

# Visualisation d'information (1) historique, applications, outils

Pierre Cubaud <cubaud@cnam.fr>

mars 2022

## Plan de l'exposé

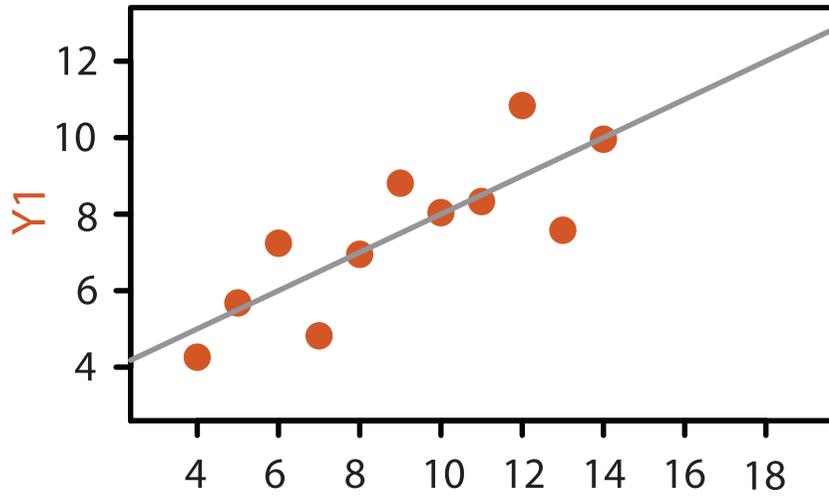
1. Exemples d'applications de la VI
2. Définition du sujet
3. Bertin et Tufte
4. Le Xerox PARC et le HCI lab
5. aujourd'hui : "Information is beautiful"
6. Logiciels

+ exemple récent des élections américaines

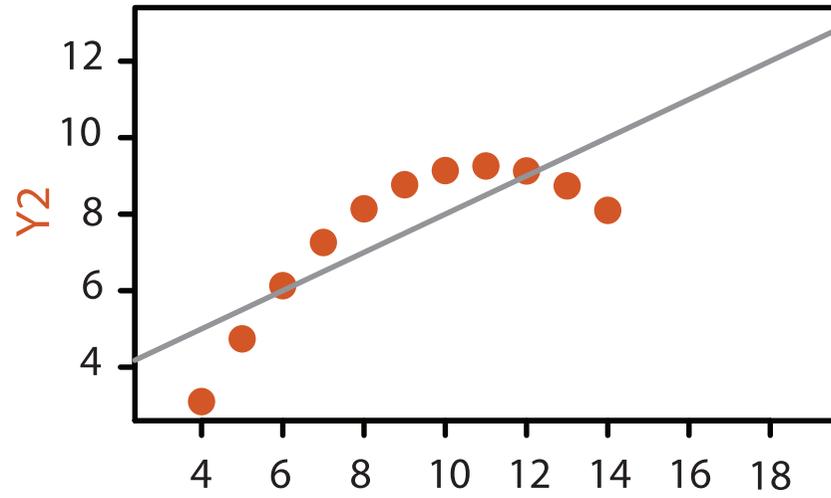
# Pourquoi faire des graphiques ?

Anscombe's Quartet: Raw Data

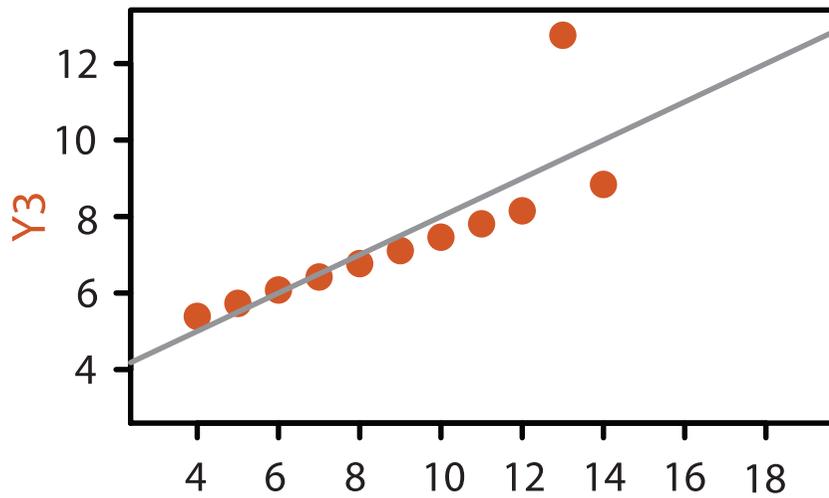
	1		2		3		4	
	X	Y	X	Y	X	Y	X	Y
	10.0	8.04	10.0	9.14	10.0	7.46	8.0	6.58
	8.0	6.95	8.0	8.14	8.0	6.77	8.0	5.76
	13.0	7.58	13.0	8.74	13.0	12.74	8.0	7.71
	9.0	8.81	9.0	8.77	9.0	7.11	8.0	8.84
	11.0	8.33	11.0	9.26	11.0	7.81	8.0	8.47
	14.0	9.96	14.0	8.10	14.0	8.84	8.0	7.04
	6.0	7.24	6.0	6.13	6.0	6.08	8.0	5.25
	4.0	4.26	4.0	3.10	4.0	5.39	19.0	12.50
	12.0	10.84	12.0	9.13	12.0	8.15	8.0	5.56
	7.0	4.82	7.0	7.26	7.0	6.42	8.0	7.91
	5.0	5.68	5.0	4.74	5.0	5.73	8.0	6.89
Mean	9.0	7.5	9.0	7.5	9.0	7.5	9.0	7.5
Variance	10.0	3.75	10.0	3.75	10.0	3.75	10.0	3.75
Correlation	0.816		0.816		0.816		0.816	



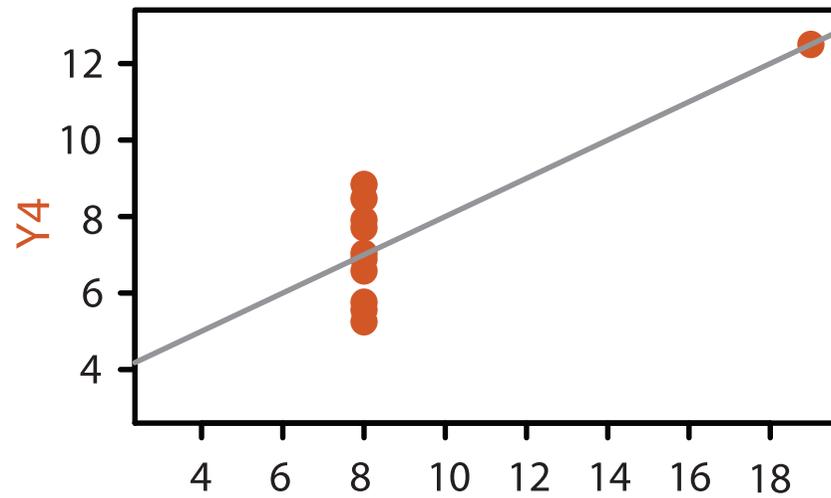
X1



X2



X3



X4

[https://fr.wikipedia.org/wiki/Quartet\\_d%27Anscombe](https://fr.wikipedia.org/wiki/Quartet_d%27Anscombe)



Xu Bing - Une histoire sans mot - Grasset, 2013

# 1. Exemples

choisir dans une grande masse d'informations

Pub dans Metro, nov 2007

metro | 05  
septembre 2007

sonyericsson.com/musictrip

J'la musique qui me ressemble

Choisissez votre musique et faites vos playlists\* selon votre humeur avec la fonction SensMe™ du nouveau mobile Walkman™ W910i.



de l'alimentation  
get des ménages.

évoit un chiffre  
hausse de 7 à 8%.  
nt, la hausse de  
cée chez Danone  
e les prix prati-  
près des distribu-  
este donc à savoir  
nent les ensei-  
la répercuteront.  
Danone, cela sera  
r, début décem-  
groupe Lactalis  
Président...)  
gumenter ses tarifs  
e 15 et 17%. "Il y a  
être trop de  
trations dans ce  
", avance François  
ier, qui évoque  
ne la possibilité  
e "entente sur les  
entre les groupes.  
**JUDITH KORBER**

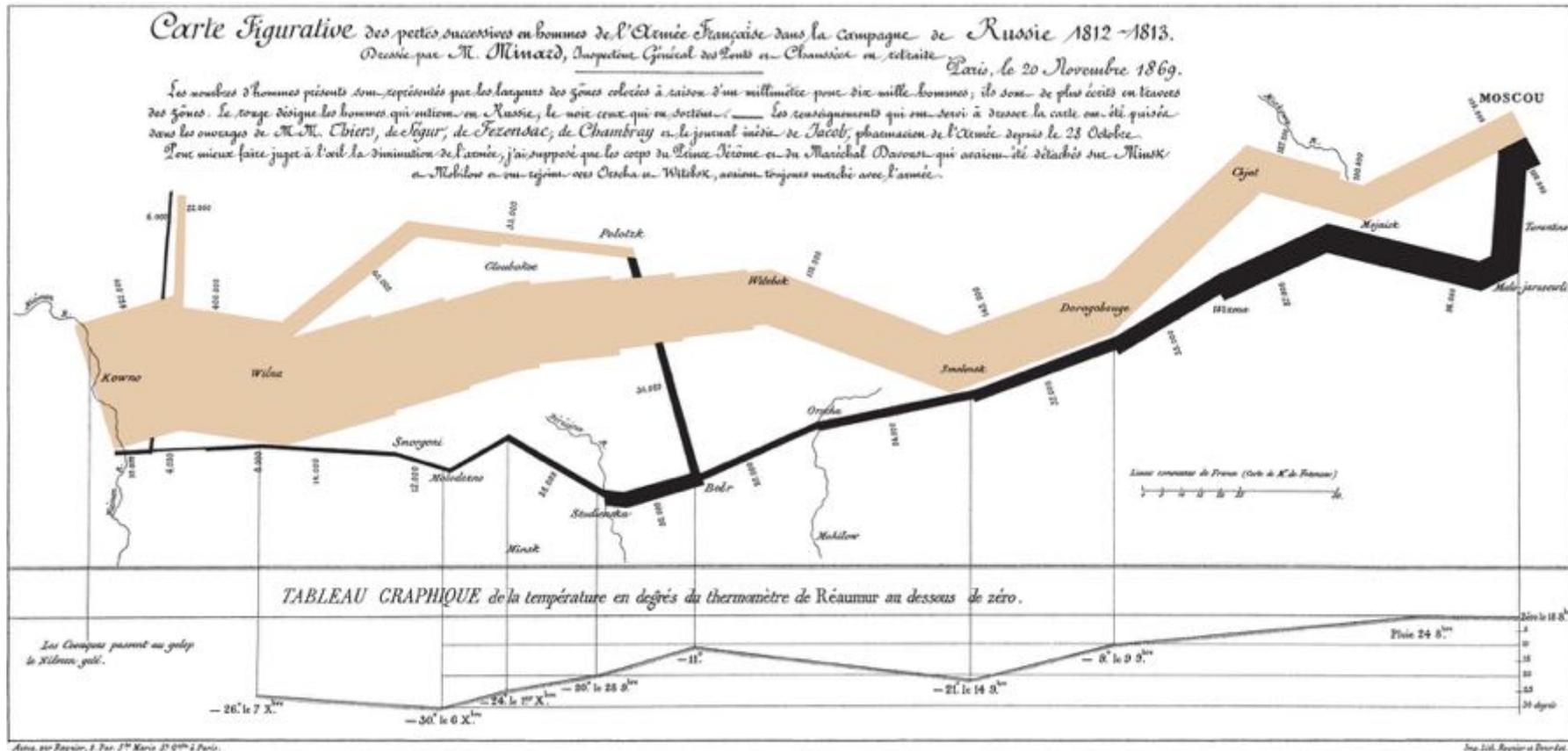
le intégral  
trofrance.com

met - SE22188 Lund - Suède - RCS Paris B 439 961 905



« cover flow » Apple Ipod Touch

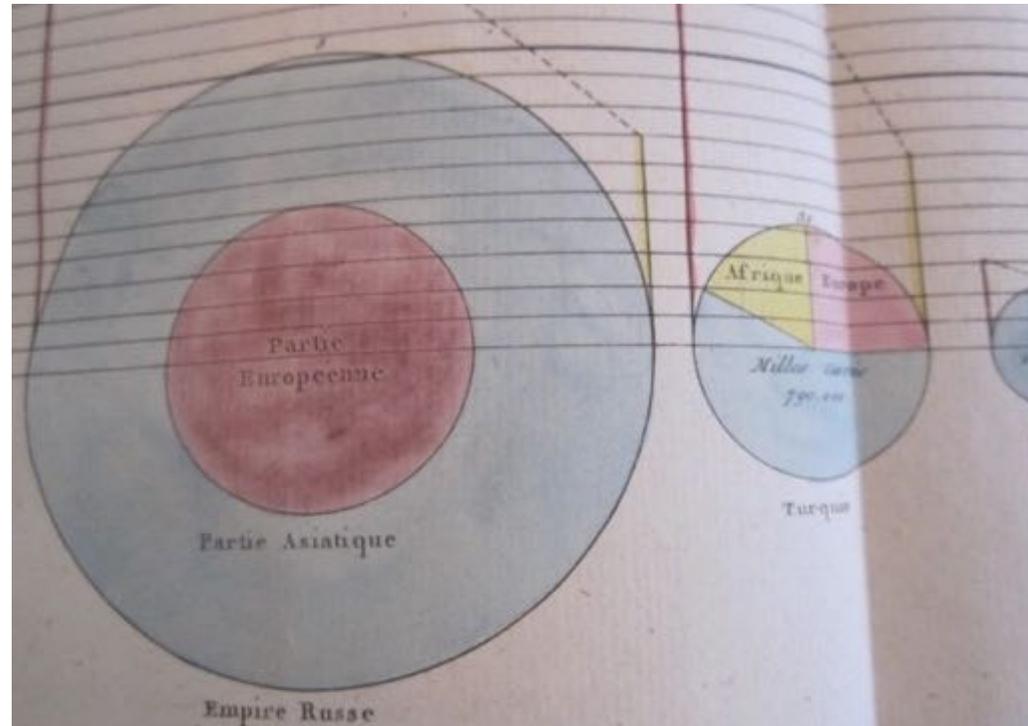
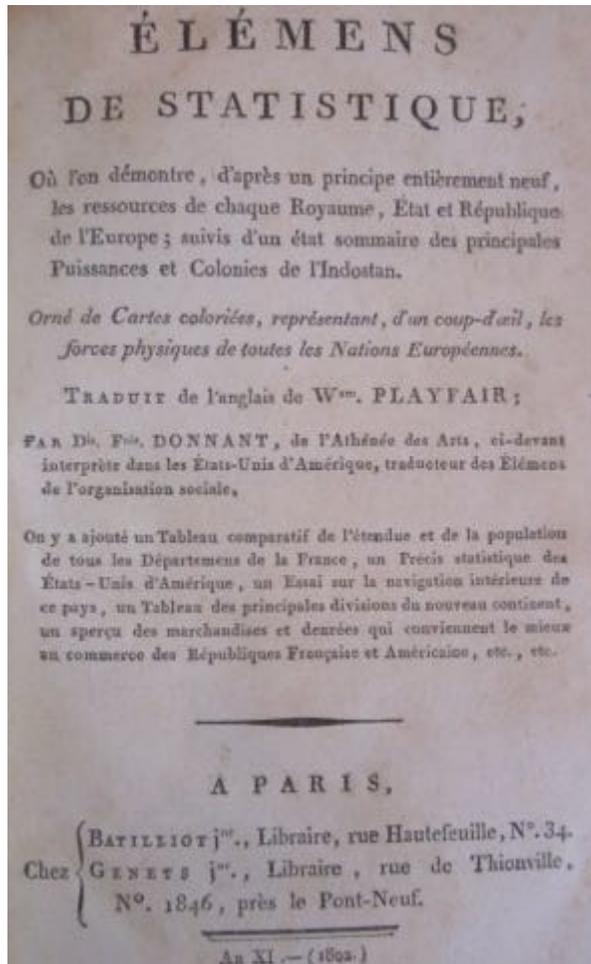
## Autre exemple : comprendre un phénomène



Edward R. Tufte (1992). The Visual Display of Quantitative Information

Minard (1869) : carte augmentée par des flots  
« graphics reveals data » (Tufte)

# Le fondateur ? W. Playfair (1800)



## Playfair, Elémens de statistique, Economie, EO, Mathématiques, Etats-Unis, les premiers diagrammes !

Etat de l'objet : —

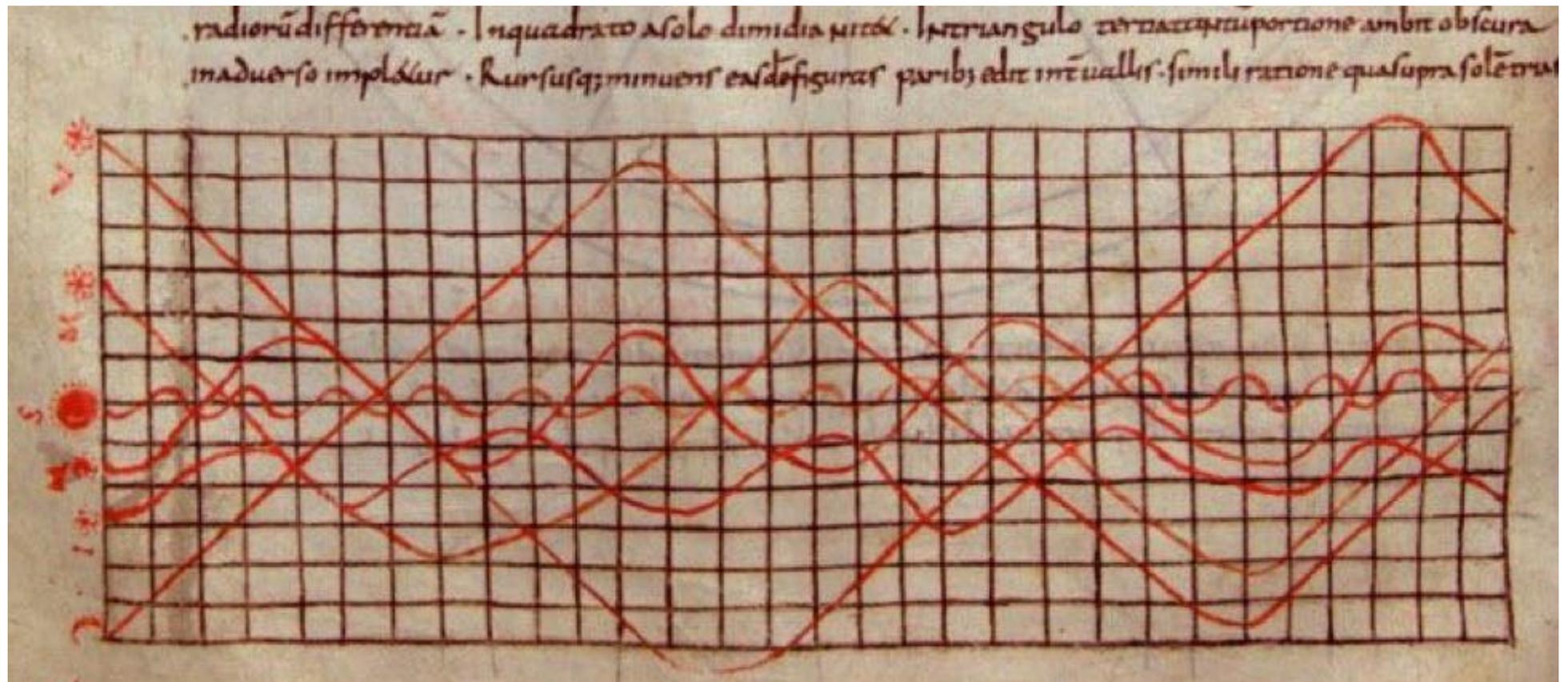
Vente terminée : 24 sept. 2013 21:16:30 Paris

Meilleure enchère : **755,00 EUR** [ 21 enchères ]

Livraison : **10,00 EUR Standard** | Détails

Lieu où se trouve l'objet : Paris, France métropolitaine

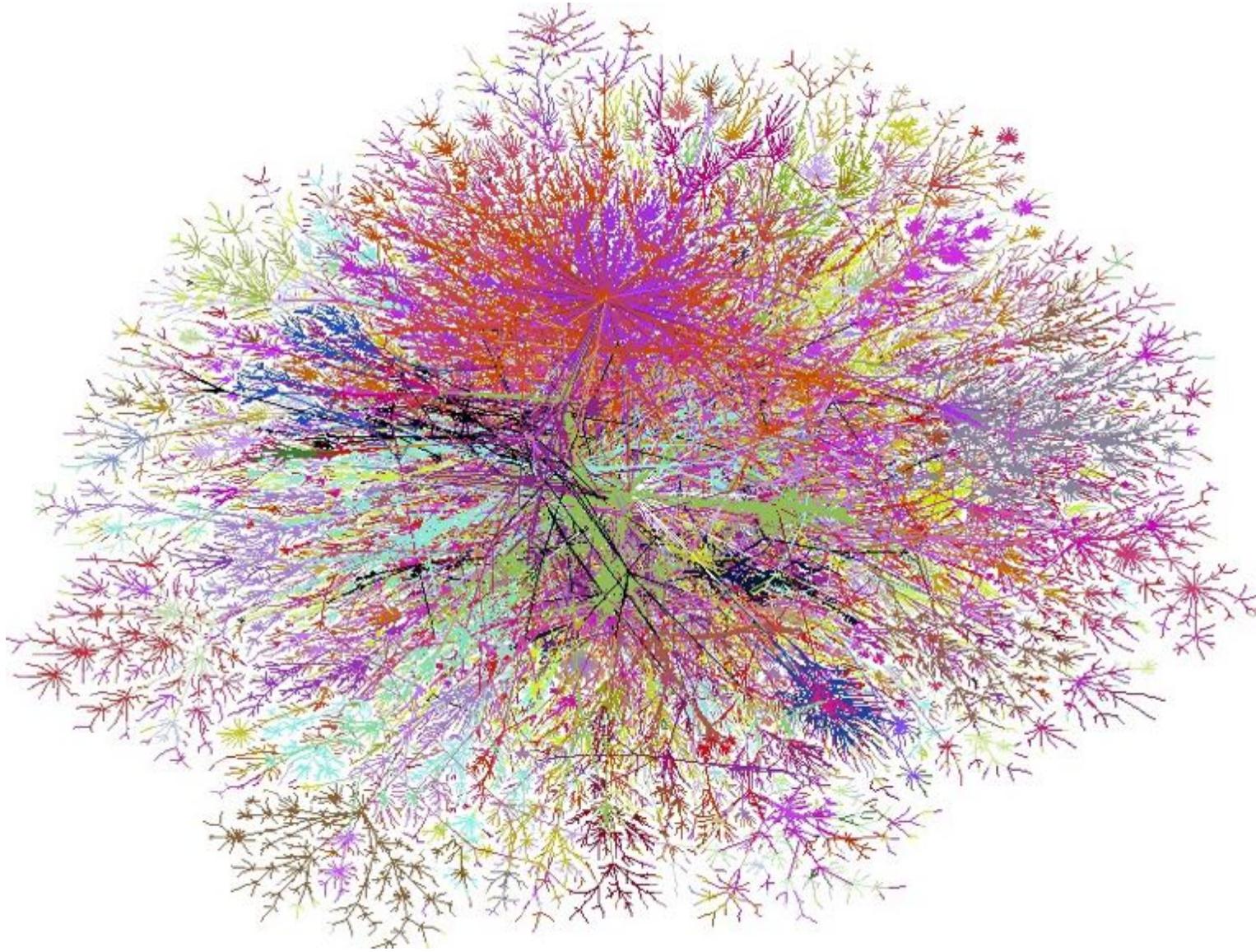
Manuscrit du Xeme s.  
chronogramme des latitudes des planètes et du soleil



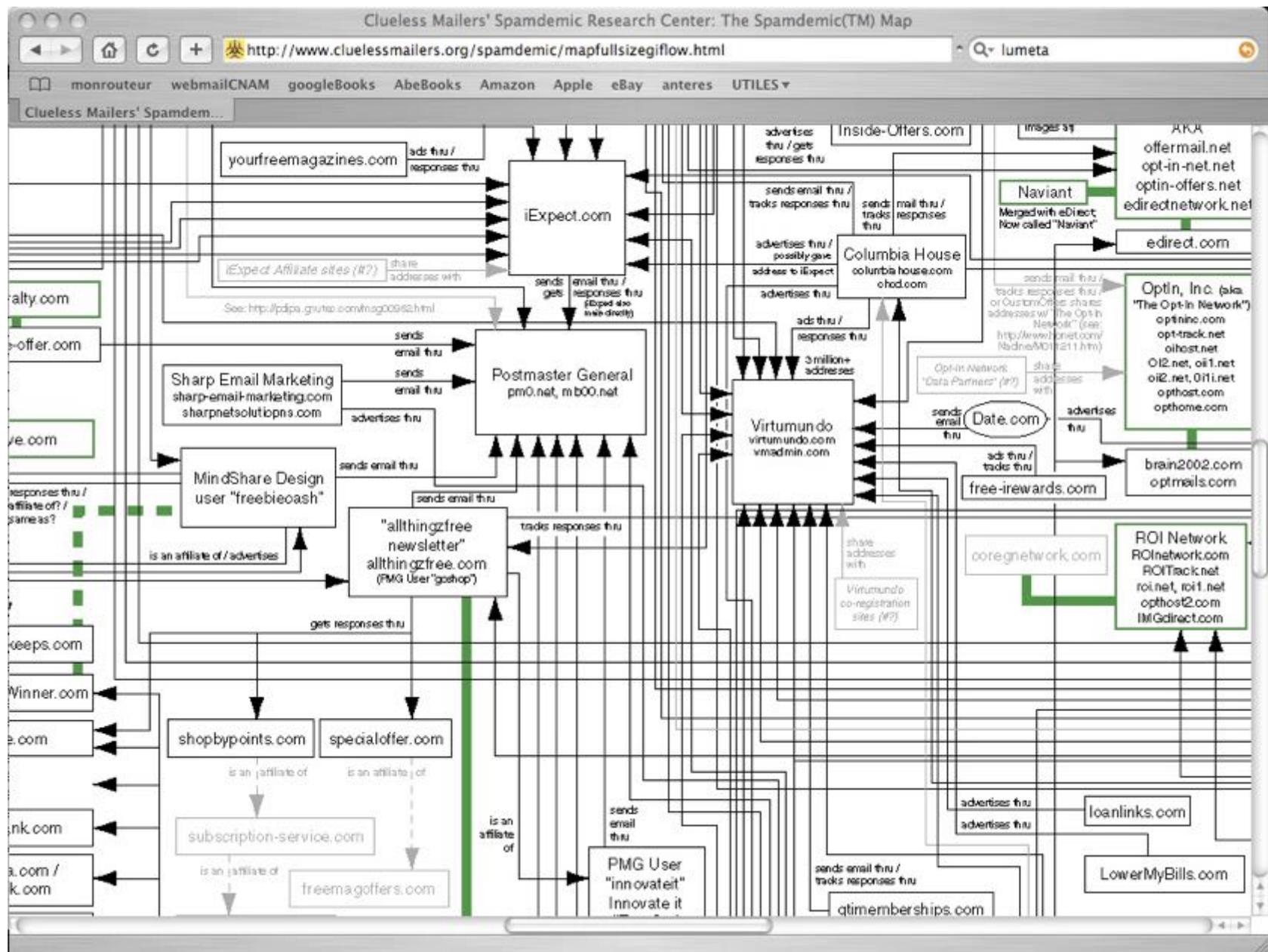
<http://www.e-codices.unifr.ch/de/list/one/bbb/0347>

exemple donné dans [Tufte] sans la couleur...

Aujourd'hui : cybergéographie

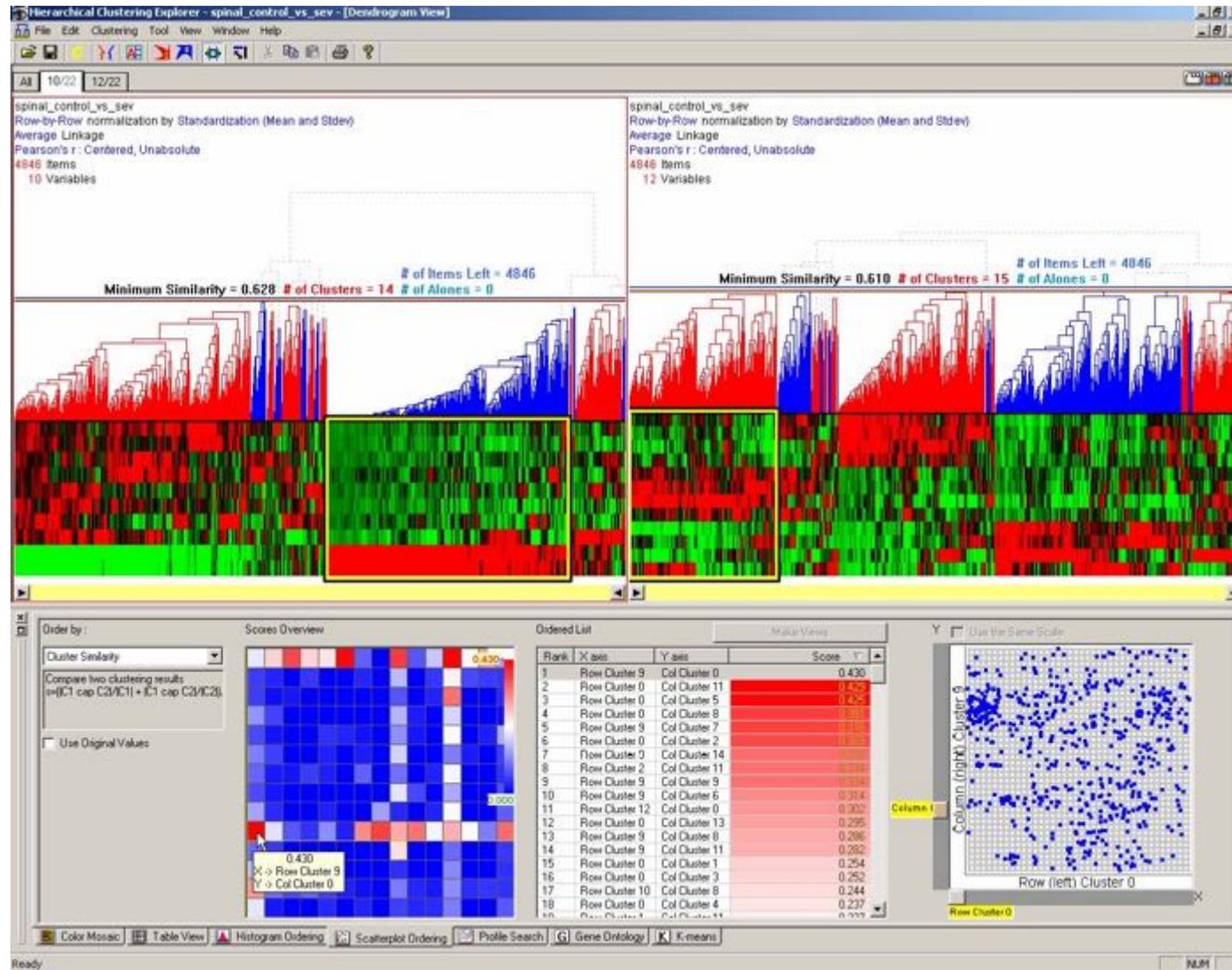


Lumeta (revue Nature)



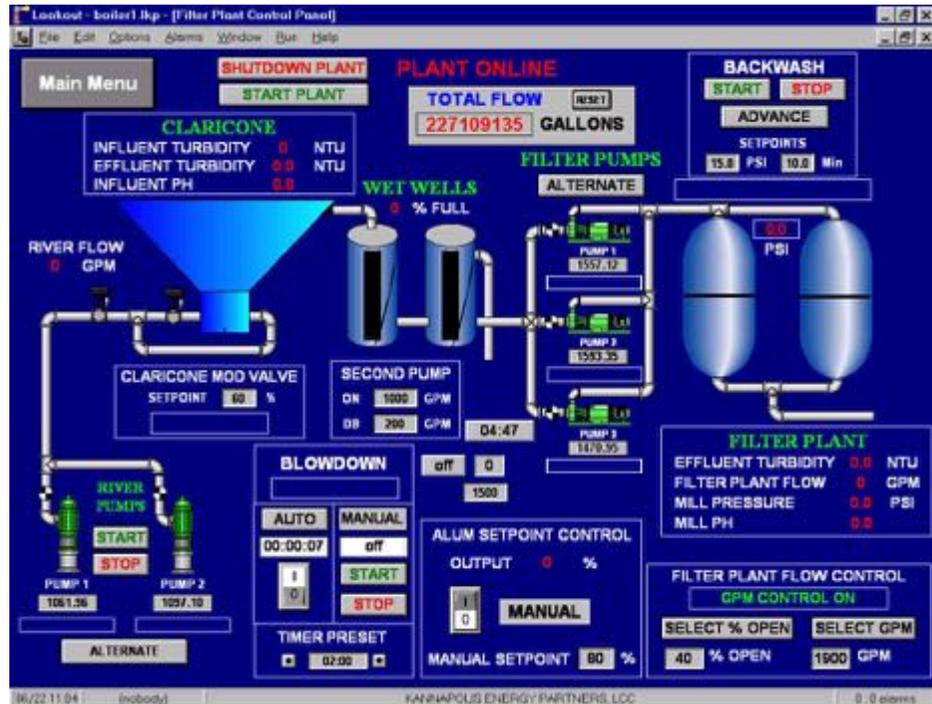
propagation d'un virus informatique

# Génétique :





# Autre exemple : piloter un processus complexe





cockpit airbus A380 (wikipedia)

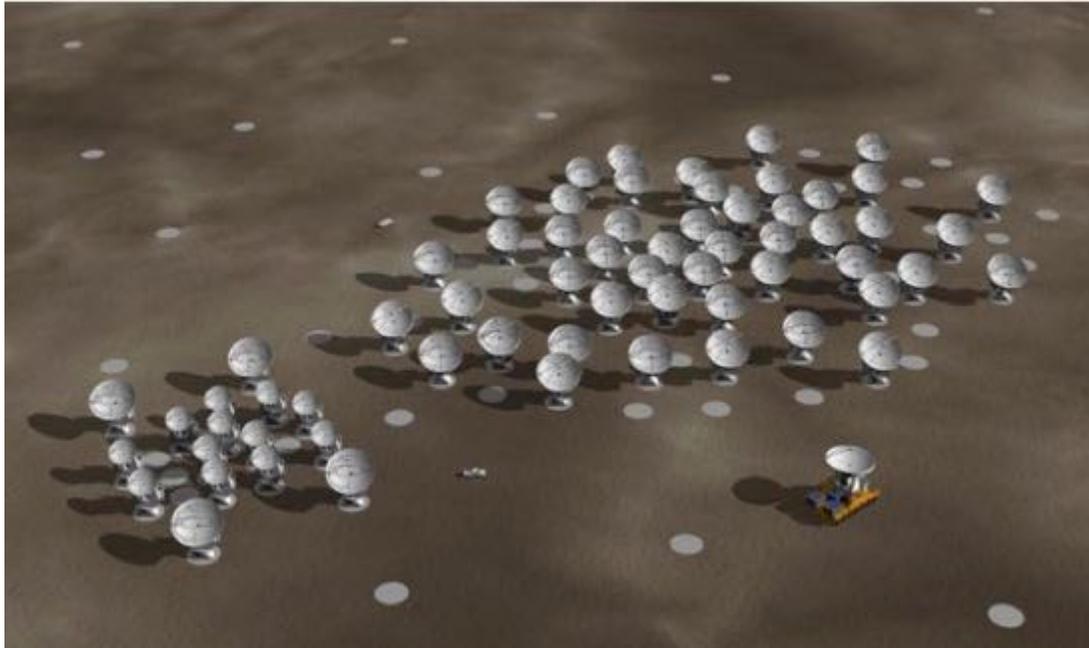
# Traders



<http://www.stocktradingtogo.com/2007/09/25/are-20-monitors-enough-for-one-trader-you-decide/>

# Grands instruments scientifiques : exemple d'ALMA

## Chili (Atacama, 5000m)



interféromètre : 66 antennes (12m + 7m) et 2145 lignes de bases (<16 km)



corrélateur : 170 TFlops, 8200 FPGA, 180 KW



ex de freq : 714 GHz !



Salle de contrôle  
en 2010-11

Java+Corba (avant 2000 !)

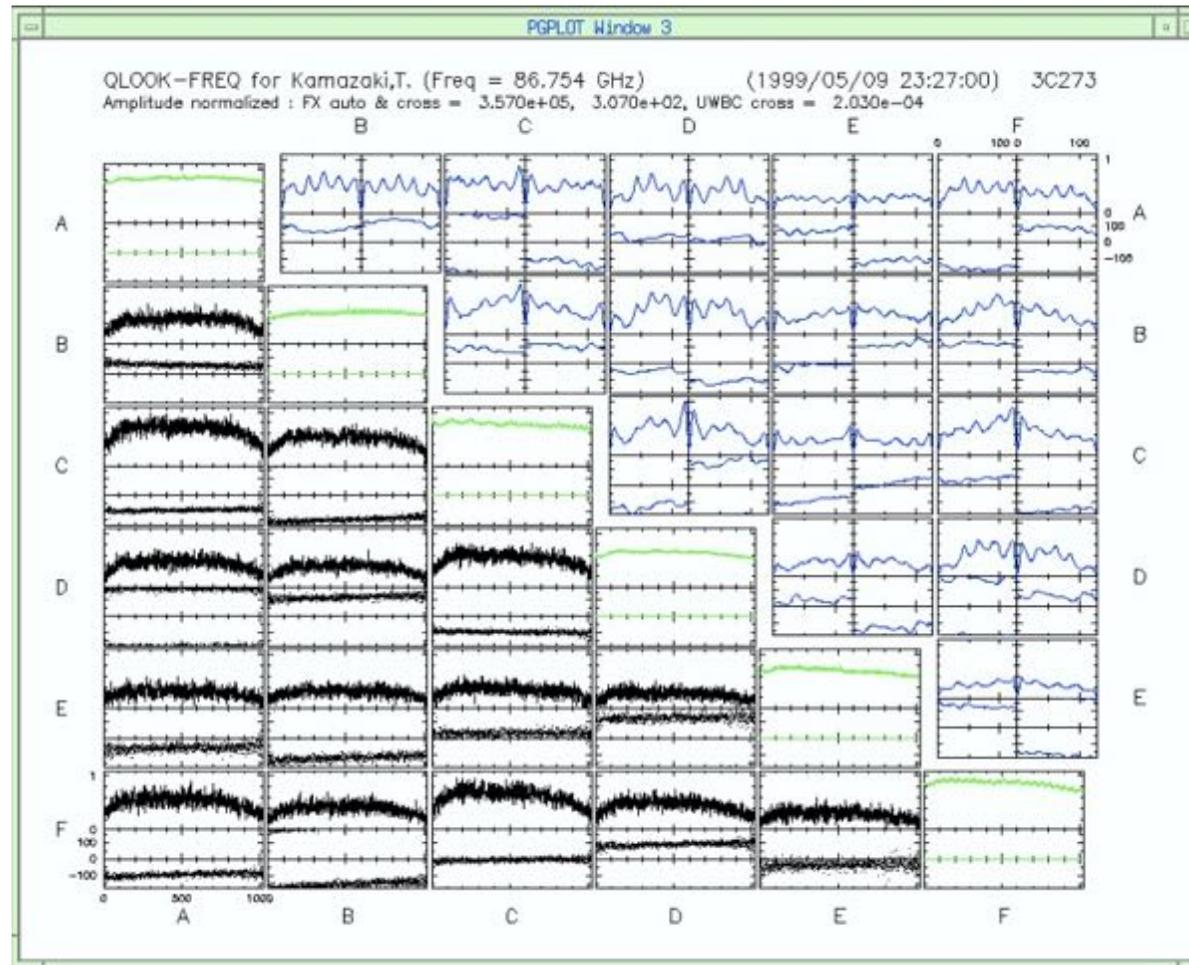
débit de capture : 1 Go/s

débit d'archivage : 180 To/an



[http://www.eso.org/public/images/max\\_a129560s/](http://www.eso.org/public/images/max_a129560s/)

# Problème du passage à l'échelle des interfaces



Exemple d'écran du VLA (Arizona) : 6 antennes =>  $6 \times 5/2$  lignes de base

Comment faire avec 2145 ?? A VOIR PLUS TARD

## 2. Définition du sujet

Compact graphical presentation and user interface for

- manipulating large numbers of items
- possibly extracted from far larger datasets

Enables users to make

- discoveries,
- decisions, or
- explanations

about

- patterns (trend, cluster, gap, outlier...),
- groups of items, or
- individual items.

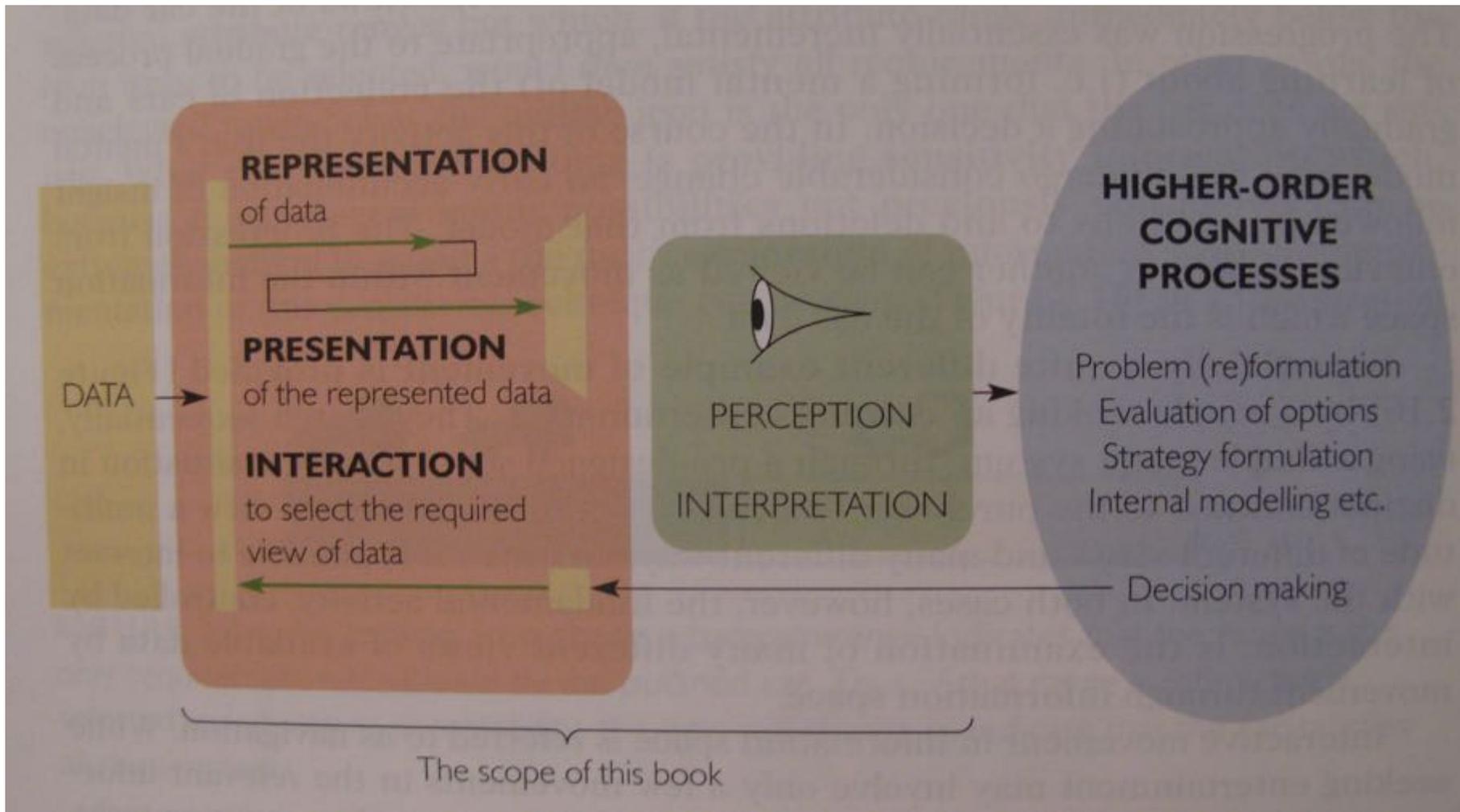
[Plaisant, 2001]

Visual representations of the semantics, or meaning, of information. In contrast to scientific visualization, information visualization typically deals with nonnumeric, nonspatial, and high-dimensional data. [Chen, 2005]

Information visualization (InfoVis) produces (interactive) visual representations of abstract data to reinforce human cognition and perception; thus enabling the viewer to gain knowledge about the internal structure of the data and causal relationships in it.

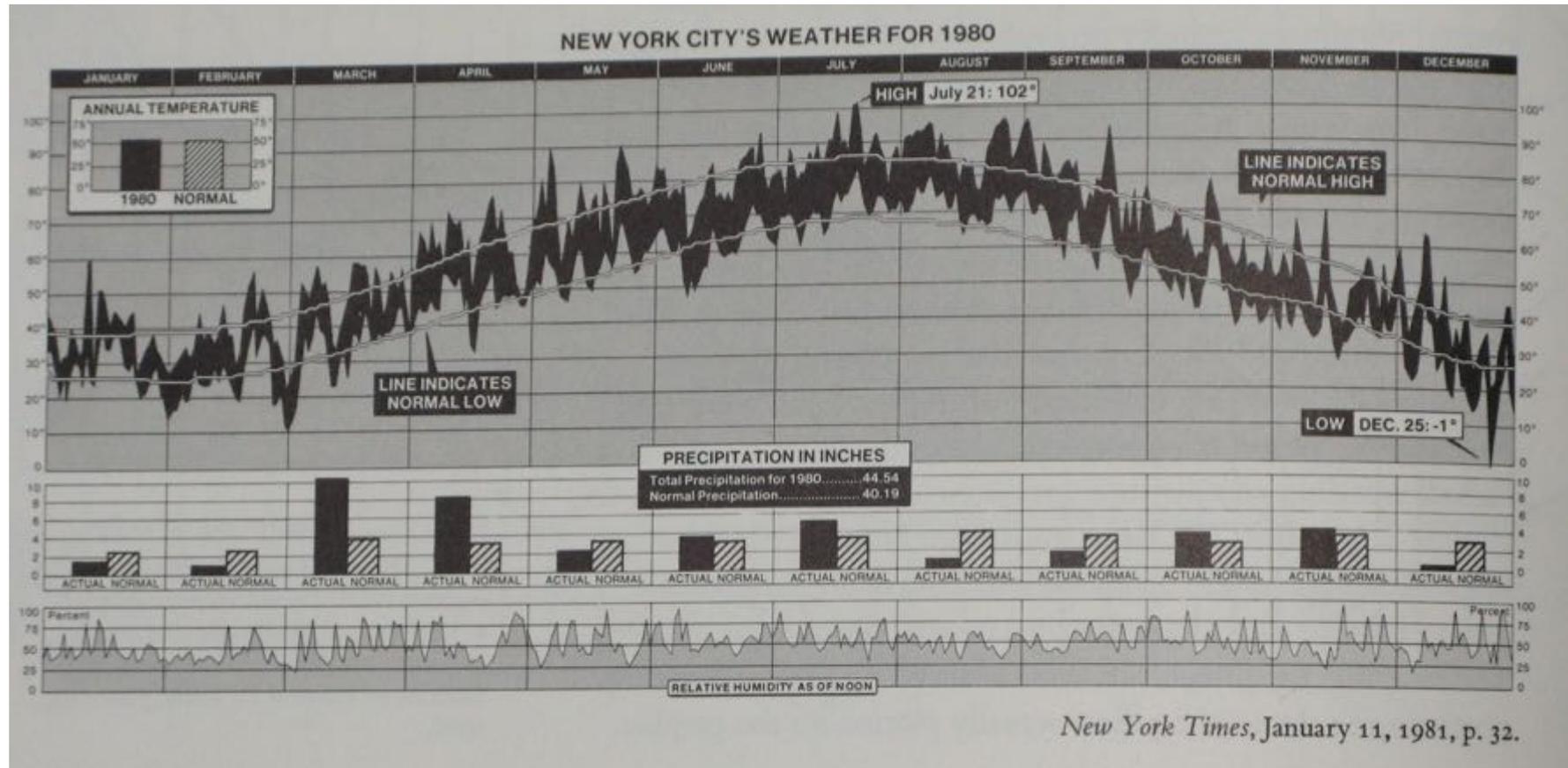
"using vision to think" (Card et al.)

[http://www.infovis-wiki.net/index.php/Information\\_Visualization](http://www.infovis-wiki.net/index.php/Information_Visualization)



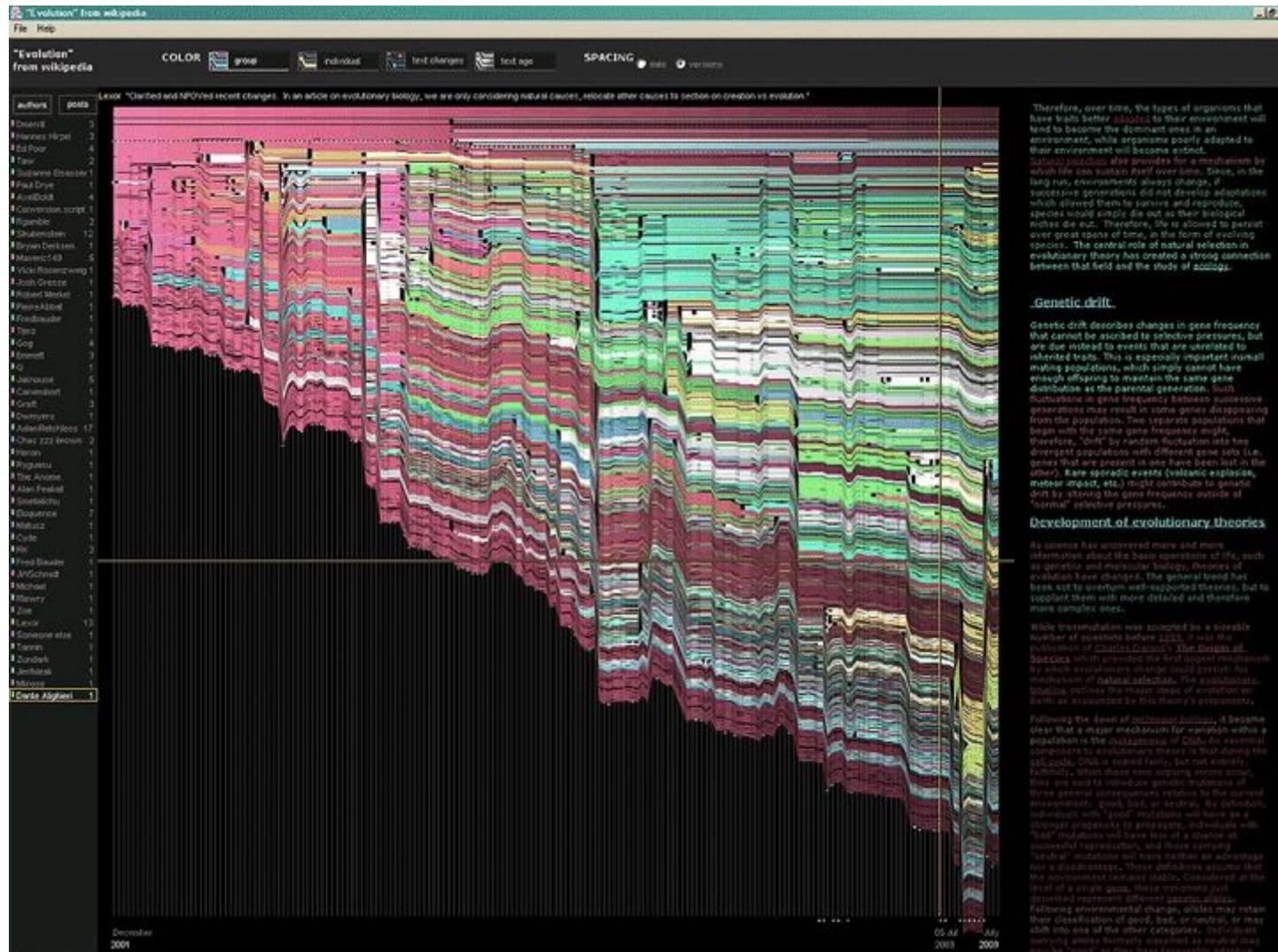
[Spence] p.26

# Un schéma pour 1888 nombres



[Tufte, Visual display ... p.30]

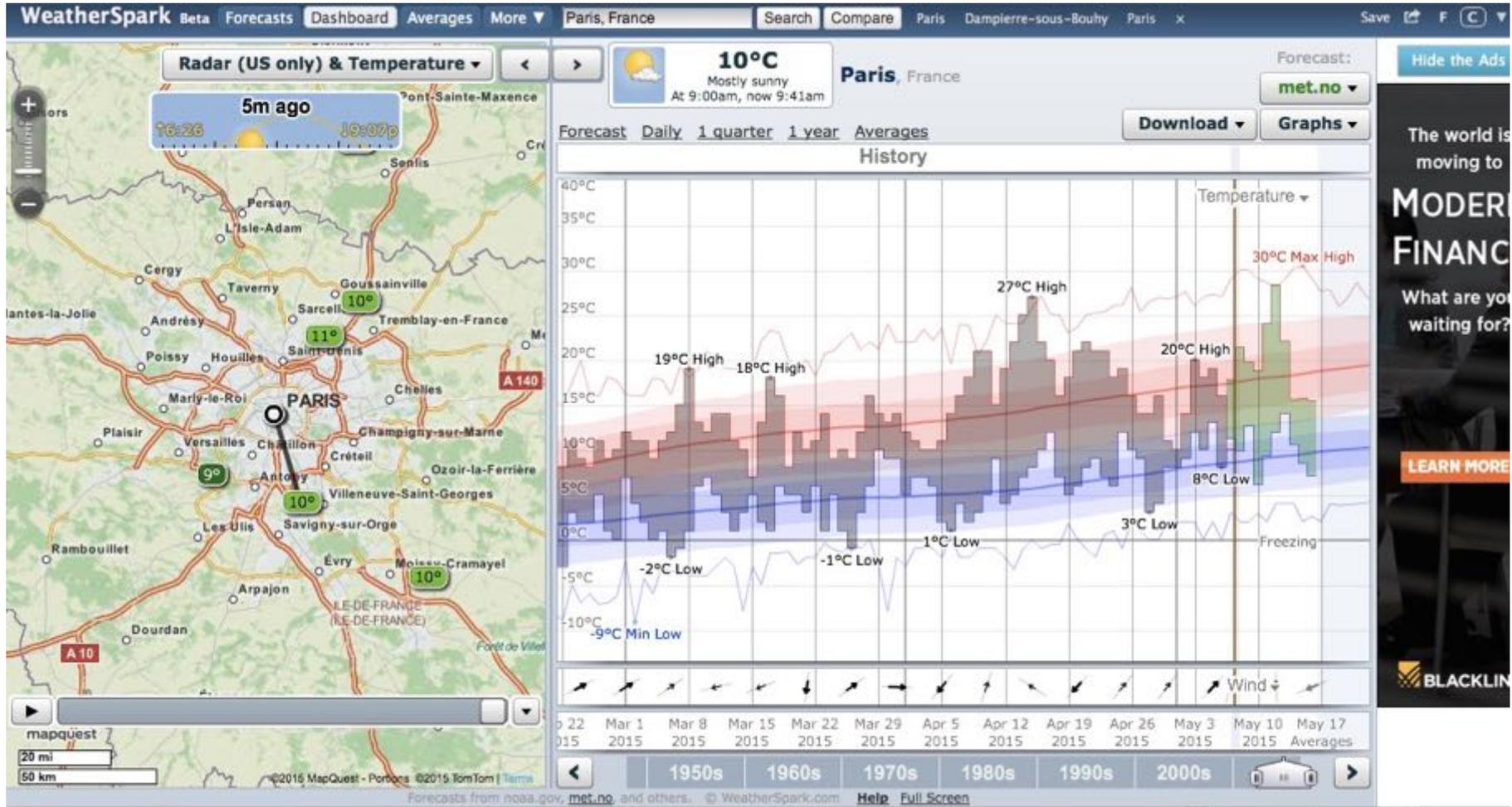
Si + de données, une interaction indispensable (zoom, etc.)



versions de l'article "evolution" sur Wikipedia

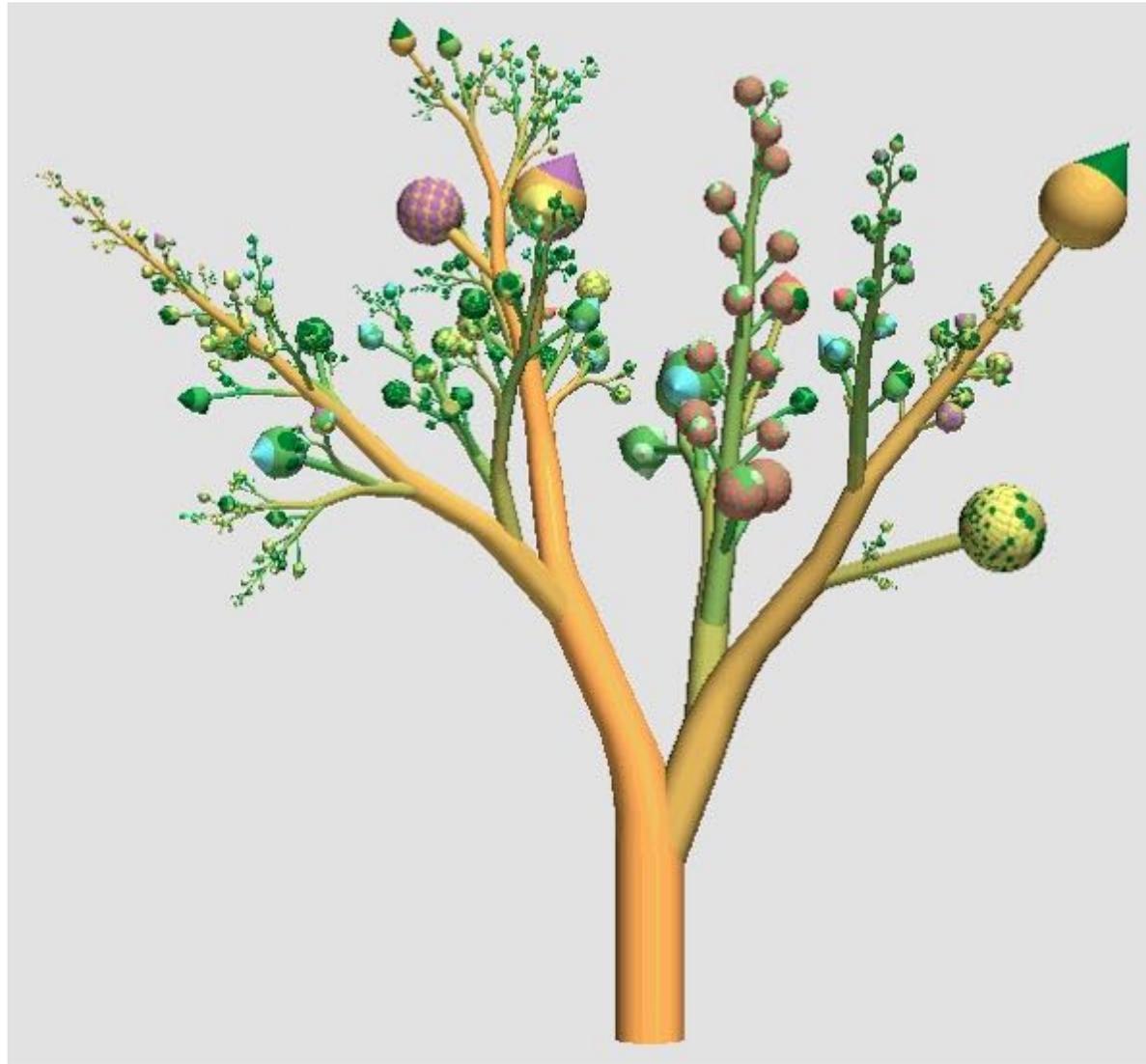
[http://www.research.ibm.com/visual/projects/history\\_flow/](http://www.research.ibm.com/visual/projects/history_flow/)

# Autre exemple avec la météo



<http://weatherspark.com/>

Représenter l'abstrait ? une usabilité à évaluer...



<http://www.infovis-wiki.net/index.php?title=Image:Boom.gif>

# Infovis : une discipline scientifique



**VIS 2015**  
25-30 October 2015  
CHICAGO, ILLINOIS, USA

VAST • INFOVIS • SCIVIS

**Welcome**

**IEEE VIS 2015** is the premier forum for advances in scientific and information visualization. This weeklong event convenes an international community of researchers and practitioners from academia, government, and industry to explore their shared interests in tools, techniques, and technology.

A full complement of research presentations, tutorials, workshops, panels, demonstrations, posters, and exhibitions make this conference one of the largest and most important gatherings of researchers and professionals who specialize in the visual analysis of data.

We invite you to participate in **IEEE Visual Analytics Science and Technology (VAST)**, **IEEE Information Visualization (InfoVis)**, and **IEEE Scientific Visualization (SciVis)**, by sharing your research, insights, experience, and enthusiasm.

The conference venue, the **Palmer House Hilton**, is a historic hotel located in the heart of downtown Chicago, the third largest city in the United States and home to world-class architecture, museums, parks, and restaurants.

**VIS 2015 General Chairs**  
Michael E. Papka, Argonne National Laboratory and Northern Illinois University  
Maxine Brown, University of Illinois at Chicago

Follow @ieeevis to keep up with conference activities and announcements.  
Questions? E-mail [info\(at\)ieeevis.org](mailto:info(at)ieeevis.org)

**Important Dates**

- Thursday April 30th** Tutorials Submission Deadline
- Thursday April 30th** Workshops Submission Deadline
- Sunday May 10th** Doctoral Colloquium Deadline
- Monday June 15th** Panels Submission Deadline
- Friday June 26th** Posters Submission Deadline
- Friday July 3rd** Visualization in Practice Posters

**Supporters (Become One)**

**Bronze**



**Call for Participation**

- Papers
- VAST • InfoVis • SciVis
- Posters
- Contests & Challenge
- SciVis • VAST
- Tutorials
- Workshops
- Panels
- Visualization in Practice
- Doctoral Colloquium
- Arts Program (VISAP)

**Co-located Events**

- IEEE LDAV 2015
- IEEE VizSec 2015
- VDS 2015

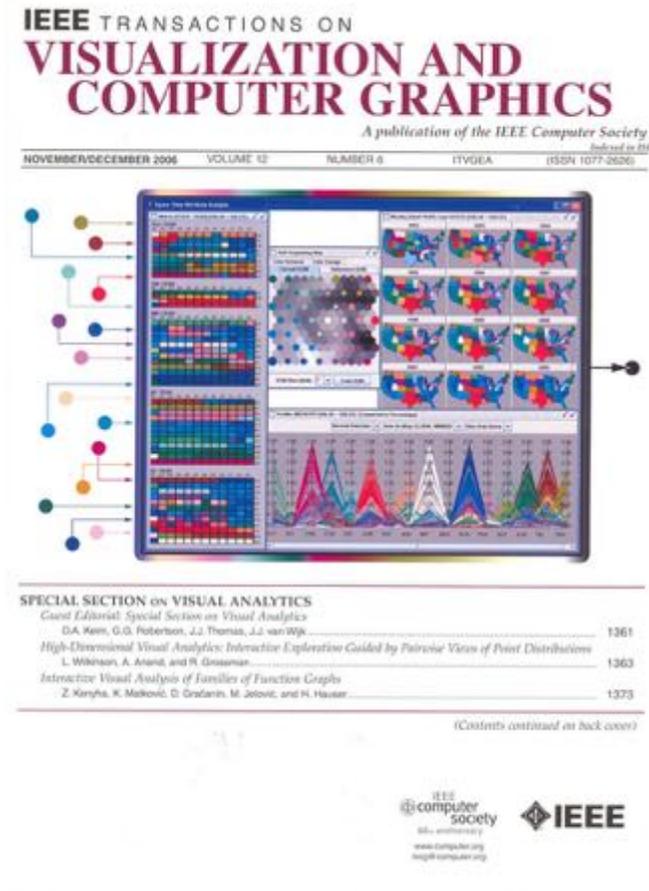
**Committees**

- VIS Conference Committee
- VIS Executive Committee
- VGTC Executive Committee
- Program Committees
- VAST • InfoVis • SciVis
- Steering Committees
- VAST • InfoVis • SciVis

**Previous Years**

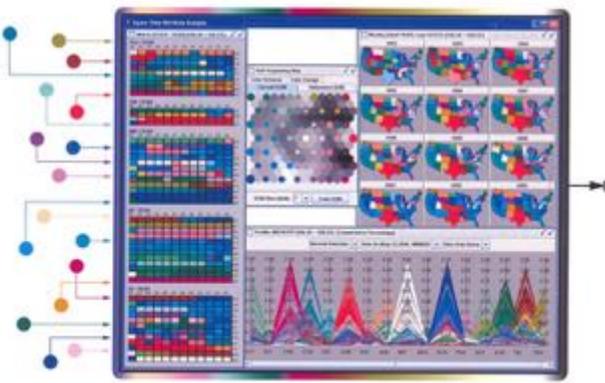
- 2014 • 2013 • 2012 • 2011
- 2010 • 2009 • 2008 •

conférence VIS



**IEEE TRANSACTIONS ON VISUALIZATION AND COMPUTER GRAPHICS**  
A publication of the IEEE Computer Society  
Indexed in DBP

NOVEMBER/DECEMBER 2006 VOLUME 12 NUMBER 6 ITVDEA (ISSN 1077-2626)



**SPECIAL SECTION on VISUAL ANALYTICS**

Guest Editorial: Special Section on Visual Analytics D.A. Keim, G.S. Poterben, J.J. Thomas, J.J. van Wijk	1361
High-Dimensional Visual Analytics: Interactive Exploration Guided by Pairwise Views of Point Distributions L. Wilkerson, A. Jensen, and R. Grossman	1363
Interactive Visual Analysis of Families of Function Graphs Z. Kangha, K. Molková, D. Gračanin, M. Jelovc, and H. Hauser	1373

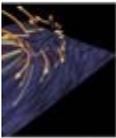
(Contents continued on back cover)

IEEE computer society  
IEEE  
www.computer.org  
http://computer.org

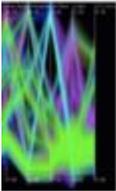
revue TVCG

à la croisée de plusieurs autres (info, psycho, ergo, design, ...)

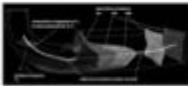
# A voir : une chronologie des 25 ans de la conference sur la visualisation



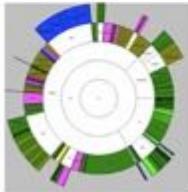
Representation of ds  
J. van Wijk



al Parallel is for Exploration datasets  
I. O. Ward, E. A. Miner



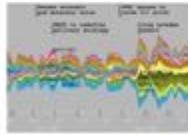
The "Parallel Vectors" Operator: A Vector Field Visualization Primitive  
R. Peikert, M. Roh



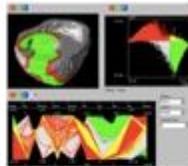
Focus+Context Display and Navigation Techniques for Enhancing Radial, Space-Filling Hierarchy Visualizations  
J. Skasko, E. Zhang



A spreadsheet interface for visualization exploration  
T. J. Jankun-Kelly, K.-L. Ma



ThemeRiver: visualizing theme changes over time  
S. Havre, B. Hetzler, L. Nowell



WEAVE: A System for Visually Linking 3D and Statistical Visualizations, Applied to Cardiac Simulation and Measurement Data  
D.L. Gresh, B.E. Rogowitz, R.L. Winslow, D.F. Scollan, C.K. Yung



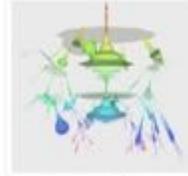
Polaris: A System for Query, Analysis and Visualization of Multi-Dimensional Relational Databases  
C. Stolte, P. Hanrahan



Volume Illustration: Non-Photorealistic Rendering of Volume Models  
D. S. Ebert, P. Rheingans



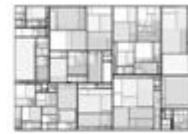
Botanical Visualization of Huge Hierarchies  
E. Kieberg, H. van de Wetering, J.J. van Wijk



Visualization of State Transition Graphs  
F. van Ham, H. van de Wetering



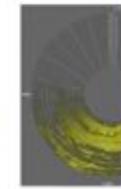
Technical Note: Visually Encoding Program Test Information to Find Faults in Software  
J. Eagan, M. J. Harrold, J. A. Jones, J. Skasko



Ordered treemap layouts  
B. Shneiderman, M. Wattenberg



Interactive Volume Rendering Using Multi-dimensional Transfer Functions and Direct Manipulation Widgets  
J. Kniss, G. Kindlmann, C. Hansen

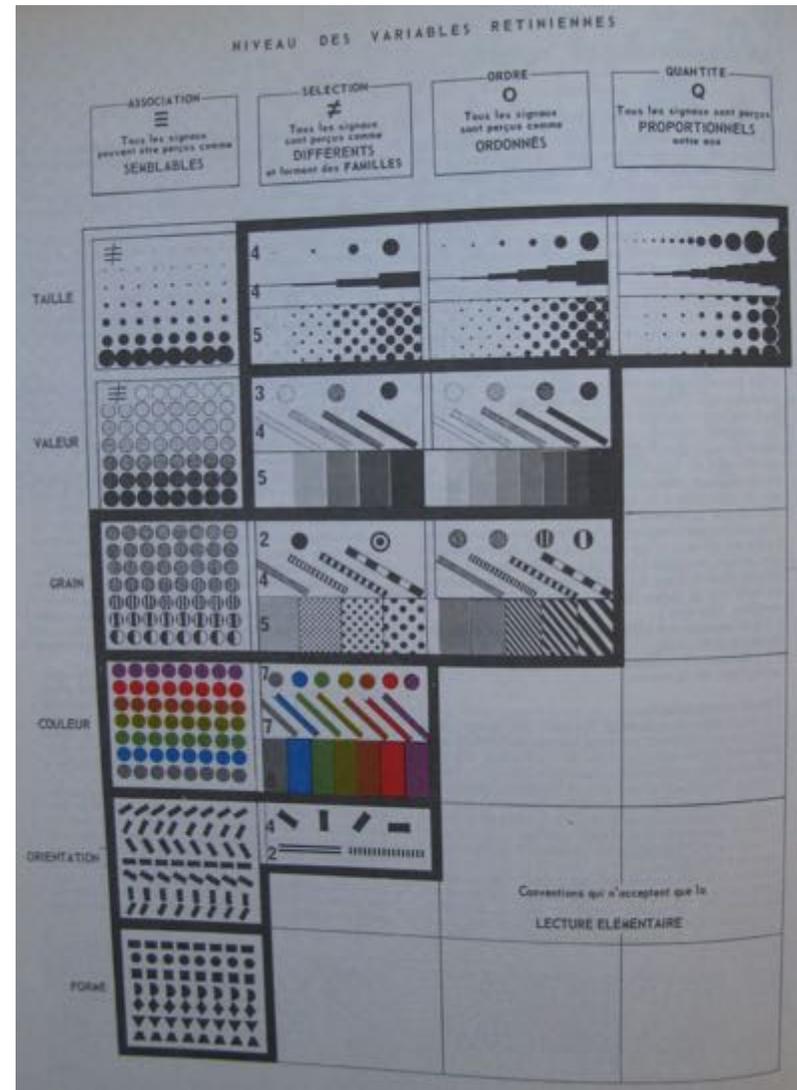
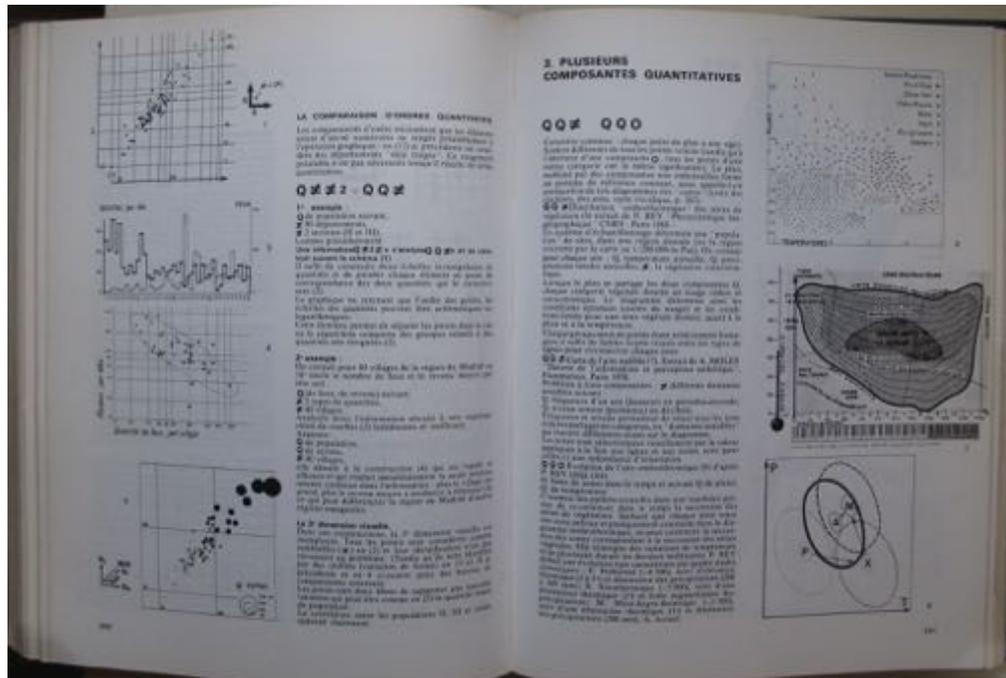


Visualizing Time Spirals  
M. Weber, M. Alk Muller

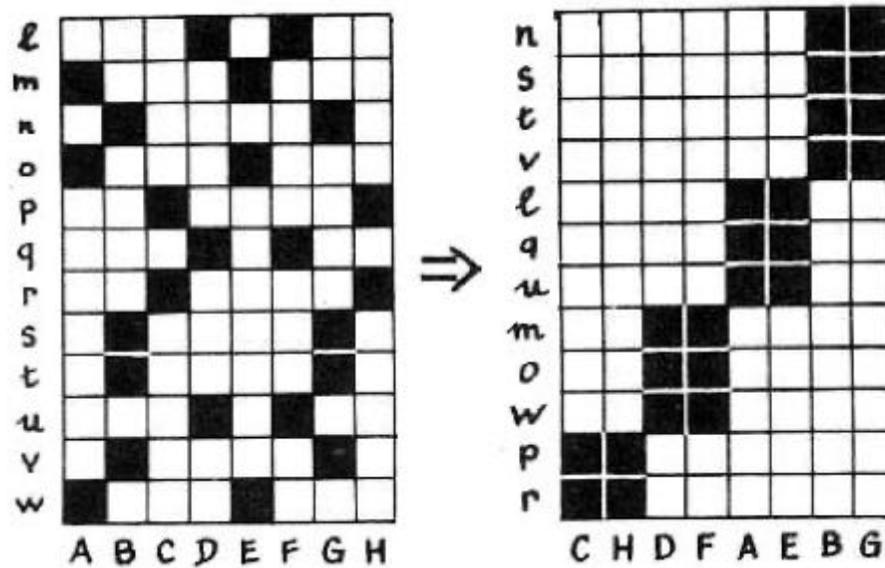
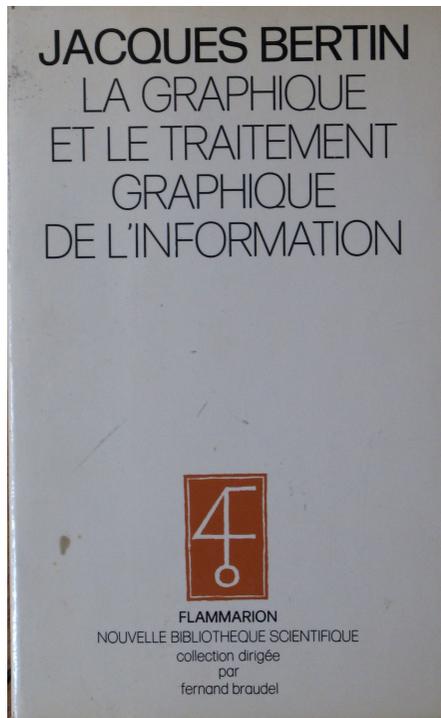
<http://www.aviz.fr/~bbach/vis25timeline/>

# 3. Travaux de Bertin et Tufte

J. Bertin  
 Sémiologie graphique  
 Mouton & Gauthier-Villars, 1967

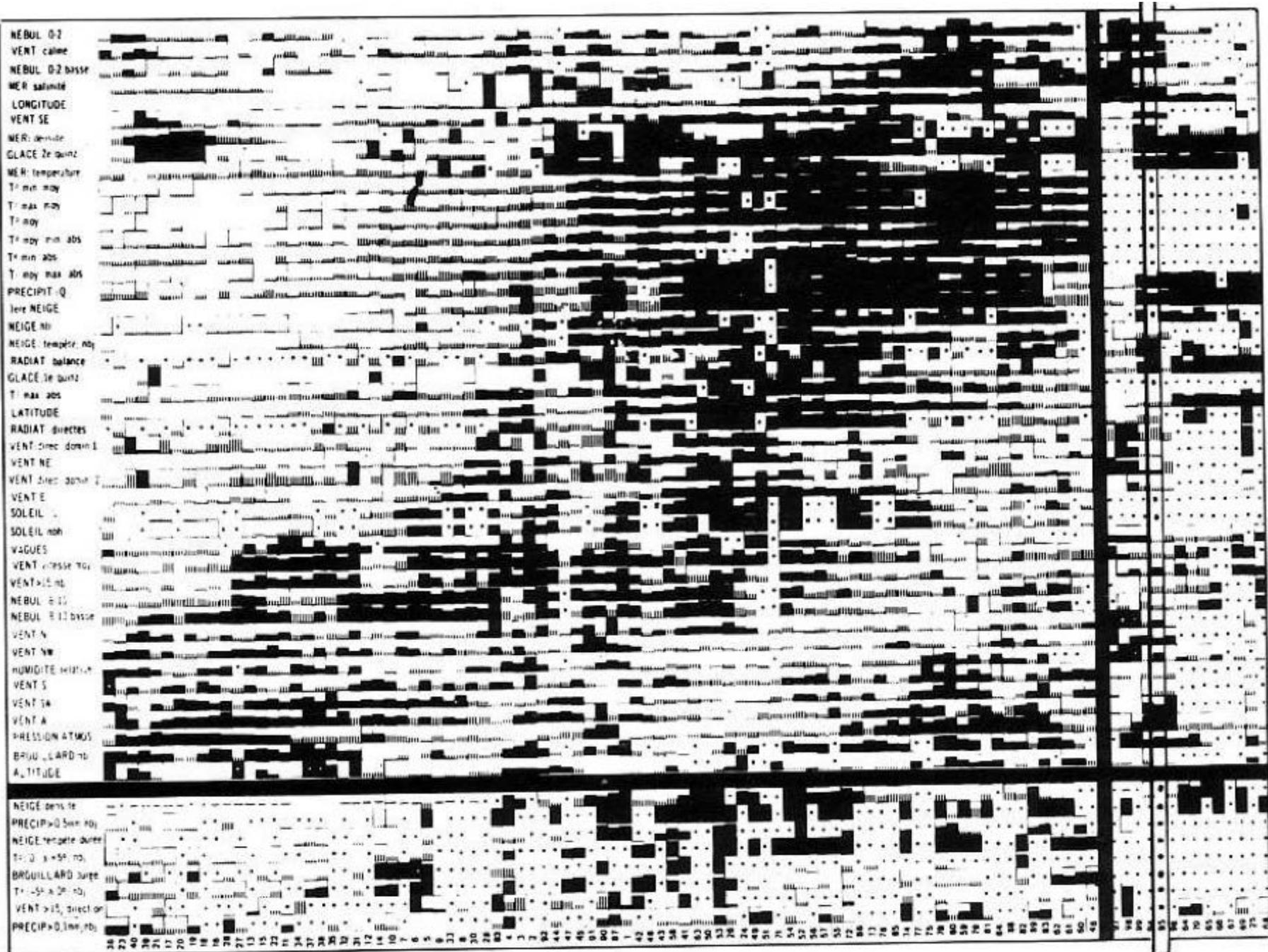


propriétés des "variables rétiennes" => cours #2



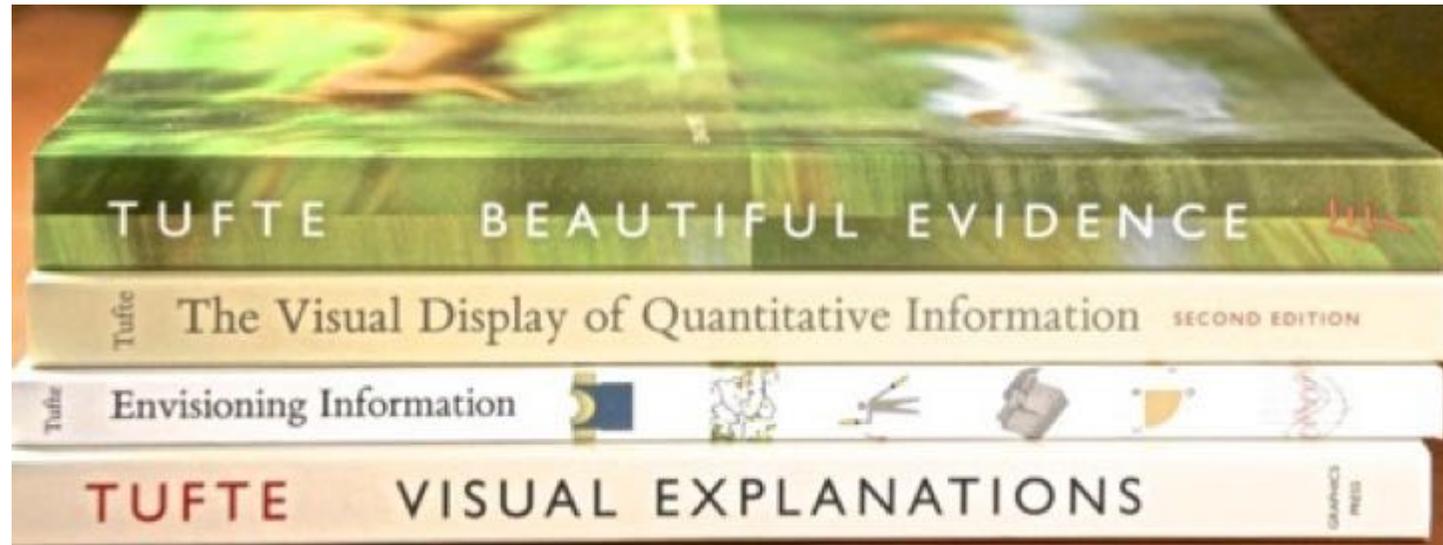
2ème livre : 1977

Matrices de permutation  
et système "Domino"



# Edward Tufte

4 livres :



<http://www.edwardtufte.com/tufte/>

- concept du data/ink ratio
- "maximize data density (within reason)"

densité= dim matrice données / surface du graphique

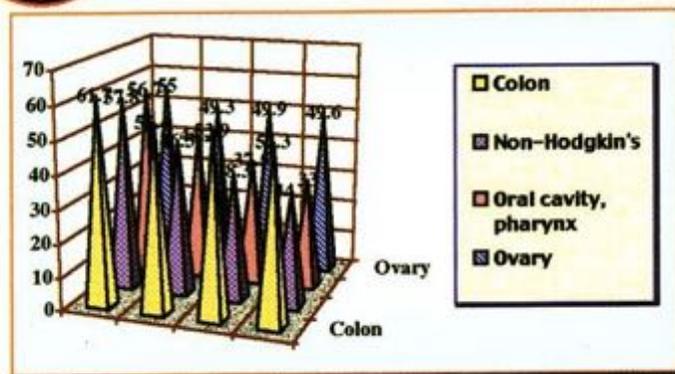
- "The graphics (...) tells a story"

# Critique du style PowerPoint (PP)

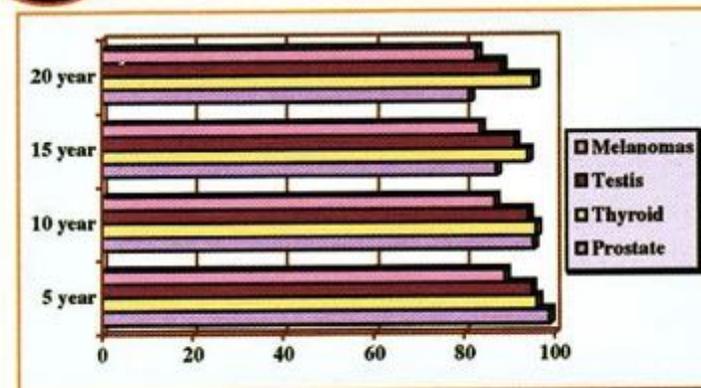
Applying the PowerPoint templates for statistical graphics to this nice straightforward table yields the analytical disasters on the facing page. These PP default-designs cause the data to explode into 6 separate chaotic slides, consuming 2.9 times the area of the table. *Everything* is wrong with these smarmy, incoherent graphs: uncomparative, thin data-density, chartjunk, encoded legends, meaningless color, logotype branding, indifference to content and evidence. Chartjunk is a clear sign of statistical stupidity; use these designs in your presentation, and your audience will quickly and correctly conclude that you don't know much about data and evidence.<sup>20</sup> Poking a finger into the eye of thought, these data graphics would turn into a nasty travesty if used for



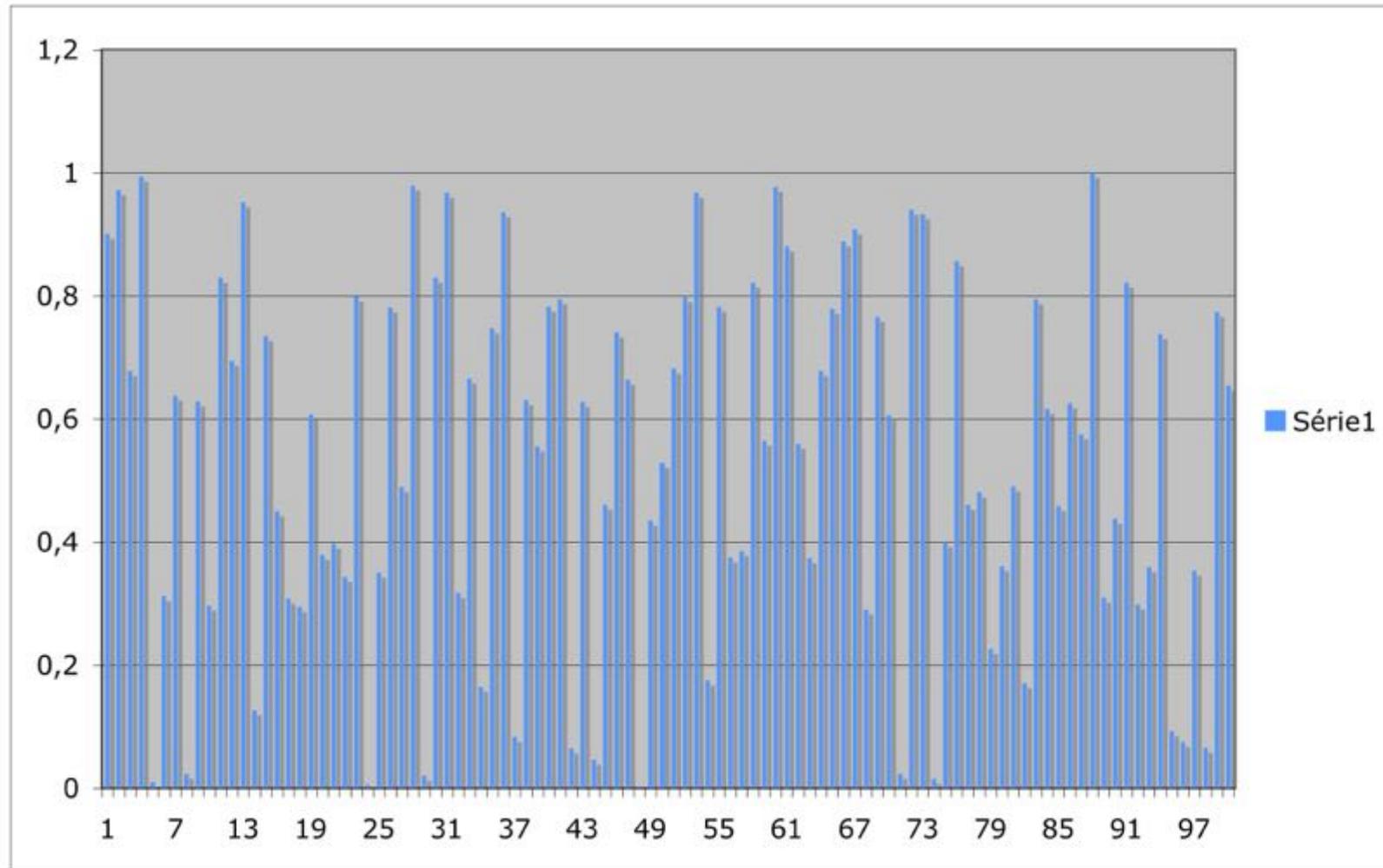
## IV. Cancer Survival Rates



## I. Cancer Survival Rates

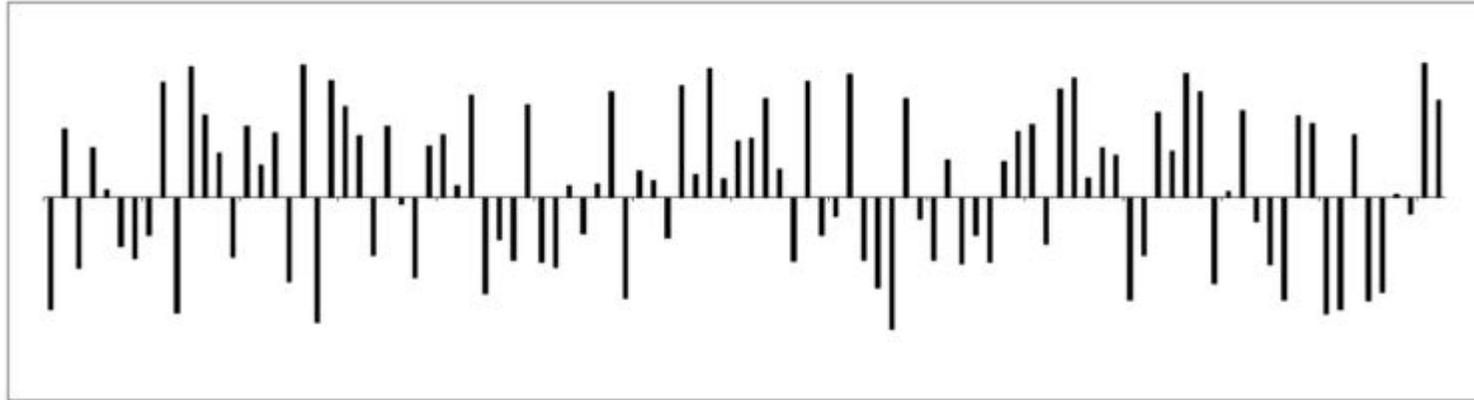


Exemple du grapheur d'Excel :

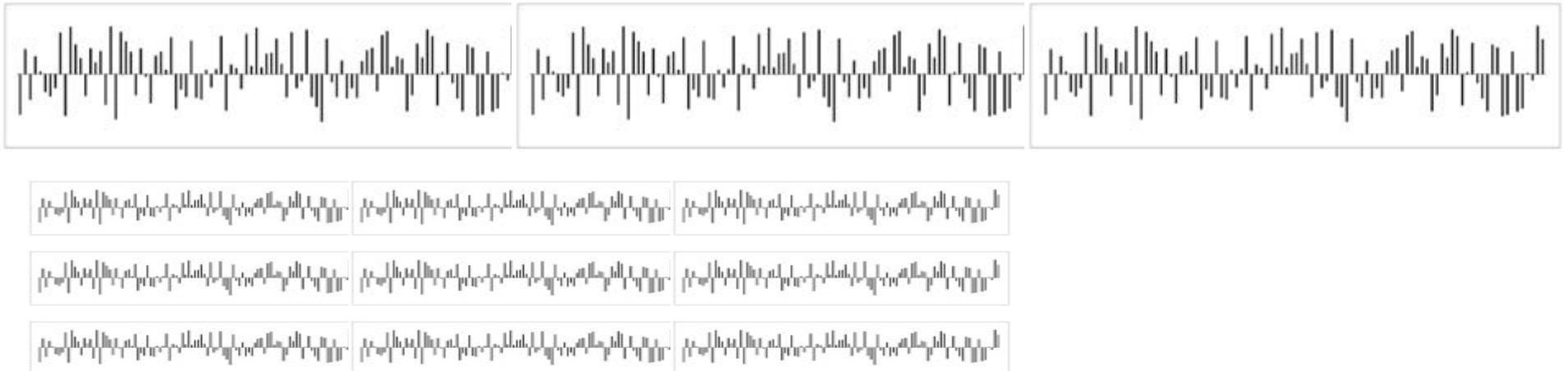


100 valeurs aléatoire entre 0 et 1, graphe par défaut

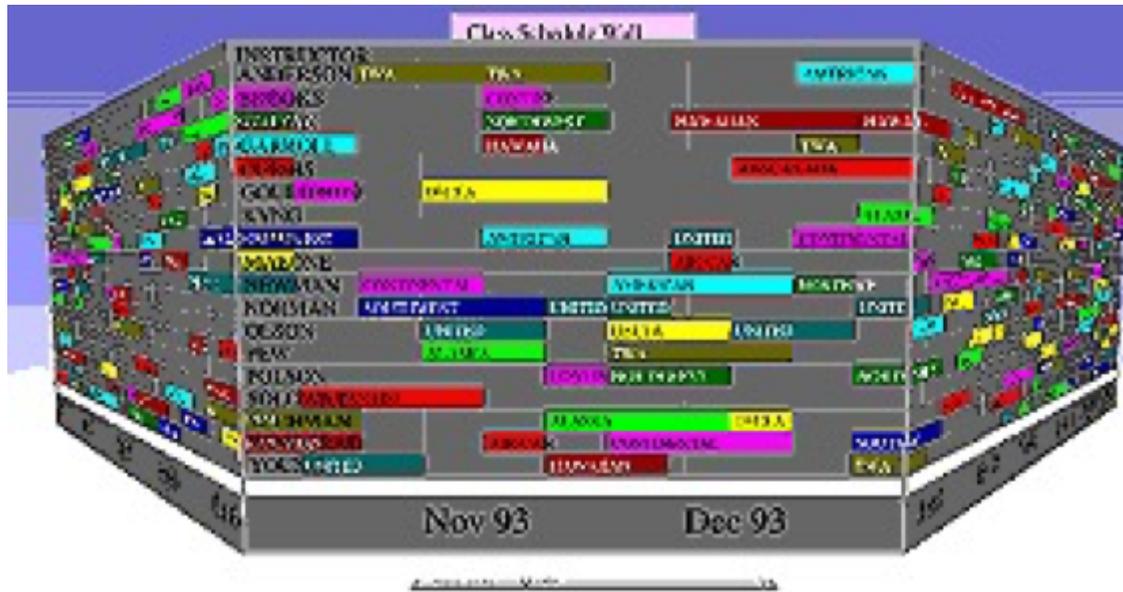
# Après application des principes de Tufte (et Bertin)



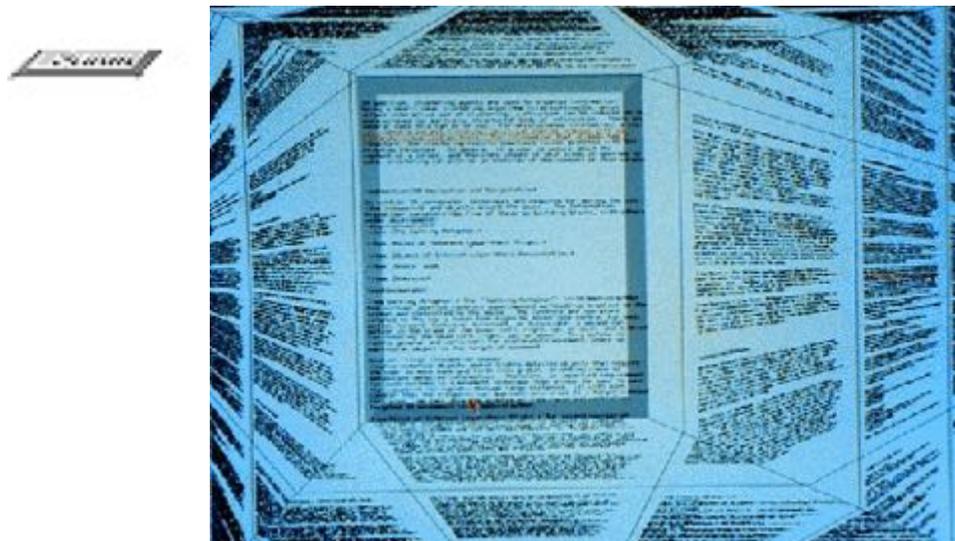
Passage à l'échelle ?



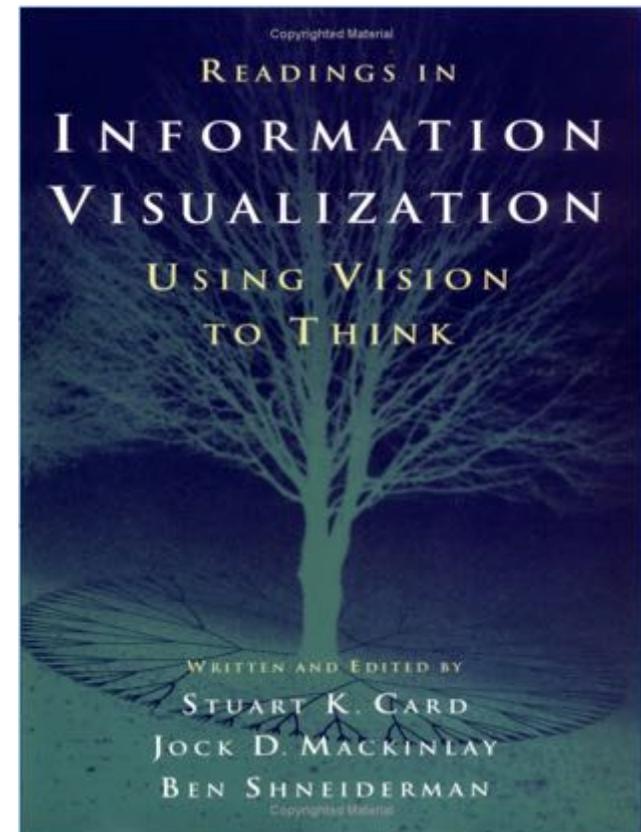




Perspective Wall



Data lens



(niveau recherche)



## visual examples | entire gallery

seeing is learning



AIDS in Perspective



Tricked Out Trochoids



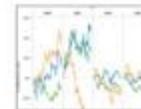
Economic Davids vs Goliaths



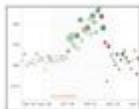
Per Capita Energy Use



"Blue-Hairing"



Hard Crash Tech Stocks



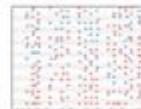
Dot.com Bubble Burst



Skittish Investors?



Buying Condos in FL?



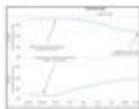
English League Soccer



Who's Online



Hurricane Tracks



Monthly Ice Cycle



Sales Pipeline



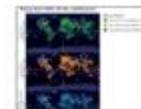
Hurricane Influences



Tropical Storm Tracks



Hot Enough Yet?

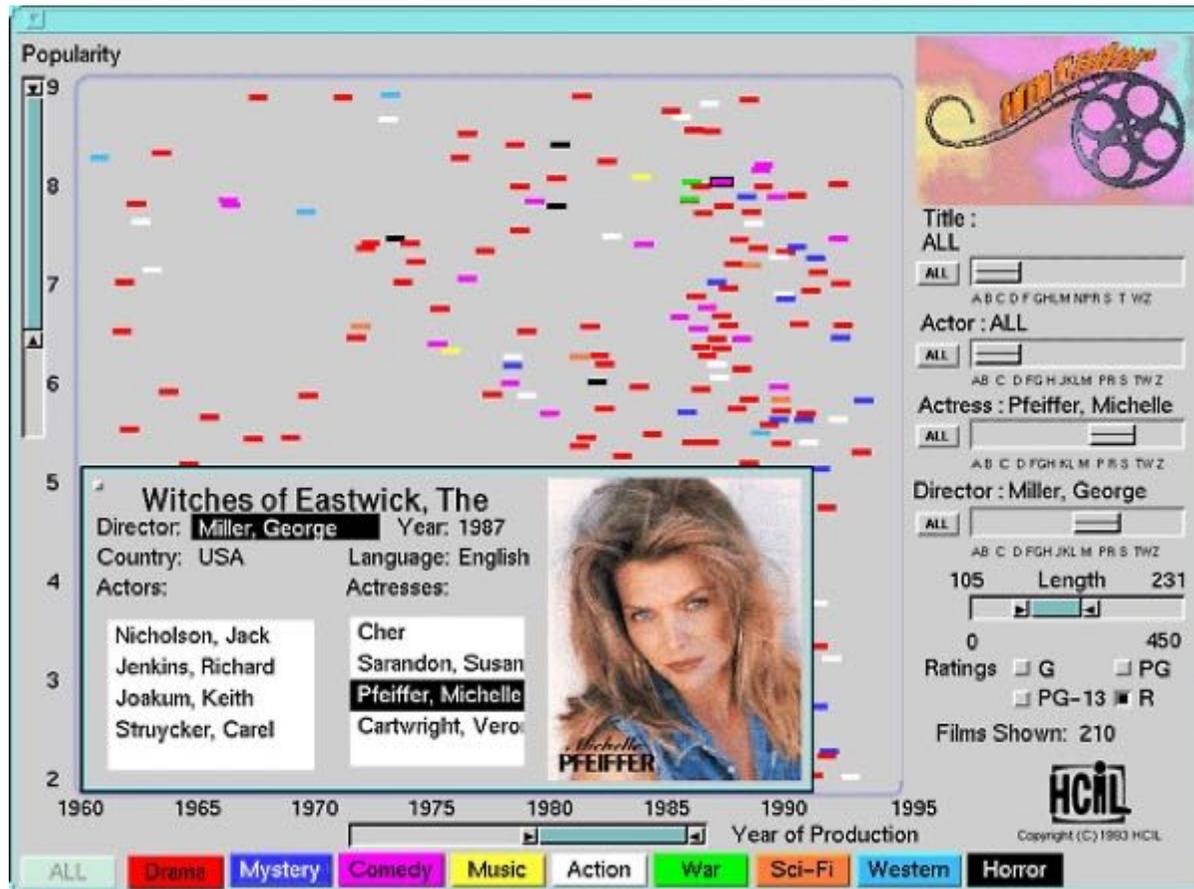


Worldwide Energy Use

# Tableau (Jock Mackinlay)

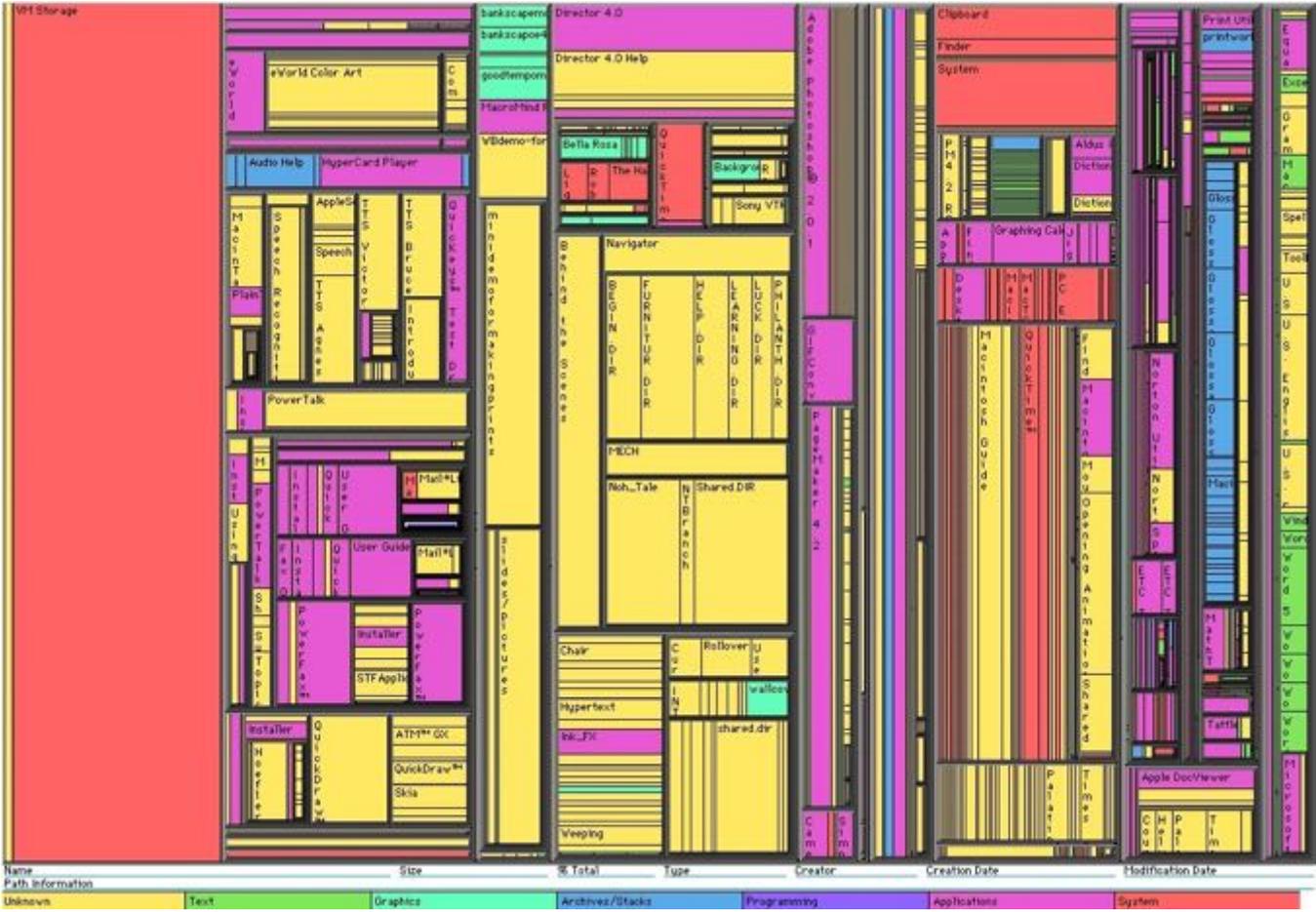
# Le HCI lab, univ. Maryland

## Dynamic queries (1993)



the FilmFinder comprised 1,838 film titles, 5,468 actors and 1,463 directors.  
Shneiderman and Ahlberg (CHI, 1994)

# Treemaps (1991)



# Infovis mantra (1996)

Overall, the bandwidth of information presentation is potentially higher in the visual domain than for media reaching any of the other senses. Humans have remarkable perceptual abilities that are greatly under-utilized in current designs. Users can scan, recognize, and recall images rapidly, and can detect changes in size, color, shape, movement, or texture. They can point to a single pixel, even in a megapixel display, and can drag one object to another to perform an action. User interfaces have been largely text-oriented, so as visual approaches are explored, appealing new opportunities are emerging.

There are many visual design guidelines but the basic principle might be summarized as the Visual Information Seeking Mantra:

Overview first, zoom and filter, then details-on-demand  
Overview first, zoom and filter, then details-on-demand

Each line represents one project in which I found myself rediscovering this principle and therefore wrote it down it as a reminder. It proved to be only a starting point

actions that users wish to perform.

The seven tasks are at a high level of abstraction. More tasks and refinements of these tasks would be natural next steps in expanding this table. The seven tasks are:

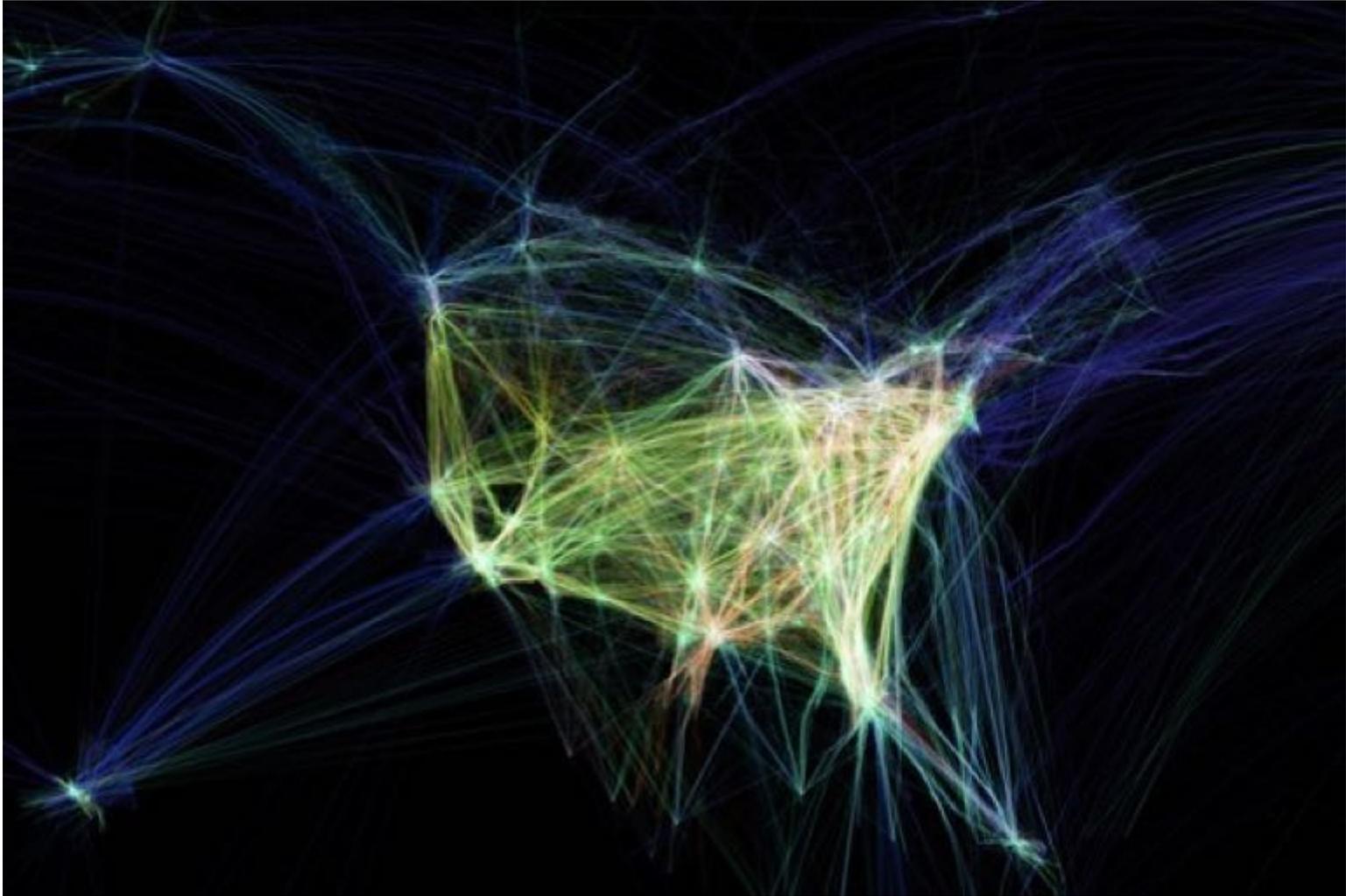
- Overview:** Gain an overview of the entire collection.
- Zoom :** Zoom in on items of interest
- Filter:** filter out uninteresting items.
- Details-on-demand:** Select an item or group and get details when needed.
- Relate:** View relationships among items.
- History:** Keep a history of actions to support undo, replay, and progressive refinement.
- Extract:** Allow extraction of sub-collections and of the query parameters.

Further discussion of the tasks follows the descriptions of the seven data types:

**1-dimensional:** linear data types include textual documents, program source code, and alphabetical lists of names which are all organized in a sequential manner. Each item in the collection is a line of text containing a string of characters. Additional line attributes might be the date of last update or author name. Interface design issues include what fonts, color, size to use and what overview, scrolling, or selection methods can be used. User problems might be to find the number of items, see items having



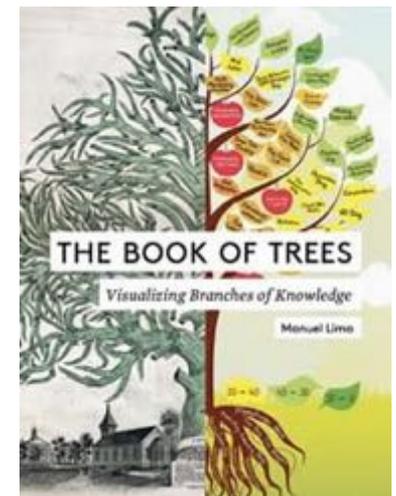
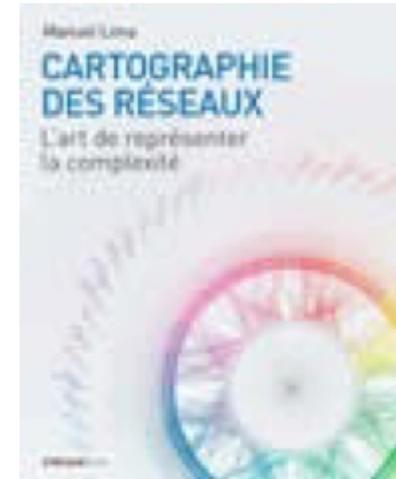




Aaron Koblin "Flight patterns" 2009

# Manuel Lina

The screenshot shows the homepage of the Visual Complexity website. At the top, there is a navigation bar with links for Home, About, VC Book, Stats, Blog, Books, Links, and Contact. A search bar is located in the top right, with the text "Search the VC database:" and a "GO" button. Below the navigation bar, the "visual complexity" logo is on the left. The main content area is titled "Latest Projects:" and features a grid of 48 thumbnail images of various network visualizations. To the right of the grid, there is a "Filter by:" section with a dropdown menu set to "SUBJECT". Below this, a list of subjects and their corresponding project counts is displayed: Art (69), Biology (55), Business Networks (42), Computer Systems (34), Food Webs (8), Internet (31), Knowledge Networks (128), Multi-Domain Representation (66), Music (41), Others (69), Pattern Recognition (46), Political Networks (32), Semantic Networks (44), Social Networks (123), Transportation Networks (57), and World Wide Web (55). A "See All (900)" link is provided below the list. At the bottom right of the grid, there is a promotional banner for the "visual complexity" book, "Mapping Patterns of Information", with a "Buy now" button.



<http://www.visualcomplexity.com/>

## 6. Explosion de sites et de logiciels !

Log in / create account

Page Discussion Read View source Search

### Main Page

welcome to the *InfoVis:Wiki*, the **Information Visualization** community platform

#### News

How to enter news?

- News: 2015-05-04: 2nd CIP: 4th International Workshop on Theory and Application of Visualizations and Human-centric Aspects in Processes (TAProVis'15) at BPM 2015 (Deadline: 29 May 2015)
- News: 2015-04-22: Job: Research Assistant (PhD Position) in InfoVis / Visual Analytics, Johannes Kepler University Linz, Austria
- News: 2015-04-22: Job: Research Assistant (PhD Position) in InfoVis / Visual Analytics, Johannes Kepler University Linz, Austria
- News: 2015-04-20: Job: Postdoc position, InfoVis/HCI, visualizing image construction in astrophysics, Nantes & Paris Saclay, France (Fall 2015)
- News: 2015-03-18: Job: Instructor needed for Information Visualization, School of Information, San Jose State University (Fall 2015)
- News: 2015-03-18: Job: PhD position in Visual Analytics, University of Montpellier, France (Deadline 1 May 2015)
- News: 2015-03-17: Job: PhD position in Interactive Visualization of Biological

The InfoVis:Wiki project is developments and news on all areas and aspects of Information Visualization. Using editable-by-anyone Wiki technology turned out to be the only way of keeping the presented information up to date and knowledge exchange vivid. Check out our top contributors list ...

<http://www.infovis-wiki.net/>

visualizing.org

Home Visualizations Data Challenges Community

Upload Your Work

### visualizing.org

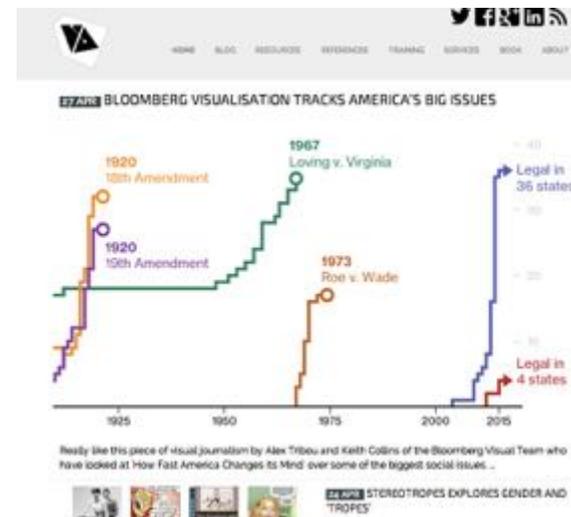
A community of creative people making sense of complex issues through data and design — join us

Share Your Work Find Visualizations

Open Data Challenges

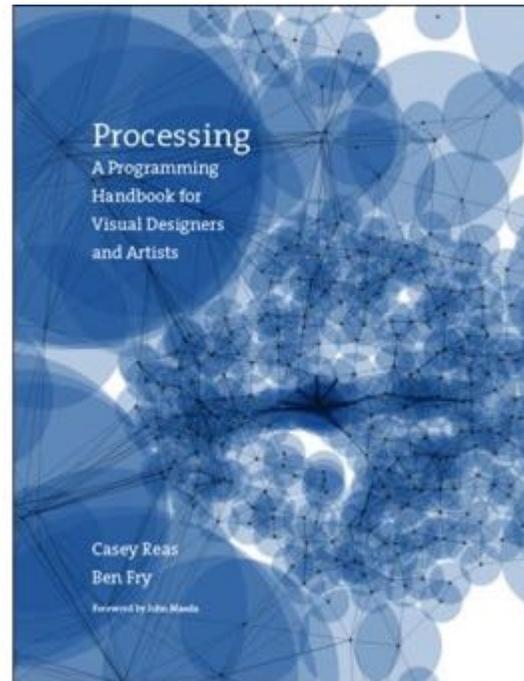
Featured Visualizations

<http://visualizing.org/>

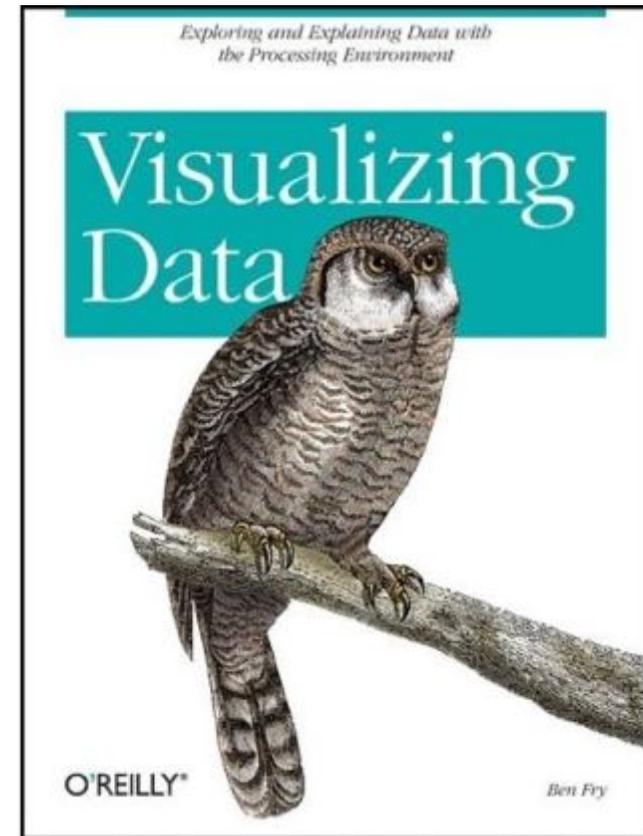


<http://www.visualisingdata.com/>

<http://processing.org>



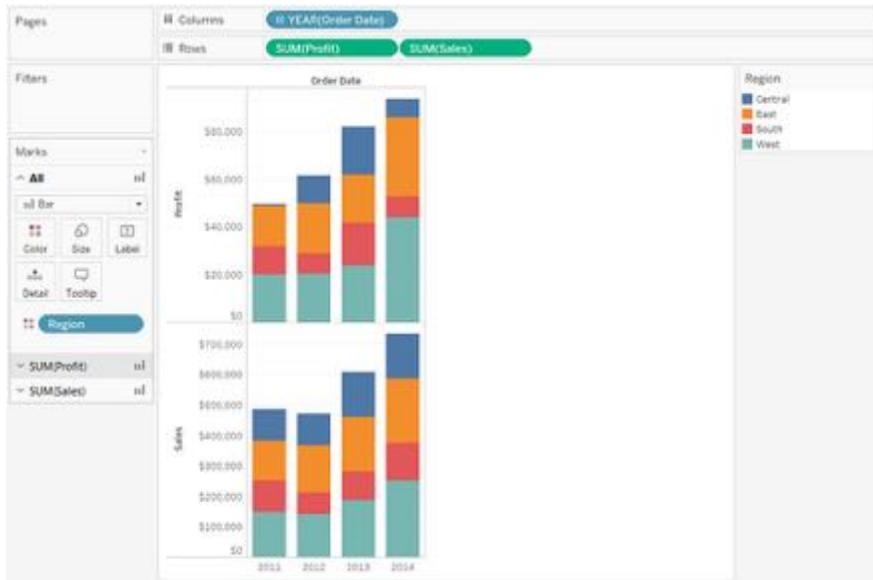
C. REAS & B. FRY



B. FRY

D3 <http://d3js.org/>

Tableau



=> pour les "dashboard"

Overview Examples Documentation Source

## Data-Driven Documents

**D3.js** is a JavaScript library for manipulating documents based on data. **D3.js** helps you bring data to life using HTML, SVG, and CSS. **D3.js**'s emphasis on web standards gives you the full capabilities of modern browsers without tying yourself to a proprietary framework, combining powerful visualization components and a data-driven approach to DOM manipulation.

Download the latest version (3.5.5) here:

See more examples.

+ vega (sur github)

Vega Examples Tutorials Documentation Usage About GitHub

## Vega – A Visualization Grammar

**Vega** is a visualization grammar, a declarative language for creating, saving, and sharing interactive visualization designs. With Vega, you can describe the visual appearance and interactive behavior of a visualization in a JSON format, and generate web-based views using Canvas or SVG.

Vega provides basic building blocks for a wide variety of visualization designs: data loading and transformation, scales, map projections, axes, legends, and orchestral marks

Version 5.1

# A ETUDIER EN TP ?

[About](#) [Blog](#) [Learning](#) [Gallery](#) [Sponsors](#) [Support us](#) [Documentation](#)

## RAWGraphs

The missing link between spreadsheets and data visualization.

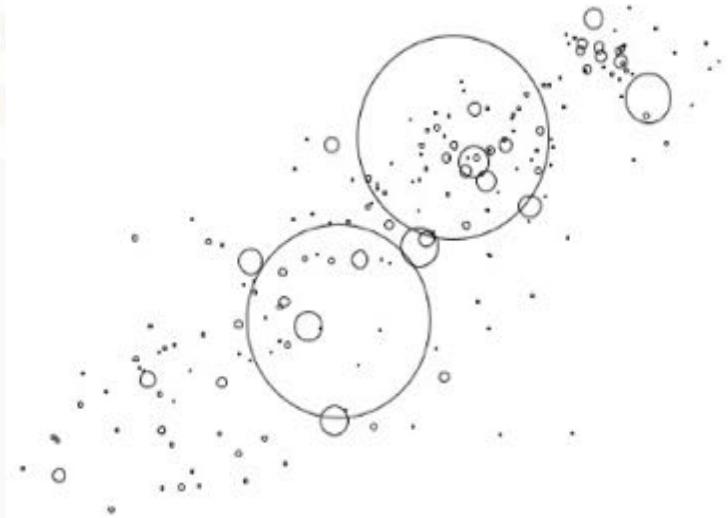
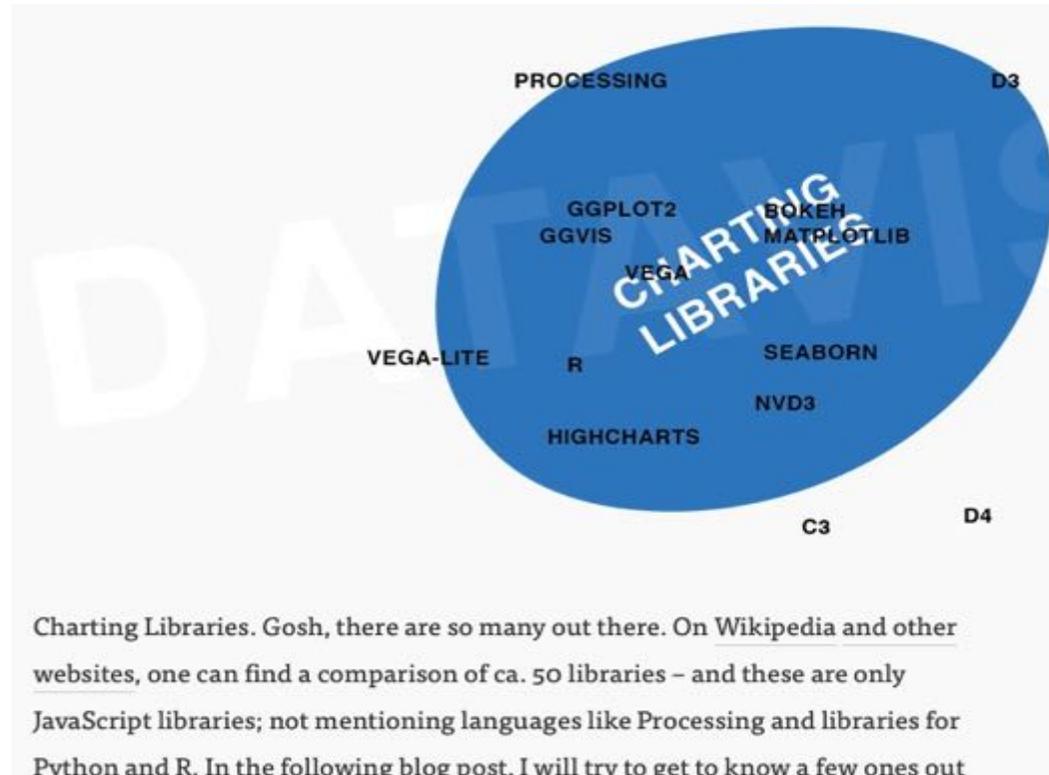
USE IT NOW!

FORK IT ON GITHUB!



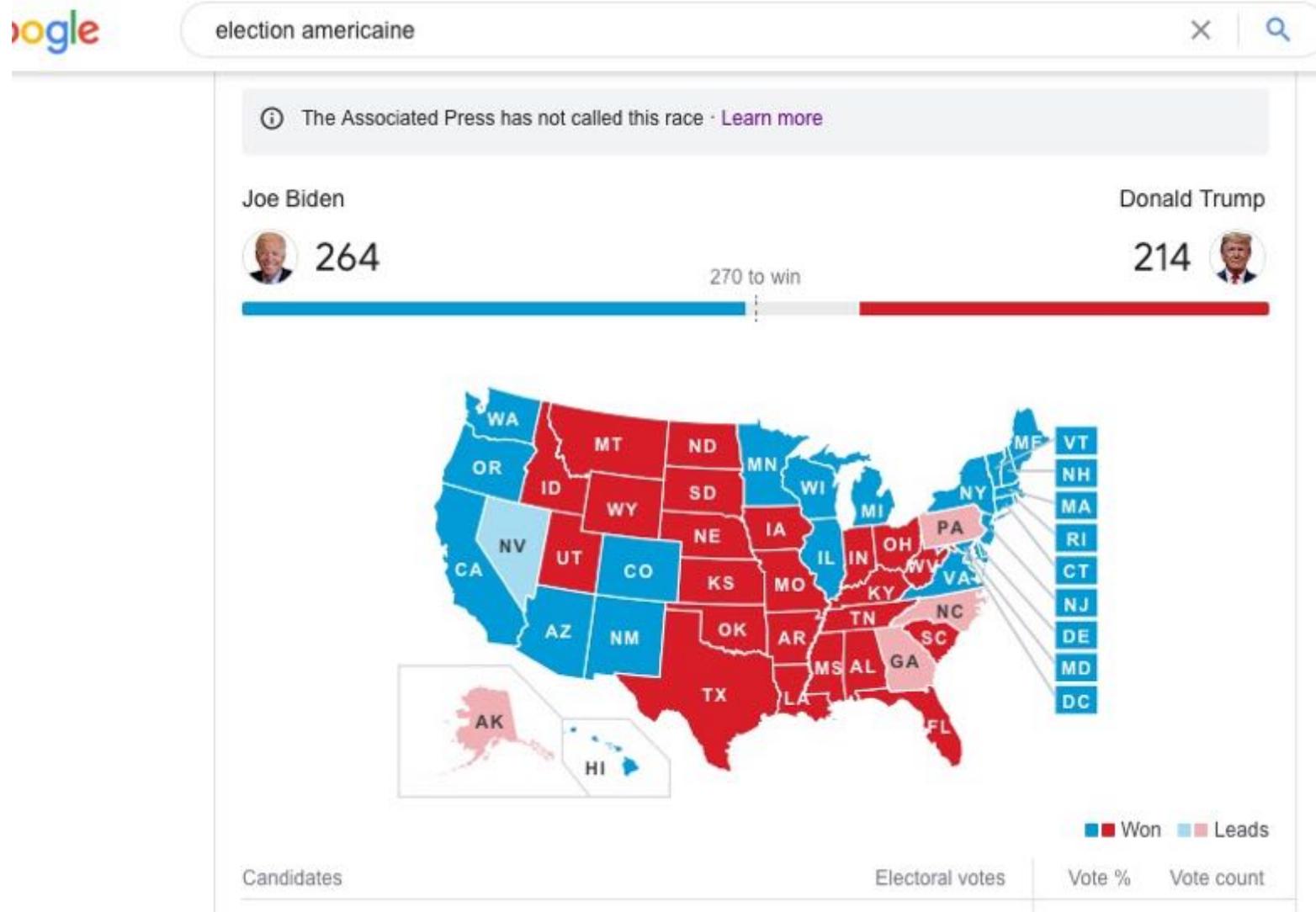
<https://rawgraphs.io>

## Un comparatif à étudier



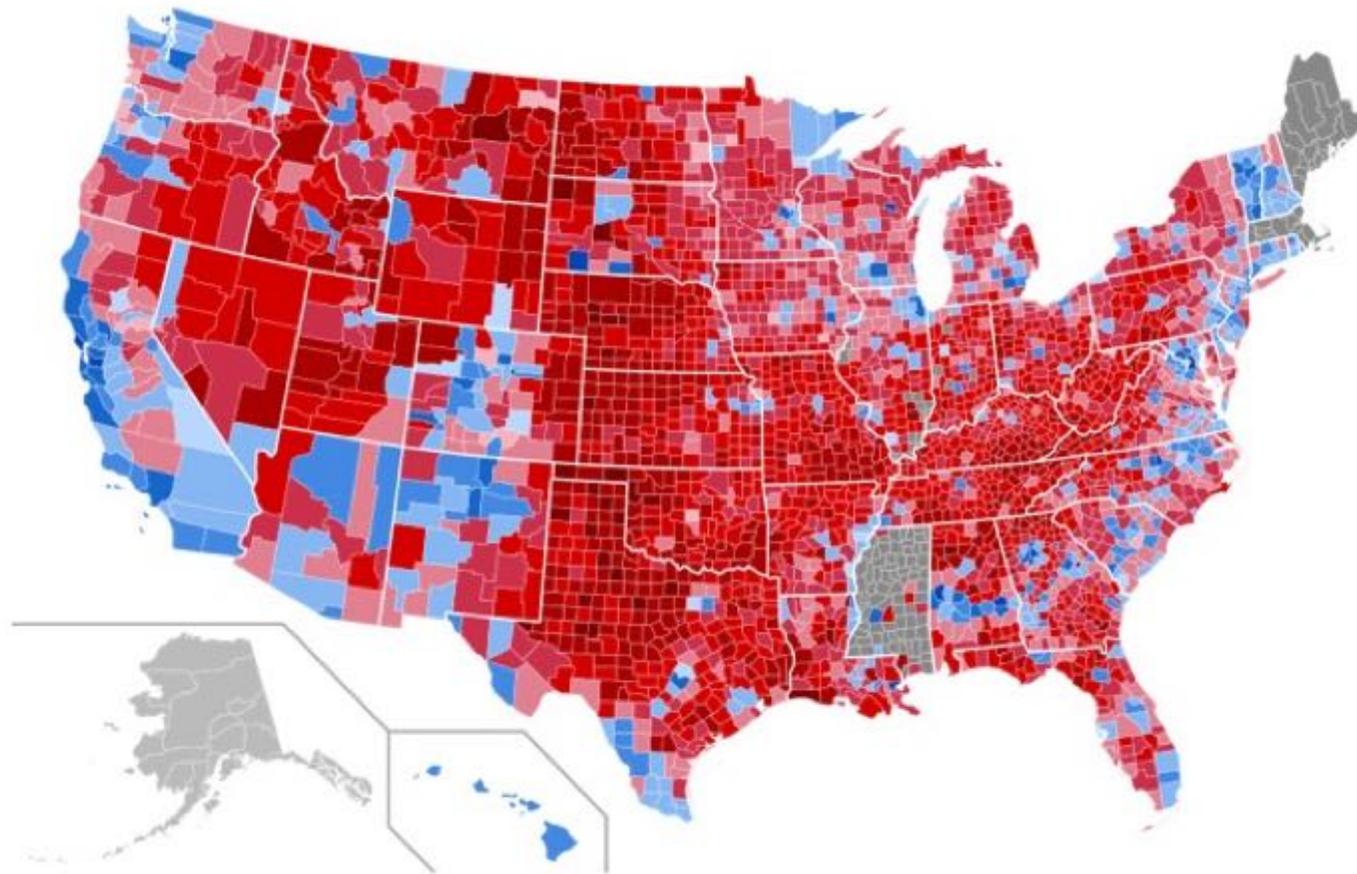
<https://lisacharlottemuth.com/2016/05/17/one-chart-code/>

# Un exemple d'avant le COVID : élections USA



qui gagne ? rouge ou bleu ?

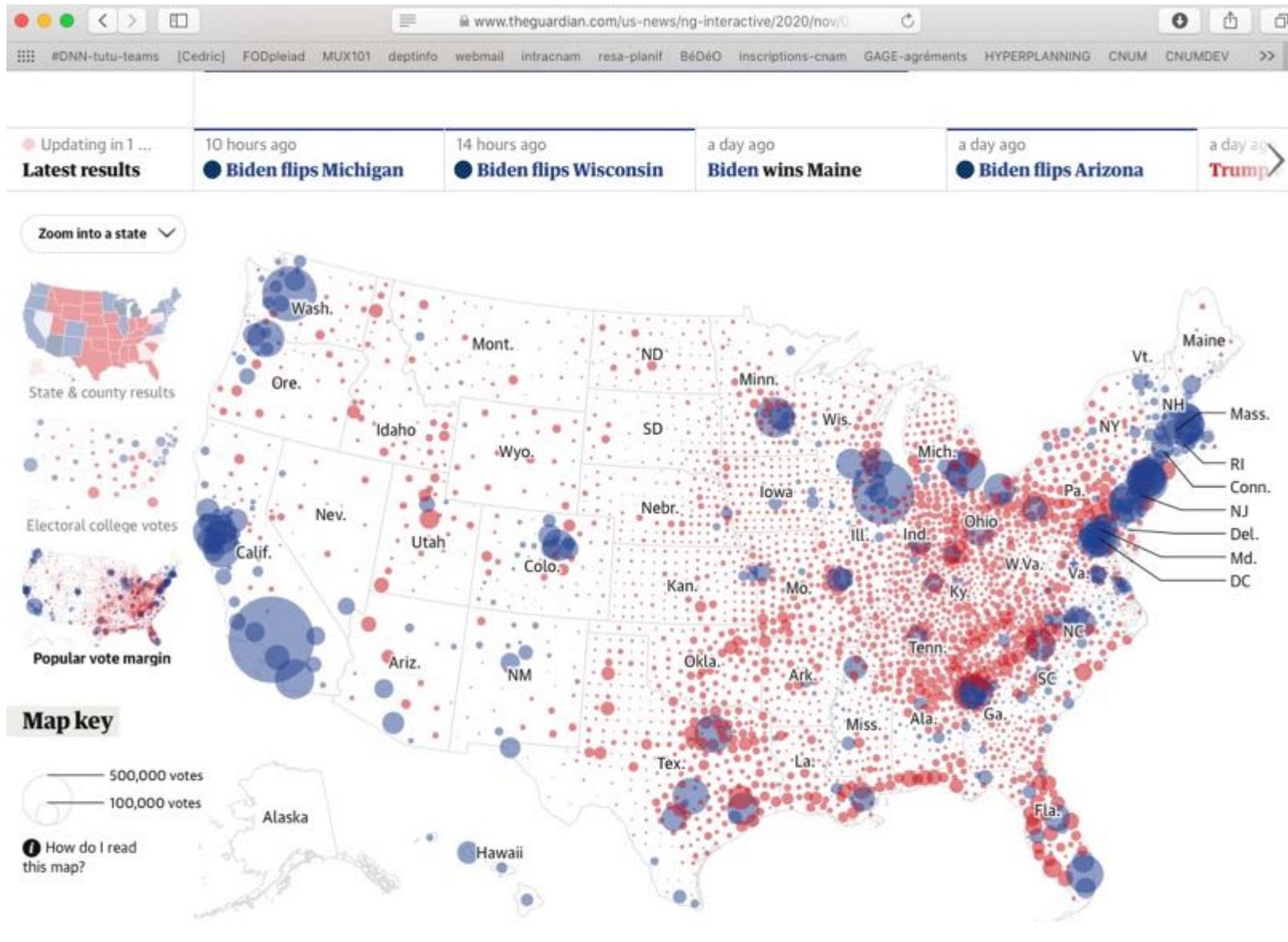
niveau de détail accru => permet une analyse plus fine



Preliminary election results by county

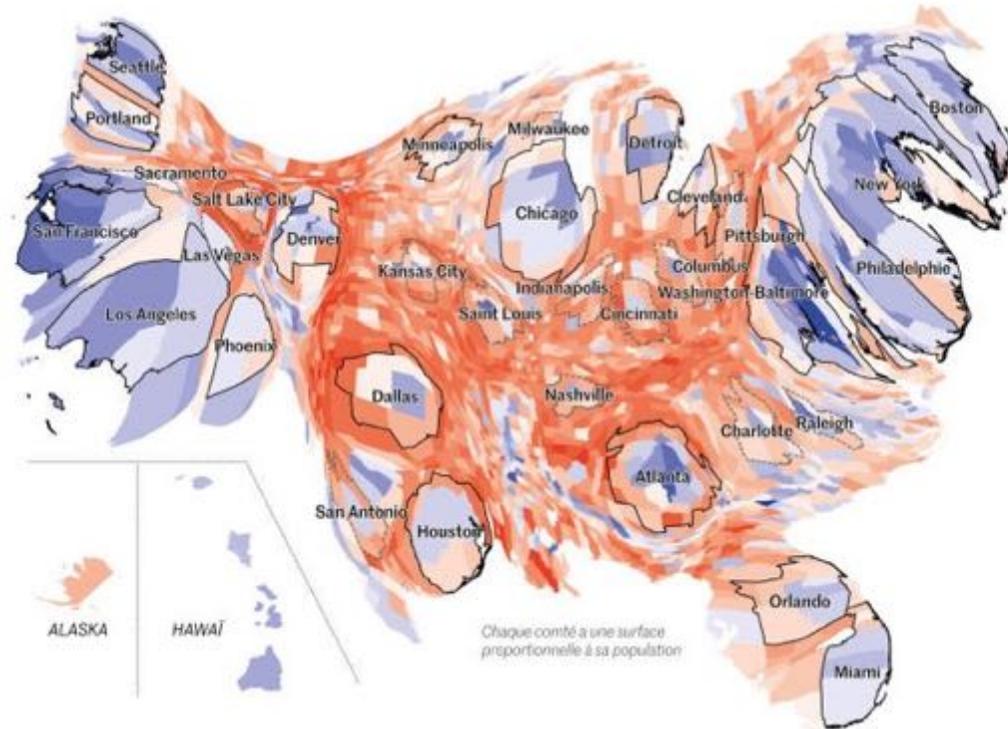
(wikipedia)

# Prise en compte de la densité de population

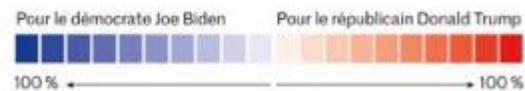


idem par anamorphose => dernier cours

### Les aires urbaines de plus de 2 millions d'habitants votent Joe Biden



Résultats par comté à l'élection présidentielle américaine, selon le poids de la population, décompte partiel au 5 novembre (11 h 30, heure de Paris)



Aires urbaines (CSA)  
□ entre 2 et 3 millions d'habitants □ plus de 3 millions d'habitants

- 1 conseiller éventuelle site nuclé.
- 2 L'épidémi popularit comploti:
- 3 Espace : le perdu pe lancer