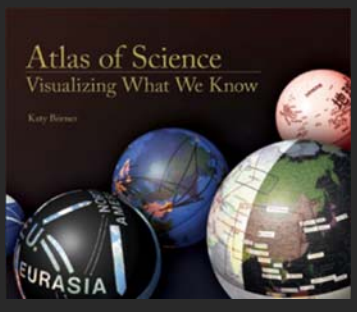
# Mining, Visualizing, and Accelerating Science and Technology

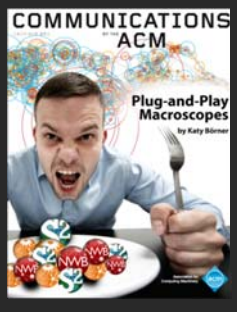
**Katy Börner**
Royal Netherlands Academy of Arts and Sciences (KNAW), The Netherlands and
Cyberinfrastructure for Network Science Center, Director
Information Visualization Laboratory, Director
School of Library and Information Science
Indiana University, Bloomington, IN
katy@indiana.edu

With special thanks to the members at the Cyberinfrastructure for Network Science Center; the Sci2, NWB, and EpiC teams; and the VIVO Collaboration

*Institut für Forschungsinformation und Qualitätssicherung , Berlin, Germany*

*Thursday June 28, 2012 • 11:00-13:00*



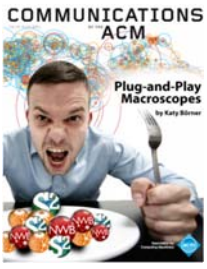




## Overview

1. **Data mining and visualization research** that aims to increase our scientific understanding of the structure and dynamics of science and technology.


2. **Novel approaches and services** that improve information access, researcher networking, and research management.

3. **Data services and plug-and-play macroscope tools** that commoditize data mining and visualization.

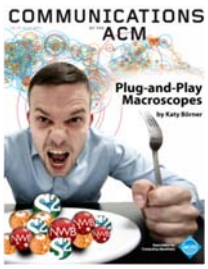


## Overview

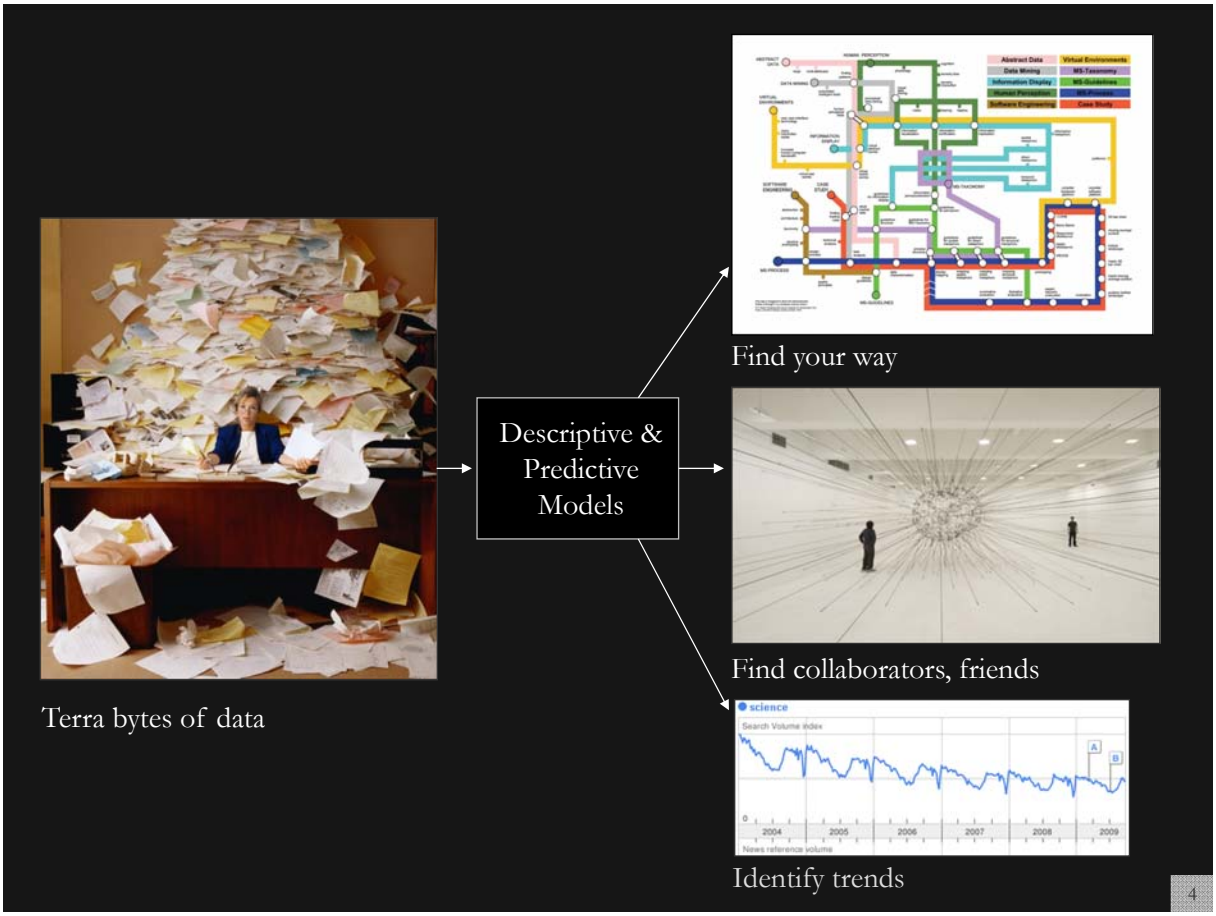
1. **Data mining and visualization research** that aims to increase our scientific understanding of the structure and dynamics of science and technology.

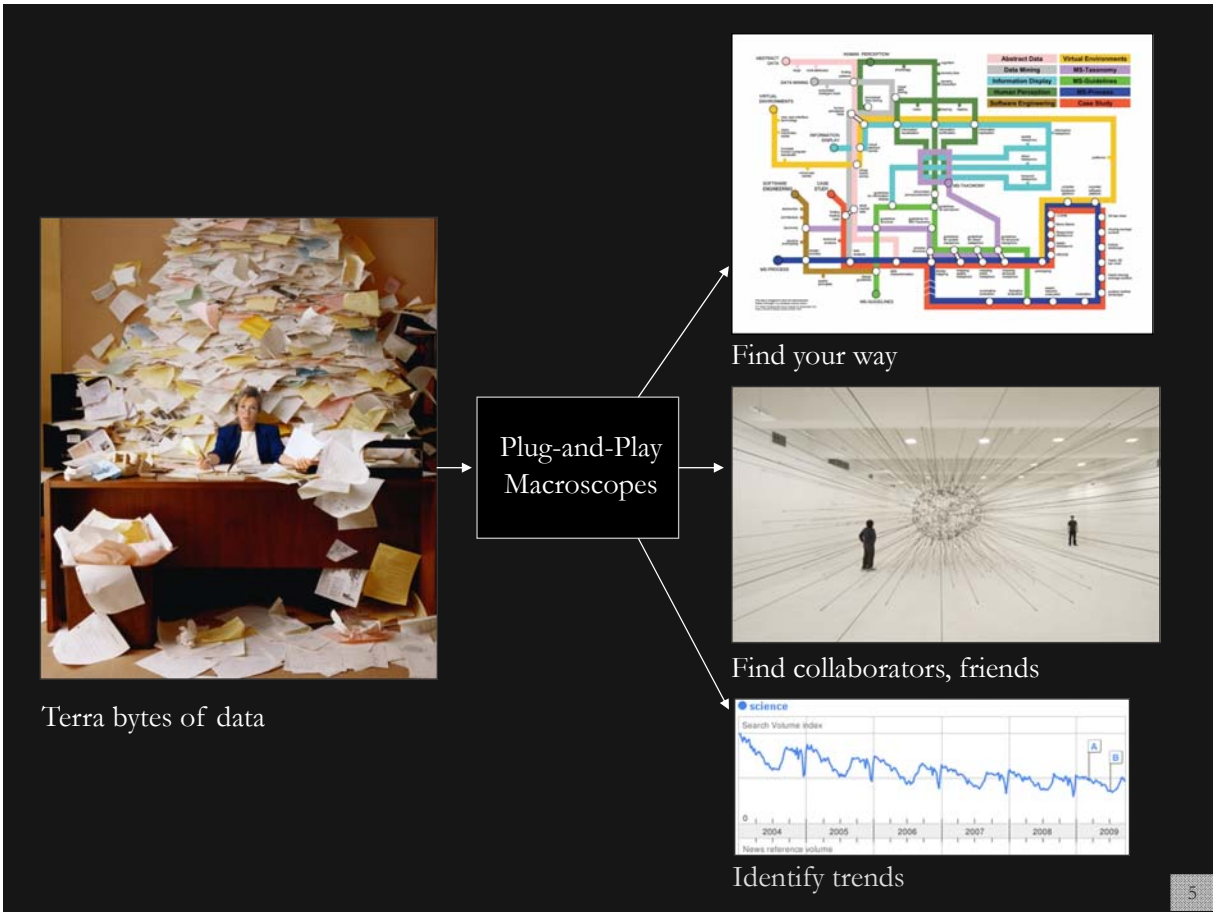

2. **Novel approaches and services** that improve information access, researcher networking, and research management.

3. **Data services and plug-and-play macroscope tools** that commoditize data mining and visualization.




cyberinfrastructure for NETWORK SCIENCE CENTER
School of Library and Information Science | Indiana University Bloomington






## 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 |

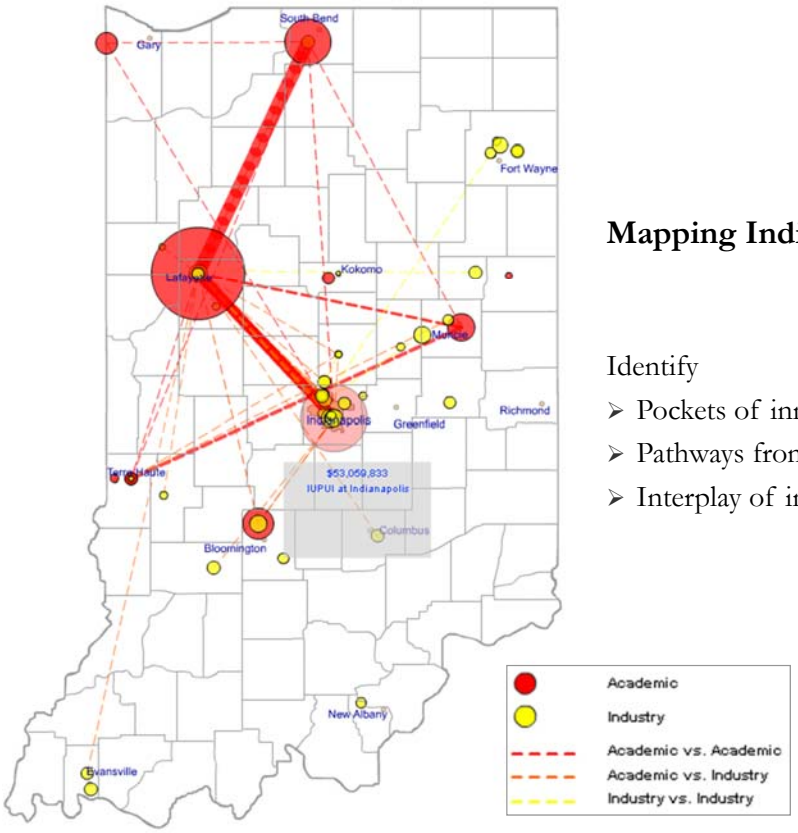
cyberinfrastructure for NETWORK SCIENCE CENTER
School of Library and Information Science | Indiana University Bloomington

## 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 NS… SA, all of sci… |
| ***Temporal Analysis (When)*** | Funding portfolio of one individual | …ic bursts …f PNAS | 113 Years of P… Research |
| ***Geospatial Analysis (Where)*** | Career trajectory of one individual | Mapping a s… intellectual l… | PNAS … |
| ***Topical Analysis (What)*** | …s. | …research | VxOrd/Topic r… NIH funding |
| ***Network Analysis (With Whom?)*** | NSF … work of one … | … | NIH's … cy |

cyberinfrastructure for NETWORK SCIENCE CENTER
School of Library and Information Science | Indiana University Bloomington





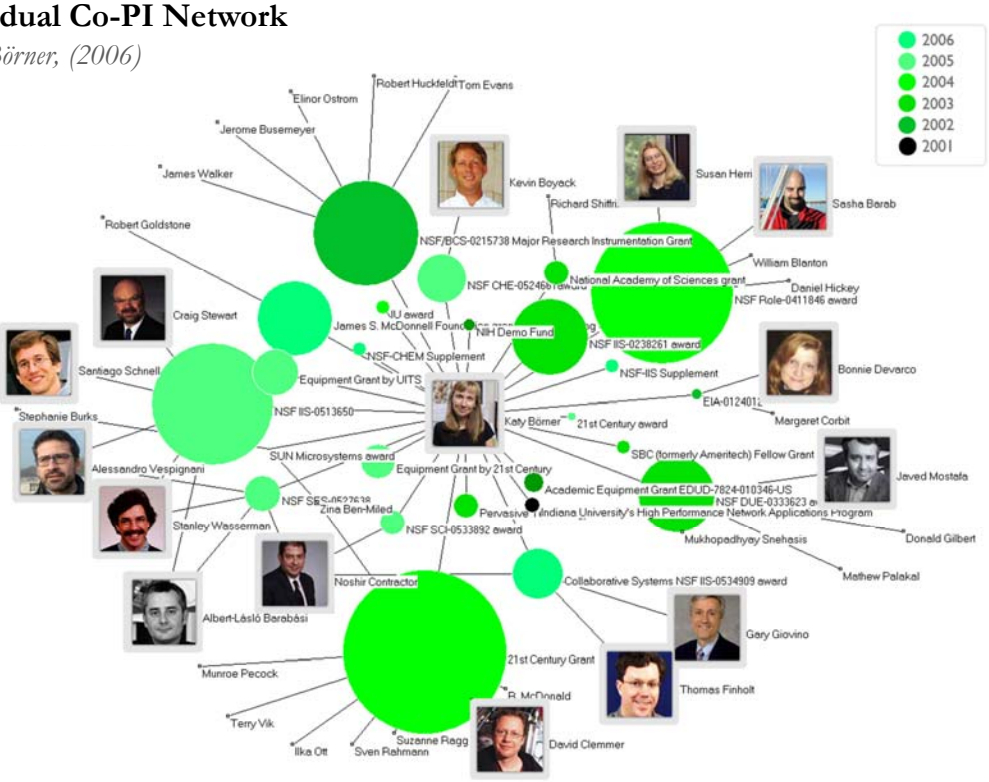

## Mapping Indiana's Intellectual Space

Identify

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

## Individual Co-PI Network

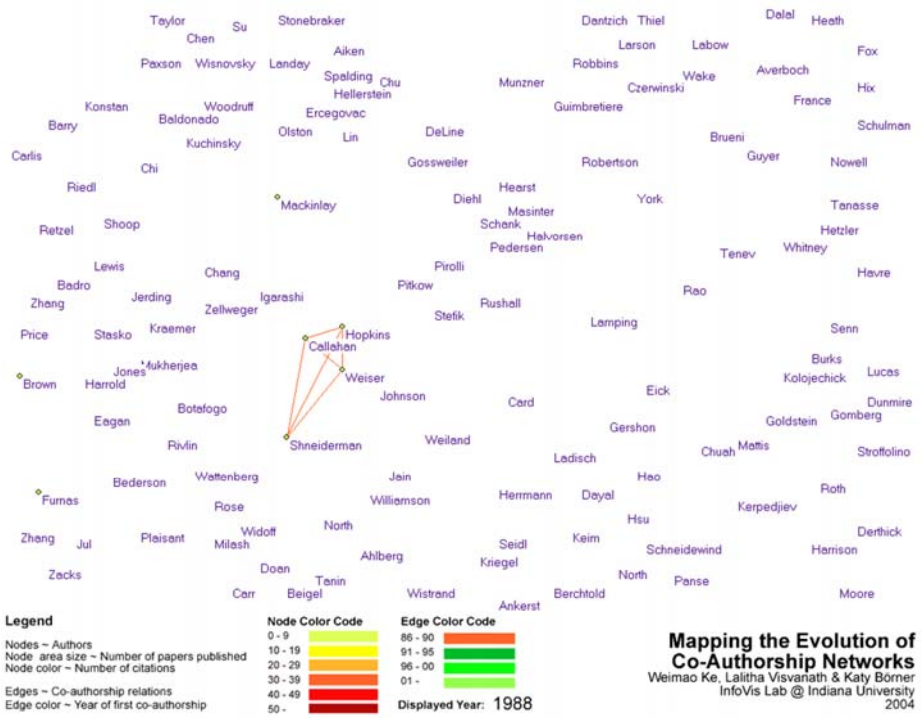
*Ke & Börner, (2006)*





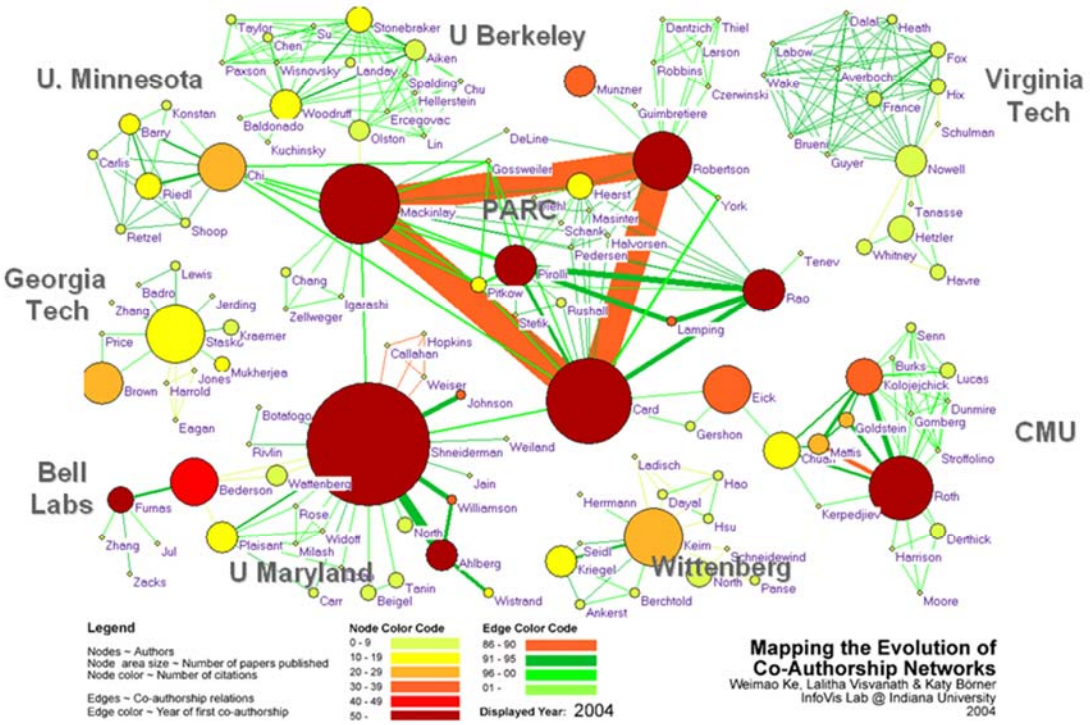

## Mapping the Evolution of Co-Authorship Networks

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



## Mapping the Evolution of Co-Authorship Networks

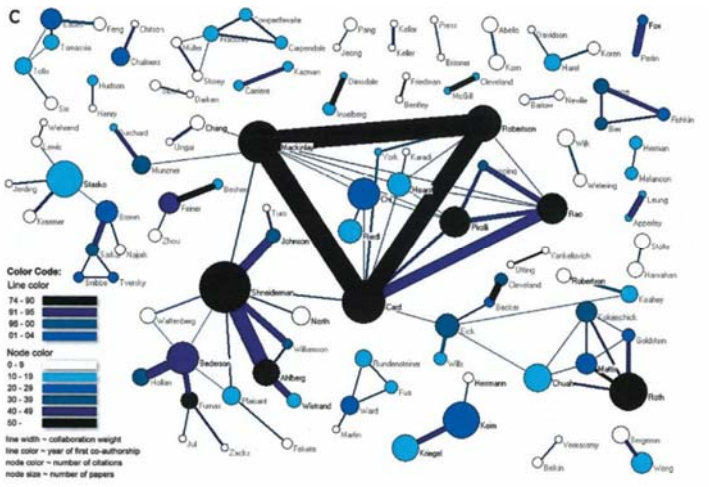
*Ke, Visvanath & Börner, (2004) Won 1st price at the IEEE InfoVis Contest*






## 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:**

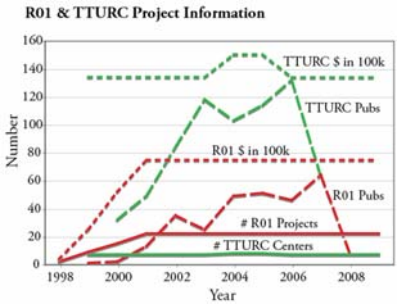
- New approach to allocate citational credit.
- Novel weighted graph representation.
- Visualization of the growth of weighted co-author network.
- Centrality measures to identify author impact.
- Global statistical analysis of paper production and citations in correlation with co-authorship team size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

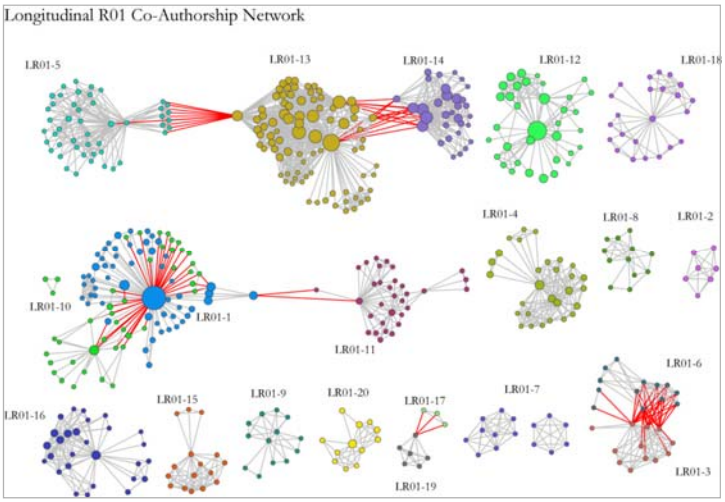
## Mapping Transdisciplinary Tobacco Use Research Centers Publications

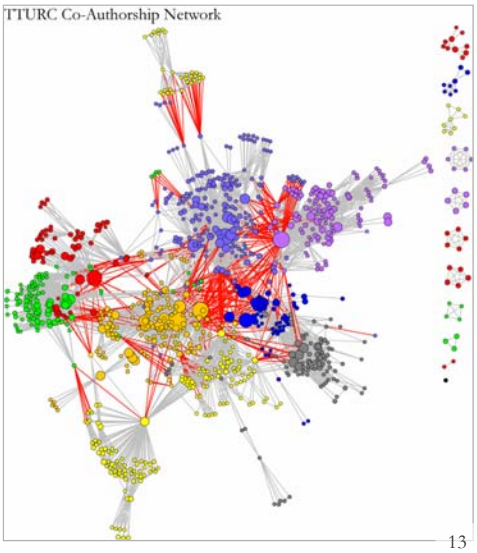
Compare R01 investigator based funding with TTURC Center awards in terms of number of publications and evolving co-author networks.

*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.*





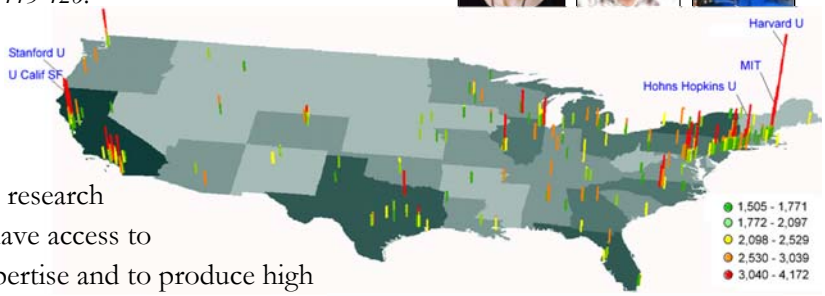
## Spatio-Temporal Information Production and Consumption of Major U.S. Research Institutions

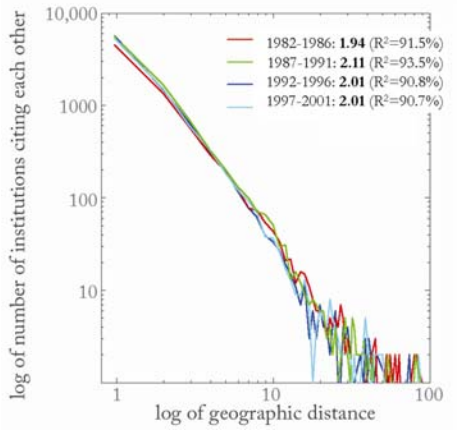


*Börner, Katy, Penumarthy, Shashikant, Meiss, Mark and Ke, Weimao. (2006) Mapping the Diffusion of Scholarly Knowledge Among Major U.S. Research Institutions. Scientometrics. 68(3), pp. 415-426.*

**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?

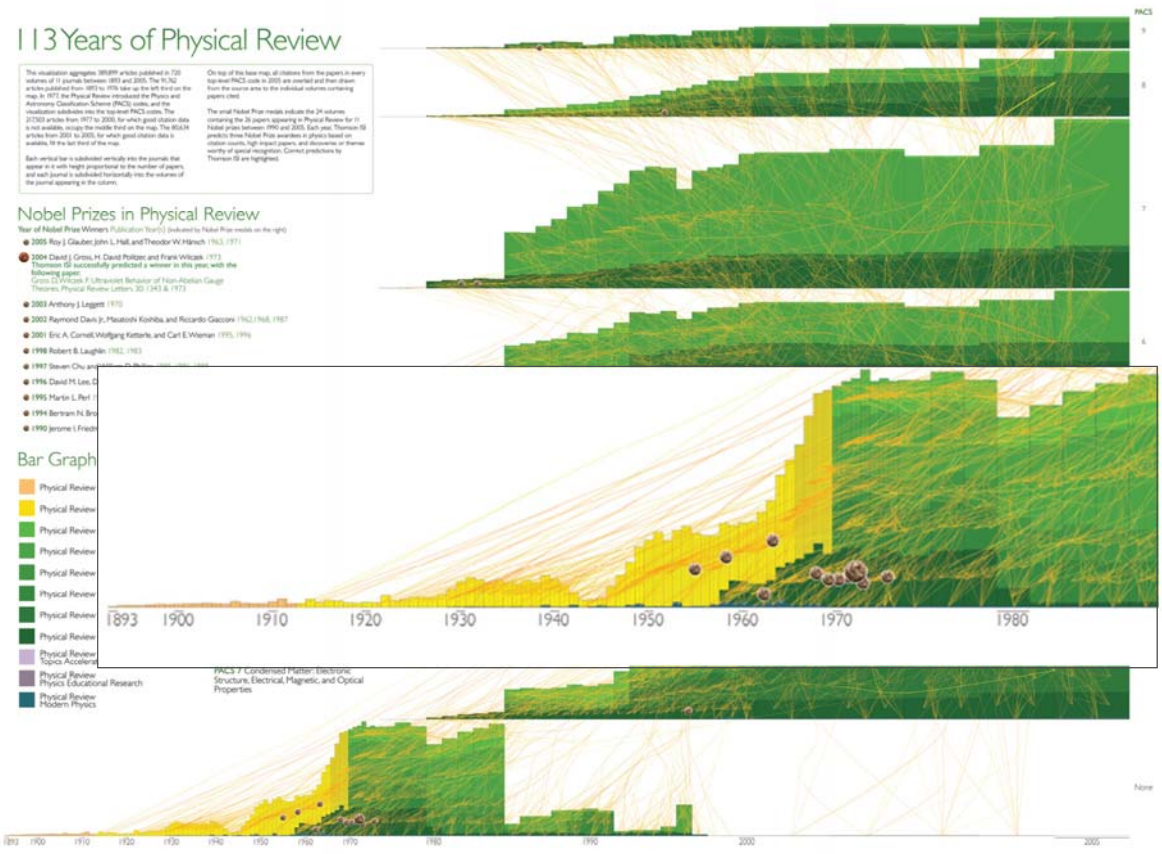



**Contributions:**

- 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

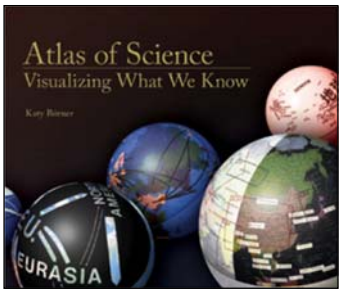
Shiffrin, Richard M. and Börner, Katy (Eds.) (2004). **Mapping Knowledge Domains**. *Proceedings of the National Academy of Sciences of the United States of America*, 101(Suppl_1).
http://www.pnas.org/content/vol101/suppl_1/

Börner, Katy, Sanyal, Soma and Vespignani, Alessandro (2007). **Network Science.** In Blaise Cronin (Ed.), *ARIST*, Information Today, Inc., Volume 41, Chapter 12, pp. 537-607.
http://ivl.slis.indiana.edu/km/pub/2007-borner-arist.pdf

Börner, Katy (2010) **Atlas of Science**. MIT Press.
http://scimaps.org/atlas

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

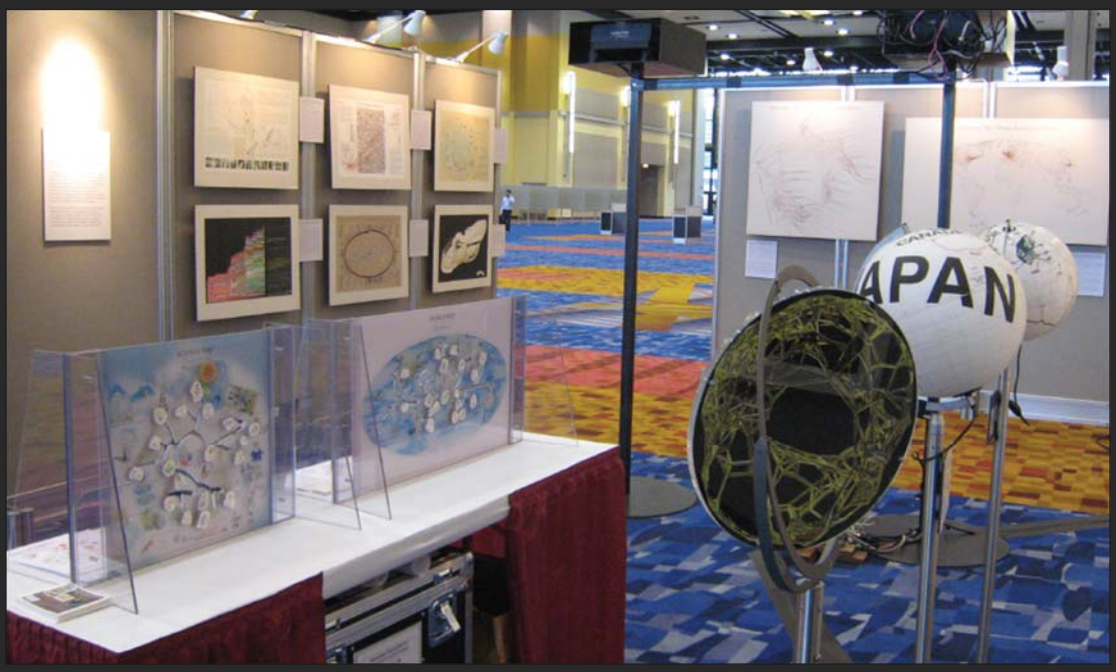





## Mapping Science Exhibit – 10 Iterations in 10 years

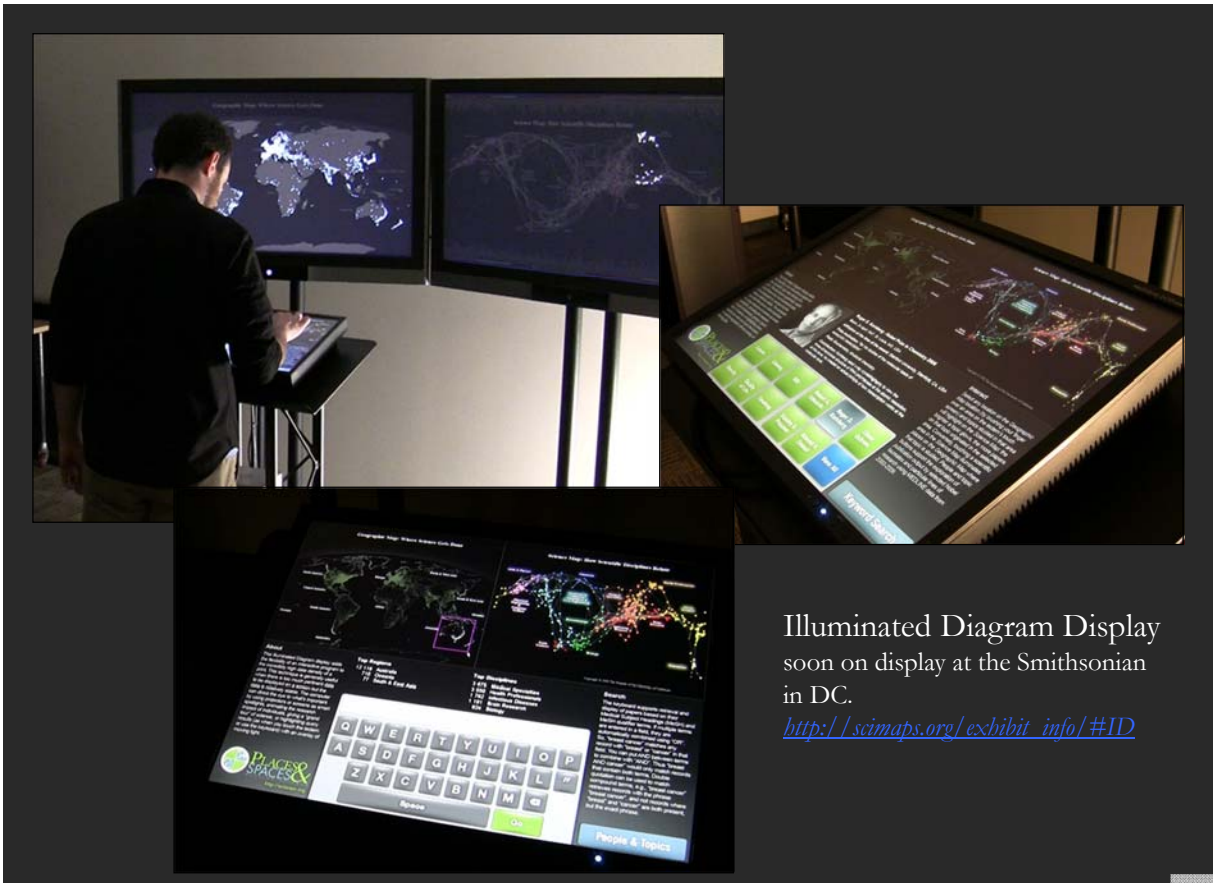
*http://scimaps.org/*



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*

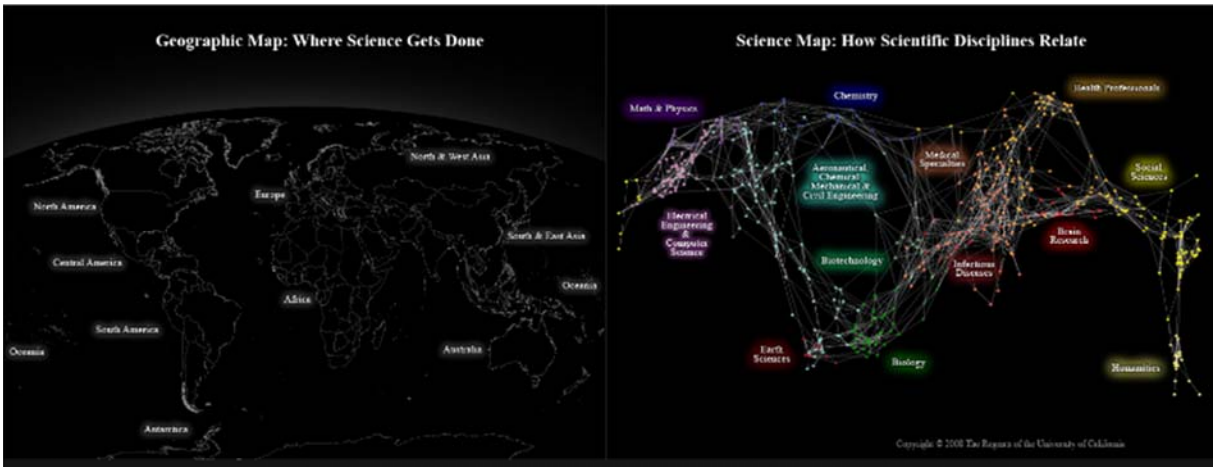



Science Maps in "Expedition Zukunft" science train visiting 62 cities in 7 months 12 coaches, 300 m long
Opening was on April 23rd, 2009 by German Chancellor Merkel
*http://www.expedition-zukunft.de*



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






## 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

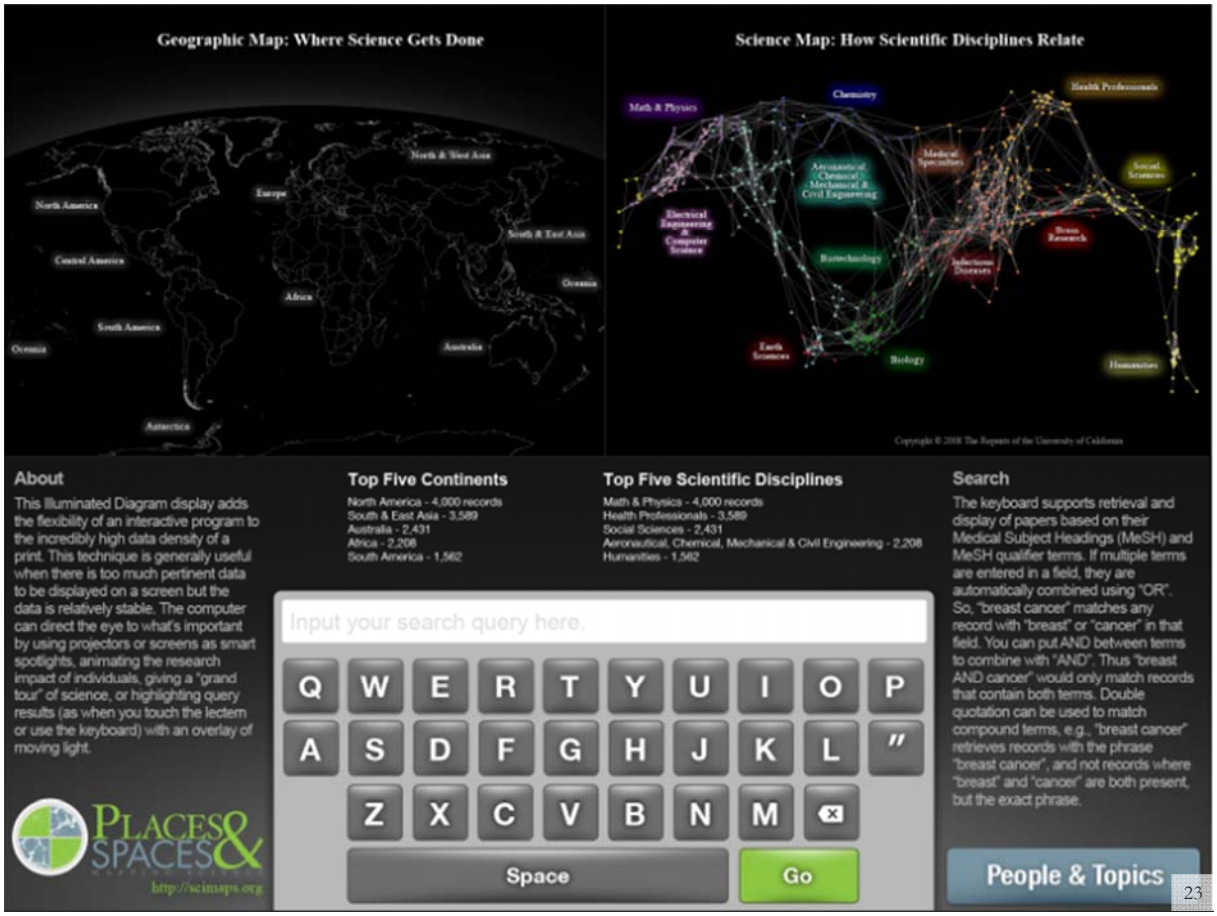
Select any location on the *Geographic Map* location (by brushing your finger over an area on the lectern's touch screen) and topics studied in that area will highlight on the *Science Map*: the brighter a topic glows, the more papers on that topic originated in the selected area. Conversely, touching 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

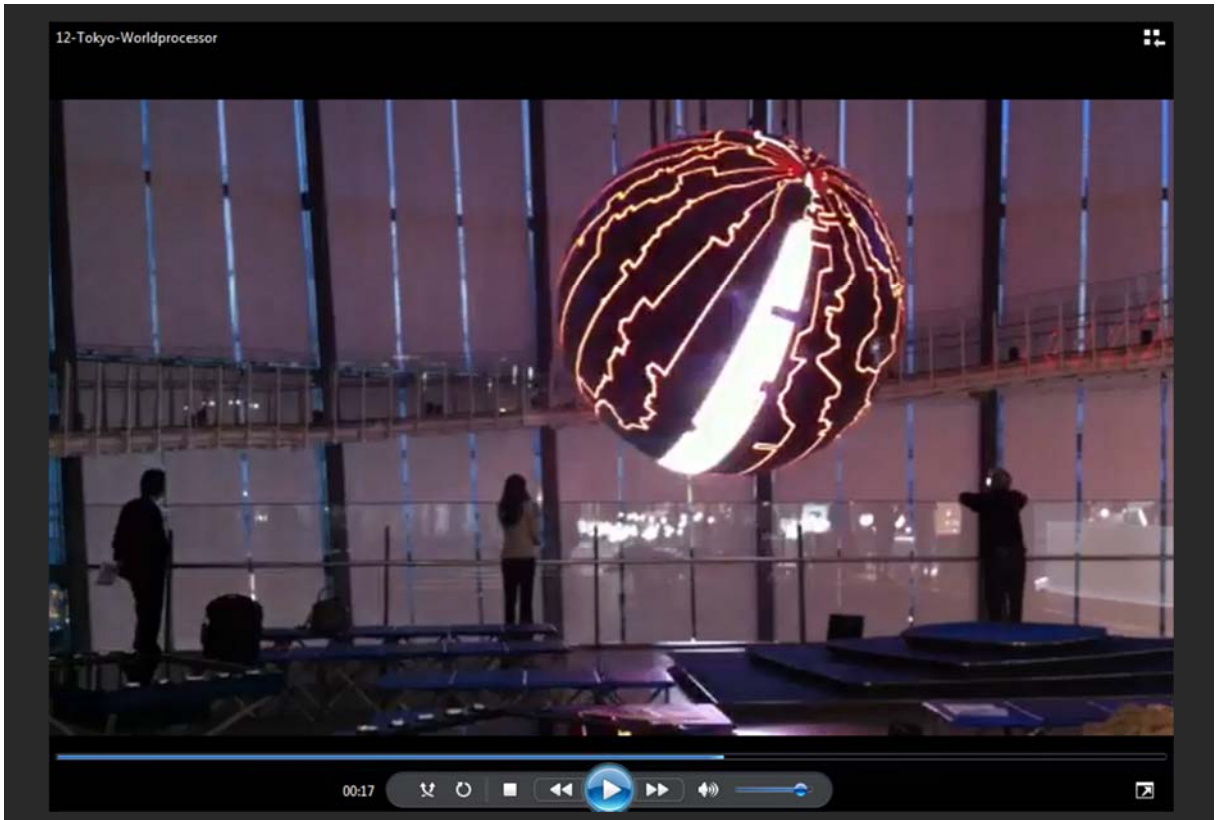
Obesity | Quality of Life | Smoking | Stanley B. Prusiner | Ahmed H. Zewail | View All

Keyword Search

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




23




Ingo Gunther's Worldprocessor globe design now on display at the Giant Geo Cosmos OLED Display at the Museum of Emerging Science and Innovation in Tokyo, Japan

24

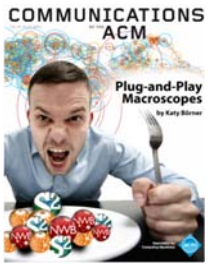

25

## Overview

1. **Data mining and visualization research** that aims to increase our scientific understanding of the structure and dynamics of science and technology.


2. **Novel approaches and data services** that improve information access, researcher networking, and research management.

3. **Data services and plug-and-play macroscope tools** that commoditize data mining and visualization.




cyberinfrastructure for NETWORK SCIENCE CENTER
School of Library and Information Science | Indiana University Bloomington

## Different Stakeholder Groups and Their Needs

### Funding Agencies

- Need to monitor (long-term) money flow and research developments, identify areas for future development, stimulate new research areas, evaluate funding strategies for different programs, decide on project durations, funding patterns.

### Scholars

- Want easy access to research results, relevant funding programs and their success rates, potential collaborators, competitors, related projects/publications *(research push)*.

### Industry

- Is interested in fast and easy access to major results, experts, etc. Influences the direction of research by entering information on needed technologies *(industry-pull)*.

### Advantages for Publishers

- Need easy to use interfaces to massive amounts of interlinked data. Need to communicate data provenance, quality, and context.

### Society

- Needs easy access to scientific knowledge and expertise.

## Scholars Have Different Roles/Needs

**Researchers and Authors**—need to select promising research topics, students, collaborators, and publication venues to increase their reputation. They benefit from a global view of competencies, reputation and connectivity of scholars; hot and cold research topics and bursts of activity, and funding available per research area.

**Editors**—have to determine editorial board members, assign papers to reviewers, and ultimately accept or reject papers. Editors need to know the position of their journals in the evolving world of science. They need to advertise their journals appropriately and attract high-quality submissions, which will in turn increase the journal's reputation.

**Reviewers**—read, critique, and suggest changes to help improve the quality of papers and funding proposals. They need to identify related works that should be cited or complementary skills that authors might consider when selecting project collaborators.

**Teachers/Mentors**—teach classes, train doctoral students, and supervise postdoctoral researchers. They need to identify key works, experts, and examples relevant to a topic area and teach them in the context of global science.

**Inventors**—create intellectual property and obtain patents, thus needing to navigate and make sense of research spaces as well as intellectual property spaces.

**Investigators**—scholars need funding to support students, hire staff, purchase equipment, or attend conferences. Here, research interests and proposals have to be matched with existing federal and commercial funding opportunities, possible industry collaborators and sponsors.

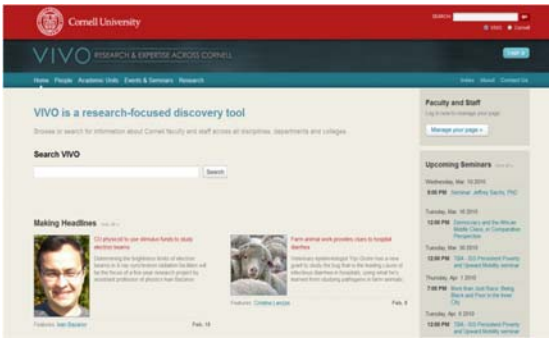
**Team Leads and Science Administrators**—many scholars direct multiple research projects simultaneously. Some have full-time staff, research scientists, and technicians in their laboratories and centers. Leaders need to evaluate performance and provide references for current or previous members; report the progress of different projects to funding agencies.

# VIVO International Researcher Network

VIVO
Enabling a National Network of Scientists

## 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 Fereira, 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 Price, 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, Michaeleen 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.

UF Clinical and Translational Science Institute
UNIVERSITY of FLORIDA



University of Florida

How do you want to compare?

by Grants

Who do you want to compare?

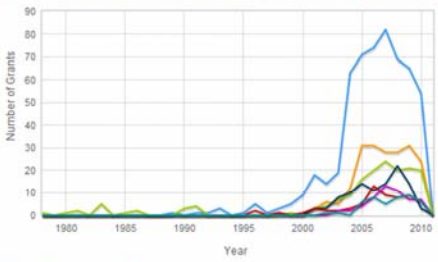
Search: X

Records 1 - 10 of 30 « First ‹ Prev Next › Last »

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

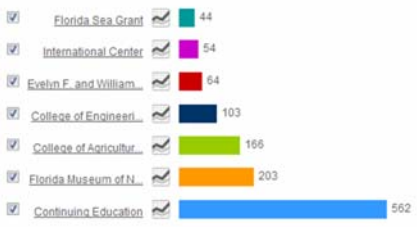
Save as CSV Clear

Comparing **Grants** of **Organizations** in University of Florida



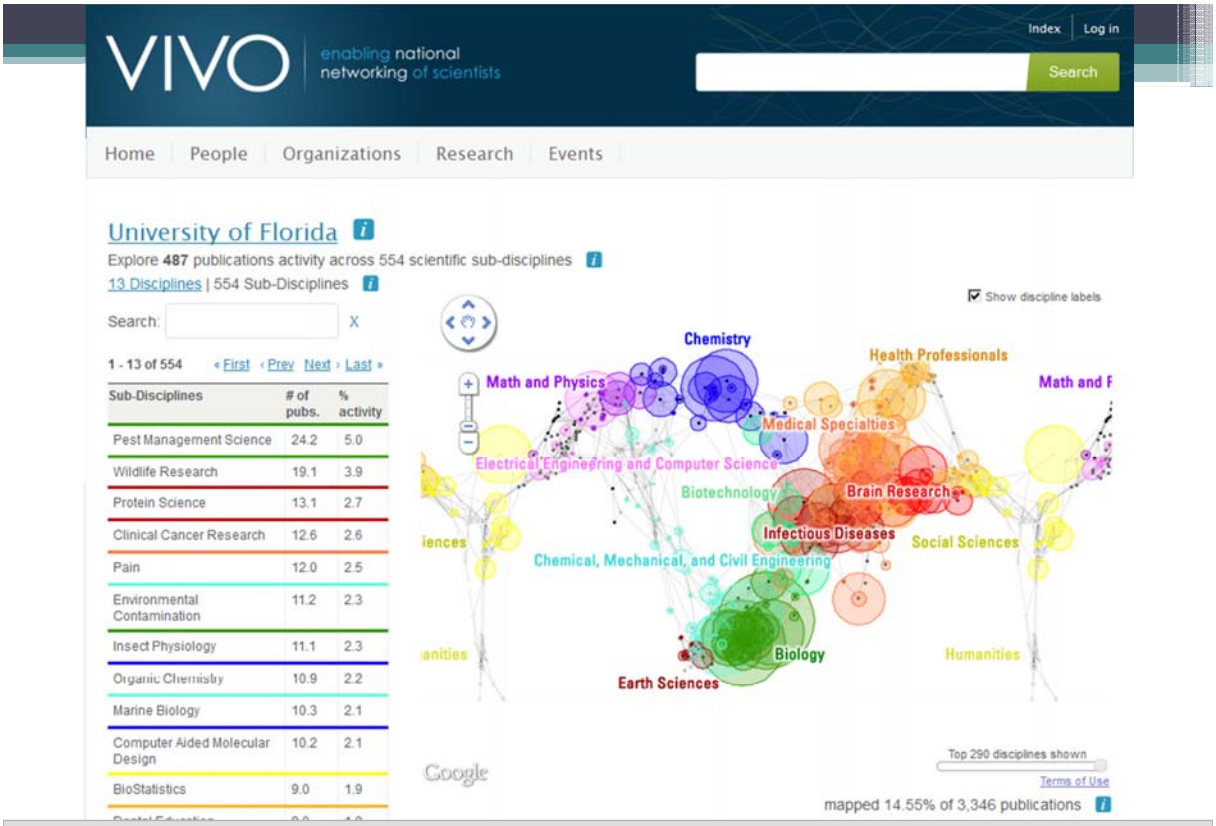

Total Number of Grants

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



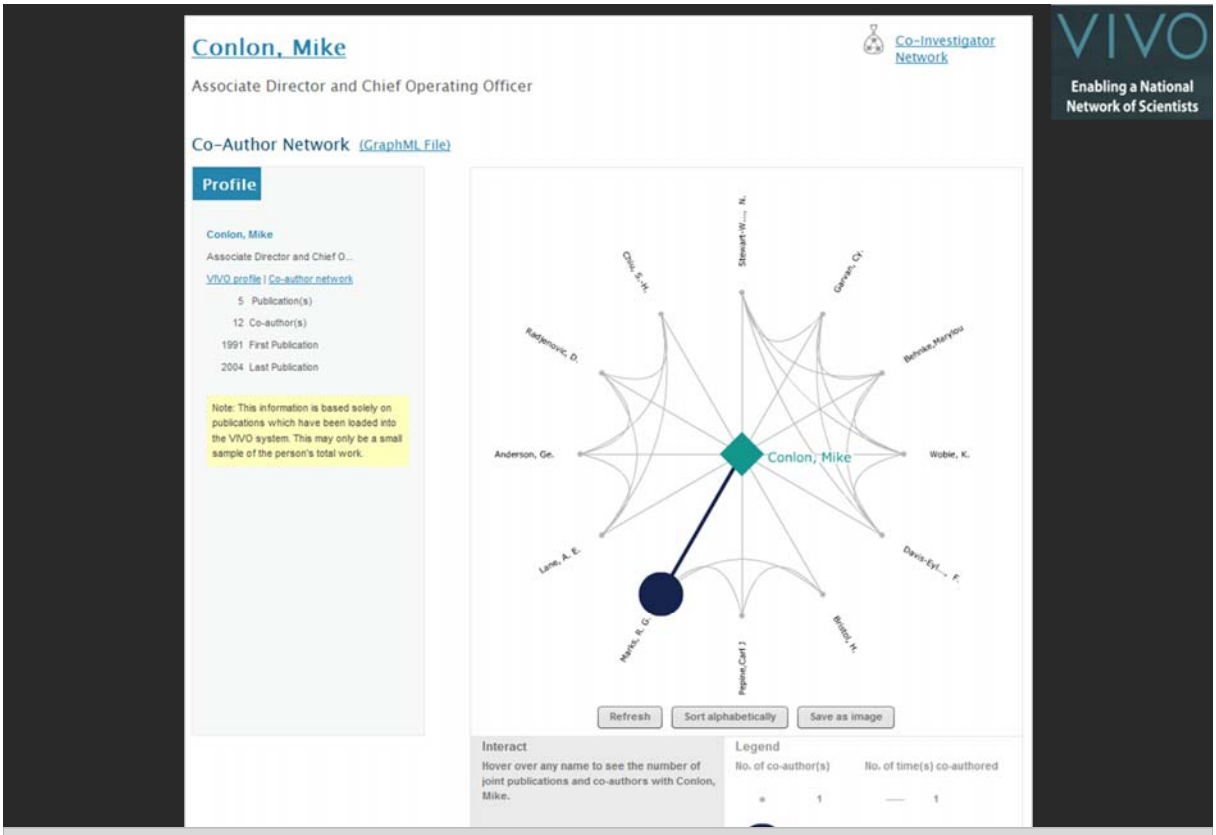

VIVO Enabling a National Network of Scientists

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




***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?


http://nrn.cns.iu.edu

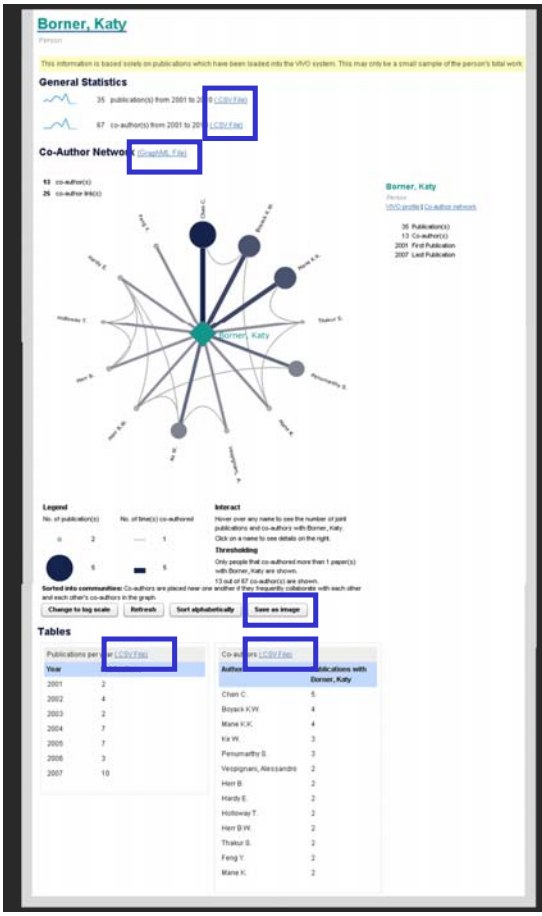
***Geospatial Analysis (Where)*** Where is what science performed by whom? Science is global and needs to be studied globally.



VIVO
Enabling a National Network of Scientists

**VIVO On-The-Go**

**Overview, Interactivity, Details on Demand**
come to commonly used devices and environments




## Download Data

### 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)

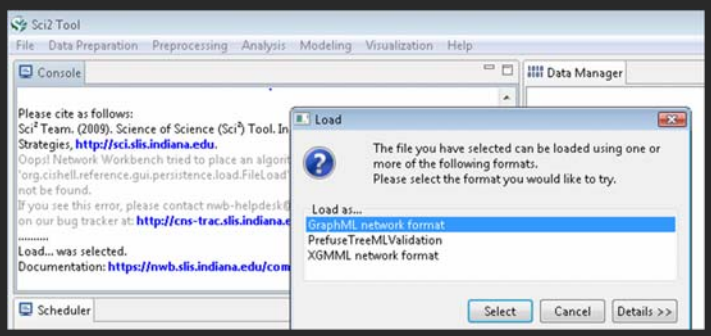
### Tables

- Publications per year (.CSV File)
- Co-authors (.CSV File)

*http://vivo.iu.edu/vis/author-network/person25557*

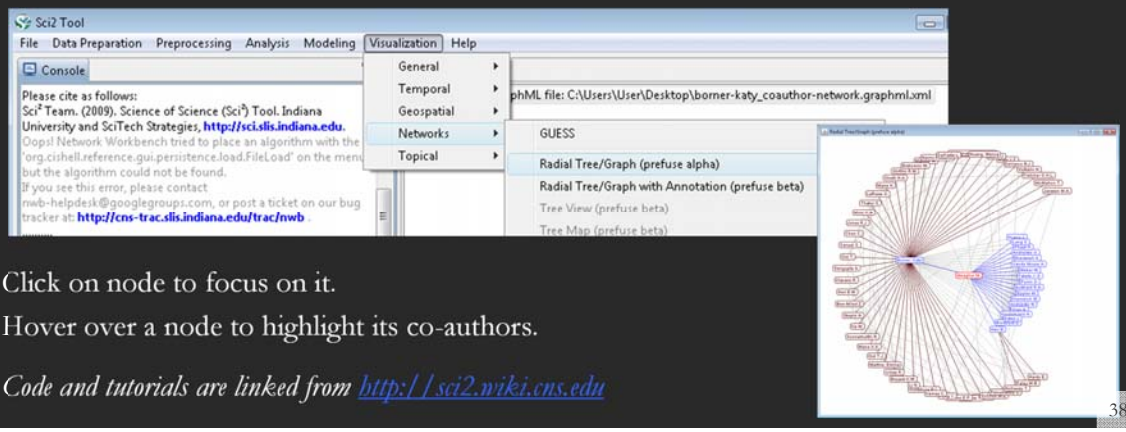


Run Sci2 Tool and Load Co-Author Network (GraphML File)




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://sci2.wiki.cns.edu*

Develop VIVO Visualizations

*See also Visualization in VIVO Workshop on Aug 24, 2011*

*http://wiki.cns.iu.edu/display/PRES/VIVO+Presentation*

## VIVO Presentation

4 Added by Chin Hua Kong, last edited by Chintan Tank on Aug 24, 2011 (view change)

### August, 2011 Workshop

#### Material

- Java 1.5 or higher - A programming language and computing platform for developing cross OS softwares.
- Science of Science tool (Sci2) - An desktop application for information analysis and visualization.
- Gephi - An interactive visualization tool for networks and complex systems, dynamic and hierarchical graphs.
- VIVO August 2011 workshop data.zip - Hands on workshop data package

#### Slides

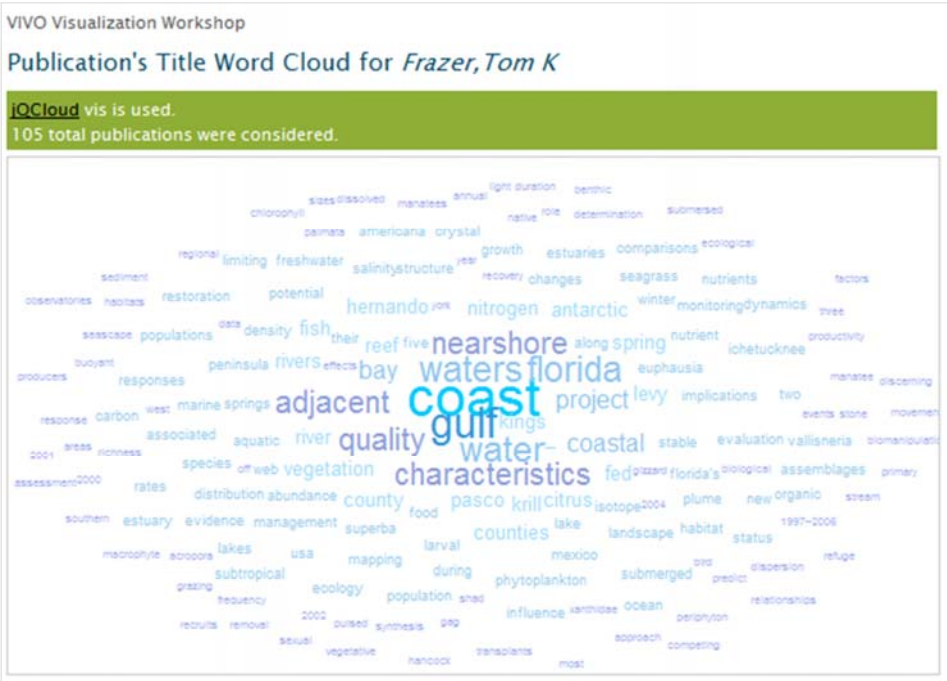
- Tutorial Slides presented at the VIVO Conference 2011
- Pre-Questionnaire and Post-Questionnaire

#### Demo Links

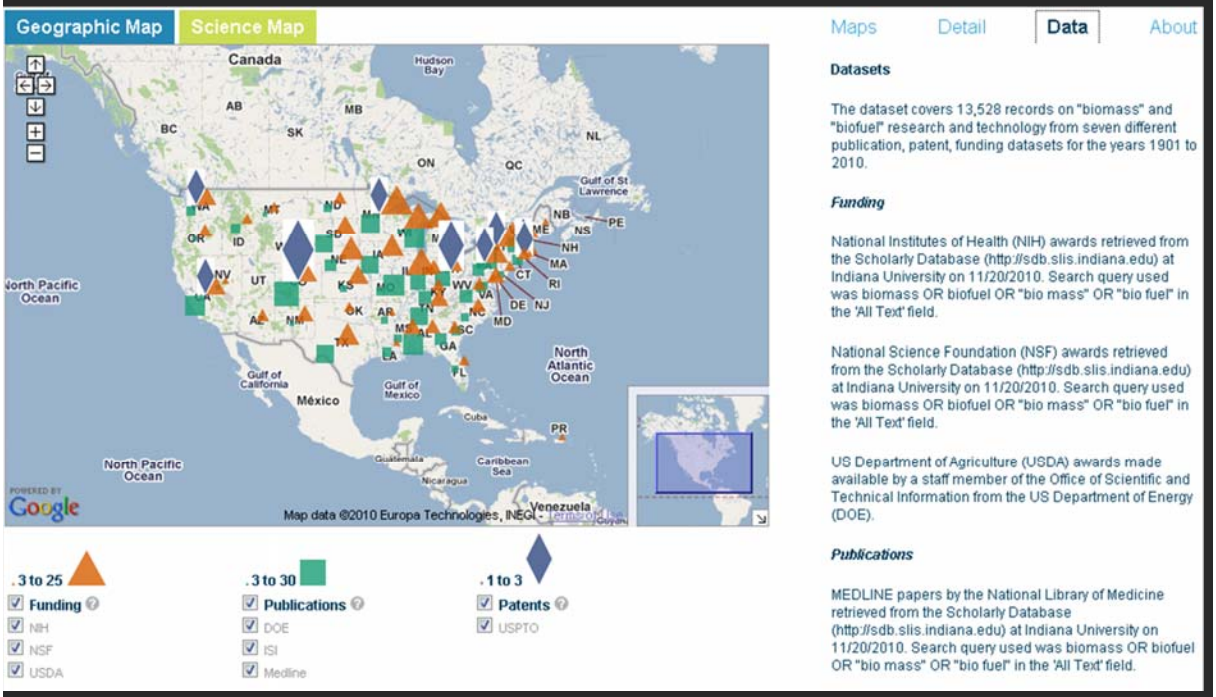
- Map of Science Visualization (dev link)
- Temporal Graph Visualization (dev link)
- National Researcher Networking Visualization
- Word Cloud Visualization dev link

Develop VIVO Visualizations

*http://vivo-vis.slis.indiana.edu/vivo1/vis/word-cloud/n868*

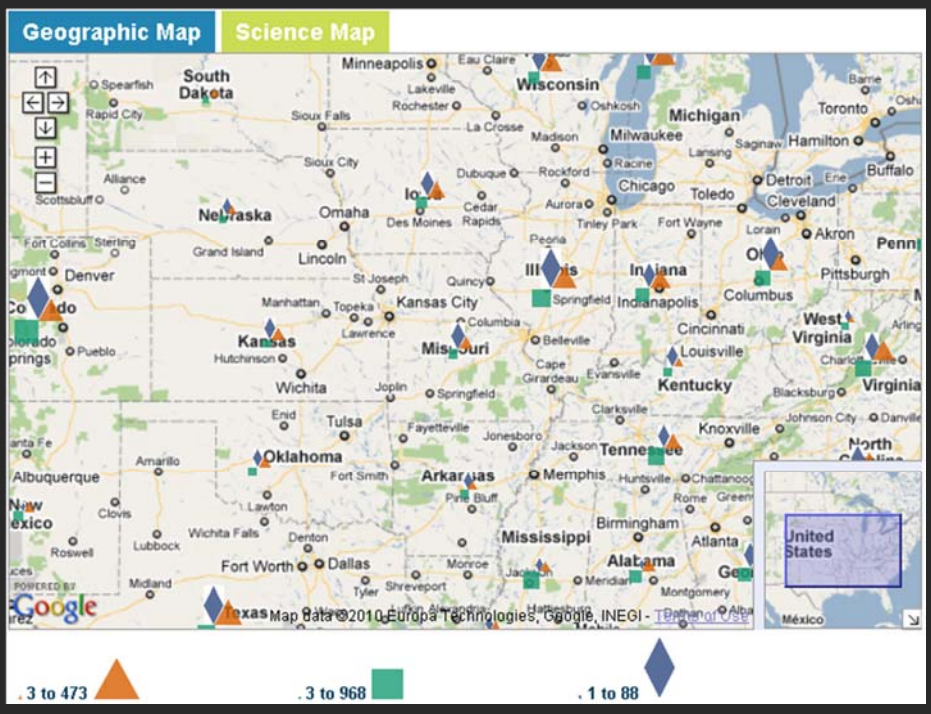


# Online Interactive Maps for Sustainability Research and Gene Therapy

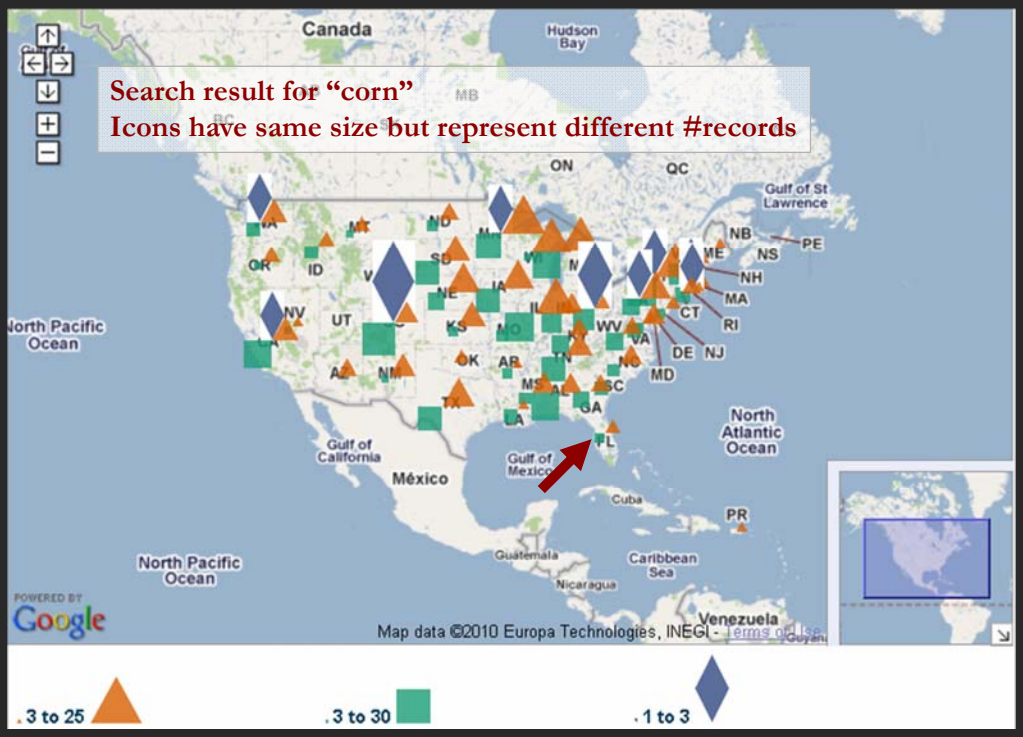



The geographic map at **state level**.

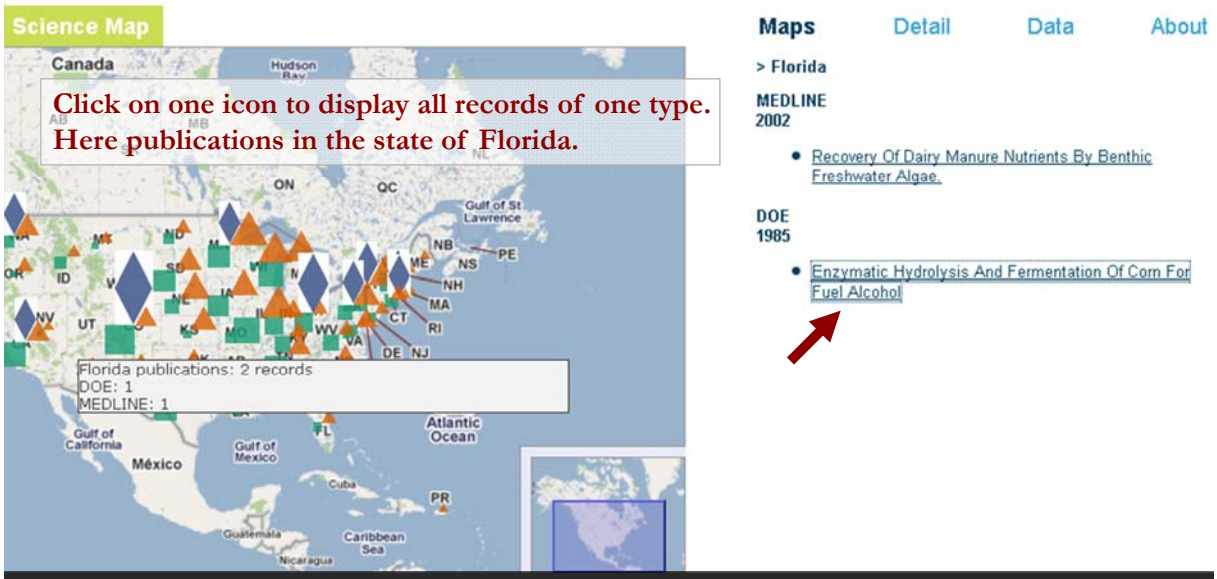


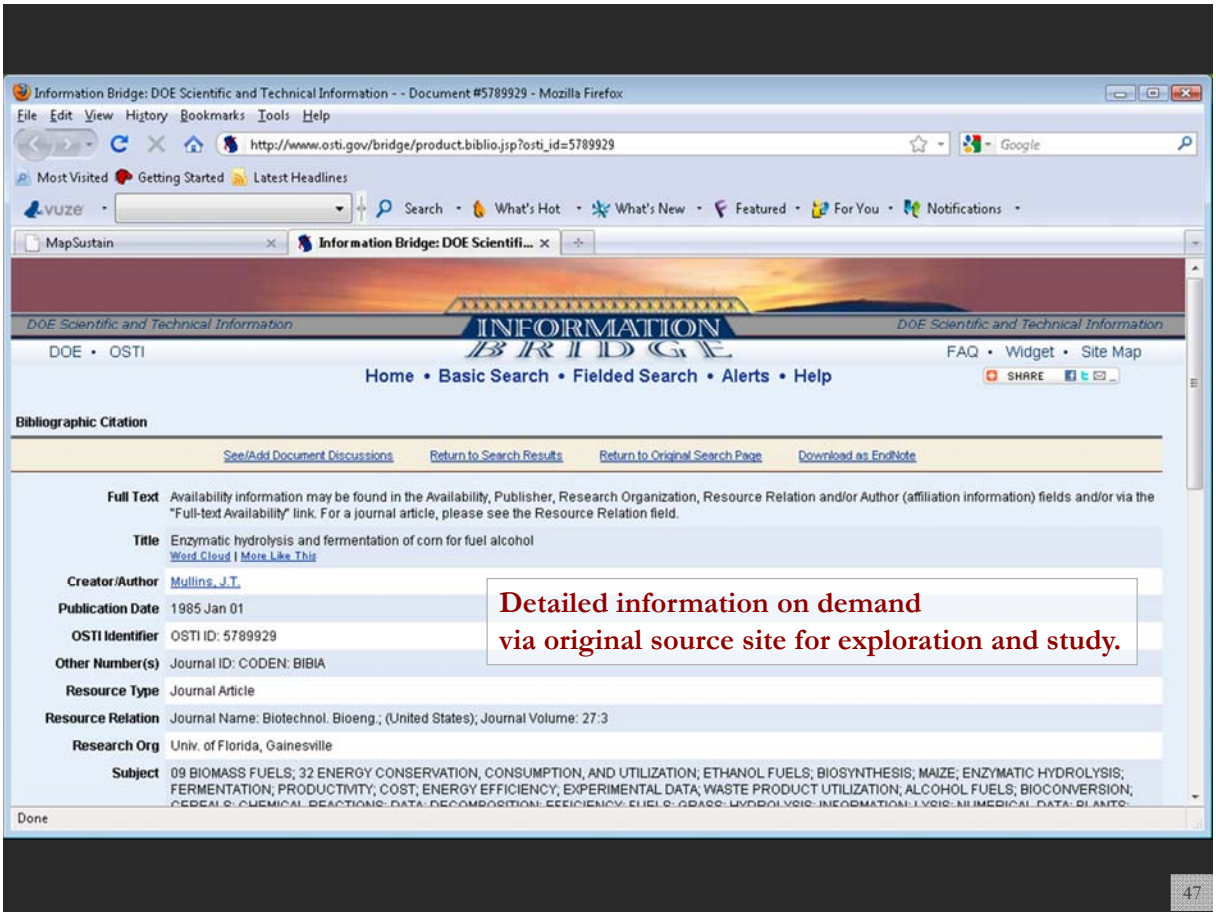



The geographic map at **city level**.

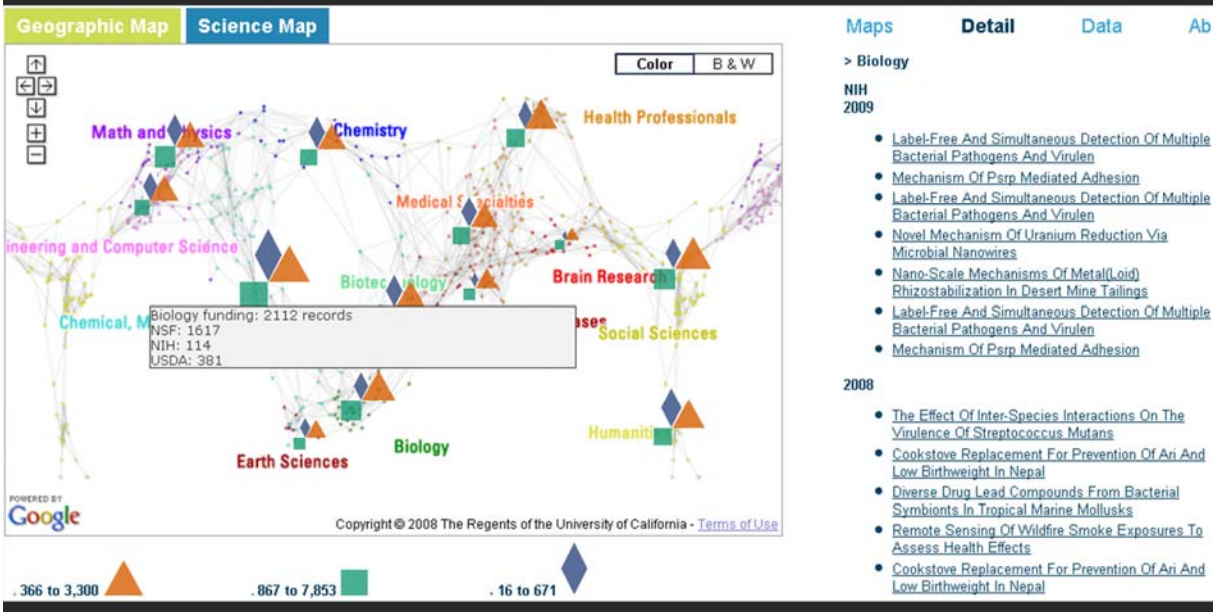

Search result for "corn"
Icons have same size but represent different #records
Canada
Hudson Bay
North Pacific Ocean
México
Gulf of California
Gulf of Mexico
North Atlantic Ocean
Cuba
PR
Caribbean Sea
Guatemala
Nicaragua
Venezuela
Map data ©2010 Europa Technologies, INEGI
.3 to 25
.3 to 30
.1 to 3



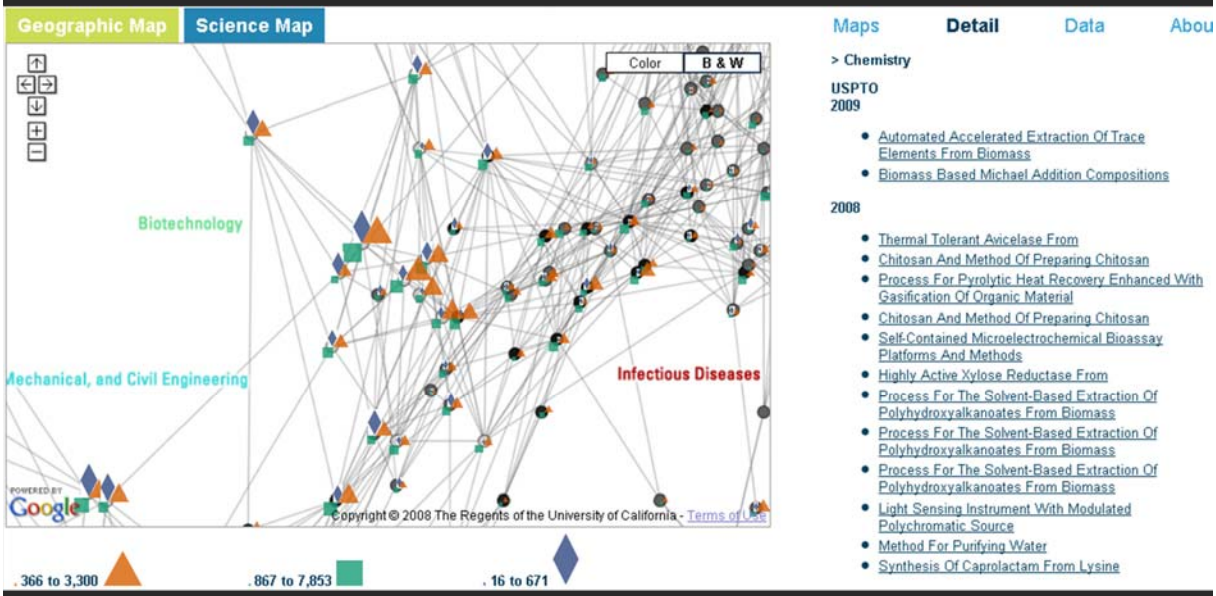

Science Map
Click on one icon to display all records of one type.
Here publications in the state of Florida.
Florida publications: 2 records
DOE: 1
MEDLINE: 1
Maps
Detail
Data
About
> Florida
MEDLINE
2002
Recovery Of Dairy Manure Nutrients By Benthic Freshwater Algae.
DOE
1985
Enzymatic Hydrolysis And Fermentation Of Corn For Fuel Alcohol





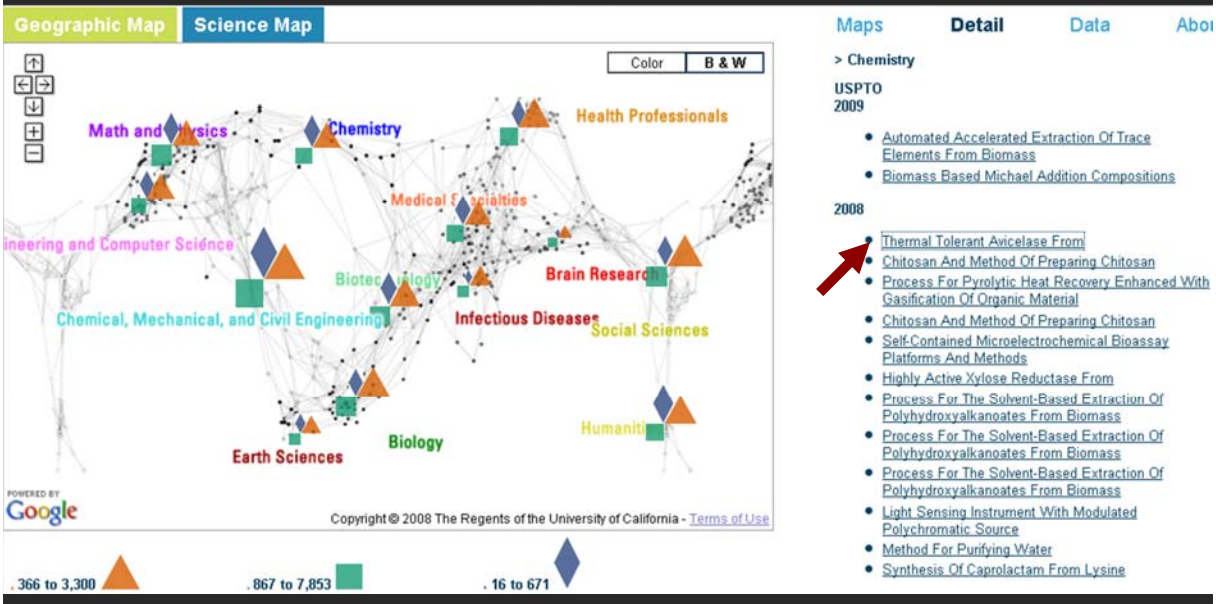



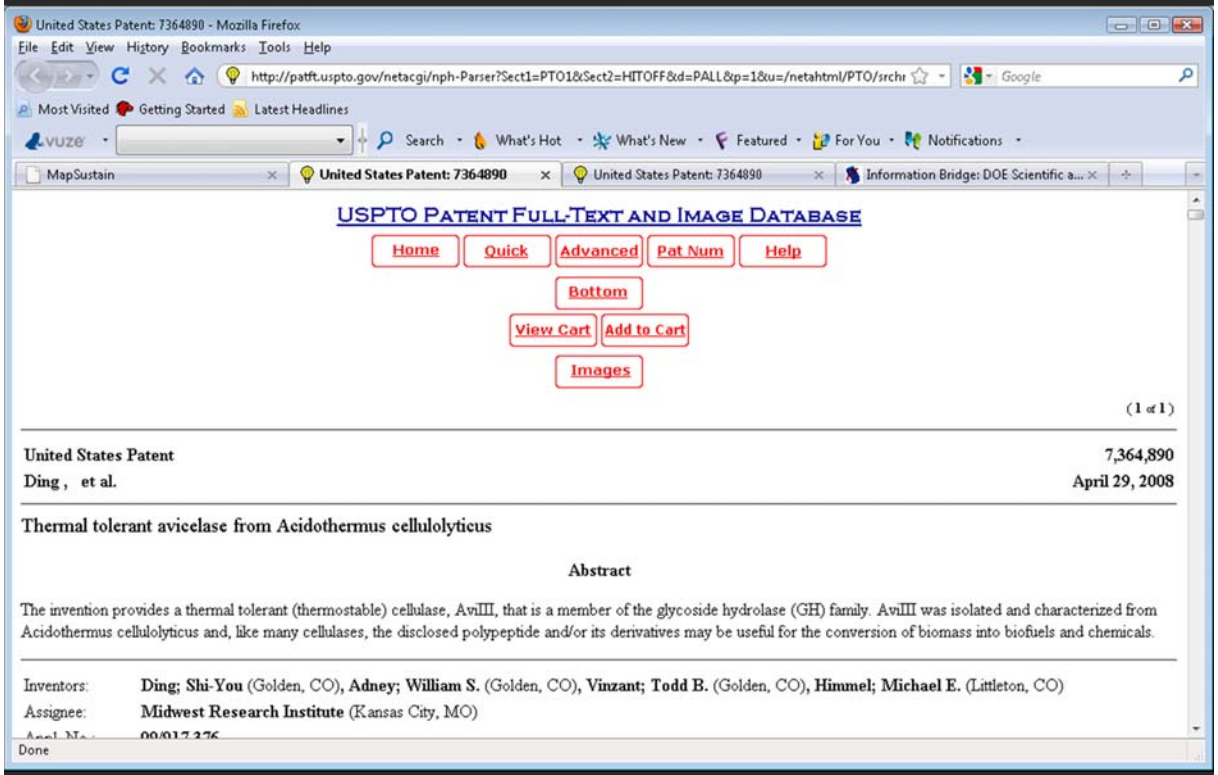

The science map at 13 top-level scientific **disciplines level**.



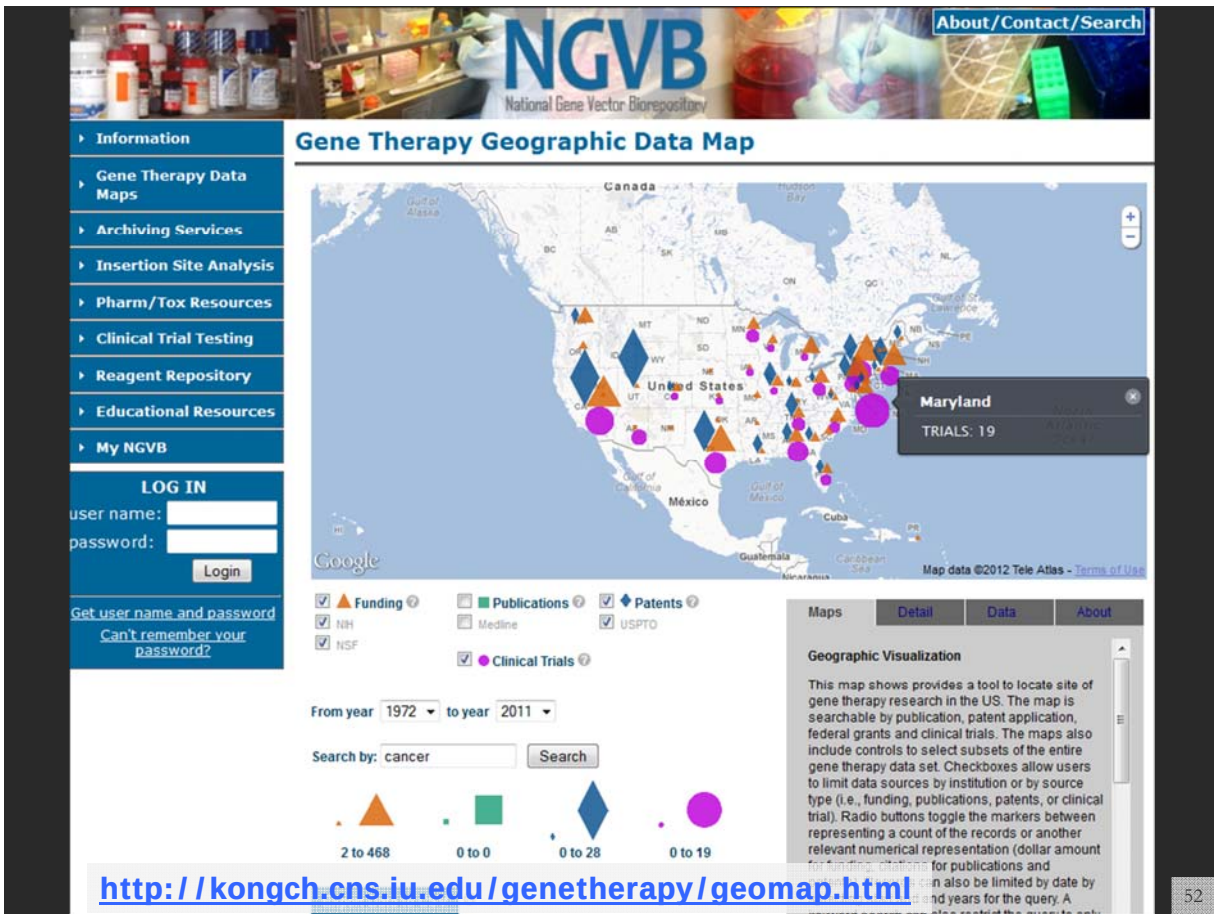

The science map at 554 **sub-disciplines level**.



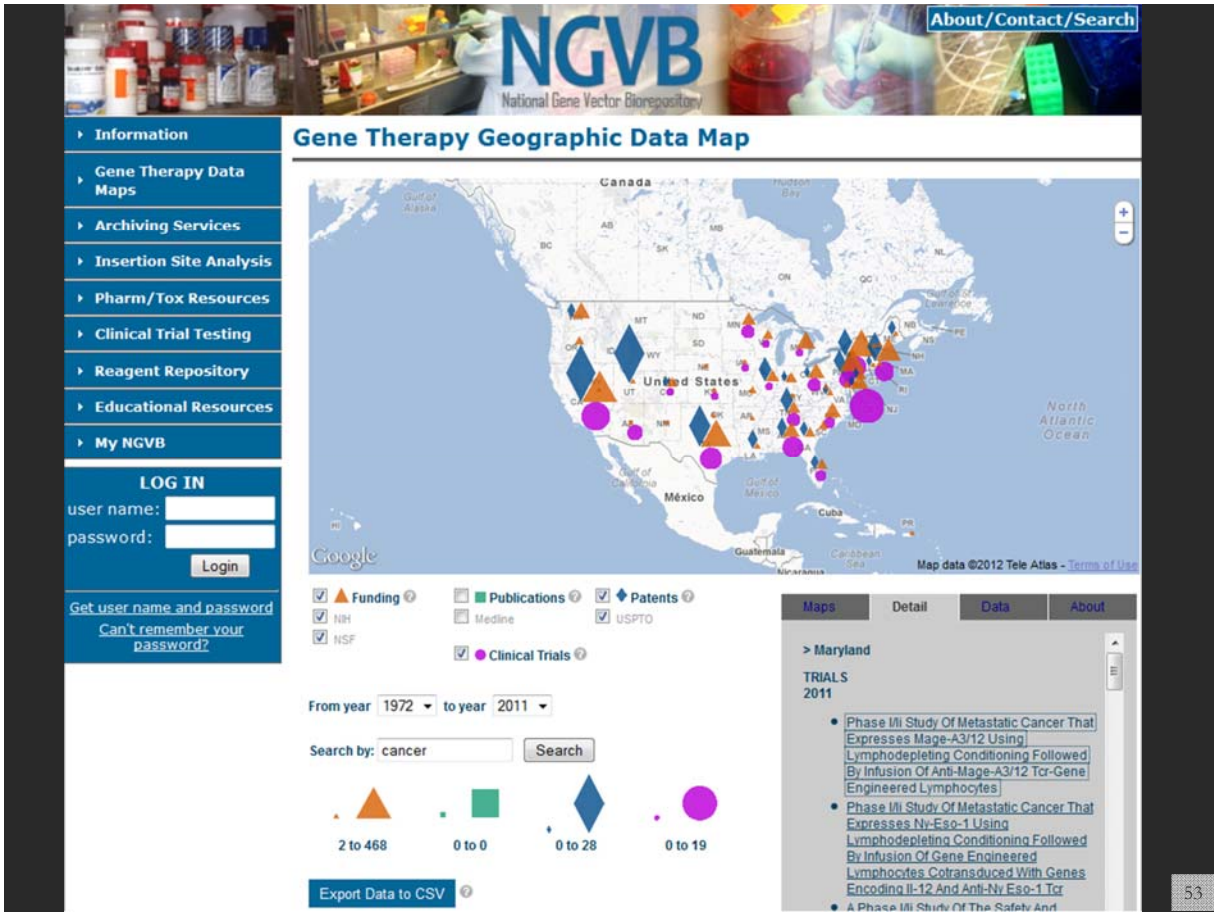





http://kongch.cns.iu.edu/genetherapy/geomap.html






ClinicalTrials.gov
A service of the U.S. National Institutes of Health

Home Search Study Topics Glossary
Search

Full Text View | Tabular View | No Study Results Posted | Related Studies

## MAGE-A3/12 Metastatic Cancer Treatment With Anti-MAGE-A3/12 TCR-Gene Engineered Lymphocytes

**This study has been suspended.**

First Received on January 7, 2011. Last Updated on March 14, 2012 History of Changes

| | |
|---|---|
| **Sponsor:** | National Cancer Institute (NCI) |
| **Information provided by:** | National Institutes of Health Clinical Center (CC) |
| **ClinicalTrials.gov Identifier:** | NCT01273181 |

### Purpose

Background:

- MAGE-A3/12 is a type of protein commonly found on certain types of cancer cells, particularly in metastatic cancer. Researchers have developed a process to take lymphocytes (white blood cells) from cancer patients, modify them in the laboratory to target cancer cells that contain MAGE-A3/12, and return them to the patient to help attack and kill the cancer cells. These modified white blood cells are an experimental treatment, but researchers are interested in determining their safety and effectiveness as a possible treatment for cancers that involve MAGE-A3/12.

Objectives:

- To evaluate the safety and effectiveness of anti-MAGE-A3/12 lymphocytes as a treatment for metastatic cancers that have not responded to standard treatment.

Eligibility:

- Individuals at least 18 years of age who have been diagnosed with metastatic melanoma, renal cell cancer, or another type of metastatic cancer that has not responded to standard treatment.

Design:

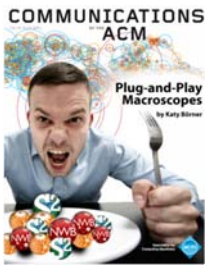
- Participants will be screened with a full medical history and physical examination, as well as blood and urine tests, tumor samples, and imaging studies.
- Participants will have leukapheresis to collect enough white blood cells for modification in the laboratory.
- Seven days before the start of anti-MAGE-A3/12 treatment, participants will have chemotherapy with cyclophosphamide and fludarabine to suppress the immune system in preparation for the treatment.

## Overview

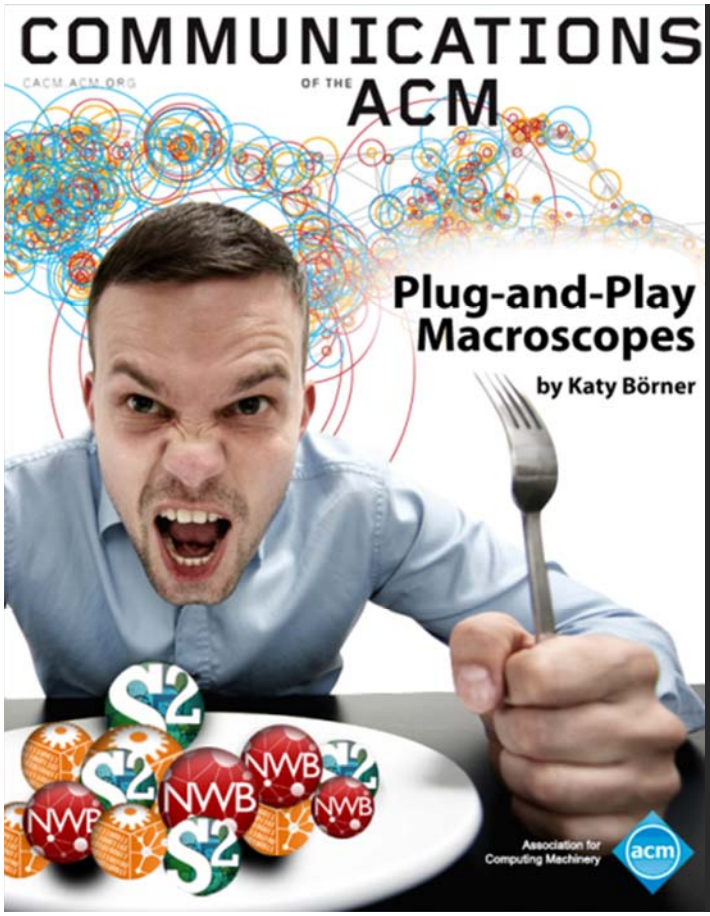
1. **Data mining and visualization research** that aims to increase our scientific understanding of the structure and dynamics of science and technology.

2. **Novel approaches and data services** that improve information access, researcher networking, and research management.

3. **Data services and plug-and-play macroscope tools** that commoditize data mining and visualization.

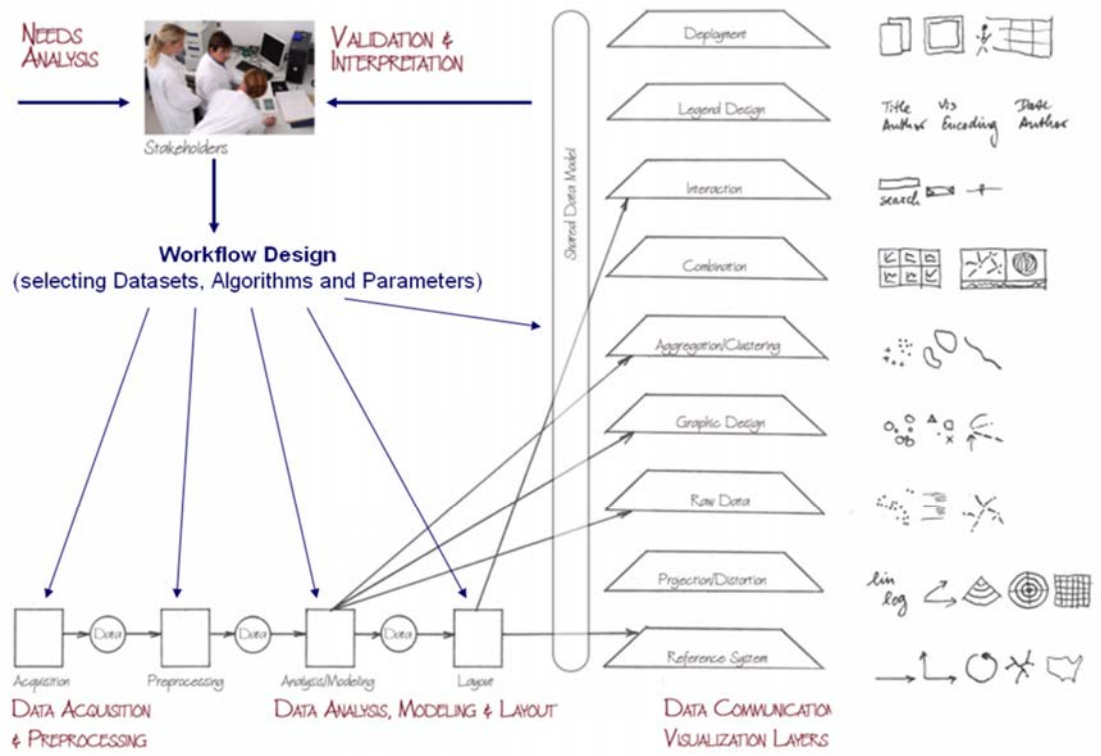

cyberinfrastructure for NETWORK SCIENCE CENTER
School of Library and Information Science | Indiana University Bloomington




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

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

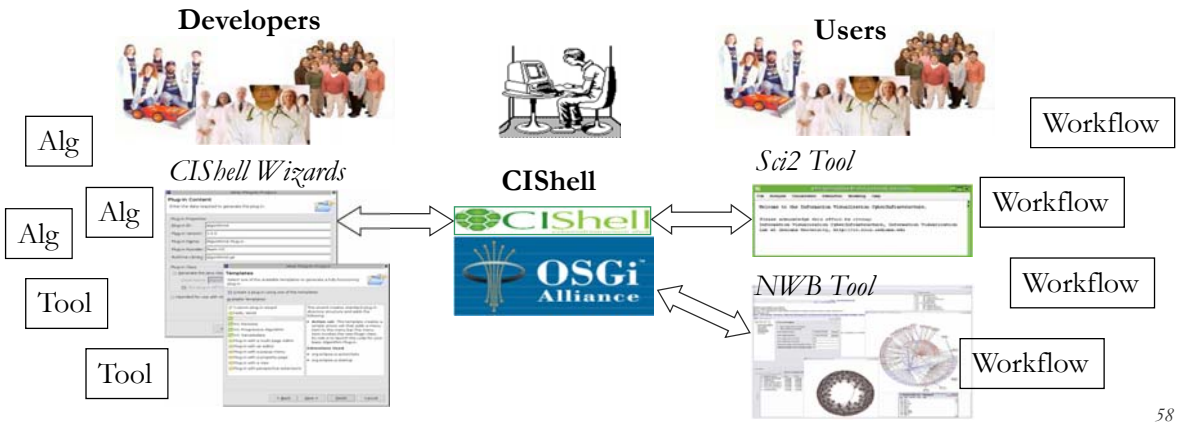
**Needs-Driven Workflow Design** using a modular data acquisition/analysis/ modeling/ visualization pipeline as well as modular visualization layers.




*Börner, Katy (2010) Atlas of Science. MIT Press.* 57

## OSGi & CIShell

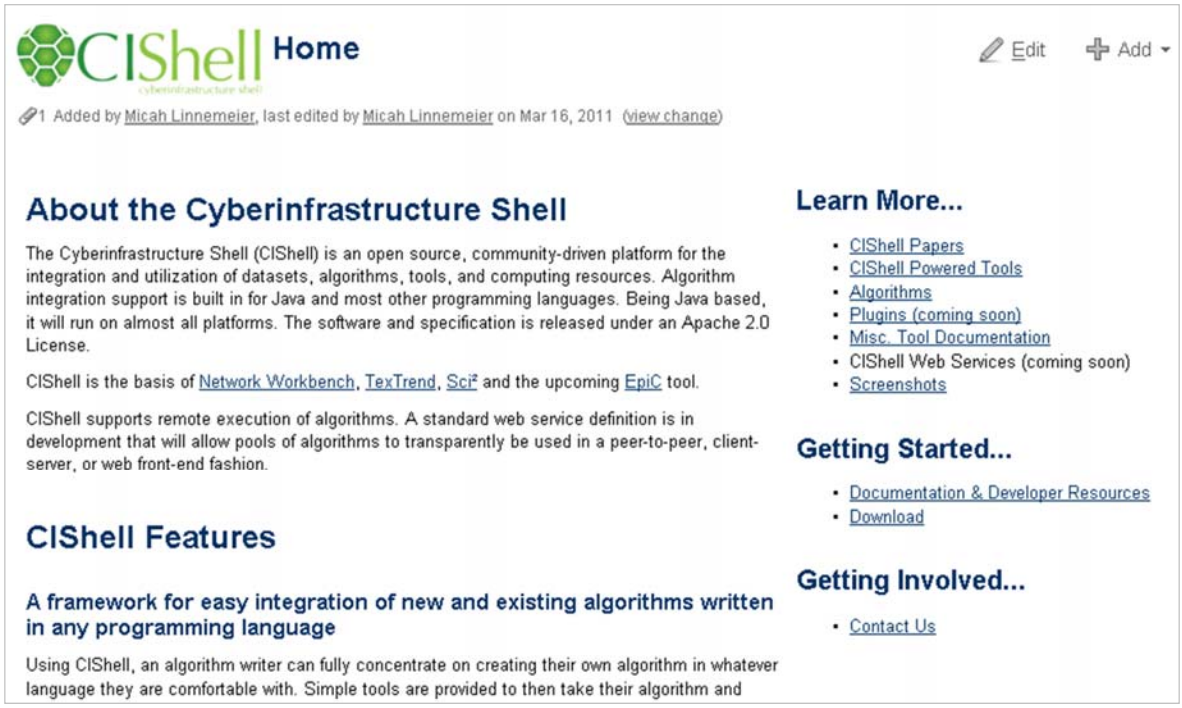
- CIShell (http://cishell.org) is an open source software specification for the integration and utilization of datasets, algorithms, and tools.
- It extends the Open Services Gateway Initiative (OSGi) (http://osgi.org), a standardized, component oriented, computing environment for networked services widely used in industry since more than 10 years.
- Specifically, CIShell provides "sockets" into which existing and new datasets, algorithms, and tools can be plugged using a wizard-driven process.




58

## CIShell Developer Guide

(http://cishell.wiki.cns.iu.edu)






## CIShell Portal (http://cishell.org)

## Network Workbench Tool

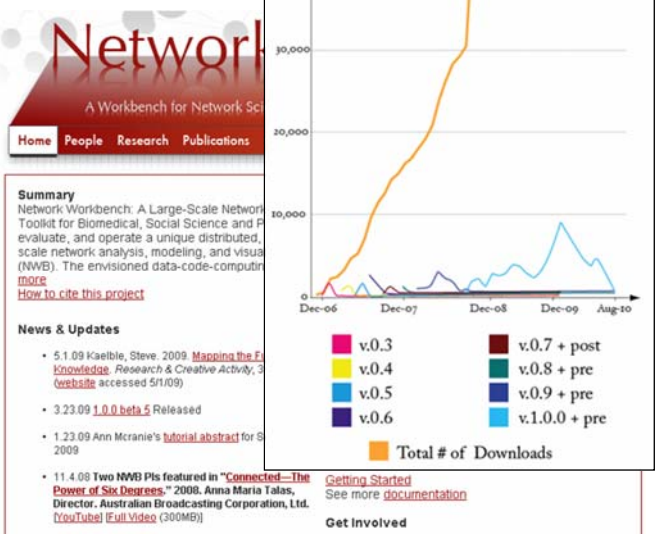
http://nwb.cns.edu

The Network Workbench (NWB) tool supports researchers, educators, and practitioners interested in the study of biomedical, social and behavioral science, physics, and other networks.

In February 2009, the tool provides more 169 plugins that support the preprocessing, analysis, modeling, and visualization of networks.

**More than 50 of these plugins can be applied or were specifically designed for S&T studies**.

It has been downloaded more than 110,000 times since December 2006.







*Herr II, Bruce W., Huang, Weixia (Bonnie), Penumarthy, Shashikant & Börner, Katy. (2007). Designing Highly Flexible and Usable Cyberinfrastructures for Convergence. In Bainbridge, William S. & Roco, Mihail C. (Eds.), Progress in Convergence - Technologies for Human Wellbeing (Vol. 1093, pp. 161-179), Annals of the New York Academy of Sciences, Boston, MA.*



## Computational Proteomics

What relationships exist between protein targets of all drugs and all disease-gene products in the human protein–protein interaction network?

*Yildriim, Muhammed A., Kwan-Il Goh, Michael E. Cusick, Albert-László Barabási, and Marc Vidal. (2007). Drug-target Network. Nature Biotechnology 25 no. 10: 1119-1126.*

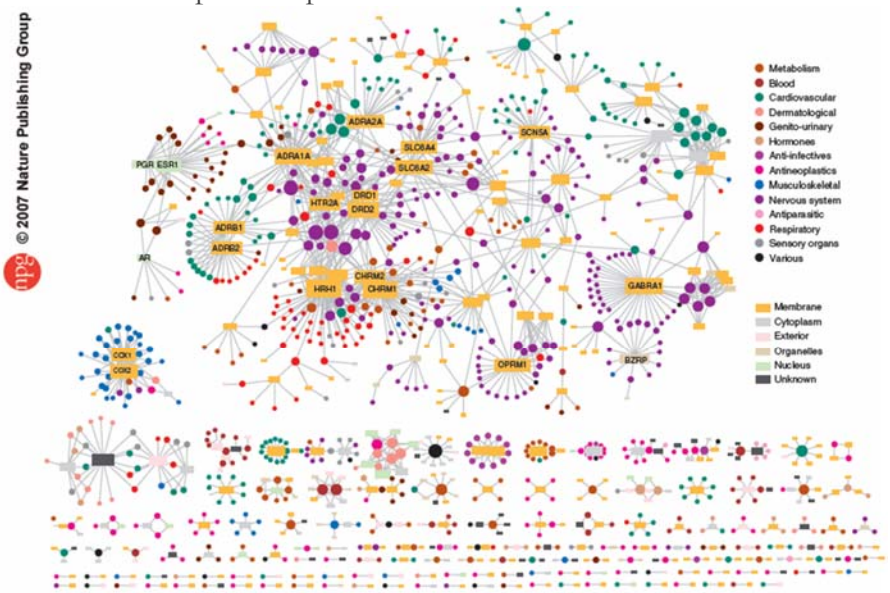



**Figure 2** Drug–target network (DT network). The DT network is generated by using the known associations between FDA-approved drugs and their target proteins. Circles and rectangles correspond to drugs and target proteins, respectively. A link is placed between a drug node and a target node if the protein is a known target of that drug. The area of the drug (protein) node is proportional to the number of targets that the drug has (the number of drugs targeting the protein). Color codes are given in the legend. Drug nodes (circles) are colored according to their Anatomical Therapeutic Chemical Classification, and the target proteins (rectangular boxes) are colored according to their cellular component obtained from the Gene Ontology database.

**Computational Economics**
Does the type of product that a country exports matter for subsequent economic performance?

*C. A. Hidalgo, B. Klinger, A.-L. Barabási, R. Hausmann (2007) The Product Space Conditions the Development of Nations. Science 317, 482 (2007).*

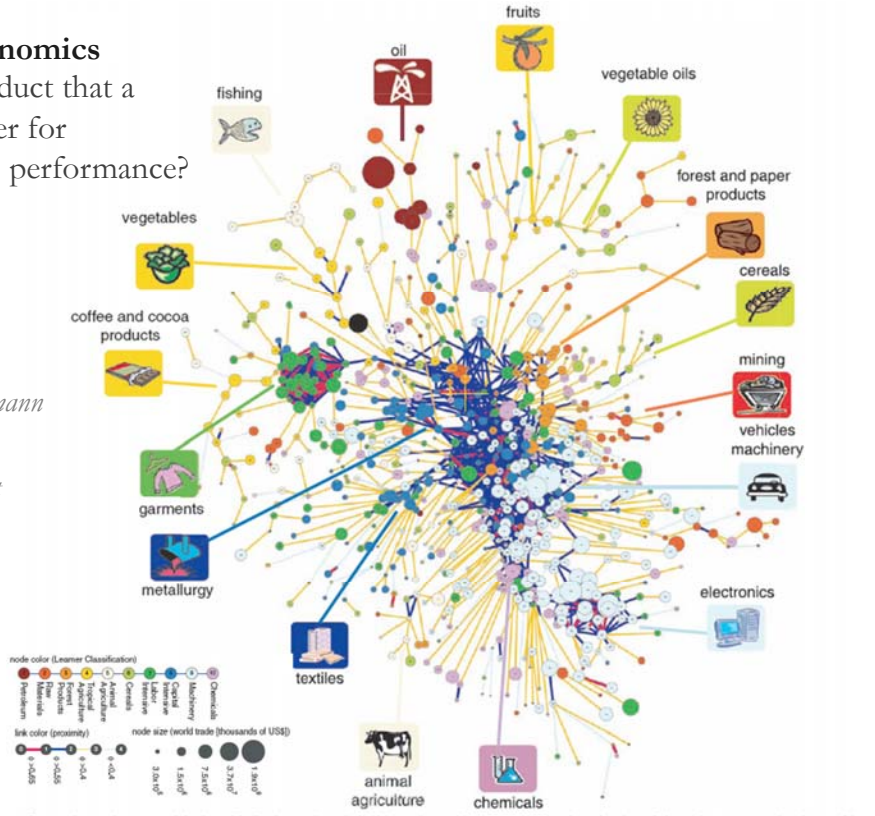



**Fig. 1.** The product space. **(A)** Hierarchically clustered proximity (φ) matrix representing the 775 SITC-4 product classes exported in the 1998–2000 period. **(B)** Network representation of the product space. Links are color coded with their proximity value. The sizes of the nodes are proportional to world trade, and their colors are chosen according to the classification introduced by Leamer.



**Computational Social Science**
Studying large scale social networks such as Wikipedia

*Second Sight: An Emergent Mosaic of Wikipedian Activity, The NewScientist, May 19, 2007*

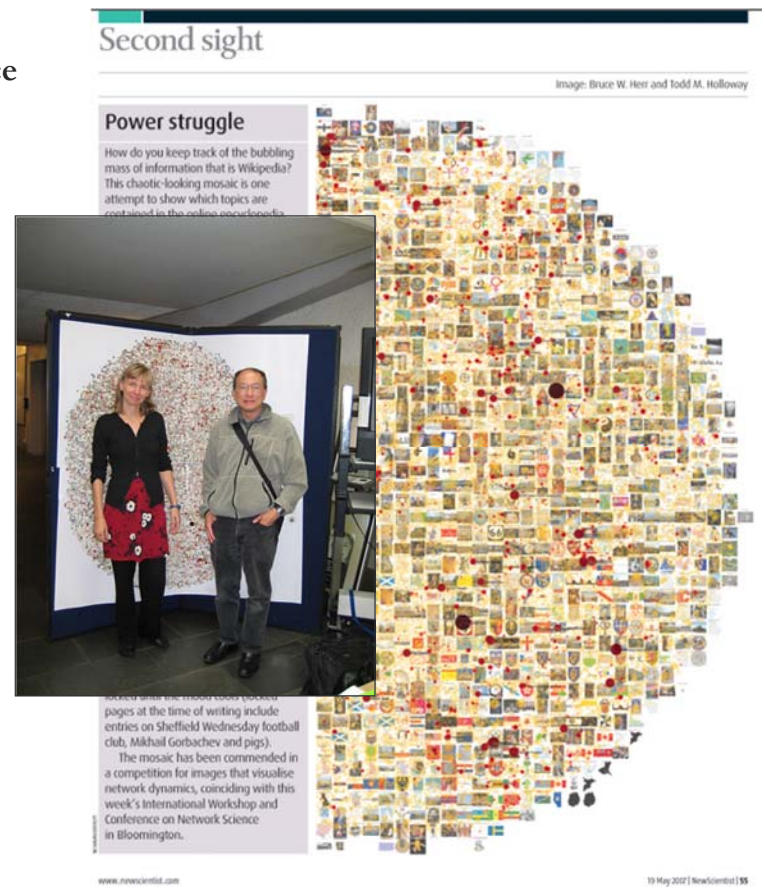

Second sight

Image: Bruce W. Herr and Todd M. Holloway

**Power struggle**

How do you keep track of the bubbling mass of information that is Wikipedia? This chaotic-looking mosaic is one attempt to show which topics are

pages at the time of writing include entries on Sheffield Wednesday football club, Mikhail Gorbachev and pigs).

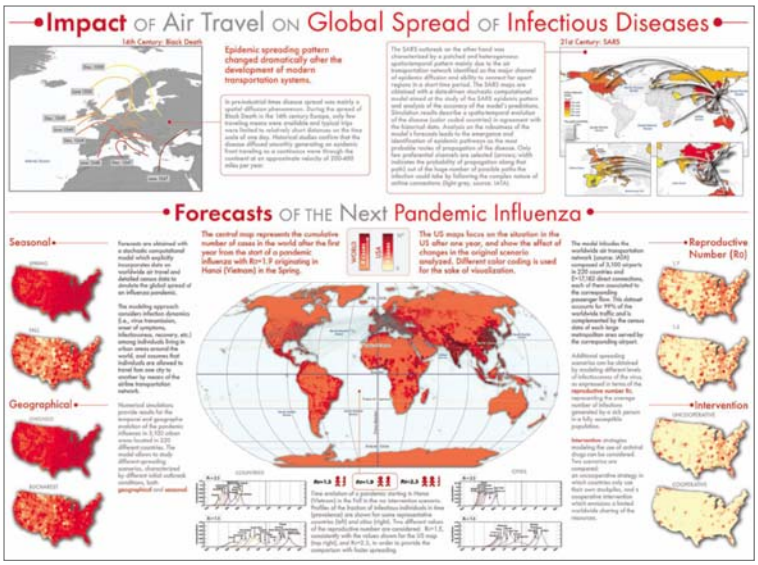
The mosaic has been commended in a competition for images that visualise network dynamics, coinciding with this week's International Workshop and Conference on Network Science in Bloomington.

## Computational Epidemics

Forecasting (and preventing the effects of) the next pandemic.

*Epidemic Modeling in Complex realities, V. Colizza, A. Barrat, M. Barthelemy, A.Vespignani, Comptes Rendus Biologie, 330, 364-374 (2007).*
*Reaction-diffusion processes and metapopulation models in heterogeneous networks, V.Colizza, R. Pastor-Satorras, A.Vespignani, Nature Physics 3, 276-282 (2007).*

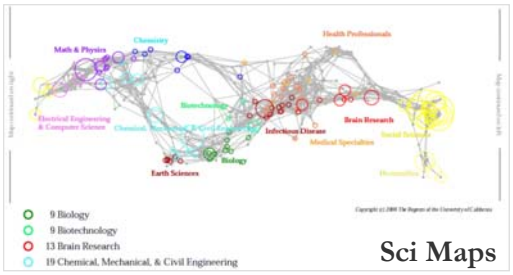
*Modeling the Worldwide Spread of Pandemic Influenza: Baseline Case and Containment Interventions, V. Colizza, A. Barrat, M. Barthelemy, A.-J. Valleron, A.Vespignani, PloS-Medicine 4, e13, 95-110 (2007).*



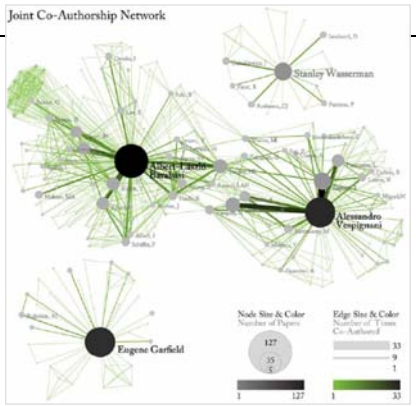

---


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

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



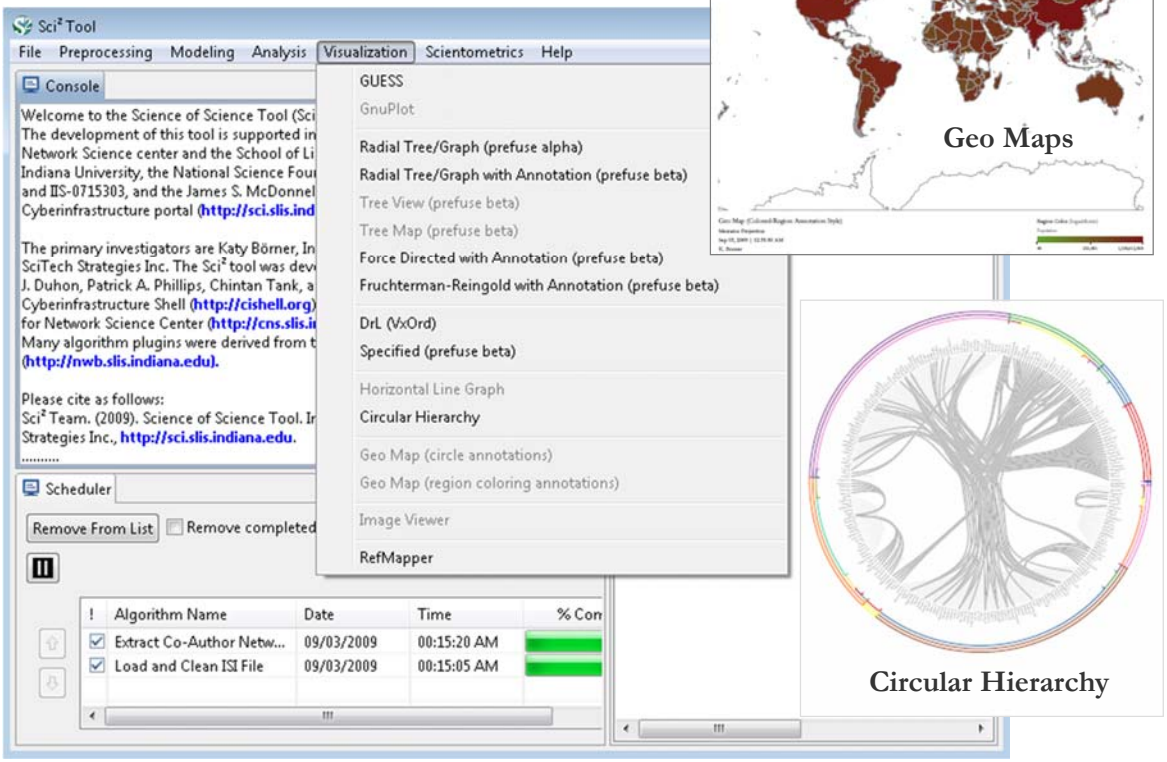

**Sci Maps**

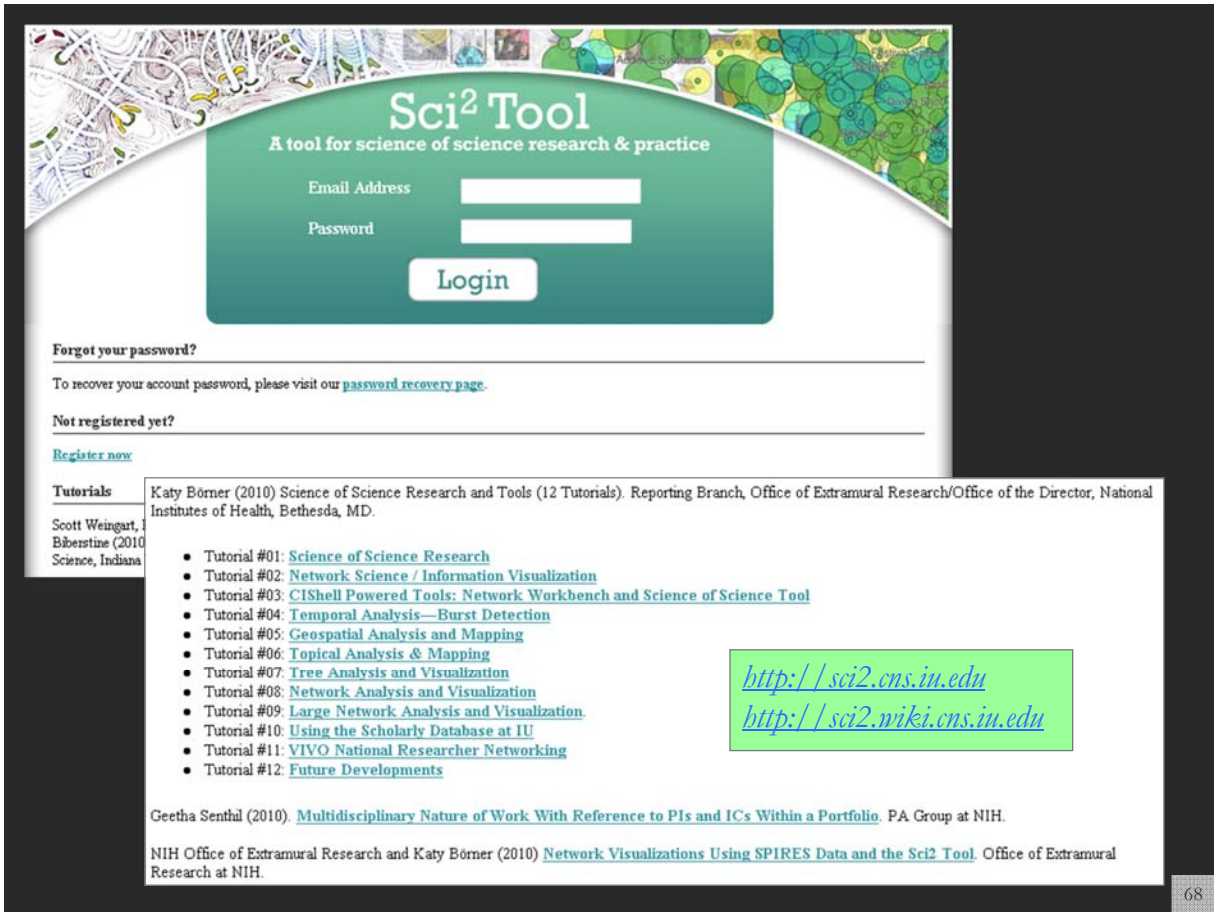



**GUESS Network Vis**


*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.*

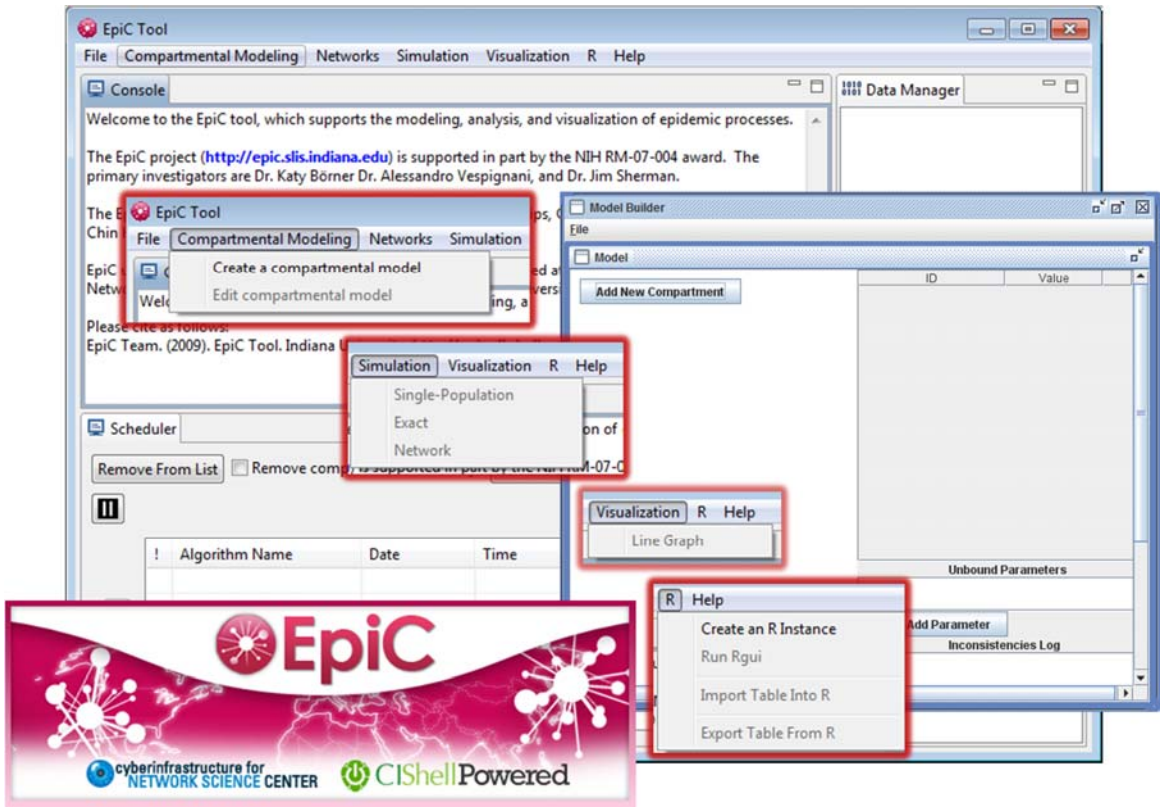
## Sci² Tool Vis cont.




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



## OSGi/CIShell Adoption

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

USA

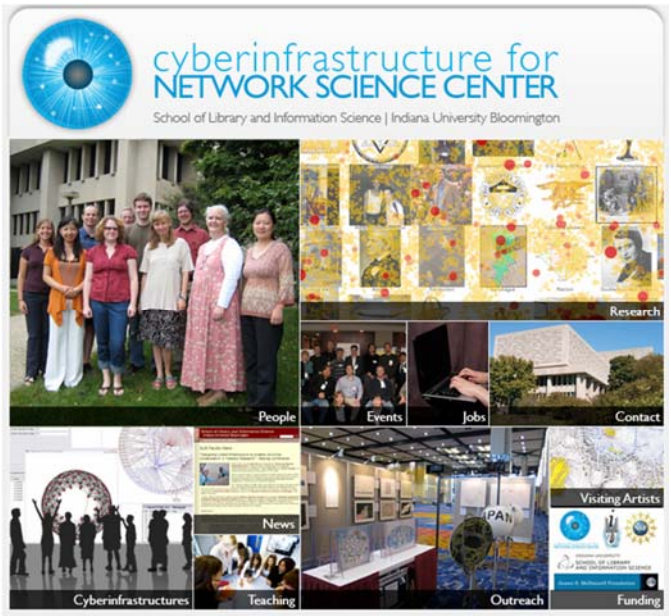
- *Cytoscape (http://cytoscape.org)* Led by Trey Ideker at the University of California, San Diego is an open source bioinformatics software platform for visualizing molecular interaction networks and integrating these interactions with gene expression profiles and other state data (Shannon et al., 2002).
- *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.






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

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