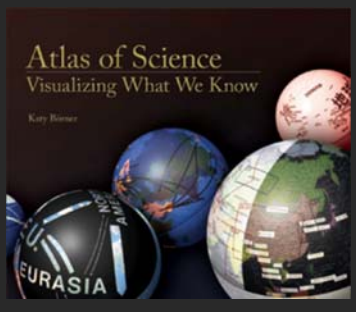
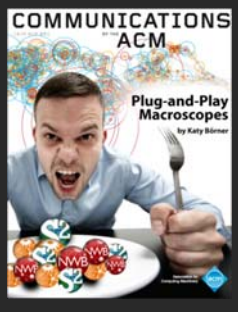
Analyzing and Visualizing Science

Katy Börner
Royal Netherlands Academy of Arts and Sciences (KNAW),
The Netherlands and
Cyberinfrastructure for Network Science Center, Director
Information Visualization Laboratory, Director
School of Library and Information Science
Indiana University, Bloomington, IN
katy@indiana.edu

With special thanks to the members at the Cyberinfrastructure for Network Science Center and the Sci2 Tool team

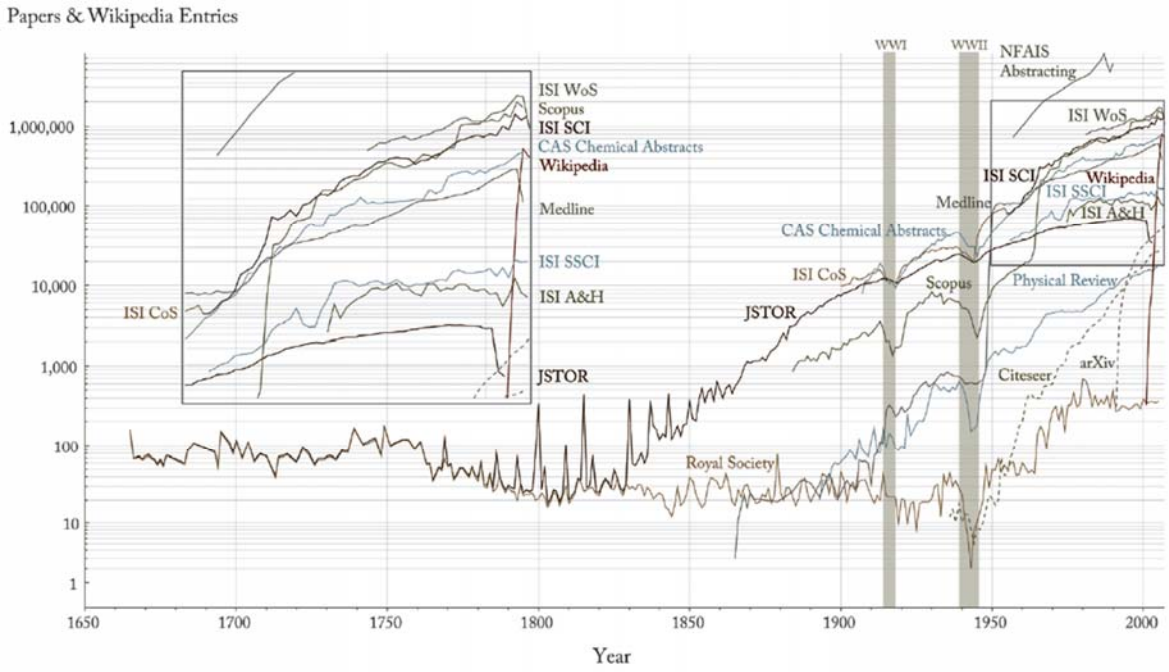


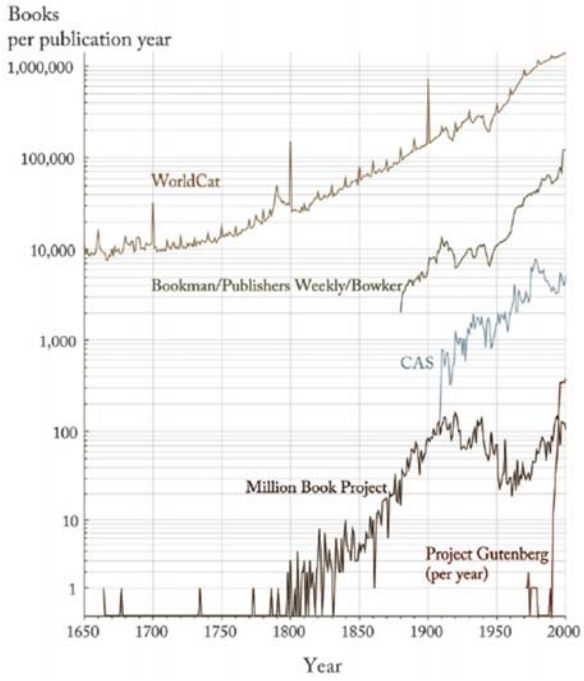


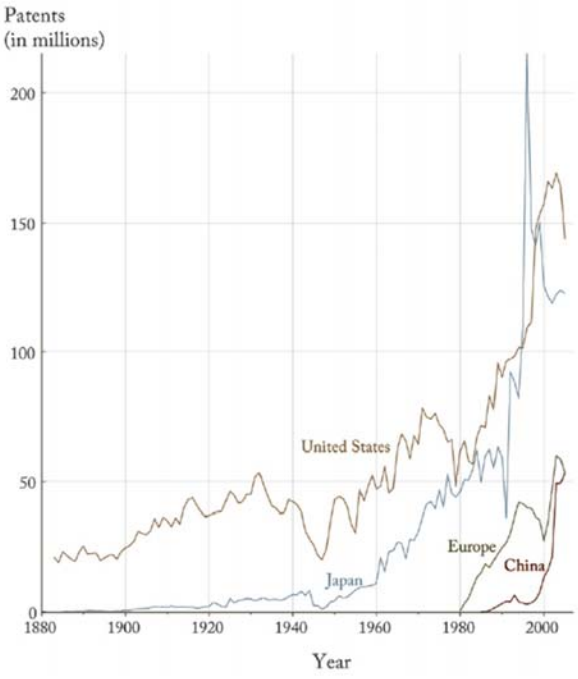
European Summer School for Scientometrics (ESSS), Leuven, Belgium

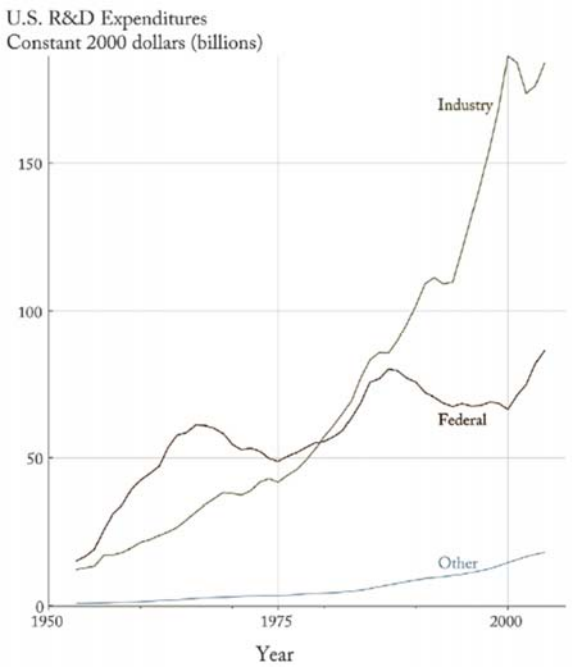
July 3, 2012

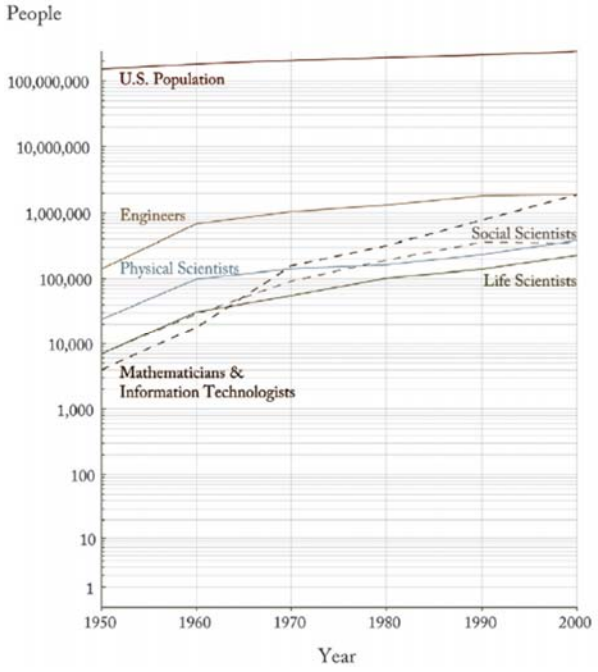
The Rise of Science and Technology




Books
per publication year
1,000,000
100,000
10,000
1,000
100
10
1
WorldCat
Bookman/Publishers Weekly/Bowker
CAS
Million Book Project
Project Gutenberg
(per year)
1650
1700
1750
1800
1850
1900
1950
2000
Year

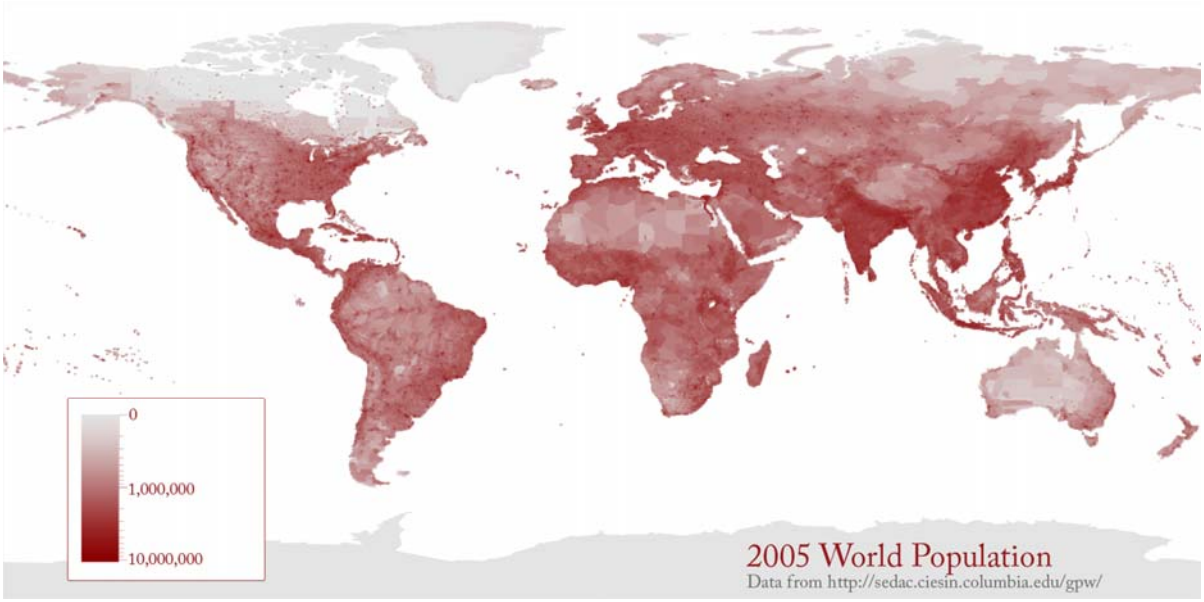

Patents
(in millions)
200
150
100
50
0
United States
Europe
China
Japan
1880
1900
1920
1940
1960
1980
2000
Year


U.S. R&D Expenditures
Constant 2000 dollars (billions)
150
100
50
0
Industry
Federal
Other
1950
1975
2000
Year


People
100,000,000
10,000,000
1,000,000
100,000
10,000
1,000
100
10
1
U.S. Population
Engineers
Social Scientists
Physical Scientists
Life Scientists
Mathematicians &
Information Technologists
1950
1960
1970
1980
1990
2000
Year

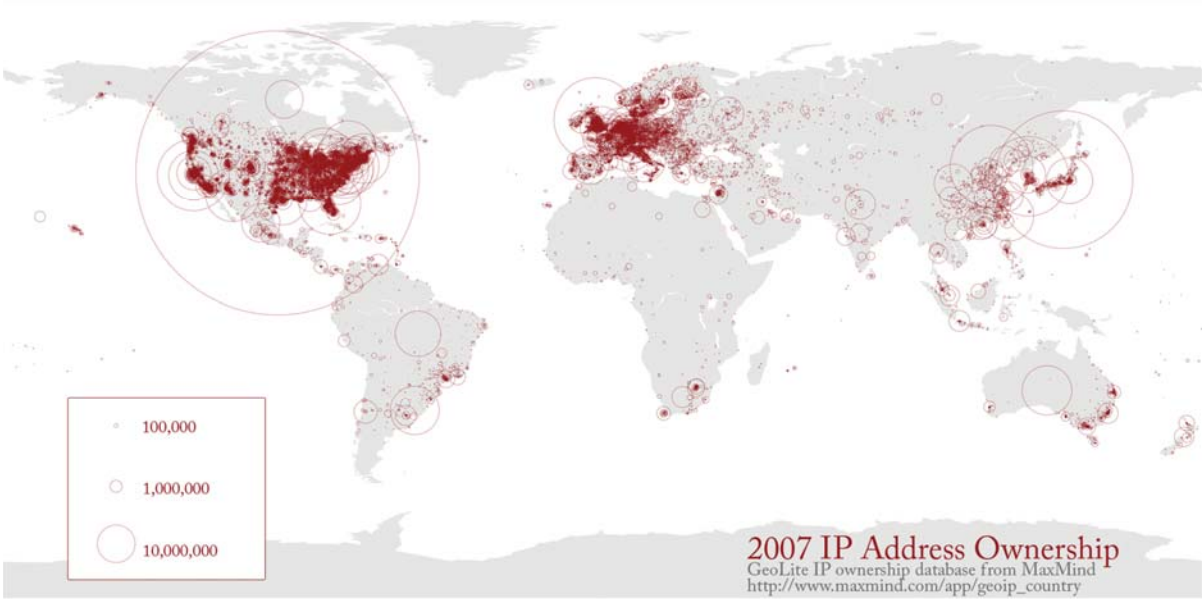
2005 World Population

The population map uses a quarter degree box resolution. Boxes with zero people are given in white. Darker shades of red indicate higher population counts per box using a logarithmic interpolation. The highest density boxes appear in Mumbai, with 11,687,850 people in the quarter degree block, Calcutta (10,816,010), and Shanghai (8,628,088).



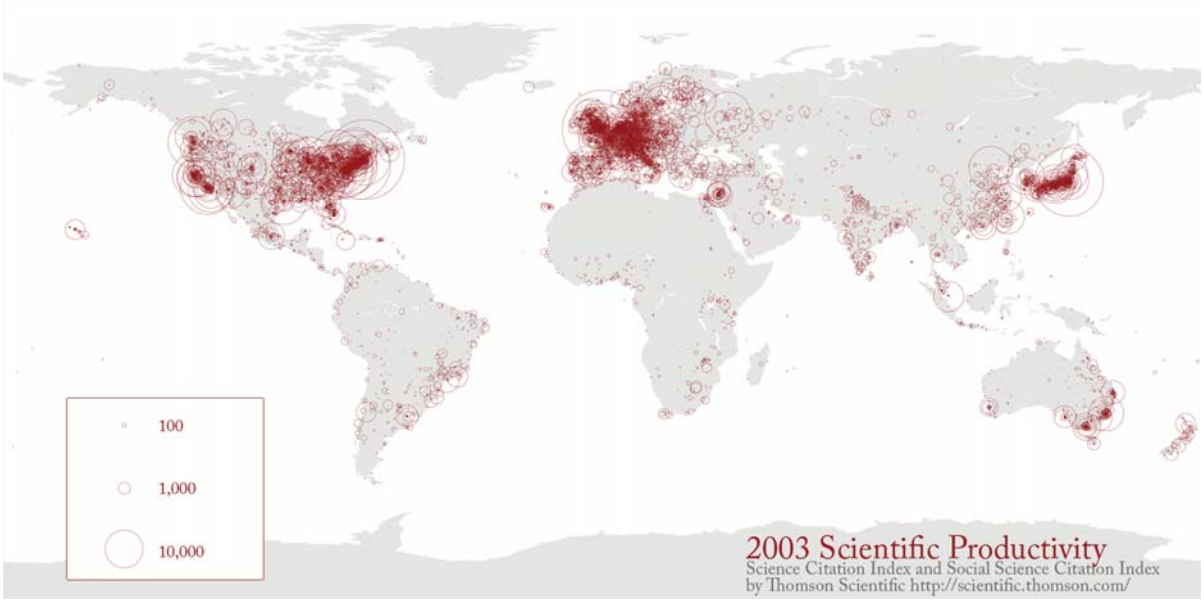
2007 IP Address Ownership

This map shows IP address ownership by location. Each owner is represented by a circle and the area size of the circle corresponds to the number of IP addresses owned. The larges circle denotes MIT's holdings of an entire class A subnet, which equates to 16,581,375 IP addresses. The countries that own the most IP addresses are US (560 million), Japan (130 million), Great Britain (47 million).



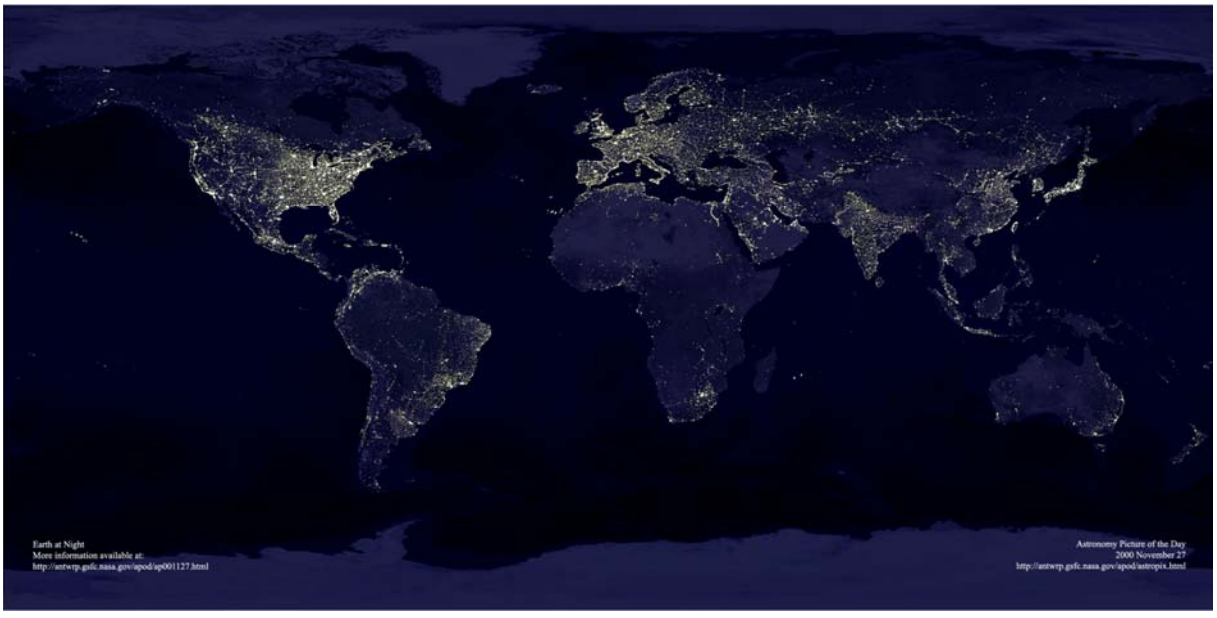
2003 Scientific Productivity

Shown is where science is performed today. Each circle indicates a geographic location at which scholarly papers are published. The larger the circle the more papers are produced. Boston, MA, London, England, and New York, NY are the top three paper production areas. Note the strong resemblance with the Night on Earth and the IP Ownership maps and the striking differences to the world population map.



2000 Night on Earth

This image shows city lights at night. It was composed from hundreds of pictures made by orbiting satellites. The seaboards of Europe, the eastern United States, and Japan are particularly well lit. Many cities exist near rivers or oceans so that goods can be exchanged cheaply by boat. The central parts of South America, Africa, Asia, and Australia are rather dark despite their high population density, see map to the left.



Early Maps of the World VERSUS Early Maps of Science

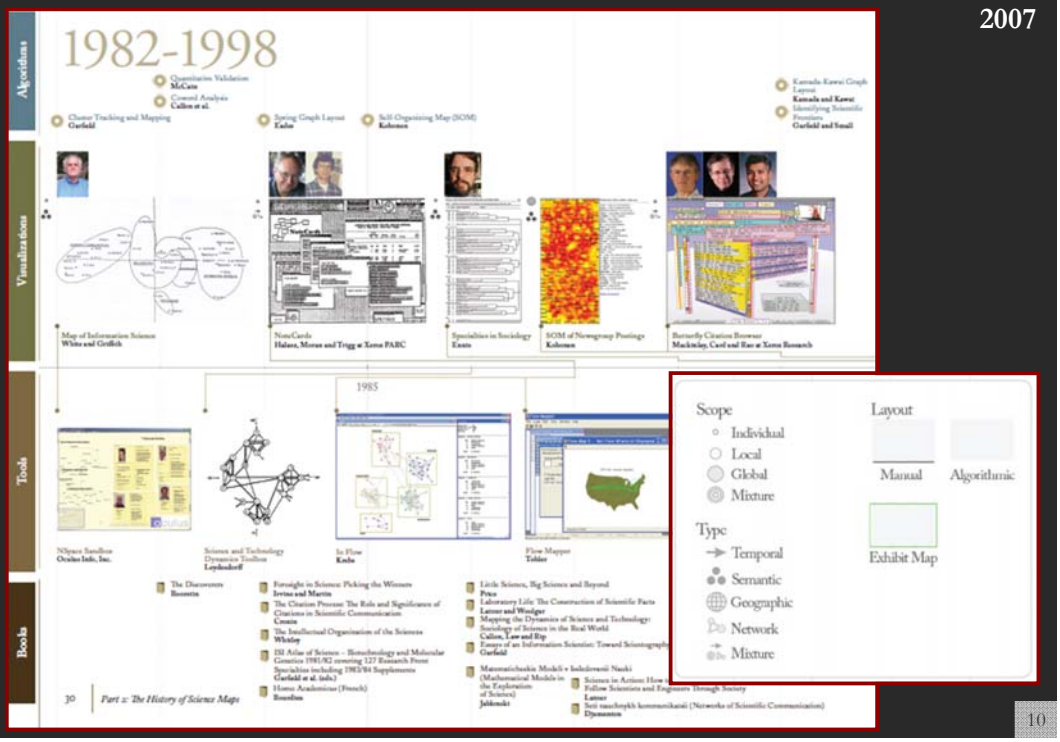
3D
Physically-based
Accuracy is measurable
Trade-offs have more to do with granularity
2-D projections are very accurate at local levels
Centuries of experience
Geo-maps can be a template for other data

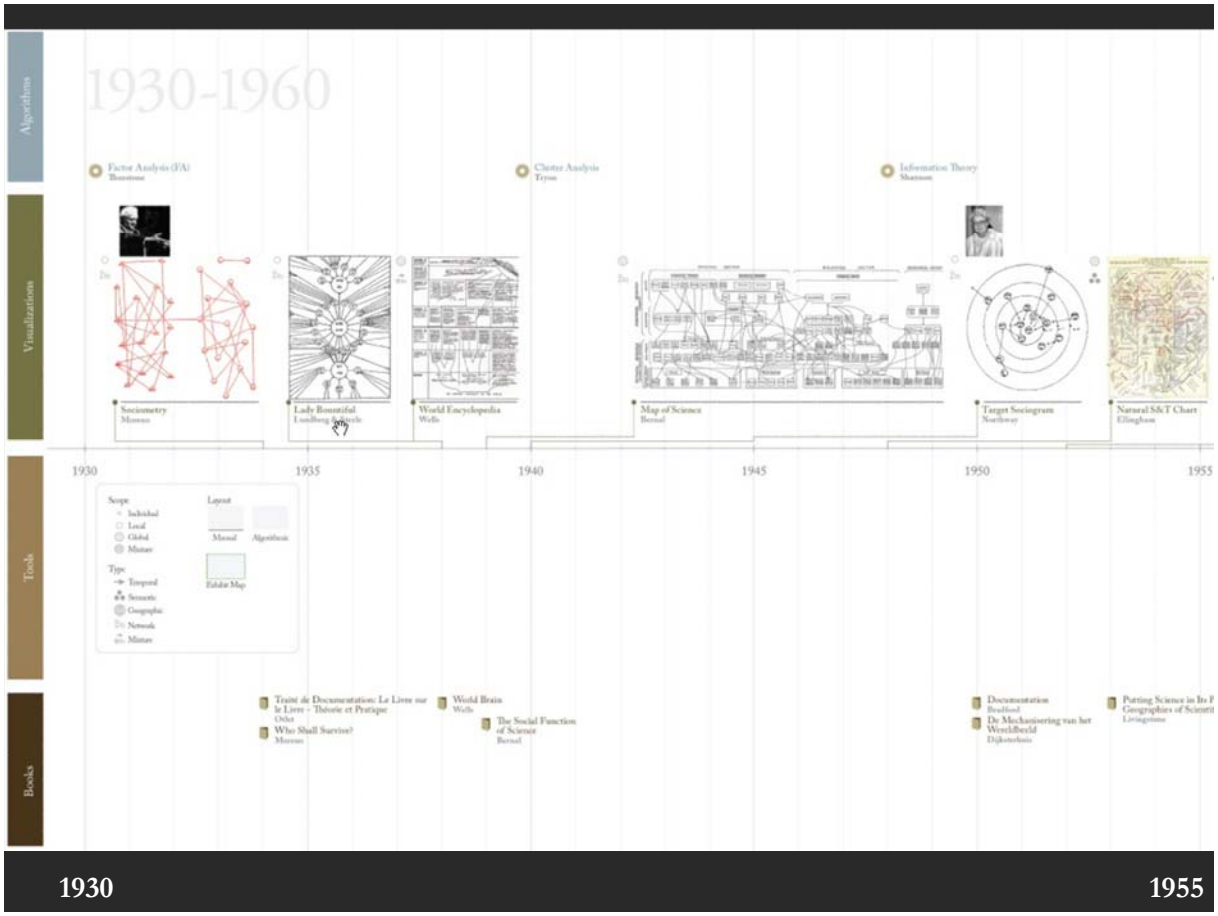
n-D
Abstract space
Accuracy is difficult
Trade-offs indirectly affect accuracy
2-D projections neglect a great deal of data
Decades of experience
Science maps can be a template for other data

Kevin W. Boyack, UCGIS Summer Meeting, June, 2009

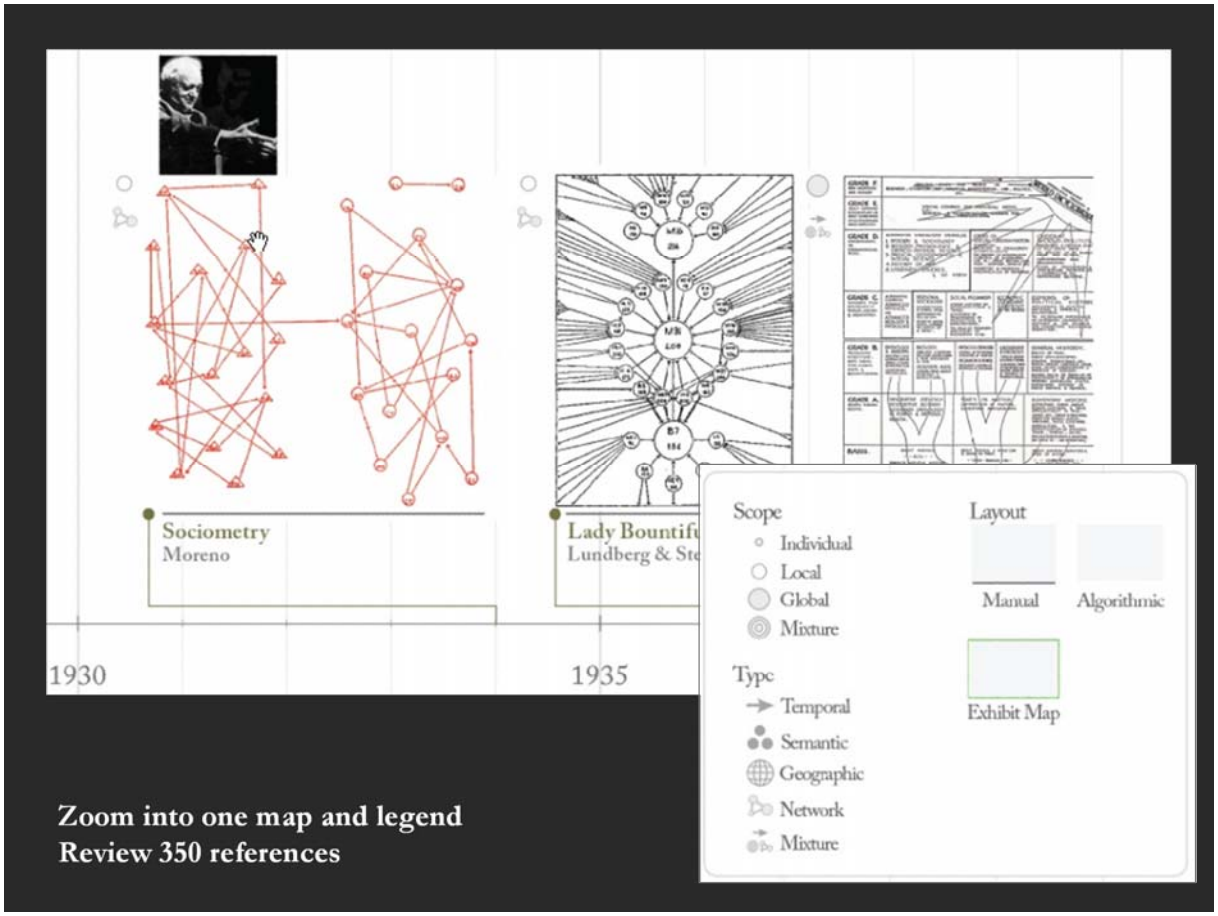
Milestones in Mapping Science

1934 **2007**





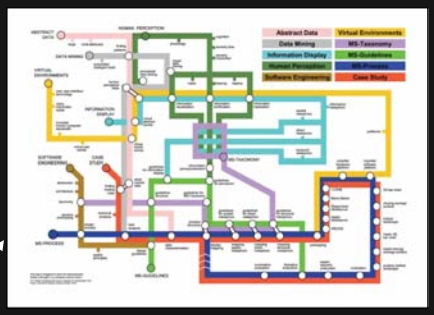
1930 1955



Zoom into one map and legend
Review 350 references

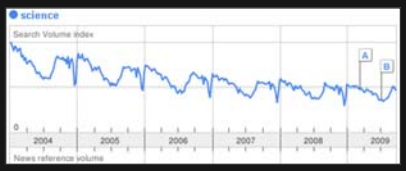
Terra bytes of data

Descriptive & Predictive Models



Find your way

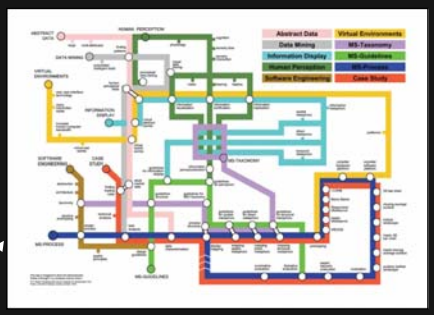
Find collaborators, friends



Identify trends

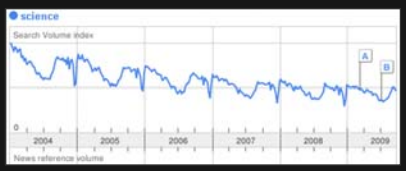
Terra bytes of data

Plug-and-Play Macroscopes



Find your way

Find collaborators, friends



Identify trends

Type of Analysis vs. Level of Analysis

	Micro/Individual (1-100 records)	***Meso/Local (101–10,000 records)***	***Macro/Global (10,000 < records)***
Statistical Analysis/Profiling	Individual person and their expertise profiles	Larger labs, centers, universities, research domains, or states	All of NSF, all of USA, all of science.
Temporal Analysis (When)	Funding portfolio of one individual	Mapping topic bursts in 20-years of PNAS	113 Years of Physics Research
Geospatial Analysis (Where)	Career trajectory of one individual	Mapping a states intellectual landscape	PNAS publications
Topical Analysis (What)	Base knowledge from which one grant draws.	Knowledge flows in Chemistry research	VxOrd/Topic maps of NIH funding
Network Analysis (With Whom?)	NSF Co-PI network of one individual	Co-author network	NIH's core competency

cyberinfrastructure for NETWORK SCIENCE CENTER
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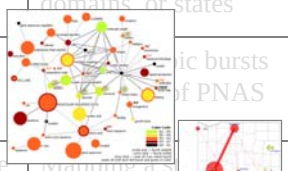
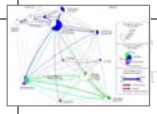
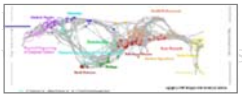
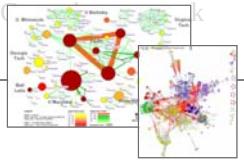
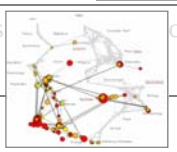
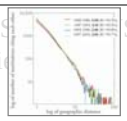
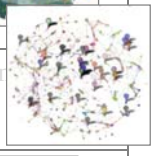
Topical Analysis (What)	s.	research	VxOrd/Topic m NIH funding
Network Analysis (With Whom?)	NSF work of one		NIH's cy





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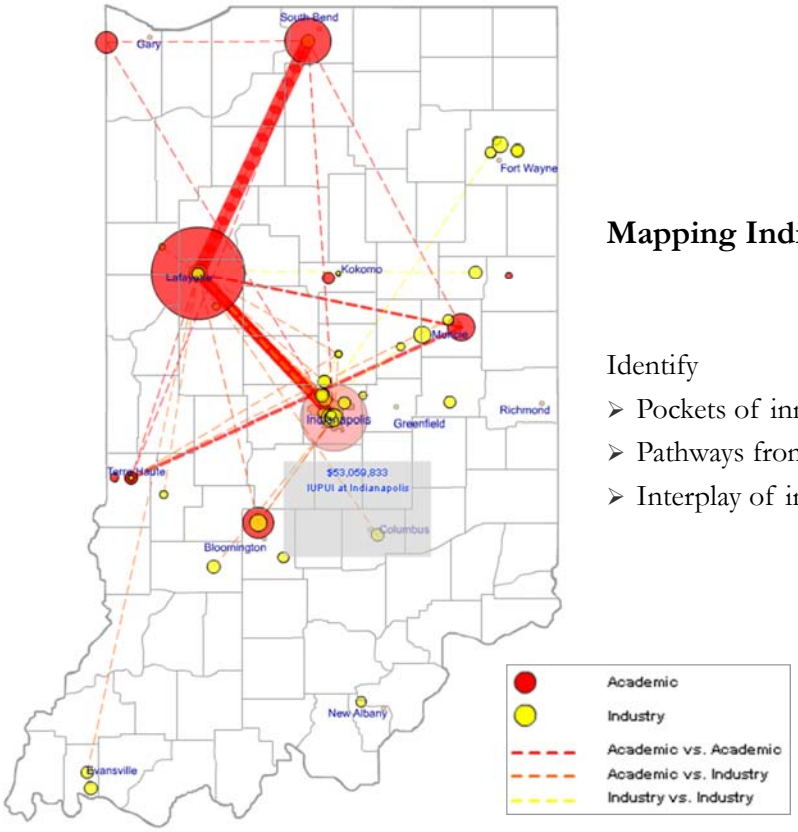


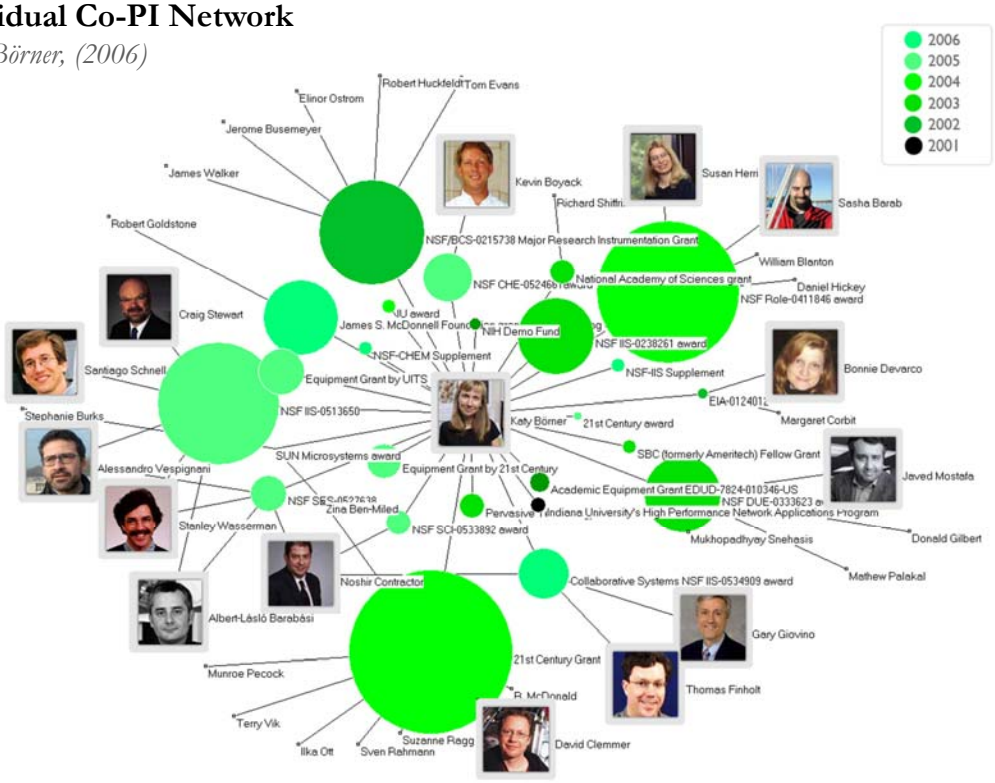
Mapping Indiana's Intellectual Space

Identify

- Pockets of innovation
- Pathways from ideas to products
- Interplay of industry and academia

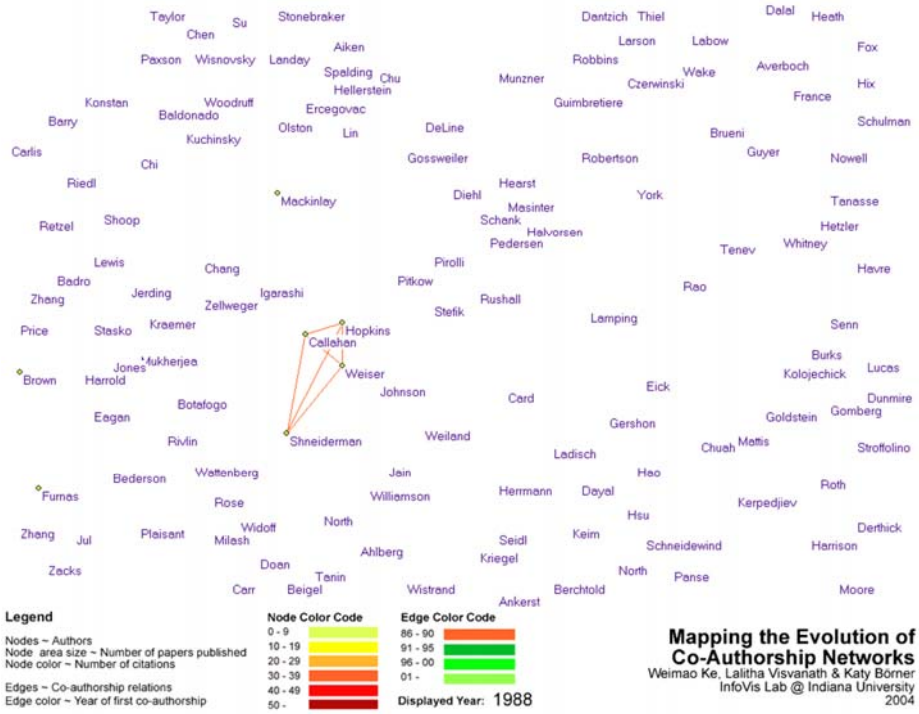
Individual Co-PI Network

Ke & Börner, (2006)



Mapping the Evolution of Co-Authorship Networks

Ke, Visvanath & Börner, (2004) Won 1st price at the IEEE InfoVis Contest.



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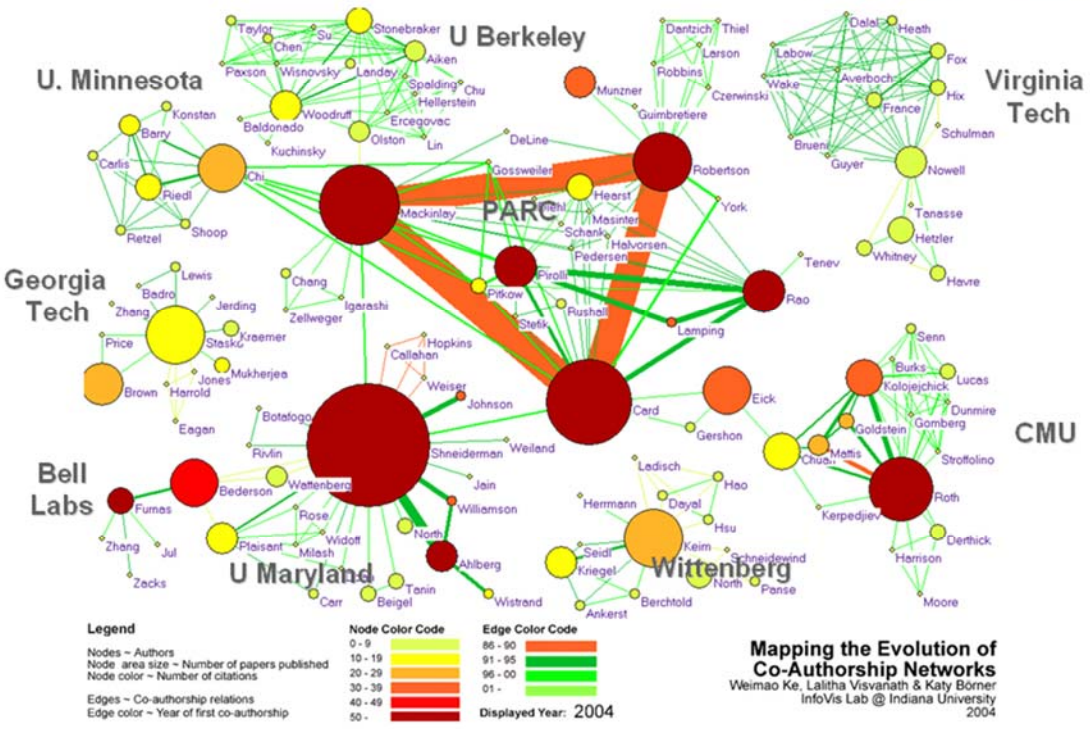
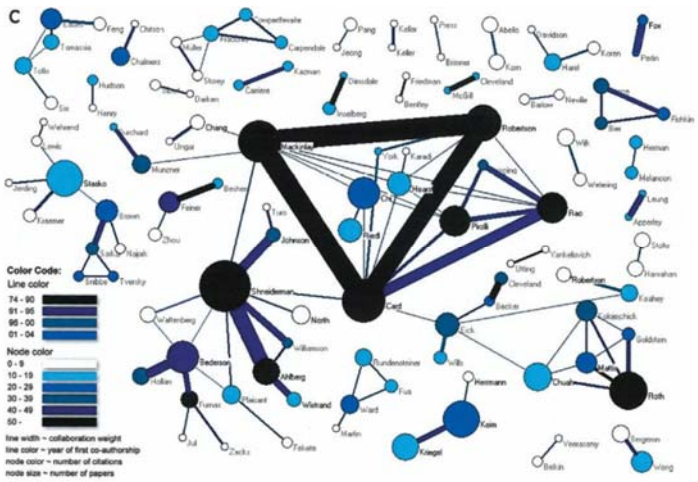


Studying the Emerging Global Brain: Analyzing and Visualizing the Impact of Co-Authorship Teams

Börner, Dall'Asta, Ke & Vespignani (2005) Complexity, 10(4):58-67.



Research question:

- Is science driven by prolific single experts or by high-impact co-authorship teams?

Contributions:

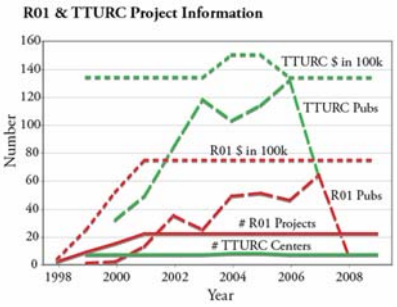
- New approach to allocate citational credit.
- Novel weighted graph representation.
- Visualization of the growth of weighted co-author network.
- Centrality measures to identify author impact.
- Global statistical analysis of paper production and citations in correlation with co-authorship team size over time.
- Local, author-centered entropy measure.

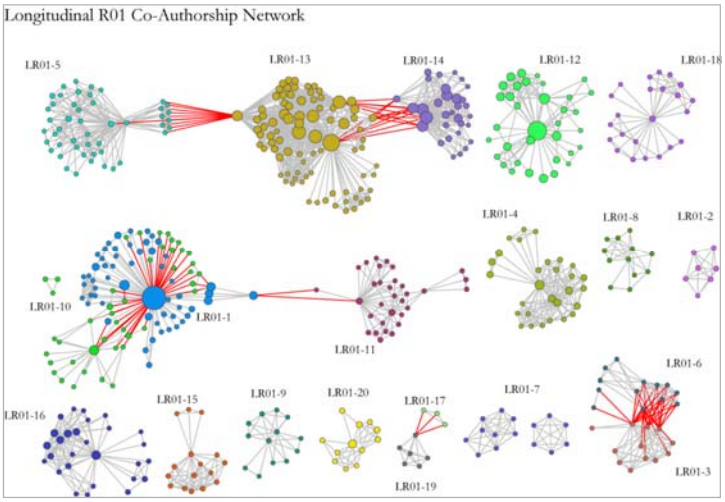
Mapping Transdisciplinary Tobacco Use Research Centers Publications

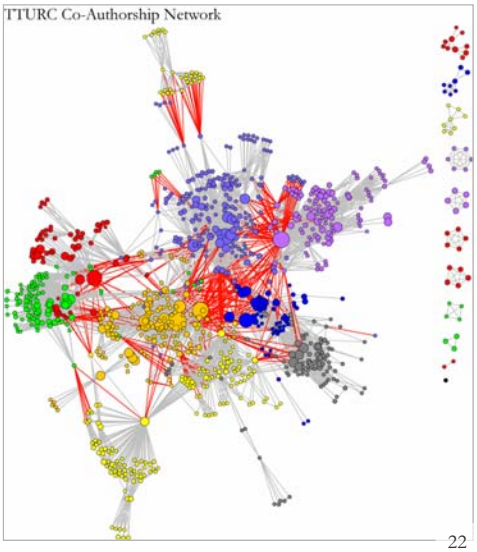
Compare R01 investigator based funding with TTURC Center awards in terms of number of publications and evolving co-author networks.

Zoss & Börner, forthcoming.

Supported by NIH/NCI Contract HHSN261200800812



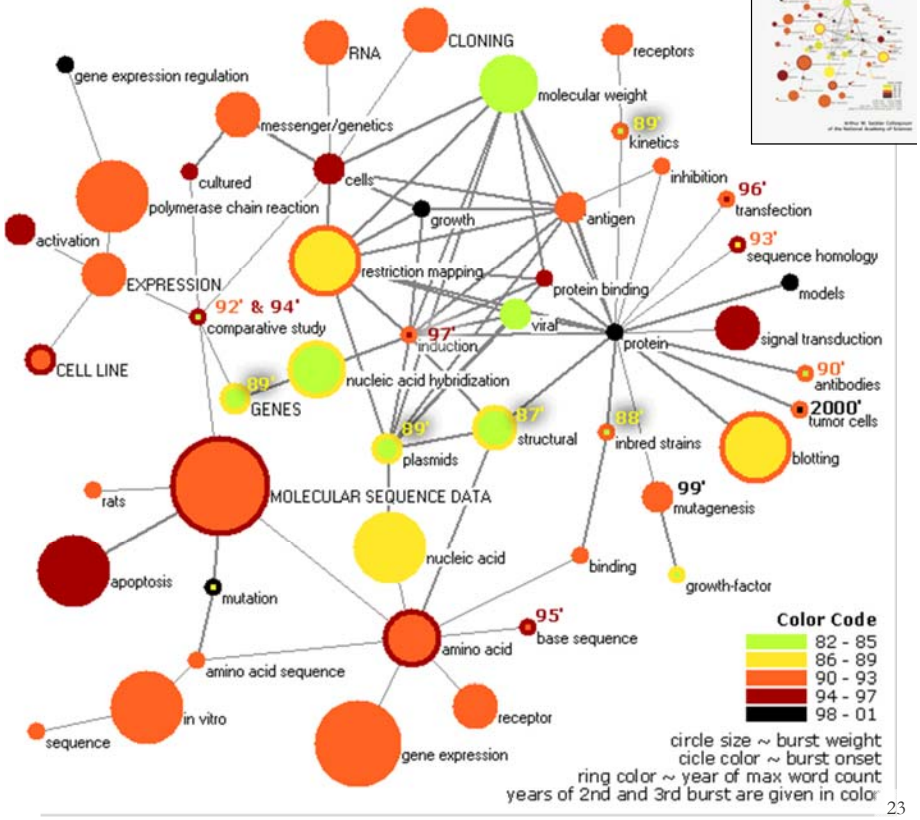




Mapping Topic Bursts

Co-word space of the top 50 highly frequent and bursty words used in the top 10% most highly cited PNAS publications in 1982-2001.

Mane & Börner. (2004) PNAS, 101(Suppl. 1): 5287-5290.

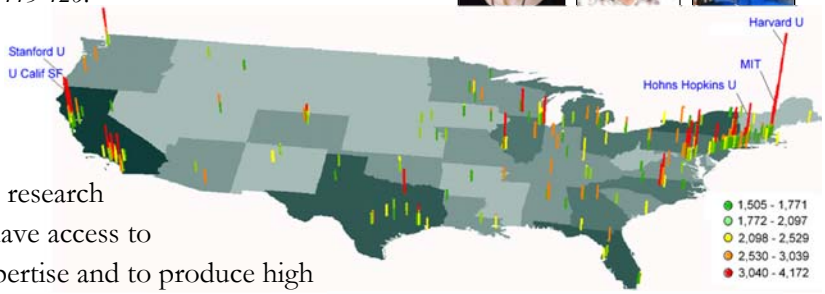


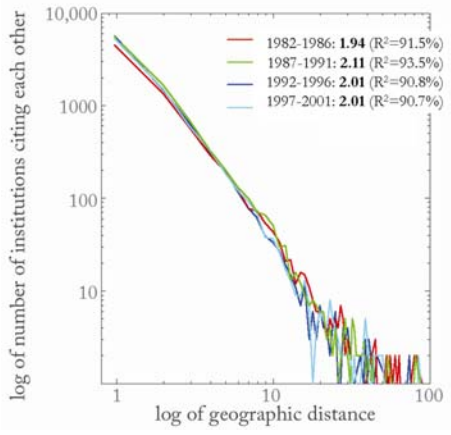
Spatio-Temporal Information Production and Consumption of Major U.S. Research Institutions

Börner, Katy, Penumarthy, Shashikant, Meiss, Mark and Ke, Weimao. (2006) Mapping the Diffusion of Scholarly Knowledge Among Major U.S. Research Institutions. Scientometrics. 68(3), pp. 415-426.

Research questions:

1. Does space still matter in the Internet age?
2. Does one still have to study and work at major research institutions in order to have access to high quality data and expertise and to produce high quality research?
3. Does the Internet lead to more global citation patterns, i.e., more citation links between papers produced at geographically distant research instructions?





Contributions:

- Answer to Qs 1 + 2 is YES.
- Answer to Qs 3 is NO.
- Novel approach to analyzing the dual role of institutions as information producers and consumers and to study and visualize the diffusion of information among them.

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/

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http://ivl.slis.indiana.edu/km/pub/2007-borner-arist.pdf

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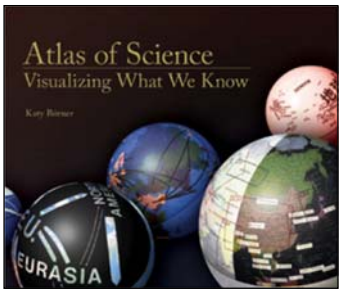
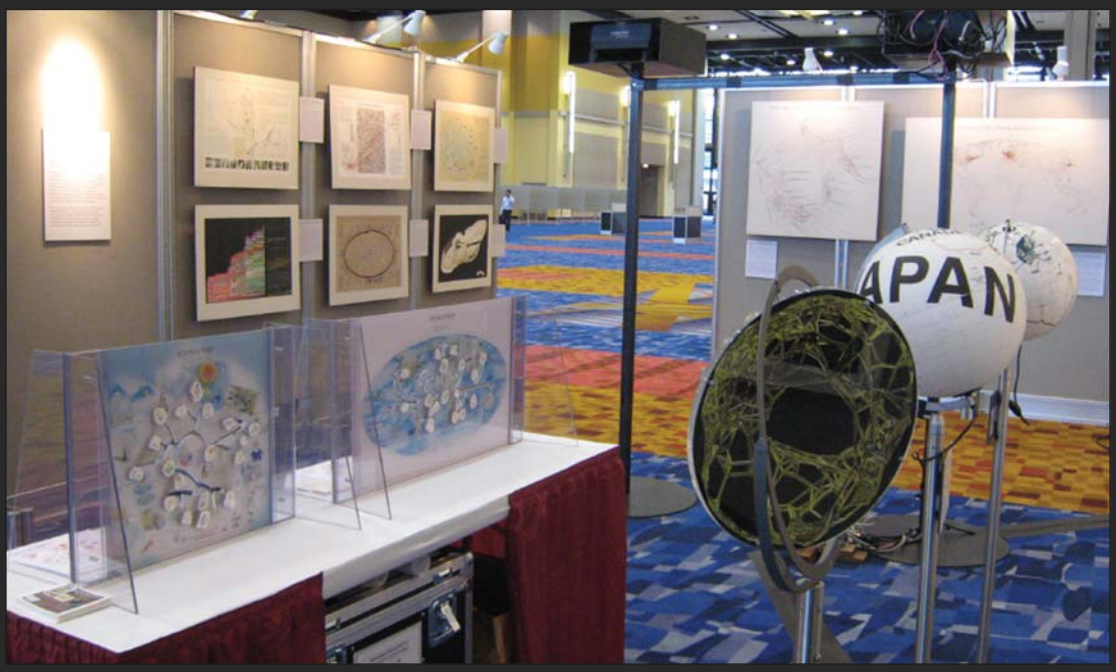
http://scimaps.org/atlas

Scharnhorst, Andrea, Börner, Katy, van den Besselaar, Peter (2012) **Models of Science Dynamics**. Springer Verlag.



Mapping Science Exhibit – 10 Iterations in 10 years

http://scimaps.org/



Mapping Science Exhibit at MEDIA X was on May 18, 2009 at Wallenberg Hall, Stanford University,
http://mediax.stanford.edu, *http://scaleindependentthought.typepad.com/photos/scimaps*

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Science Maps in "Expedition Zukunft" science train visiting 62 cities in 7 months 12 coaches, 300 m long
Opening was on April 23rd, 2009 by German Chancellor Merkel
http://www.expedition-zukunft.de

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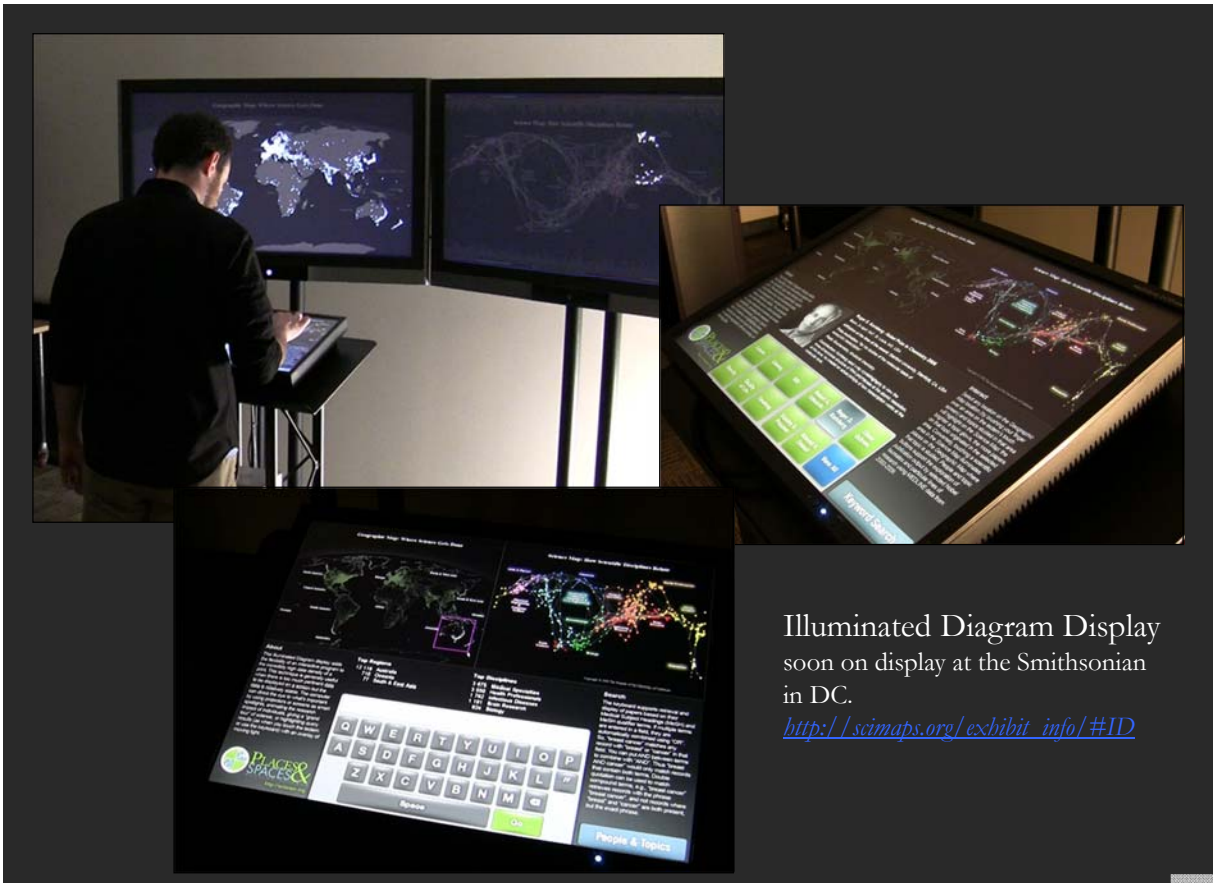
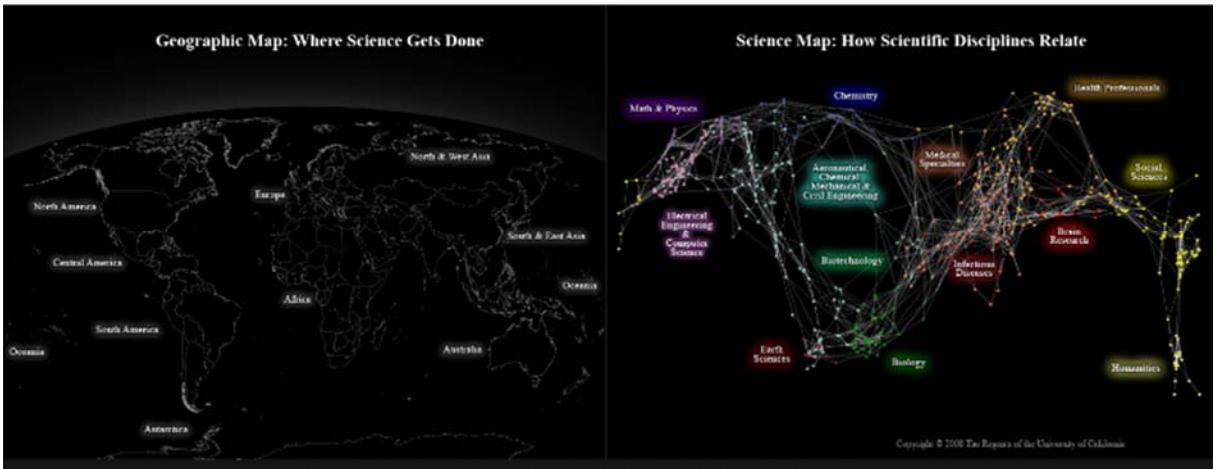


Illuminated Diagram Display
soon on display at the Smithsonian in DC.
http://scimaps.org/exhibit_info/#ID

29



About

This Illuminated Diagram display adds the flexibility of an interactive program to the incredibly high data density of a print. This technique is generally useful when there is too much pertinent data to be displayed on a screen but the data is relatively stable. The computer can direct the eye to what's important by using projectors or screens as smart spotlights, animating the research impact of individuals, giving a "grand tour" of science, or highlighting query results (as when you touch the lectern or use the keyboard) with an overlay of moving light.

Elinor Ostrom - Nobel Prize in Economic Sciences 2009

Born: 7 August 1933, New York, NY, USA

Affiliation at the time of the award: Indiana University, Bloomington, IN, USA; Arizona State University, Tempe, AZ, USA

Prize motivation: "for her analysis of economic governance, especially the commons"

Field: Economic governance

Contribution: Challenged the conventional wisdom by demonstrating how local property can be successfully managed by local commons without any regulation by central authorities or privatization.

Interact

Select any location on the *Geographic Map* location (by brushing your finger over an area on the lectern's touch screen) and topics studied in that area will highlight on the *Science Map*: the brighter a topic glows, the more papers on that topic originated in the selected area. Conversely, touching a scientific area in the *Science Map* illuminates places on the *Geographic Map* where that topic is studied. People and topic buttons support the exploration of publication output by selected Noble laureates and particular lines of research using MEDLINE data from 2000-2009.

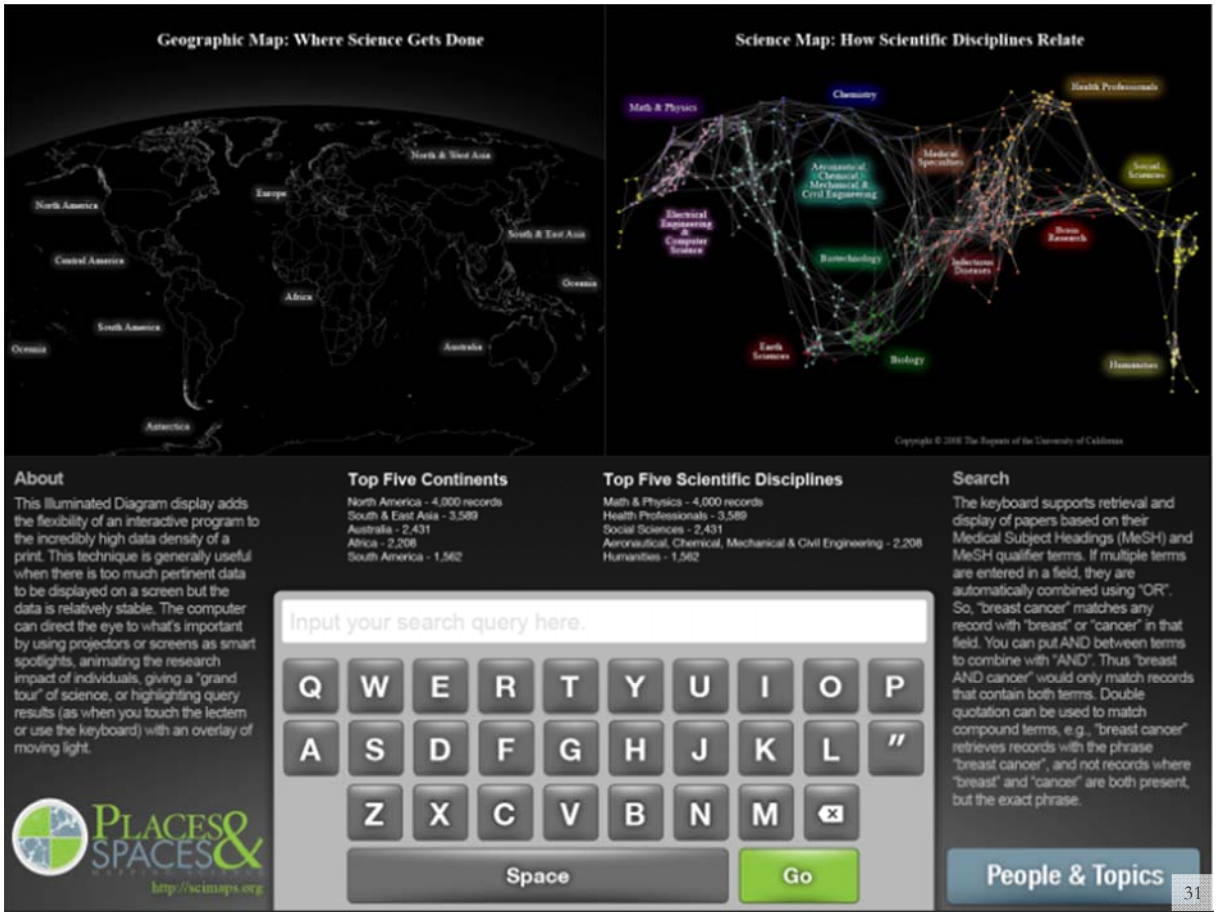
Cancer | Cloning | HIV | Robert G. Edwards | Roger D. Kornberg | Elinor Ostrom

Obesity | Quality of Life | Smoking | Stanley B. Prusiner | Ahmed H. Zewail | View All

Keyword Search

PLACES & SPACES MAPPING SCIENCE
http://scimaps.org

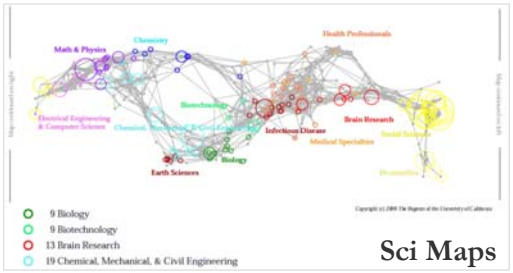
30


Geographic Map: Where Science Gets Done
North America
Europe
North & West Asia
South & East Asia
Central America
Africa
Oceania
South America
Oceania
Australia
Antarctica
Science Map: How Scientific Disciplines Relate
Math & Physics
Chemistry
Health Professionals
Aeronautical, Chemical, Mechanical & Civil Engineering
Medical Specialties
Social Sciences
Electrical Engineering & Computer Science
Biotechnology
Infectious Diseases
Brain Research
Earth Sciences
Biology
Humanities
Copyright © 2008 The Regents of the University of California
About
This Illuminated Diagram display adds the flexibility of an interactive program to the incredibly high data density of a print. This technique is generally useful when there is too much pertinent data to be displayed on a screen but the data is relatively stable. The computer can direct the eye to what's important by using projectors or screens as smart spotlights, animating the research impact of individuals, giving a "grand tour" of science, or highlighting query results (as when you touch the lectern or use the keyboard) with an overlay of moving light.
PLACES & SPACES
http://scimaps.org
Top Five Continents
North America - 4,000 records
South & East Asia - 3,589
Australia - 2,431
Africa - 2,208
South America - 1,582
Top Five Scientific Disciplines
Math & Physics - 4,000 records
Health Professionals - 3,589
Social Sciences - 2,431
Aeronautical, Chemical, Mechanical & Civil Engineering - 2,208
Humanities - 1,582
Input your search query here.
Q W E R T Y U I O P
A S D F G H J K L "
Z X C V B N M
Space
Go
Search
The keyboard supports retrieval and display of papers based on their Medical Subject Headings (MeSH) and MeSH qualifier terms. If multiple terms are entered in a field, they are automatically combined using "OR". So, "breast cancer" matches any record with "breast" or "cancer" in that field. You can put AND between terms to combine with "AND". Thus "breast AND cancer" would only match records that contain both terms. Double quotation can be used to match compound terms, e.g., "breast cancer" retrieves records with the phrase "breast cancer", and not records where "breast" and "cancer" are both present, but the exact phrase.
People & Topics

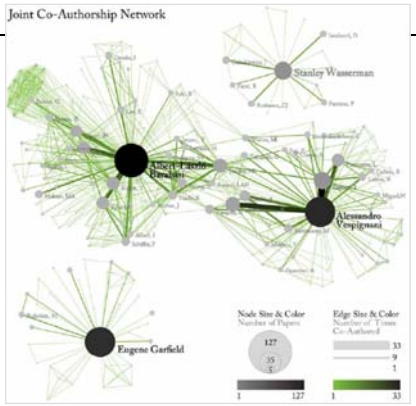
INDIANA UNIVERSITY
PLACES AND SPACES
EXHIBIT

Sci² Tool – "Open Code for S&T Assessment"

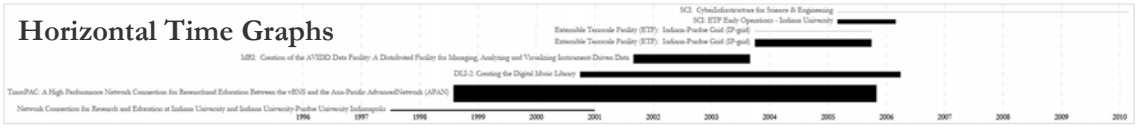
OSGi/CIShell powered tool with NWB plugins and many new scientometrics and visualizations plugins.



Sci Maps

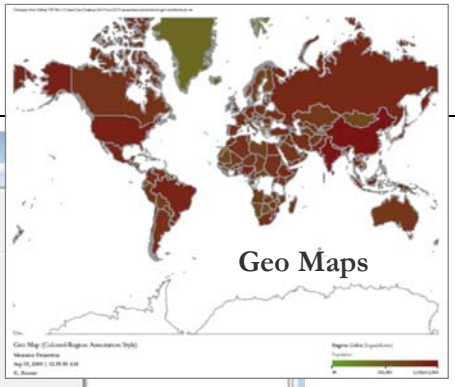


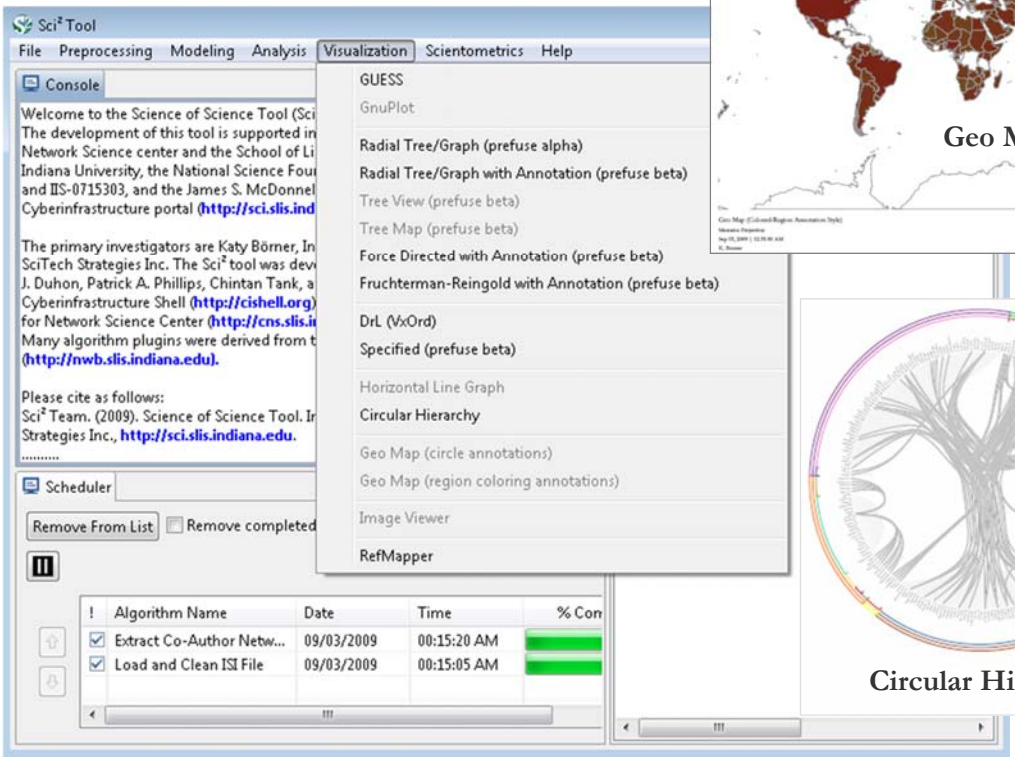
GUESS Network Vis

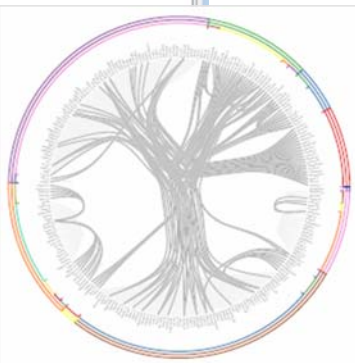


Börner, Katy, Huang, Weixia (Bonnie), Linnemeier, Micah, Duhon, Russell Jackson, Phillips, Patrick, Ma, Nianli, Zoss, Angela, Guo, Hanning & Price, Mark. (2009). Rete-Netzwerk-Red: Analyzing and Visualizing Scholarly Networks Using the Scholarly Database and the Network Workbench Tool. Proceedings of ISSI 2009: 12th International Conference on Scientometrics and Informetrics, Rio de Janeiro, Brazil, July 14-17 . Vol. 2, pp. 619-630.

Sci² Tool Vis cont.





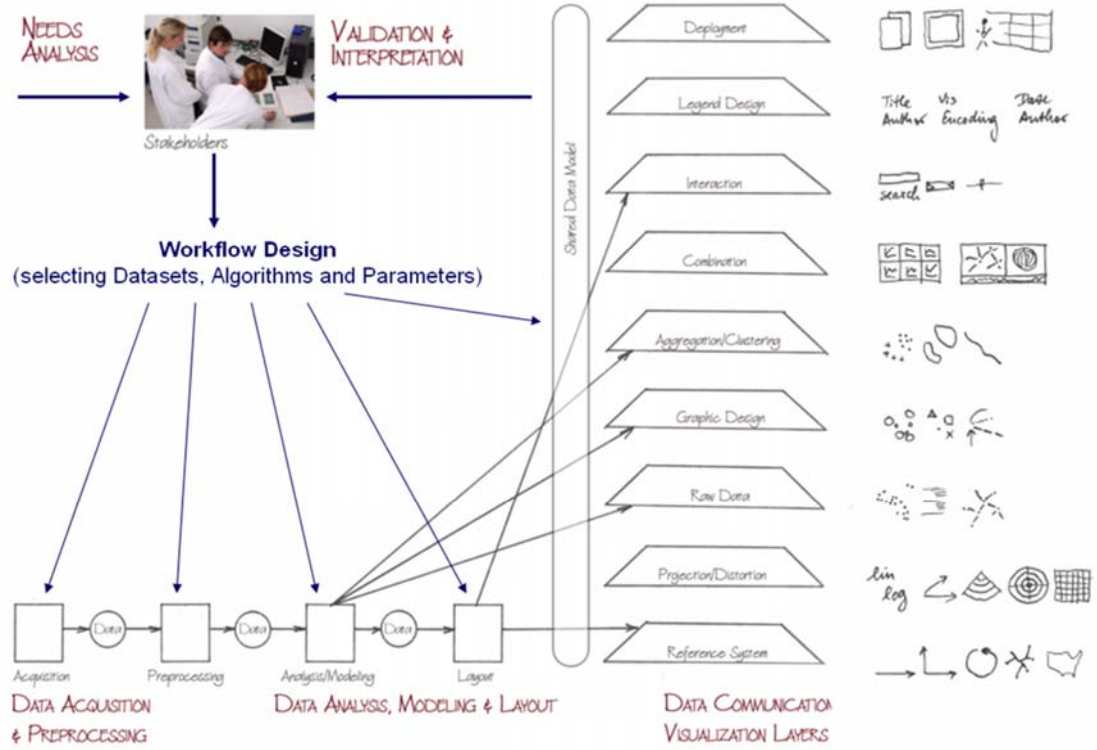


Circular Hierarchy

Wordle.net of "Interest to Learn" response by users from more than 73 countries

35

Needs-Driven Workflow Design using a modular data acquisition/analysis/ modeling/ visualization pipeline as well as modular visualization layers.



Börner, Katy (2010) Atlas of Science. MIT Press.

36

Sci2 Tool v1.0 Alpha (June 13, 2012)

Major Release
featuring a Web services compatible CIShell v2.0 (http://cishell.org)

New Features
- Google Scholar citation reader
- New visualizations such as
  - geospatial maps
  - science maps
  - bi-modal network layout
- R statistical tool bridging
- Gephi visualization tool bridging
- Comprehensive online documentation

Release Note Details
http://wiki.cns.iu.edu/display/SCI2TUTORIAL/4.4+Sci2+Release+Notes+v1.0+alpha

New Visualizations

Types
- Geospatial maps: **Choropleth Map** and **Proportional Symbol Map**
- **Science Map**: Based on 25,000 journals or 554 subdisciplines.
- **Bi-Modal Network Layout**

Shared Features
- Uniform layout
- Scalable to extremely large datasets as rendered into PS, PDF files.
- Header information on file mapped and footer information
- Automatic legend generation
- 'How To Read This Map" information
- Additional pages for details
- Color coding suitable for black and white printout and color blind users

New Visualizations

Geospatial Visualization (Choropleth Map)

Generated from CSV file: Preprocessed-usptoInfluenza-8383730939137543104.csv
Jun 05, 2012 | 05:45:00 PM EDT

Legend

Country Color (Linear)

Times Cited

1 110 220

How to Read this Map

This *choropleth map* shows 209 countries of the world using the equal-area Eckert IV projection. Each country may be color coded in proportion to a numerical value. Minimum and maximum data values are given in the legend.

CNS (cns.iu.edu)

New Visualizations

Geospatial Visualization (Proportional Symbol Map)

Generated from CSV file: C:\sci2\sampledata\geo\usptoInfluenza.csv
Jun 14, 2012 | 05:56:39 PM EDT

Legend

Area (Logarithmic)

Times Cited

220

14.8

1

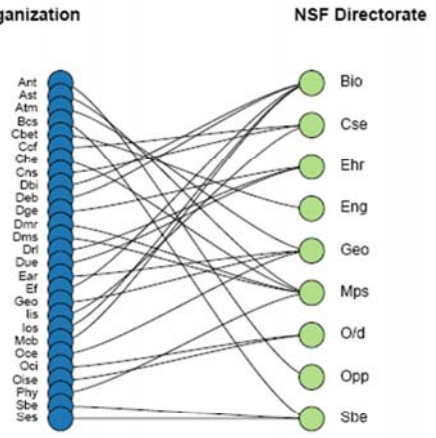
How to Read this Map

This *proportional symbol map* shows 209 countries of the world using the equal-area Eckert IV projection. Each dataset record is represented by a circle centered at its geolocation. The area, interior color, and exterior color of each circle may represent numeric attribute values. Minimum and maximum data values are given in the legend.

CNS (cns.iu.edu)

New Visualizations

Network Visualization
Generated from bipartite network from NSF Organization to NSF Directorate
June 5, 2012 | 5:05 PM EDT



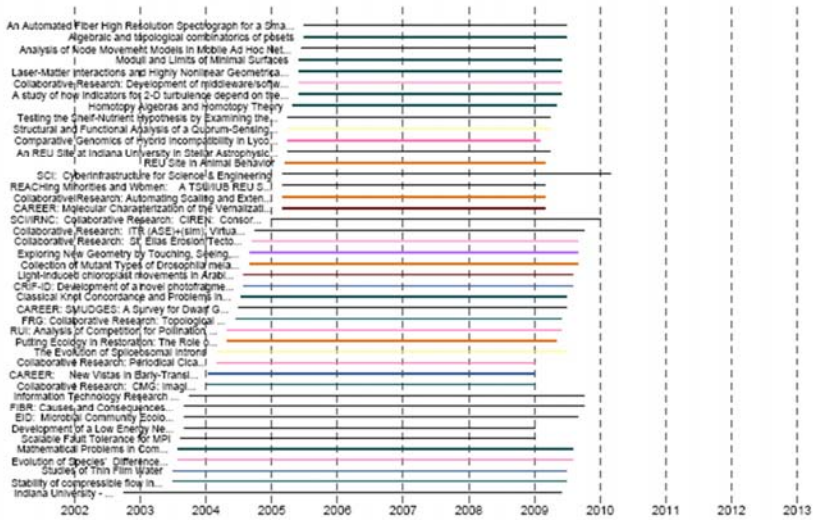
Legend
Sorted by
Left side:
Alphabetical
Right side:
Alphabetical

How To Read This Map
This *bipartite network* shows two record types and their interconnections. Each record is represented by a labeled circle that is size coded by a numerical attribute value. Records of each type are vertically aligned and sorted, e.g., by node size or alphabetically. Links between records of different type may be weighted as represented by line thickness.

CNS (cns.iu.edu)

New Visualizations

Temporal Visualization
Generated from NSF csv file: C:UserskatyDesktopTOOLSsci2-2012.06.04-KNAWsampledatascientometricssfindiana.nsf
June 05, 2012 | 4:50 PM EDT



Legend
Area size: Award Number
Minimum = 220,560
Maximum = 952,643
Text label: Title
Color: NSF Organization
See end of PDF for color legend.

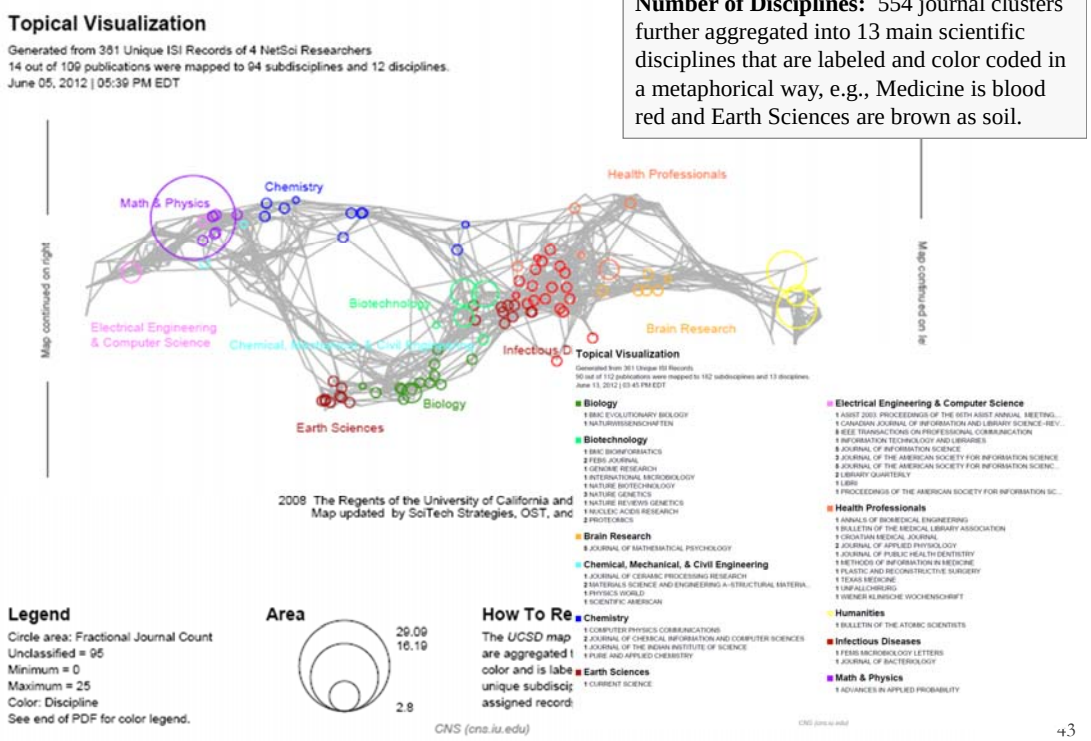
Area
2,198,107
732,702
244,234
0
0.96 Year(s)

How To Read This Map
This *temporal bar graph* visualization represents each record as a horizontal bar with a specific start and end date and a text label on its left side. The area of each bar encodes a numerical attribute value, e.g., total amount of funding. Bars may be colored to present categorical attribute values of records.

CNS (cns.iu.edu)

New Visualizations

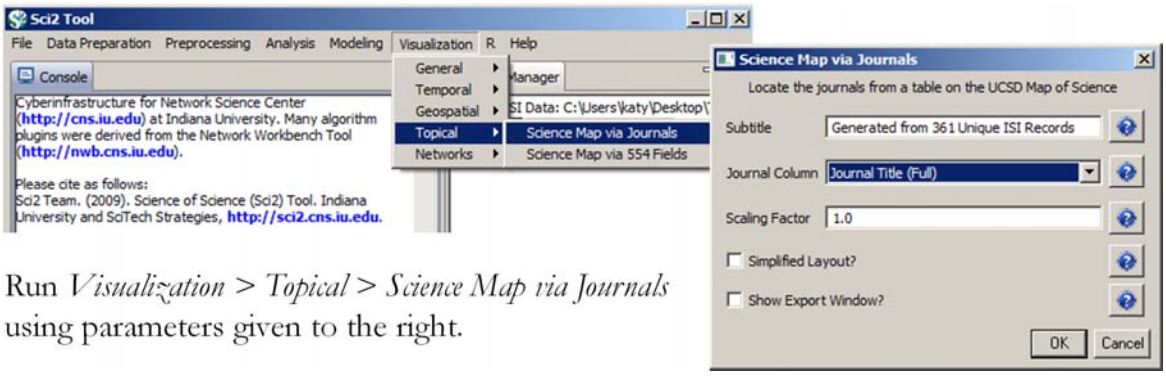
Data: WoS and Scopus paper level data for 2001–2010, about 25,000 separate journals, proceedings, and series.
Similarity Metric: Combination of bibliographic coupling and keyword vectors.
Number of Disciplines: 554 journal clusters further aggregated into 13 main scientific disciplines that are labeled and color coded in a metaphorical way, e.g., Medicine is blood red and Earth Sciences are brown as soil.



DIY Science Maps using the Sci2 Tool

Download Sci2 Tool v1.0 Alpha (June 13, 2012) from http://sci2.cns.iu.edu
Unpack into a /sci2 directory. Run /sci2/sci2.exe
Sci2 Manual is at http://sci2.wiki.cns.iu.edu

Load an ISI (*.isi), Bibtex (*.bib), Endnote Export Format (*.enw), Scopus csv (*.scopus) file such as */sci2/sampledata/scientometrics/isi/FourNetSciResearchers.isi*

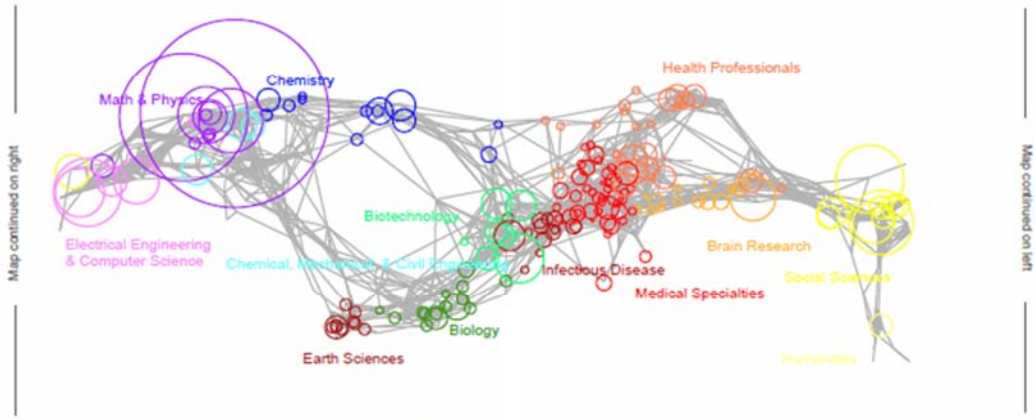


Run *Visualization > Topical > Science Map via Journals* using parameters given to the right.

Postscript file will appear in *Data Manager*. Save and open with a Postscript Viewer.

Topical Visualization

Generated from 361 Unique ISI Records
90 out of 112 publications were mapped to 182 subdisciplines and 13 disciplines.
June 24, 2012 | 04:04 PM EDT

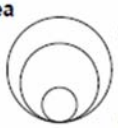


2008 The Regents of the University of California and SciTech Strategies.
Map updated by SciTech Strategies, OST, and CNS in 2011.

Legend

Circle area: Fractional Journal Count
Unclassified = 22
Minimum = 0
Maximum = 98
Color: Discipline
See end of PDF for color legend.

Area



How To Read This Map

The *UCSD map of science* depicts a network of 554 subdiscipline nodes that are aggregated to 13 main disciplines of science. Each discipline has a distinct color and is labeled. Overlaid are circles, each representing all records per unique subdiscipline. Circle area is proportional to the number of fractionally assigned records. Minimum and maximum data values are given in the legend.

CNS (cns.iu.edu)

Topical Visualization

Generated from 361 Unique ISI Records
90 out of 112 publications were mapped to 182 subdisciplines and 13 disciplines.
June 24, 2012 | 04:04 PM EDT

Biology
1 BMC EVOLUTIONARY BIOLOGY
1 NATURWISSENSCHAFTEN

Biotechnology
1 BMC BIOINFORMATICS
2 FEBS JOURNAL
1 GENOME RESEARCH
1 INTERNATIONAL MICROBIOLOGY
1 NATURE BIOTECHNOLOGY
3 NATURE GENETICS
1 NATURE REVIEWS GENETICS
1 NUCLEIC ACIDS RESEARCH
2 PROTEOMICS

Brain Research
5 JOURNAL OF MATHEMATICAL PSYCHOLOGY

Chemical, Mechanical, & Civil Engineering
1 JOURNAL OF CERAMIC PROCESSING RESEARCH
2 MATERIALS SCIENCE AND ENGINEERING A-STRUCTURAL MATERIA...
1 PHYSICS WORLD
1 SCIENTIFIC AMERICAN

Chemistry
1 COMPUTER PHYSICS COMMUNICATIONS
2 JOURNAL OF CHEMICAL INFORMATION AND COMPUTER SCIENCES
1 JOURNAL OF THE INDIAN INSTITUTE OF SCIENCE
1 PURE AND APPLIED CHEMISTRY

Earth Sciences
1 CURRENT SCIENCE

Electrical Engineering & Computer Science
1 ASIST 2003: PROCEEDINGS OF THE 66TH ASIST ANNUAL MEETING,...
1 CANADIAN JOURNAL OF INFORMATION AND LIBRARY SCIENCE-REV...
5 IEEE TRANSACTIONS ON PROFESSIONAL COMMUNICATION
1 INFORMATION TECHNOLOGY AND LIBRARIES
5 JOURNAL OF INFORMATION SCIENCE
3 JOURNAL OF THE AMERICAN SOCIETY FOR INFORMATION SCIENCE
5 JOURNAL OF THE AMERICAN SOCIETY FOR INFORMATION SCIENC...
2 LIBRARY QUARTERLY
1 LIBRI
1 PROCEEDINGS OF THE AMERICAN SOCIETY FOR INFORMATION SC...

Health Professionals
1 ANNALS OF BIOMEDICAL ENGINEERING
1 BULLETIN OF THE MEDICAL LIBRARY ASSOCIATION
1 CROATIAN MEDICAL JOURNAL
2 JOURNAL OF APPLIED PHYSIOLOGY
1 JOURNAL OF PUBLIC HEALTH DENTISTRY
1 METHODS OF INFORMATION IN MEDICINE
1 PLASTIC AND RECONSTRUCTIVE SURGERY
1 TEXAS MEDICINE
1 UNFALLCHIRURG
1 WIENER KLINISCHE WOCHENSCHRIFT

Humanities
1 BULLETIN OF THE ATOMIC SCIENTISTS

Infectious Diseases
1 FEMS MICROBIOLOGY LETTERS
1 JOURNAL OF BACTERIOLOGY

Math & Physics
1 ADVANCES IN APPLIED PROBABILITY

CNS (cns.iu.edu)

Topical Visualization

Generated from 361 Unique ISI Records
90 out of 112 publications were mapped to 182 subdisciplines and 13 disciplines.
June 24, 2012 | 04:04 PM EDT

Math & Physics

10 APPLIED PHYSICS LETTERS
1 BRAZILIAN JOURNAL OF PHYSICS
3 CHAOS SOLITONS & FRACTALS
1 COMPLEXITY
1 COMPUTATIONAL MATERIALS SCIENCE
11 EUROPEAN PHYSICAL JOURNAL B
12 EUROPHYSICS LETTERS
2 INTERNATIONAL JOURNAL OF MODERN PHYSICS B
6 JOURNAL OF PHYSICS A-MATHEMATICAL AND GENERAL
1 JOURNAL OF STATISTICAL MECHANICS-THEORY AND EXPERIMENT
1 JOURNAL OF STATISTICAL PHYSICS
1 JOURNAL OF THE KOREAN PHYSICAL SOCIETY
1 MATERIALS SCIENCE AND ENGINEERING B-SOLID STATE MATERIAL...
3 NATURE PHYSICS
3 NUCLEAR INSTRUMENTS & METHODS IN PHYSICS RESEARCH SEC...
12 PHYSICA A
5 PHYSICAL REVIEW A
2 PHYSICAL REVIEW B
45 PHYSICAL REVIEW LETTERS
2 REVIEWS OF MODERN PHYSICS

Medical Specialties

1 ANNALS OF INTERNAL MEDICINE
1 REVISTA DE INVESTIGACION CLINICA

Social Sciences

1 ADMINISTRATIVE SCIENCE QUARTERLY
1 AMERICAN BEHAVIORAL SCIENTIST
1 AMERICAN SOCIOLOGICAL REVIEW
1 ANNALS OF THE AMERICAN ACADEMY OF POLITICAL AND SOCIAL S...
1 ARBOR-CIENCIA PENSAMIENTO Y CULTURA
3 BRITISH JOURNAL OF MATHEMATICAL & STATISTICAL PSYCHOLOGY
1 JOURNAL OF CLASSIFICATION

Social Sciences

2 JOURNAL OF MATHEMATICAL SOCIOLOGY
3 JOURNAL OF THE AMERICAN STATISTICAL ASSOCIATION
2 PSYCHOLOGICAL BULLETIN
5 PSYCHOMETRIKA
1 RECHERCHE
5 SCIENTOMETRICS
1 SOCIAL FORCES
6 SOCIAL NETWORKS
3 SOCIOLOGICAL METHODS & RESEARCH

Multiple Categories

1 BRITISH MEDICAL JOURNAL
2 JAMA-JOURNAL OF THE AMERICAN MEDICAL ASSOCIATION
1 JOURNAL OF THEORETICAL BIOLOGY
18 NATURE
44 PHYSICAL REVIEW E
5 PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE ...
6 SCIENCE

Unclassified

1 ALGORITHMS AND MODELS FOR THE WEB-GRAPHS, PROCEEDINGS
2 AMERICAN DOCUMENTATION
2 ASIST 2002: PROCEEDINGS OF THE 65TH ASIST ANNUAL MEETING, ...
1 BIOLOGIYA MORYA-MARINE BIOLOGY
1 BULLETIN OF THE AMERICAN SOCIETY FOR INFORMATION SCIENCE
1 CHEMIKER-ZEITUNG
3 CHEMTECH
1 COMBINATORIAL AND ALGORITHMIC ASPECTS OF NETWORKING
7 CURRENT COMMENTS
3 CURRENT CONTENTS/LIFE SCIENCES
1 FEDERATION PROCEEDINGS
5 FRACTALS-AN INTERDISCIPLINARY JOURNAL ON THE COMPLEX GE...
1 FRONTIERS OF LIBRARIANSHIP-SYRACUSE UNIVERSITY

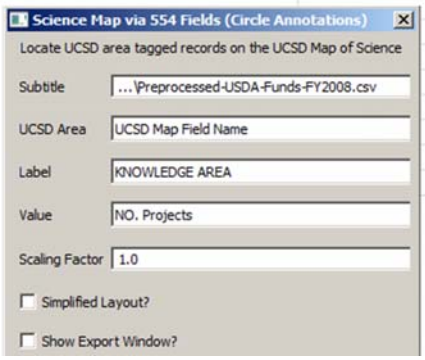
CNS (cns.iu.edu)

DIY Science Maps using the Sci2 Tool

In addition to using **journal names** to
- Map career trajectories
- Identify evolving expertise areas
- Compare expertise profiles

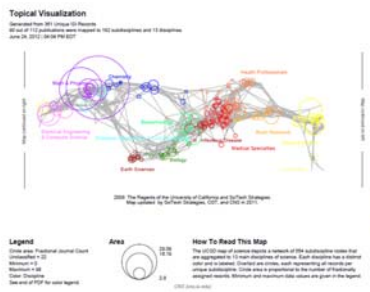
Existing classifications can be aligned and used to generate science map overlays.

B	C	D	E	F	G
KNOWLEDGE AREA	NO. Projects	USDA Staff Years	STATE APPR	TOTAL FUNDS	UCSD Map Field Name
101 Appraisal of Soil Resources					315
102 Soil, Plant, Water, Nutrient Relationships					227
103 Management of Saline and Sodic Soils and Salinity					158
104 Protect Soil from Harmful Effects of Natural Elements					120
111 Conservation and Efficient Use of Water					245
112 Watershed Protection and Management					245
121 Management of Range Resources					520
122 Management and Control of Forest and Range Fires					520
123 Management and Sustainability of Forest Resources					231
124 Urban Forestry					231
125 Agroforestry					231

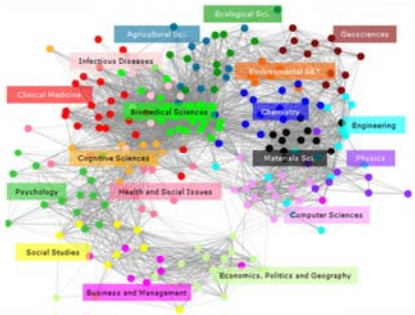


Run *Visualization > Topical > Science Map via 554 Fields* using parameters given to the right.
Postscript file will appear in *Data Manager*.
Save and open with a Postscript Viewer.

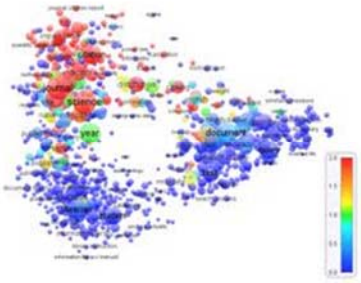
Align Science Basemaps using the Sci2 Tool



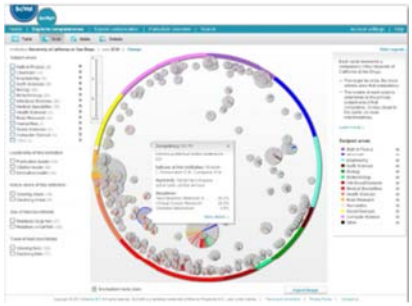
UCSD Map



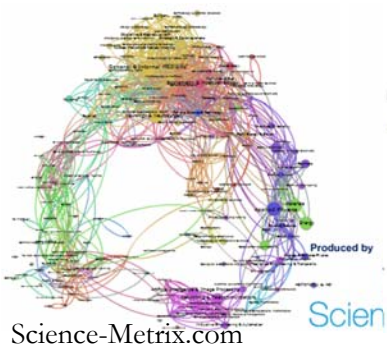
Loet et al science maps ISI categories



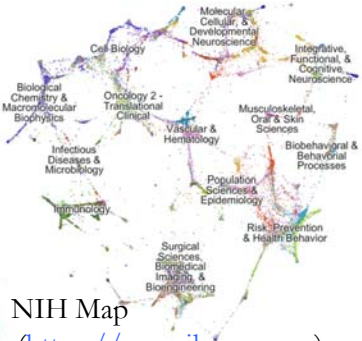
http://vosviewer.com



Elsevier's SciVal Map



Science-Metrix.com



NIH Map (https://app.nihmaps.org)

Geomap with Gephi Network Overlay

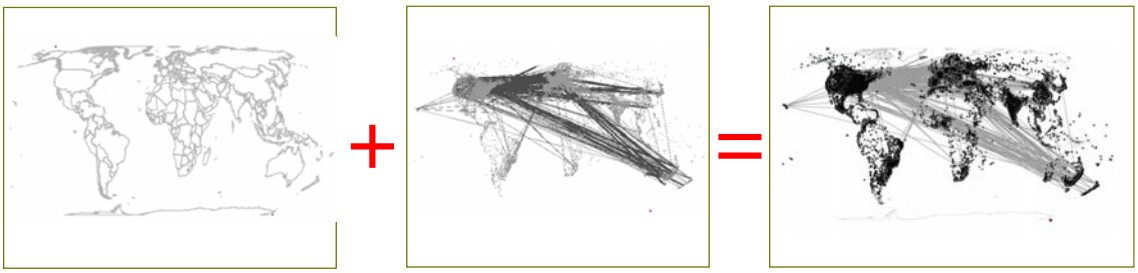
See 4.7.6 on http://sci2.wiki.cns.iu.edu

File with geolocations and linkage info, e.g., an isi bibliography file. →

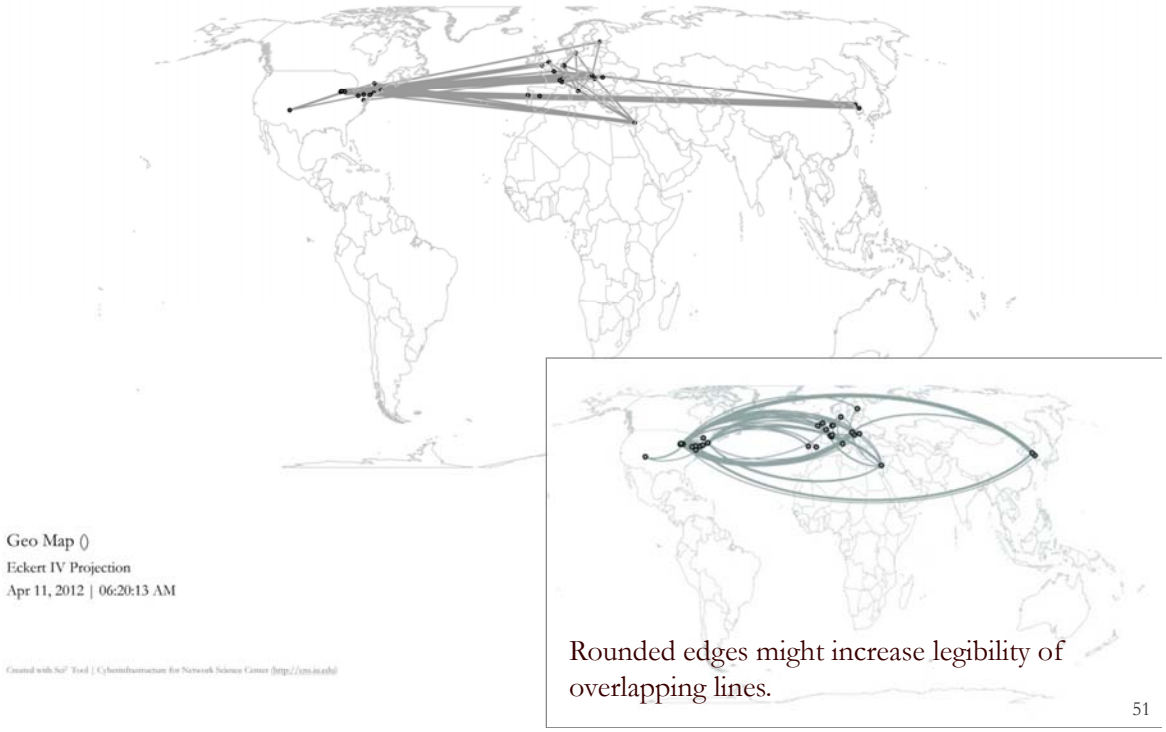
Use Yahoo! Geocoder to identify Latitude, Longitude for each geolocation
Extract attributes per geolocation, e.g., total times cited (TC)
Extract linkages and their attributes, e.g., number of co-occurences
See sample /geo/LaszloBarabasiGeo.net with co-occurrence of "Research Addresses" and full counting of TC per geolocation.

↓

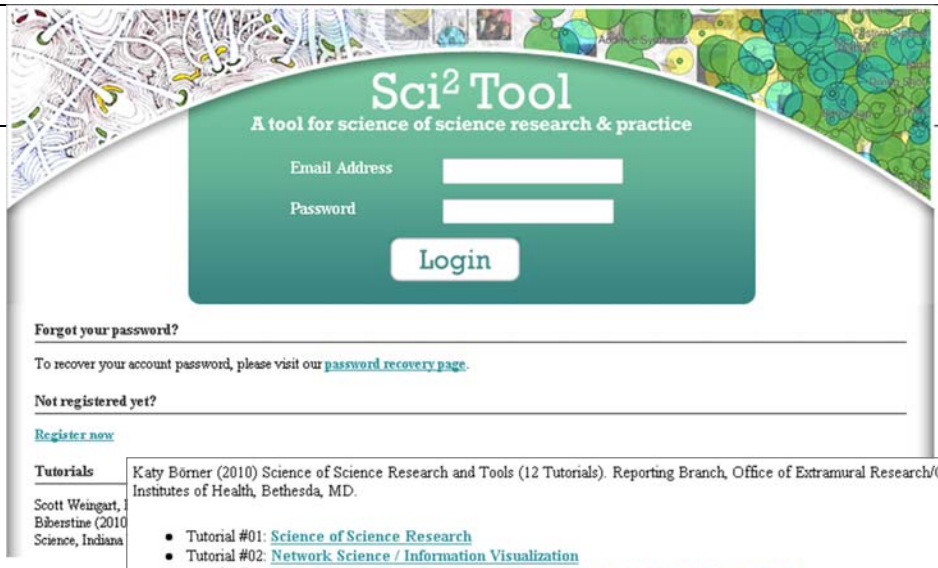
Read into Sci2 Tool to generate geomap and network file → Layout network in Gephi → Combine geomap and network in Photoshop



Practice these steps using "LaszloBarabasi-collaborations.net" linked from Sci2 wiki:
4.7.6 Using Gephi to Render Networks Overlaid on GeoMaps



Rounded edges might increase legibility of overlapping lines.



http://sci2.cns.iu.edu
http://sci2.wiki.cns.iu.edu

OSGi/CIShell Adoption

A number of other projects recently adopted OSGi and/or CIShell:

USA

- *Cytoscape (http://cytoscape.org)* Led by Trey Ideker at the University of California, San Diego is an open source bioinformatics software platform for visualizing molecular interaction networks and integrating these interactions with gene expression profiles and other state data (Shannon et al., 2002).
- *MAEviz (https://wiki.ncsa.uiuc.edu/display/MAE/Home)* Managed by Jong Lee at NCSA is an open-source, extensible software platform which supports seismic risk assessment based on the Mid-America Earthquake (MAE) Center research.

Europe

- *Taverna Workbench (http://taverna.org.uk)* Developed by the myGrid team (http://mygrid.org.uk) led by Carol Goble at the University of Manchester, U.K. is a free software tool for designing and executing workflows (Hull et al., 2006). Taverna allows users to integrate many different software tools, including over 30,000 web services.
- *TEXTrend (http://textrend.org)* Led by George Kampis at Eötvös Loránd University, Budapest, Hungary supports natural language processing (NLP), classification/mining, and graph algorithms for the analysis of business and governmental text corpuses with an inherently temporal component.
- *DynaNets (http://www.dynanets.org)* Coordinated by Peter M.A. Sloot at the University of Amsterdam, The Netherlands develops algorithms to study evolving networks.
- *SISOB (http://sisob.lcc.uma.es)* An Observatory for Science in Society Based in Social Models.

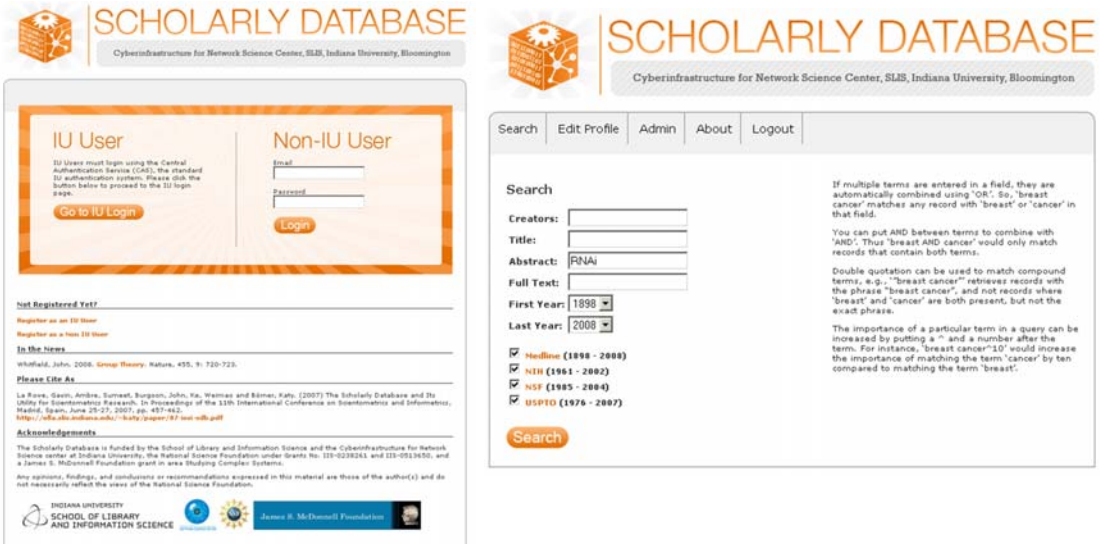
As the functionality of OSGi-based software frameworks improves and the number and diversity of dataset and algorithm plugins increases, the capabilities of custom tools will expand.

Scholarly Database at Indiana University

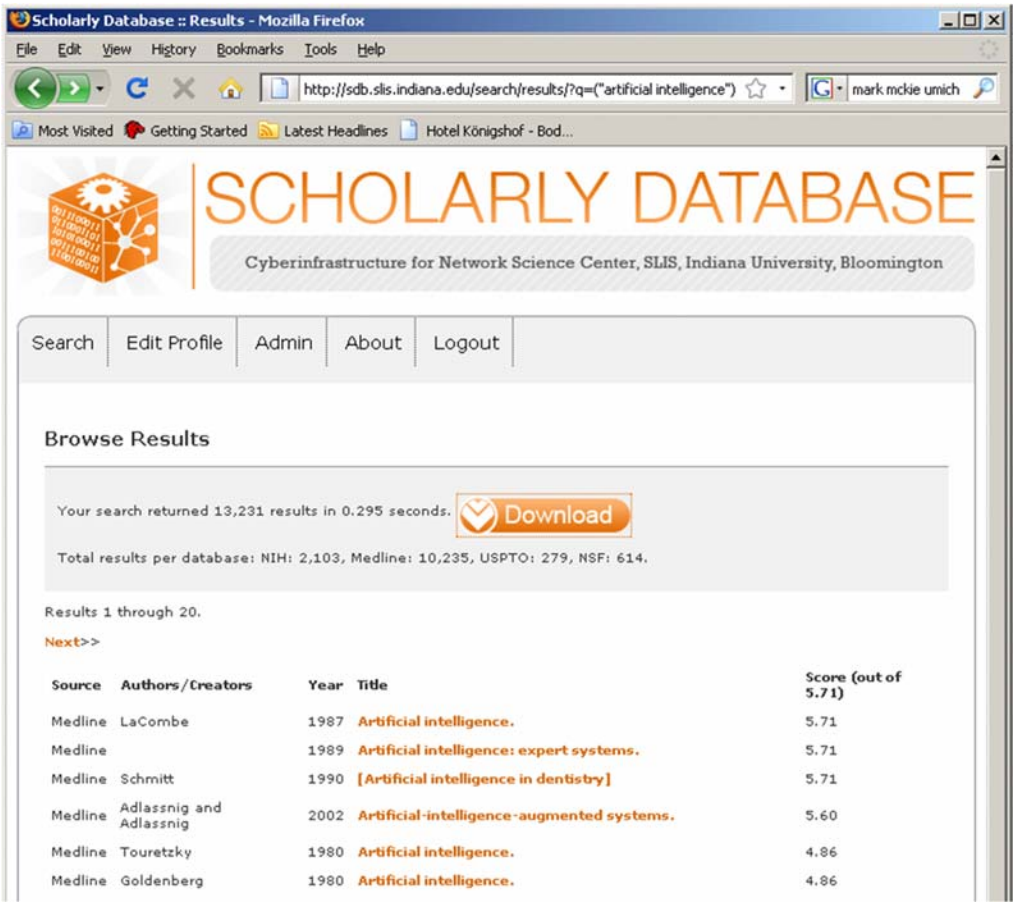
http://sdb.wiki.cns.iu.edu

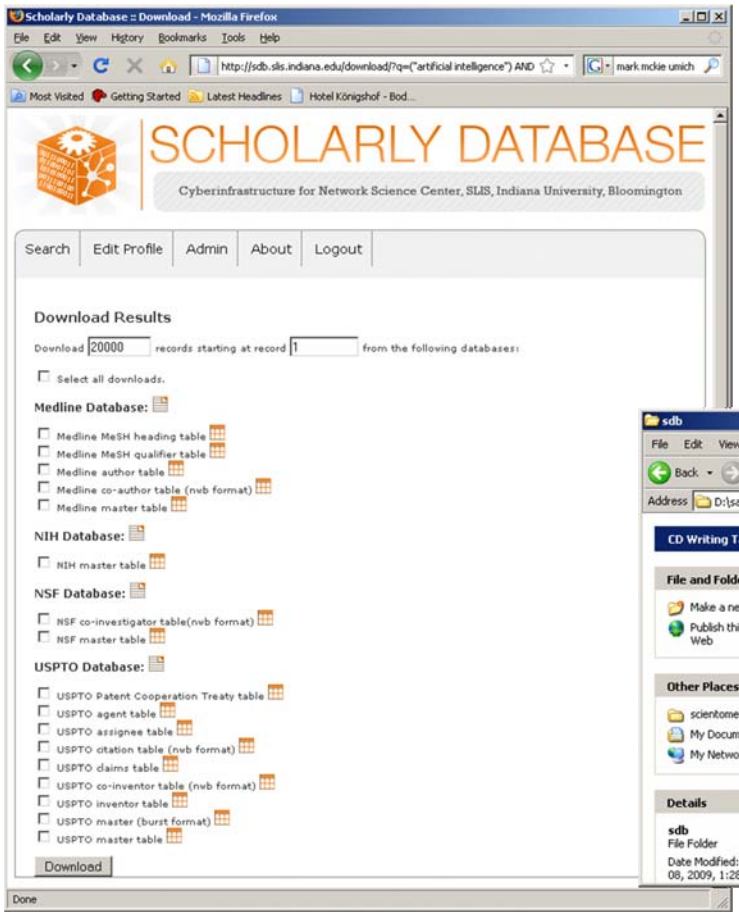
Supports federated search of 25 million publication, patent, grant records.

Results can be downloaded as data dump and (evolving) co-author, paper-citation networks.



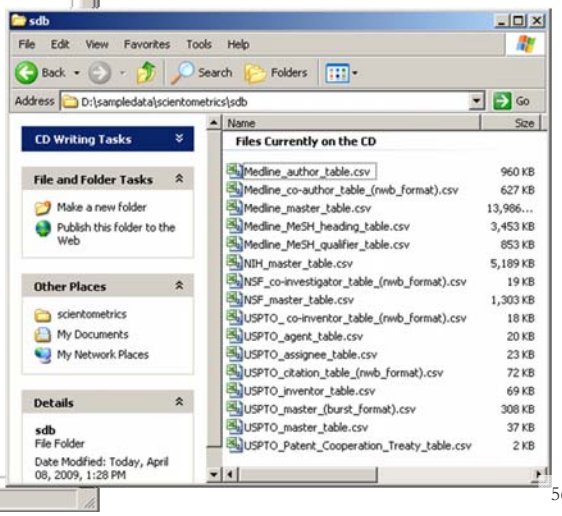
Register for free access at http://sdb.cns.iu.edu

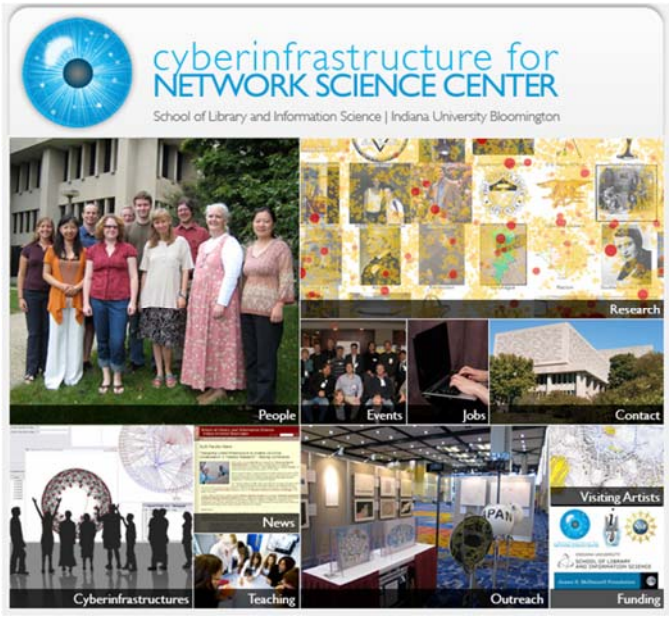




Since March 2009:
Users can download networks:
- Co-author
- Co-investigator
- Co-inventor
- Patent citation

and tables for
burst analysis in NWB.





All papers, maps, tools, talks, press are linked from http://cns.iu.edu

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Mapping Science Exhibit Facebook: http://www.facebook.com/mappingscience