

Science of Science Research and Tools

Katy Börner

Visiting Scientist in Dirk Helbing's Group, SOMS, ETHZ
Cyberinfrastructure for Network Science Center, Director
Information Visualization Laboratory, Director
School of Library and Information Science
Indiana University, Bloomington, IN
katy@indiana.edu



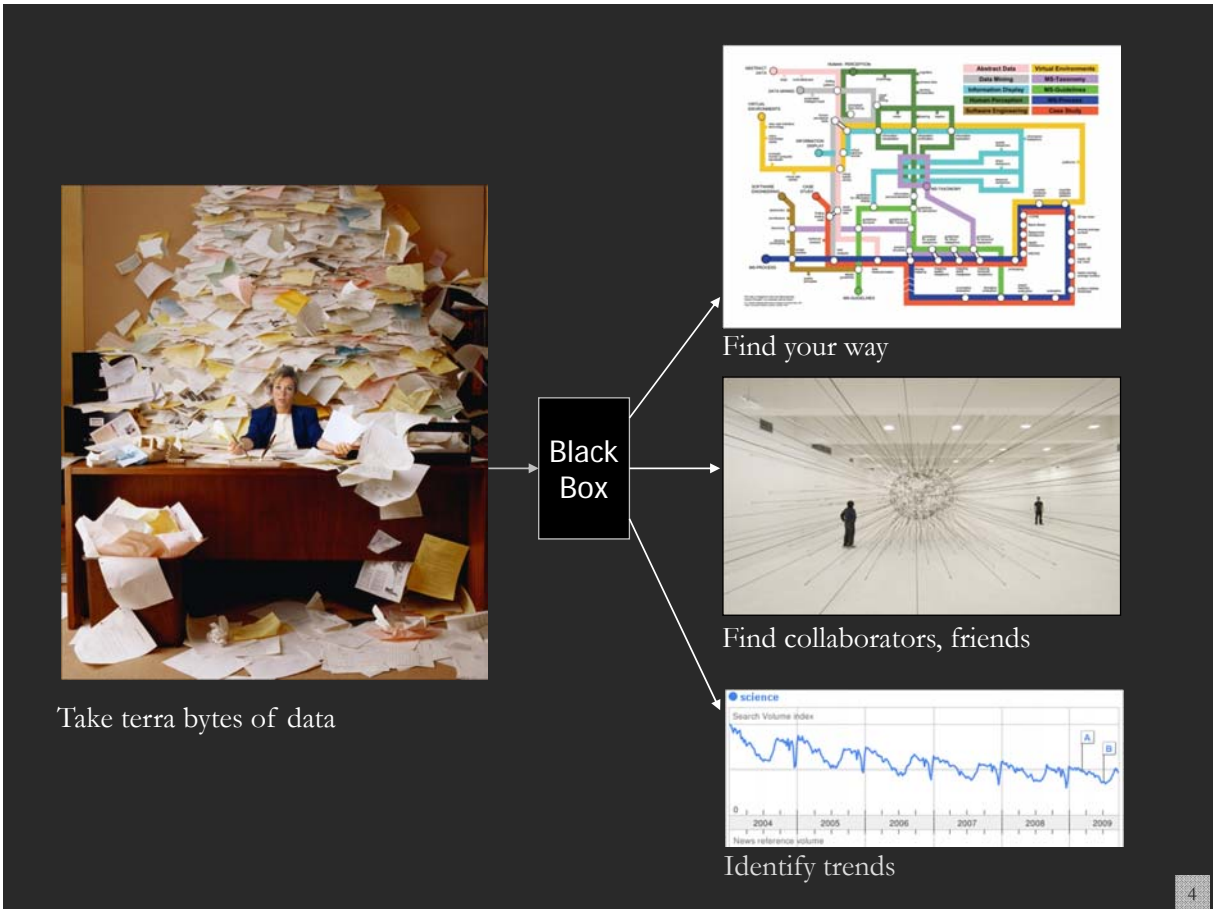
With special thanks to the members at the Cyberinfrastructure for Network Science Center, Kevin W. Boyack, the Mapping Science exhibit advisory board, and the VIVO Consortium

*Research Seminar, Dirk Helbing's Team
Eidgenössische Technische Hochschule Zürich*

June 9, 2011

Four Parts:

1. Atlas of Science and Mapping Science exhibit
2. Macroscopes: The Science of Science (Sci2) Tool
- 3. Interactive Science and Technology Maps**
4. S&T Studies that Use Semantic Web Data (VIVO)



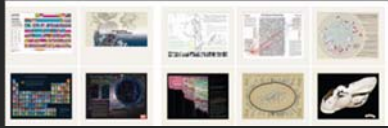
Mapping Science Exhibit – 10 Iterations in 10 years

<http://scimaps.org>

The Power of Maps (2005)



The Power of Reference Systems (2006)



The Power of Forecasts (2007)



Science Maps for Economic Decision Makers (2008)



Science Maps for Science Policy Makers (2009)



Science Maps for Scholars (2010)

Science Maps as Visual Interfaces to Digital Libraries (2011)

Science Maps for Kids (2012)

Science Forecasts (2013)

Towards Science Mapping Standards (2014)

Exhibit has been shown in 72 venues on four continents. Currently at
 - NSF, 10th Floor, 4201 Wilson Boulevard, Arlington, VA
 - Center of Advanced European Studies and Research, Bonn, Germany
 - University of Michigan, Ann Arbor, MI



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MAPS OF SCIENCE

A visualization of 7.2 million scholarly documents
 appearing in over 16,000 journals, proceedings or symposia
 between Jan, 2001 and Dec, 2005

The map of science was constructed by sorting more than 15,000 journals into disciplines. Disciplines, represented as circles, are split into fields that use a common literature. The three-dimensional model was used to determine the position of each discipline on the surface of a sphere based on the linkages between disciplines. The result is a map that allows fields to be seen in a different view of the map.

The spherical map, which is not shown here, was converted in a meridian projection (the same one used to show the continents of the earth on a two-dimensional map) to give the large map shown below. This projection allows inspection of the entire map of science at once. Note that the disciplines tend to cluster along the middle of the map. If this were a map of the earth it would be like a single continent containing almost the equator. There are no disciplines at the top or bottom of the map. The map also projects an invisible dimension. We tend to forget that the left side is connected to the right side, and consider that the results in each quadrant of the map, the most relevant, follow on the right context with the computer system (links) on the left in our conventional world.

The six map projections shown at the bottom are stages of what you would see if looking directly ahead of the north pole of the map, at six different rotations. When viewed this way, the map looks like a wheel with an inner ring and outer ring. This wheel of science corresponds very closely with the two-dimensional maps we have previously produced.

Forecasting Large Trends in Science

Calculations were performed using the large network structure of disciplines (links) to determine if any of these were likely to expand or contract through the duration of current year, 2001-2005. A simple regression analysis was conducted to see if there were significant changes in their connectivity coefficient from year to year.

If the structure of science shown below is making toward stability, we would expect connections between neighboring fields to increase, and connections between distant fields to decrease. We found the opposite, suggesting that the underlying structure is unstable and likely to change dramatically over the next decade.

In terms, representing how the structure is likely to change, are provided below. Maps with white areas represent a decrease of distant fields that are likely to be pulled closer to the other side of the wheel. Maps with dark areas represent fields that are likely to be pulled away from the center. The map shows that future maps of science will show change in factors corresponding to these dimensions. Fields will get larger slightly, while the physical centers will tighten and draw closer to the medial fields.

Today used as a science “base map”, see later slides

Medical Engineering & Computer Science (METS)
 METS is the most stable in the new wheel as a field whose connectivity has been increasing each year since 2001. This suggests a continuing trend of increasing connectivity and all other fields from 2001-2005. The connectivity will continue to increase, and METS will continue to be a major force in the new map.

Interdisciplinary
 Interdisciplinary, indicated by the dark red color, shows the most significant increase in connectivity with other fields (2001-2005). It has relatively low connectivity with the other fields and is likely to be pulled closer to the center of the wheel.

Infectious Diseases
 Infectious Diseases, indicated by the dark red color, shows the most significant increase in connectivity with other fields (2001-2005). It has relatively low connectivity with the other fields and is likely to be pulled closer to the center of the wheel.

Medical Specialties
 Medical Specialties, indicated by the dark red color, shows the most significant increase in connectivity with other fields (2001-2005). It has relatively low connectivity with the other fields and is likely to be pulled closer to the center of the wheel.

Health Professionals
 The Health Professionals field, indicated by the yellow color, shows the most significant increase in connectivity with other fields (2001-2005). It has relatively low connectivity with the other fields and is likely to be pulled closer to the center of the wheel.

Social Sciences
 The Social Sciences field, indicated by the yellow color, shows the most significant increase in connectivity with other fields (2001-2005). It has relatively low connectivity with the other fields and is likely to be pulled closer to the center of the wheel.

Richard Klavans & Kevin W. Boyack. 2007. Maps of Science: Forecasting Large Trends in Science

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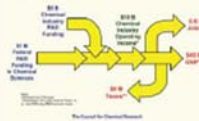
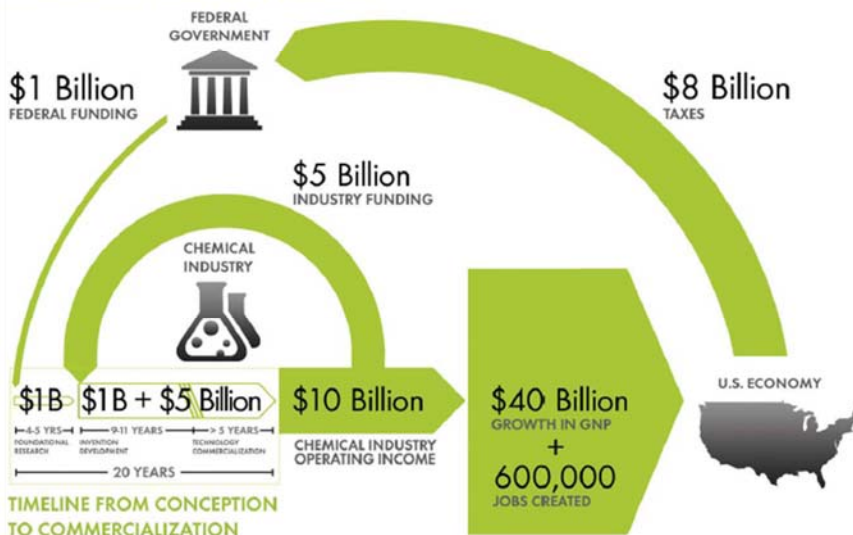
Chemical Research & Development Powers the U.S. Innovation Engine

Macroeconomic Implications of Public and Private R&D Investments in Chemical Sciences

The Council for Chemical Research (CCR)

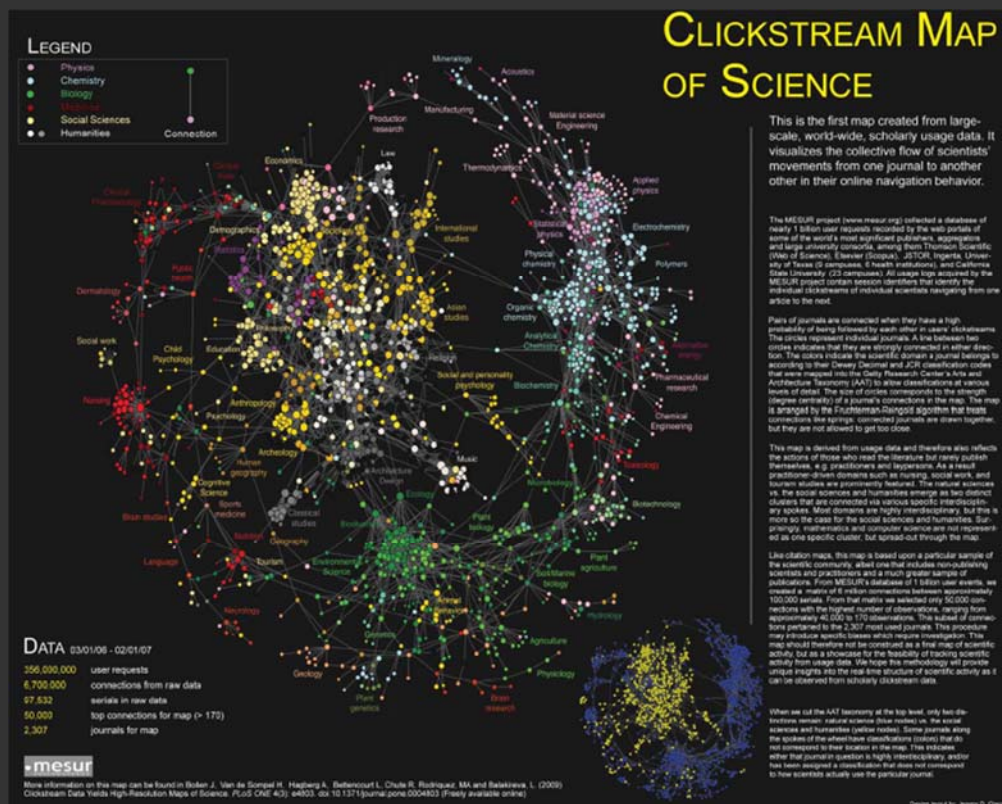
has provided the U.S. Congress and government policy makers with important results regarding the impact of Federal Research & Development (R&D) investments on U.S. innovation and global competitiveness through its commissioned 5-year two phase study. To take full advantage of typically brief access to policy makers, CCR developed the graphic below as a communication tool that distills the complex data produced by these studies in direct, concise and clear terms.

INVESTMENT IN CHEMICAL SCIENCE R&D



The design shows that an input of \$1B in federal investment, leveraged by \$5B industry investment, brings new technologies to market and results in \$10B of operating income for the chemical industry, \$40B growth in the Gross National Product (GNP) and further impacts the US economy by generating approximately 600,000 jobs, along with a return of \$8B in taxes. Additional details, also reported in the CCR studies, are depicted in the map to the left. This map clearly shows the two R&D investment cycles; the shorter industry investment at the innovation stage to commercialization cycle; and the longer federal investment cycle which begins in basic research and culminates in national economic and job growth along with the increase tax base that in turn is available for investment in basic research.

Council for Chemical Research. 2009. Chemical R&D Powers the U.S. Innovation Engine. Washington, DC. Courtesy of the Council for Chemical Research.



Bollen, Johan, Herbert Van de Sompel, Aric Hagberg, Luis M.A. Bettencourt, Ryan Chute, Marko A. Rodriguez, Lyudmila Balakireva. 2008. A Clickstream Map of Science.

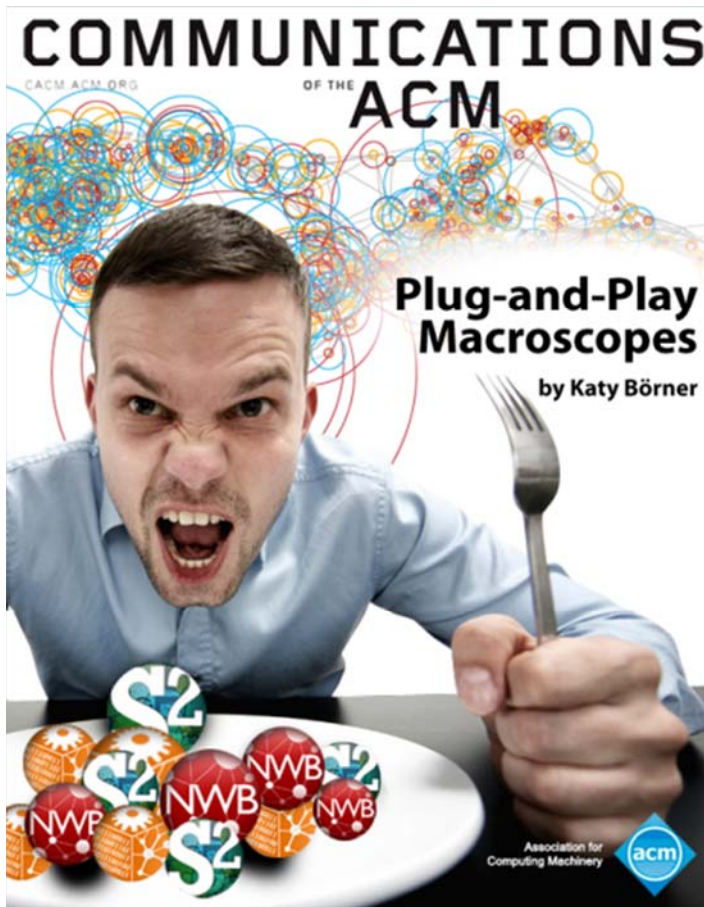


Debut of 5th Iteration of the Mapping Science Exhibit at MEDIA X was in 2009 at Wallenberg Hall, Stanford University, <http://mediax.stanford.edu>, <http://scaleindependentthought.typepad.com/photos/scimaps>





Science Maps in “Expedition Zukunft” science train visiting 62 cities in 7 months, 12 coaches, 300 m long. <http://www.expedition-zukunft.de>



Börner, Katy. (March 2011). Plug-and-Play Macroscopes. *Communications of the ACM*, 54(3), 60-69.

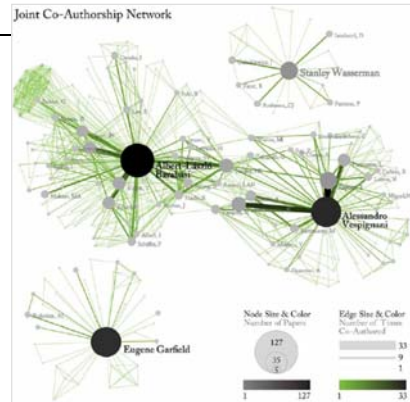
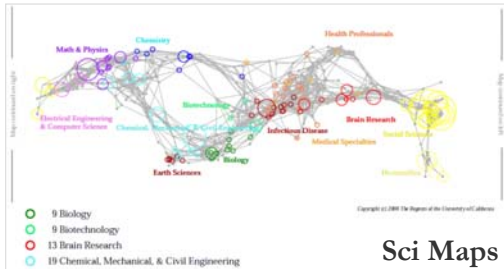
Video and paper are at <http://www.scivee.tv/node/27704>



Sci² Tool – “Open Code for S&T Assessment”

<http://sci2.cns.iu.edu>

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



Horizontal Time Graphs



Börner, Katy, Huang, Weixia (Bonnie), Linnemeier, Micah, Dubon, Russell Jackson, Phillips, Patrick, Ma, Nianli, Zoss, Angela, Guo, Hanning & Price, Mark. (2009). *Reti-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

Sci² Tool

File Preprocessing Modeling Analysis Visualization Scientometrics Help

Console

Welcome to the Science of Science Tool (Sci²). The development of this tool is supported in Network Science center and the School of Li Indiana University, the National Science Foundation and IIS-0715303, and the James S. McDonnell Cyberinfrastructure portal (<http://sci.slis.indiana.edu>).

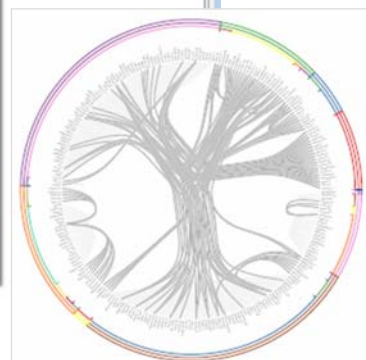
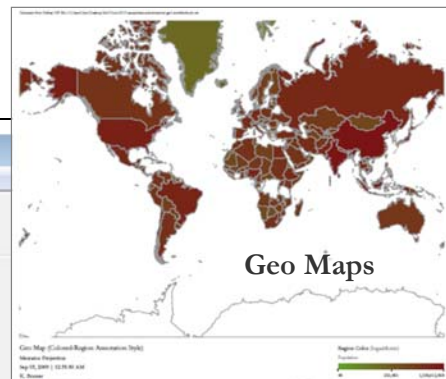
The primary investigators are Katy Börner, In SciTech Strategies Inc. The Sci² tool was developed by J. Duhon, Patrick A. Phillips, Chintan Tank, a Cyberinfrastructure Shell (<http://cishell.org>) for Network Science Center (<http://cns.slis.indiana.edu>). Many algorithm plugins were derived from the Network Workbench Tool (<http://nwb.slis.indiana.edu>).

Please cite as follows:
Sci² Team. (2009). Science of Science Tool. In SciTech Strategies Inc., <http://sci.slis.indiana.edu>.

Scheduler

Remove From List Remove completed

!	Algorithm Name	Date	Time	% Con
<input checked="" type="checkbox"/>	Extract Co-Author Netw...	09/03/2009	00:15:20 AM	100%
<input checked="" type="checkbox"/>	Load and Clean ISI File	09/03/2009	00:15:05 AM	100%



Sci² Tool
A tool for science of science research & practice

Email Address

Password

Login

Forgot your password?
To recover your account password, please visit our [password recovery page](#).

Not registered yet?
[Register now](#)

Tutorials
Katy Börner (2010) Science of Science Research and Tools (12 Tutorials). Reporting Branch, Office of Extramural Research/Office of the Director, National Institutes of Health, Bethesda, MD.

Scott Weingart, Biberstine (2010) Science, Indiana

- Tutorial #01: [Science of Science Research](#)
- Tutorial #02: [Network Science / Information Visualization](#)
- Tutorial #03: [CIShell Powered Tools: Network Workbench and Science of Science Tool](#)
- Tutorial #04: [Temporal Analysis—Burst Detection](#)
- Tutorial #05: [Geospatial Analysis and Mapping](#)
- Tutorial #06: [Topical Analysis & Mapping](#)
- Tutorial #07: [Tree Analysis and Visualization](#)
- Tutorial #08: [Network Analysis and Visualization](#)
- Tutorial #09: [Large Network Analysis and Visualization](#)
- Tutorial #10: [Using the Scholarly Database at IU](#)
- Tutorial #11: [VIVO National Researcher Networking](#)
- Tutorial #12: [Future Developments](#)

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

Geetha Senthil (2010) [Multidisciplinary Nature of Work With Reference to PIs and ICs Within a Portfolio](#). PA Group at NIH.

NIH Office of Extramural Research and Katy Börner (2010) [Network Visualizations Using SPIRES Data and the Sci2 Tool](#). Office of Extramural Research at NIH.



Type of Analysis vs. Level of Analysis

	<i>Micro/Individual</i> (1-100 records)	<i>Meso/Local</i> (101–10,000 records)	<i>Macro/Global</i> (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	NSF's core competency



Sci² Tool: Algorithms

Preprocessing

Extract Top N% Records
Extract Top N Records
Normalize Text
Slice Table by Line

Extract Top Nodes
Extract Nodes Above or Below Value
Delete Isolates

Extract top Edges
Extract Edges Above or Below Value
Remove Self Loops
Trim by Degree
MST-Pathfinder Network Scaling
Fast Pathfinder Network Scaling

Snowball Sampling (in nodes)
Node Sampling
Edge Sampling

Symmetrize
Dichotomize
Multipartite Joining

Geocoder

Extract ZIP Code

Modeling

Random Graph
Watts-Strogatz
Small World
Barabási-Albert Scale-Free
TARL

Analysis

Network Analysis Toolkit (NAT)
Unweighted & Undirected

Node Degree
Degree Distribution

K-Nearest Neighbor (Java)
Watts-Strogatz Clustering Coefficient
Watts Strogatz Clustering Coefficient over K

Diameter
Average Shortest Path
Shortest Path Distribution
Node Betweenness Centrality

Weak Component Clustering
Global Connected Components

Extract K-Core
Annotate K-Coreeness

HTTS

Weighted & Undirected

Clustering Coefficient
Nearest Neighbor Degree
Strength vs Degree
Degree & Strength
Average Weight vs End-point Degree
Strength Distribution
Weight Distribution
Randomize Weights

Blondel Community Detection

HTTS

Unweighted & Directed

Node Indegree
Node Outdegree
Indegree Distribution
Outdegree Distribution

K-Nearest Neighbor
Single Node in-Out Degree Correlations

Dyad Reciprocity
Arc Reciprocity
Adjacency Transitivity

Weak Component Clustering
Strong Component Clustering

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Sci² Tool: Algorithms cont.

Extract K-Core
Annotate K-Coreeness

HTTS
PageRank
Weighted & Directed
HTTS
Weighted PageRank

Textual

Burst Detection

Visualization

GnuPlot
GUESS
Image Viewer

Radial Tree/Graph (prefuse alpha)
Radial Tree/Graph with Annotation
(prefuse beta)
Tree View (prefuse beta)
Tree Map (prefuse beta)
Force Directed with Annotation
(prefuse beta)
Fruchterman-Reingold with Annotation
(prefuse beta)

DrL (VxOrd)
Specified (prefuse beta)

Horizontal Bar Graph
Circular Hierarchy
Geo Map (Circle Annotation Style)
Geo Map (Colored-Region Annotation Style)
Science Map (Circle Annotation)

Scientometrics

Remove ISI Duplicate Records
Remove Rows with Multitudinous Fields
Detect Duplicate Nodes
Update Network by Merging Nodes

Extract Directed Network

Extract Paper Citation Network
Extract Author Paper Network

Extract Co-Occurrence Network

Extract Word Co-Occurrence Network
Extract Co-Author Network
Extract Reference Co-Occurrence
(Bibliographic Coupling) Network

Extract Document Co-Citation Network

Soon:

Database support for ISI and NSF data.

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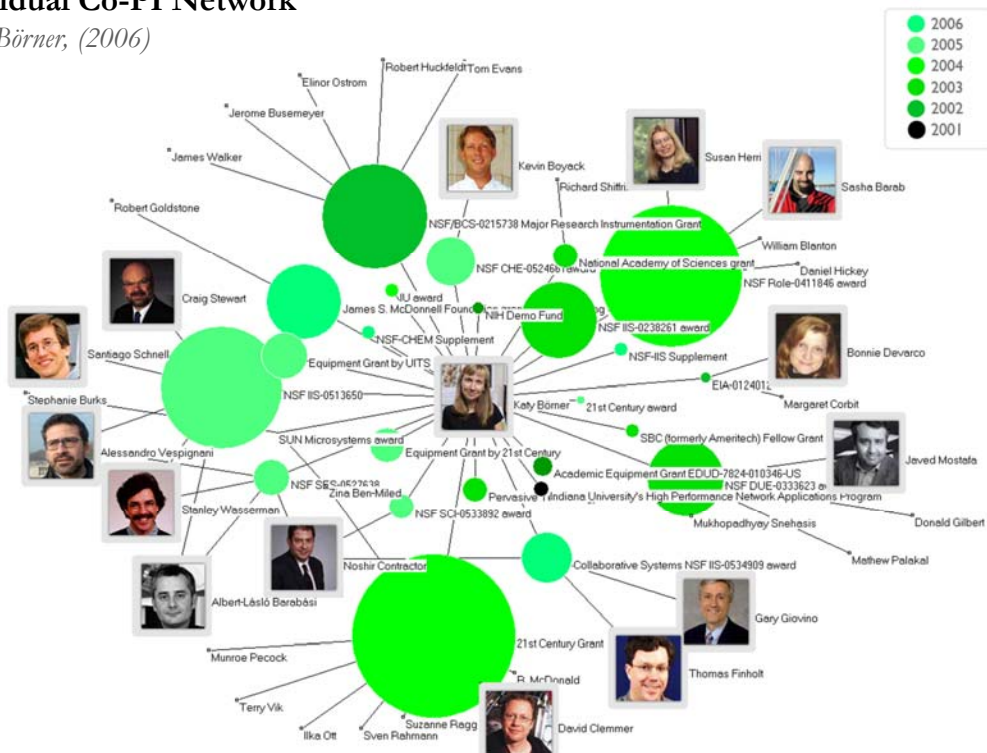
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Statistical Analysis/Profiling	Individual person and their expertise profiles	Larger labs, centers, universities, research domains, or states	All of NSF SA, all of sci
Temporal Analysis (When)	Funding portfolio of one individual	Research bursts of PNAS	113 Years of P Research
Geospatial Analysis (Where)	Career trajectory of one individual	Mapping a network of intellectual links	PNAS
Topical Analysis (What)		Research	VxOrd/Topic NIH funding
Network Analysis (With Whom?)	NSI network of one		NIH's network

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Individual Co-PI Network

Ke & Börner, (2006)



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

Börner, Katy, Penumarty, 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



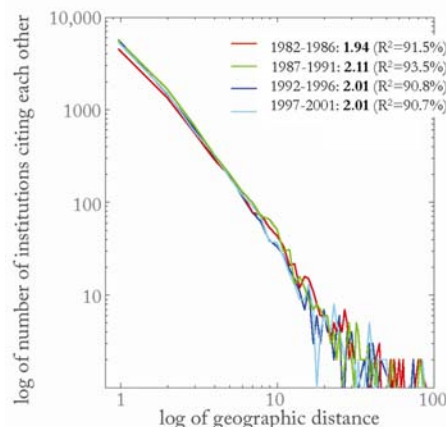
Research questions:

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 institutions?



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.



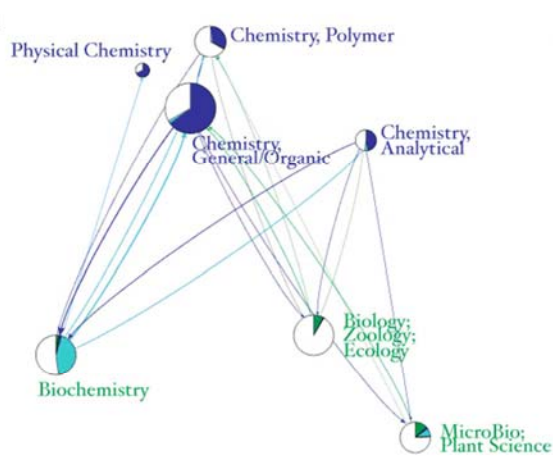
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Topical Composition and Knowledge Flow Patterns in Chemistry Research for 1974 and 2004

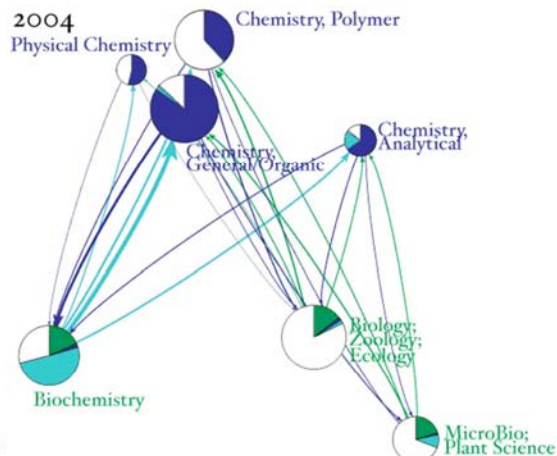
Kevin W. Boyack, Katy Börner, & Richard Klavans (2007)

Chemistry - Biology Interface

1974



2004



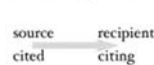
Number of papers by cluster



Fraction of papers by cluster



Knowledge flows cluster to cluster



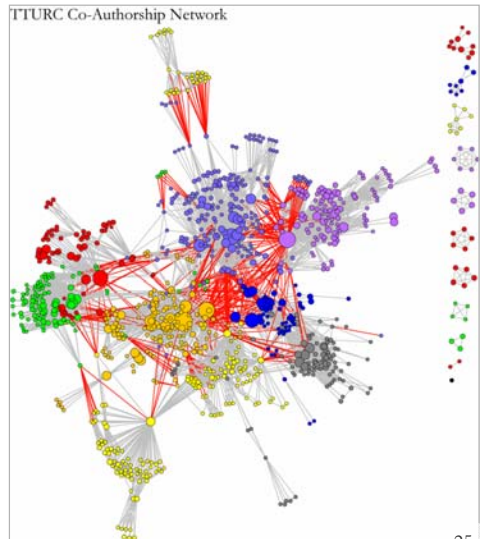
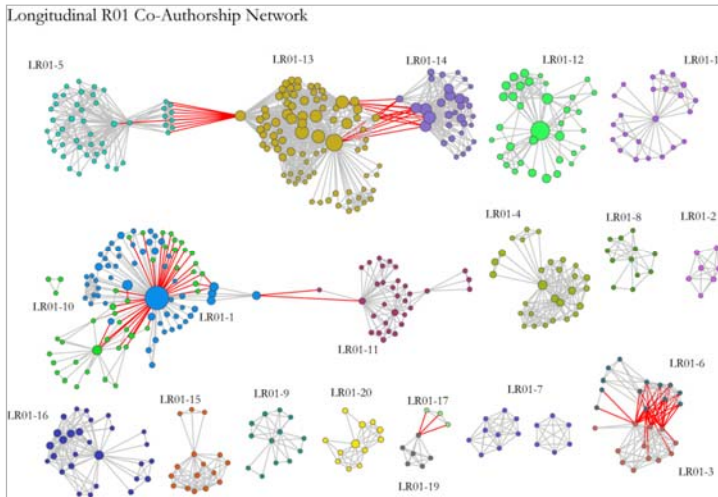
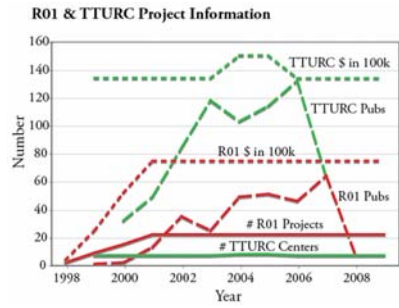
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Mapping Transdisciplinary Tobacco Use Research Centers Publications

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

Zoss & Börner, *forthcoming*.

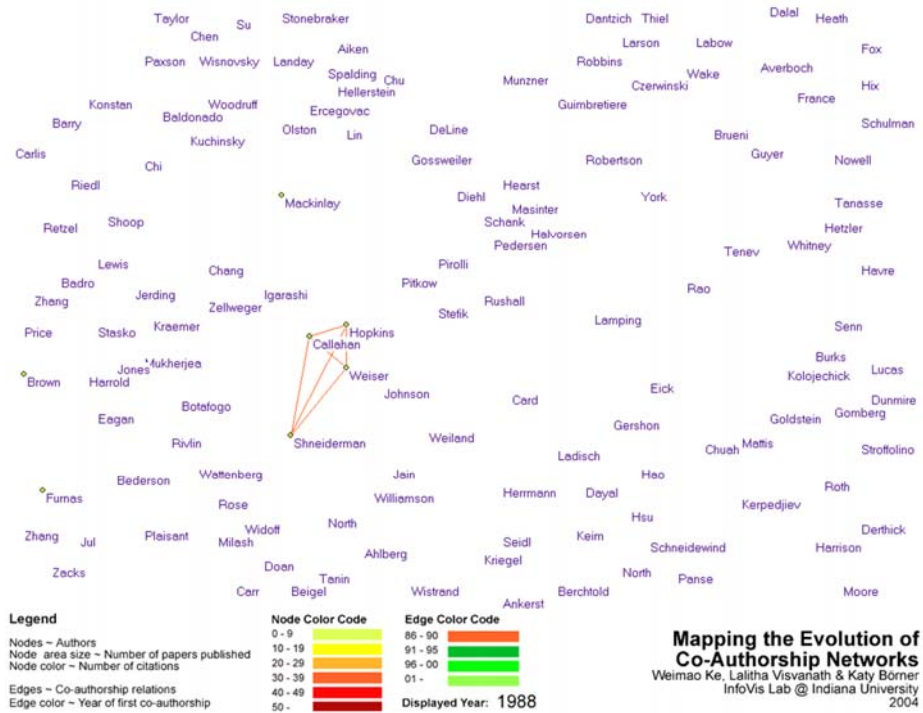
Supported by NIH/NCI Contract HHSN261200800812



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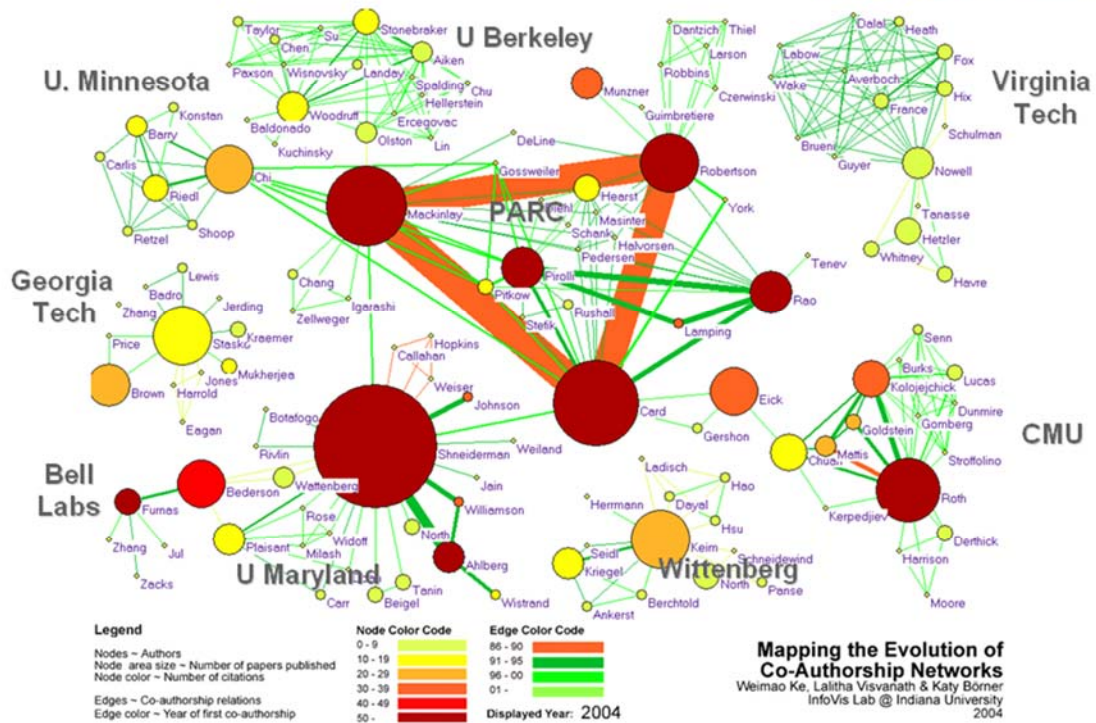
Mapping the Evolution of Co-Authorship Networks

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



Mapping the Evolution of Co-Authorship Networks

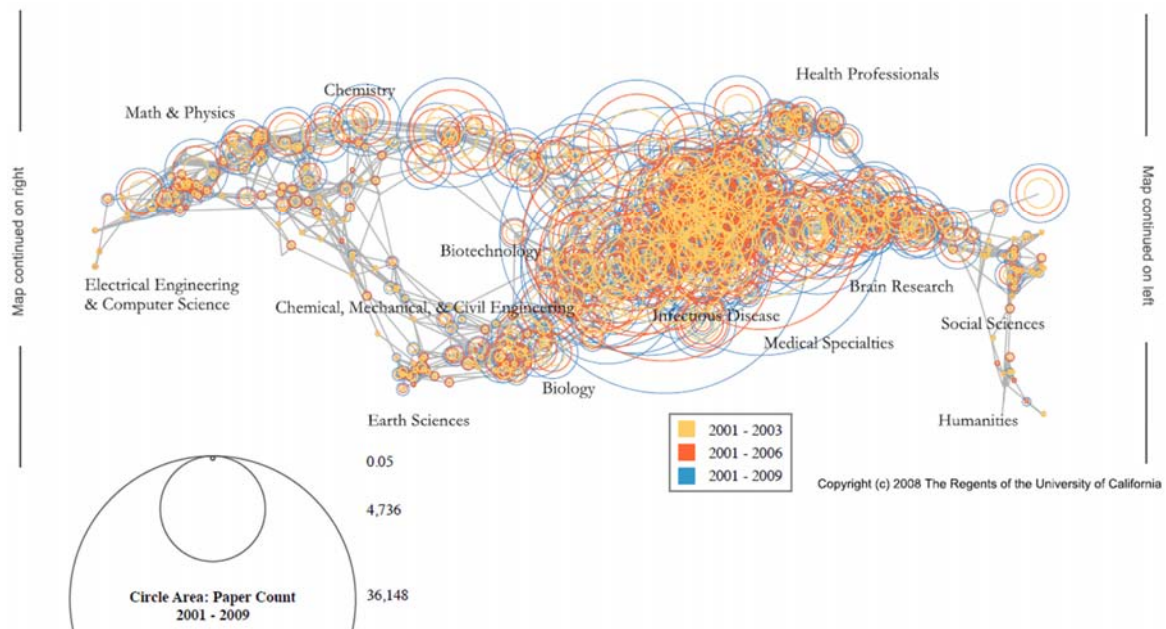
Ke, Viswanath & Börner, (2004) Won 1st price at the IEEE InfoVis Contest



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MEDLINE Publication Output by The National Institutes of Health (NIH) Using Nine Years of ExPORTER Data

Katy Börner, Nianli Ma, Joseph R. Biberstine, Cyberinfrastructure for Network Science Center, SLIS, Indiana University, Robin M. Wagner, Rediet Berhane, Hong Jiang, Susan E. Ivey, Katrina Pearson and Carl McCabe, Reporting Branch, Division of Information Services, Office of Research Information Systems, Office of Extramural Research, Office of the Director, National Institutes of Health (NIH), Bethesda, MD.



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OSGi/CIShell Adoption

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

- *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).
- *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.
- *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.
- *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.

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.

Interactive S&T Maps

Maps of Science - Windows Internet Explorer
 http://mapofscience.com/
 File Edit View Favorites Tools Help
 Maps of Science
 Overview Detail Disciplinary Maps Competency Maps Paradigm Maps Posters Education
BETTER MAPS • BETTER DECISIONS
 Copyright 2008 SciTech Strategies Inc. All rights reserved.
 Done Internet

<http://mapofscience.com> and SciVal by Elsevier

Interactive World and Science Map of S&T Jobs

Angela Zoss, Michael Connover, Katy Börner (2010)

Visualization of Job Postings
 Map of Science Geographic
 Geographic Visualization
 Postdoc at Harvard Medical School
 Link to Post
Visualization of Job Postings
 Map of Science Geographic
Map of Science
 Scientific domains are highly interconnected. The boundaries between different domains are often fuzzy. One way of thinking about the relationships between domains is to conceptualize all scientific domains as existing within a large network of research.
 Creating a network of scientific research can be accomplished by looking at scientific journals and their articles. The UCSD Map of Science used here is the product of a large study by researchers at the University of California San Diego using 7.2 million papers and over 16,000 separate journals, proceedings, and series from Thomson Scientific and Scopus over the five year period from 2001 to 2005. The researchers used citations between the papers and journals to cluster journals into small groups of highly related journals.
 Those clusters are represented by 554 individual nodes in the network. The links between the clusters show that some clusters are related to other clusters but are not as tightly connected as the journals that make up each cluster. Then the clusters are labeled both by the content area shared by the journals in the cluster and by the overarching scientific domain for that cluster (represented by one of 13 colors).
 Maps of science like this one can be used to understand many different data sets and how they can be represented by topic. Here we are looking at the topics that appear in job postings from large inst.
 Search for Jobs
 Search for Jobs
 Search
 Biotechnology
 Search
 Copyright © 2008 The Regents of the University of California - Terms of Use

Geographic Map **Science Map**

Funding
 NIH
 NSF
 USDA

Publications
 DOE
 ISI
 Medline

Patents
 USPTO

Citations Count

Amount Count
 From year to year
 Search by keyword

Detail **About**

Geographic Visualization

Here we have a more traditional view of the records - a geographic overlay. Featured here are the records that list both a city and state in the United States. Feel free to search, zoom, pan, and click for descriptions.

<http://mapsustain.cns.iu.edu>

Geographic Map **Science Map**

Funding
 NIH
 NSF
 USDA

Publications
 DOE
 ISI
 Medline

Patents
 USPTO

Citations Count

Amount Count
 From year to year
 Search by keyword

Maps **Detail** **Data** **About**

About

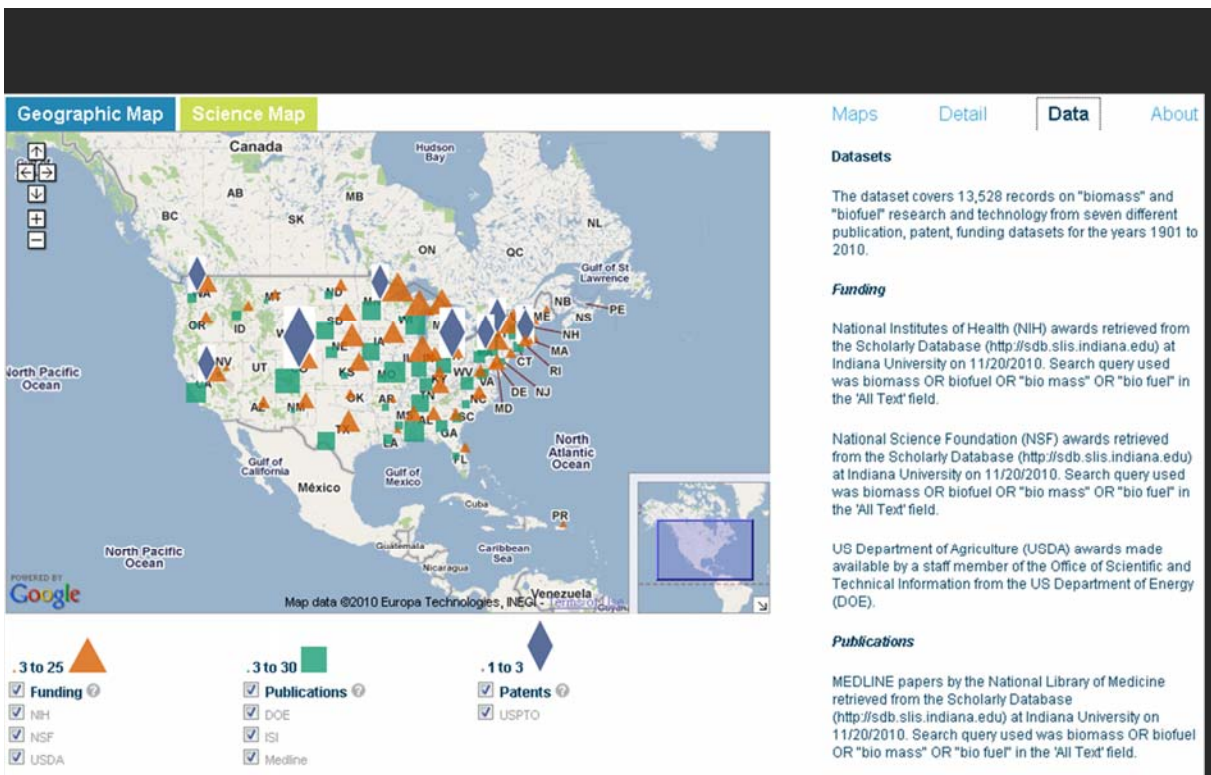
A new field of *Sustainability Science and Engineering* is emerging that seeks to understand the fundamental character of interactions between nature and human society and to help steer the impact of humanity's needs on the planet's natural resources towards sustainable trajectories. The field is unified in clear terms by its ultimate goals but occupies an interdisciplinary position among traditional research fields, spanning both science and engineering and spreading across disciplines as diverse as agriculture, ecology, oceanography, climate studies, economics, a diverse set of social sciences, energy and materials and several additional aspects of engineering, physics, biology, and chemistry. Although Sustainability Science and engineering is by now widely discussed in the scientific and engineering community, and is beginning to be connected to the political agenda for economic and social development, it remains unclear to what extent its many facets are being integrated into a global perspective and whether researchers are utilizing it as a nexus to collaborate across traditional scientific and engineering fields.

Please consult the [Mapping the Structure and Evolution of Sustainability Science](#) workshop web page for further information and details.

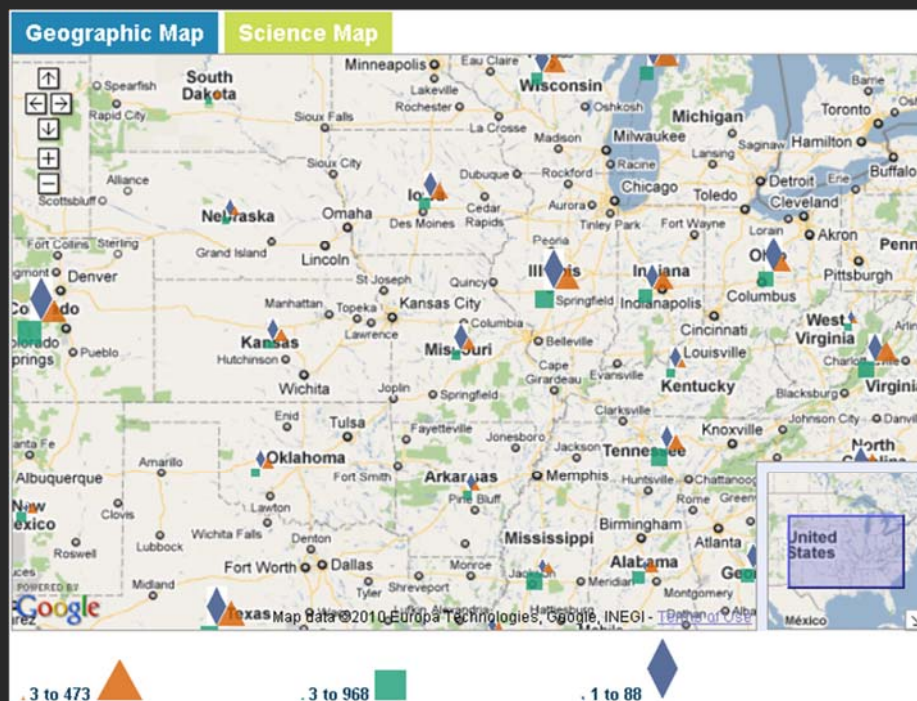
Web Page Design

This web site provides an interactive interface to publication, patent, and funding data on 'biomass' and 'biofuel' research. Visitors are invited to explore what funding is available in what geospatial regions and in what areas of science and what publications and patents

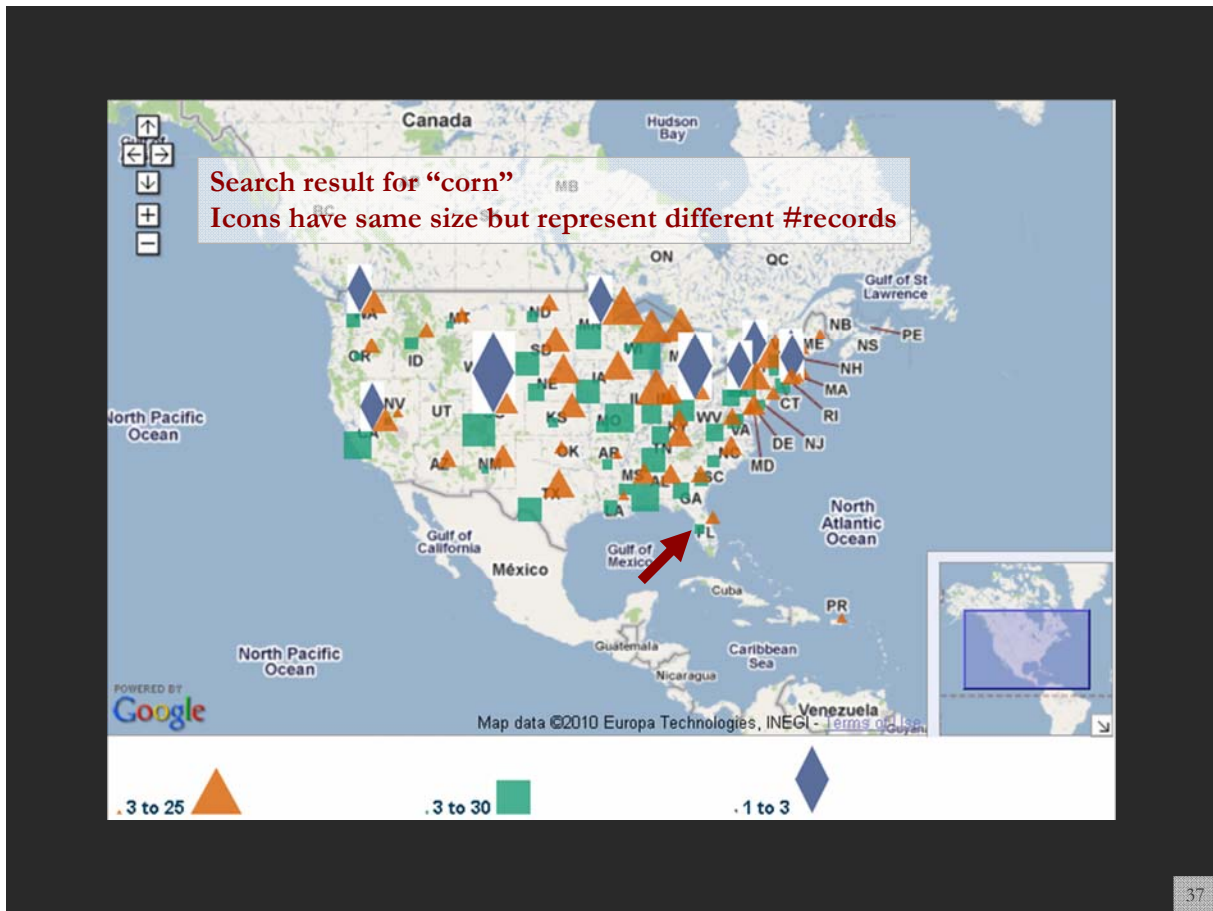
Google Map JavaScript API was used to implement both maps with two aggregation layers for each. The geographic map aggregates to the **state level** and the **city level**. The science map has a high level of aggregation of 13 top-level scientific **disciplines** and a low level of 554 **sub-disciplines**.



The geographic map at state level.



The geographic map at city level.



Science Map

Click on one icon to display all records of one type.
Here publications in the state of Florida.

Florida publications: 2 records
DOE: 1
MEDLINE: 1

Maps Detail Data About

> Florida

MEDLINE 2002

- [Recovery Of Dairy Manure Nutrients By Benthic Freshwater Algae](#)

DOE 1985

- [Enzymatic Hydrolysis And Fermentation Of Corn For Fuel Alcohol](#)

Information Bridge: DOE Scientific and Technical Information - - Document #5789929 - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://www.osti.gov/bridge/product.biblio.jsp?osti_id=5789929

Most Visited Getting Started Latest Headlines

MapSustain Information Bridge: DOE Scientifi...

DOE Scientific and Technical Information

DOE • OSTI

INFORMATION BRIDGE

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Full Text Availability information may be found in the Availability, Publisher, Research Organization, Resource Relation and/or Author (affiliation information) fields and/or via the "Full-text Availability" link. For a journal article, please see the Resource Relation field.

Title Enzymatic hydrolysis and fermentation of corn for fuel alcohol
[Word Cloud](#) | [More Like This](#)

Creator/Author [Mullins, J.T.](#)

Publication Date 1985 Jan 01

OSTI Identifier OSTI ID: 5789929

Other Number(s) Journal ID: CODEN: BIBIA

Resource Type Journal Article

Resource Relation Journal Name: Biotechnol. Bioeng.; (United States); Journal Volume: 27:3

Research Org Univ. of Florida, Gainesville

Subject 09 BIOMASS FUELS; 32 ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION; ETHANOL FUELS; BIOSYNTHESIS; MAIZE; ENZYMATIC HYDROLYSIS; FERMENTATION; PRODUCTIVITY; COST; ENERGY EFFICIENCY; EXPERIMENTAL DATA; WASTE PRODUCT UTILIZATION; ALCOHOL FUELS; BIOCONVERSION; CEREALS; CHEMICAL REACTIONS; DATA; DECOMPOSITION; EFFICIENCY; FUELS; GRASS; HYDROLYSIS; INFORMATION; LYSIS; NUMERICAL DATA; PLANTS;

Done

Detailed information on demand via original source site for exploration and study.

39

Geographic Map Science Map

Search result for "Miscanthus," a special energy biomass crops for second generation biofuel.

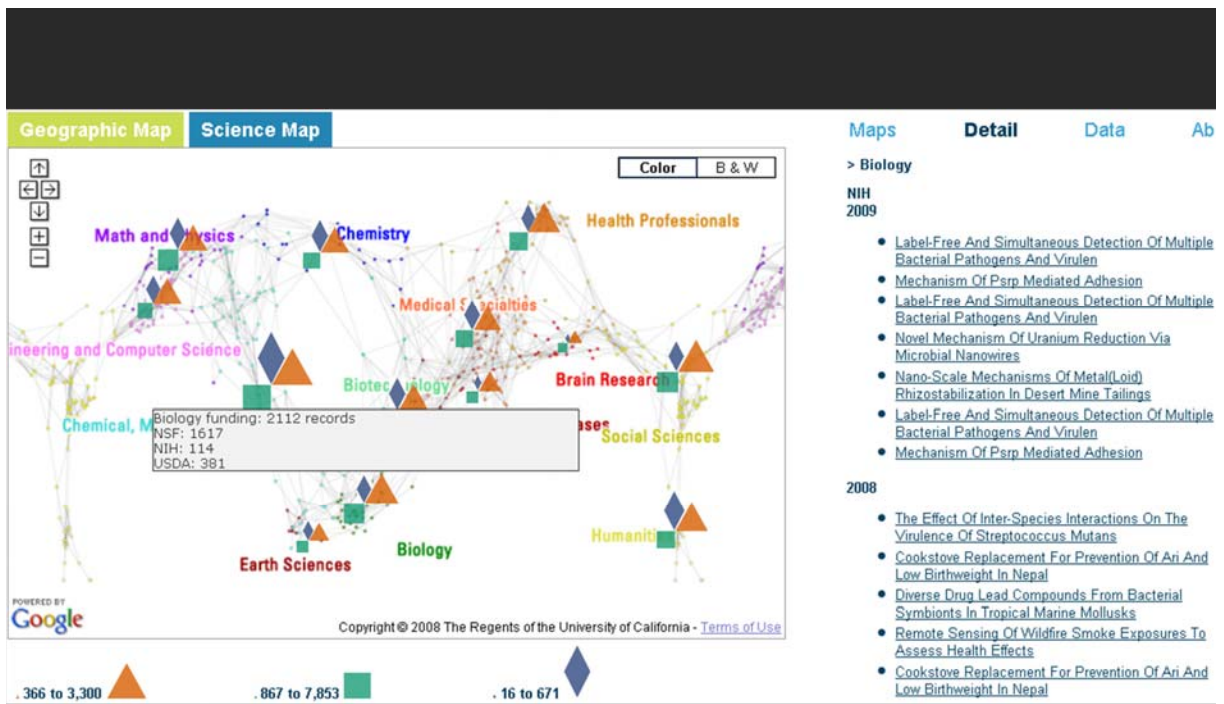
POWERED BY Google

Map data ©2010 Europa Technologies, INEGI

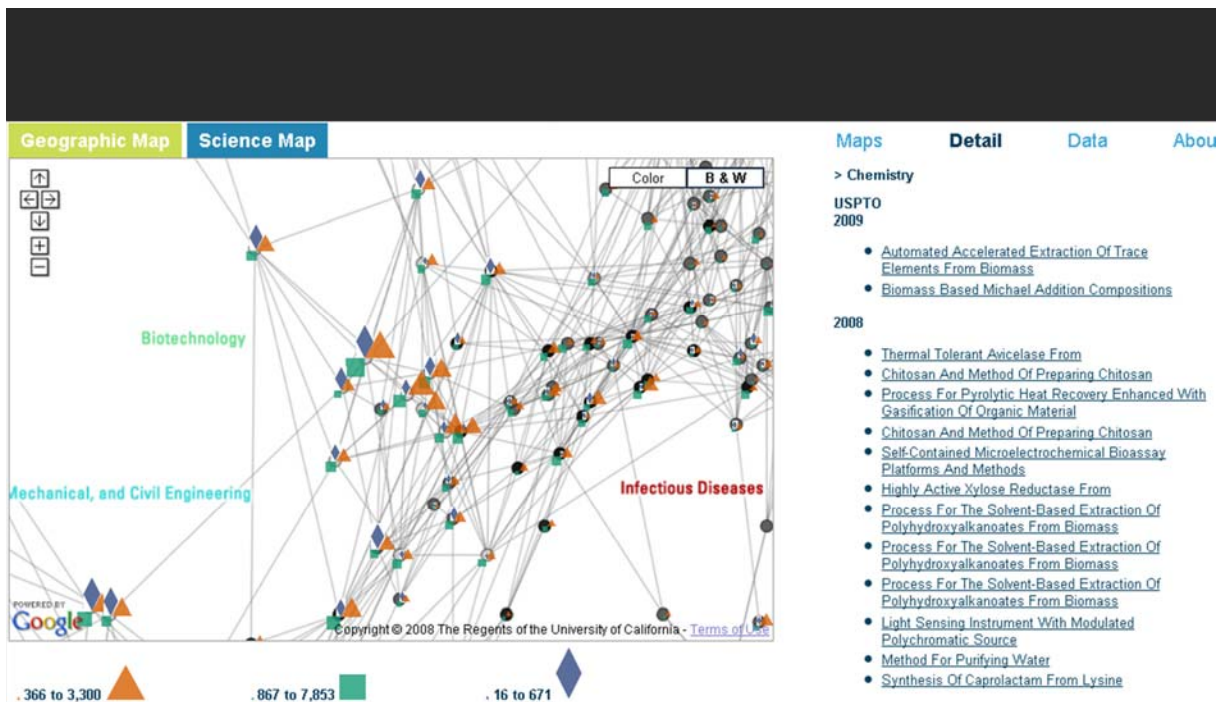
2 to 2 .3 to 4 .0 to 0

Venezuela - Terms of Use

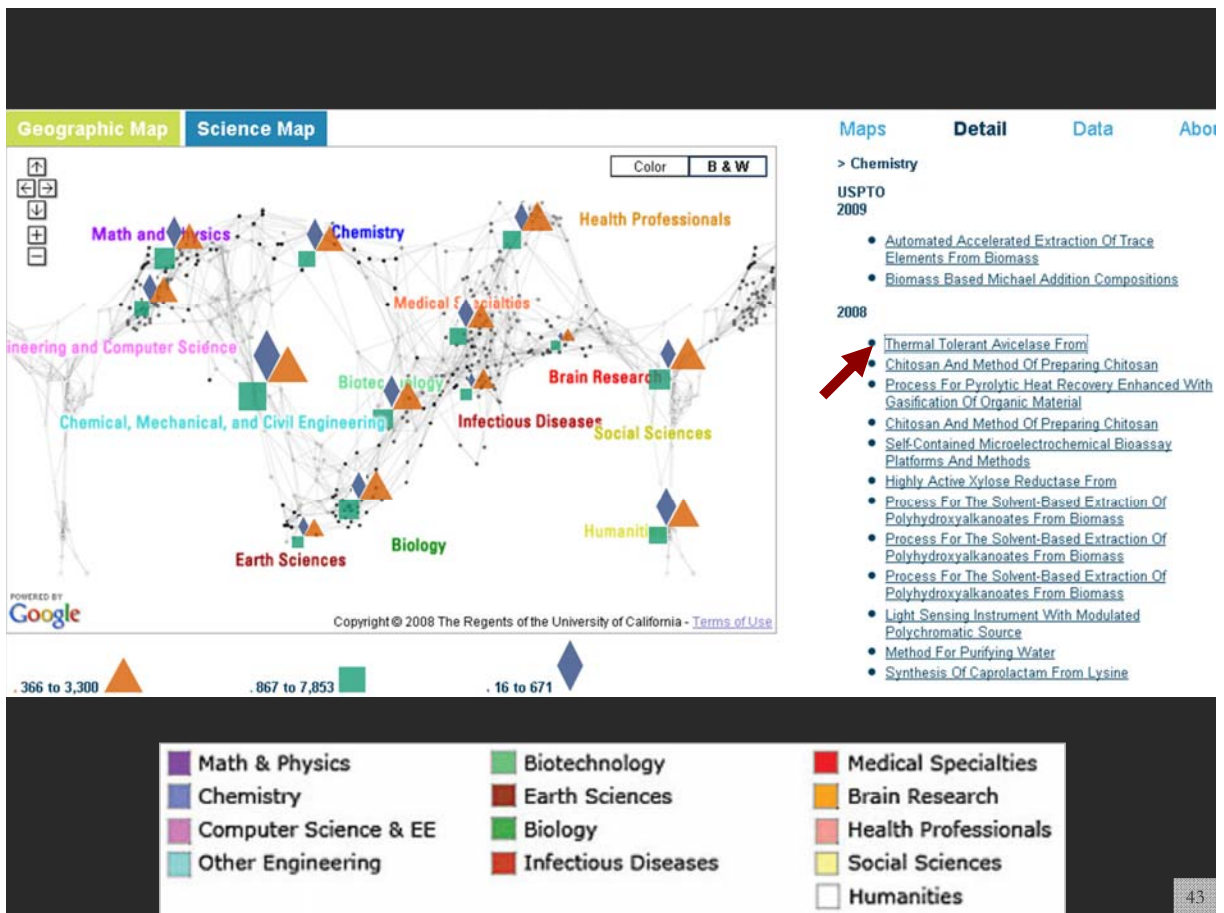
40



The science map at 13 top-level scientific disciplines level.



The science map at 554 sub-disciplines level.



- Maps Detail Data About
- > Chemistry
- USPTO
- 2009
- Automated Accelerated Extraction Of Trace Elements From Biomass
 - Biomass Based Michael Addition Compositions
- 2008
- Thermal Tolerant Avicelase From Chitosan And Method Of Preparing Chitosan
 - Process For Pyrolytic Heat Recovery Enhanced With Gasification Of Organic Material
 - Chitosan And Method Of Preparing Chitosan
 - Self-Contained Microelectrochemical Bioassay Platforms And Methods
 - Highly Active Xylose Reductase From Process For The Solvent-Based Extraction Of Polyhydroxyalkanoates From Biomass
 - Process For The Solvent-Based Extraction Of Polyhydroxyalkanoates From Biomass
 - Process For The Solvent-Based Extraction Of Polyhydroxyalkanoates From Biomass
 - Light Sensing Instrument With Modulated Polychromatic Source
 - Method For Purifying Water
 - Synthesis Of Caprolactam From Lysine

United States Patent: 7364890 - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://patft.uspto.gov/netacgi/nph-Parser?Sect1=PTO1&Sect2=HITOFF&d=PALL&p=1&u=/netacgi/PTO/srch

MapSustain United States Patent: 7364890 United States Patent: 7364890 Information Bridge: DOE Scientific a...

USPTO PATENT FULL-TEXT AND IMAGE DATABASE

Home Quick Advanced Pat Num Help

Bottom

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Images

(1 of 1)

United States Patent 7,364,890
Ding, et al. April 29, 2008

Thermal tolerant avicelase from *Acidothermus cellulolyticus*

Abstract

The invention provides a thermal tolerant (thermostable) cellulase, AvIII, that is a member of the glycoside hydrolase (GH) family. AvIII was isolated and characterized from *Acidothermus cellulolyticus* and, like many cellulases, the disclosed polypeptide and/or its derivatives may be useful for the conversion of biomass into biofuels and chemicals.

Inventors: Ding; Shi-You (Golden, CO), Adney; William S. (Golden, CO), Vinzant; Todd B. (Golden, CO), Himmel; Michael E. (Littleton, CO)

Assignee: Midwest Research Institute (Kansas City, MO)

App. No. 09/017,276

Done

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NIH TOPIC MAPS

A Topic Database of NIH-Funded Grants

NIH Map Viewer

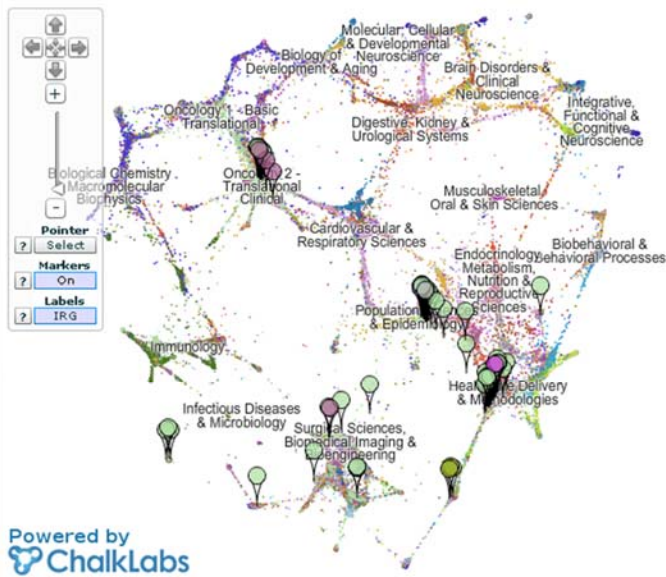
Show Topic Browser ?

Export Data

Methods

Feedback

2009 ? add delete AND Topic Words cancer breast cancers cancer_risk cancer_p 20 00 ? Search Clear Search



- FIC
- NCCAM
- NCI
- NCMHD
- NCRR
- NEI
- NHGRI
- NHLBI
- NIA
- NIAAA
- NIAID
- NIAMS
- NIBIB
- NICHD
- NIDA
- NIDCD
- NIDCR
- NIDDK
- NIEHS
- NIGMS
- NIMH
- NINDS
- NINR
- NLM
- OD

Institutes (9) ?

NIH Inst	# Grants	Count	+
NCI		116	
NCRR		10	
NIEHS		5	
NCMHD		1	
NIA		-	

Topics ?

%	Title Words	+
25.9	breast, cancer, cancer_risk, women, cancer_sui	
3.86	risk, risk_factors, cancer, prospective, women,	
3.76	genome_wide_association, loci, genome_wide,	
3.70	genetic, genetics, genes, gene_environment, i	

Grants (137) ?

NIH Inst	Grant	+
NCRR	3P20RR011792-10S2 6914 OBESITY, INSULIN RESISTANCE, IGF'S, AND BREAST CANCER RISK IN AFRICAN AMERICANS PI: CUI, YONG	
NCI	3R01CA120562-03S1 Commonly Used Medications and Breast Cancer Recurrence PI: BOUDREAU, DENISE M	
NCI	3R01CA120562-03 Commonly Used Medications and Breast Cancer Recurrence PI: BOUDREAU, DENISE M	
NCI	3R01CA093772-06 Long-term Survivorship in Older Women with Early Stage Breast	

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NIH TOPIC MAPS

A Topic Database of NIH-Funded Grants

NIH Topic Browser - Institute Information

NLM NCI NEI NCCAM NIEHS NIGMS NINR NICHD NINDS NIA NCMHD NIAMS NIH NIDDK NHLBI NIAAA NIMH NHGRI FIC NIBIB NIDCR NCRR NIAID NIDA NIDCD

Institute: NCI - National Cancer Institute

Export Data

Top Topics

%	Topic	Topic Words	Title Words	Phrases	+
4.05	210	cancer cancer_center program cancer_research	cancer_center, program, cancer, core, spore, tra	anderson cancer_center, shared resource, canc	
2.42	597	cancer tumor tumorigenesis tumors myc tumor_	cancer, tumorigenesis, myc, tumor_suppressor,	tumor progression, malignant transformation, tu	
2.28	430	cancer treatment therapy patients tumor disea	cancer, therapy, treatment, tumor, prostate, bre	cancer treatment, treatment cancer, metastatic	
1.73	16	metastasis invasion tumor metastatic progressi	metastasis, cancer, invasion, breast, tumor, pro	tumor progression, invasion metastasis, cancer	
1.47	345	clinical_trials trials oncology cancer treatment di	clinical_trials, clinical_oncology, oncology, unit,	clinical_trials unit, phase_j clinical_trials, cancer	
1.43	686	cancer breast cancers cancer_risk cancer_patie	breast, cancer, cancer_risk, women, cancer_sur	breast cancer, breast cancer_risk, breast cancer	
1.41	370	tumor immunotherapy t_cells t_cell immunity an	tumor, immunotherapy, t_cell, immunity, t_cells,	antitumor immunity, adoptive immunotherapy, t	
1.14	480	therapeutic agents treatment therapies targets	therapeutic, targeting, agents, treatment, ther	therapeutic agents, therapeutic targets, therap	
1.08	346	biomarkers markers biomarker disease patients	biomarkers, biomarker, markers, disease, cance	disease progression, biomarker validation, seru	
0.98	660	prostate cancer pca cancer_cells incap androge	prostate, cancer, cancer_cells, androgen_recep	prostate cancer, prostate cancer_cells, prostate	
0.90	171	scientific committee administrative management	core, administrative, administration, planning, a	steering committee, internal external, institutor	
0.87	182	breast cancer her2 cancer_cells human mcd7 ne	breast, cancer, cancer_cells, her2, human, estre	breast cancer, breast cancer_cells, her2 neu, br	
0.85	437	risk risk_factors cases cohort prospective high_	risk, risk_factors, cancer, prospective, women,	cases controls, prospective cohort_study, modif	
0.85	23	tumor tumors tumor_growth mice treatment tun	tumor, tumors, cancer, tumor_growth, targeting	tumor regression, tumor burden, tumor progres	
0.85	695	core statistical projects biostatistics investigat	core, biostatistics, data_management, bioinform	biostatistics core, projects core, data_manager	
0.79	603	intervention interventions program prevention p	intervention, prevention, interventions, program	randomized_controlled trial, intervention reduce	

<https://app.nihmaps.org>

NIH TOPIC MAPS

A Topic Database of NIH-Funded Grants

NIH Topic Browser

Show Map Viewer ?

Export Data

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Feedback

Topics by NIH Institute

Topics by Category

2009

?

add

delete

AND

Exact Text

cancer

Search

Clear Search

2009 Grants (137)

Institutes (9)

Col	NIH Inst	Project/Subprojec	Title	Investigator(s)	# 1 Topic	# 1 Topic Word	NIH Inst	# Grants	Count
	NCRR	3P20RR011792-10S2 6914	OBESITY, INSULIN RESISTANCE, IGF'S, AND BREAST CANCER RISK IN AFRICAN AMERICANS	CUI, YONG	686 (50%)	cancer brea...	NCI	116	116
	NCI	3R01CA120562-03S1	Commonly Used Medications and Breast Cancer Recurrence	BOUDREAU, DENISE M	686 (42%)	cancer brea...	NCRR	10	10
	NCI	5R01CA120562-03	Commonly Used Medications and Breast Cancer Recurrence	BOUDREAU, DENISE M	686 (42%)	cancer brea...	NIHHS	5	5
	NCI	5R01CA093772-06	Long-term Survivorship in Older Women with Early Stage Breast Cancer	SILLIMAN, REBECCA A	686 (42%)	cancer brea...	NCMHD	1	1
	NCI	5R01CA064277-11	Shanghai Breast Cancer Study	ZHENG, WEI	686 (41%)	cancer brea...	NIA	1	1
							NCCAM	1	1
							NIHCHD	1	1
							NIHNR	1	1
							NHGRI	1	1

Topics

Similar Grants

Show Top 100 on Map

%	Topic	Topic Words	Title Words	Similar	C	NIH Inst	Grant
25.91	686	cancer breast	cancers cancer_risk cancer_patients	6.51	NCI	1R01CA129639-01A2	Genome-Wide Association Study of Radiation Exposure and Bilateral Breast Cancer PI: BERNSTEIN, JONINE LISA
3.86	437	risk risk_factors cases cohort prospective high_ris	risk, risk_factors, v	6.46	NCI	1K07CA136758-01A1	Genetic variants in the PI3K pathway in mammographic density and breast cancer PI: THOMPSON, CHERYL L.
3.76	544	snps snp genome_wide_association cases genes	genome_wide_ass	6.31	NCI	5P50CA116199-05	UTMDACC SPORE in Breast Cancer PI: HORTOBAGYI, GABRIEL N.
3.70	173	genetic genes risk susceptibility polymorphisms g	genetic, genetics, tre	6.02	NCI	2R01CA050385-21A1	Risk Factors for Breast Cancer in Younger Nurses PI: WILLETT, WALTER C.
2.62	252	treatment patients management patient outcom	management, tre	4.6	NCI	5R01CA127617-02	Who Cares For Older Breast Cancer Survivors And How Does It Affect Quality? PI: MANDELBLATT, JEANNE
1.64	235	conference meeting workshop symposium scienti	th, conference, sy				
1.63	351	community implementation community_based he	community, preve				
1.54	325	million disease treatment united_states public_h	disease, treatmen				
1.51	580	training candidate career skills applicant program	treatment, depres				

<https://app.nihmaps.org>

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NIH TOPIC MAPS

A Topic Database of NIH-Funded Grants

3P20RR011792-10S2 6914

Map Viewer

Topic Browser

Export Data

Methods

Feedback

2009 NCRR CUI, YONG

NIH RePORTer

Map Similar Grants

Highlight on Map

Show Parent/Other Subs

OBESITY, INSULIN RESISTANCE, IGF'S, AND BREAST CANCER RISK IN AFRICAN AMERICANS

The purpose of this study is to better understand how lifestyle factors and their interaction with genetic factors influence a women's risk of developing breast cancer. In order to learn more about the causes of breast cancer, we need to compare the lifestyles of people who have breast cancer with those who do not. 600 women are expected to be enrolled.

Top Topics

50.00	686	cancer breast	cancers cancer_risk cancer_patients women cancer_surviv
11.54	378	african_american white ethnic racial african_americans black race white	
11.54	548	obesity weight bmi obese overweight weight_loss body_mass_index kg	

Tags

NIH Reporting Categories

Breast Cancer... Cancer... Obesity

NIH Concept Keywords

African American... cancer risk... Clinical Research... Computer Retrieval of Information on

Similar Grants

Similar	Co	NIH Inst	Project/Subprojec	Title	Investigator(s)	# 1 Topic	# 1 Topic Word
0.54		NCI	3K22CA127519-03S1	Beyond Adiposity: Insulin and Inflammation in Postmenopausal Breast Cancer	NUNEZ, NOMELI PANIAGUA	686 (33%)	cancer breast...
0.54		NCI	5K22CA127519-03	Beyond Adiposity: Insulin and Inflammation in Postmenopausal Breast Cancer	NUNEZ, NOMELI PANIAGUA	686 (33%)	cancer breast...
0.48		NCI	5R01CA128799-02	Mechanisms for Increased Breast Cancer Risk in Type 2 Diabetes	LEROITH, DEREK	66 (17%)	diabetes diab...
0.48		NCI	3P30CA013696-36S2 0007	BREAST CANCER RESEARCH	PARSONS, RAMON E	210 (40%)	cancer cancer...
0.48		NCI	3P30CA013696-36S3 0007	BREAST CANCER RESEARCH	PARSONS, RAMON E	210 (40%)	cancer cancer...

<https://app.nihmaps.org>

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NIH TOPIC MAPS

NIH Map Viewer Show Topic Browser ? Export Data Methods Feedback

2009 ? add delete AND Related Grants 7960745 Top 100 Search Clear Search

Institutes (3) ?

NIH Inst	#Grants	Count	+
NCI	94		
NCRB	6		
NCMHD	1		

Topics ?

%	Title Words	+
14.7%	breast, cancer, cancer_risk, women, cancer_sui	
11.0%	breast, mammography, mammographic, canc	
9.60%	risk, risk_factors, cancer, prospective, women,	
3.23%	genome_wide_association, lod, genome_wide,	

Grants (101) ?

NIH Inst	Grant	+
NCRB	3P20RR011792-10S2 6914 OBESITY, INSULIN RESISTANCE, IGF'S, AND BREAST CANCER RISK IN AFRICAN AMERICANS P1: CUI, YONG	
NCI	5R01CA120562-03S1 Commonly Used Medications and Breast Cancer Recurrence PI: BOUDREAU, DENISE M	
NCI	5R01CA120562-03 Commonly Used Medications and Breast Cancer Recurrence PI: BOUDREAU, DENISE M	
NCI	5R01CA093772-06 Long-term Survivorship in Older Women with Early Stage Breast	

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R+D Dashboard BETA Tracking our progress. Leading the world in scientific and technological innovation.

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Publications
Discover Publications by clicking on map or using the options below.

Illinois ▼
National Science Foundation ▼
Year(s): 2000-2009

Refine results by selecting institutions or topics:

Top Research Institutions

Top Topics

- climate model atmospheric data global
- flow fluid transport wave dynamic
- optical laser light high system
- economic policy market decision public**
- technology engineering team technologies

Download selected data as CSV

USA View Highlight selected area Map ▼

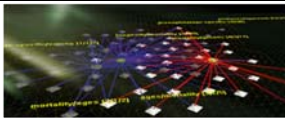
Year	Publication Number	Grant Number	Federal Agency	Receiving Institution
2009	PUB 5767715	0848647	NSF	American Bar Foundation

Map data ©2011 Europa Technologies, Google, INEGI - Terms of Use

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S&T Studies Using Semantic Web Data

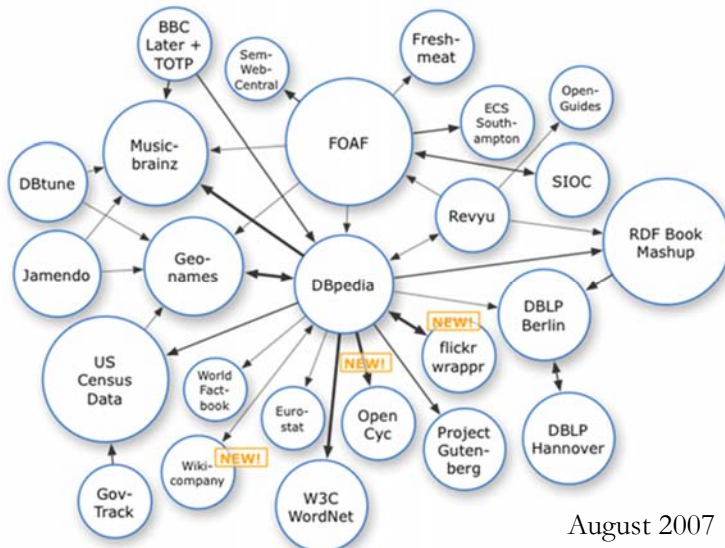
51



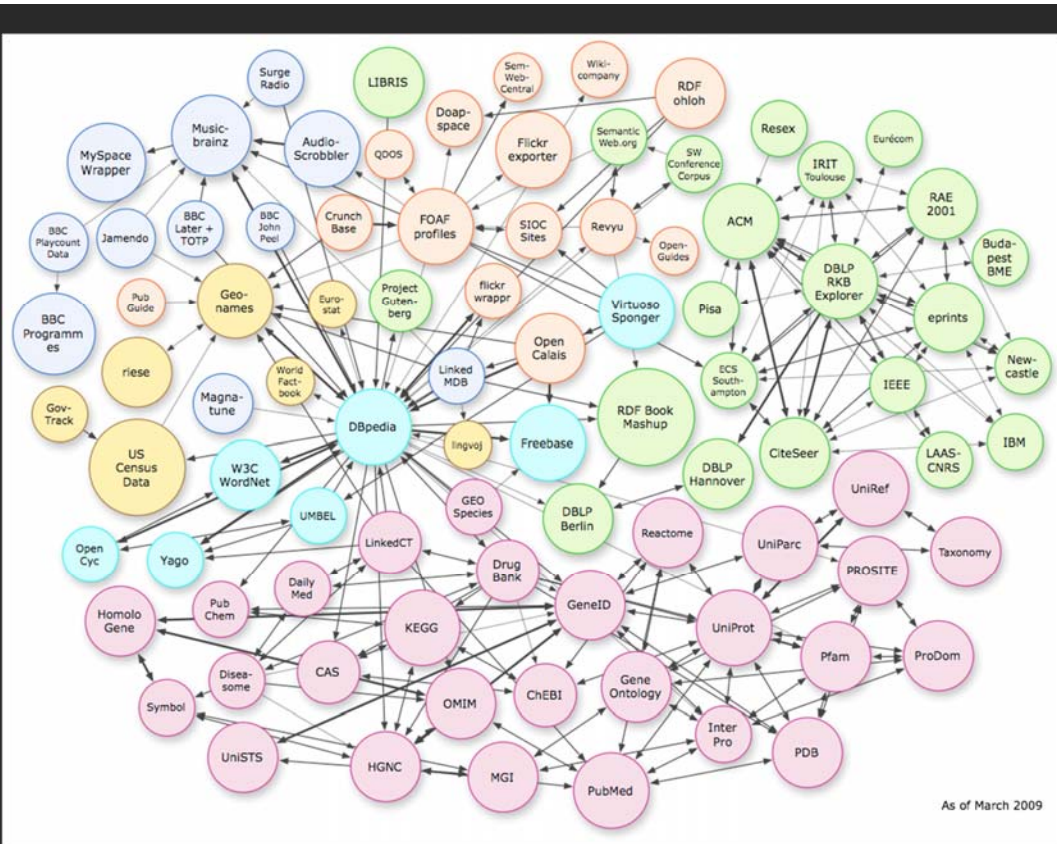
Linked Open Data

- Interlinking existing data silos and
- Exposing them as structured data
- Adding new high quality data relevant for S&T studies

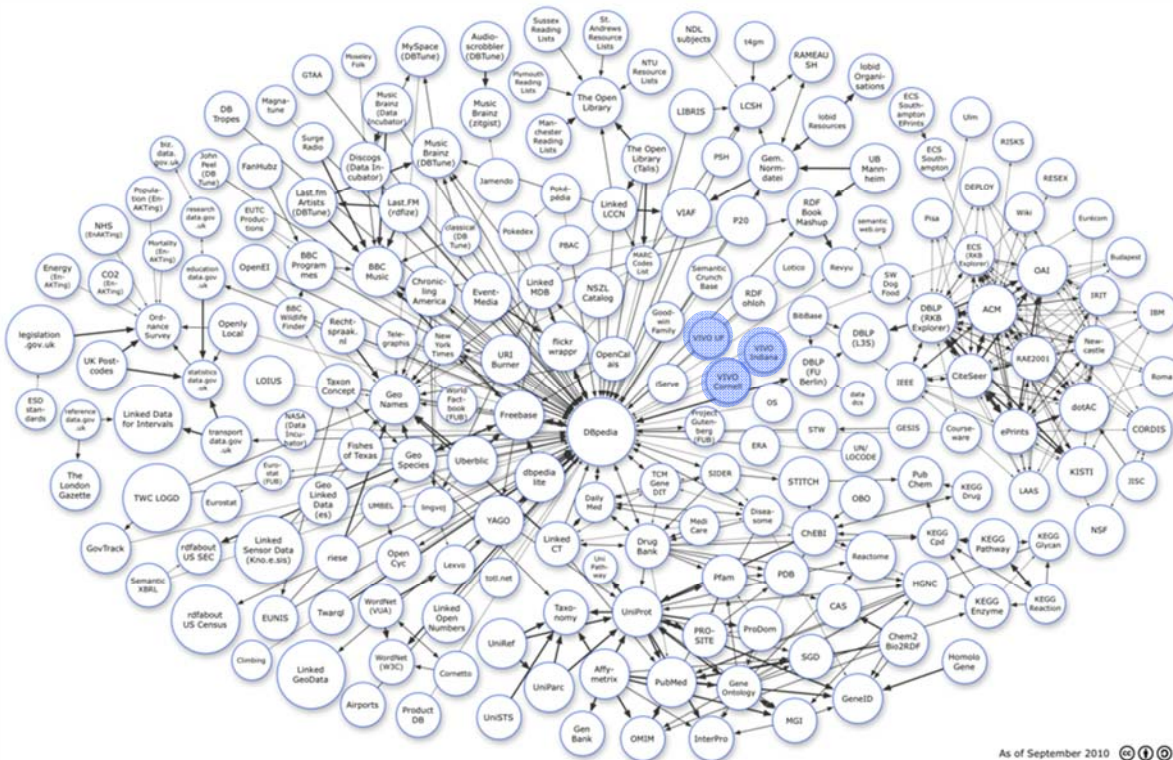
<http://linkeddata.org>



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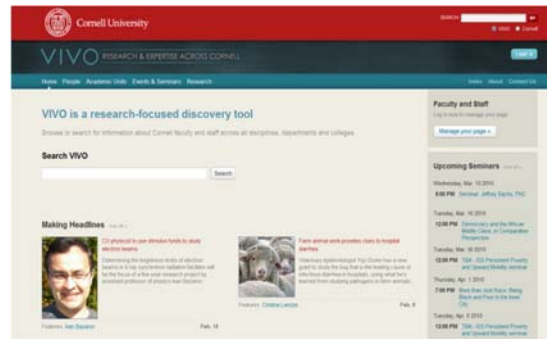


http://www4.wiwiss.fu-berlin.de/bizer/pub/lod-datasets_2009-03-05_colored.png



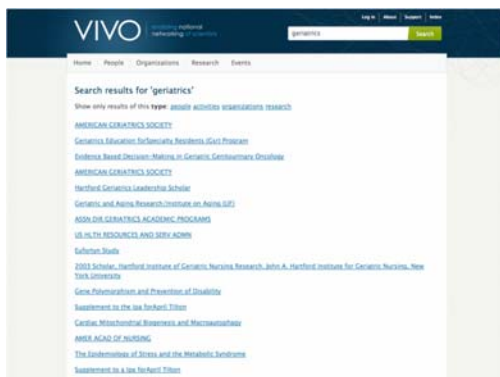
VIVO: A Semantic Approach to Creating a National Network of Researchers (<http://vivoweb.org>)

- Semantic web application and ontology editor originally developed at Cornell U.
- Integrates research and scholarship info from systems of record across institution(s).
- Facilitates research discovery and cross-disciplinary collaboration.
- Simplify reporting tasks, e.g., generate biosketch, department report.



Funded by \$12 million NIH award.

Cornell University: Dean Krafft (Cornell PI), Manolo Bevia, Jim Blake, Nick Cappadona, Brian Caruso, Jon Corson-Rikert, Elly Cramer, Medha Devare, John Ferreira, Brian Lowe, Stella Mitchell, Holly Mistlebauer, Anup Sawant, Christopher Westling, Rebecca Younes. **University of Florida:** Mike Conlon (VIVO and UF PI), Cecilia Botero, Kerry Britt, Erin Brooks, Amy Buhler, Ellie Bushhousen, Chris Case, Valrie Davis, Nita Ferree, Chris Haines, Rae Jesano, Margeaux Johnson, Sara Kreinest, Yang Li, Paula Markes, Sara Russell Gonzalez, Alexander Rockwell, Nancy Schaefer, Michele R. Tennant, George Hack, Chris Barnes, Narayan Raum, Brenda Stevens, Alicia Turner, Stephen Williams. **Indiana University:** Katy Borner (IU PI), William Barnett, Shanshan Chen, Ying Ding, Russell Duhon, Jon Dunn, Micah Linnemeier, Nianli Ma, Robert McDonald, Barbara Ann O'Leary, Mark Ping, Yuyin Sun, Alan Walsh, Brian Wheeler, Angela Zoss. **Ponce School of Medicine:** Richard Noel (Ponce PI), Ricardo Espada, Damaris Torres. **The Scripps Research Institute:** Gerald Joyce (Scripps PI), Greg Dunlap, Catherine Dunn, Brant Kelley, Paula King, Angela Murrell, Barbara Noble, Cary Thomas, Michaelen Trimarchi. **Washington University, St. Louis:** Rakesh Nagarajan (WUSTL PI), Kristi L. Holmes, Sunita B. Koul, Leslie D. McIntosh. **Weill Cornell Medical College:** Curtis Cole (Weill PI), Paul Albert, Victor Brodsky, Adam Cheriff, Oscar Cruz, Dan Dickinson, Chris Huang, Itay Klaz, Peter Michelini, Grace Migliorisi, John Ruffing, Jason Specland, Tru Tran, Jesse Turner, Vinay Varughese.





Type of Analysis vs. Level of Analysis

	<i>Micro/Individual</i> (1-100 records)	<i>Meso/Local</i> (101-10,000 records)	<i>Macro/Global</i> (10,000 < records)
Statistical Analysis/Profiling	Individual person and their expertise profiles	Larger labs, centers, universities, research domains, or states	All of NSF, SA, all of sci
Temporal Analysis (When)	Funding portfolio of one individual	Research bursts of PNAS	113 Years of P Research
Geospatial Analysis (Where)	Career trajectory of one individual	Mapping a s intellectual l	PNAS
Topical Analysis (What)		research	VxOrd/Topic r NIH funding
Network Analysis (With Whom?)	NSI network of one		NIH's cy

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University of Florida

How do you want to compare?
by Grants

Who do you want to compare?
Search: X

Records 1 - 10 of 30

Entity Label	Grant Count	Entity Type
<input checked="" type="checkbox"/> Continuing Education	562	UF Department, Agent, Non-Academic Department, Department
<input checked="" type="checkbox"/> Florida Museum of Natural History	203	Museum, Agent
<input checked="" type="checkbox"/> College of Agricultural and Life Sciences	166	Agent, UF College, College
<input checked="" type="checkbox"/> College of Engineering	103	Agent, UF College, College
<input checked="" type="checkbox"/> Evelyn F. and William L. McKnight Brain Institute of the University of Florida	64	UF Center, Agent, Center
<input checked="" type="checkbox"/> International Center	54	UF Department, Agent, Non-Academic Department, Department
<input checked="" type="checkbox"/> Florida Sea Grant	44	UF Center, Agent, Center
<input type="checkbox"/> Whitney Laboratory for Marine Bioscience	42	UF Research Laboratory, Agent, Laboratory, Research Laboratory
<input type="checkbox"/> Water Institute	38	UF Center, Agent, Center
<input type="checkbox"/> College of Dentistry	35	Agent, UF College, College

Save as CSV Clear

VIVO
Enabling a National Network of Scientists

Comparing Grants of Organizations in University of Florida

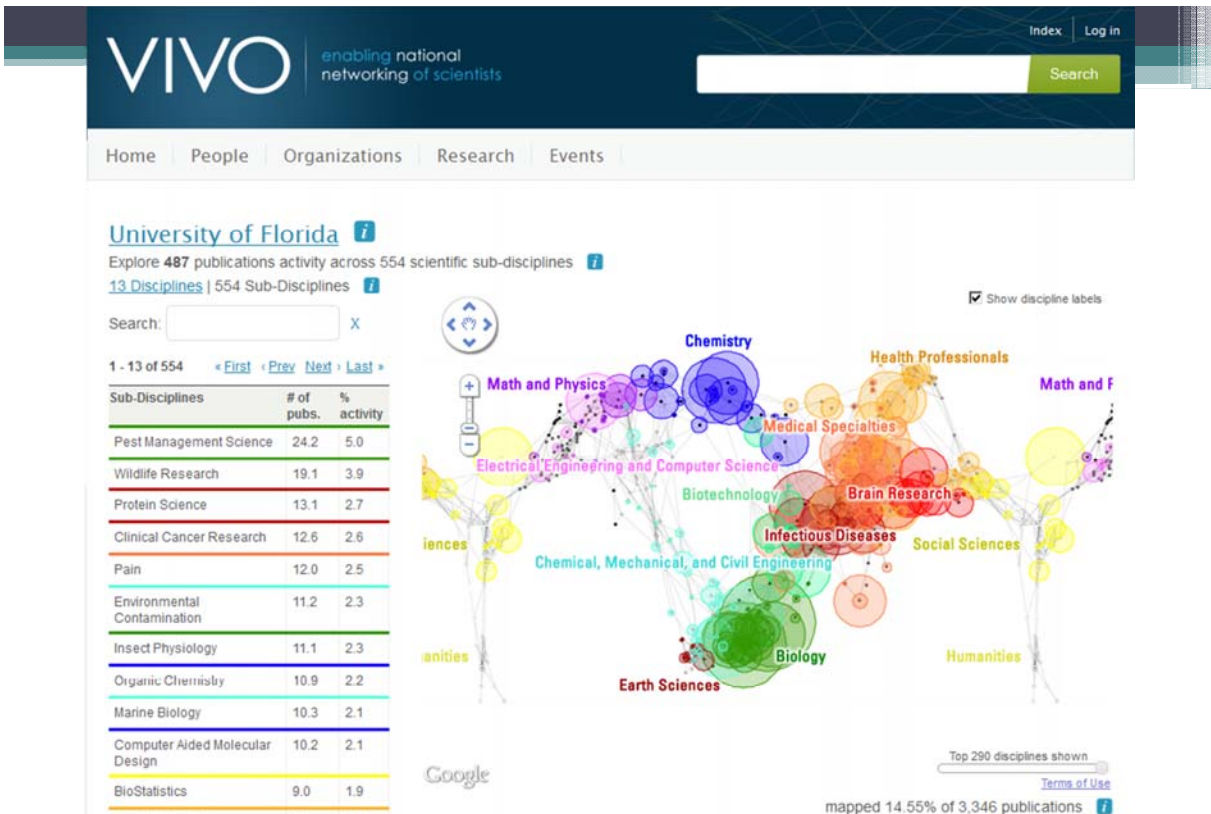
Total Number of Grants

You have selected 7 of a maximum 10 organizations to compare. Clear

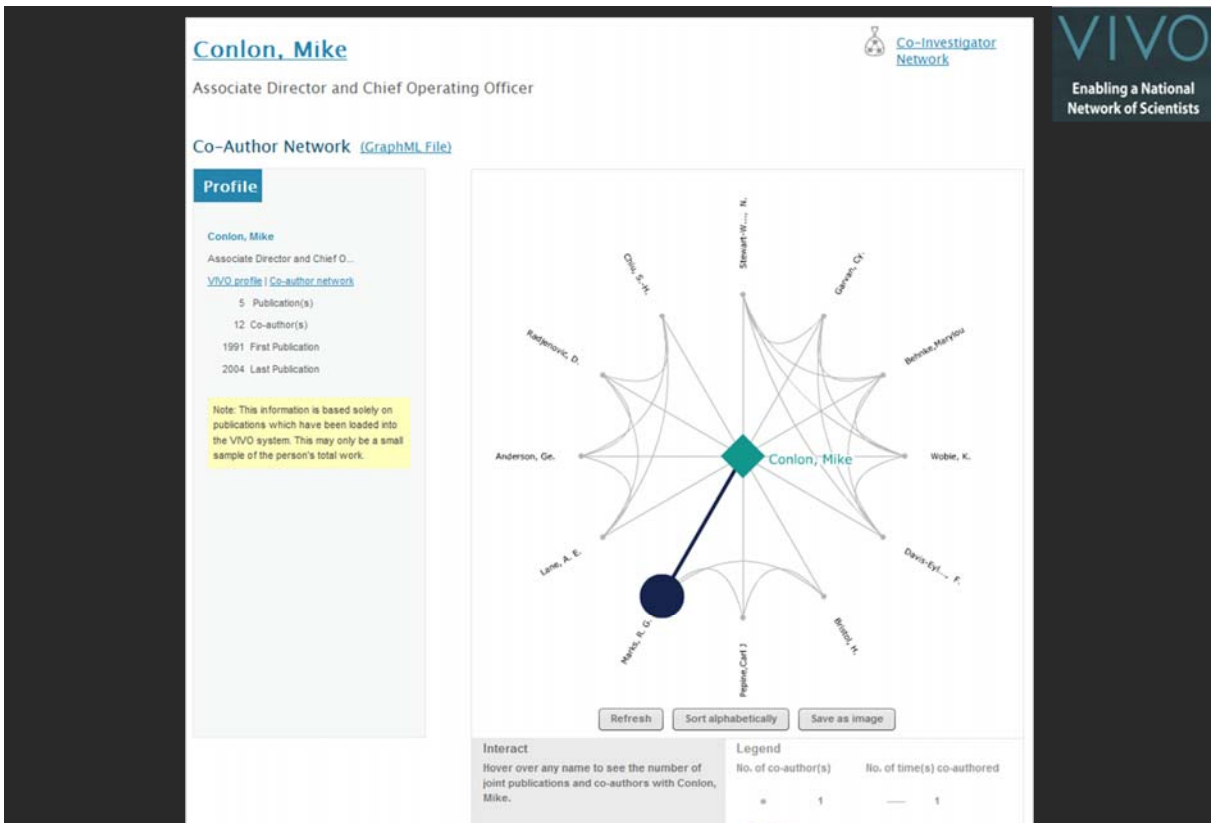
- Florida Sea Grant 44
- International Center 54
- Evelyn F. and William L. McKnight Brain Institute of the University of Florida 64
- College of Engineering 103
- College of Agricultural and Life Sciences 166
- Florida Museum of Natural History 203
- Continuing Education 562

Temporal Analysis (When) Temporal visualizations of the number of papers/funding award at the institution, school, department, and people level

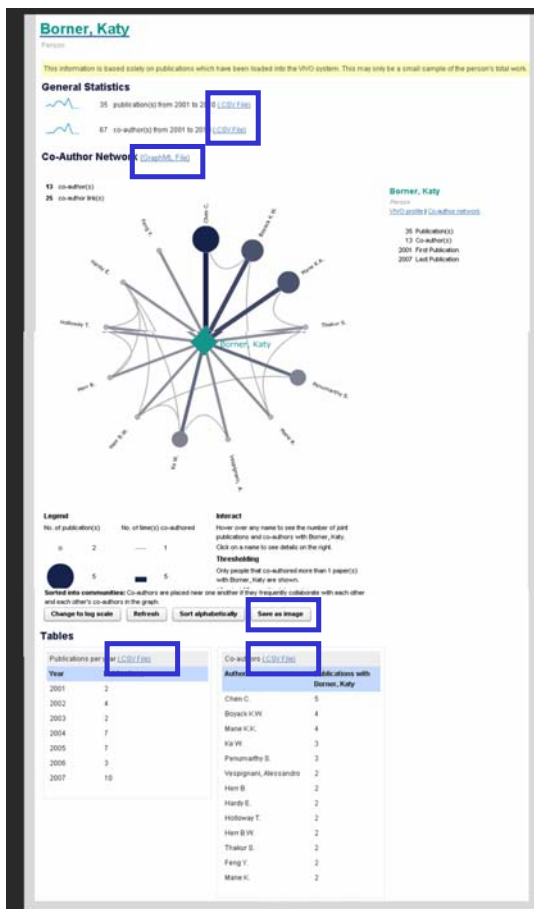
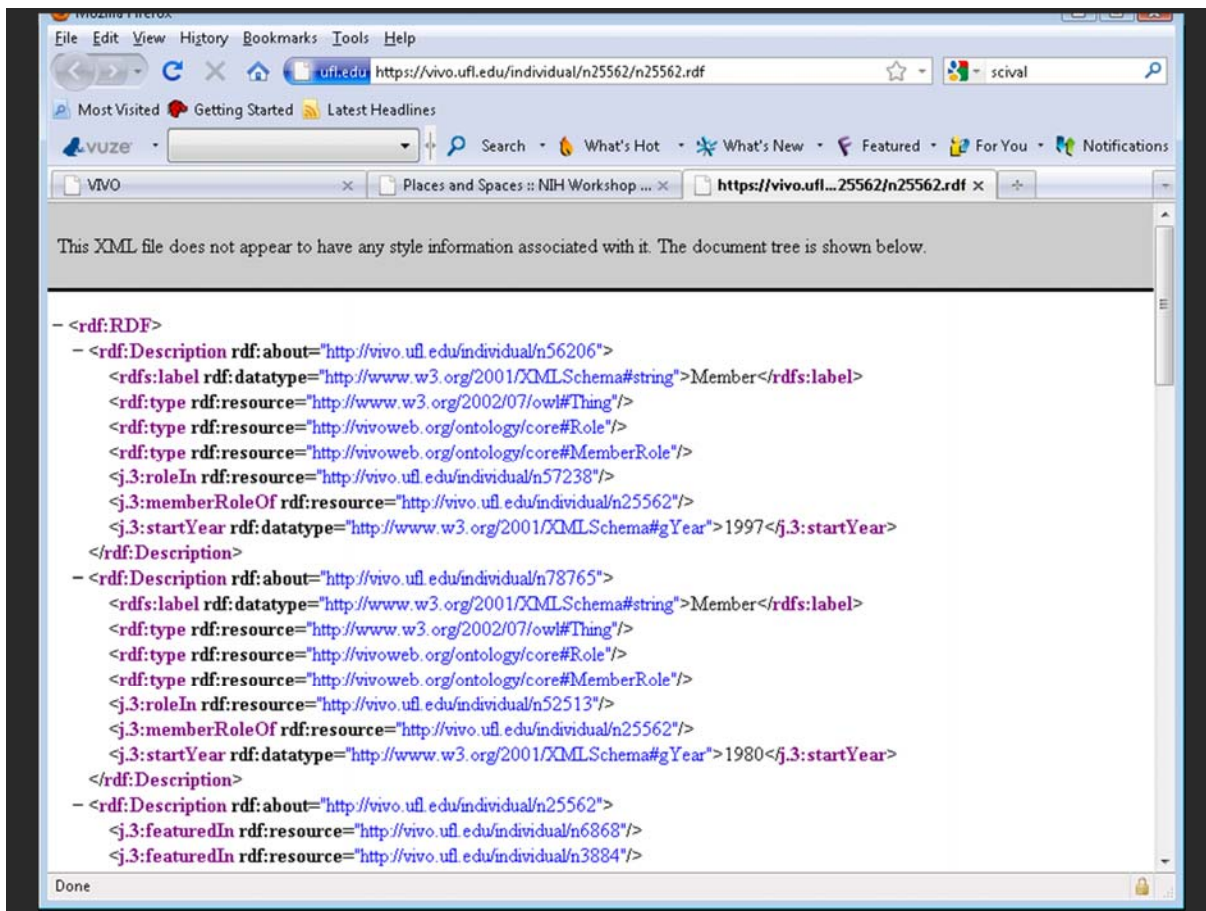
58



Topical Analysis (What) Science map overlays will show where a person, department, or university publishes most in the world of science. (in work)



Network Analysis (With Whom?) Who is co-authoring, co-investigating, co-inventing with whom? What teams are most productive in what projects?



Data Download Support

General Statistics

- 36 publication(s) from 2001 to 2010 [\(.CSV File\)](#)
- 80 co-author(s) from 2001 to 2010 [\(.CSV File\)](#)

Co-Author Network

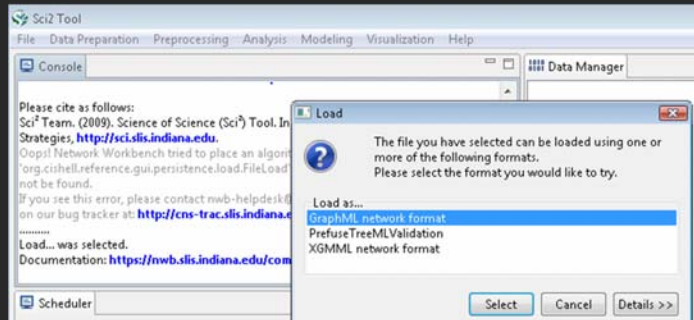
[\(GraphML File\)](#)

Save as Image (.PNG file)

Tables

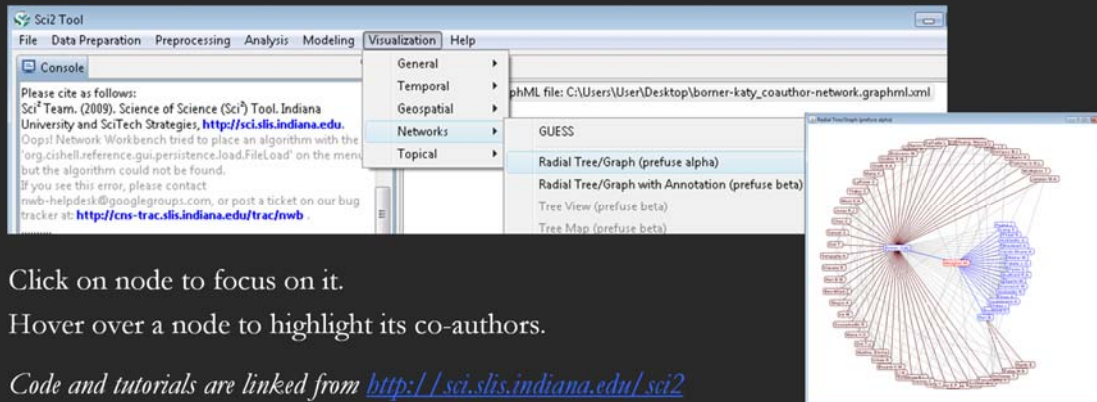
- Publications per year [\(.CSV File\)](#)
- Co-authors [\(.CSV File\)](#)

Run Science of Science (Sci2) Tool and load Co-Author Network ([GraphML File](#))



Network Analysis Toolkit
Nodes: 81
Edges: 390

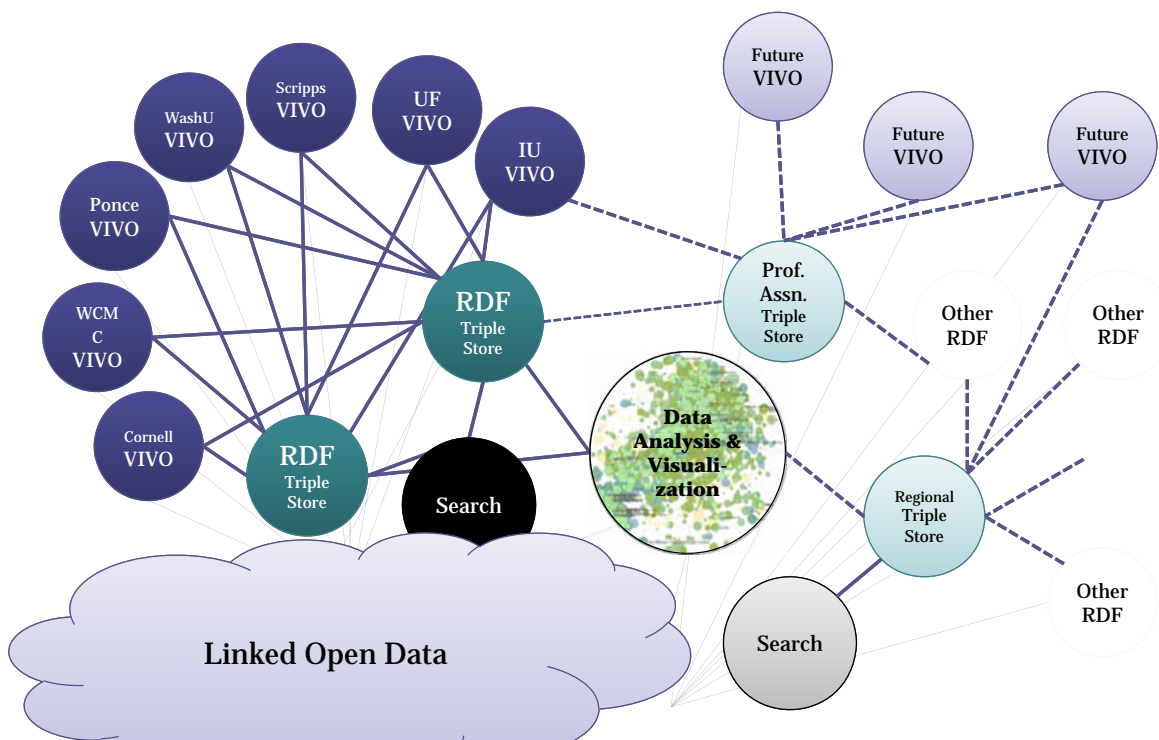
Visualize the file using Radial Graph layout.



Click on node to focus on it.
Hover over a node to highlight its co-authors.

Code and tutorials are linked from <http://sci.slis.indiana.edu/sci2>

VIVO National Level Visualizations



National Researcher Networking Visualization 1.0

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Second Annual VIVO Conference

August 24-26, 2011

Gaylord National, Washington D.C.

<http://vivoweb.org/conference>



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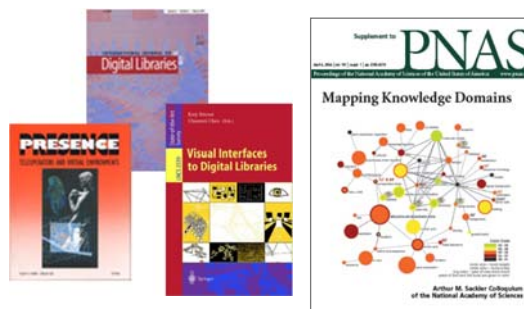
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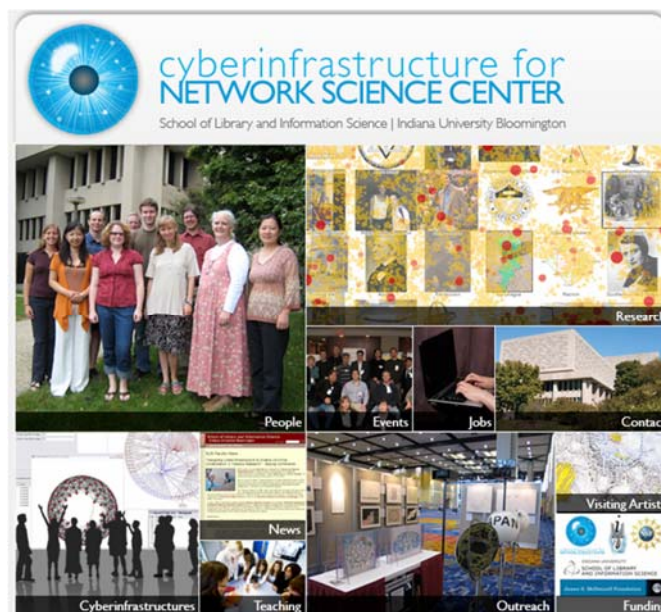
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All papers, maps, tools, talks, press are linked from <http://cns.iu.edu>

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