

# Actionable Data Visualizations

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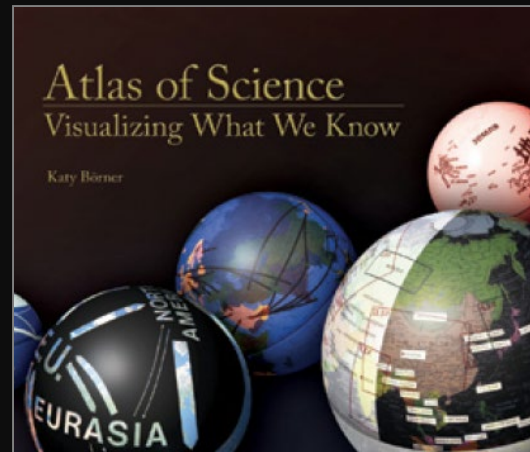
*Dagstuhl Seminar on “Network Visualization in the Humanities”  
Dagstuhl, Germany*

*November 27, 2018*



# Maps of Science & Technology

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



# Maps of Science & Technology

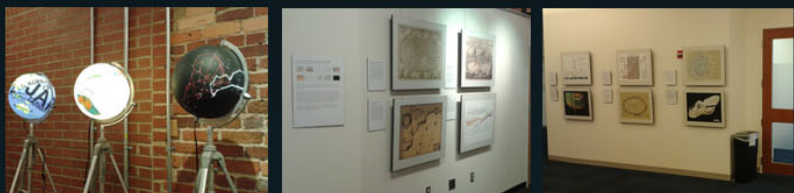
<http://scimaps.org>



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



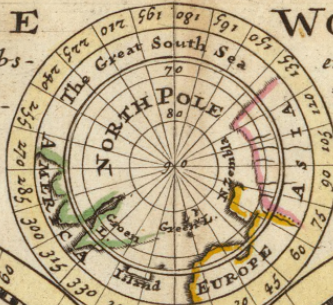
The David J. Sencer CDC Museum, Atlanta, GA.  
January 25 - June 17, 2016.

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

A New Map of the **WHOLE**  
According to y<sup>e</sup> latest and most Exact Obs-

**WORLD** with the Trade winds  
ervations By H. Moll Geographer

In this Maps is inserted A View of y<sup>e</sup> General & Coasting Trade Winds, Monsoons or y<sup>e</sup> Shifting Trade winds Note that y<sup>e</sup> Arrows among y<sup>e</sup> Lines shew y<sup>e</sup> Course of those General & Coasting Winds. and y<sup>e</sup> Arrows in y<sup>e</sup> void Spaces shew y<sup>e</sup> Course of y<sup>e</sup> Shifting Trade winds, and y<sup>e</sup> Abbreviation Sep: &c. Shew y<sup>e</sup> Times of y<sup>e</sup> Year when such Winds Blow.

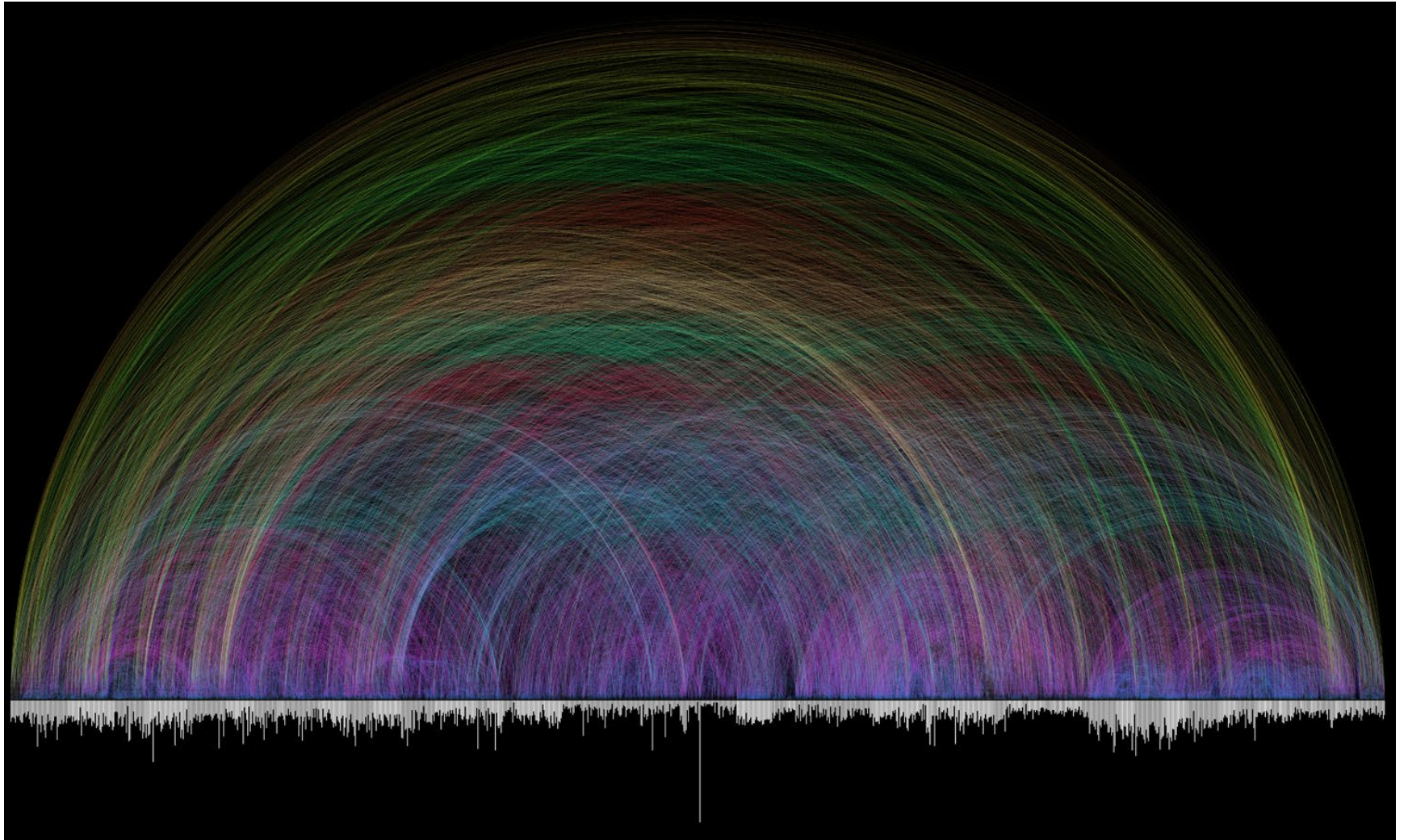


The Signs of the Zodiac, The First 6 are Northern, the other Southern Signs



Printed for Tho: Bowles Print and Map Seller next y<sup>e</sup> Charter House in S<sup>t</sup>. Pauls Church yard; and John Bowles Print and Map Seller at the Black Horse in Cornhill London.

1.3 A New Map of the Whole World with Trade Winds According to the Latest and Most Exact Observations - Herman Moll - 1736



# Literary Empires

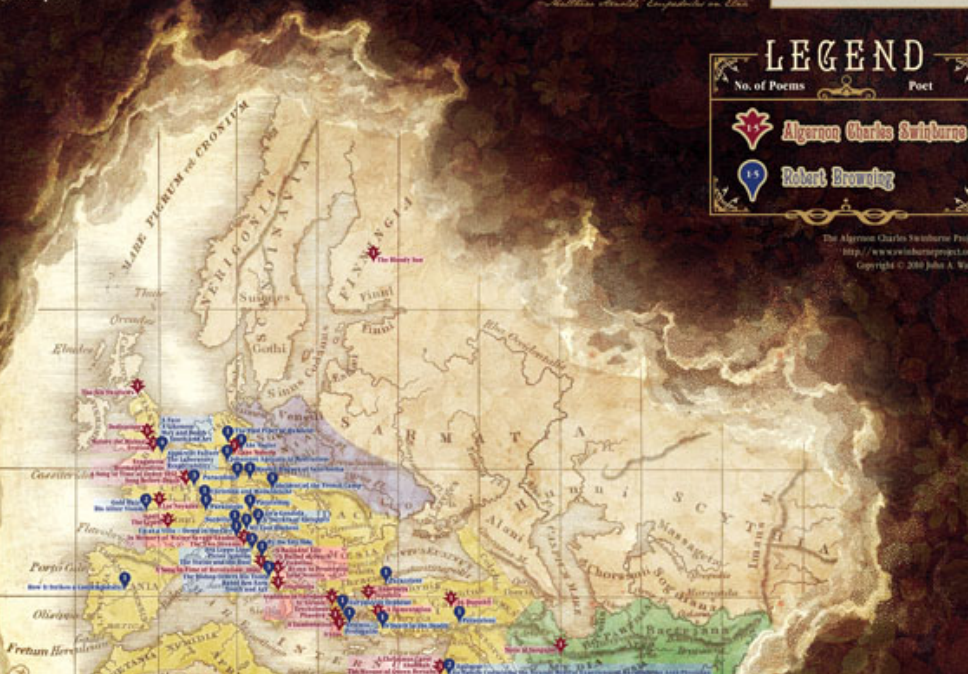
Mapping Temporal & Spatial Settings of Victorian Poetry

*Look, the world laughs our eyes,  
And we would know it all!  
We map the starry sky,  
We measure the sea fairs, we number the sea sands.  
We straddle the dates  
Of long past human things,  
The hours of effort slain,  
The lives of downed kings:  
We search out dead men's words, and works of dead men's hands.*  
*— Matthew Arnold, 'Empedocles on Staph', 1852*

Setting is a basic characteristic of literature. North, south, east, west, distance, time, and such factors—especially narrative poetry—typically have an identifiable setting in both time and space. Victorian poet Matthew Arnold's "Empedocles on Staph," for instance, is set in Greek Sicily in the fifth century BC. "Empedocles" was published in 1852. Matthew Arnold's *Empedocles on Staph* is set in Sicily, Greece, and Britain, but is an American legendary medieval chronicle in the absence of a narrative setting. Many poems are situated geographically through allusion, metaphor, and other means. Victorian literature and Victorian modernisms are two important discursive phenomena in Victorian literature. Many Victorian poets were influenced by the literature, history, and culture of ancient and

classical Greece and medieval Europe and the literary tradition inspired by those periods. Many Victorian poets, including Tennyson, the Brownings, Arnold, Keats, and Swinburne, provide a rich variety of representations of classical and medieval worlds. But what does the geographic distance reveal about these phenomena? The data on a growing number of published works or lines of verse from any given period, or among a defined set of authors or texts, how many texts have classical, medieval, biblical, or contemporary settings? How many texts are set in other periods such as the Renaissance, with which Victorian literature was so fascinated? The data can answer these questions and provide scholars with other insights into literary history. After explicitly discussing in XML code a database, or other structure,

the temporal and spatial settings of individual literary works, we can map and visualize the distribution of literary settings across historical periods and geographic space. Compare these data to other information, such as year of publication or composition, and visualize networks of authors and works during common settings. The data on a growing collection of work titles, dates, time ranges, and geographic coordinates and coordinates. Challenges include setting of metaphors, legends, and beyond time and place.  
  
The map may be found as a snapshot of data for Victorian poet Robert Browning and Algernon Charles Swinburne. A geography viewer version is available at [http://jtwalsh.org/swinburne/victoria/vic\\_austria12.html](http://jtwalsh.org/swinburne/victoria/vic_austria12.html).



### LEGEND

- No. of Poems
- Poet

15 **Algernon Charles Swinburne**

15 **Robert Browning**

The Algernon Charles Swinburne Project  
<http://www.swinburneproject.org/>  
Copyright © 2000 John A. Walsh

### Poems Sorted by Temporal Settings

Time	Place	Poet	Poem	Collection
1861	London	Algernon Charles Swinburne	Before the Mirror	Poems and Ballads, First Series (1862)
1864	London	Algernon Charles Swinburne	Before the Mirror	Poems and Ballads, First Series (1862)
1864	London	Algernon Charles Swinburne	Unlabeled	Poems and Ballads, First Series (1862)
1864	London	Algernon Charles Swinburne	A Ballad of Death	Poems and Ballads, First Series (1862)
1864	London	Algernon Charles Swinburne	A Ballad of Life	Poems and Ballads, First Series (1862)
1864	London	Algernon Charles Swinburne	A Ballad of Love	Poems and Ballads, First Series (1862)
1865	London	Algernon Charles Swinburne	A Ballad of Love	Poems and Ballads, First Series (1862)
1865	London	Algernon Charles Swinburne	A Ballad of Love	Poems and Ballads, First Series (1862)
1865	London	Algernon Charles Swinburne	A Ballad of Love	Poems and Ballads, First Series (1862)
1865	London	Algernon Charles Swinburne	A Ballad of Love	Poems and Ballads, First Series (1862)
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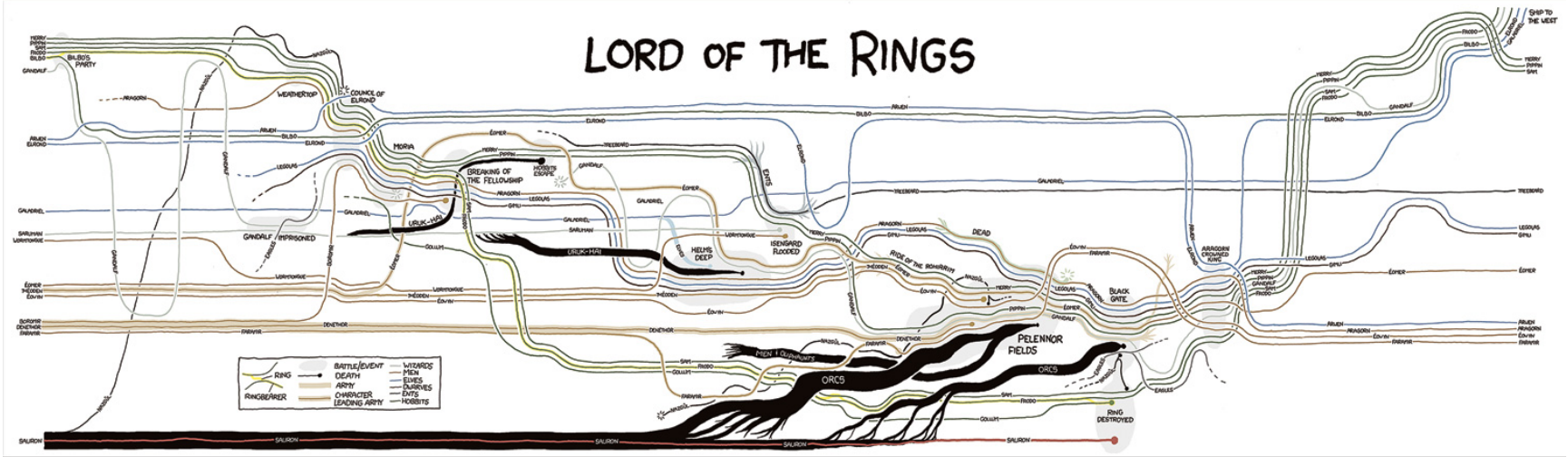


VI.7 Literary Empires: Mapping Temporal and Spatial Settings of Victorian Poetry

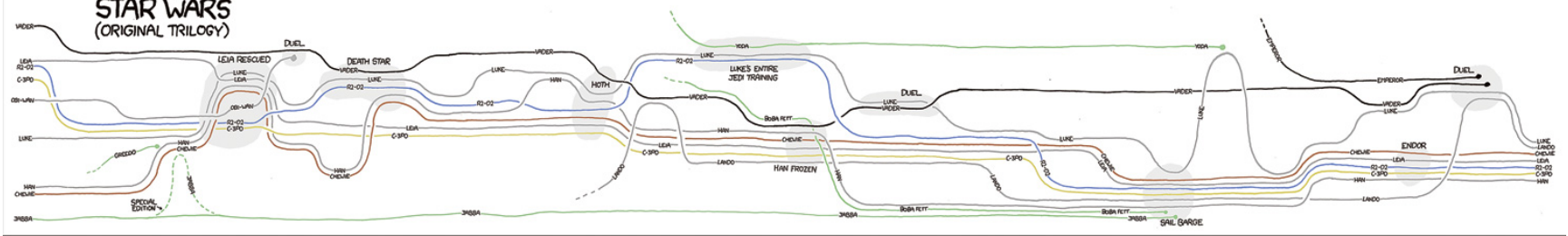
John A. Walsh, Devin Becker, Bradford Demarest, Jonathan Tweedy, Theodora Michaelidou, and Laura Pence - 2010

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.

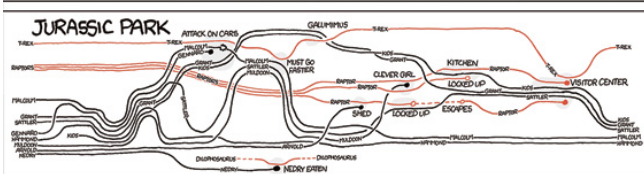
## LORD OF THE RINGS



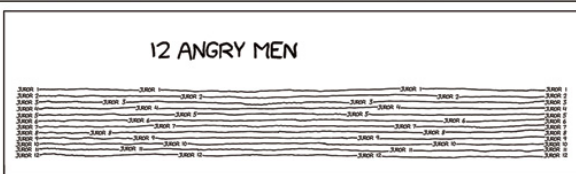
## STAR WARS (ORIGINAL TRILOGY)



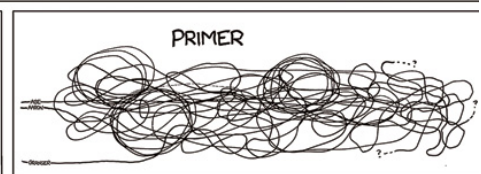
## JURASSIC PARK



## 12 ANGRY MEN



## PRIMER



# Map of Scientific Collaborations from 2005-2009







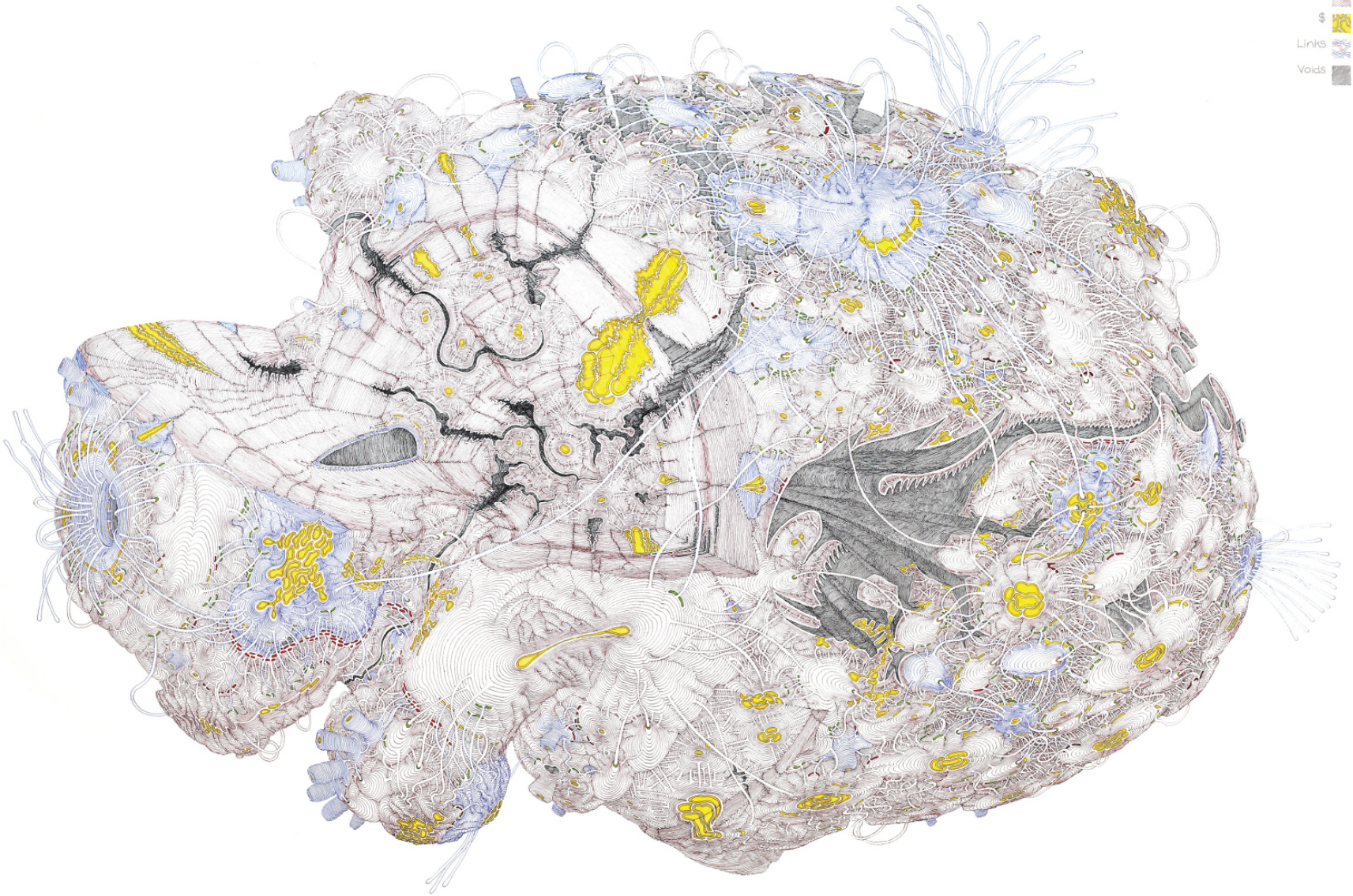
Computed Using Data from Elsevier's Scopus





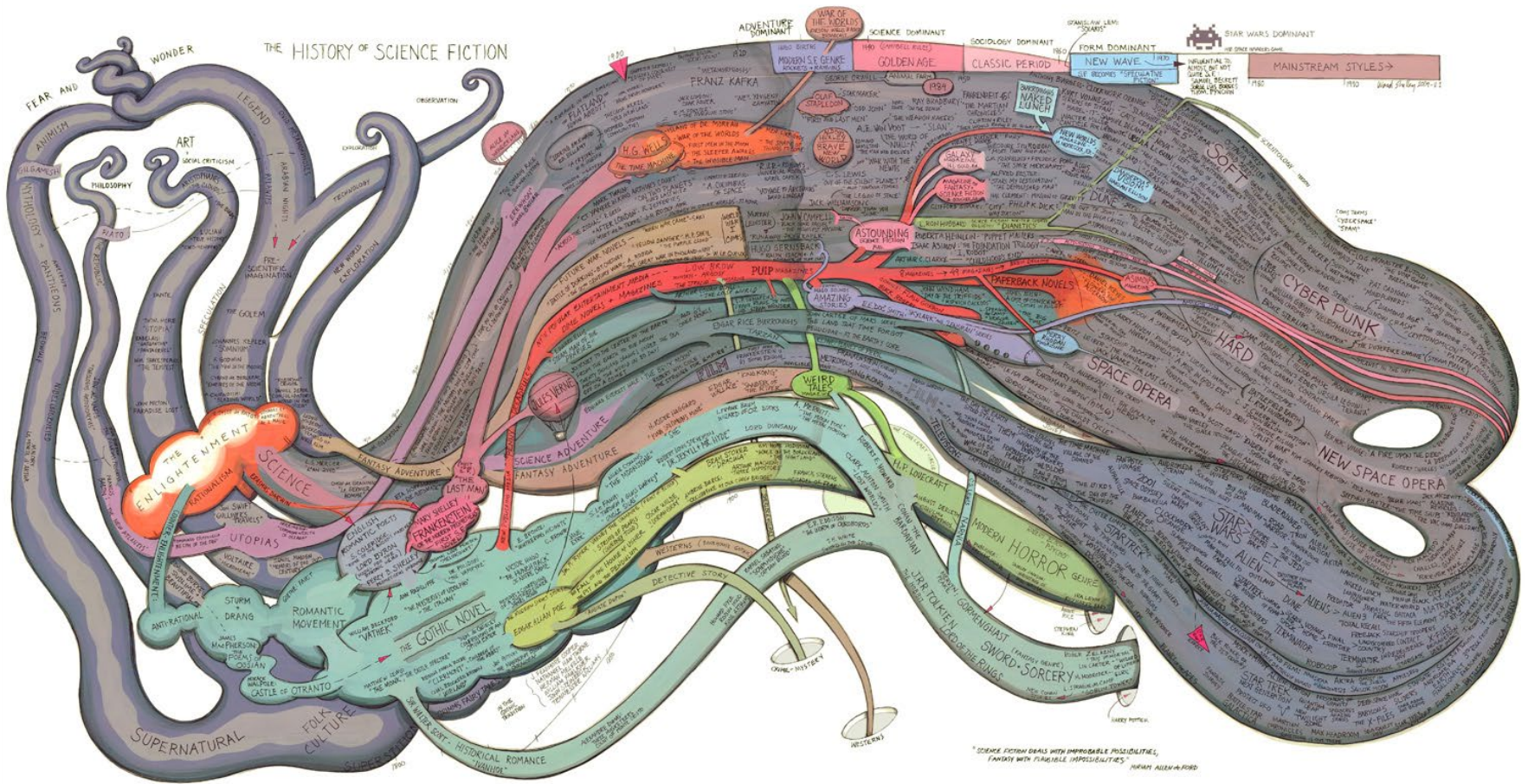
X.2 Map of the Internet - Martin Vargic - 2014

- 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!

VII.10  
History of Science Fiction, by Ward Shelley

BROOKLYN, NY, 2011  
Courtesy of Ward Shelley Studio

Ward Shelley is an artist identified with the Williamsburg scene in Brooklyn, New York. This map plots the science fiction literary genre from its nascent roots in the 18th century, emerging out of the data, here the narrative structure proceeds and organizes the data into a form where the genre's roots are like trace roots to pre-historical sources and whose body is a modernist whose tentacles are like trace roots to pre-historical sources and whose body is a modernist, which birthed gothic fictions, source not only of Sci-Fi, but also of critical theory, progressed through a number of distinct periods, which are charted, citing hundreds of authors and works.

PLACES & SPACES  
MAPPING & DESIGN

Visit [scimaps.org](http://scimaps.org) and check out all our maps in stunning detail!

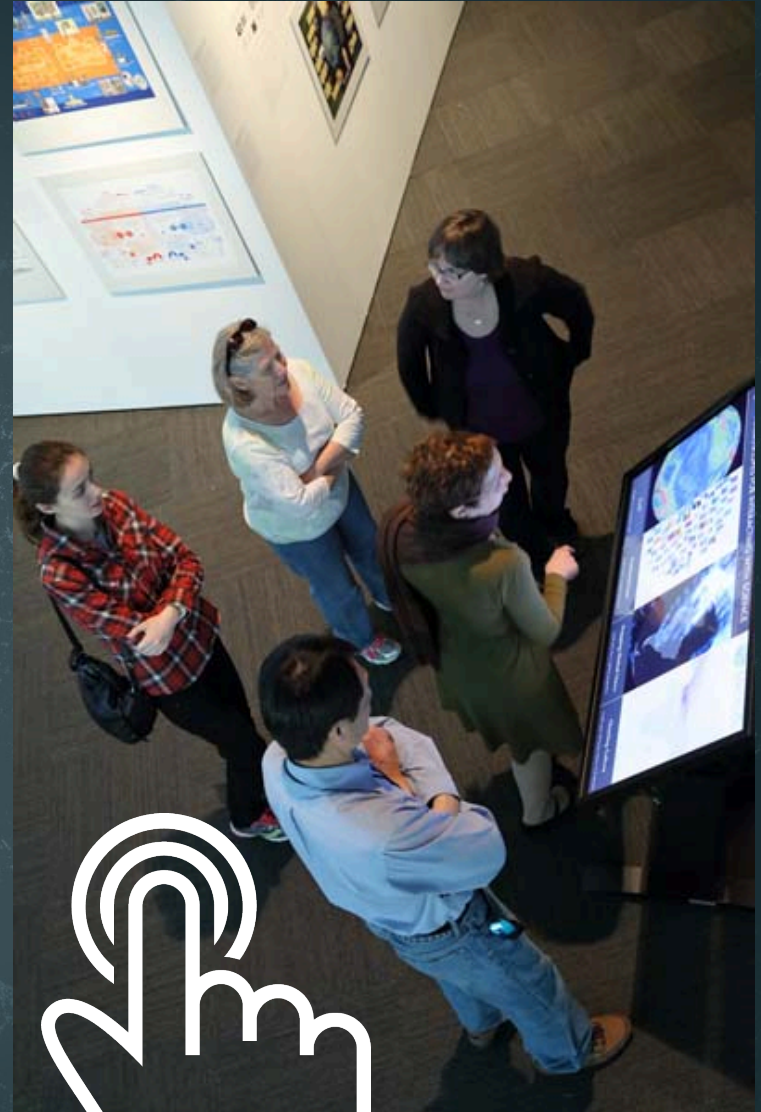


100 Maps of Science on Display in Hörsaalzentrum (Augustusplatz), Uni Leipzig, July 13-30, 2018

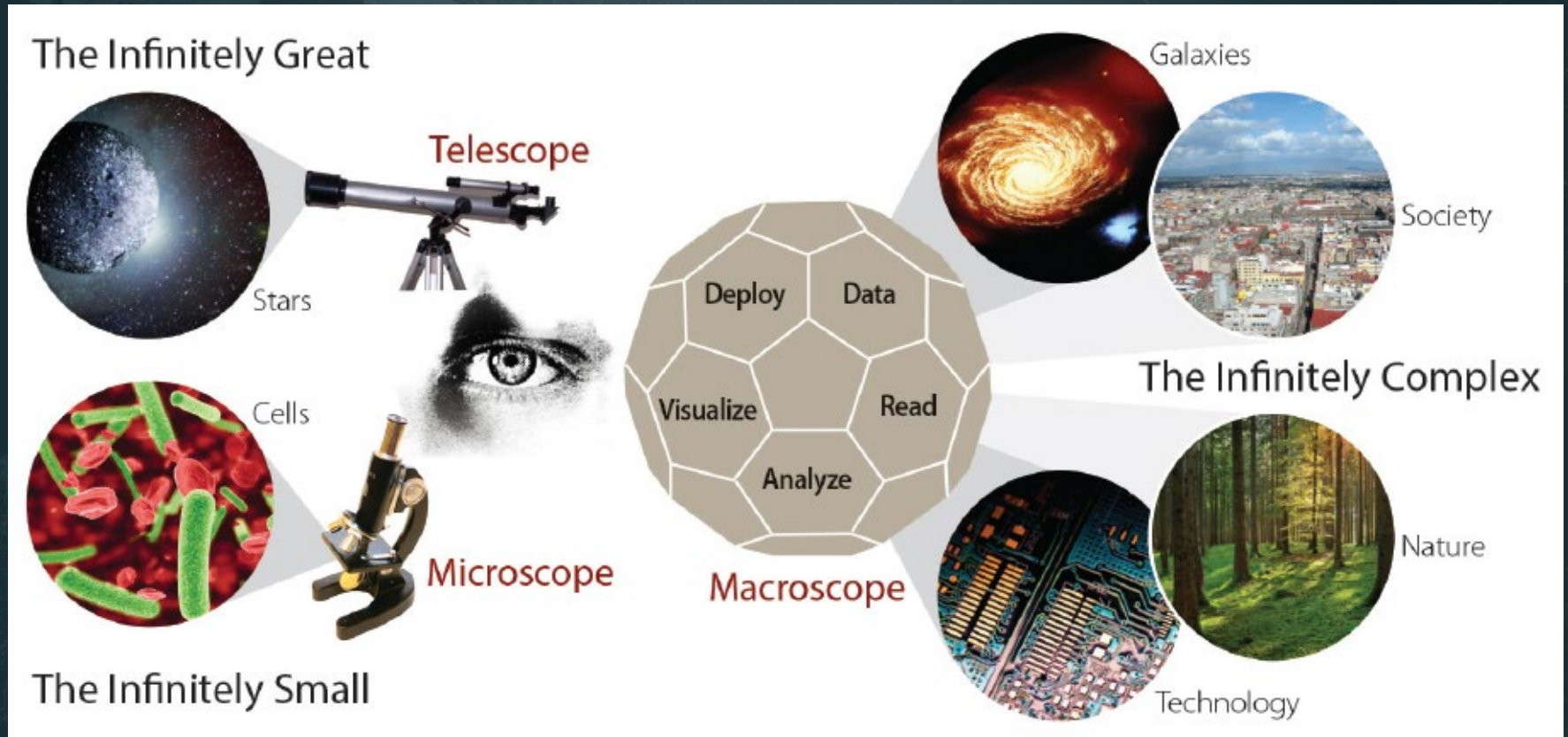




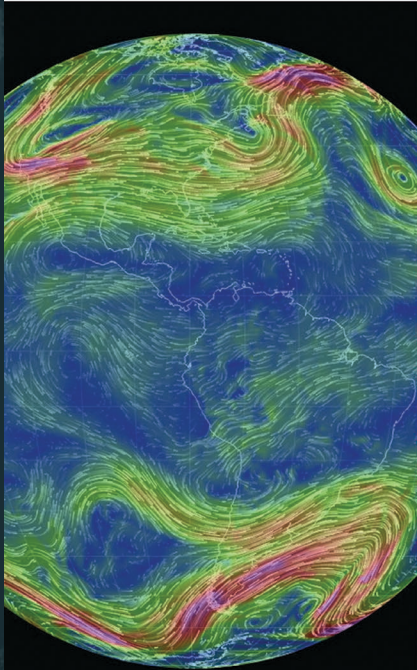
MAPS  
vs.  
MACROSCOPES



# Microscopes & Telescopes vs. MACROSCOPES



# i 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*



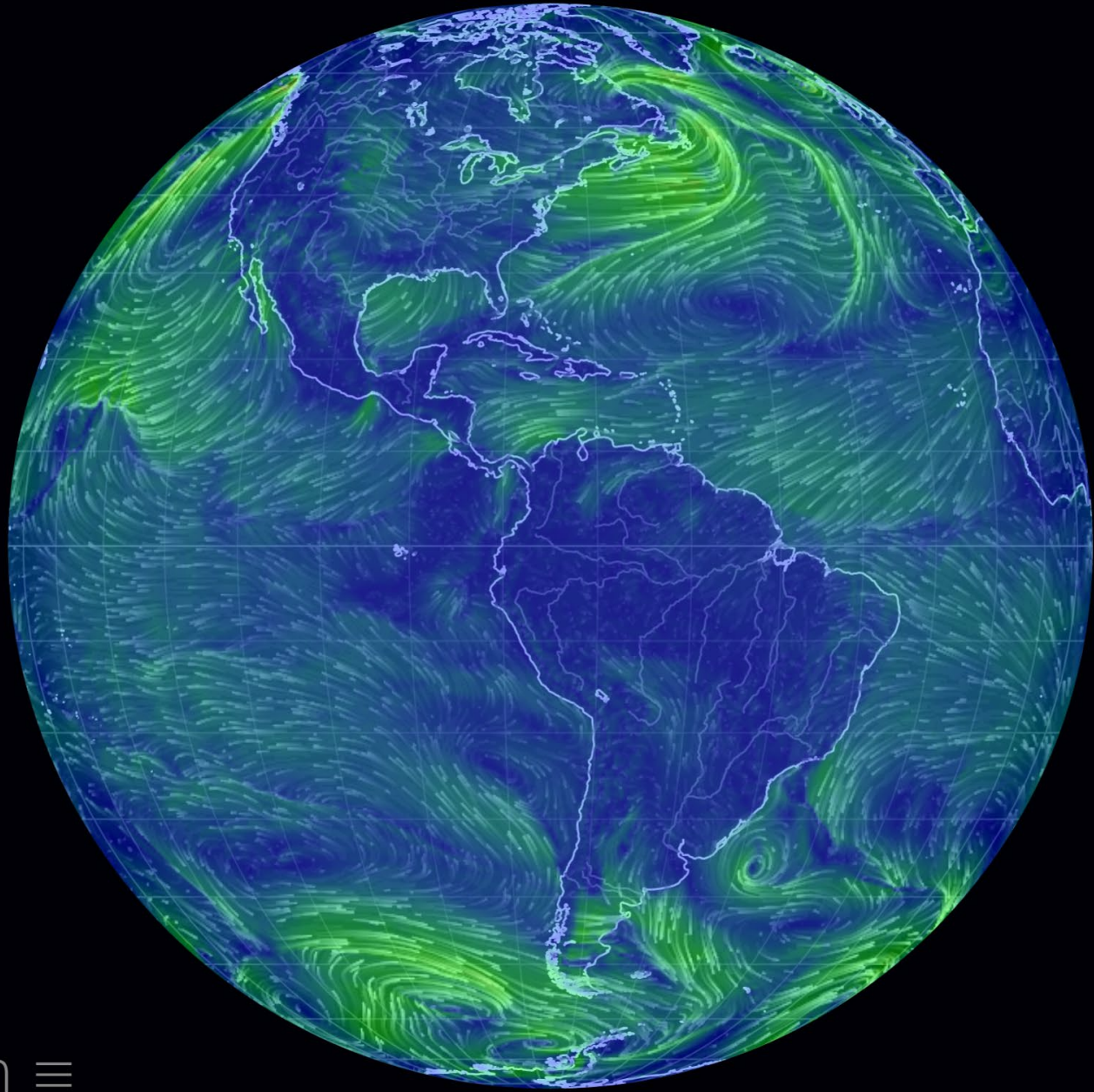
**Charting Culture**

*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

opic=282

# 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%

Timeline navigation: 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



COOCCUR

IN%

OUT%



**Smelly Maps**

*Charting urban smellscapes*



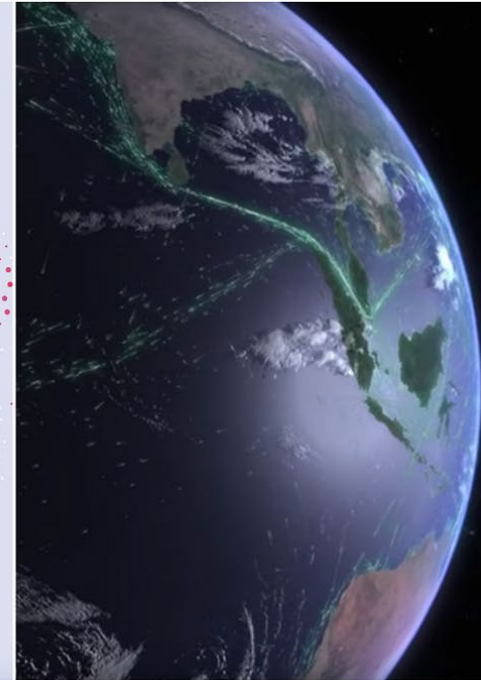
**HathiTrust**

*Storehouse of knowledge*



**Excellence Networks**

*Publish or perish together*

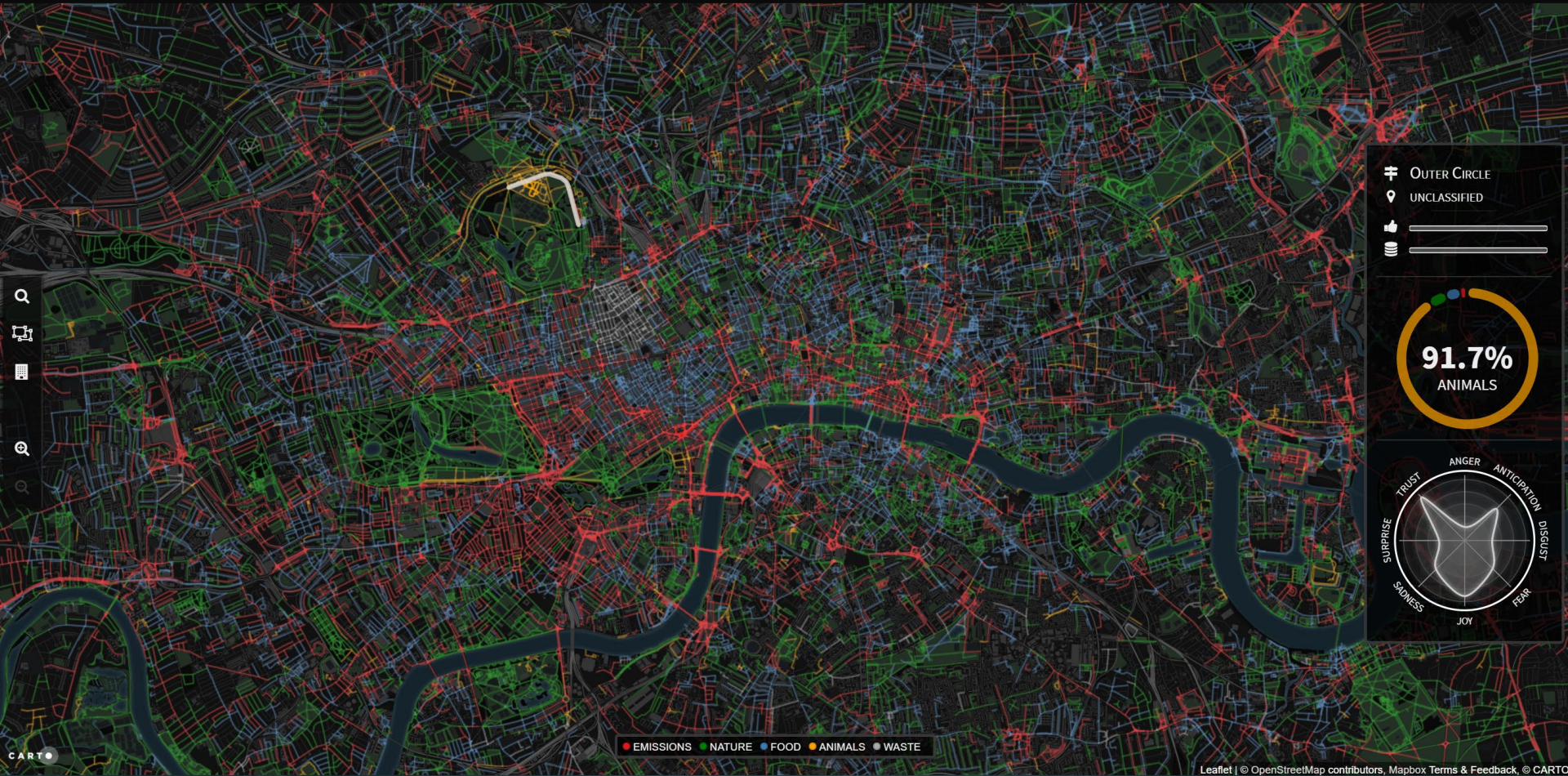


**FleetMon Explorer**

*Tracking the seven seas*

## Iteration XII (2016): Macrosopes for Making Sense of Science

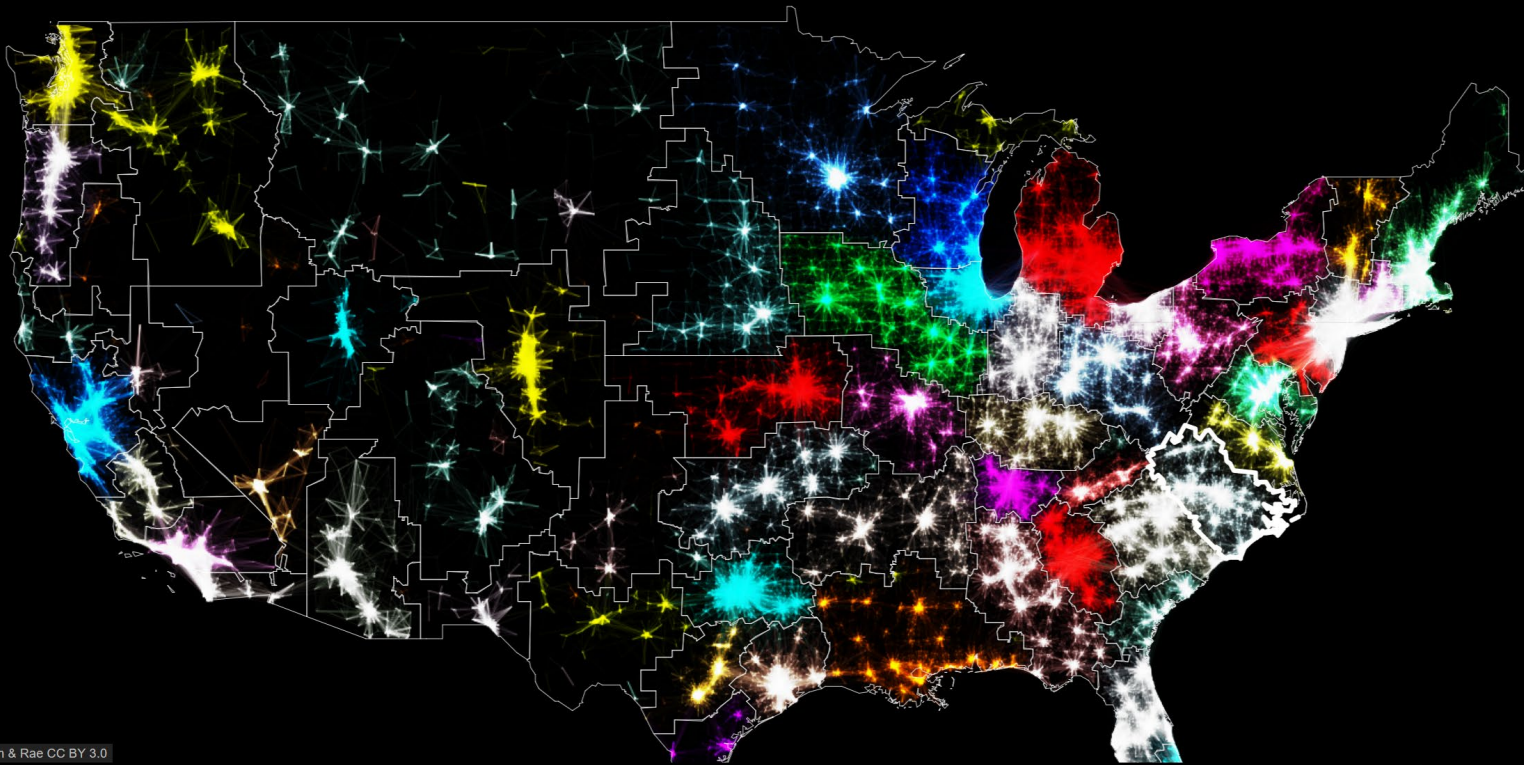
<http://scimaps.org/iteration/12>



*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 commuted.



Leaflet | Nelson & Rae CC BY 3.0



This is the Roanoke (Raleigh) megaregion.

 **FleetMon**  
Tracking the Seven Seas



Monday, September 10, 2012

00:08

01:31

*FleetMon Explorer* – FleetMon – 2012

# Models of Science & Technology

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







# Modeling Science, Technology & Innovation Conference

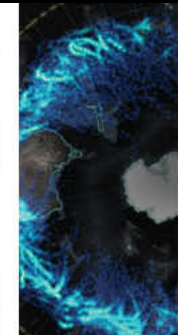
WASHINGTON D.C. | MAY 17-18, 2016

[View Agenda](#)

Government, academic, and industry leaders discussed challenges and opportunities associated with using big data, visual analytics, and computational models in STI decision-making.

Conference slides, recordings, and report are available via <http://modsti.cns.iu.edu/report>





## Modeling and Visualizing Science and Technology Developments

National Academy of Sciences Sackler Colloquium, December 4-5, 2017, Irvine, CA

### Rankings and the Efficiency of Institutions

H. Eugene Stanley | Albert-László Barabási | Lada Adamic | Marta González | Kaye Husbands Fealing | Brian Uzzi | John V. Lombardi

### Higher Education and the Science & Technology Job Market

Katy Börner | Wendy L. Martinez | Michael Richey | William Rouse | Stasa Milojevic | Rob Rubin | David Krakauer

### Innovation Diffusion and Technology Adoption

William Rouse | Donna Cox | Jeff Alstott | Ben Shneiderman | Rahul C. Basole | Scott Stern | Cesar Hidalgo

### Modeling Needs, Infrastructures, Standards

Paul Trunfio | Sallie Keller | Andrew L. Russell | Guru Madhavan | Azer Bestavros | Jason Owen-Smith



## PROGRAMS

## Sackler Colloquia

- » About Sackler Colloquia
- » Upcoming Colloquia
- » Completed Colloquia
- » Sackler Lectures
- » Video Gallery
- » Connect with Sackler Colloquia
- » Give to Sackler Colloquia

## Cultural Programs

## Distinctive Voices

## Kavli Frontiers of Science

## Keck Futures Initiative

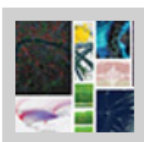
## LabX

## Sackler Forum

## Science &amp; Entertainment Exchange



## Modeling and Visualizing Science and Technology Developments



December 4-5, 2017; Irvine, CA

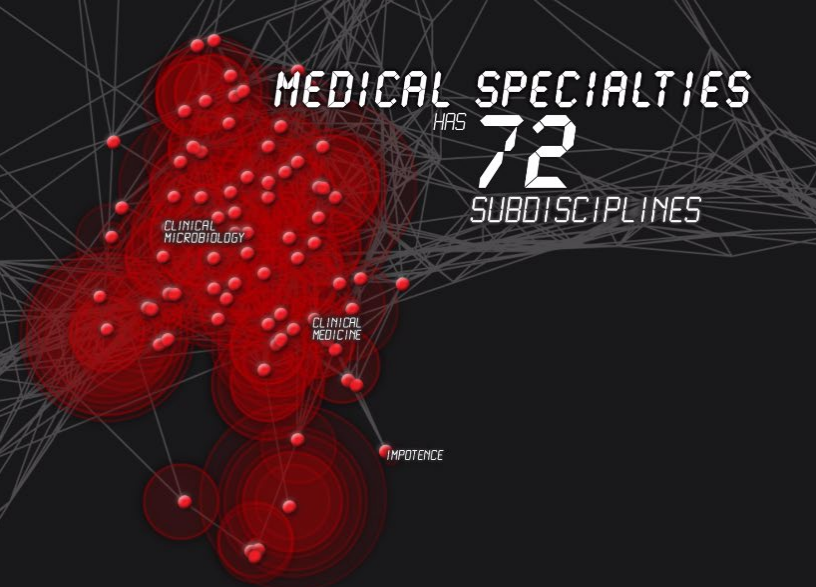
Organized by Katy Börner, H. Eugene Stanley, William Rouse and Paul Trunfio

### Overview

This colloquium was held in Irvine, CA on December 4-5, 2017.

This colloquium brought together researchers and practitioners from multiple disciplines to present, discuss, and advance computational models and visualizations of science and technology (S&T). Existing computational models are being applied by academia, government, and industry to explore questions such as: What jobs will exist in ten years and what career paths lead to success? Which types of institutions will likely be most innovative in the future? How will the higher education cost bubble burst affect these institutions? What funding strategies have the highest return on investment? How will changing demographics, alternative economic growth trajectories, and relationships among nations impact answers to these and other questions? Large-scale datasets (e.g., publications, patents, funding, clinical trials, stock market, social media data) can now be utilized to simulate the structure and evolution of S&T. Advances in computational power have created the possibility of implementing scalable, empirically validated computational models. However, because the databases are massive and multidimensional, both the data and the models tend to exceed human comprehension. How can advances in data visualizations be effectively employed to communicate the data, the models, and the model results to diverse stakeholder groups? Who will be the users of next generation models and visualizations and what decisions will they be addressing.

Videos of the talks are available on the [Sackler YouTube Channel](#).



# Science Forecast S1:E1



# Science Forecast

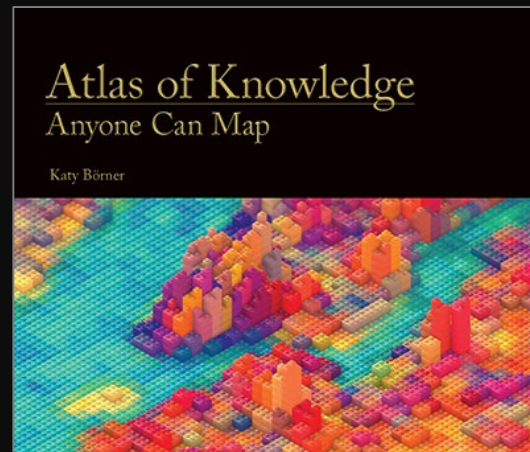
## S1:E1

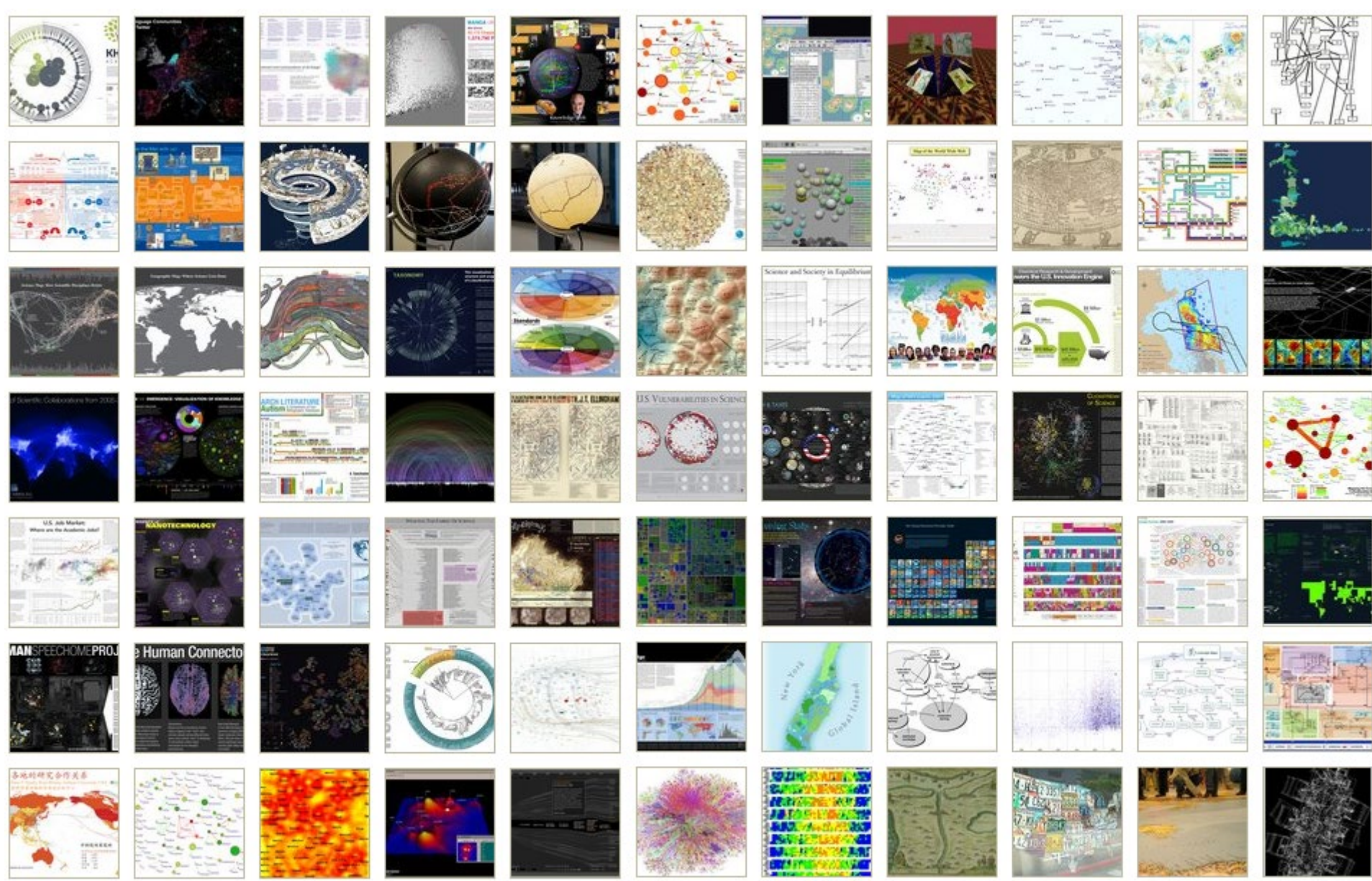


[https://www.youtube.com/watch?v=lByX2\\_eb\\_QQ](https://www.youtube.com/watch?v=lByX2_eb_QQ)

# 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 ?



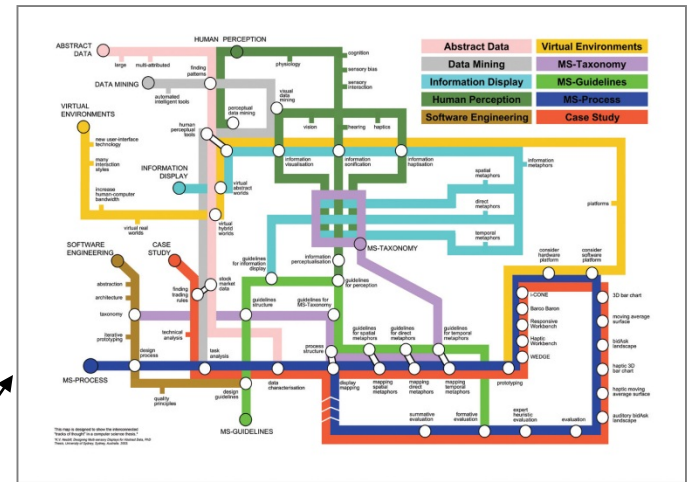


# Different Question Types



Terabytes of data

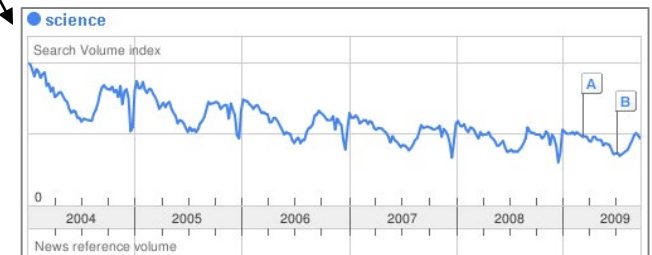
Descriptive & Predictive Models



Find your way



Find collaborators, friends



Identify trends

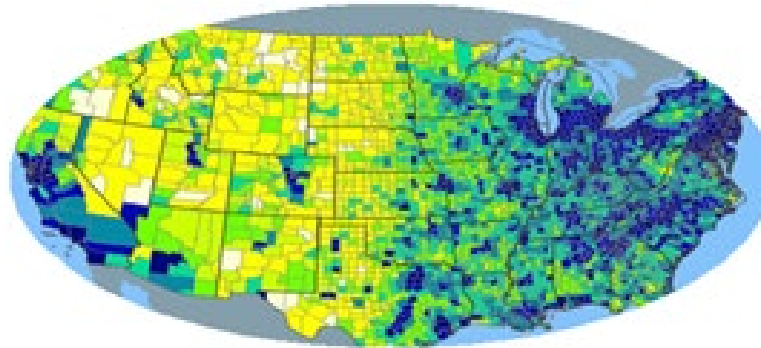
# Different Question Types

- 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

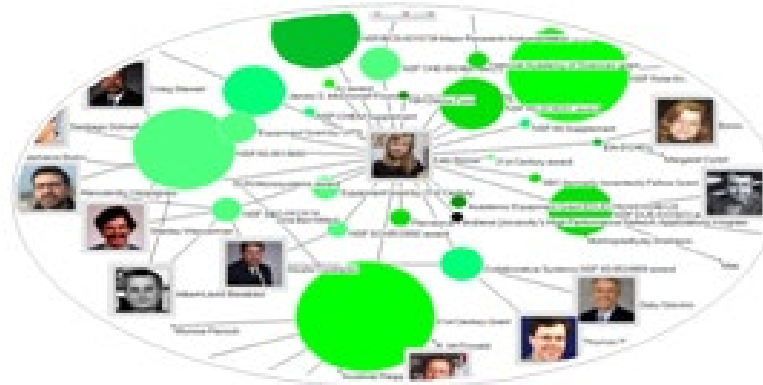
And other **WHEN, WHERE, WHAT, WITH WHOM** questions.

# Different Levels of Abstraction/Analysis

Macro/Global  
Population Level



Meso/Local  
Group Level

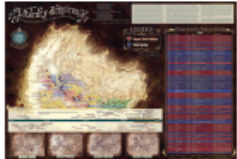



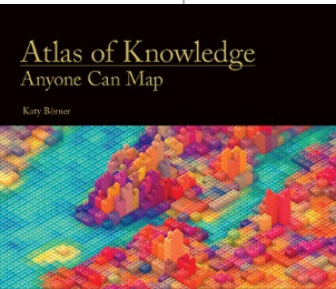
Micro  
Individual Level



# Tasks

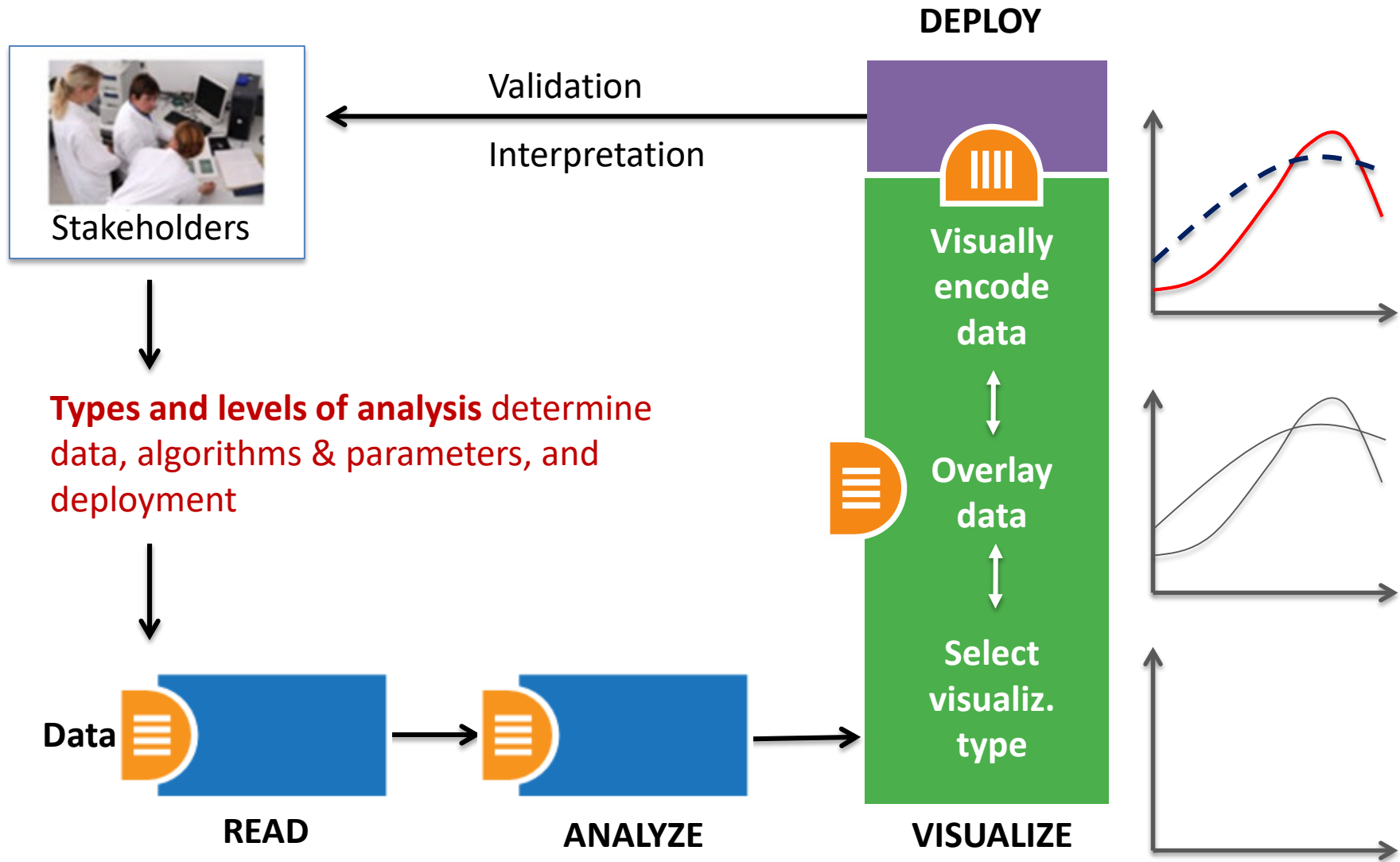
## LEVELS

	<b>MICRO: Individual Level</b> about 1–1,000 records page 6	<b>MESO: Local Level</b> about 1,001–100,000 records page 8	<b>MACRO: Global Level</b> more than 100,000 records page 10
<b>TYPES</b>			
<b>Statistical Analysis</b> 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
<b>WHEN: Temporal Analysis</b> 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
<b>WHERE: Geospatial Analysis</b> page 52	 Cell phone usage in Milan, Italy page 109	 Victorian poetry in Europe page 137	 Ecological footprint of countries page 99
<b>WHAT: Topical Analysis</b> page 56	 Evolving patent holdings of Apple Computer, Inc. and Jerome Lemelson page 89	 Evolving journal networks in nanotechnology page 139	 Product space showing co-export patterns of countries page 93
<b>WITH WHOM: Network Analysis</b> page 60	 World Finance Corporation network page 87	 Electronic and new media art networks page 133	 World-wide scholarly collaboration networks page 157

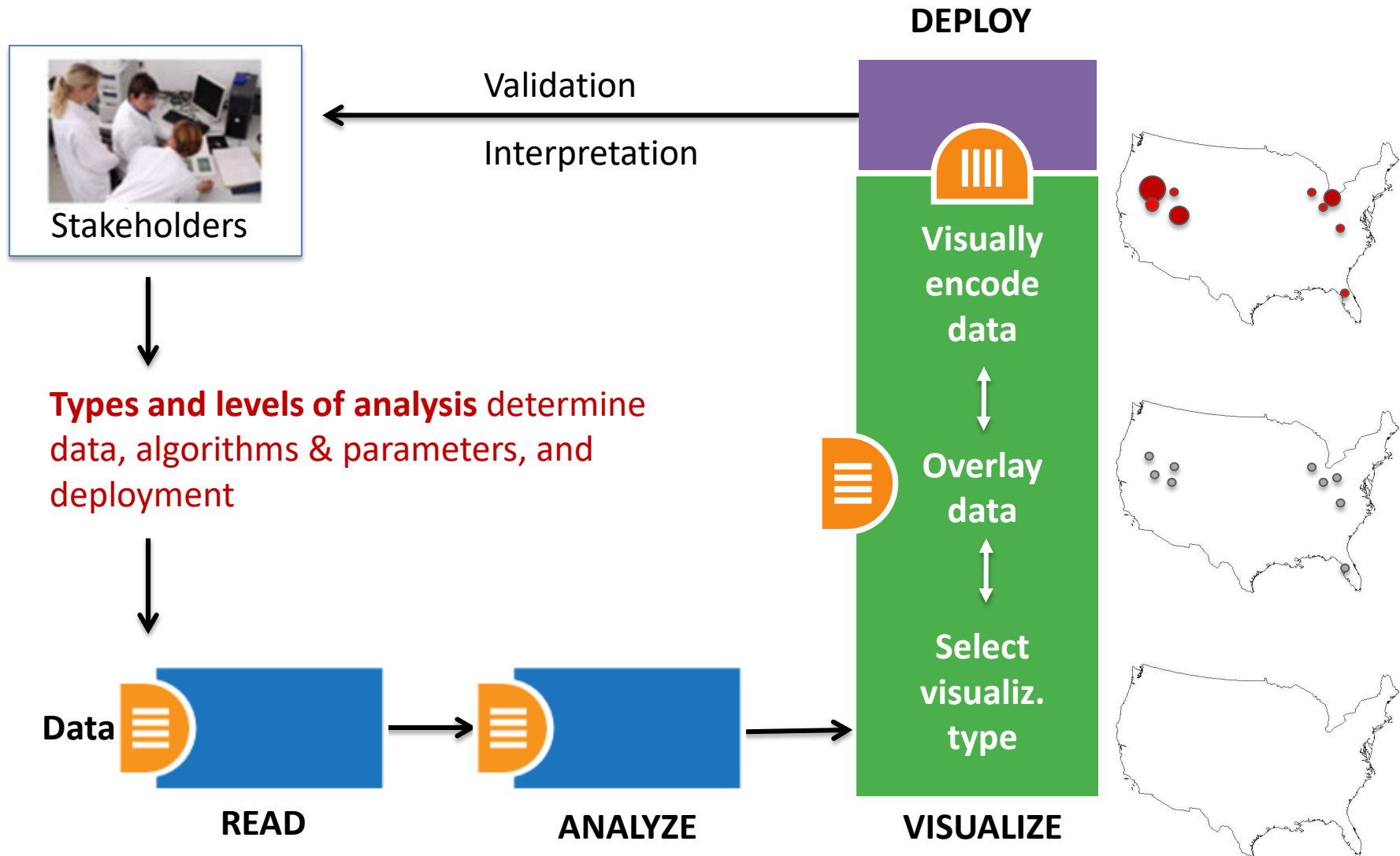


See *Atlas of Science: Anyone Can Map*, page 5

# Needs-Driven Workflow Design

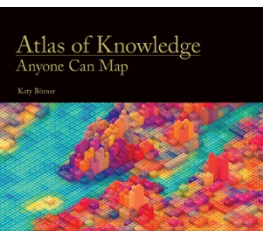


# Needs-Driven Workflow Design



# 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"><li>• categorize/cluster</li><li>• order/rank/sort</li><li>• distributions (also outliers, gaps)</li><li>• comparisons</li><li>• trends (process and time)</li><li>• geospatial</li><li>• compositions (also of text)</li><li>• correlations/relationships</li></ul>	<ul style="list-style-type: none"><li>• nominal</li><li>• ordinal</li><li>• interval</li><li>• ratio</li></ul>	<ul style="list-style-type: none"><li>• table</li><li>• chart</li><li>• graph</li><li>• map</li><li>• network layout</li></ul>	<ul style="list-style-type: none"><li>• geometric symbols<ul style="list-style-type: none"><li>point</li><li>line</li><li>area</li><li>surface</li><li>volume</li></ul></li><li>• linguistic symbols<ul style="list-style-type: none"><li>text</li><li>numerals</li><li>punctuation marks</li></ul></li><li>• pictorial symbols<ul style="list-style-type: none"><li>images</li><li>icons</li><li>statistical glyphs</li></ul></li></ul>	<ul style="list-style-type: none"><li>• spatial<ul style="list-style-type: none"><li>position</li></ul></li><li>• retinal<ul style="list-style-type: none"><li>form</li><li>color</li><li>optics</li><li>motion</li></ul></li></ul>	<ul style="list-style-type: none"><li>• overview</li><li>• zoom</li><li>• search and locate</li><li>• filter</li><li>• details-on-demand</li><li>• history</li><li>• extract</li><li>• link and brush</li><li>• projection</li><li>• distortion</li></ul>



See page 24

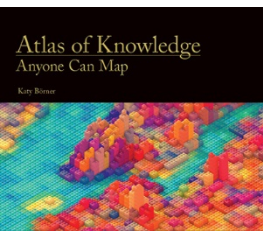
# Visualization Framework

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"> <li>• categorize/cluster</li> <li>• order/rank/sort</li> <li>• distributions (also outliers, gaps)</li> <li>• comparisons</li> <li>• trends (process and time)</li> <li>• geospatial</li> <li>• compositions (also of text)</li> <li>• correlations/relationships</li> </ul>	<ul style="list-style-type: none"> <li>• nominal</li> <li>• ordinal</li> <li>• interval</li> <li>• ratio</li> </ul>	<ul style="list-style-type: none"> <li>• table</li> <li>• chart</li> <li>• graph</li> <li>• map</li> <li>• network layout</li> </ul>	<ul style="list-style-type: none"> <li>• geometric symbols               <ul style="list-style-type: none"> <li>point</li> <li>line</li> <li>area</li> <li>surface</li> <li>volume</li> </ul> </li> <li>• linguistic symbols               <ul style="list-style-type: none"> <li>text</li> <li>numerals</li> <li>punctuation marks</li> </ul> </li> <li>• pictorial symbols               <ul style="list-style-type: none"> <li>images</li> <li>icons</li> <li>statistical glyphs</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• spatial               <ul style="list-style-type: none"> <li>position</li> </ul> </li> <li>• retinal               <ul style="list-style-type: none"> <li>form</li> <li>color</li> <li>optics</li> <li>motion</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• overview</li> <li>• zoom</li> <li>• search and locate</li> <li>• filter</li> <li>• details-on-demand</li> <li>• history</li> <li>• extract</li> <li>• link and brush</li> <li>• projection</li> <li>• distortion</li> </ul>



See page 24

# Graphic Variable Types Versus Graphic Symbol Types

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

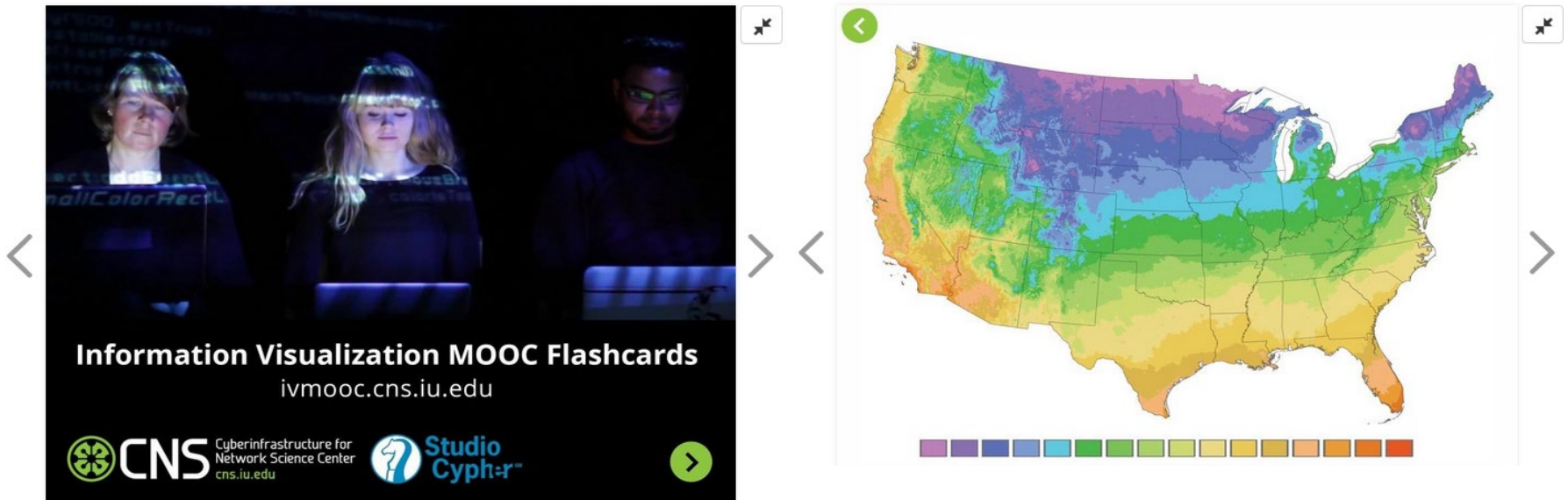
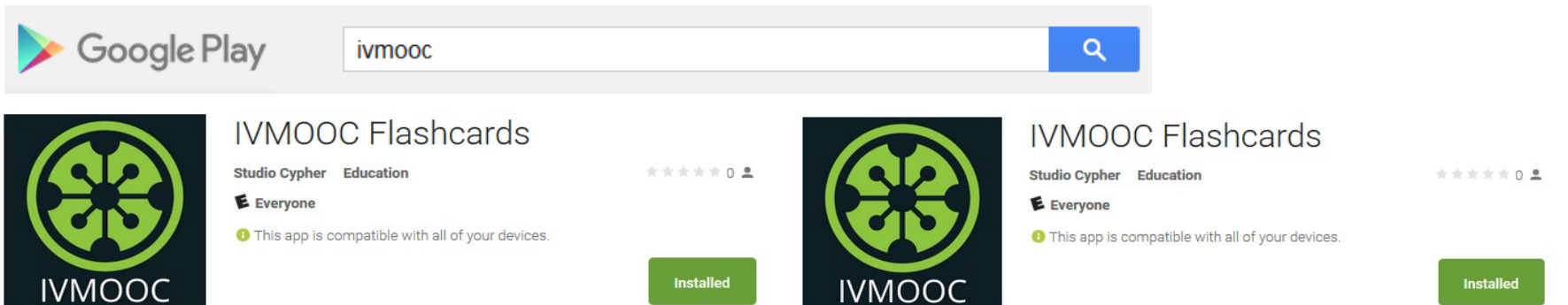
# Graphic Variable Types Versus Graphic Symbol Types

			Geometric Symbols			Linguistic Symbols Text, Numerals, Punctuation Marks		Pictorial Symbols Images, Icons, Statistical Glyphs	
Spatial	x	quantitative							
	y	quantitative							
	z	quantitative							
Form	Size	quantitative	NA (Not Applicable)						
	Shape	qualitative	NA						
	Rotation	quantitative	NA						
	Curvature	quantitative	NA						
	Angle	quantitative	NA						
	Closure	quantitative	NA						
	Value	quantitative							
Color	Hue	qualitative							
	Saturation	quantitative							

			Geometric Symbols			Linguistic Symbols Text, Numerals, Punctuation Marks		Pictorial Symbols Images, Icons, Statistical Glyphs	
Texture	Spacing	quantitative							
	Granularity	quantitative							
	Pattern	qualitative							
	Orientation	quantitative	NA						
	Gradient	quantitative							
	Blur	quantitative							
	Transparency	quantitative							
Optics	Shading	quantitative							
	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	Icons in foreground -- background
	Speed	quantitative							
Motion	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	Blinking icons slow -- fast

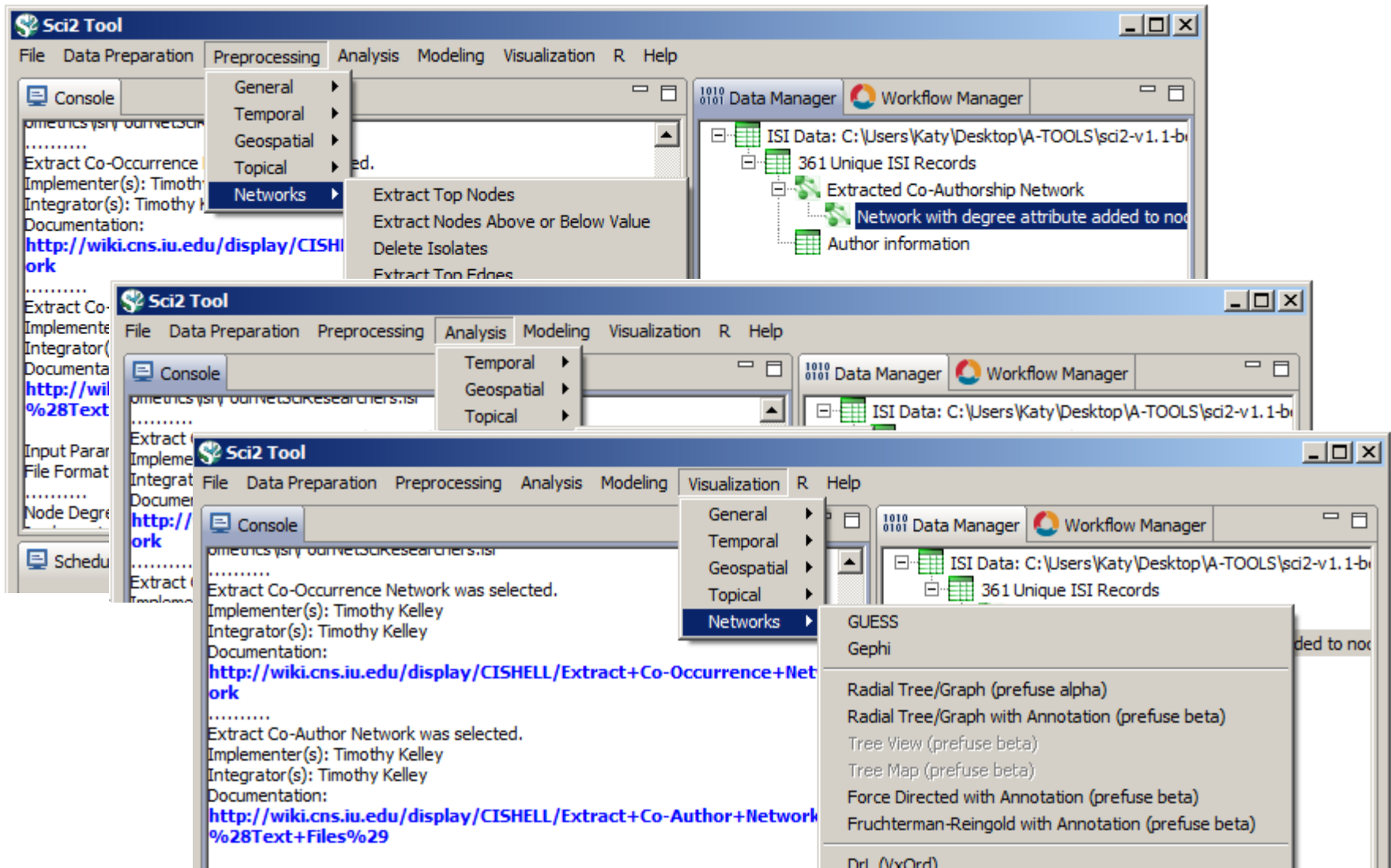
# IVMOOC App

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>



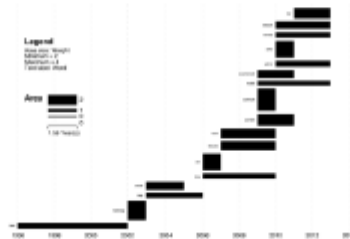
# Load **One** File and Run **Many** Analyses and Visualizations

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 Microscopes	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



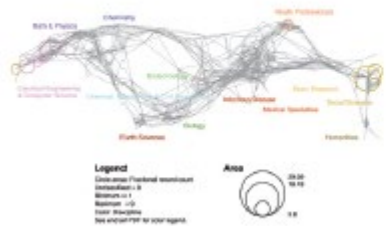
Geospatial Analysis—p. 52



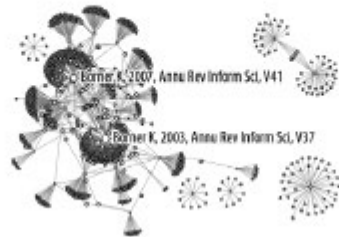
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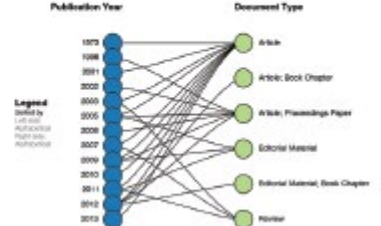
Topical Analysis—p. 56



Paper Citation Network—p. 60



Bi-Modal Network—p. 60



Co-author and many other bi-modal networks.

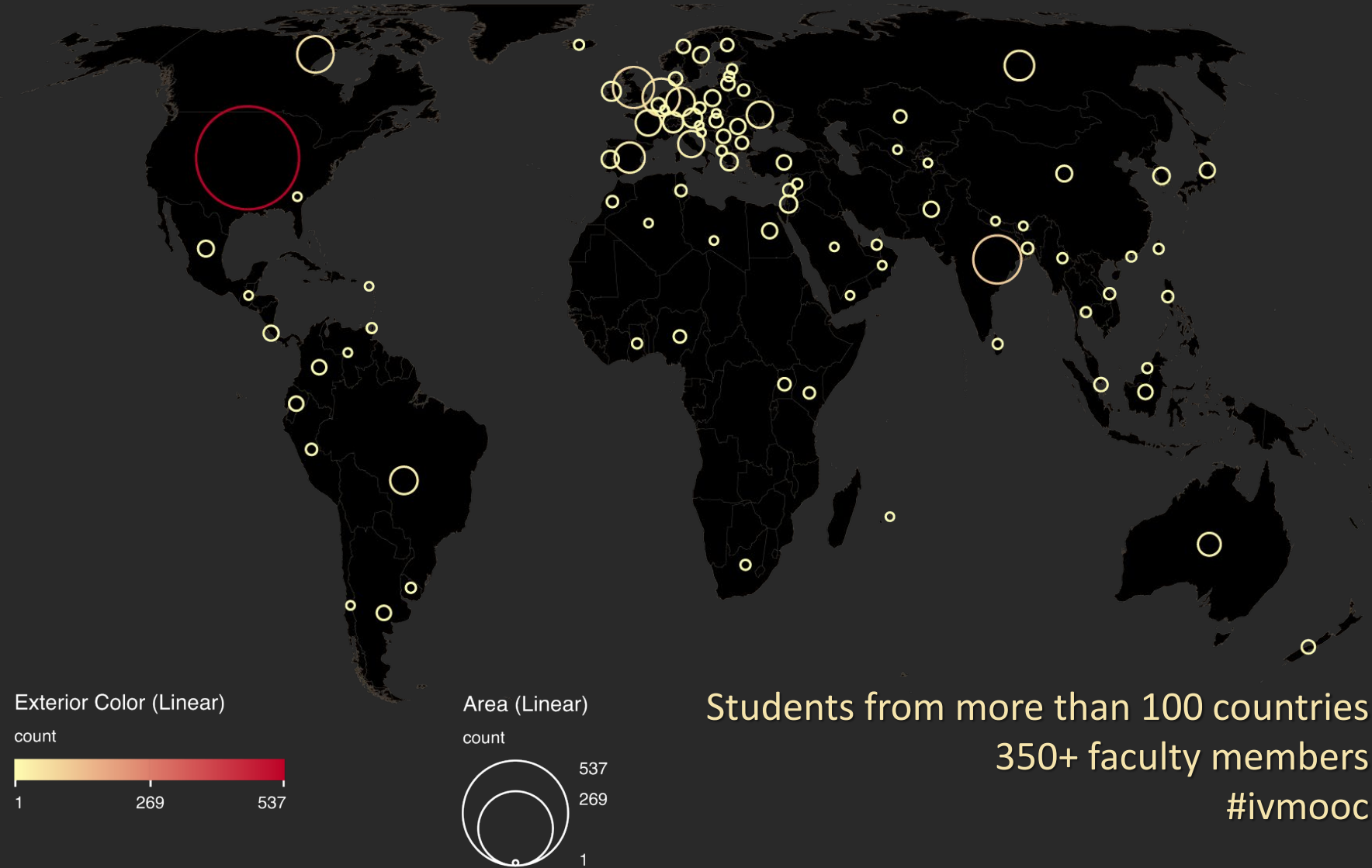


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# The Information Visualization MOOC

[ivmooc.cns.iu.edu](http://ivmooc.cns.iu.edu)



# 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

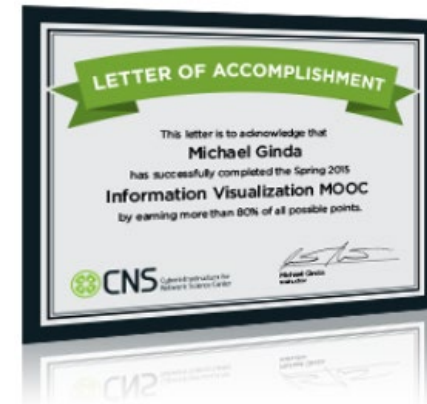
## Mid-Term

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

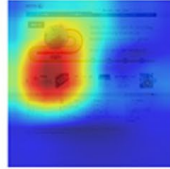
## Final Exam

## 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%**).



# Client Projects



## Visualizing the Evolution of Website Design

With over 25 years of history, the web itself has become a significant cultural artifact. We are studying how website design has changed over time, and how these changes reflect changes

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## Visualizing Research Silos in Ecological Interaction datasets

Open access to high quality and integrated ecological datasets is important to better

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## ChaCha Menopause queries

The ChaCha menopause query data is the foundation for building intervention modules to improve people's knowledge and problem solving skills related to menopause. For this project,

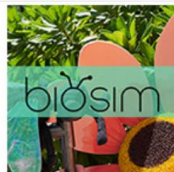
[Read more...](#)



## Text-Mining of User-Generated Queries on Menstrual Pain

Menstrual pain is a leading cause of disability among women of reproductive age. To ease relief of pain

[Read more...](#)



## BioSimmer

BioSim is a participatory simulation where young students (grades K-3) enact the roles of ants and biological systems through the assistance of electronically-enhanced e-puppets. It is

[Read more...](#)

2018 projects are at <https://ivmooc.cns.iu.edu/clients.html>

Submit your own 2019 client project via [FORM](#) by Dec 6, 2018.

# References

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](http://www.pnas.org/content/vol101/suppl_1)

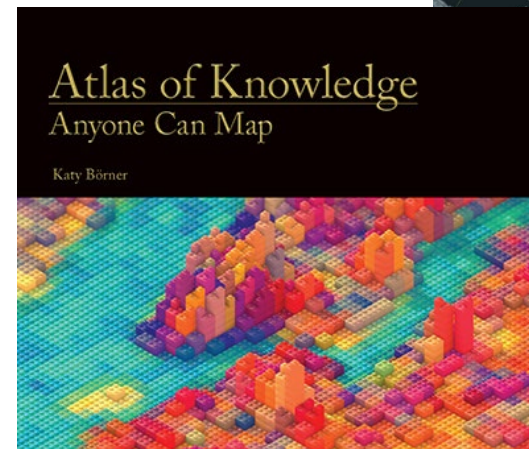
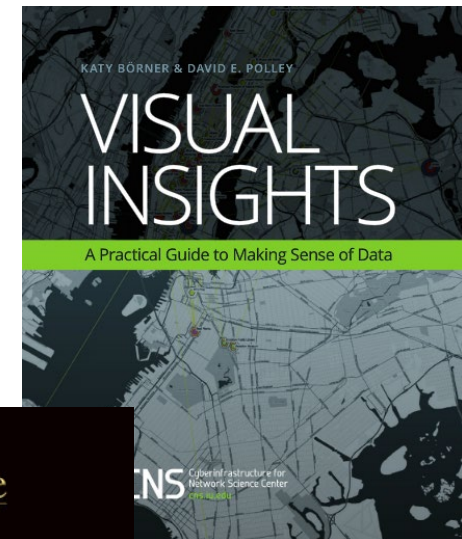
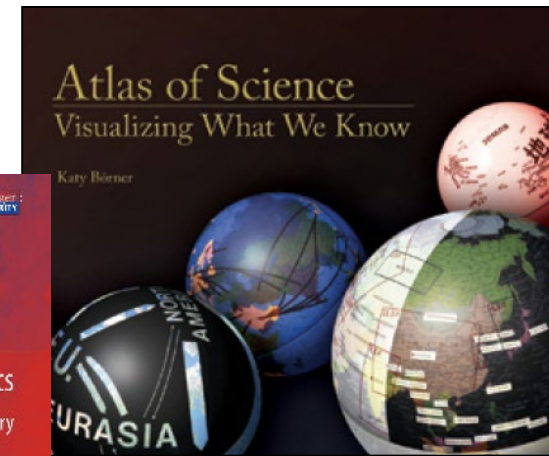
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# Interdisciplinary Training in Complex Networks and Systems

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## The program

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Understanding complex networked systems is key to solving some of the most vexing problems confronting humankind, from discovering how dynamic brain connections give rise to thoughts and behaviors, to detecting and preventing the spread of misinformation or unhealthy behaviors across a population. Graduate training, however, typically occurs in one of two dimensions: experimental and observational methods in a specific area such as biology and sociology, or in general methodologies such as machine learning and data science.



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<https://cns-nrt.indiana.edu>

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<https://commonfund.nih.gov/HuBMAP>  
[https://projectreporter.nih.gov/project\\_info\\_description.cfm?aid=9687220](https://projectreporter.nih.gov/project_info_description.cfm?aid=9687220)
- **Postdoc** as part of NSF: Collaborative Research: Multi-Level Graph Representation for Exploring Big Data (with Stephen Kobourov)  
[https://www.nsf.gov/awardsearch/showAward?AWD\\_ID=1839167](https://www.nsf.gov/awardsearch/showAward?AWD_ID=1839167)




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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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