

Actionable Data Visualizations

Katy Börner [@katycns](https://twitter.com/katycns)

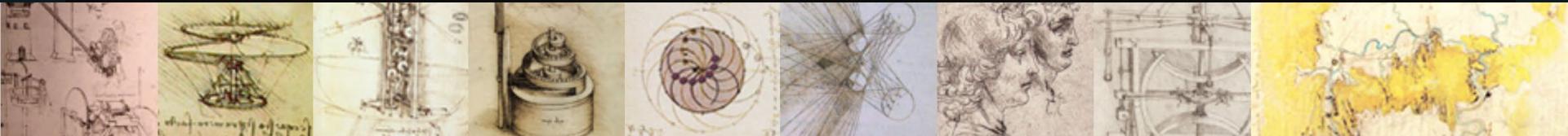
Victor H. Yngve Distinguished Professor of
Intelligent Systems Engineering & Information Science
Director, Cyberinfrastructure for Network Science Center
School of Informatics, Computing, and Engineering
Indiana University Network Science Institute (IUNI)
Indiana University, Bloomington, IN, USA
2018 Humboldt Fellow, TU Dresden, Germany



Data Science Meets Social Science

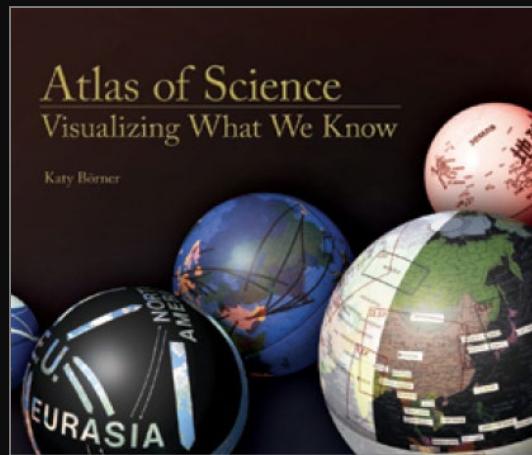
(formerly presented at The European Summer University in Digital Humanities, July 17, 2018)

Social Science Research Commons (SSRC), IUB
September 27, 2018



Maps of Science & Technology

Using large scale datasets, advanced data mining and visualization techniques, and substantial computing resources.



Maps of Science & Technology

<http://scimaps.org>



101st Annual Meeting of the Association of American Geographers, Denver, CO.
April 5th - 9th, 2005 (First showing of Places & Spaces)



University of Miami, Miami, FL.
September 4 - December 11, 2014.



Duke University, Durham, NC.
January 12 - April 10, 2015



The David J. Sencer CDC Museum, Atlanta, GA.
January 25 - June 17, 2016.

100 maps and 12 macroscopes by 215 experts on display at 354 venues in 28 countries.



100 Maps of Science on Display in Hörsaalzentrum (Augustusplatz), Uni Leipzig, July 13-30, 2018



Opening of the
Exhibition is on
7/18, 2018, 18:15



ESU Summer Workshops

- [XML-TEI document encoding, structuring, rendering and transformation](#)
- [Hands on Humanities Data Workshop - Creation, Discovery and Analysis](#)
- [Collocations from a multilingual perspective: theory, tools, and applications](#)
- [Reflected Text Analysis in the Digital Humanities](#)
- [Humanities Data and Mapping Environments](#)
- [Building and analysing multimodal corpora](#)
- [Stylometry](#)
- [Asking questions to data in the humanities: right, correct, efficient \(Introducing and comparing XQuery, SQL, SPARQL for data from the humanities\)](#)
- [Computer Vision Intervention. How digital methods help to visually understand corpora of art and cultural heritage](#)
- [Integrating Human Science Data using CIDOC-CRM as Formal Ontology: a practical approach](#)
- [The humanities scholar's perspective on rule based machine translation](#)
- [Word Vectors and Corpus Text Mining with Python](#)
- [Text Mining with Canonical Text Services](#)
- [How Research Infrastructures empower eHumanities and eHeritage Research\(ers\)](#)
- [Introduction to Project Management](#)

A New Map of the WHOLE
According to y^e latest and most Exact Obs-

WORLD with the Trade winds
erations By H. Moll Geographer.

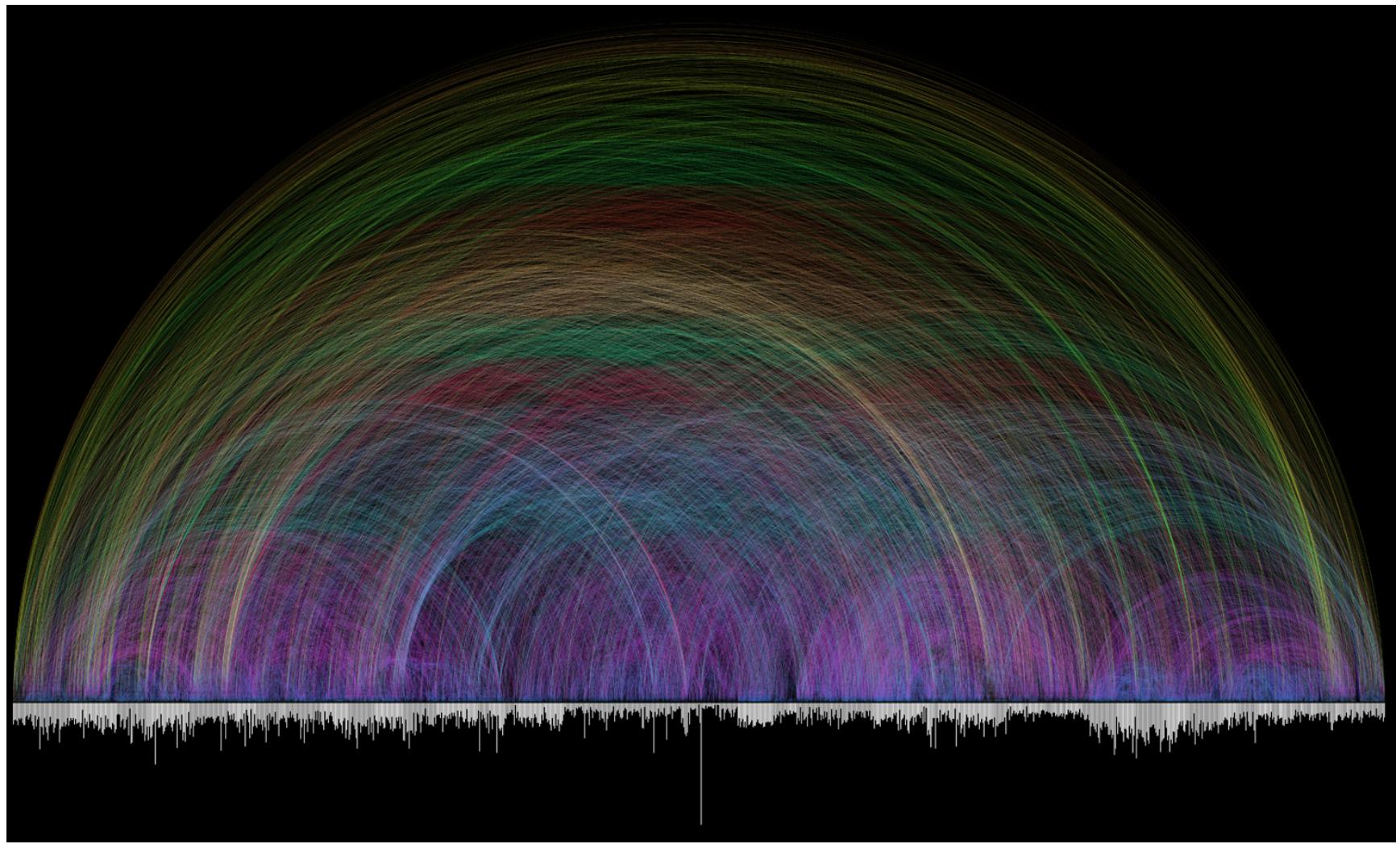
In this Map is inserted A View of y^e General & Coasting Trade-winds, Monsoons, or y^e Shifting Trade-winds. Note that y^e Arrows among y^e Lines shew y^e Course of those General & Coasting winds. and y^e Arrows in y^e void Spaces shew y^e Course of y^e Shifting Trade-winds, and y^e Abbreviation Sept &c.

Show y^e Times of y^e Year when
such Winds Blow.

The Signs of the Zodiac. The first 6 are Northern, the others Southern signs.
 I Aries . March & Leo . July
 II Taurus . April & Virgo . August
 III Gemini . May & Libra . September
 IV Cancer . June & Scorpio . October
 V Leo . July & Sagittarius . November
 VI Virgo . August & Capricornus . December
 VII Libra . September & Aquarius . January
 VIII Scorpio . October & Pisces . February



Printed for Tho: Bowles Print and Map Seller next to Chapter House in St Pauls Church yard; and John Bowles Print and Map Seller at the Black Horse in Cornhill London.

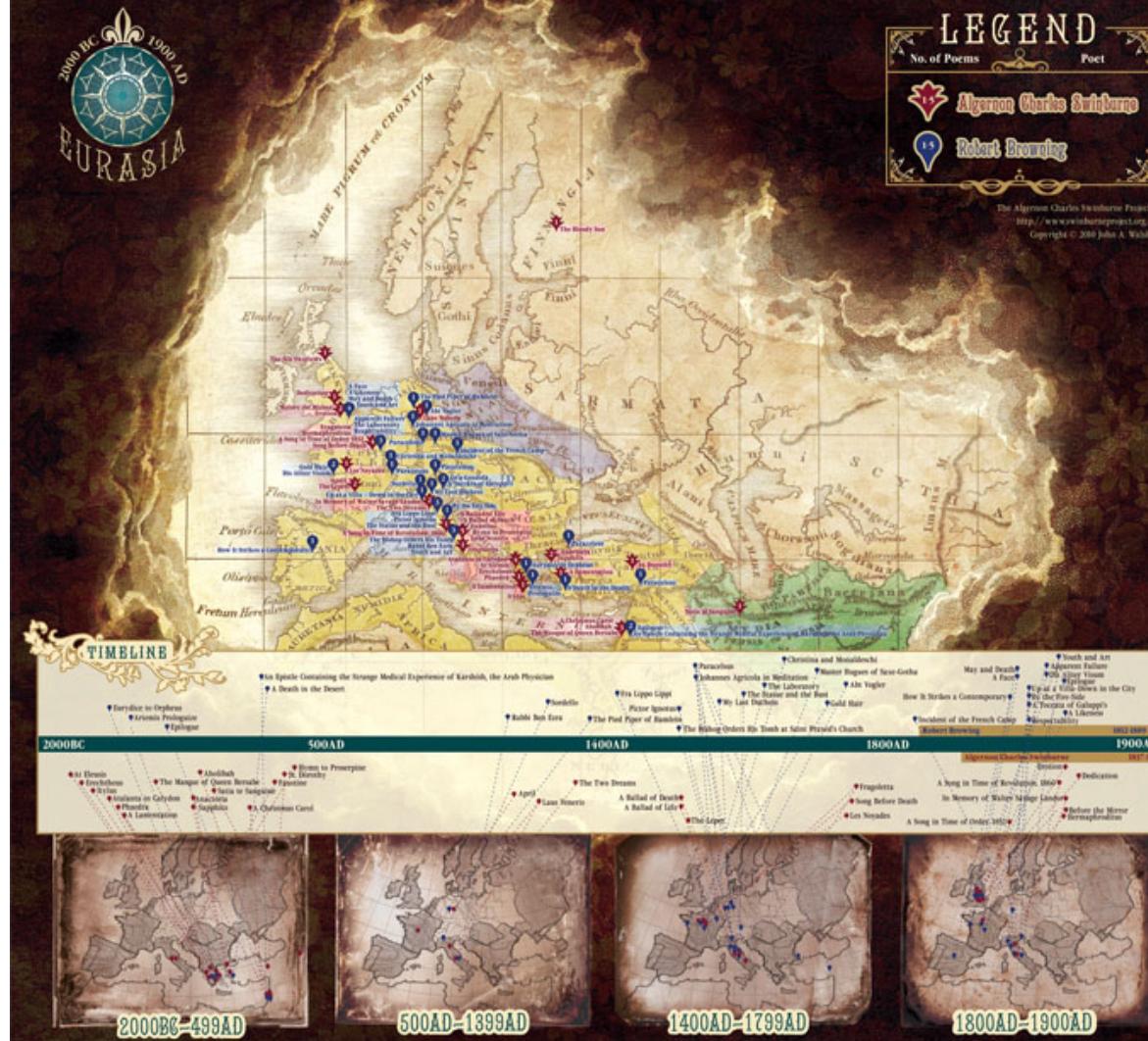


VII.3 Visualizing Bible Cross-References - Chris Harrison and Christoph Römhild - 2008

Literary Empires

Mapping Temporal & Spatial Settings of Victorian Poetry

*Look, the world tempts you, eye,
And we would know it all!
We may the starry sky,
We miss the earthen ball.
We measure the sea tides, we number the sea sand;*
*We scrutinize the dates
Of long-past human things,
The scenes of affliction, states,
In times of deepest kings.
We search and dead men's words, and works of dead men's bands.*



the temporal and spatial settings of individual literary works, one can map and visualize the distribution of literary writings across historical periods and geographic space; compare these data to other information, such as year of publication or composition and visualise networks of authors and works sharing common settings. The data set is a growing collection of work titles, dates, date ranges, and geographic identifiers and coordinates. Challenges include settings of imprecise, legendary, and fictional time and place.

The map here is based on a sampling of poems by Victorian poets Robert Browning and Nigerian Charles Iwundu. A prototype online version is available at <http://patrickcraig.iwunduhomereadings.vic.accessex.ac.uk/>.

Poems Sorted by Temporal Settings

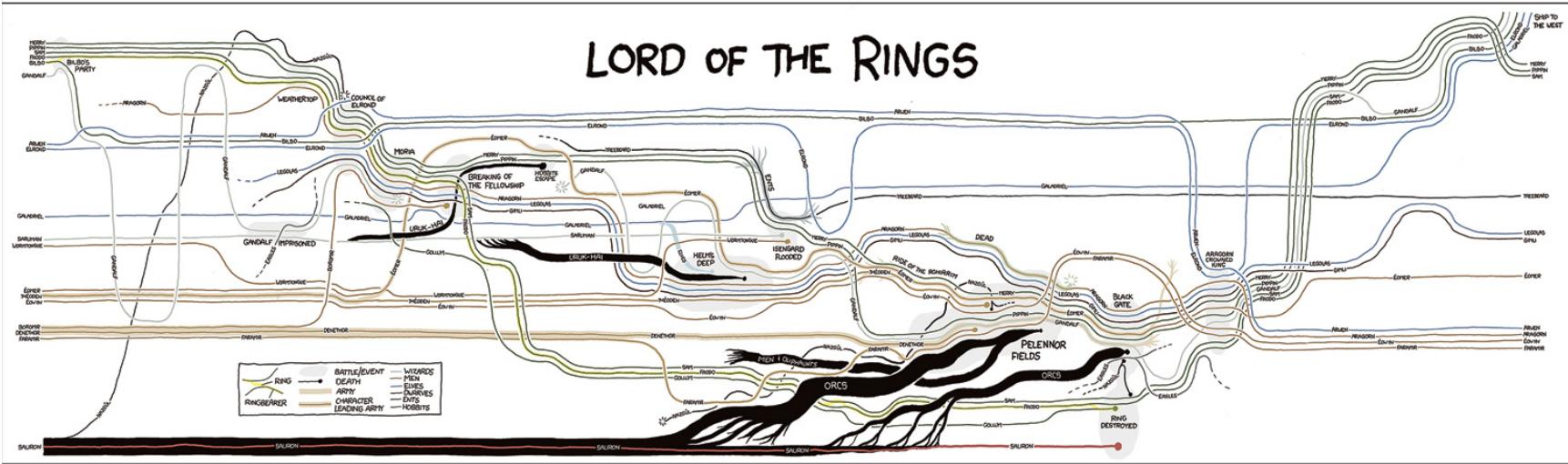
Time	Place	Poet	Poem	Collection
1004	Oxford	Swidulfus	Indiction	Poems and Ballads, First Series (1864)
1004	London	Swidulfus	Before the Mirror	Poems and Ballads, First Series (1864)
1004	London	Swidulfus	Erlotan	Poems and Ballads, First Series (1864)
1004	London	Swidulfus	In Memory of Walter Savage Landor	Poems and Ballads, First Series (1864)
1004	London	Browning	A Litel Lee	Sonnets Personae (1864)
1005	Paris	Swidulfus	Vergeronion	Poems and Ballads, First Series (1864)
1005	France	Browning	Apolyne	Dramatic Personae (1864)
1006	Italy	Swidulfus	A Song in Time of Revolution, 1000	Poems and Ballads, First Series (1864)
1006	Rome; London	Browning	Ironies and Arts	Dramatic Personae (1864)
1006	Paris	Browning	Apparition Failure	Dramatic Personae (1864)
1006	French coast	Browning	The Old Vicar of St. Le Bihan	Sonnets Personae (1864)
1007	Spain	Browning	Up a Vital-Down in the Day	Men and Women (1864)
1008	Italy	Browning	By the Five Pines	Men and Women (1864)
1008	Paris	Browning	S. Tertius of Galapagos	Men and Women (1864)
1008	Tuscany	Browning	Interpretable	Men and Women (1864)
1002	Paris	Swidulfus	A Song in Time of Order, 1002	Poems and Ballads, First Series (1864)
1002	England	Browning	A Face	Dramatic Personae (1864)
1002	Dulwich Wood, London	Browning	May and Death	Dramatic Personae (1864)
1003	Madrid	Browning	How It Works a Contemporary	Men and Women (1864)
1009	Rosillon, Germany	Browning	Incident of the French Camp	Dramatic Lyrical (1862)
1009	Paris, Naples	Swidulfus	Frigidaria	Poems and Ballads, First Series (1864)
1005	Paris	Swidulfus	Song Before Death	Poems and Ballads, First Series (1864)
1001	Spain	Swidulfus	Les Soyeux	Poems and Ballads, First Series (1864)
1073	Germany	Browning	The Voyager	Dramatic Personae (1864)
1052	Paris, France	Browning	Gold Hair	Dramatic Personae (1864)
1052	Saint-Germain, Germany	Browning	Master Blagoi of Saint-Germain	Men and Women (1864)
1052	Transylvania, France	Browning	Monasteries and Monarchs	Journals and Sketches (1864)
1053	Spain	Browning	The Laboratory	Men and Women and Sappho (1864)
1008	France	Browning	The Last and the Best	Men and Women (1864)
1004	France	Browning	My Little Duckie	Dramatic Tales (1862)
1000	Germany	Browning	Melancholy Apples in Melancholy	Dramatic Tales (1862)
1030	Würzburg Contzenburg, Sankt Gallen, Schaffhausen	Browning	Paracelsus	Paracelsus (1860)
1005	France	Swidulfus	The Apper	Poems and Ballads, First Series (1864)
1005	Paris	Swidulfus	A Ballad of Life	Poems and Ballads, First Series (1864)
1006	Rome	Swidulfus	A Ballad of Death	Poems and Ballads, First Series (1864)
1006	Florence	Browning	Polar Spiders	Men and Women (1864)
1006	Rome	Browning	The Bishop Prudox His Book at St. Peter's Church	Dramatic Romances and Lyrics (1864)
1005	Florence	Browning	Fra Lippo Lippi	Men and Women (1864)
1006	Hanover	Browning	The Poor of Hanover	Dramatic Lyrics (1862)
1000	Florence	Swidulfus	The Two Drunks	Poems and Ballads, First Series (1864)
1006	Verona; Rome	Swidulfus	Lamia Moysa	Poems and Ballads, First Series (1864)
1006	London	Browning	Nordolia	Sordello (1860)
1006	France	Swidulfus	April	Poems and Ballads, First Series (1864)
1010	Rome	Browning	Rabbi Ben Ezra	Dramatic Personae (1864)
1005	Rome	Browning	Ritual in Proportion	Poems and Ballads, First Series (1864)
1001	Cambridge, Mass.	Browning	Mr. Maupin	Poems and Ballads, First Series (1864)
1001	Rome	Browning	Pauline	Poems and Ballads, First Series (1864)
1006	Desert near Elgome	Browning	A Break in the Jaws	Dramatic Personae (1864)
1006	Berkeley	Browning	An Epoch Containing the Strange Medical Experience of Knobell, the Self-Poisoner	Men and Women (1864)
I	Netherland	Swidulfus	a Christmas Carol	Poems and Ballads, First Series (1864)
1000 B.C.	Egypt; Peru	Swidulfus	Star at Singorpe	Poems and Ballads, First Series (1864)
1000 B.C.	Israel and Judah	Swidulfus	Sheoloth	Poems and Ballads, First Series (1864)
1000 B.C.	London	Swidulfus	Antekora	Poems and Ballads, First Series (1864)
1000 B.C.	Greece	Swidulfus	Triglypes	Poems and Ballads, First Series (1864)
1000 B.C.	Shiloh, Israel	Browning	Apolyne	Dramatic Personae (1864)
1000 B.C.	Jerusalem	Swidulfus	The Magie of Queen Berinde	Poems and Ballads, First Series (1864)
1200 B.C.	Athens	Browning	Aratus Prologue	Dramatic Personae (1864)
1000 B.C.	Mount Ossa, Thrace	Swidulfus	A Lamentation	Poems and Ballads, First Series (1864)
1000 B.C.	Thessaly, Greece	Swidulfus	Phœnix	Poems and Ballads, First Series (1864)
1000 B.C.	Cassandra (Greece)	Browning	Barbara in Ingolstadt	Dramatic Personae (1864)
1000 B.C.	Calidonia, Greece	Swidulfus	Medea in Calydon	Studies in Calydon (1864)
1000 B.C.	Thessaly, Greece	Swidulfus	Phœnix	Poems and Ballads, First Series (1864)
1000 B.C.	Athens	Swidulfus	Proklos	Poems and Ballads, First Series (1864)
1000 B.C.	Greece, Greece	Swidulfus	At Phœnix	Poems and Ballads, First Series (1864)
—	—	Swidulfus	The Sea Phoenix	Poems and Ballads, First Series (1864)
—	—	Swidulfus	The Black Sun	Poems and Ballads, First Series (1864)
Venice	Browning	In a Gondola	Dramatic Lyrics (1862)	

VI.7 Literary Empires: Mapping Temporal and Spatial Settings of Victorian Poetry

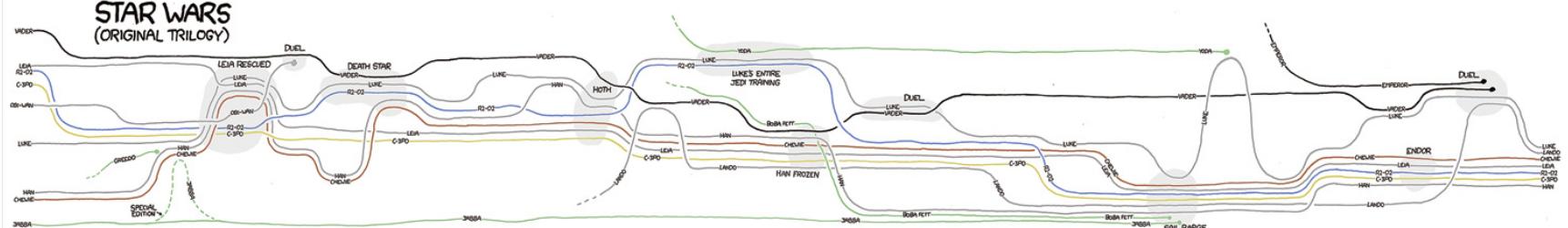
John A. Walsh, Devin Becker, Bradford Demarest, Jonathan Tweedy, Theodora Michaelidou, and Laura Pence - 2010

THESE CHARTS SHOW MOVIE CHARACTER INTERACTIONS.
THE HORIZONTAL AXIS IS TIME. THE VERTICAL GROUPING OF THE
LINES INDICATES WHICH CHARACTERS ARE TOGETHER AT A GIVEN TIME.

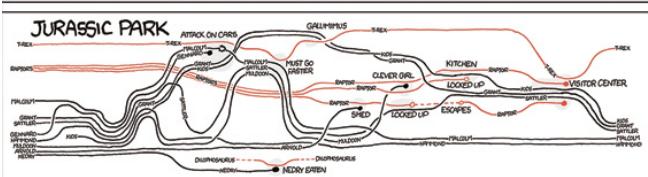
LORD OF THE RINGS



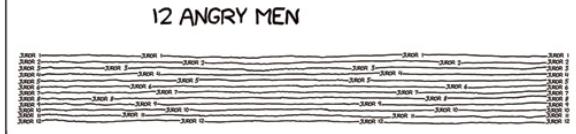
STAR WARS (ORIGINAL TRILOGY)



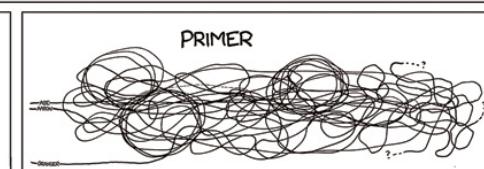
JURASSIC PARK



12 ANGRY MEN



PRIMER



Map of Scientific Collaborations from 2005-2009

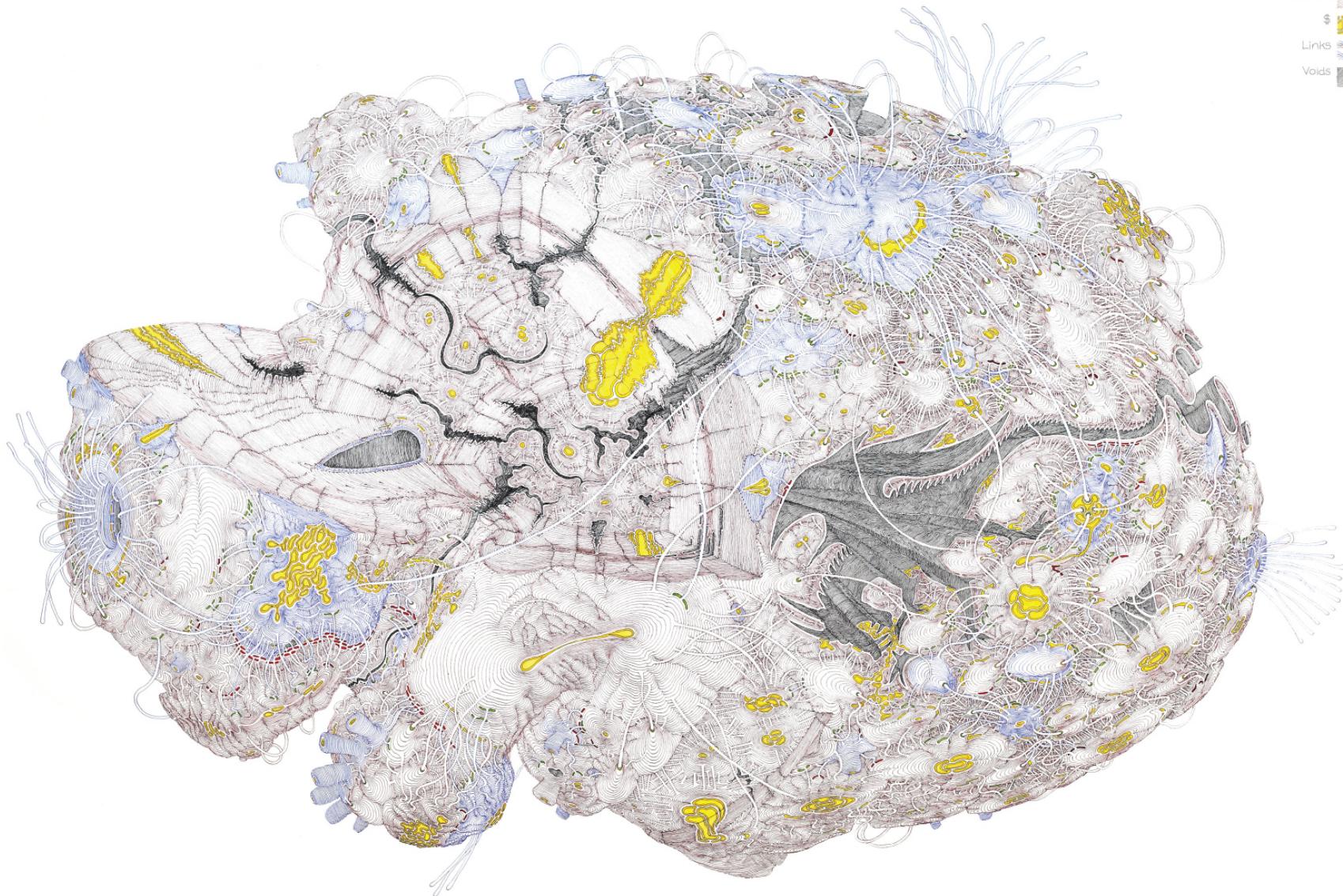


Computed Using Data from Elsevier's Scopus



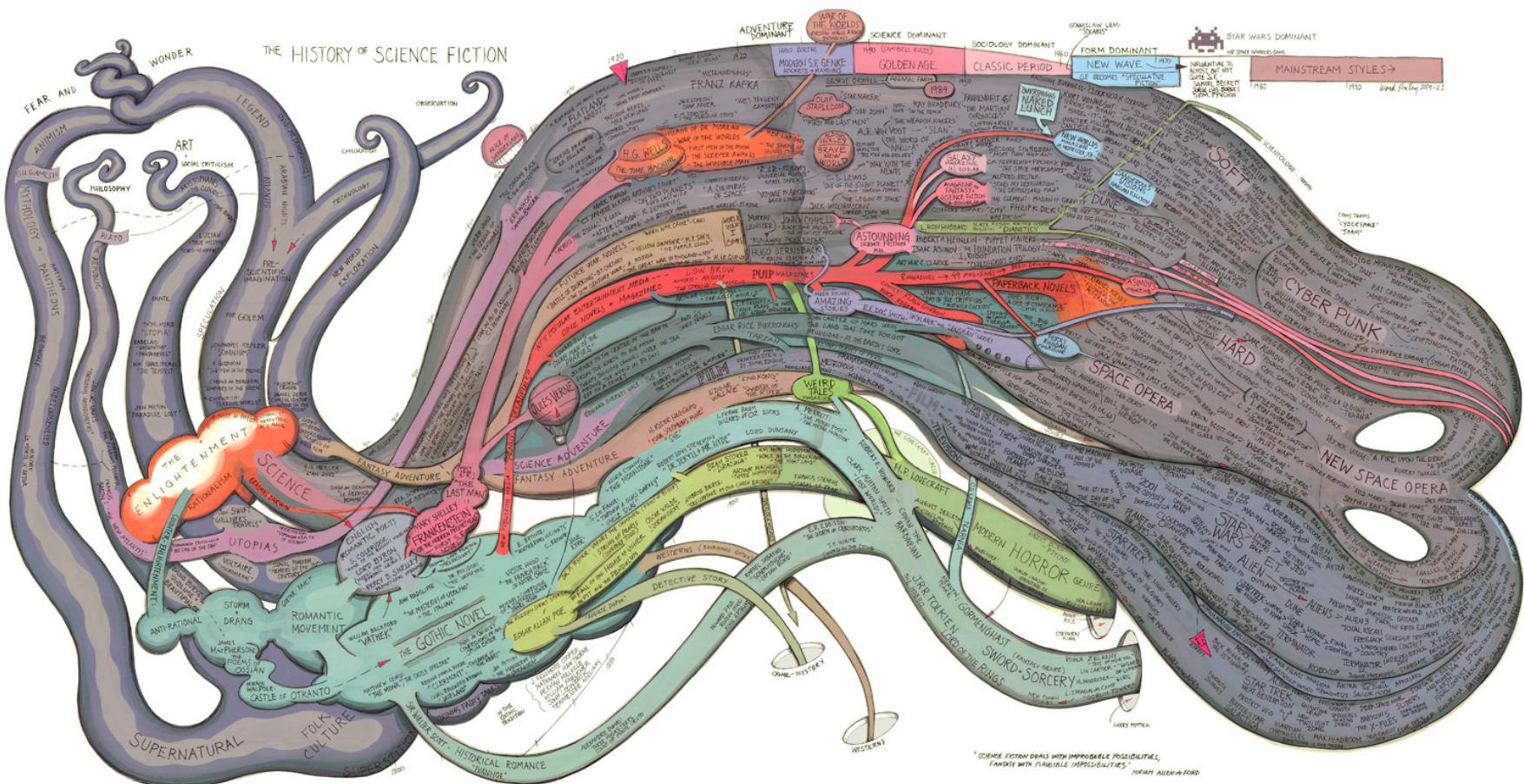
X.2 Map of the Internet - Martin Vargic - 2014

Emerging 
Established 
\$ 
Links 
Voids 



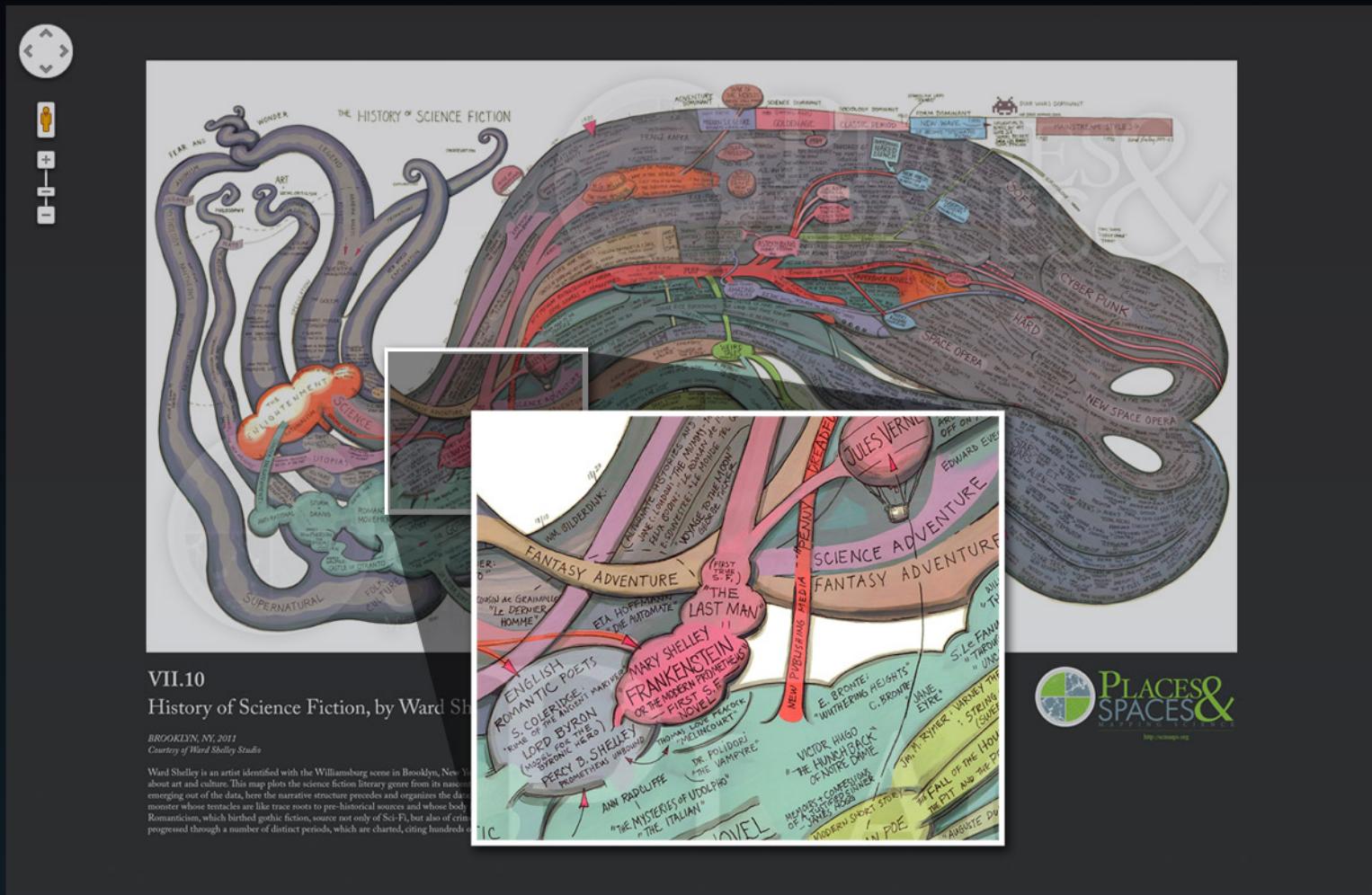
One of Many Possible Interpretations

Daniel Zeller 2007



VII.10 *History of Science Fiction* - Ward Shelley - 2011

Check out our Zoom Maps online!



Visit scimaps.org and check out all our maps in stunning detail!



MAPS vs. MACROSCOPES



Microscopes & Telescopes vs. MACROSCOPES

The Infinitely Great



Telescope

Stars



Cells



Microscope

The Infinitely Small



Galaxies



Society

The Infinitely Complex



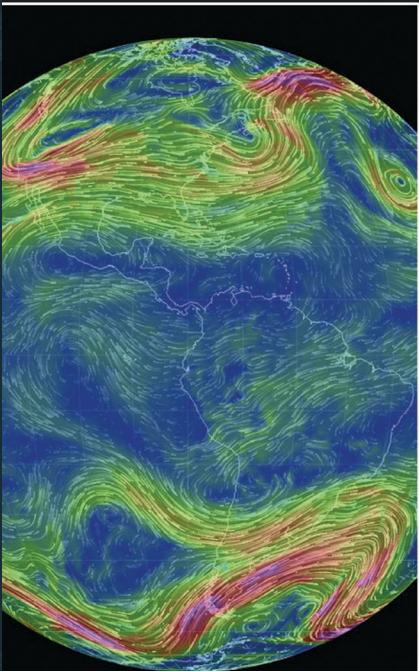
Nature



Technology

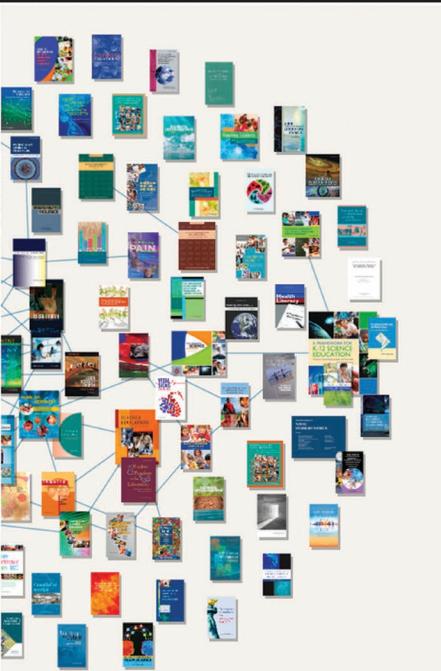


MACROSCOPES FOR INTERACTING WITH SCIENCE



Earth

Weather on a worldwide scale



AcademyScope

Exploring the scientific landscape



Mapping Global Society

Local news from a global perspective

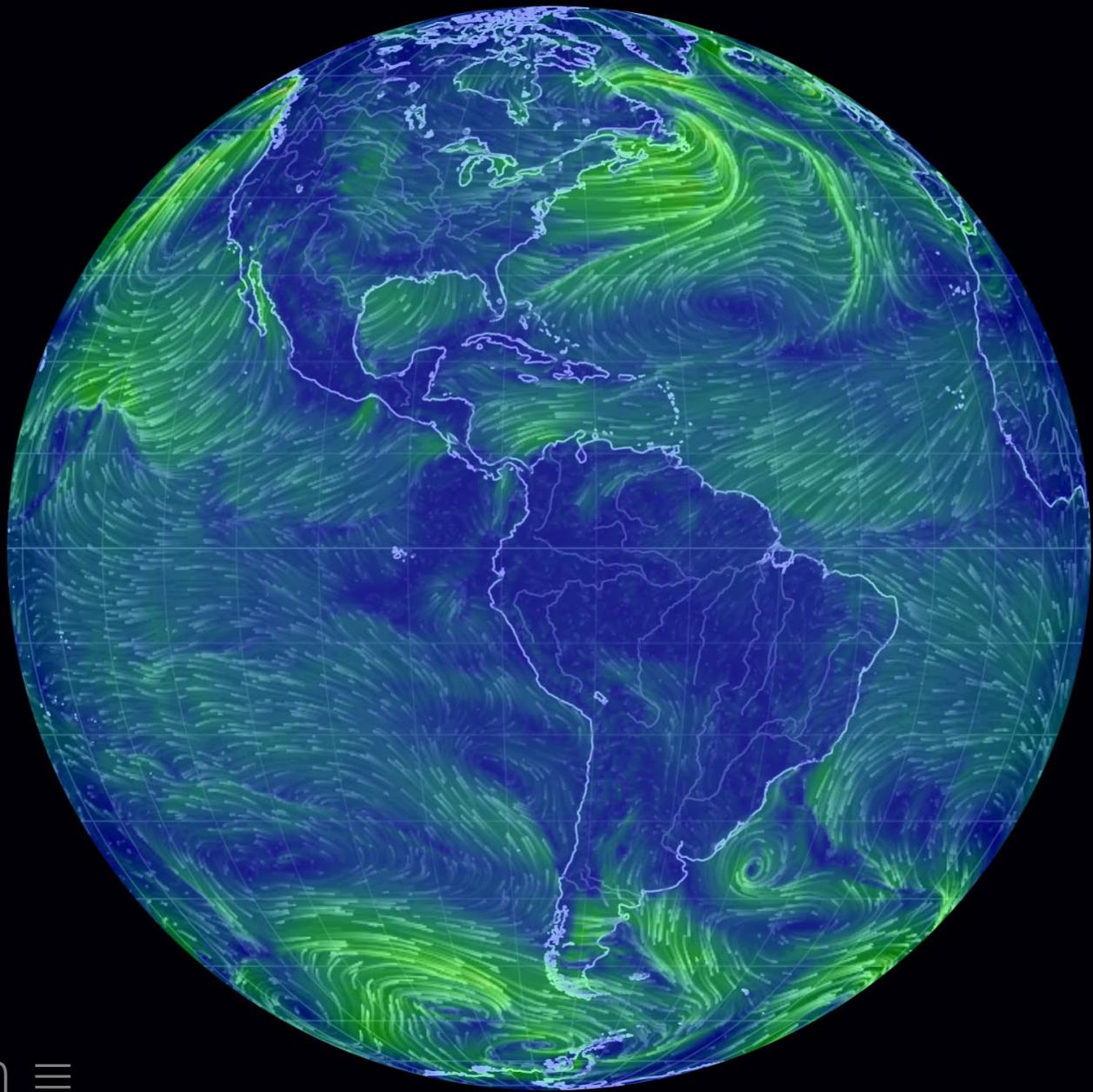


Charting Culture

2,600 years of human history in 5 minutes



Iteration XI (2015): Macroscopes for Interacting with Science
<http://scimaps.org/iteration/11>

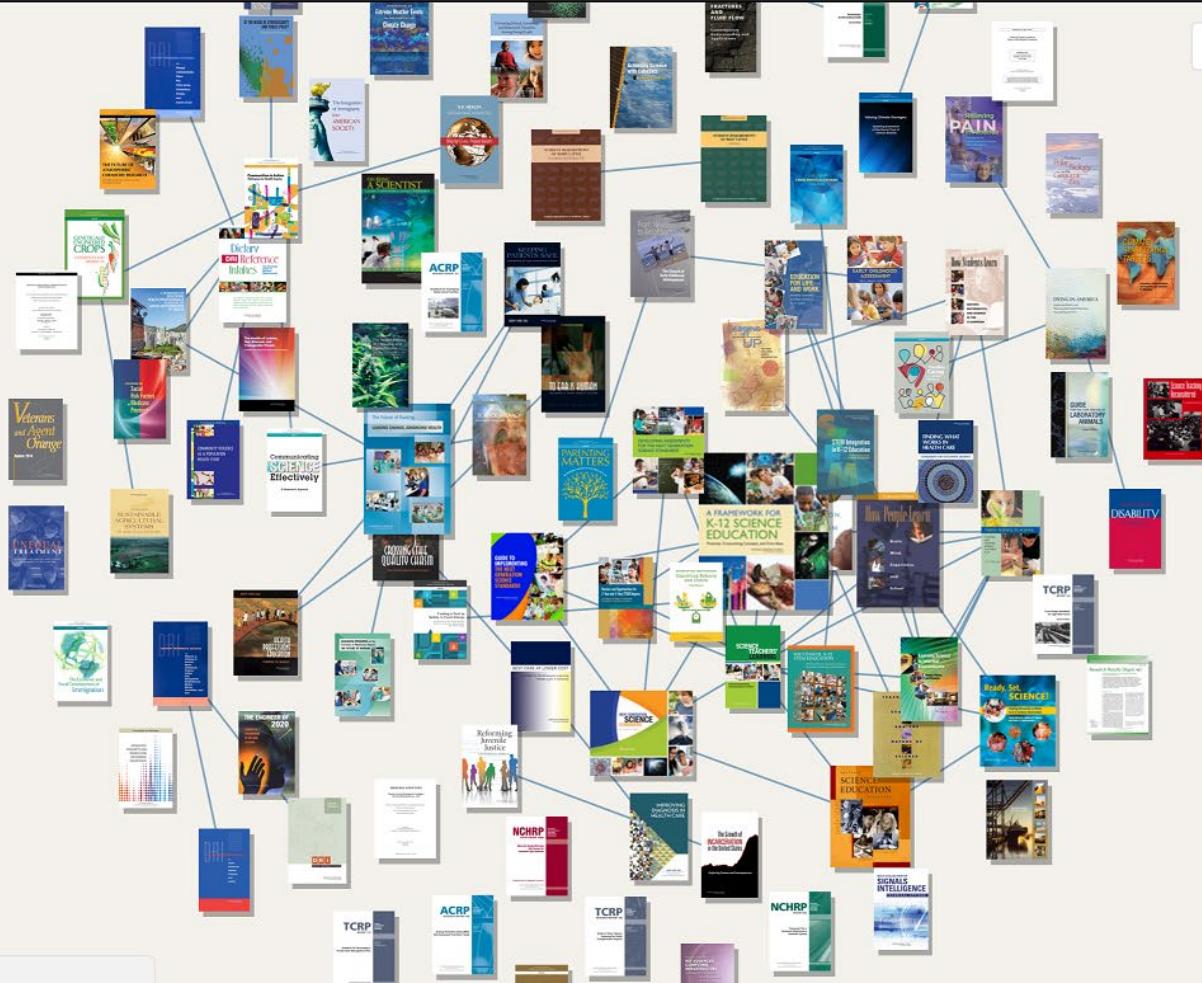


earth ≡

Earth – Cameron Beccario

Top downloads

- +



- Agriculture
- Behavioral and Social Sciences
- Biography and Autobiography
- Biology and Life Sciences
- Computers and Information Technology
- Conflict and Security Issues
- Earth Sciences
- Education
- Energy and Energy Conservation
- Engineering and Technology
- Environment and Environmental Studies
- Explore Science
- Food and Nutrition
- Health and Medicine
- Industry and Labor
- Math, Chemistry and Physics
- Policy for Science and Technology
- Space and Aeronautics
- Transportation

topic=282

AcademyScope – National Academy of the Sciences & CNS

The News Co-occurrence Globe

An interactive visualization of how countries are mentioned together in the world's news media



UNITED KINGDOM

SEARCH

ABOUT

2.92K
COOCCUR%

UNITED KINGDOM

cooccurrences in: 2,922%
cooccurrences out: 80%



Feb 22 Mar 1 Mar 8 Mar 15 Mar 22 Mar 29 Apr 5 Apr 12 Apr 19 Apr 26 May 3 May 10 May 17 May 24



COOCCURR

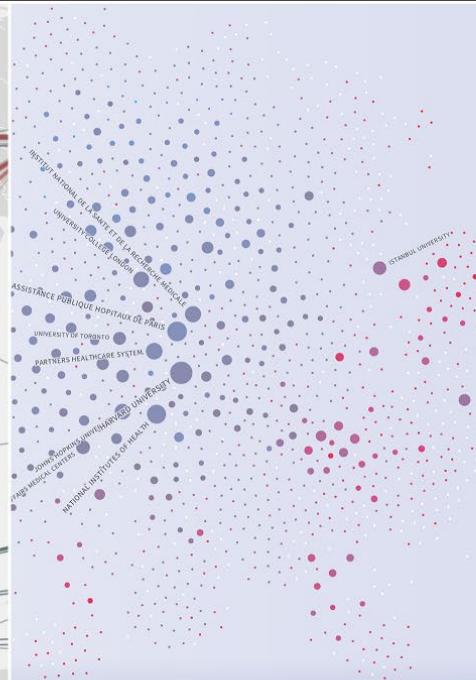


IN%



OUT%

Mapping Global Society –Kalev Leetaru



Smelly Maps
Charting urban smellscapes

HathiTrust
Storehouse of knowledge

Excellence Networks
Publish or perish together

FleetMon Explorer
Tracking the seven seas

Iteration XII (2016): Macroscopes for Making Sense of Science
<http://scimaps.org/iteration/12>

SMELLY
MAPS

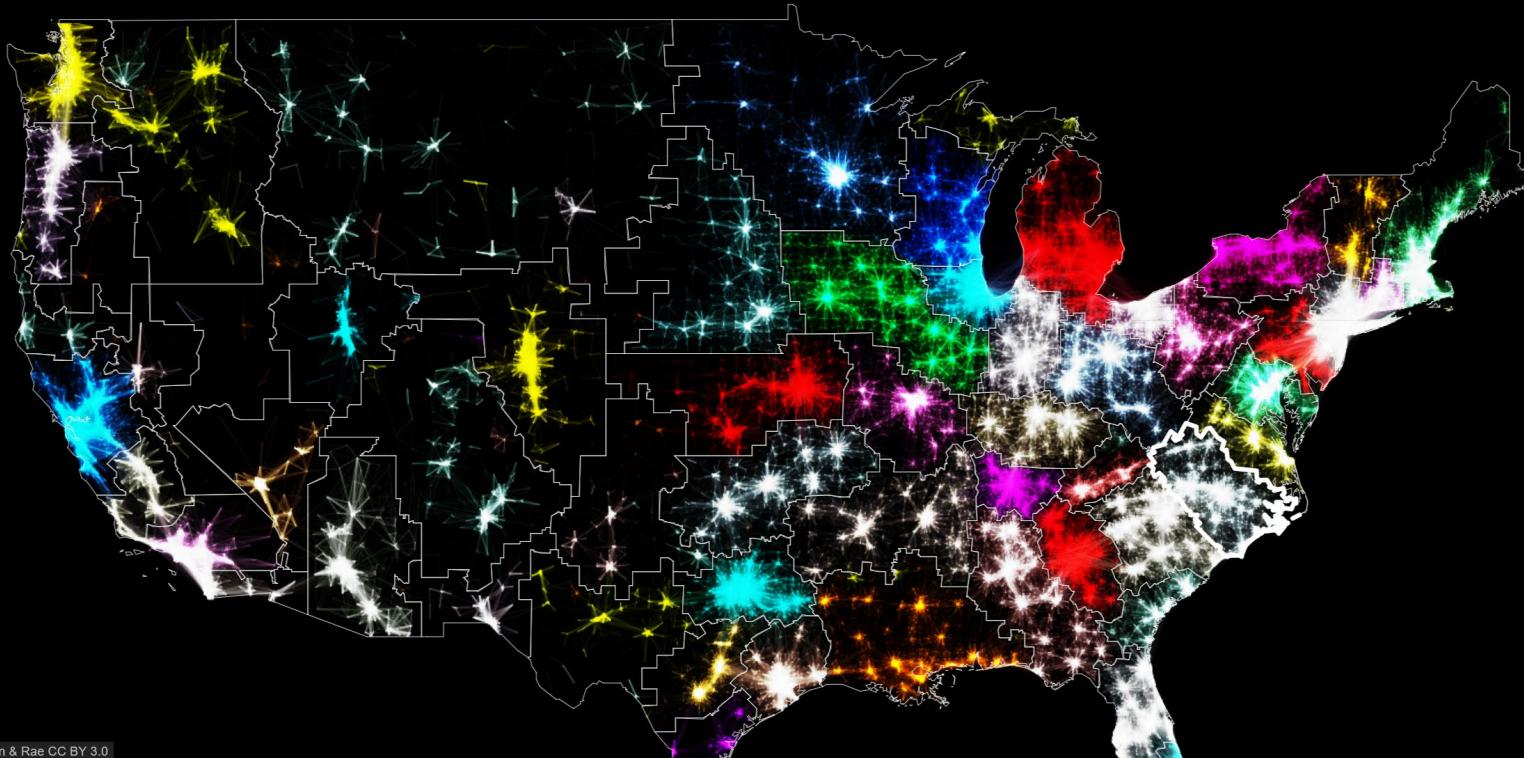


Leaflet | © OpenStreetMap contributors, Mapbox Terms & Feedback, © CARTO

Smelly Maps – Daniele Quercia, Rossano Schifanella, and Luca Maria Aiello – 2015

THE MEGAREGIONS OF THE US

Explore the new geography of commuter connections in the US.
Tap to identify regions. Tap and hold to see a single location's commuteshed.



This is the [Roanoke](#) (Raleigh) megaregion.



FleetMon

Tracking the Seven Seas

INDIAN OCEAN

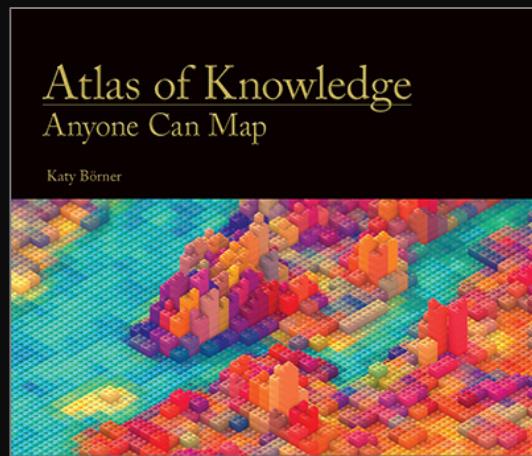
Monday, September 10, 2012

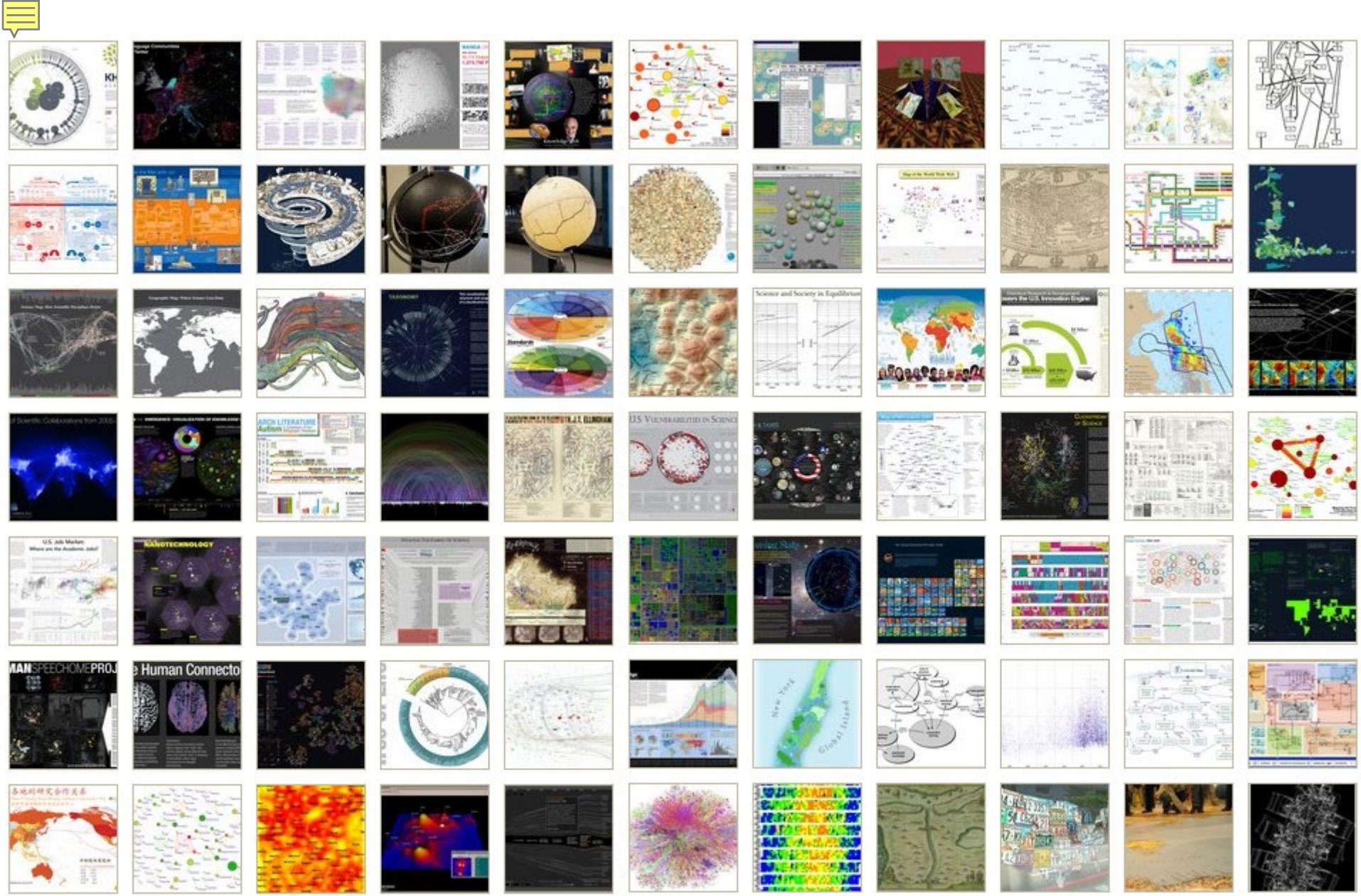
01:31

FleetMon Explorer – FleetMon – 2012

Making Science & Technology Visualizations

Using a theoretically grounded visualization framework that defines key terminology and processes together with valid workflows and data mappings.





Places & Spaces: Mapping Science Exhibit, online at <http://scimaps.org>

How to Classify (Name & Make) Different Visualizations?

By

- User insight needs?
- User task types?
- Data to be visualized?
- Data transformation?
- Visualization technique?
- Visual mapping transformation?
- Interaction techniques?
- Or ?

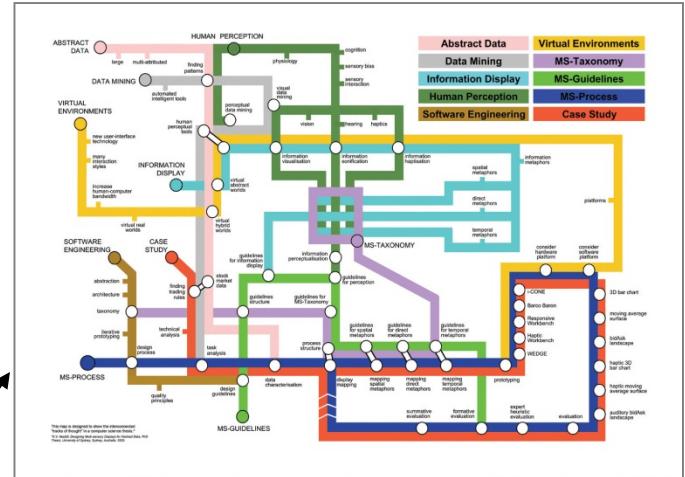


Different Question Types



Descriptive &
Predictive
Models

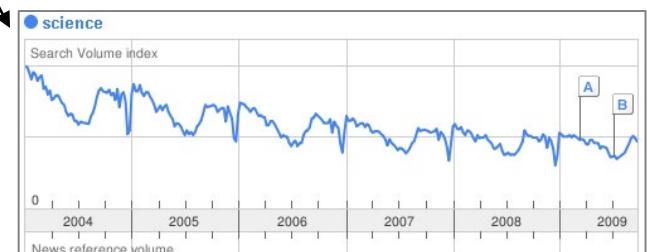
Terabytes of data



Find your way



Find collaborators, friends



Identify trends



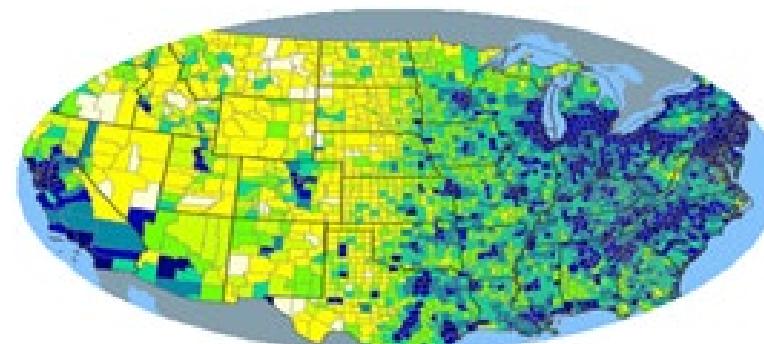
Different Question Types

- Monitor Data Quality
- Customer Complaints
- Customer/Supplier/Learner Churn
- Optimizing Supplier Chains
- Improving (Traffic/Communication) Network Resilience
- Optimizing Traffic/Communication Flows
- Optimizing Work Cells/Built Process
- Workforce Development

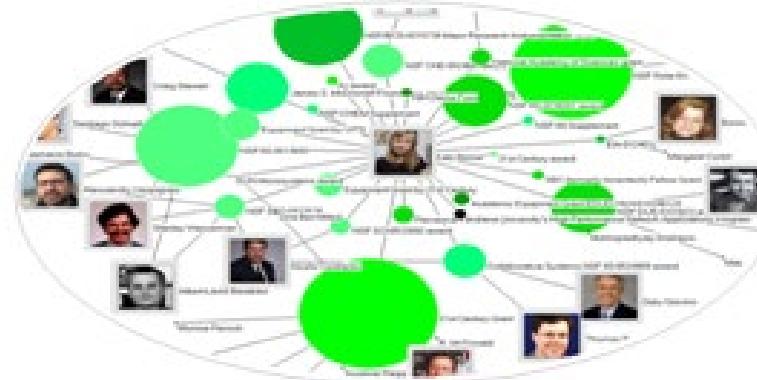
And other **WHEN, WHERE, WHAT, WITH WHOM** questions.

Different Levels of Abstraction/Analysis

Macro/Global
Population Level



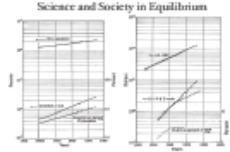
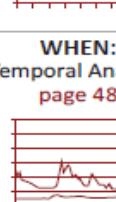
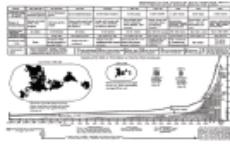
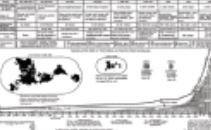
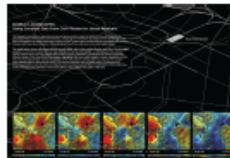
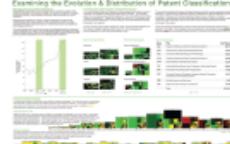
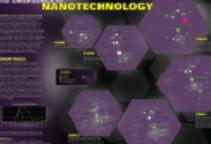
Meso/Local
Group Level



Micro
Individual Level



Tasks

	LEVELS		
TYPES	MICRO: Individual Level about 1–1,000 records page 6	MESO: Local Level about 1,001–100,000 records page 8	MACRO: Global Level more than 100,000 records page 10
Statistical Analysis page 44	  Knowledge Cartography page 135	  Productivity of Russian life sciences research teams page 105	  Science and Society in Equilibrium Number of scientists versus population and R&D costs versus GNP. page 103
WHEN: Temporal Analysis page 48	  Visualizing decision-making processes page 95	  Key events in the development of the video tape recorder page 85	  Increased travel and communication speeds page 83
WHERE: Geospatial Analysis page 52	  Cell phone usage in Milan, Italy page 109	  Victorian poetry in Europe page 137	  Ecological footprint of countries page 99
WHAT: Topical Analysis page 56	  Learning Outcomes & Learning Objectives for Technology Design Research	  Evolving patent holdings of Apple Computer, Inc. and Jerome Lemelson page 89	  Evolving journal networks in nanotechnology page 139
WITH WHOM: Network Analysis page 60	  World Finance Corporation network page 87	  Mapping the Electronics & Distribution of Patent Classification	  Electronic and new media art networks page 133

Atlas of Knowledge
Anyone Can Map

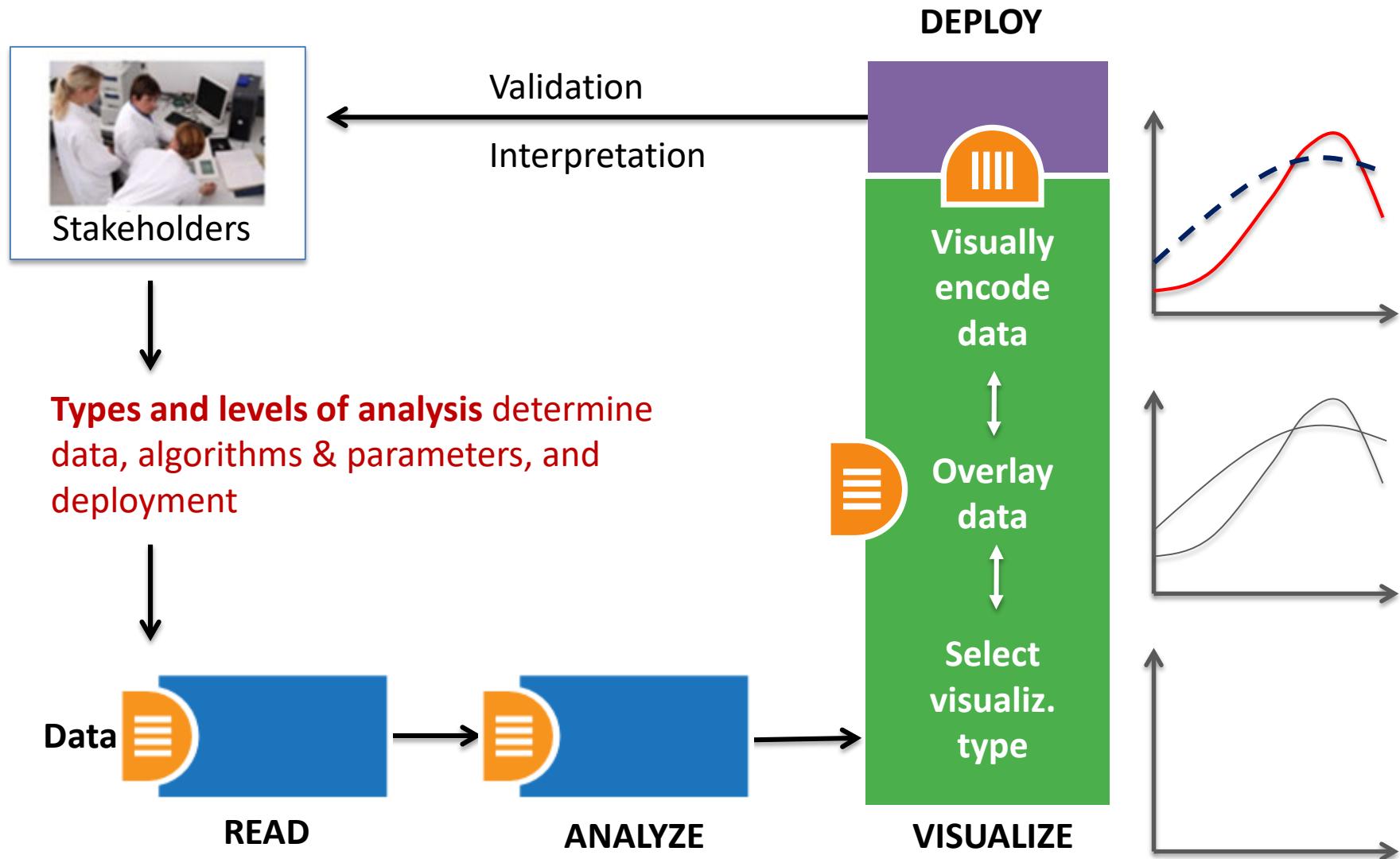


See *Atlas of Science: Anyone Can Map*, page 5

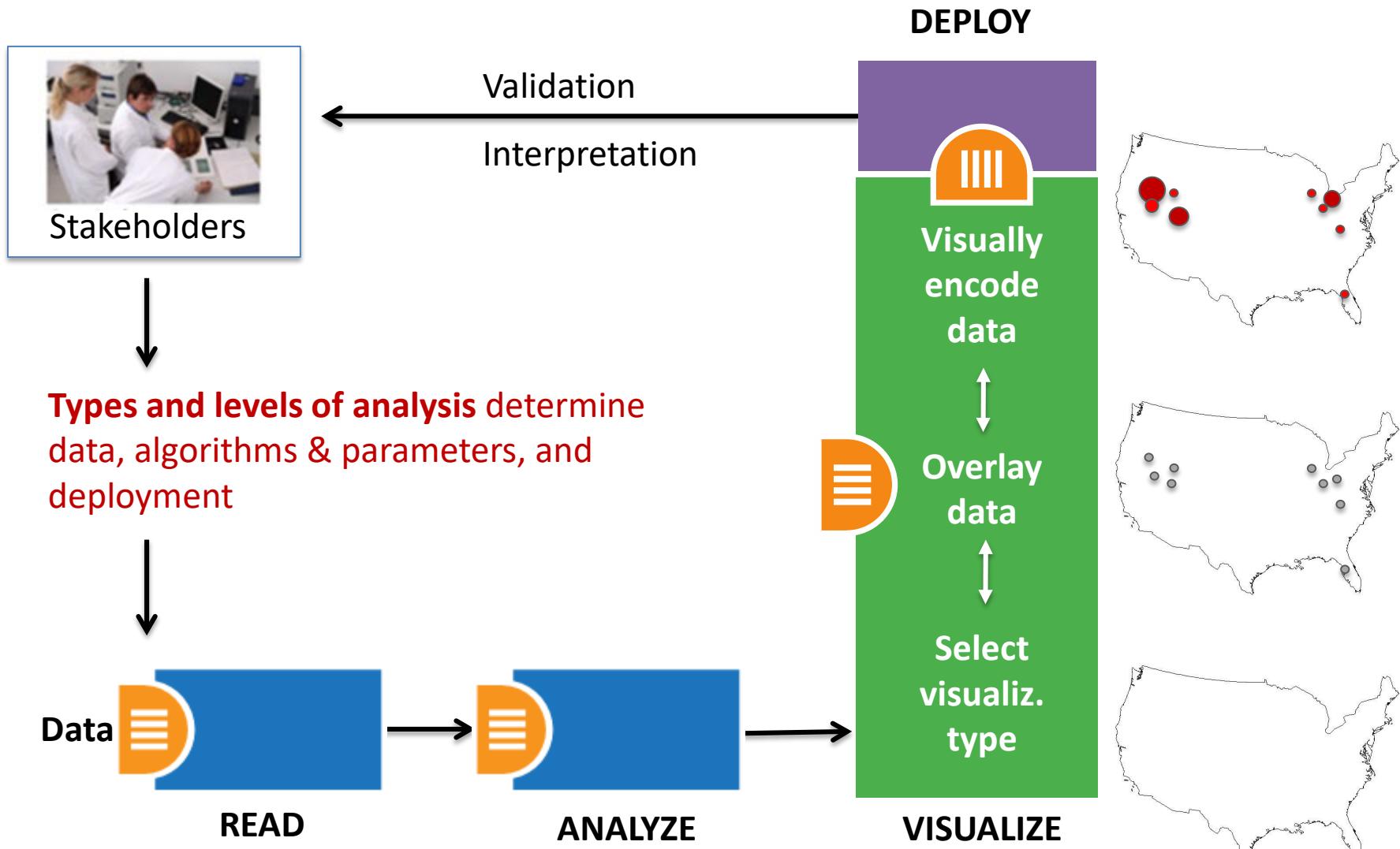
Katy Borner



Needs-Driven Workflow Design

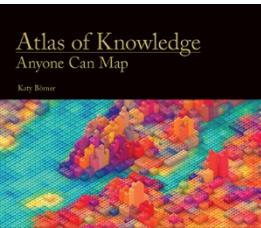


Needs-Driven Workflow Design



Visualization Framework

Insight Need Types page 26	Data Scale Types page 28	Visualization Types page 30	Graphic Symbol Types page 32	Graphic Variable Types page 34	Interaction Types page 26
<ul style="list-style-type: none">• categorize/cluster• order/rank/sort• distributions (also outliers, gaps)• comparisons• trends (process and time)• geospatial• compositions (also of text)• correlations/relationships	<ul style="list-style-type: none">• nominal• ordinal• interval• ratio	<ul style="list-style-type: none">• table• chart• graph• map• network layout	<ul style="list-style-type: none">• geometric symbolspointlineareasurfacevolume• linguistic symbolstextnumeralspunctuation marks• pictorial symbolsimagesiconsstatistical glyphs	<ul style="list-style-type: none">• spatialposition• retinalformcoloropticsmotion	<ul style="list-style-type: none">• overview• zoom• search and locate• filter• details-on-demand• history• extract• link and brush• projection• distortion



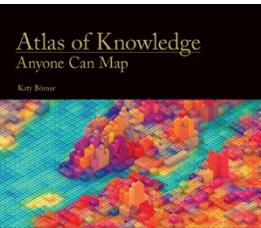
See page 24

Visualization Framework

Basic Task Types								
Bertin, 1967	Wehrend & Lewis, 1996	Few, 2004	Yau, 2011	Rendgen & Wiedemann, 2012	Frankel, 2012	Tool: Many Eyes	Tool: Chart Chooser	Börner, 2014
selection	categorize			category				categorize/cluster
order	rank	ranking				table		order/rank/sort
	distribution	distribution					distribution	distributions (also outliers, gaps)
	compare	nominal comparison & deviation	differences	compare and contrast	compare data values	comparison		comparisons
		time series	patterns over time	time	process and time	track rises and falls over time	trend	trends (process and time)
		geospatial	spatial relations	location		generate maps		geospatial
quantity		part-to-whole	proportions	form and structure	see parts of whole, analyze text		composition	compositions (also of text)
association	correlate	correlation	relationships	hierarchy		relations between data points	relationship	correlations/relationships

Visualization Framework

Insight Need Types page 26	Data Scale Types page 28	Visualization Types page 30	Graphic Symbol Types page 32	Graphic Variable Types page 34	Interaction Types page 26
<ul style="list-style-type: none">• categorize/cluster• order/rank/sort• distributions (also outliers, gaps)• comparisons• trends (process and time)• geospatial• compositions (also of text)• correlations/relationships	<ul style="list-style-type: none">• nominal• ordinal• interval• ratio	<ul style="list-style-type: none">• table• chart• graph• map• network layout	<ul style="list-style-type: none">• geometric symbols<ul style="list-style-type: none">pointlineareasurfacevolume• linguistic symbols<ul style="list-style-type: none">textnumeralspunctuation marks• pictorial symbols<ul style="list-style-type: none">imagesiconsstatistical glyphs	<ul style="list-style-type: none">• spatial<ul style="list-style-type: none">position• retinal<ul style="list-style-type: none">formcoloropticsmotion	<ul style="list-style-type: none">• overview• zoom• search and locate• filter• details-on-demand• history• extract• link and brush• projection• distortion



See page 24

Graphic Variable Types Versus Graphic Symbol Types

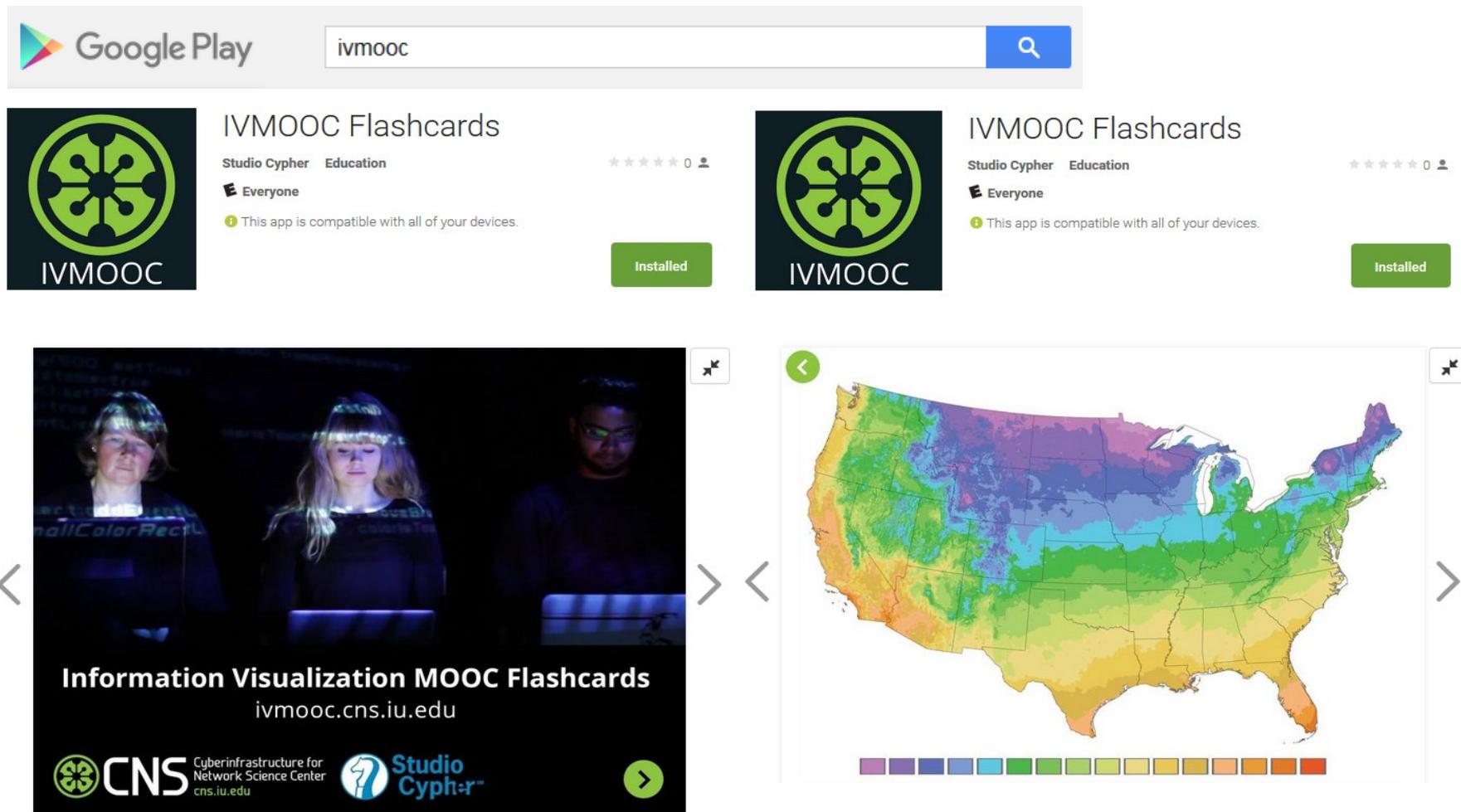
		Geometric Symbols			
		Point	Line	Area	
Spatial	x	quantitative			
	y	quantitative			
	z	quantitative			
Retinal	Size	quantitative	NA (Not Applicable)		
	Shape	qualitative	NA		
	Rotation	quantitative	NA		
	Curvature	quantitative	NA		
	Angle	quantitative	NA		
	Closure	quantitative	NA		
	Value	quantitative			
	Hue	qualitative			
Color	Saturation	quantitative			

Graphic Variable Types Versus Graphic Symbol Types

		Geometric Symbols					Linguistic Symbols					Pictorial Symbols		
		Point	Line	Area	Surface	Volume	Text, Numerals, Punctuation Marks		Images, Icons, Statistical Glyphs					
Spatial	x	quantitative						Text						
	y	quantitative						Text						
	z	quantitative						Text						
Retinal Form	Size	quantitative	NA (Not Applicable)					Text						
	Shape	qualitative	NA					Text						
	Rotation	quantitative	NA					Text						
Color	Curvature	quantitative	NA					Text						
	Angle	quantitative	NA					Text						
	Closure	quantitative	NA					Text						
Retinal Texture	Value	quantitative	NA					Text						
	Hue	qualitative	NA					Text						
	Saturation	quantitative	NA					Text						
Retinal Optics	Texture	quantitative	NA					Text						
	Granularity	quantitative	NA					Text						
	Pattern	qualitative	NA					Text						
Motion	Orientation	quantitative	NA					Text						
	Gradient	quantitative	NA					Text						
	Blur	quantitative	NA					Text						
Motion	Transparency	quantitative	NA					Text						
	Shading	quantitative	NA					Text						
	Stereoscopic Depth	quantitative	Point in foreground	— background	Line in foreground	... background	Area in foreground	— background	Surface in foreground	— background	Volume in foreground	— background	Text in foreground	... background
Speed	Speed	quantitative	—	—	—	—	—	—	—	—	—	—		
	Velocity	quantitative	—	—	—	—	—	—	—	—	—	—		
	Rhythm	quantitative	Blinking point slow	— fast	Blinking line slow	... fast	Blinking area slow	— fast	Blinking surface slow	— fast	Blinking volume slow	— fast	Blinking text slow	— fast

IVMOOC App

The “IVMOOC Flashcards” app can be downloaded from Google Play and Apple iOS stores.



Sci2 Tool Interface Components Implement Vis Framework

Download tool for free at <http://sci2.cns.iu.edu>

The image displays three separate windows of the Sci2 Tool interface, each showing a different component of the software:

- Top Window:** Shows the "Preprocessing" tab selected. A dropdown menu under "Networks" is open, listing options: Extract Top Nodes, Extract Nodes Above or Below Value, Delete Isolates, and Extract Top Edges.
- Middle Window:** Shows the "Analysis" tab selected. A dropdown menu under "Temporal" is open, listing options: General, Temporal, Geospatial, and Topical.
- Bottom Window:** Shows the "Visualization" tab selected. A dropdown menu under "Networks" is open, listing options: General, Temporal, Geospatial, Topical, and Networks. The "Networks" option is highlighted.

In all three windows, the right pane contains a "Data Manager" and a "Workflow Manager". The Data Manager shows a tree structure for "ISI Data" located at C:\Users\Katy\Desktop\A-TOOLS\sci2-v1.1-beta\ISI\ISI_Extracted_Co-Authorship_Network\ISI_Extracted_Co-Authorship_Network\ISI_Extracted_Co-Authorship_Network. The Workflow Manager shows a single step labeled "ISI Data: C:\Users\Katy\Desktop\A-TOOLS\sci2-v1.1-beta\ISI\ISI_Extracted_Co-Authorship_Network\ISI_Extracted_Co-Authorship_Network\ISI_Extracted_Co-Authorship_Network".

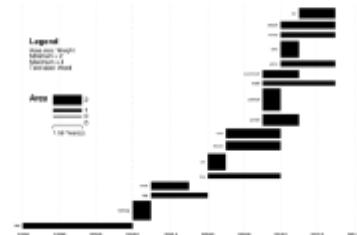
Load One File and Run Many Analyses and Visualizations

Times Cited	Publication Year	City of Publisher	Country	Journal Title (Full)	Title	Subject Category	Authors
12	2011	NEW YORK	USA	COMMUNICATIONS OF THE ACM	Plug-and-Play Macroscopes	Computer Science	Borner, K
18	2010	MALDEN	USA	CTS-CLINICAL AND TRANSLATIONAL SCIENCE	Advancing the Science of Team Science	Research & Experimental Medicine	Falk-Krzesinski, HJ Borner, K Contractor, N Fiore, SM Hall, KL Keyton, J Spring, B Stokols, D Trochim, W Uzzi, B
13	2010	WASHINGTON	USA	SCIENCE TRANSLATIONAL MEDICINE	A Multi-Level Systems Perspective for the Science of Team Science	Cell Biology Research & Experimental Medicine	Borner, K Contractor, N Falk-Krzesinski, HJ Fiore, SM Hall, KL Keyton, J Spring, B Stokols, D Trochim, W Uzzi, B

Statistical Analysis—p. 44

Location	Count	# Citations
Netherlands	13	292
United States	9	318
Germany	11	36
United Kingdom	1	2

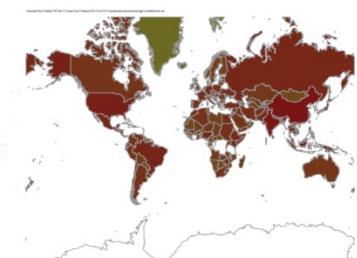
Temporal Burst Analysis—p. 48



Geospatial Analysis—p. 52



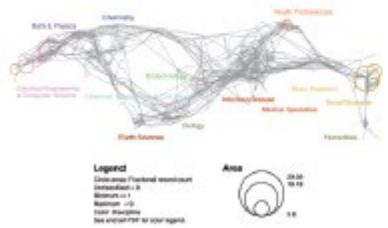
Geospatial Analysis—p. 52



Load One File and Run Many Analyses and Visualizations

Times Cited	Publication Year	City of Publisher	Country	Journal Title (Full)	Title	Subject Category	Authors
12	2011	NEW YORK	USA	COMMUNICATIONS OF THE ACM	Plug-and-Play Macroscopes	Computer Science	Borner, K
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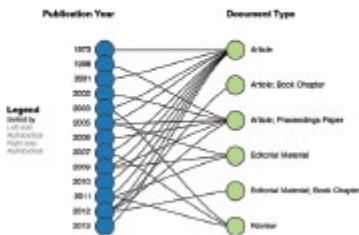
Topical Analysis—p. 56



Paper Citation Network—p. 60



Bi-Modal Network—p. 60



Co-author and many other bi-modal networks.



Information Visualization MOOC

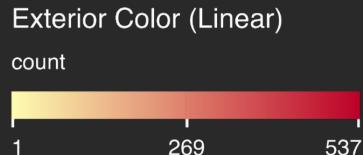
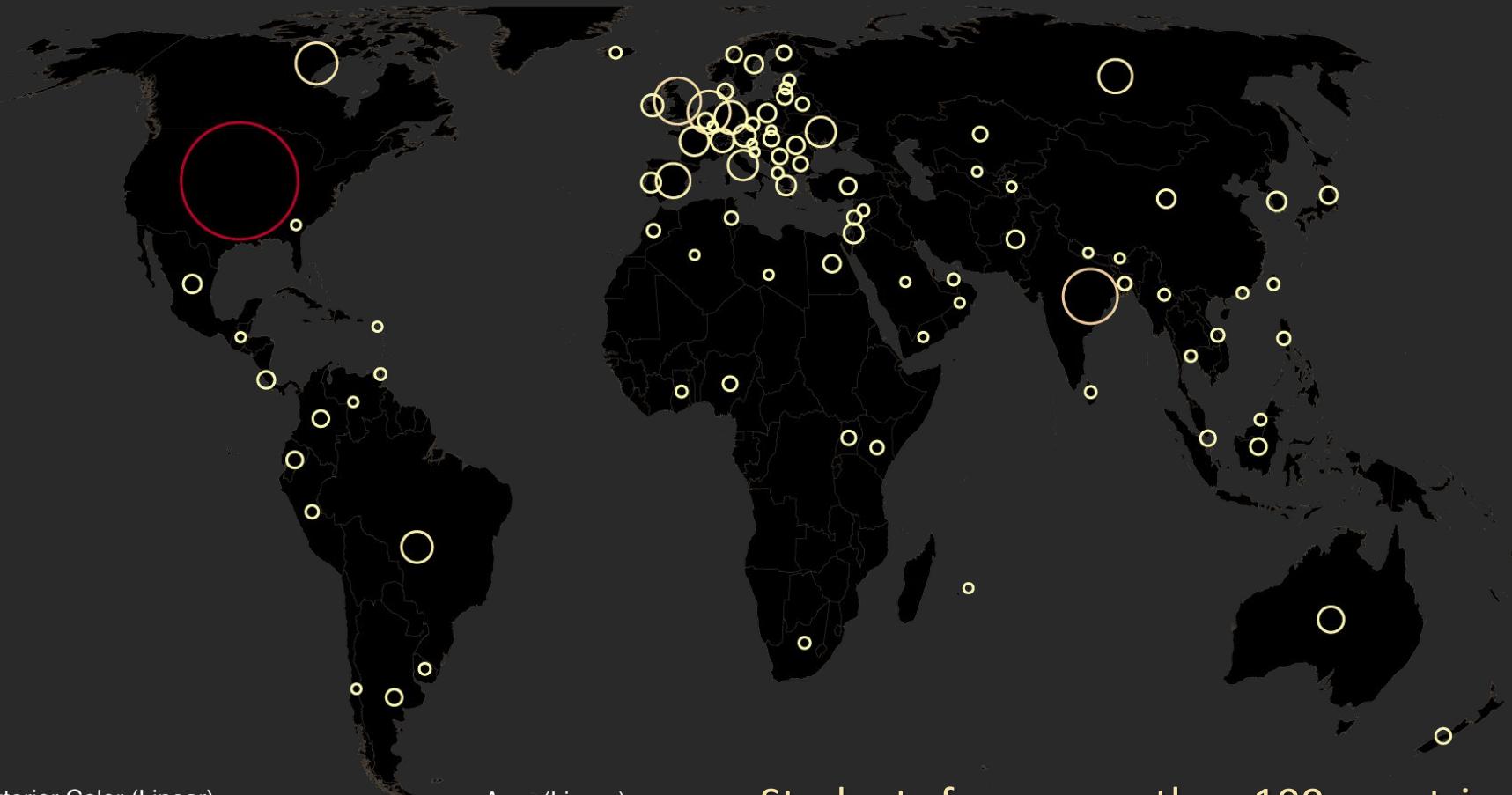
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Course Schedule

Part 1: Theory and Hands-On

- **Session 1** – Workflow Design and Visualization Framework
- **Session 2** – “When:” Temporal Data
- **Session 3** – “Where:” Geospatial Data
- **Session 4** – “What:” Topical Data

Mid-Term

- **Session 5** – “With Whom:” Trees
- **Session 6** – “With Whom:” Networks
- **Session 7** – Dynamic Visualizations and Deployment

Final Exam

Part 2: Students work in teams on client projects.

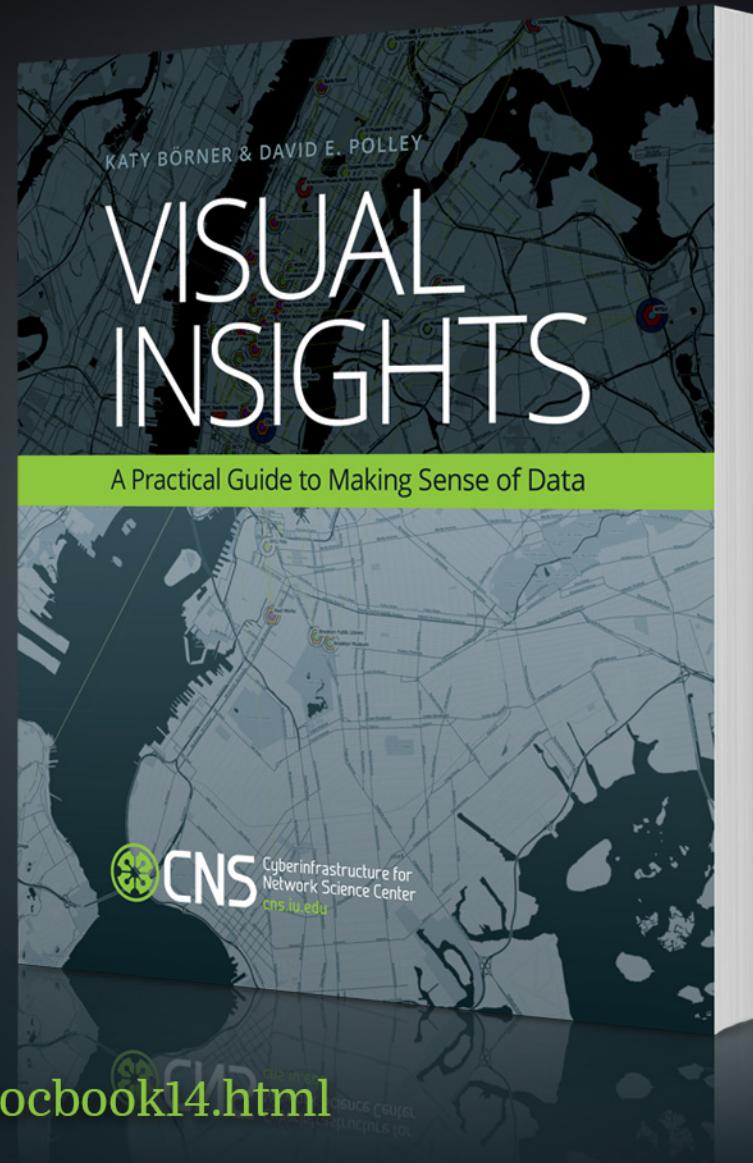
Final grade is based on Homework and Quizzes (**10%**), Midterm (**20%**), Final (**30%**), Client Project (**30%**), and Class Participation (**10%**).



The IVMOOC Companion Textbook

This textbook offers a gentle introduction to the design of insightful visualizations. It seamlessly blends theory and practice, giving readers both the theoretical foundation and the practical skills necessary to render data into insights.

The book accompanies the Information Visualization MOOC that attracted students, scholars, and practitioners from many fields of science and more than 100 different countries.



cns.iu.edu/ivmoocbook14.html

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Börner, Katy, Chen, Chaomei, and Boyack, Kevin. (2003). **Visualizing Knowledge Domains.** In Blaise Cronin (Ed.), *ARIST*, Medford, NJ: Information Today, Volume 37, Chapter 5, pp. 179-255. <http://ivl.slis.indiana.edu/km/pub/2003-borner-arist.pdf>

Shiffrin, Richard M. and Börner, Katy (Eds.) (2004). **Mapping Knowledge Domains.** *Proceedings of the National Academy of Sciences of the United States of America*, 101(Suppl_1). http://www.pnas.org/content/vol101/suppl_1

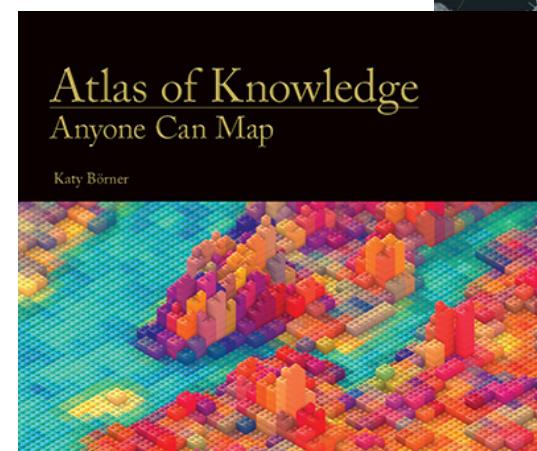
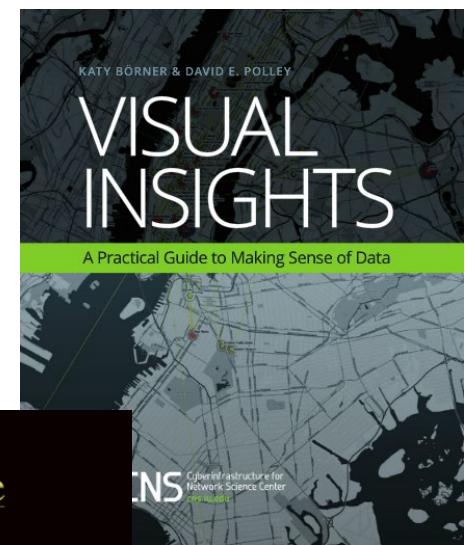
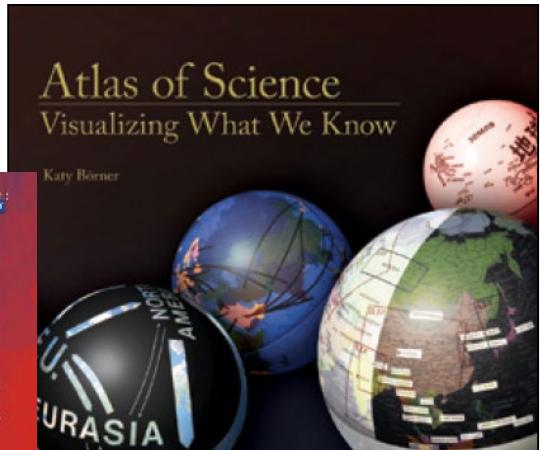
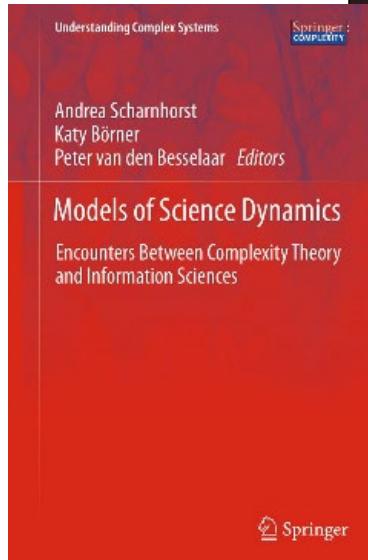
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1

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10.13 Katy Börner presents Mapping Science Exhibit at WSSF

10.15 Ted Polley & Google Team present IVMOOC at EDUCAUSE

10.22 Katy Börner presents at the SciELO 15 Years Conference

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Dan Edelstein (Stanford University, US)

Tamara Mchedlidze (KIT – Karlsruher Institut für Technologie, DE)

Gerik Scheuermann (Universität Leipzig, DE)

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Simone Schilke for administrative matters

Andreas Dolzmann for scientific matters