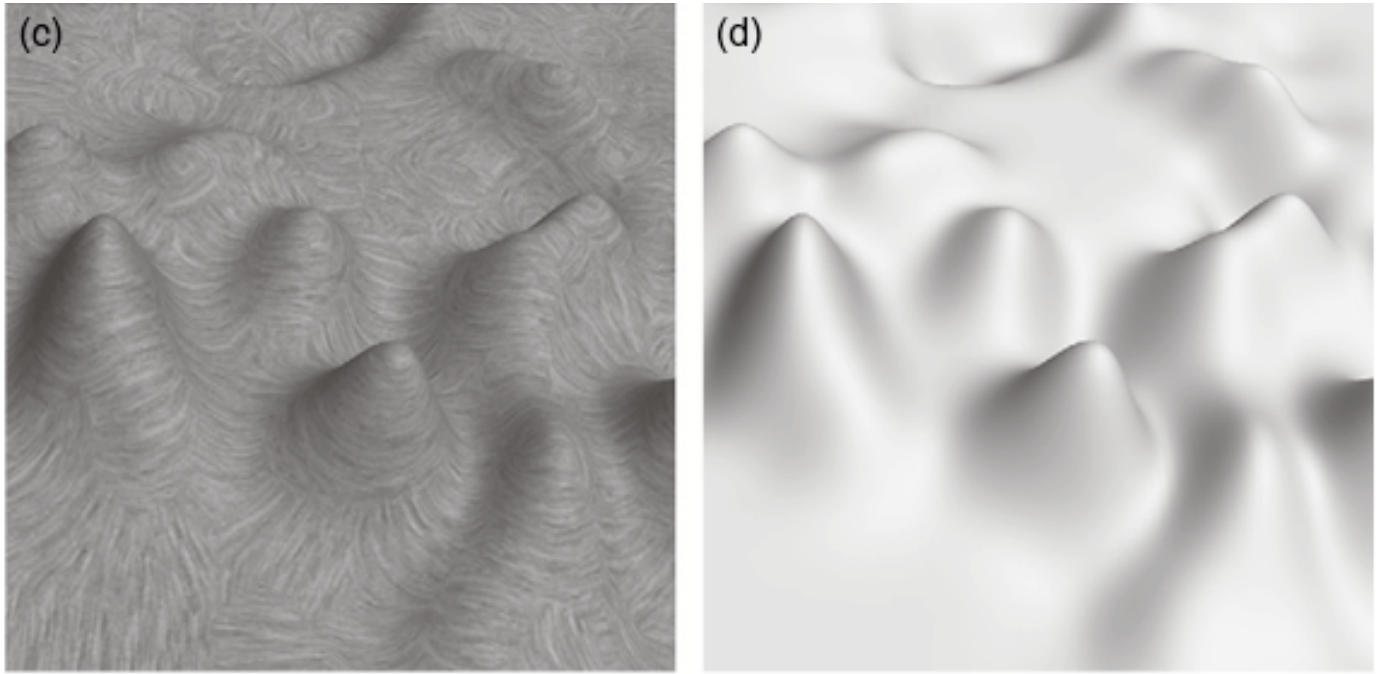


Figure 7.2 Perspective cues arising from perspective geometry include the convergence of lines and the fact that more distant objects become smaller on the picture plane.

Information Visualization: Perception for Design, Chapter 7: Space Perception, Colin Ware,.

Texture



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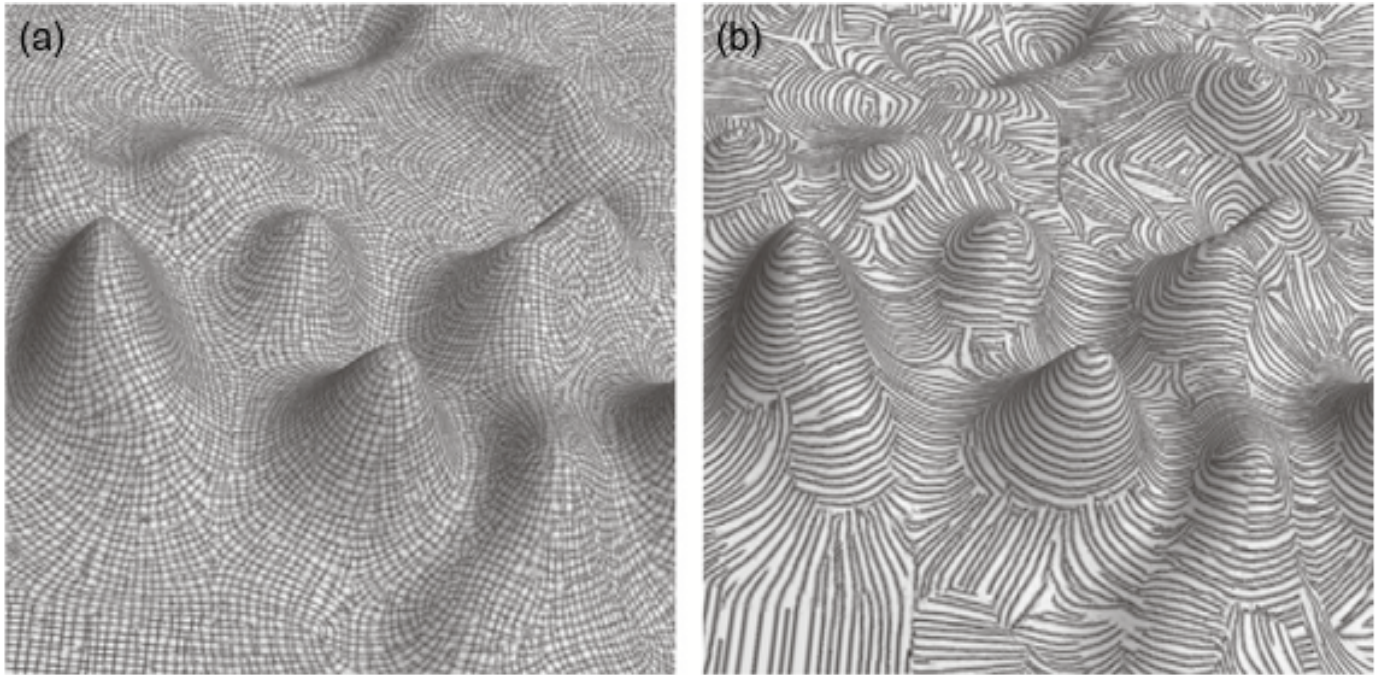
Texture



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Occlusion

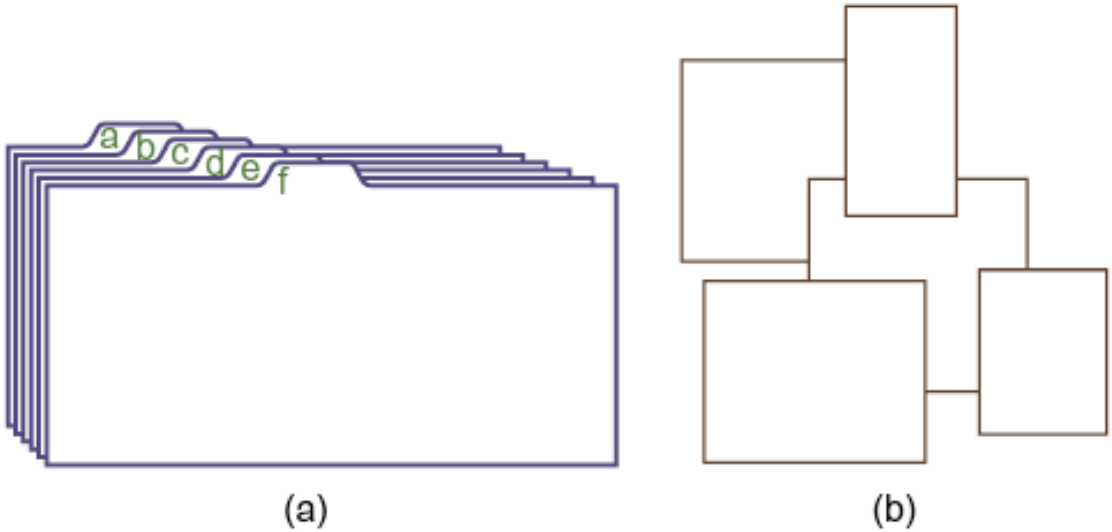


Figure 7.9 (a) Careful use of occlusion enables small tabs to provide access to larger objects. (b) Window interfaces use occlusion.

Information Visualization: Perception for Design, Chapter 7: Space Perception, Colin Ware,.

Shadow and Light

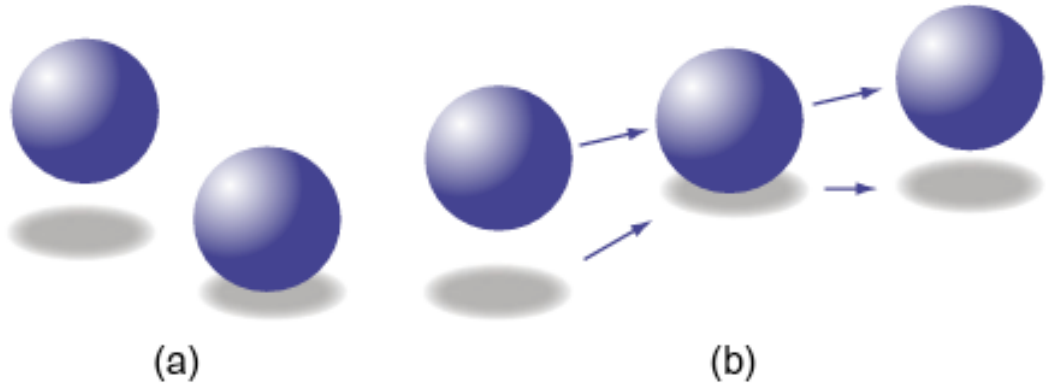
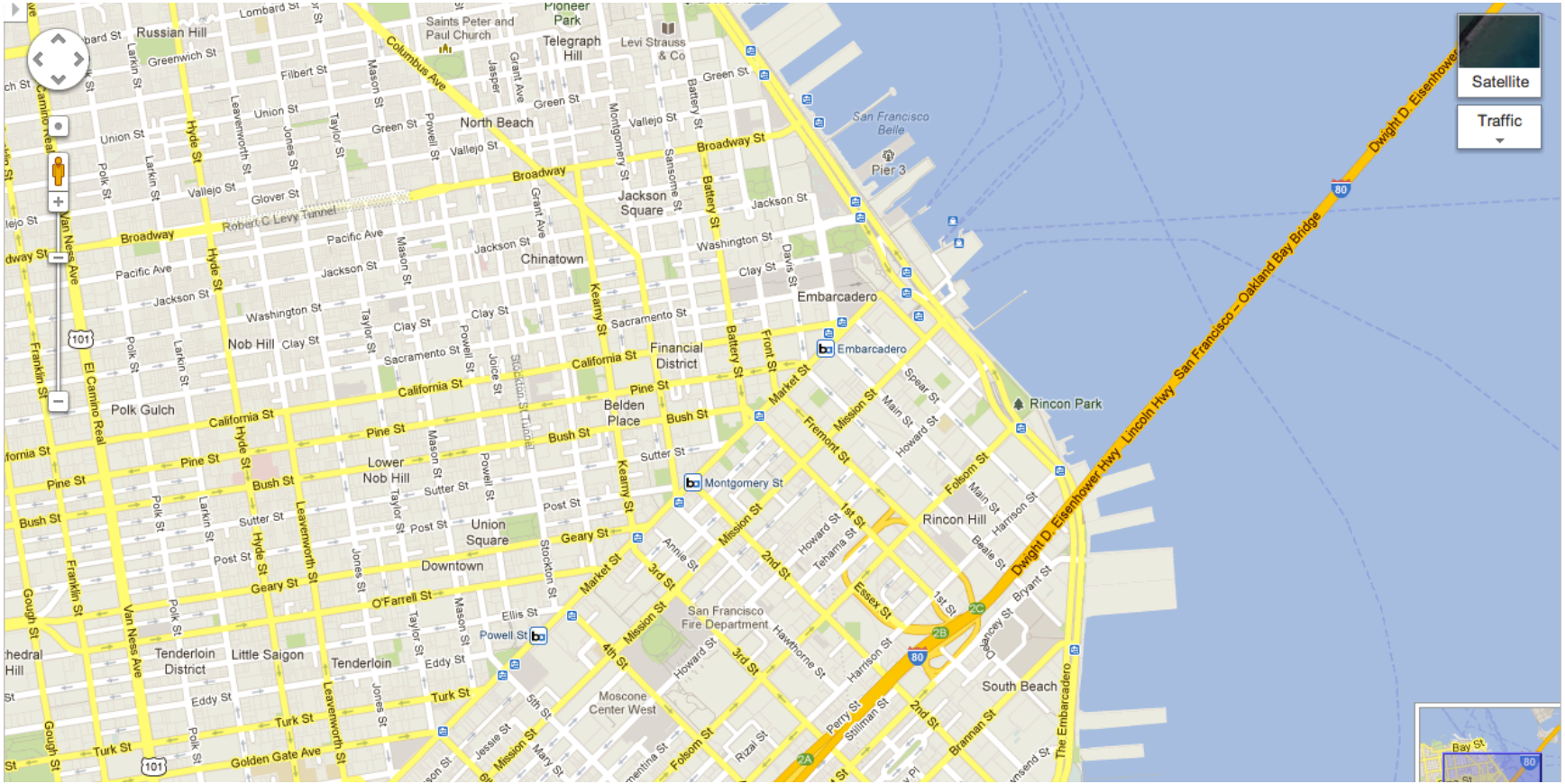


Figure 7.19 (a) Shadows can provide a strong cue for the relative height of objects above a plane. (b) The effect is even stronger with motion. The ball actually appears to bounce when the ball and shadows are animated to follow the trajectories shown by the arrows.

Information Visualization: Perception for Design, Chapter 7: Space Perception, Colin Ware,.



http://goo.gl/maps/8wa0x

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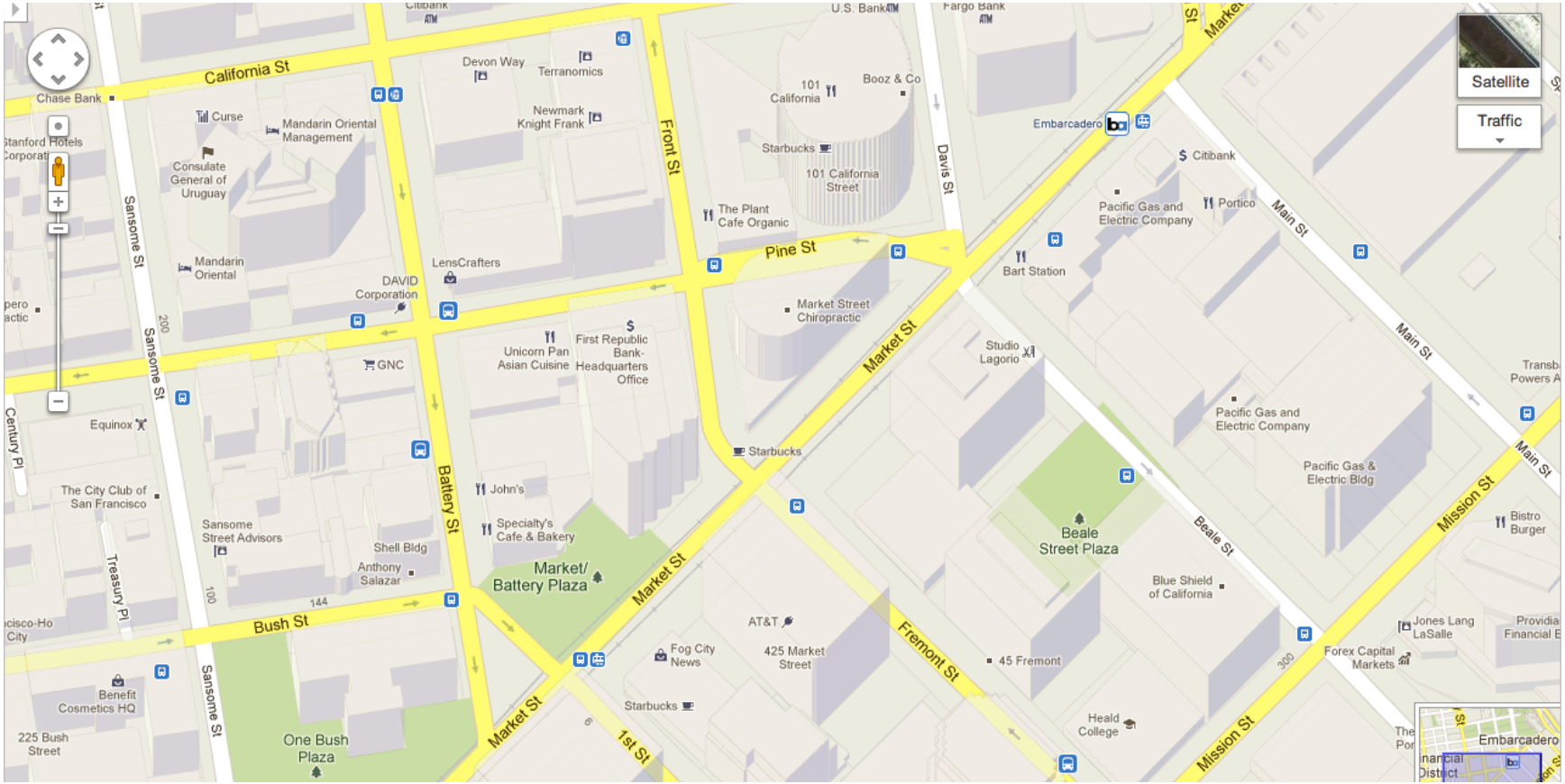

http://goo.gl/maps/cCJFB

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RESOURCES

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Resources

Envisioning Information
Edward R. Tufte, Graphics Press, 1990

Visual Explanations
Edward R. Tufte, Graphics Press, 1997

Visual Display of Quantitative Information
Edward R. Tufte, Graphics Press, 2001

Now You See It
Stephen Few, Analytics Press, 2009

Design with a 2.5D Attitude
Colin Ware, 2003.

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QUESTIONS

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