VIEWS

DESIGN CHOICES FOR MULTIPLE VIEWS

Juxtapose and Coordinate Multiple Side-by-Side Views

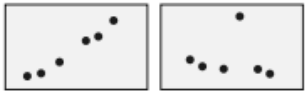
- Share Encoding: Same/Different
  - *Linked Highlighting*

- Share Data: All/Subset/None

- Share Navigation

		Data		
		All	Subset	None
Encoding	Same	Redundant	Overview/ Detail	Small Multiples
	Different	Multiform	Multiform, Overview/ Detail	No Linkage

Partition into Side-by-Side Views



Superimpose Layers

WHY MULTIPLE VIEWS?

Eyes beat memory

- Showing two views side by side are easier to compare than changing views over time

No single visual encoding is optimal for all possible tasks

- Use different encoding for one data

Too many to shown in one view

LINKED VIEWS

Multiple views are simultaneously visible and linked together

Actions in one view affect the others

LINKED VIEWS OPTIONS

Four options

- Highlighting: to link, or not
- Navigation: to share, or not
- Encoding: same or multiform
- Dataset: Shared all, subset, or none

→ Share Encoding: Same/Different

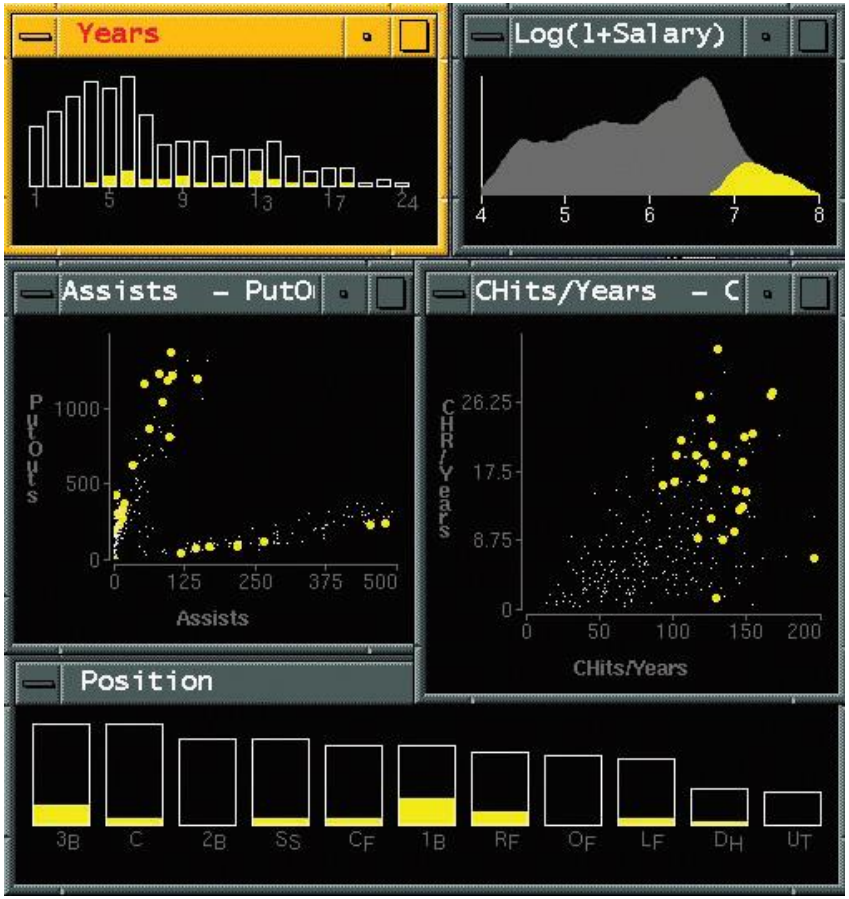
→ *Linked Highlighting*

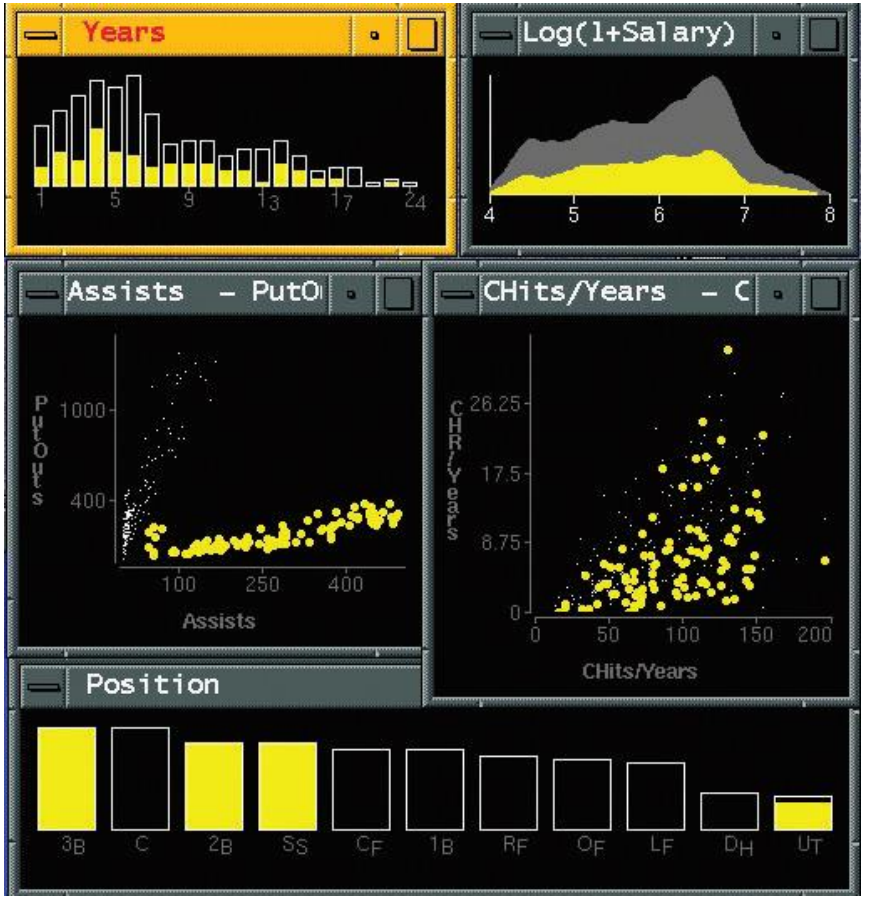
→ Share Data: All/Subset/None

→ Share Navigation

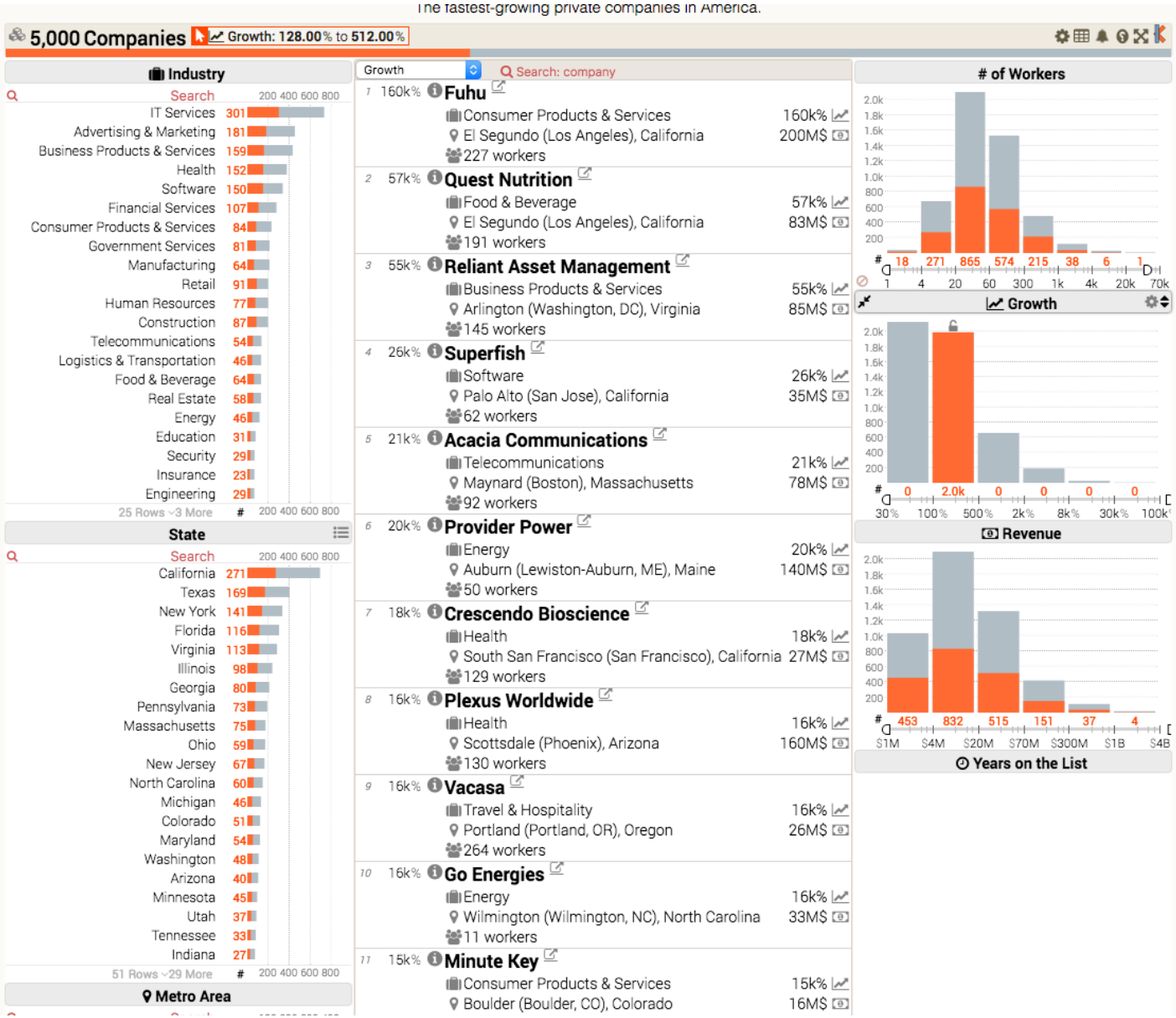
		Data		
		All	Subset	None
Encoding	Same	Redundant	Overview/ Detail	Small Multiples
	Different	Multiform	Multiform, Overview/ Detail	No Linkage

LINKED HIGHLIGHTING

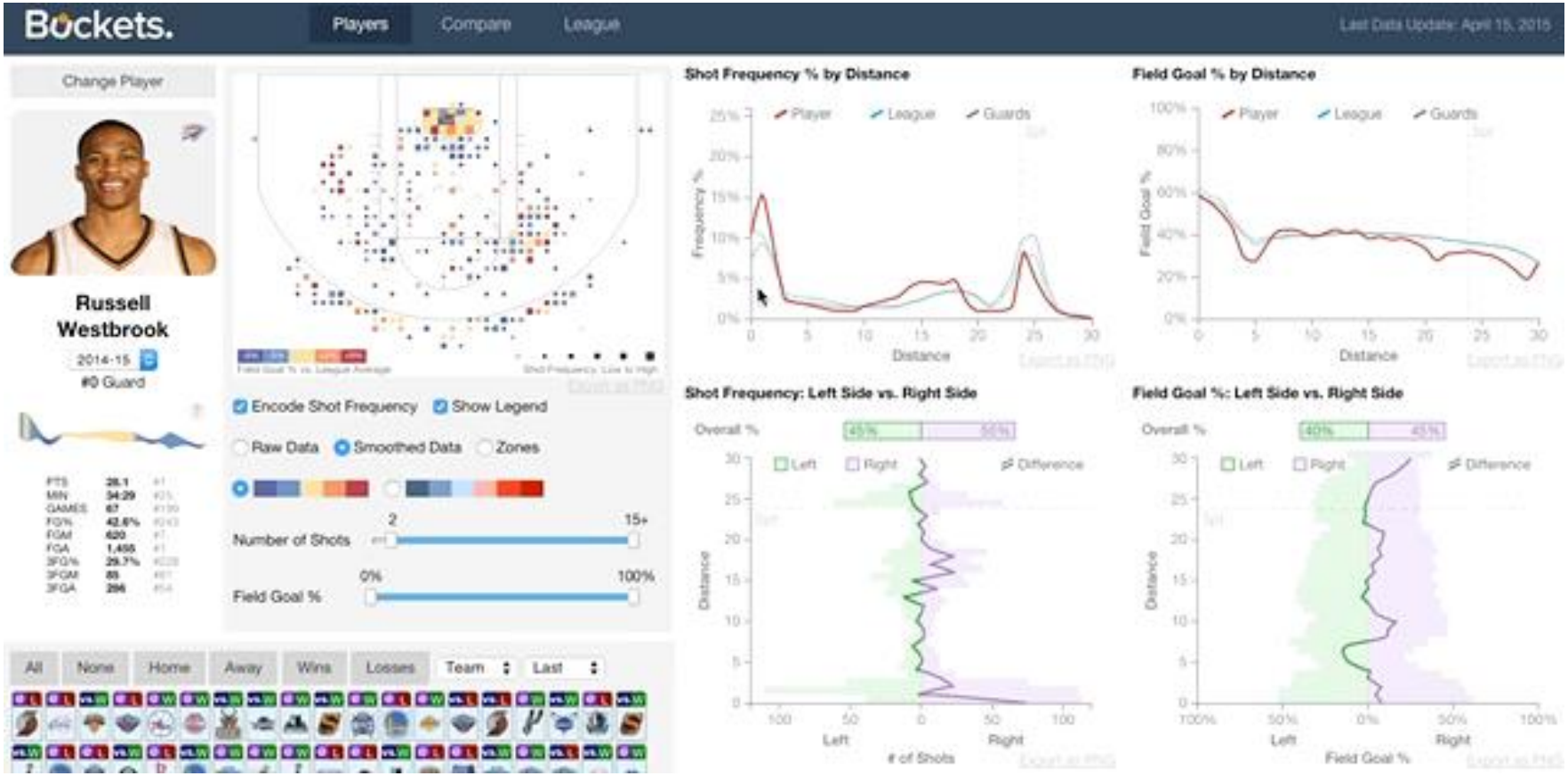




LINKED HIGHLIGHTING



MULTIDIRECTIONAL LINKING



https://buckets.peterbeshai.com/app/#/playerView/201935_2015

MULTIFORM

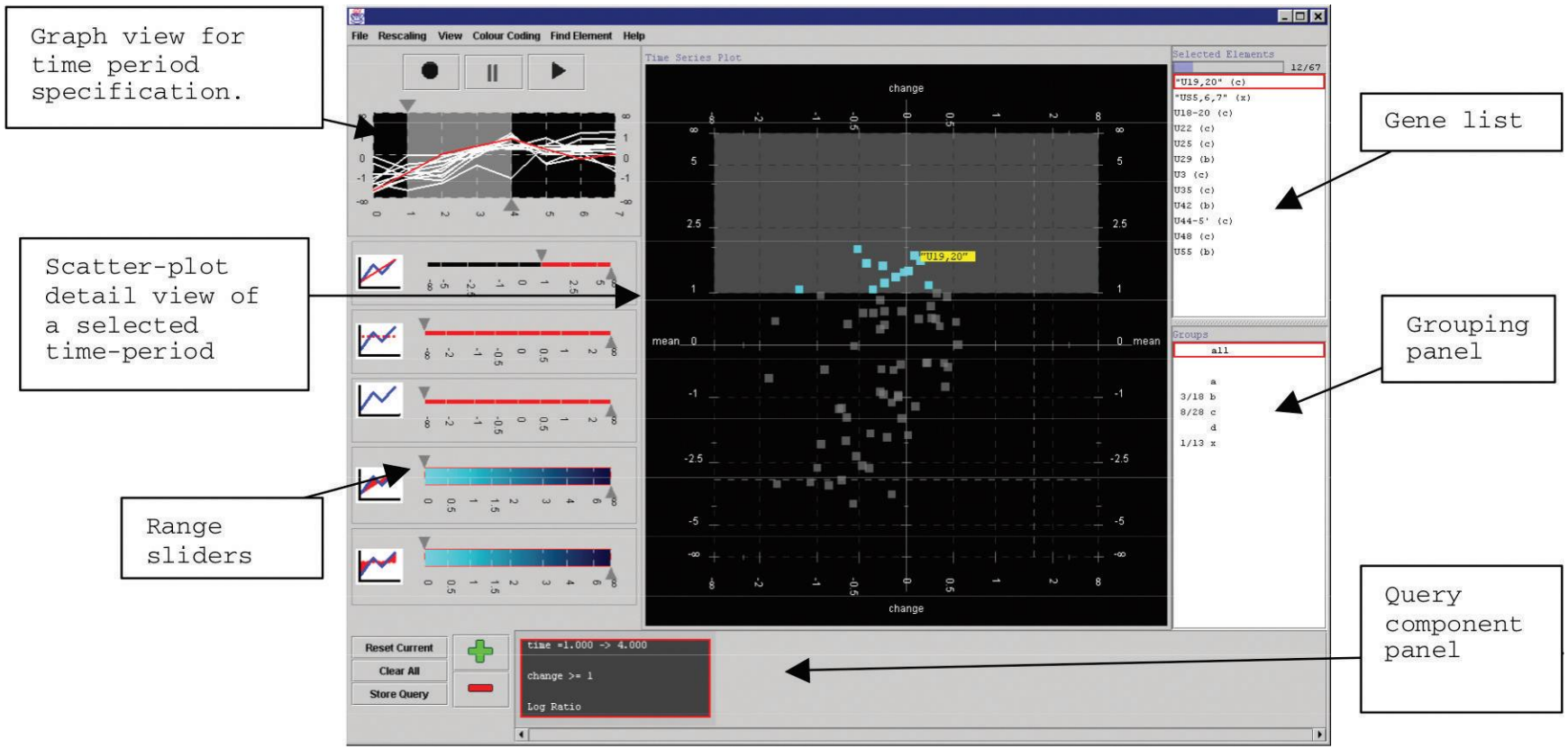
Different visual encodings are used between views

- shared data: either all data, or subset of data (overview + detail)

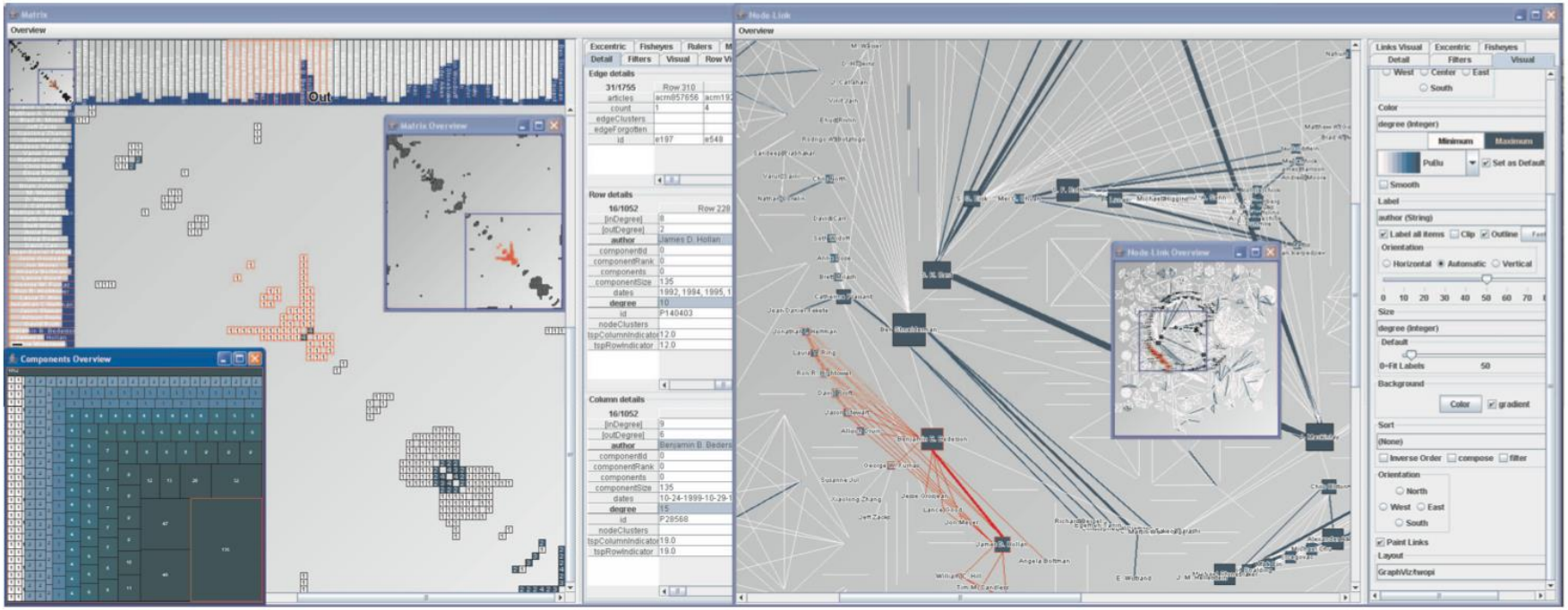
Rational:

- Single view has strong limits on the numbers of attributes that can be shown simultaneously
- Different views support different tasks

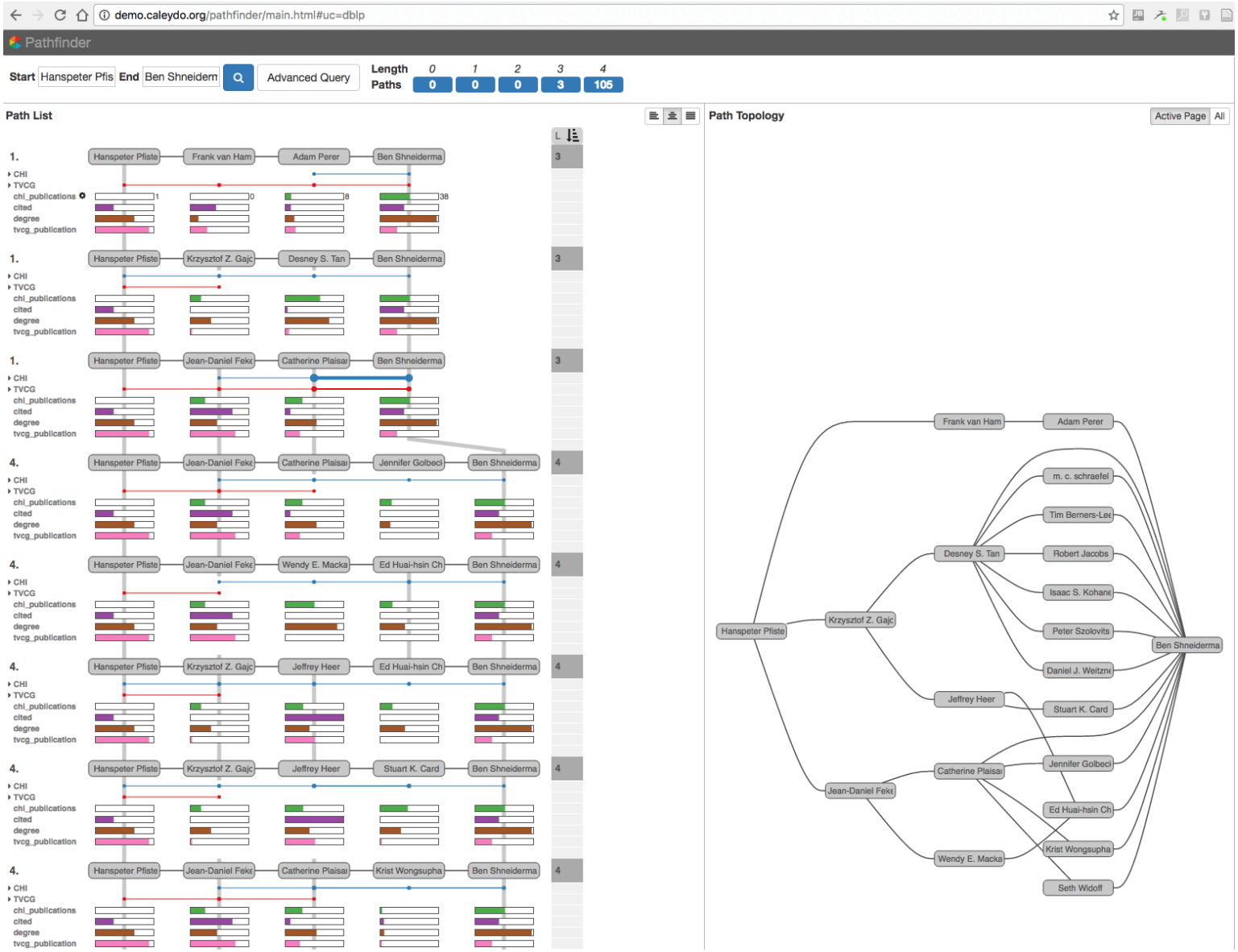
MULTIFORM OVERVIEW-DETAIL



MATRIX EXPLORER



MULTIFORM


demo.caleydo.org/pathfinder/main.html#uc=dblp
Pathfinder
Start Hanspeter Pfis End Ben Shneiderm
Advanced Query
Length 0 1 2 3 4
Paths 0 0 0 3 105
Path List
Path Topology
Active Page
All
Hanspeter Pfiste
Frank van Ham
Adam Perer
Ben Shneiderma
Krzysztof Z. Gajc
Desney S. Tan
Jean-Daniel Feke
Catherine Plaisa
Jennifer Golbeck
Wendy E. Macka
Ed Huai-hsin Ch
Jeffrey Heer
Stuart K. Card
Krist Wongsupha
m. c. schraefel
Tim Berners-Lee
Robert Jacobs
Isaac S. Kohane
Peter Szolovits
Daniel J. Weitzne
Seth Widoff
CHI
TVCG
chi_publications
cited
degree
tvcg_publication

OVERVIEW + DETAIL

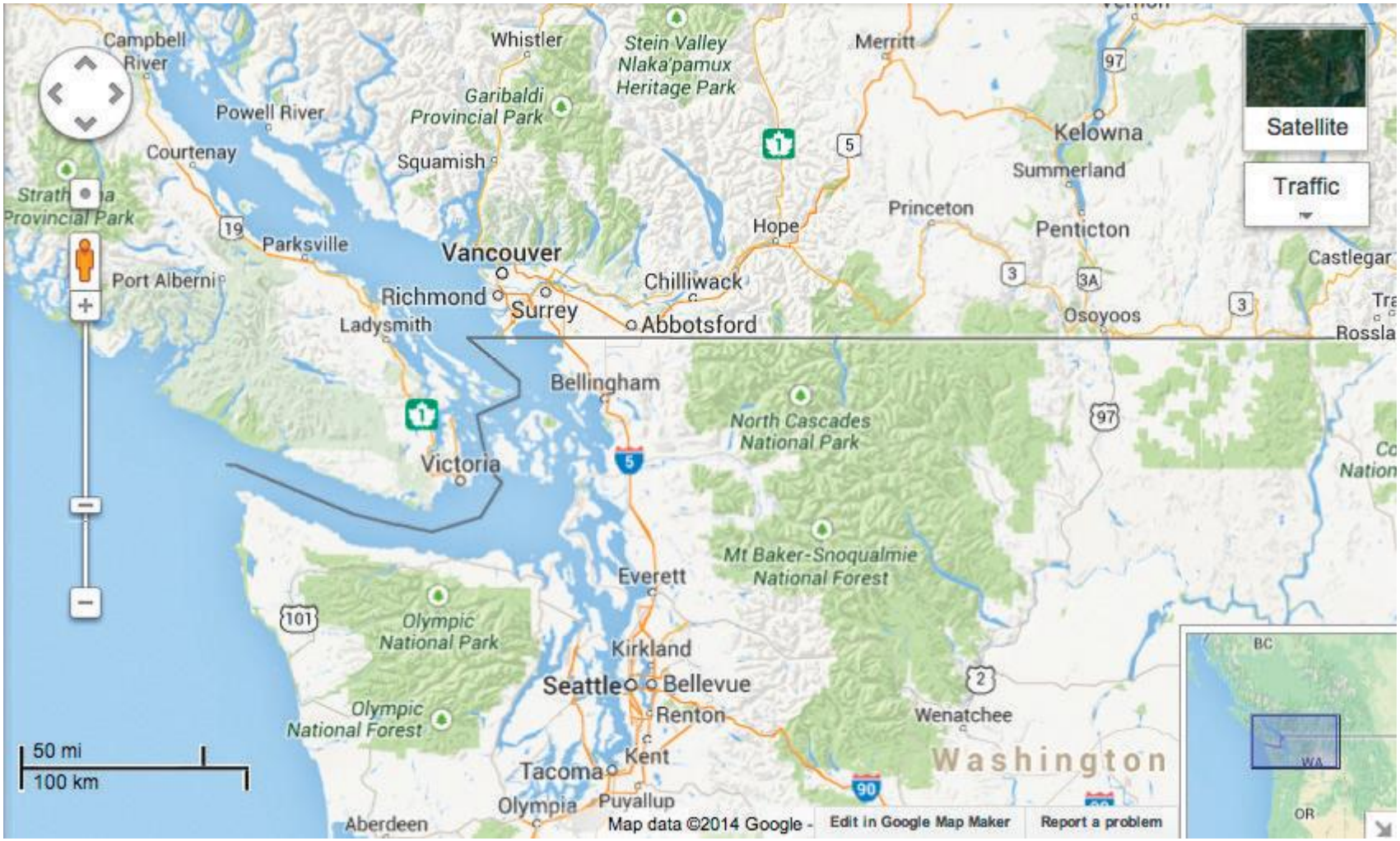
One view shows (often summarized) information about entire dataset

Additional view(s) show more detailed information about a subset of the data

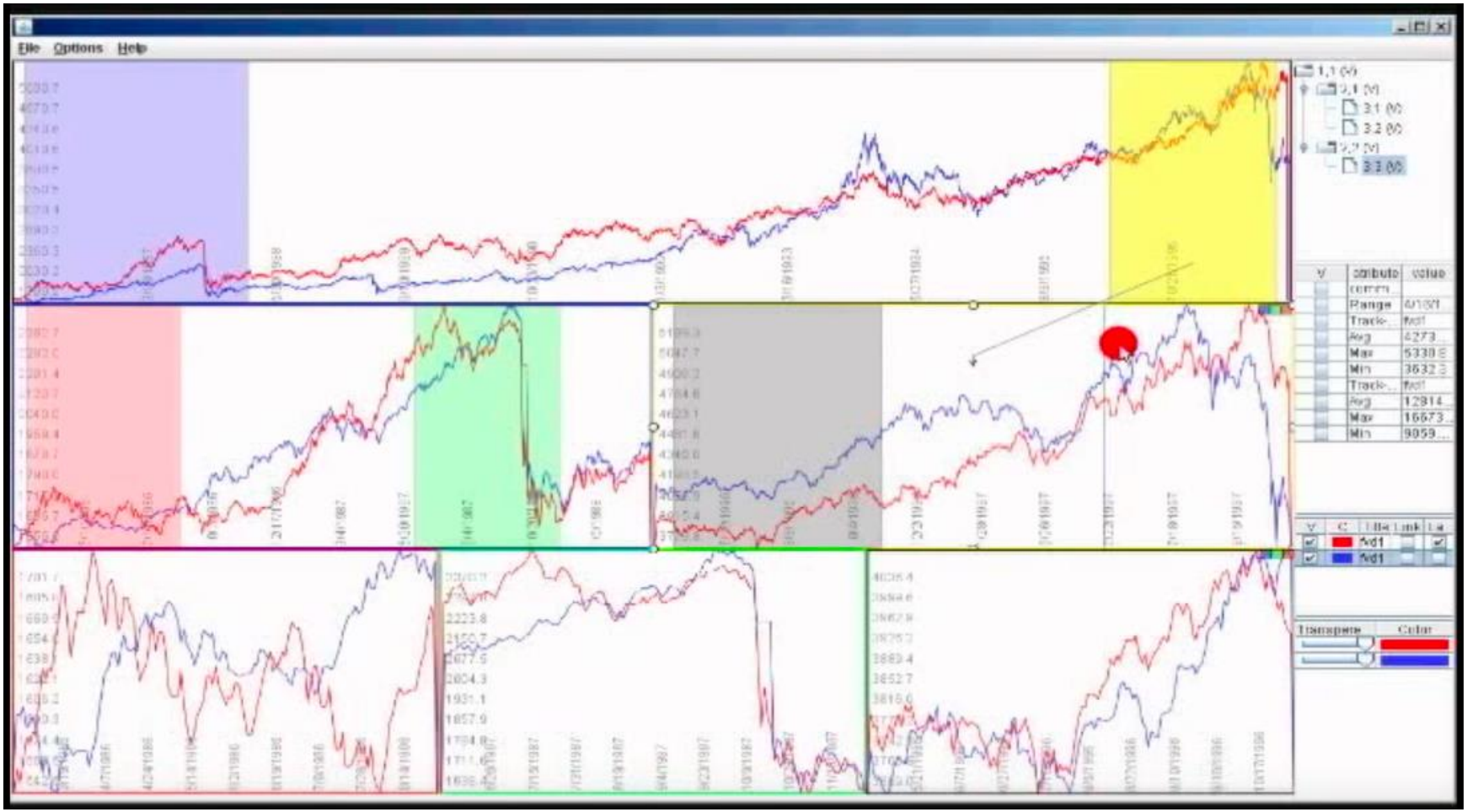
Rational:

For large or complex data, a single view of the entire dataset cannot capture fine details

MULTIFORM: OVERVIEW-DETAIL



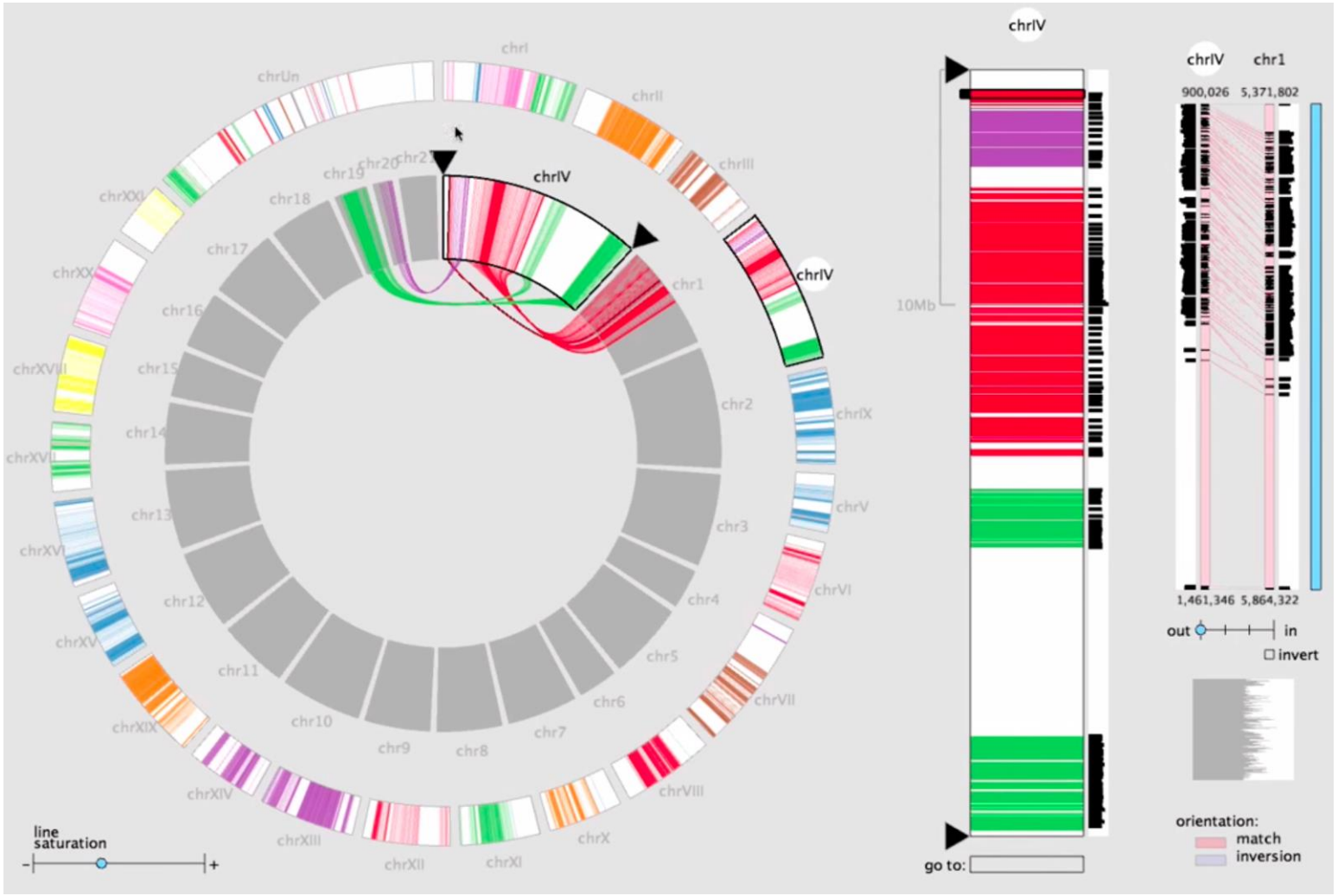
STACK ZOOMING



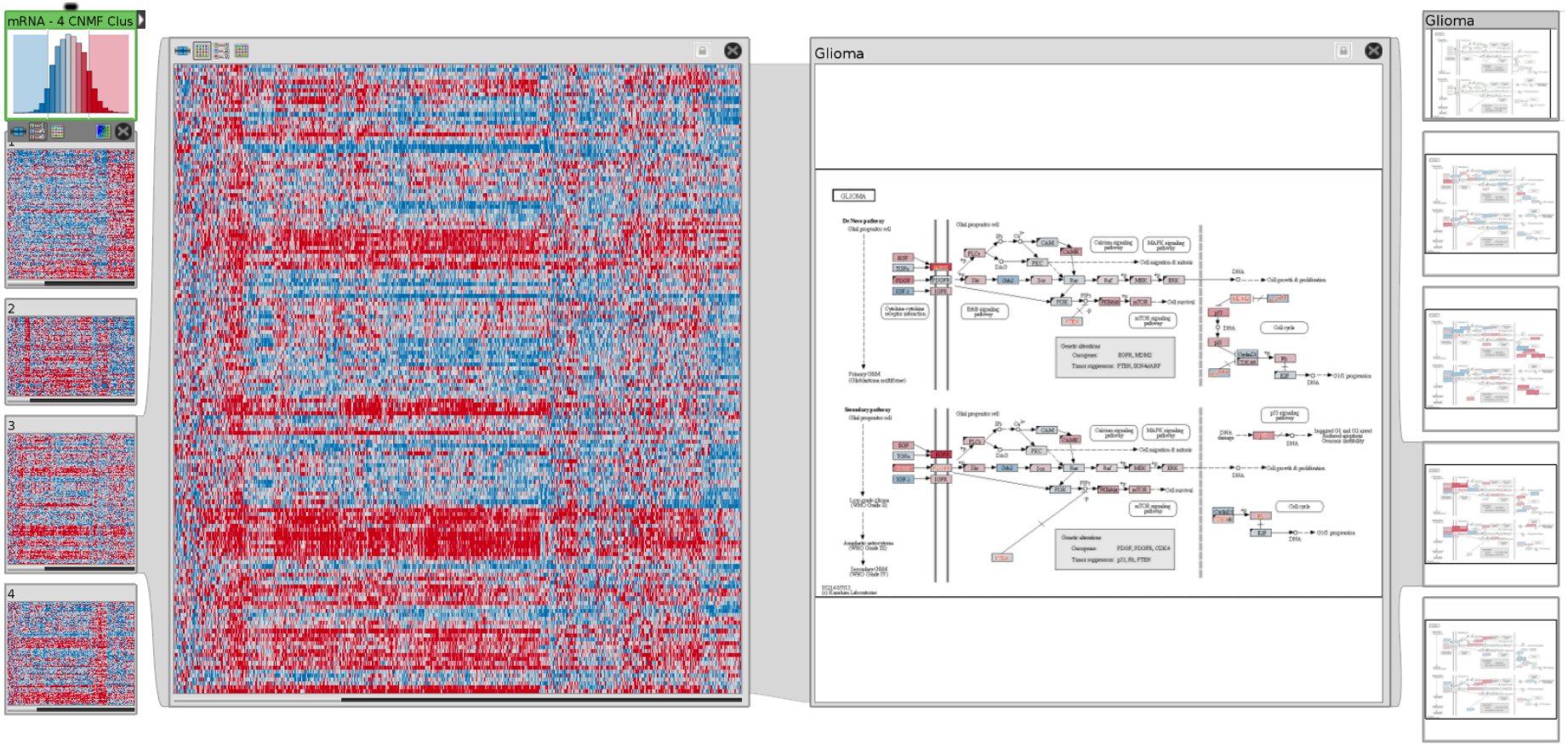
Same Data - Same Encoding, Different Resolution

[Javed & Emlqvist, PacificVis, 2010]

MIZBEE


chrI
chrII
chrIII
chrIV
chrV
chrVI
chrVII
chrVIII
chrIX
chrX
chrXI
chrXII
chrXIII
chrXIV
chrXV
chrXVI
chrXVII
chrXVIII
chrXIX
chrXX
chrXXI
chrUn
chr1
chr2
chr3
chr4
chr5
chr6
chr7
chr8
chr9
chr10
chr11
chr12
chr13
chr14
chr15
chr16
chr17
chr18
chr19
chr20
chr21
line saturation
-
+
chrIV
10Mb
go to:
chrIV
chr1
900,026
5,371,802
1,461,346
5,864,322
out
in
invert
orientation:
match
inversion

STRATOMEX



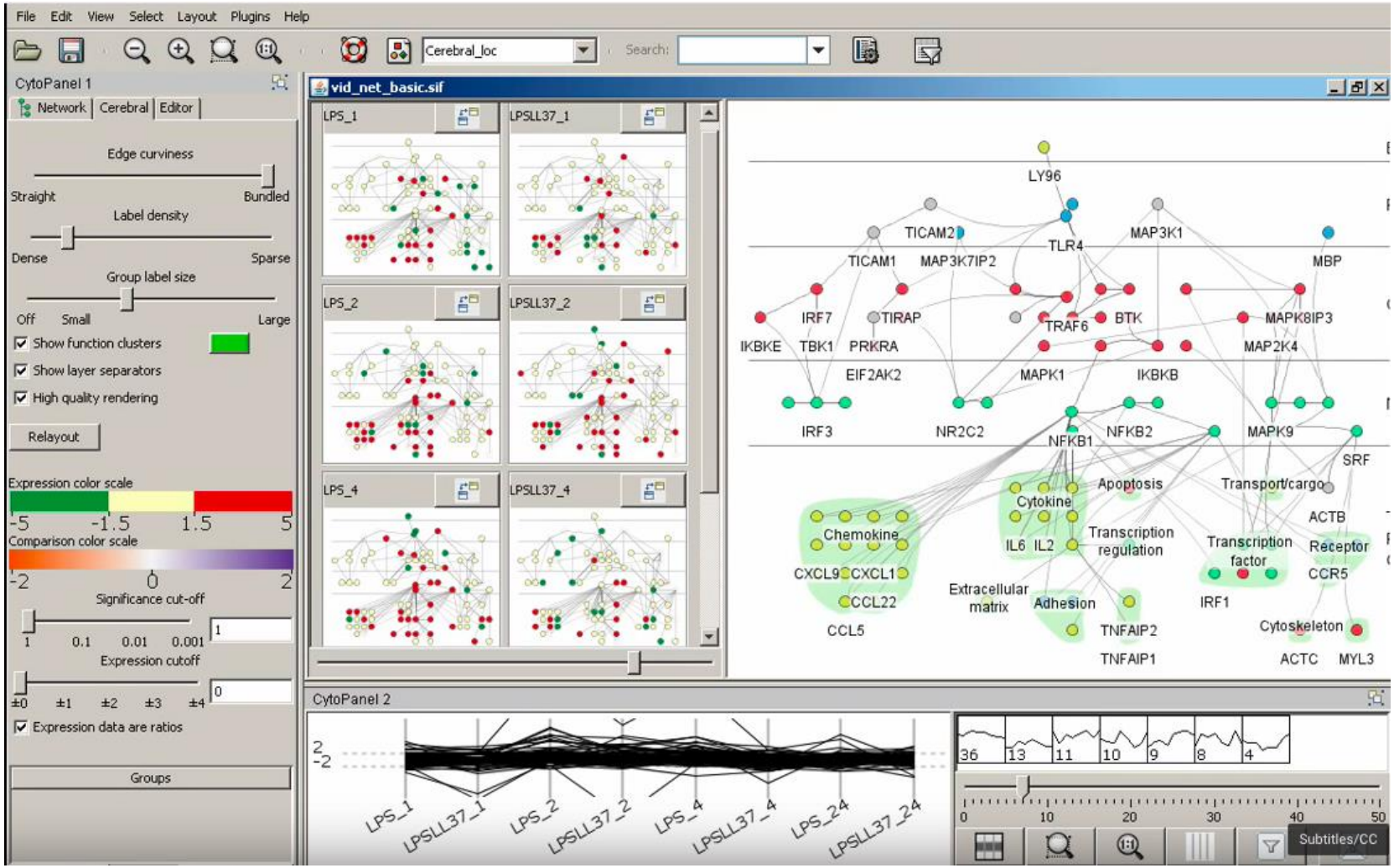
SMALL MULTIPLES

Each view uses the same visual encoding, but shows a different subset of the data

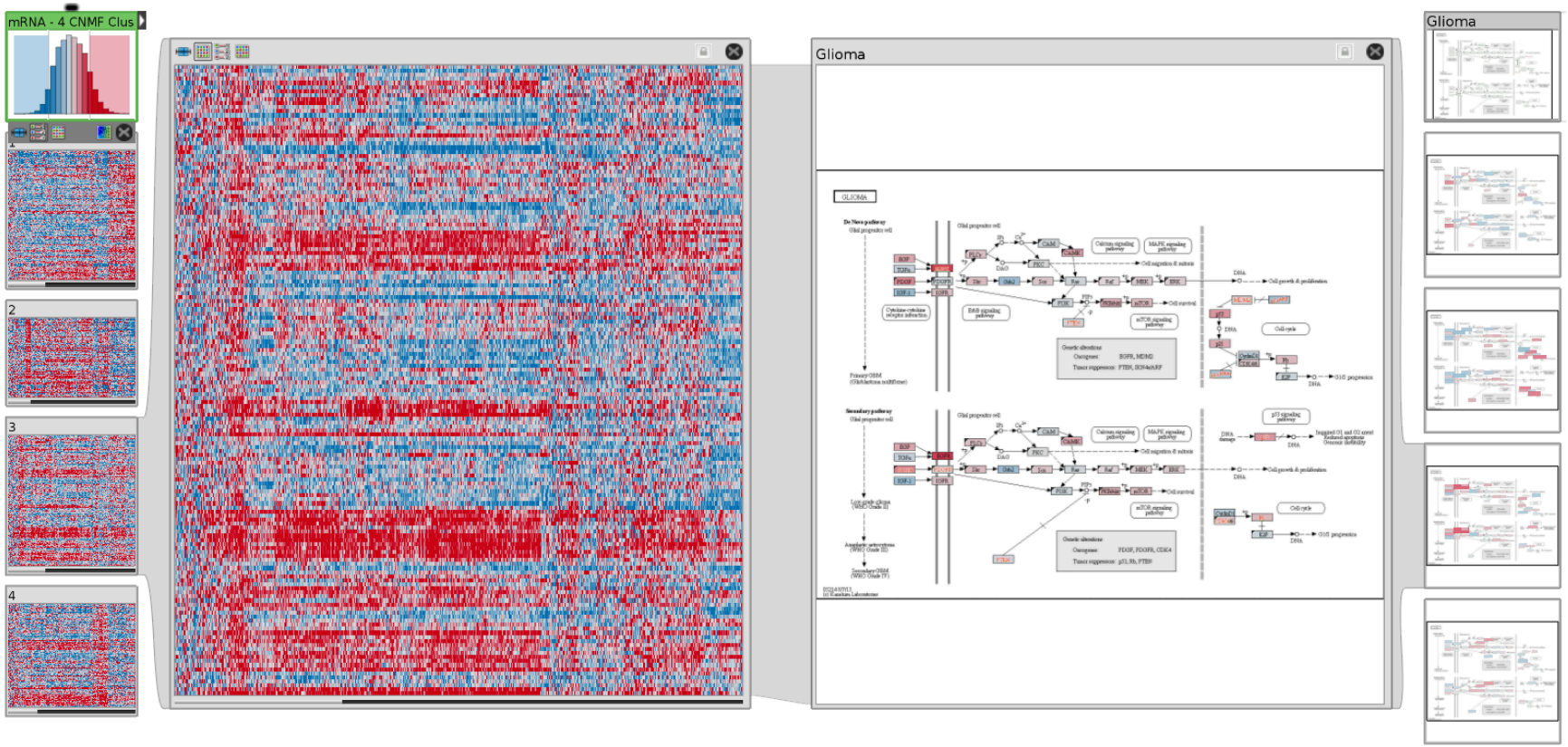
Rational:

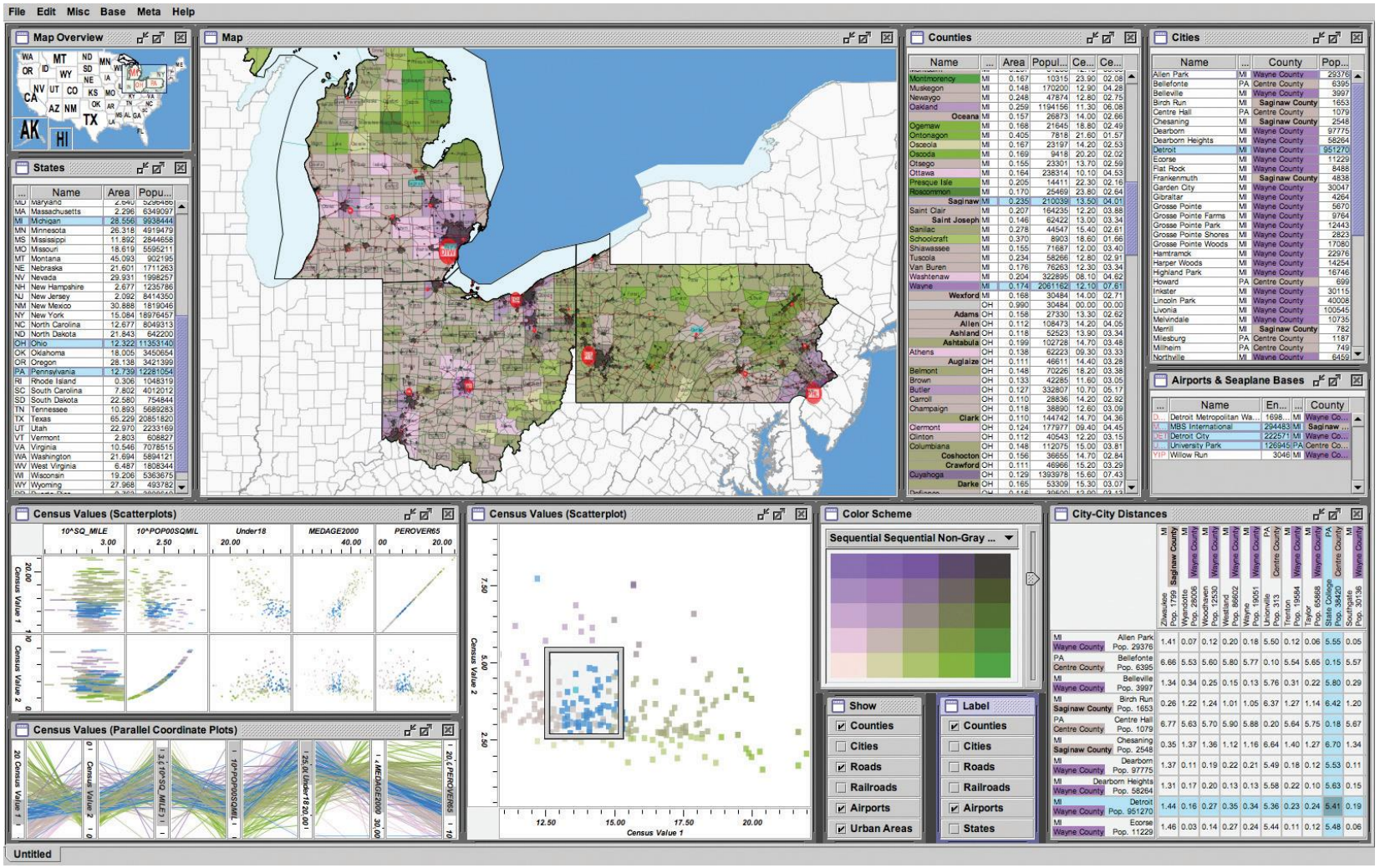
Quickly compare different parts of a dataset, relying on eyes instead of memory

SMALL MULTIPLES FOR GRAPH ATTRIBUTES

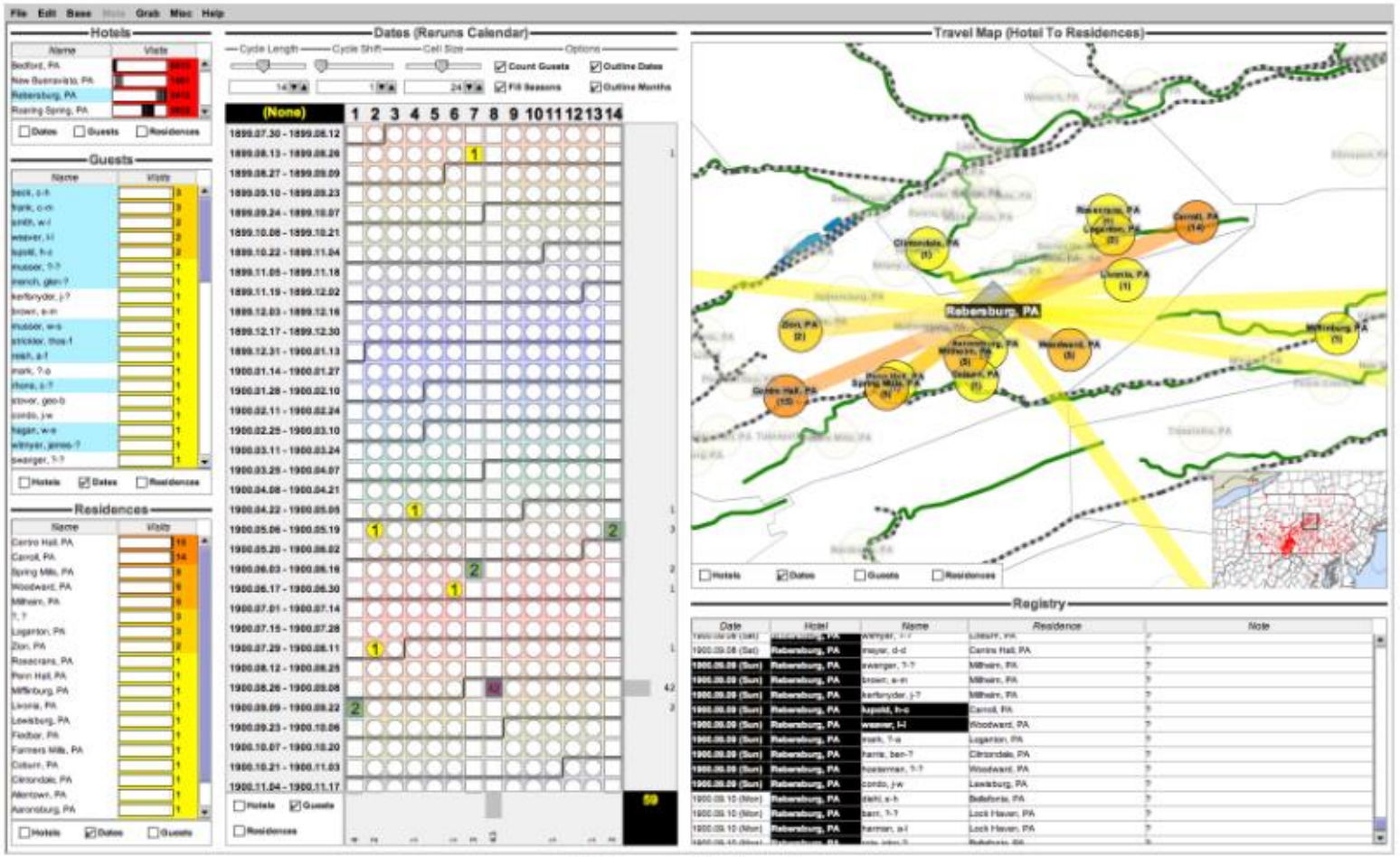


STRATOMEX




File Edit Misc Base Meta Help
Map Overview
Map
Counties
Cities
States
Airports & Seaplane Bases
Census Values (Scatterplots)
Census Values (Scatterplot)
Color Scheme
Sequential Sequential Non-Gray ...
City-City Distances
Census Values (Parallel Coordinate Plots)
Show
Counties
Cities
Roads
Railroads
Airports
Urban Areas
Label
Counties
Cities
Roads
Railroads
Airports
States
Census Value 1
Census Value 2
Untitled

VISUAL ANALYSIS OF HISTORICAL HOTEL VISITATION PATTERNS



Click image for full-size version.

https://www.youtube.com/watch?v=Tzsv6wkZoiQ

PARTITIONING

PARTITIONING

Action on the dataset that separates the data into groups

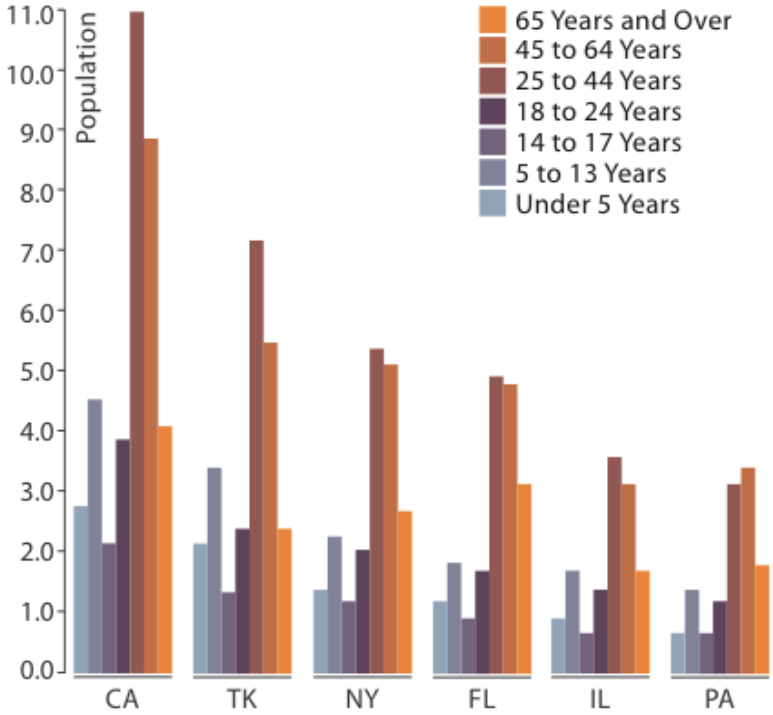
Design choices

- How to divide data up between views, given a hierarchy of attributes
- How many splits, and order of splits
- How many views (usually data driven)

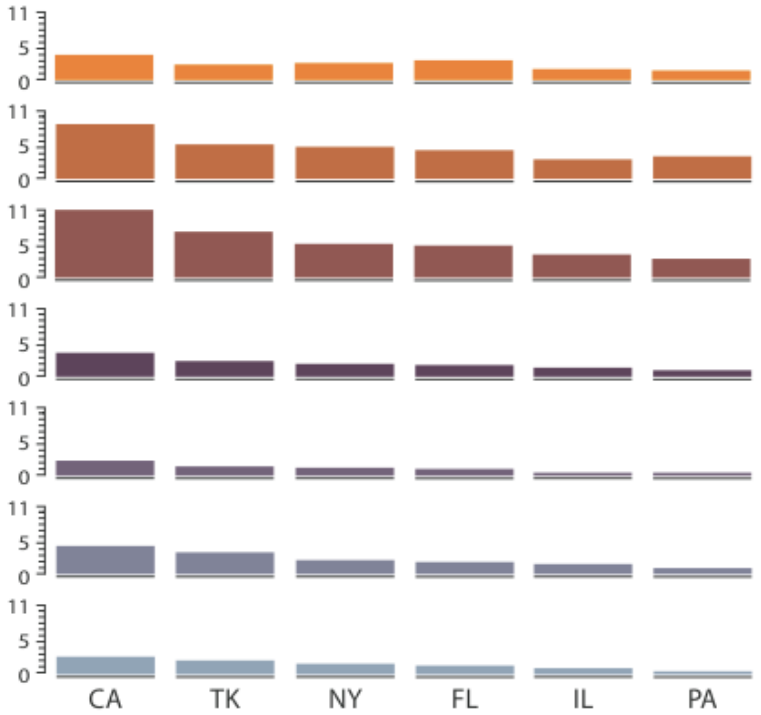
Partition attribute(s)

Typically categorical

AGE DISTRIBUTION BY STATE



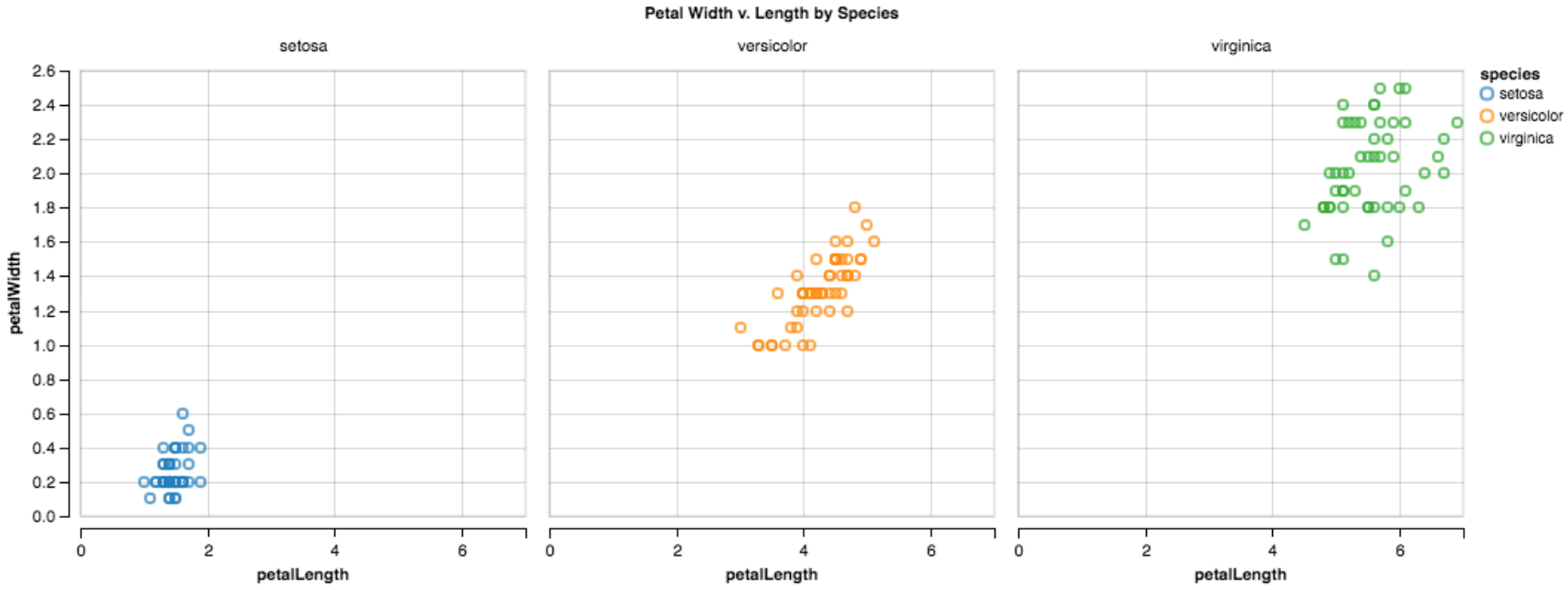
Partitioned by State



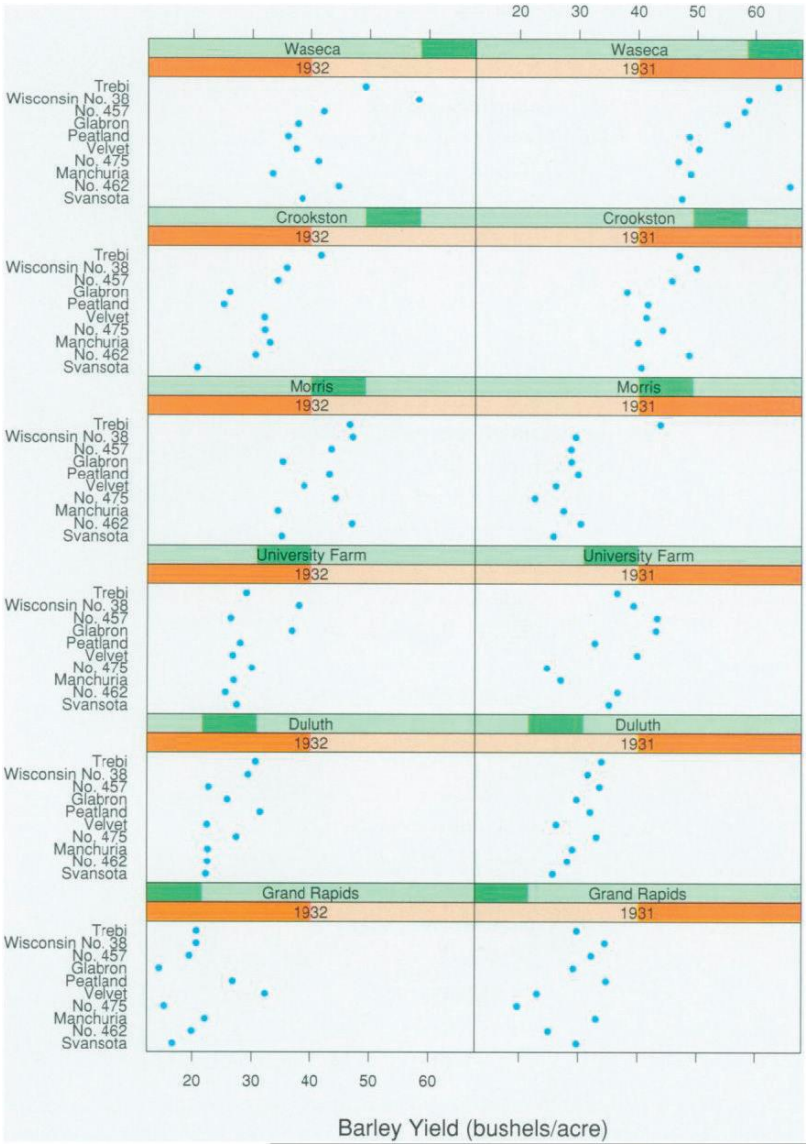
Partitioned by Age Group and State

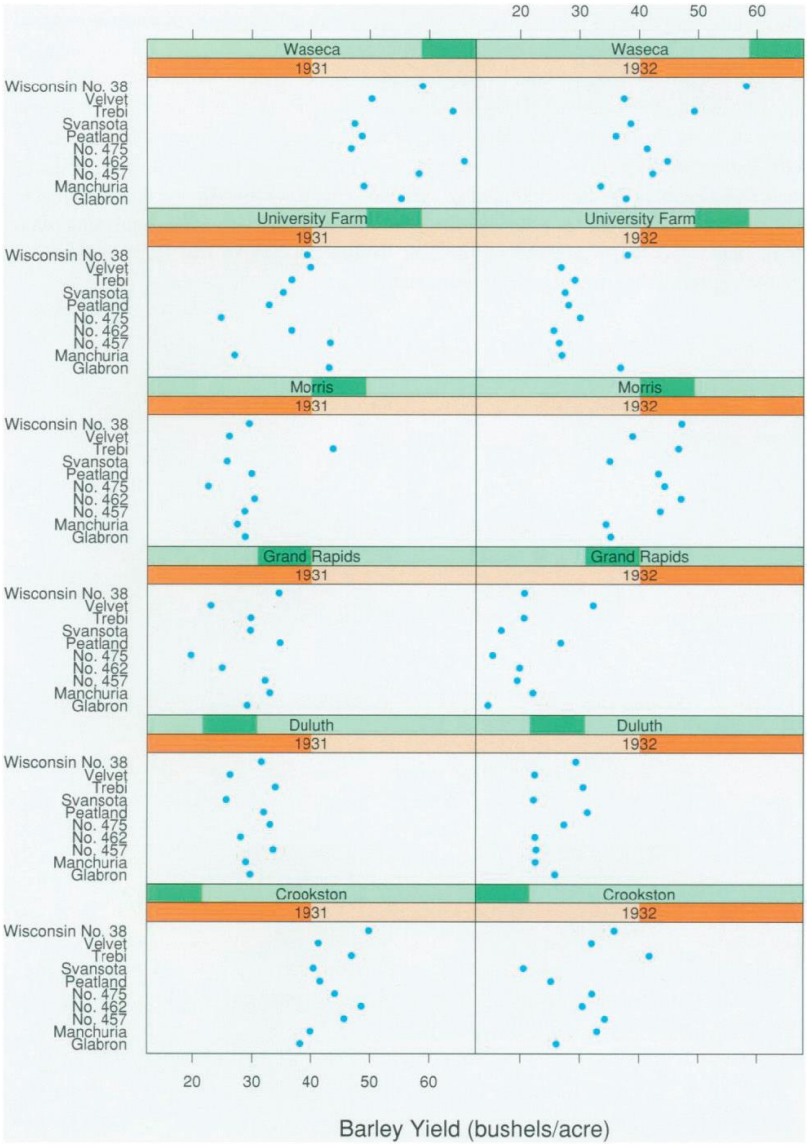
https://bl.ocks.org/mbostock/4679202

PARTITION BY CATEGORY



TRELLIS


Waseca 1932
Waseca 1931
Crookston 1932
Crookston 1931
Morris 1932
Morris 1931
University Farm 1932
University Farm 1931
Duluth 1932
Duluth 1931
Grand Rapids 1932
Grand Rapids 1931
Trebi
Wisconsin No. 38
No. 457
Glabron
Peatland
Velvet
No. 475
Manchuria
No. 462
Svansota
20 30 40 50 60
Barley Yield (bushels/acre)


Waseca 1931
Waseca 1932
University Farm 1931
University Farm 1932
Morris 1931
Morris 1932
Grand Rapids 1931
Grand Rapids 1932
Duluth 1931
Duluth 1932
Crookston 1931
Crookston 1932
Wisconsin No. 38
Velvet
Trebi
Svansota
Peatland
No. 475
No. 462
No. 457
Manchuria
Glabron
20 30 40 50 60
Barley Yield (bushels/acre)

TRELLIS PLOTS

panel variables

attributes encoded in individual views

partitioning variables

partitioning attributes assigned to columns and rows

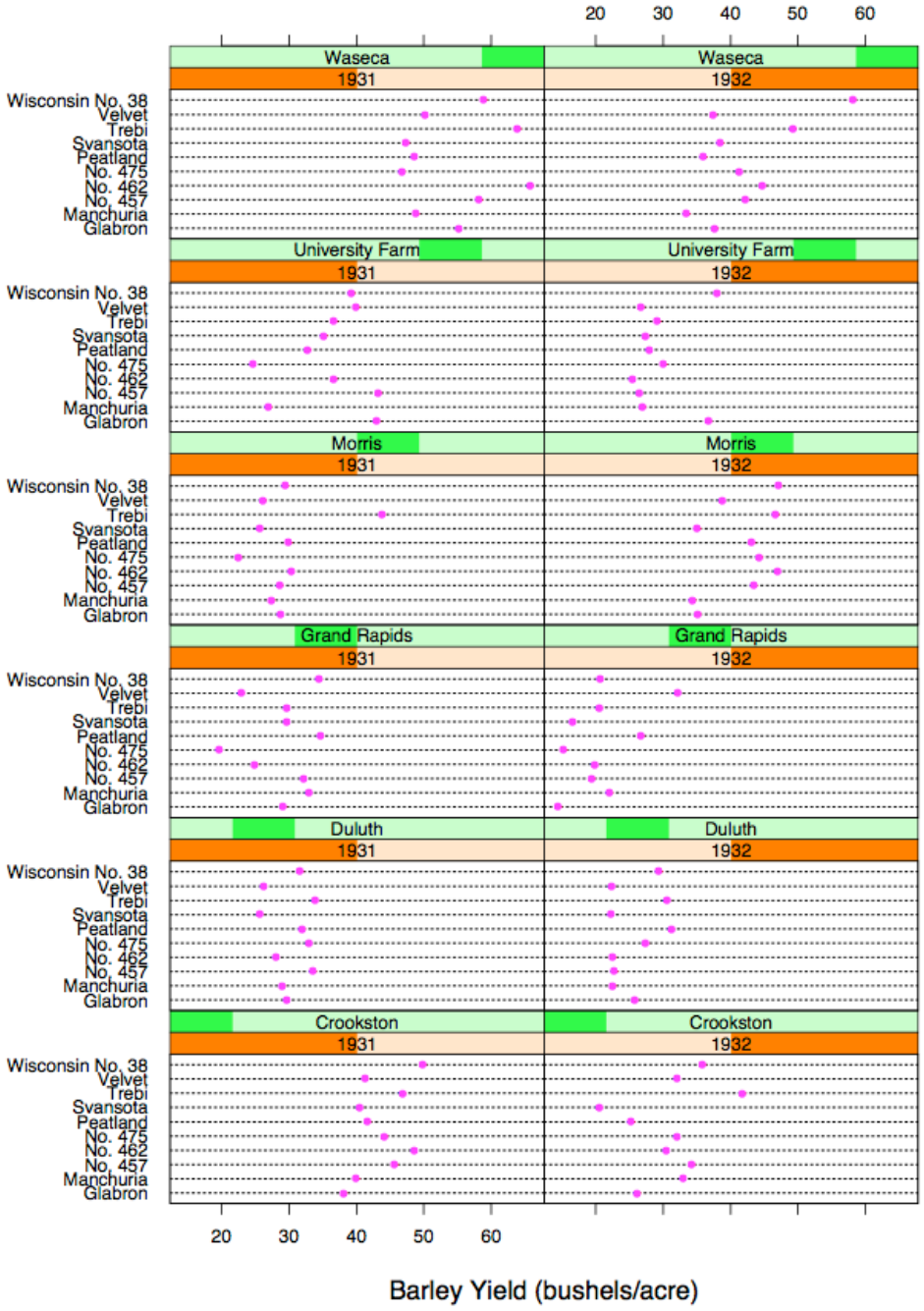
main-effects ordering

order partitioning variable based on derived data

support perception of trends and structure in data

Data
Barley Yields in two years across multiple farms for multiples barley strains

partitioning variables
Columns partitioned by year
Rows partitioned by farm

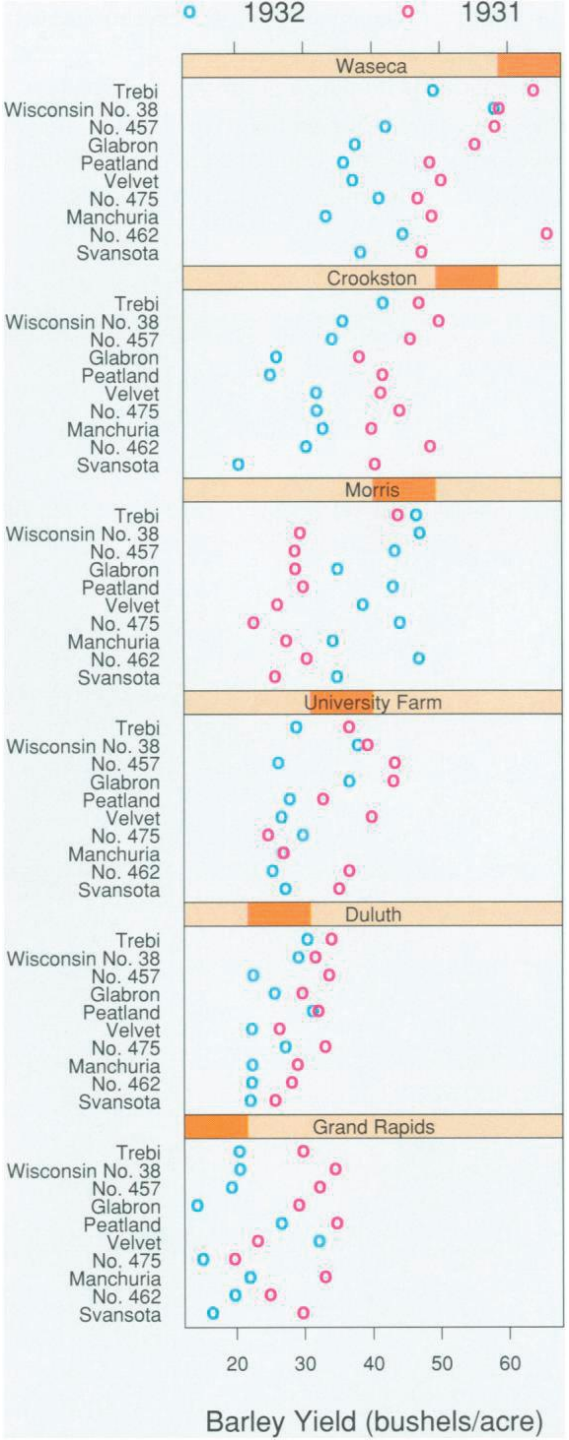


TRELLIS

Years in a single plot with year encoded by color

Showing strong evidence of an anomaly in the data

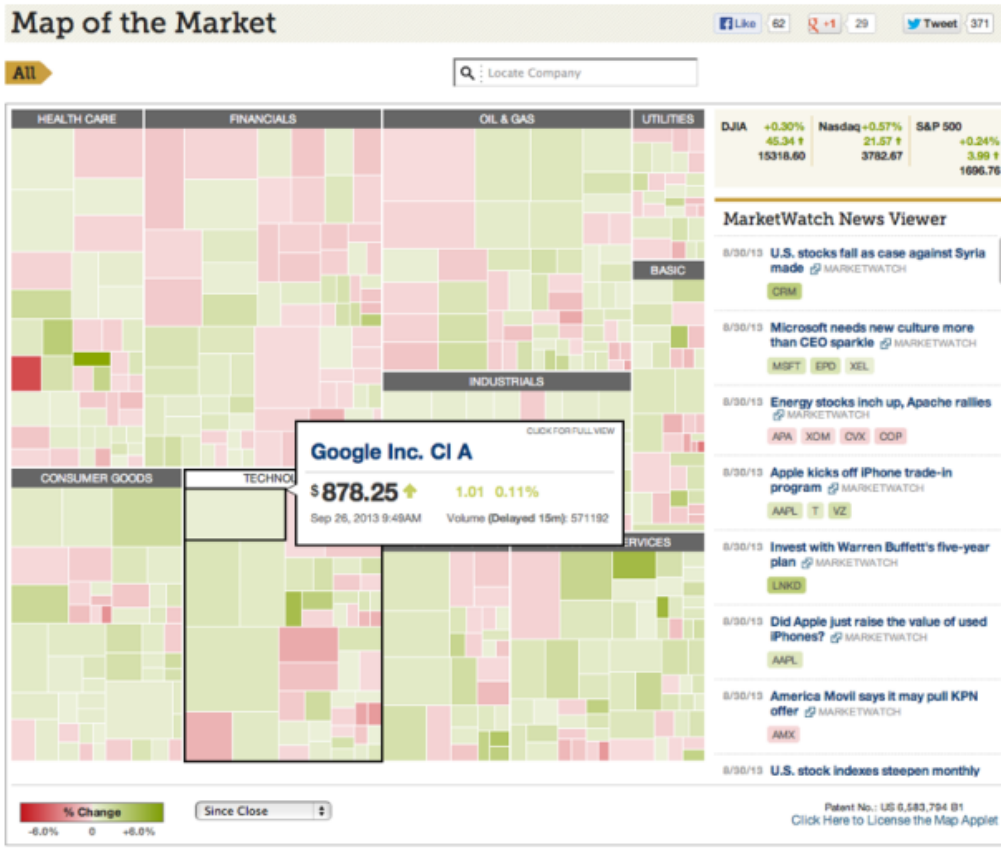
(the 3rd part)



RECURSIVE SUBDIVISION

partitioning:

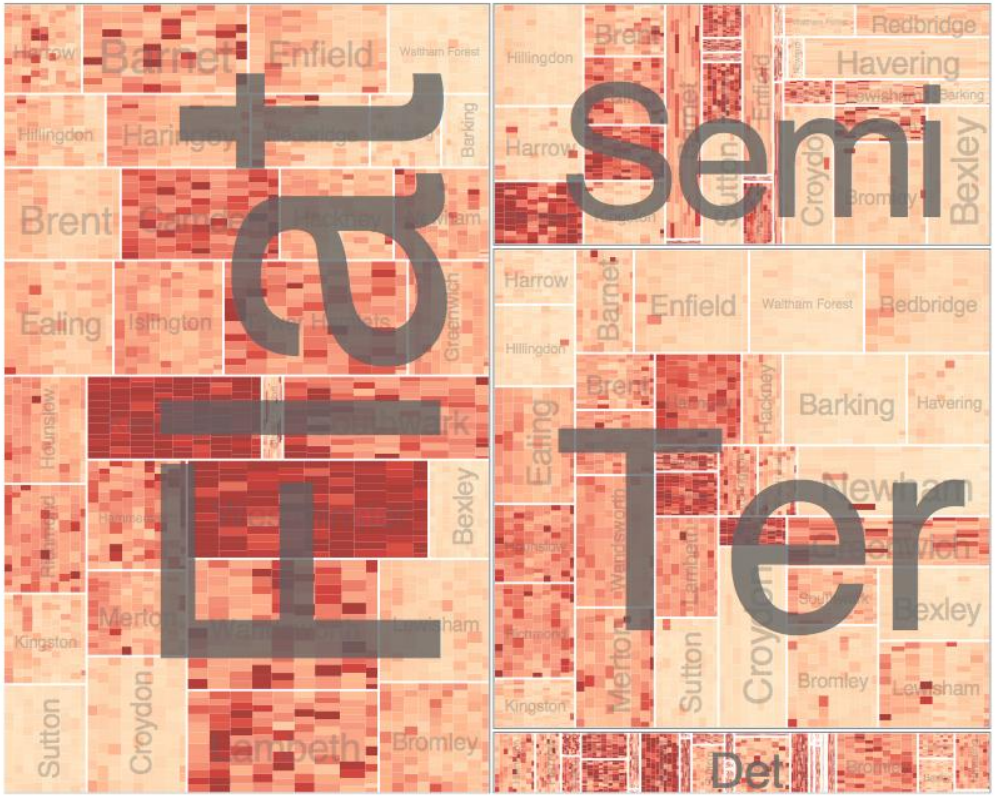
Flexibly transform data attributes into a hierarchy use **treemaps** as spacefilling rectangular layouts



Treemap

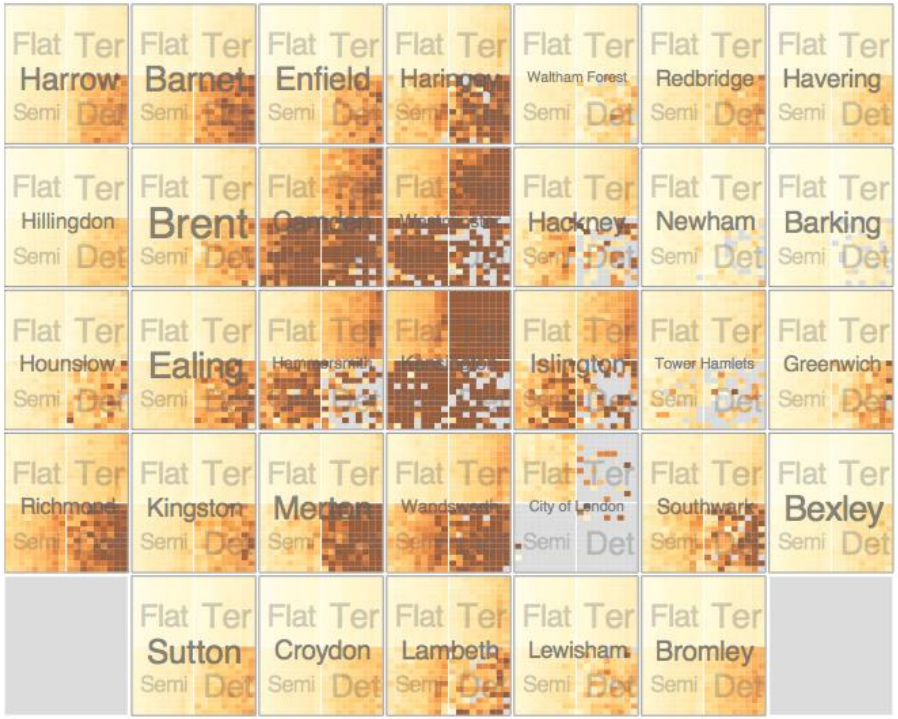
HIVE EXAMPLE: LONDON PROPERTY

partitioning attributes
house type
neighborhood
sale time
encoding attributes
average price (color)
number of sales (size)
results
between neighborhoods, different housing distributions
within neighborhoods, similar prices



HIVE EXAMPLE

partitioning attributes
neighborhood
house type
sale time (year)
sale time (month)
encoding attributes
neighborhood location (approximate)
average price (color)
n/a (size)
results
expensive neighborhoods near center of city



Configuring Hierarchical Layouts to Address Research Questions

Aidan Slingsby, Jason Dykes and Jo Wood
giCentre, Department of Information Science, City University London
http://www.gicentre.org/hierarchical_layouts/

https://vimeo.com/9870257

LAYERING

Combining multiple views on top of one another

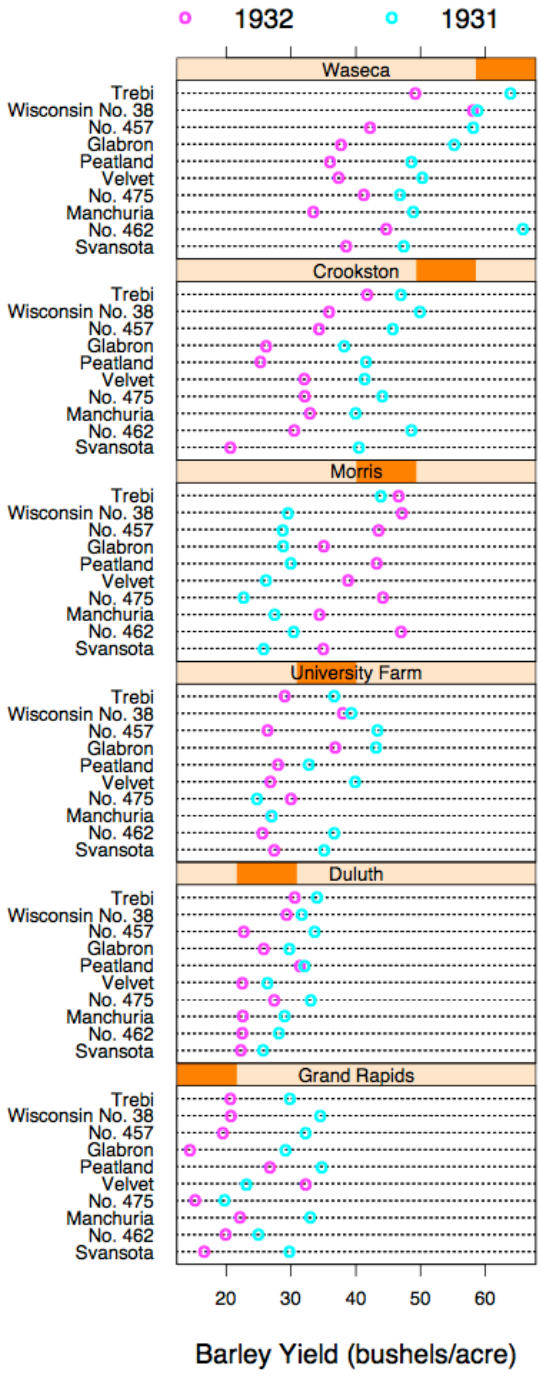
To form a composite view

Rational

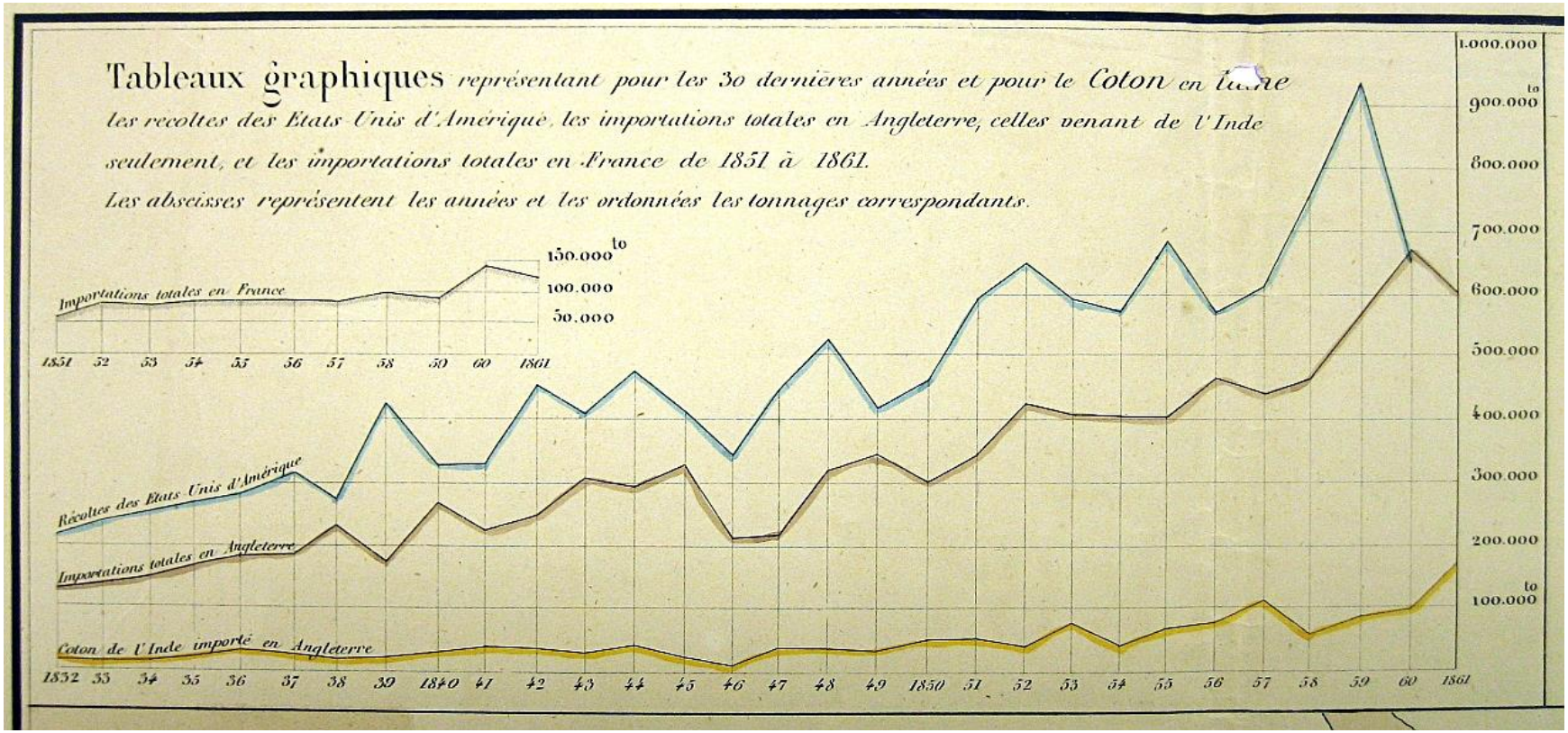
Supports a larger, more detailed view than using multiple views

Trade-off

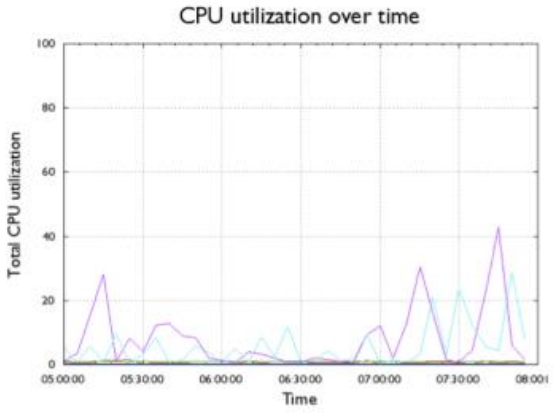
Layering imposes constraints on visual encoding choice as well as number of layers that can be shown

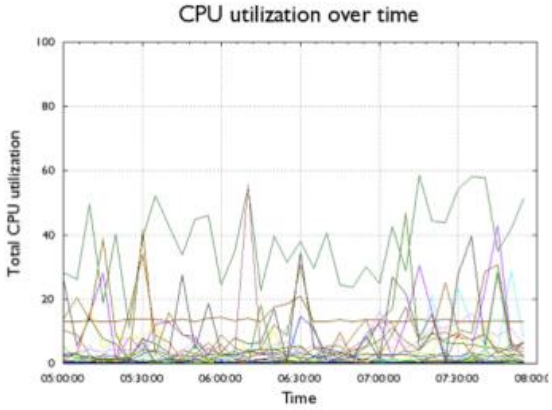


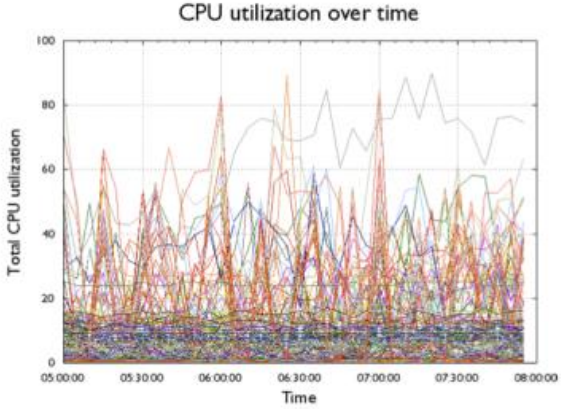
JOSEPH MINARD



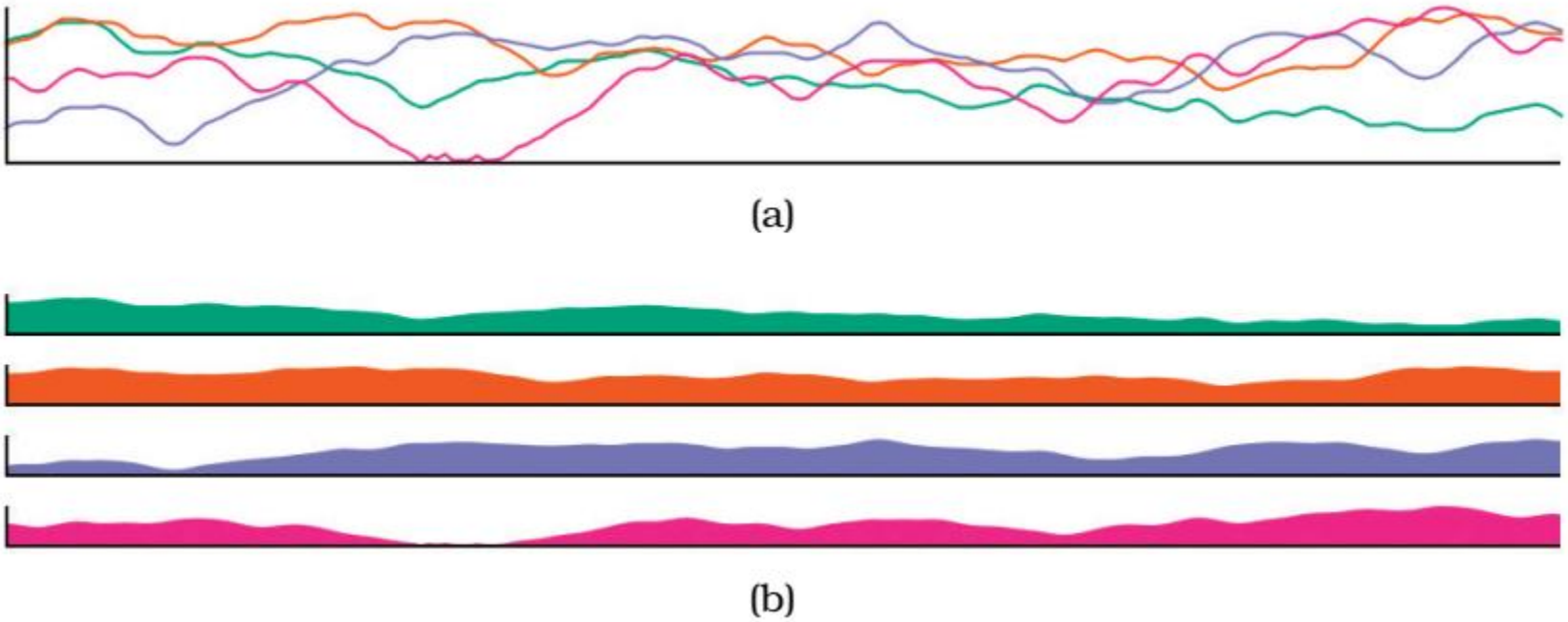
OVERLAYS


CPU utilization over time
Total CPU utilization
Time


CPU utilization over time
Total CPU utilization
Time


CPU utilization over time
Total CPU utilization
Time

SUPERIMPOSED VS JUXTAPOSED

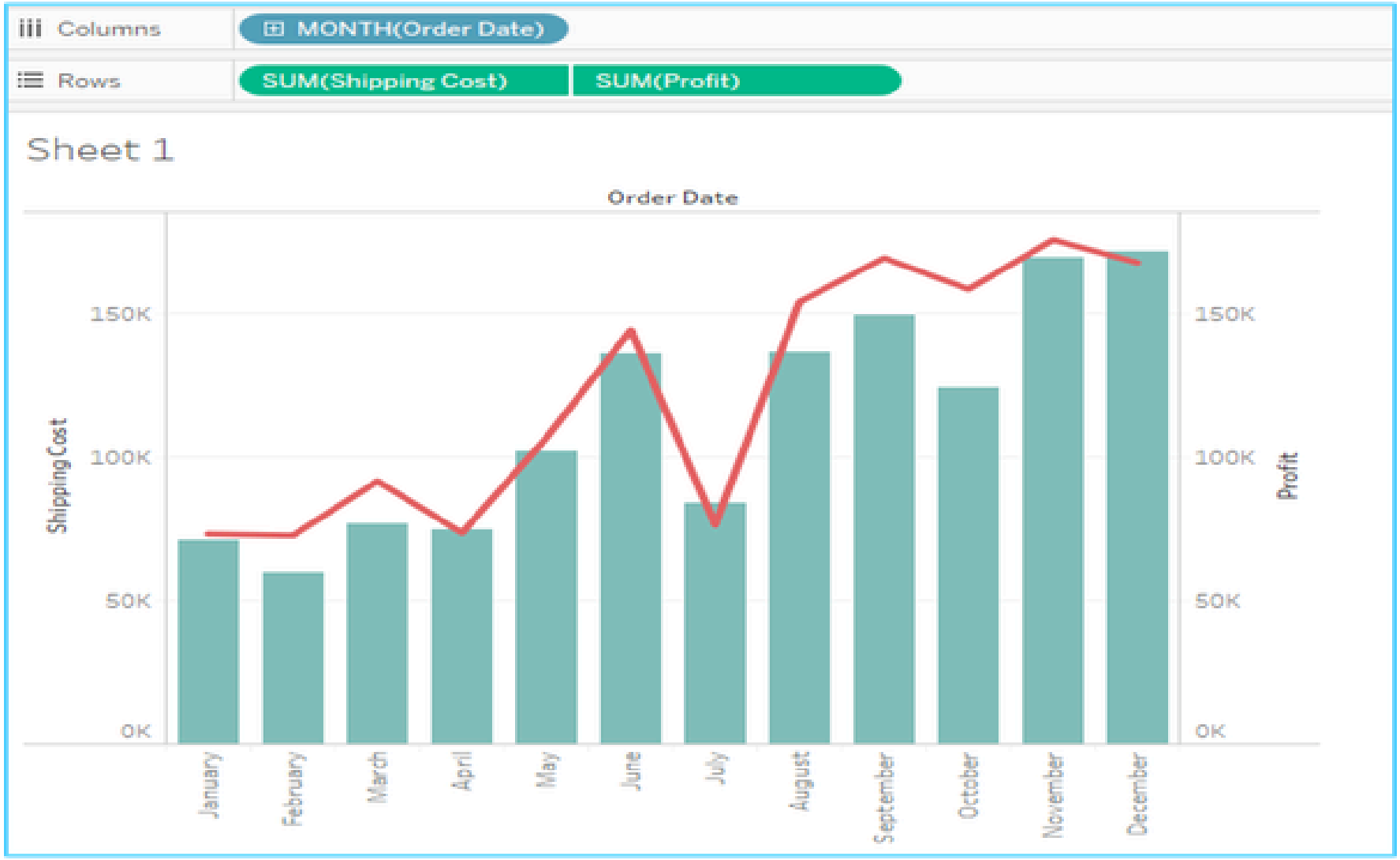


Empirical study comparing superimposed line charts to juxtaposed filled-area line charts. (a) Superimposed line charts performed best for tasks carried out within a local visual span. (b) Juxtaposed filled area charts were best for global tasks, especially as the number of time series increased.

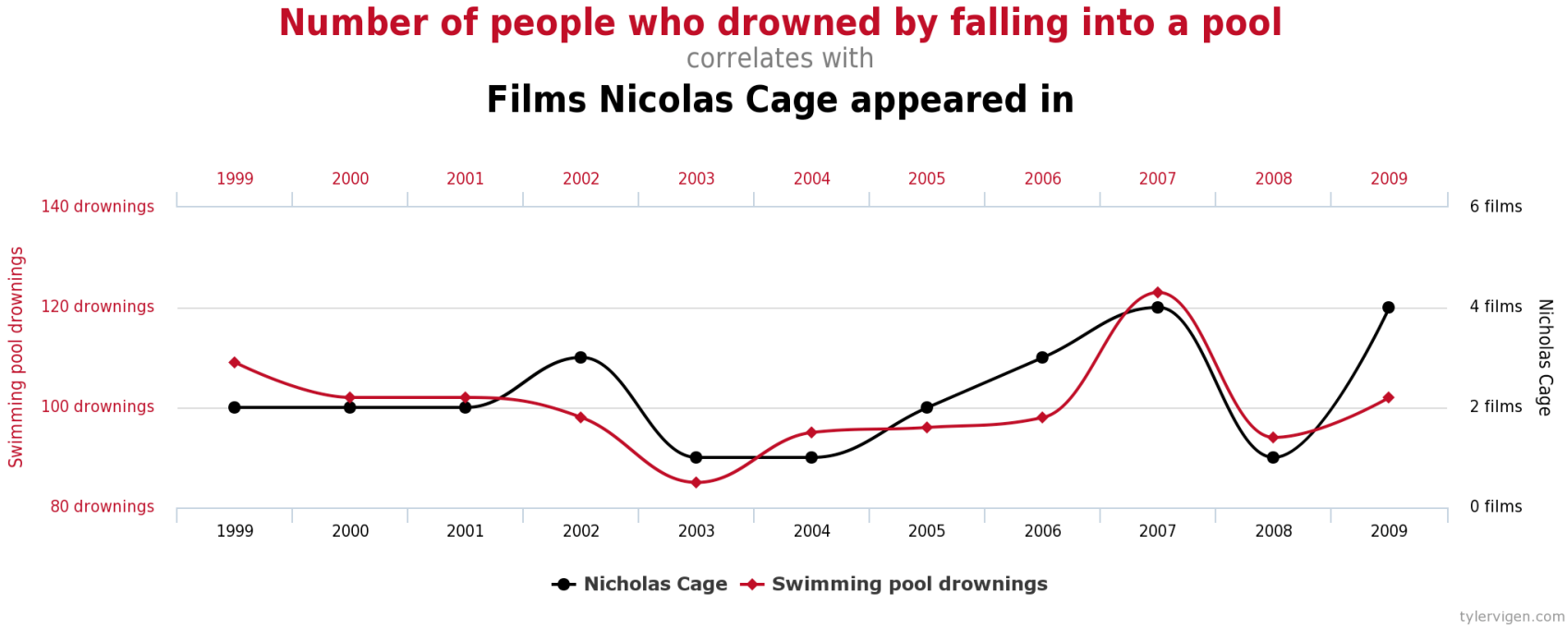
LAYERING


Petaluma
Tomales
1
Point Reyes Station
Point Reyes-Petaluma Rd
Novato Blvd
101
121
37
Novato
SAN PABLO BAY
Olema
Sir Francis Drake Boulevard
POINT REYES NATIONAL SEASHORE
San Rafael
80
580
1
PACIFIC OCEAN
Oakland
GOLDEN GATE
0
10 Kilometers
0
10 Miles
San Francisco

DUAL AXIS


Columns
MONTH(Order Date)
Rows
SUM(Shipping Cost)
SUM(Profit)
Sheet 1
Order Date
Shipping Cost
Profit
150K
100K
50K
0K
January
February
March
April
May
June
July
August
September
October
November
December

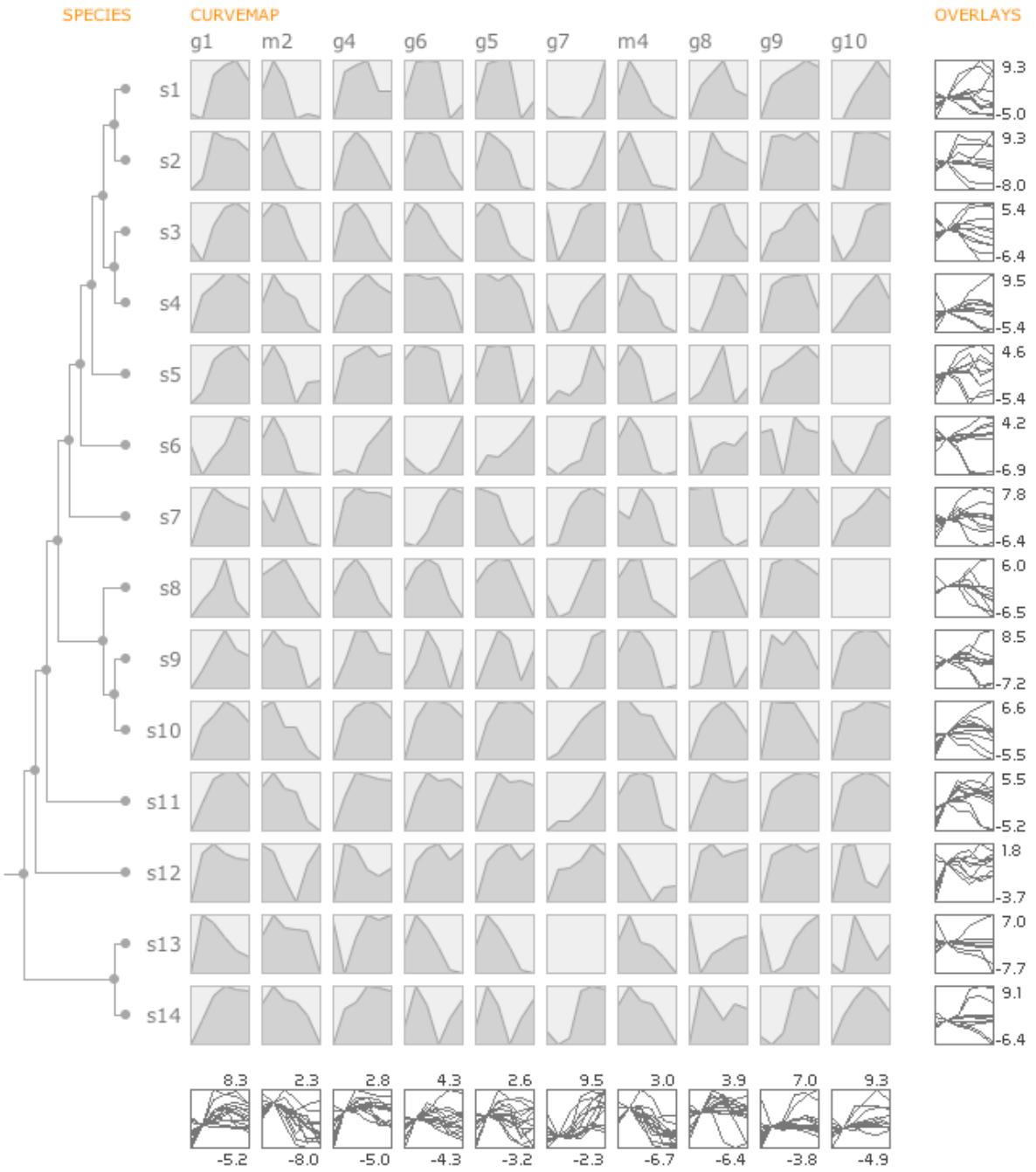
DUAL AXIS (DON'T)



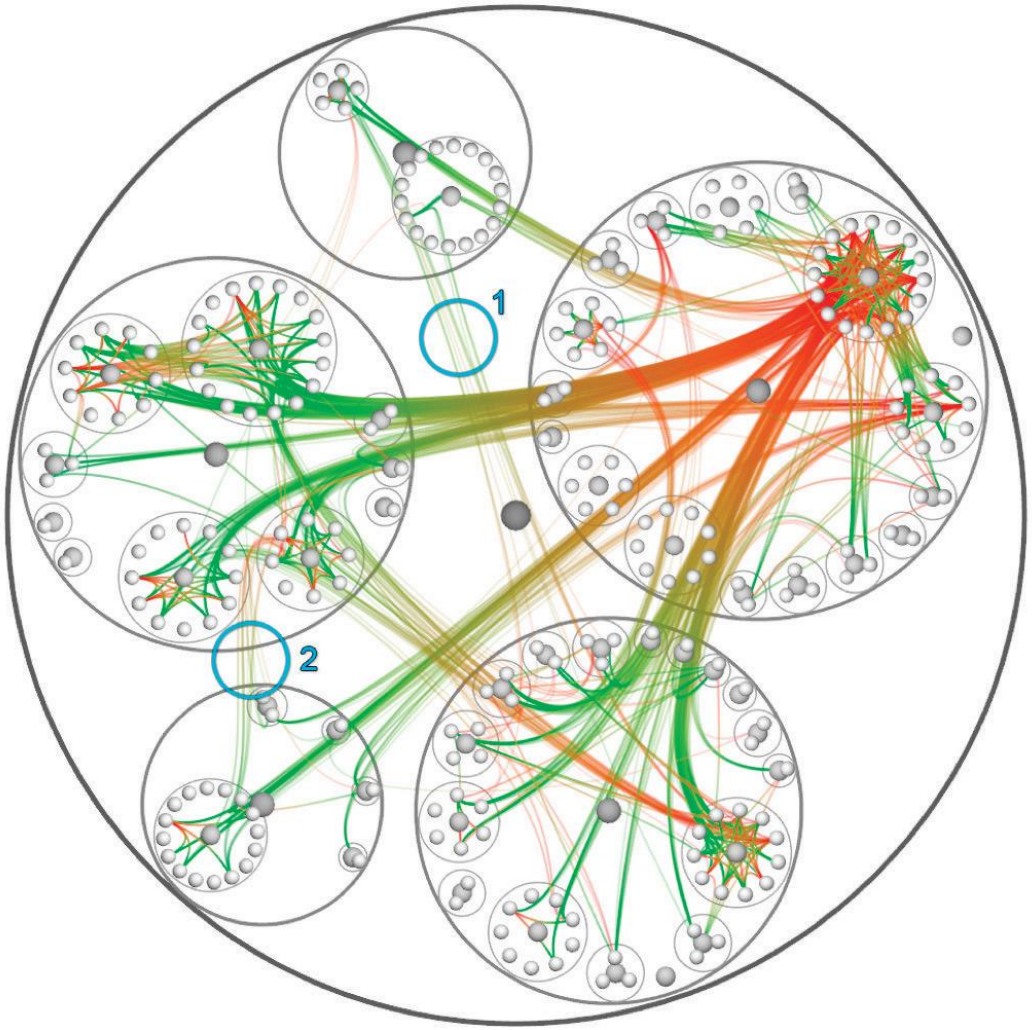
COMBINED

Partitioned + layered graph

Synchronized through highlighting

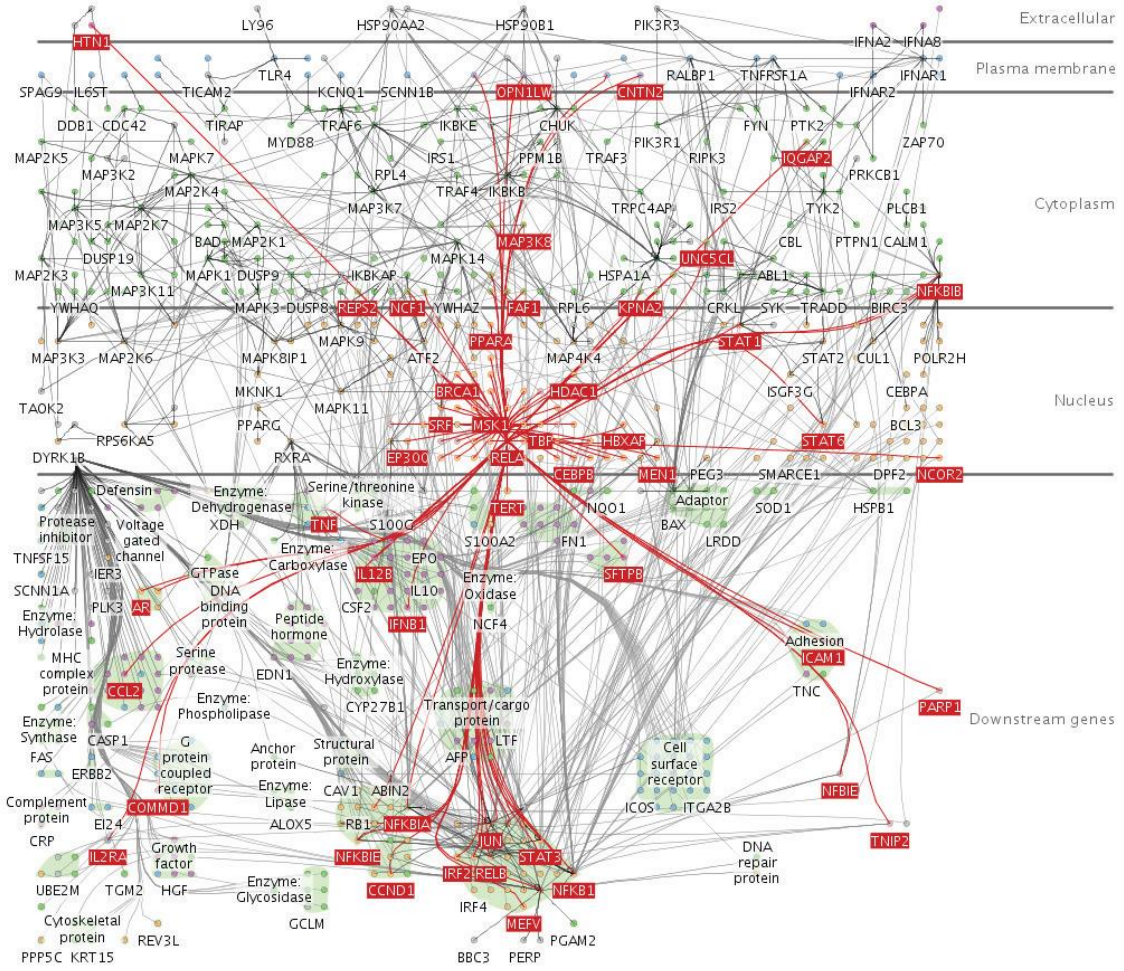


LAYERS

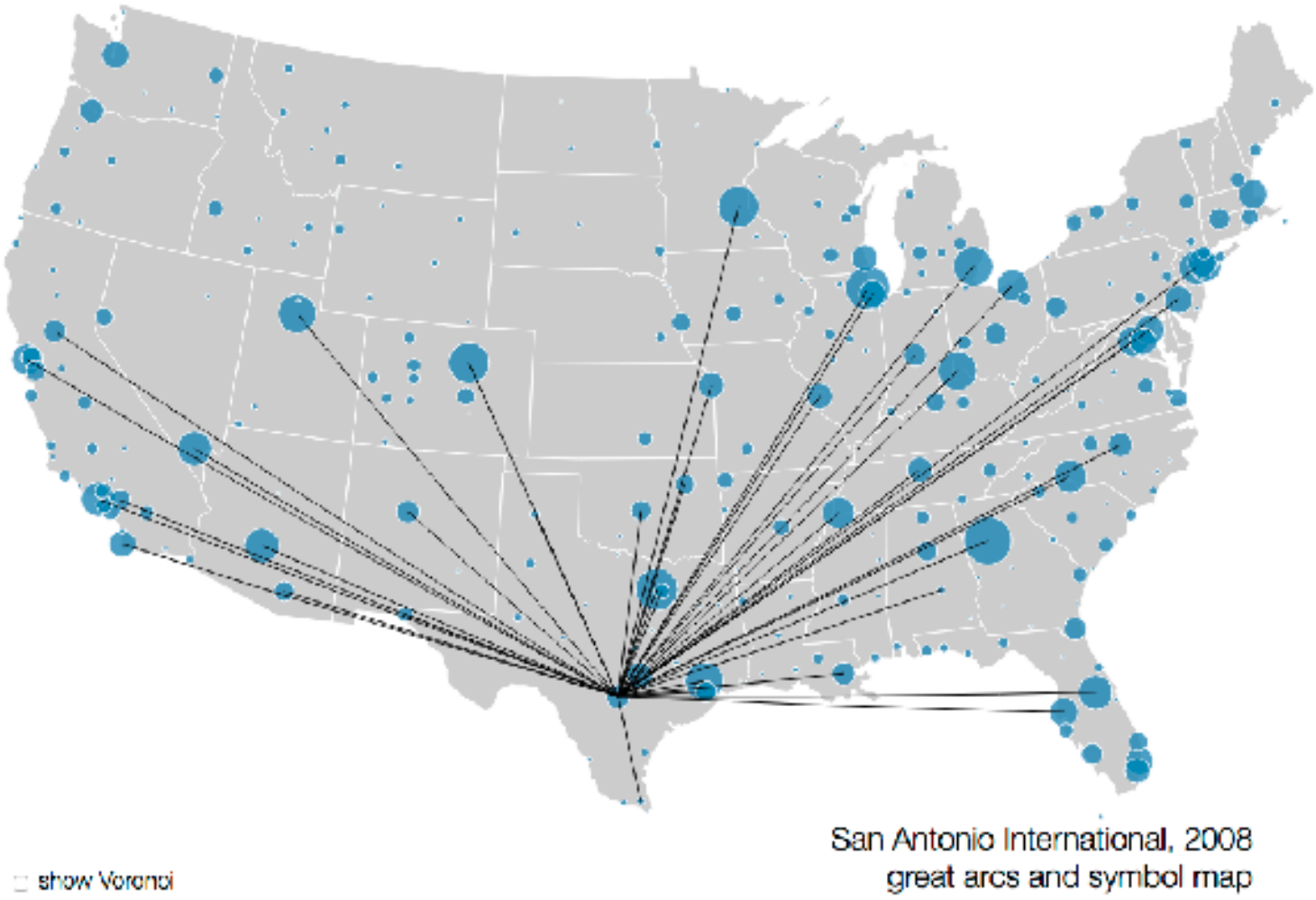


DYNAMIC LAYERS

in response to user selection.
The number of possible layers can be huge



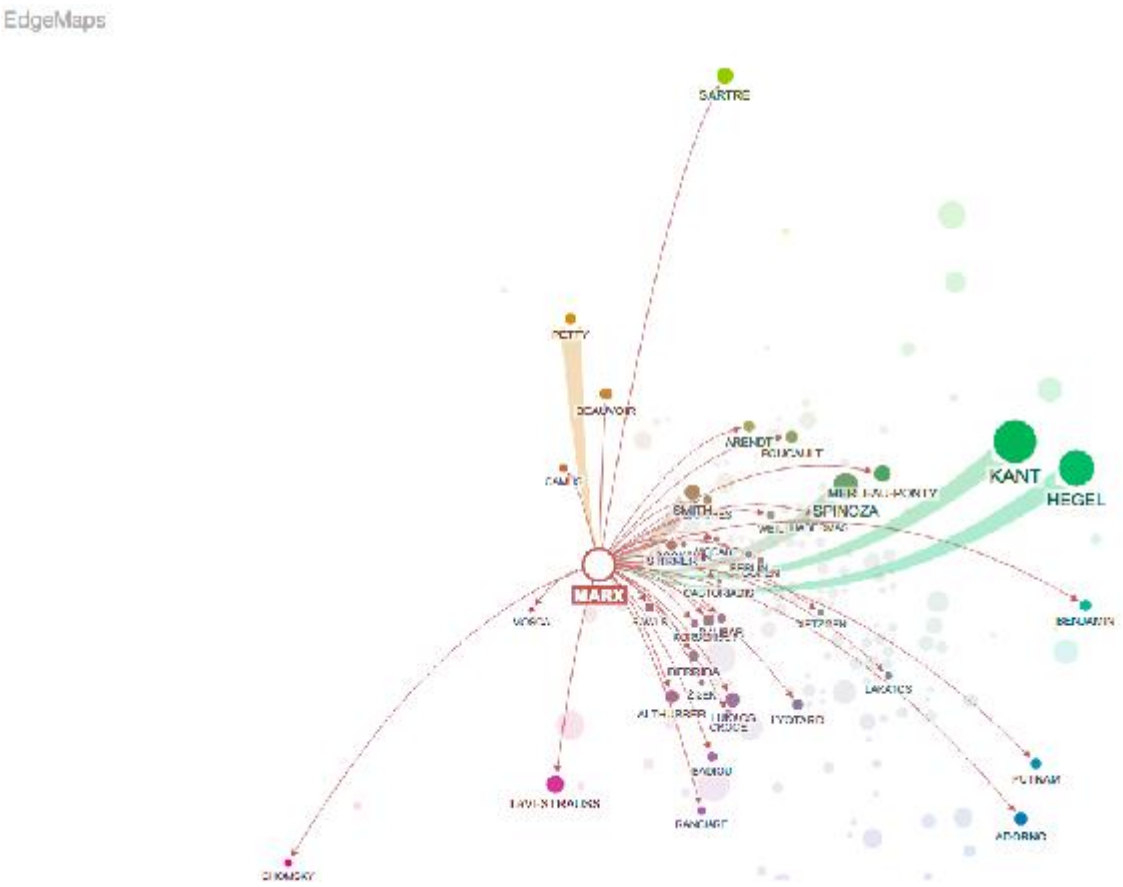
DYNAMIC VISUAL LAYERING



http://mbostock.github.io/d3/talk/20111116/airports.html

DYNAMIC VISUAL LAYERING

One-hop neighbor highlighting



https://mariandoerk.de/edgemaps/demo/