Multi-Scale Maps of Scholarly Activity

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Paris, France
http://www.oecd.org

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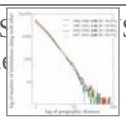
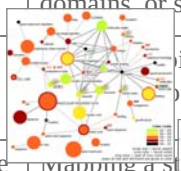
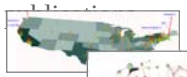
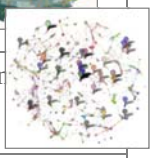
Type of Analysis vs. Level of Analysis

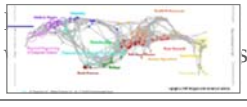
	Micro/Individual (1-100 records)	***Meso/Local (101–10,000 records)***	***Macro/Global (10,000 < records)***
Statistical Analysis/Profiling	Individual person and their expertise profiles	Larger labs, centers, universities, research domains, or states	All of NS SA, all of sci
Temporal Analysis (When)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

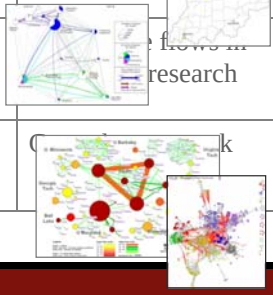


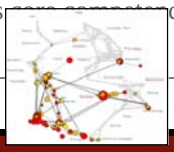








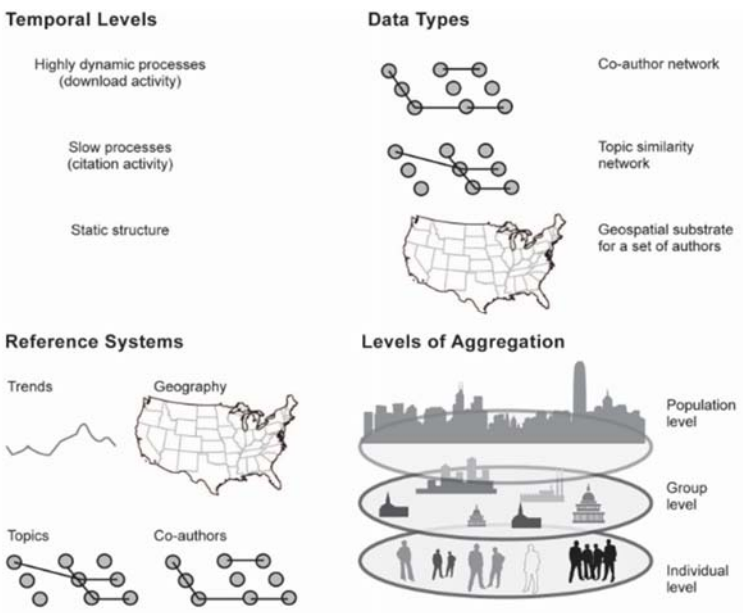




Modeling Science Dynamics using

- multi-level,
- mixed methods, and
- multi-perspective models

Katy Börner, Kevin W. Boyack, Staša Milojević, Steven Morris. (2012) An introduction to modeling science: Basic model types, key definitions, and a general framework for the comparison of process models. In *Scharnhorst, Andrea, van den Besselaar, Börner (Eds) Models of Science Dynamics. Springer Verlag.*



Descriptive Models of Science

- Detect advances of scientific knowledge via "longitudinal mapping" (Garfield, 1994).
- Synthesis of specialty narratives from co-citation clusters (Small, 1986).
- Identify cross-disciplinary fertilization via "passages through science" (Small, 1999, 2000).
- Understand scholarly information foraging (Sandstrom, 2001).
- Knowledge discovery in un-connected terms (Swanson & Smalheiser, 1997).
- Determine areas of expertise for specific researcher, research group via "invisible colleges" (note that researchers self definition might differ from how field defines him/her) (Crane, 1972).
- Identify profiles of authors, also called CAMEOS, to be used to for document retrieval or to map an author's subject matter and studying his/her publishing career, or to map the social and intellectual networks evident in citations to and from authors and in co-authorships (White, 2001).

Descriptive Models of Science cont.

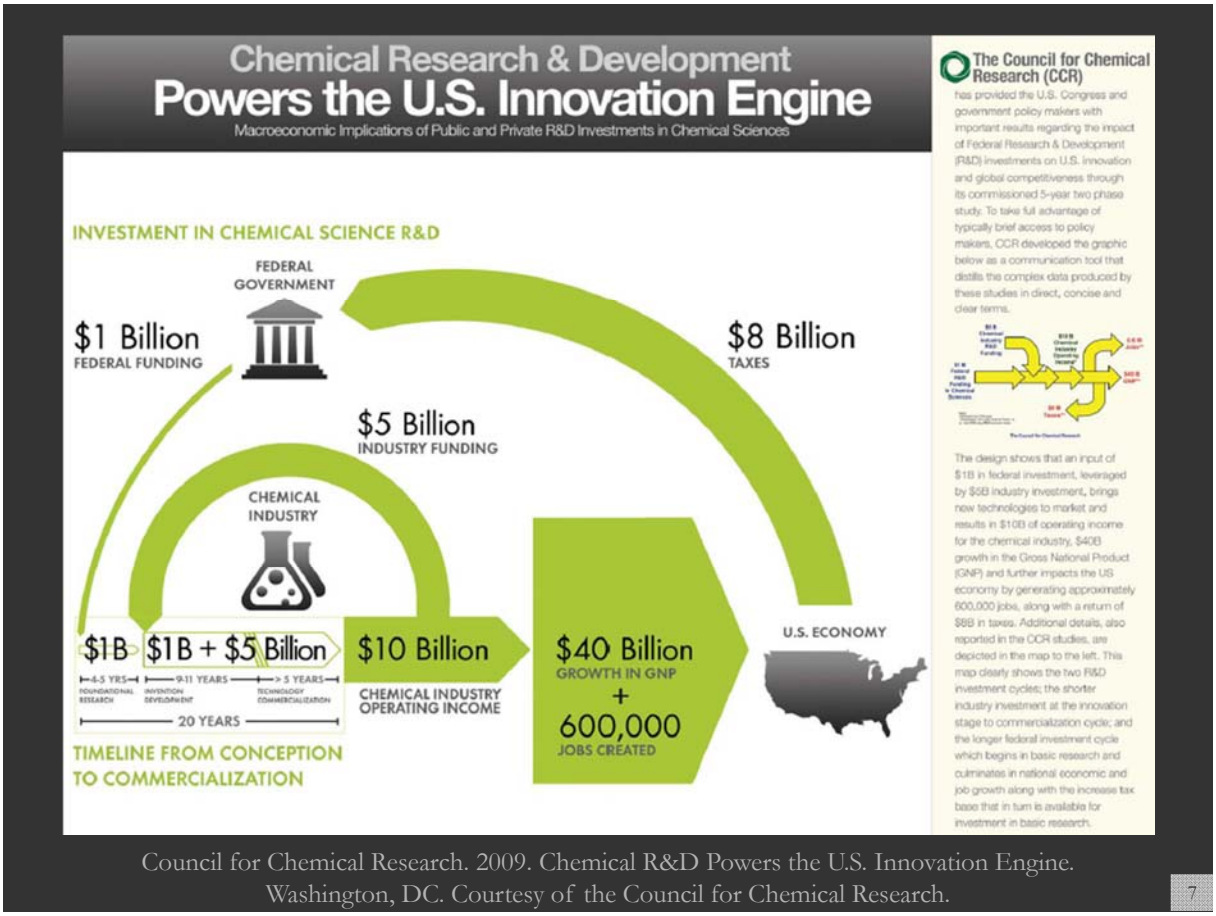
- Identification of scientific frontiers http://www.science-frontiers.com/.
- *ISI's Essential Science Indicators* http://essentialscience.com/
- Import-export studies (Stigler, 1994).
- Evaluation of 'big science' facilities using 'converging partial indicators' (Martin, 1996; Martin & Irvine, 1983).
- Input (levels of funding, expertise of scientists, facilities used) - output (publications, patents, Nobel prices, improved health, reduced environment insults, etc. - influenced by political, economic, financial, and legal factors studies (Kostroff & DelRio, 2001).
- Determine influence of funding on research output (Boyack & Borner, 2002).
- How to write highly influential paper (van Dalen & Henkens, 2001).

Process Models of Science

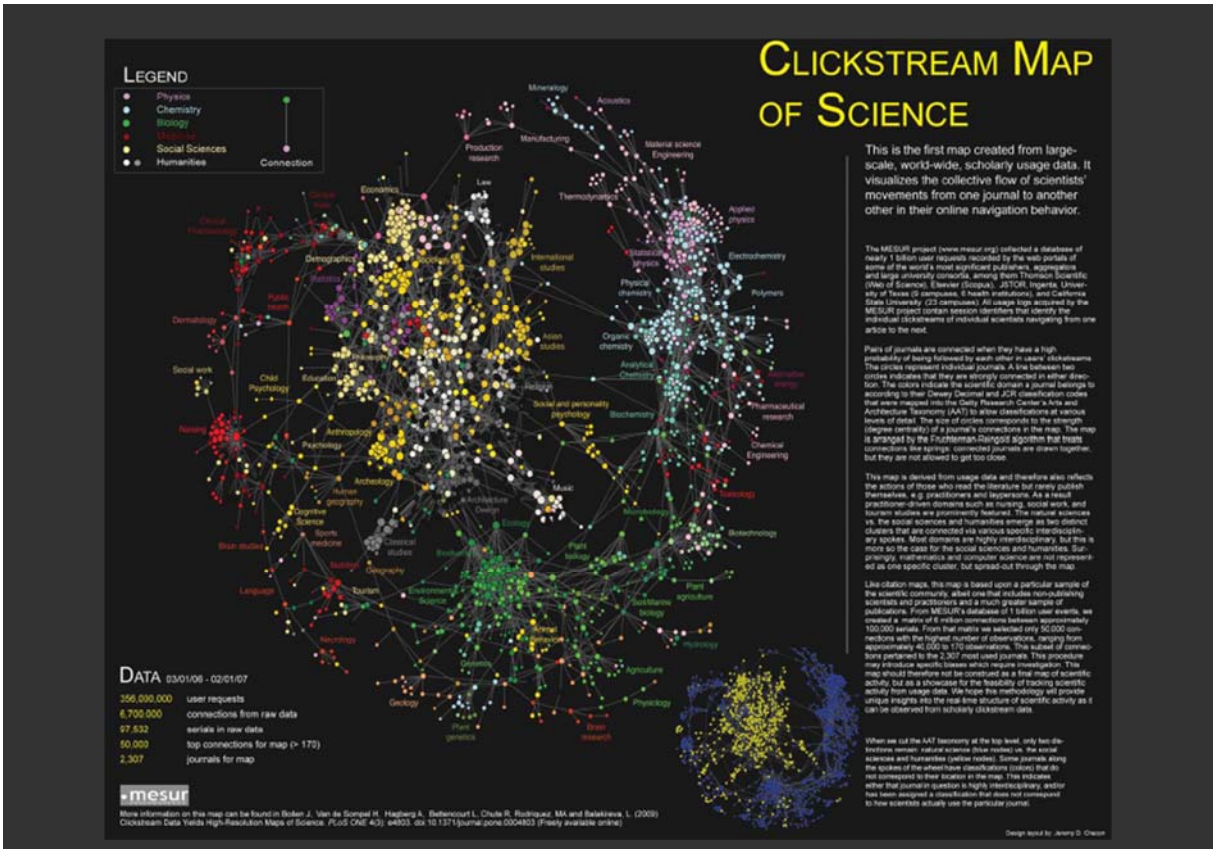
Can be used to predict the effects of

- Large collaborations vs. single author research on information diffusion.
- Different publishing mechanisms, e.g., E-journals vs. books on co-authorship, speed of publication, etc.
- Supporting disciplinary vs. interdisciplinary collaborations.
- Many small vs. one large grant on # publications, Ph.D. students, etc.
- Resource distribution on research output.
- …

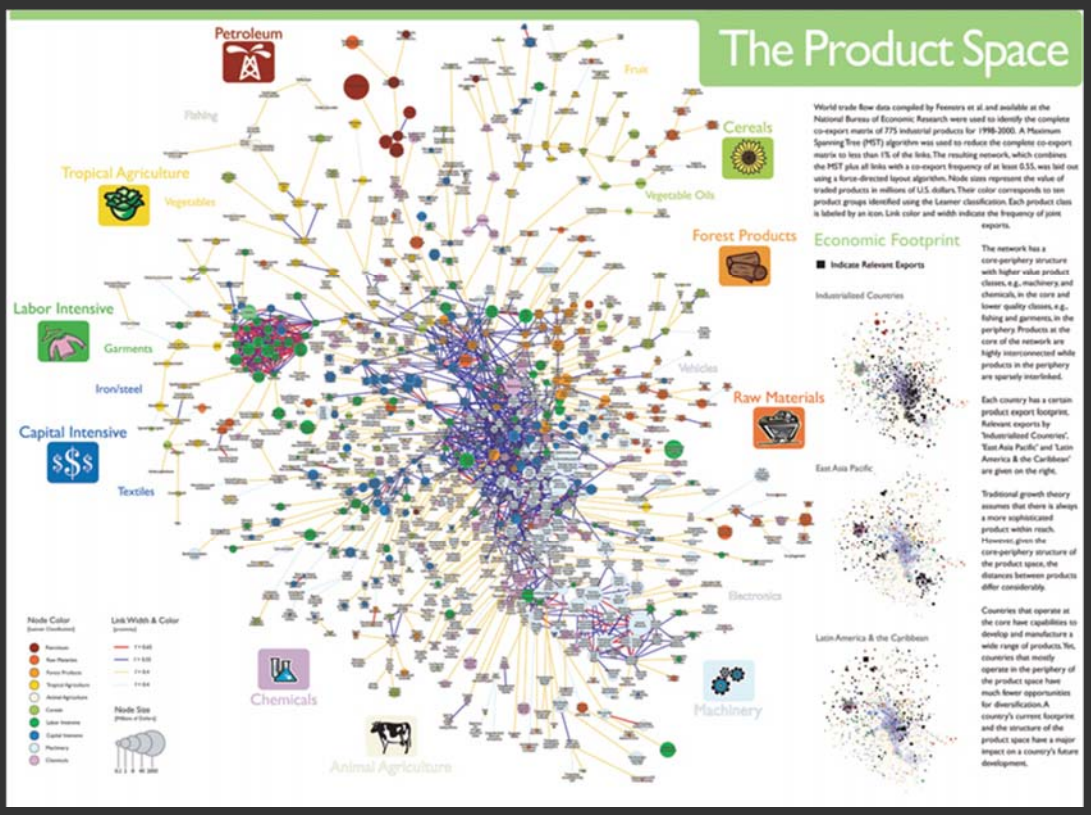
In general, process model provide a means to analyze the structure and dynamics of science -- to study science using the scientific methods of science as suggested by Derek J. deSolla Price about 40 years ago.



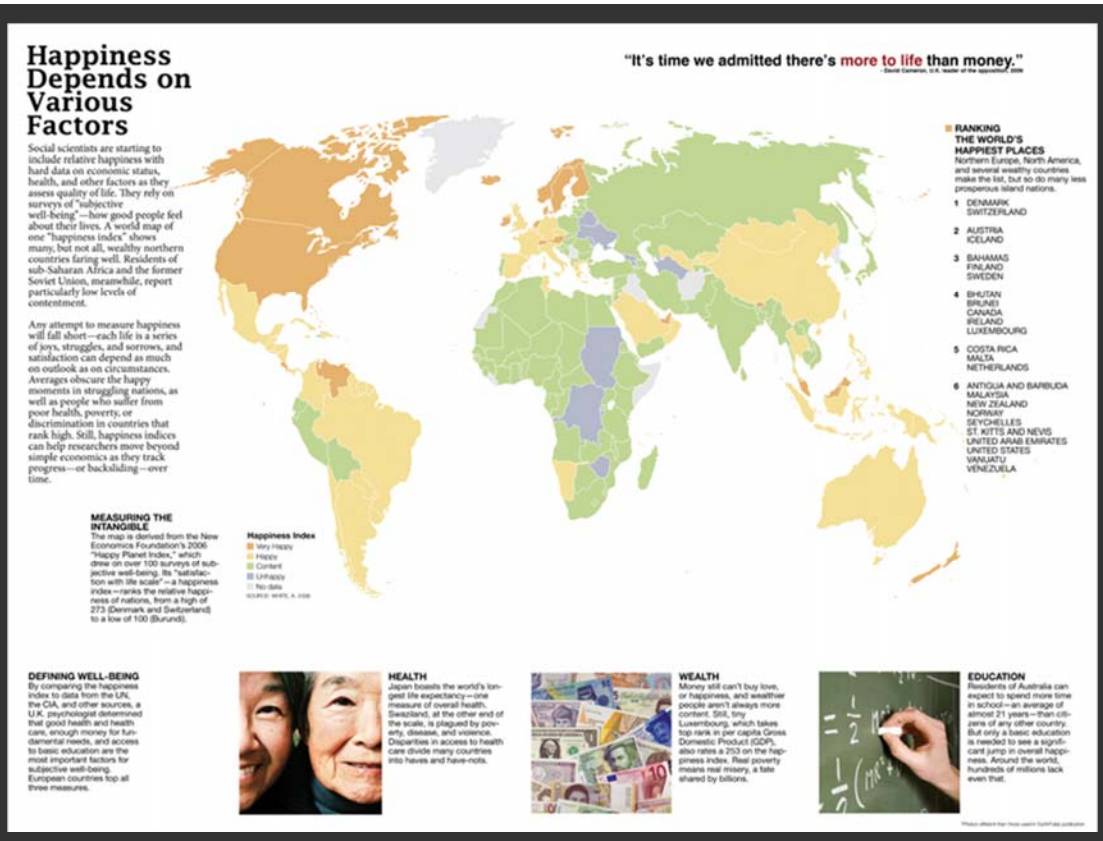
Council for Chemical Research. 2009. Chemical R&D Powers the U.S. Innovation Engine. Washington, DC. Courtesy of the Council for Chemical Research.



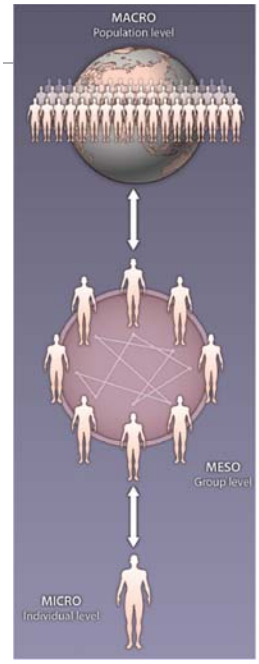
Bollen, Johan, Herbert Van de Sompel, Aric Hagberg, Luis M.A. Bettencourt, Ryan Chute, Marko A. Rodriquez, Lyudmila Balakireva. 2008. A Clickstream Map of Science.



Cesar A. Hidalgo, Bailey Klinger, Albert-László Barabási , Ricardo Hausmann . 2007. The Product Space



Adrian White and the National Geographic EarthPulse Team. 2008.
A Global Projection of Subjective Well-being



TEAM SCIENCE

A Multi-Level Systems Perspective for the Science of Team Science

Katy Börner,[1*] Noshir Contractor,[2] Holly J. Falk-Krzesinski,[3] Stephen M. Fiore,[4] Kara L. Hall,[5] Joann Keyton,[6] Bonnie Spring,[7] Daniel Stokols,[8] William Trochim,[9] Brian Uzzi[10]

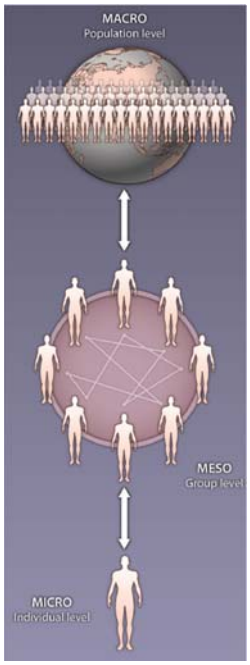
Published 15 September 2010; Volume 2 Issue 49 49cm24

This Commentary describes recent research progress and professional developments in the study of scientific teamwork, an area of inquiry termed the "science of team science" (SciTS, pronounced "sahyts"). It proposes a systems perspective that incorporates a mixed-methods approach to SciTS that is commensurate with the conceptual, methodological, and translational complexities addressed within the SciTS field. The theoretically grounded and practically useful framework is intended to integrate existing and future lines of SciTS research to facilitate the field's evolution as it addresses key challenges spanning macro, meso, and micro levels of analysis.

Science of (team) science research and practice requires an interdisciplinary, multi-level, mixed-methods approach. Expertise, theories, methods, data, and tools from diverse research fields need to be applied and advanced to arrive at a holistic understanding of the science system.

INDIANA UNIVERSITY

Börner et al. 2010. "A Multi-Level Systems Perspective for the Science of Team Science". *Science Translational Medicine* 2 (49): 49(cm)24.

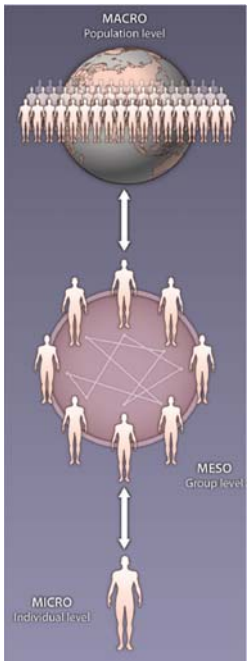


Mixed-Methods, Multi-Level Science of Science (or Team Science or SciSIP) studies need:

Expertise – identify and access it at the perfect moment using, e.g., Facebook, LinkedIn, Academia, VIVO, Harvard Profiles, Elsevier's Collexis, Loki, Stanford's CAP, or other systems.

Data – find, interlink, unify, merge, reformat, share them, e.g., using web sites analogous to http://www.diggingintodata.org/Repositories/tabid/167/Default.aspx, SDB, or LOD.

Tools – identify, learn, advance, share code, e.g., via Plug-and-Play Macroscopes, to arrive at a holistic understanding of the science system.



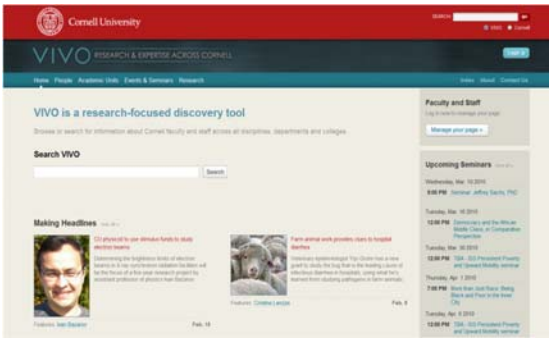
Expertise – identify and

access it at the perfect moment using, e.g., Facebook, LinkedIn, Academia, VIVO, Harvard Profiles, Elsevier's Collexis, Loki, Stanford's CAP, or other systems.

VIVO
Enabling a National Network of Scientists

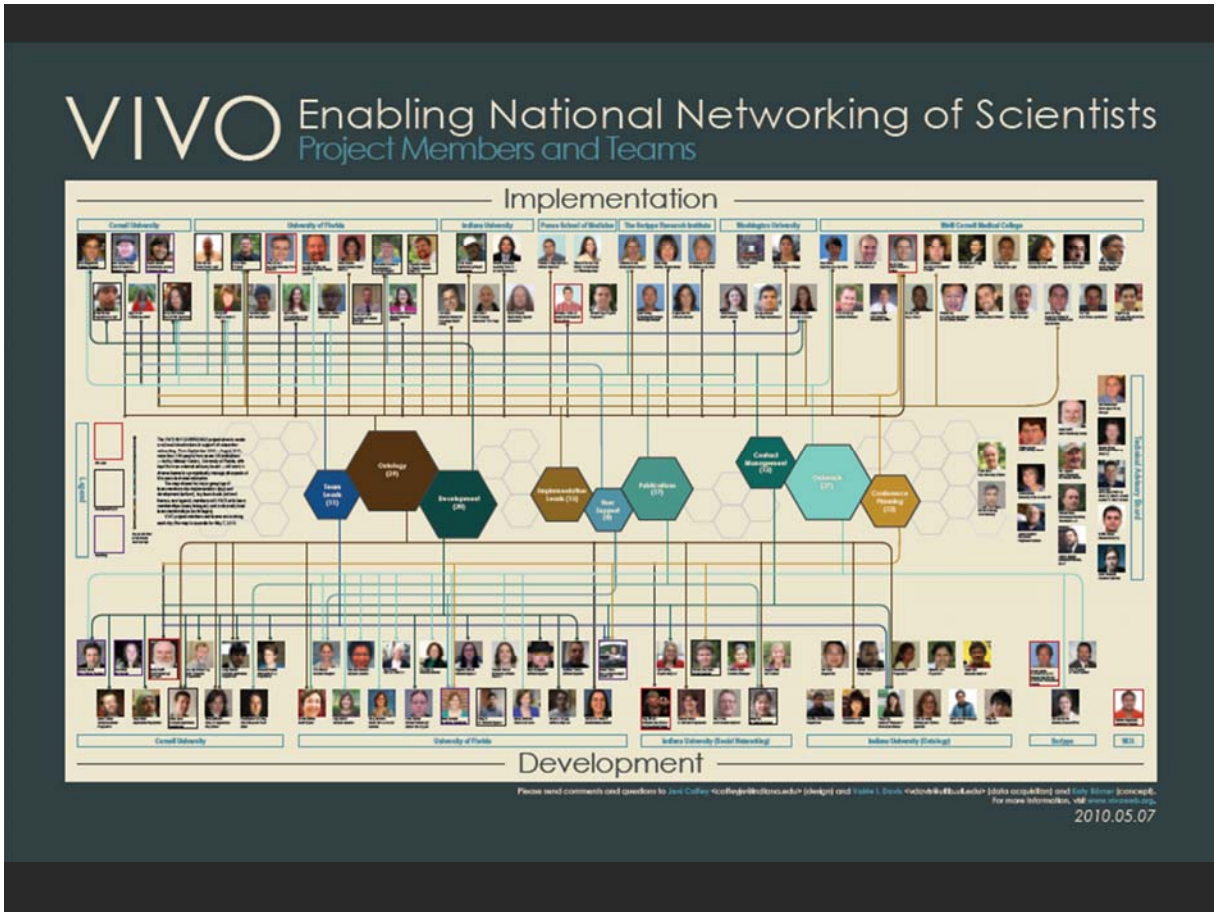
VIVO: A Semantic Approach to Creating a National Network of Researchers (http://vivoweb.org)

- 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.

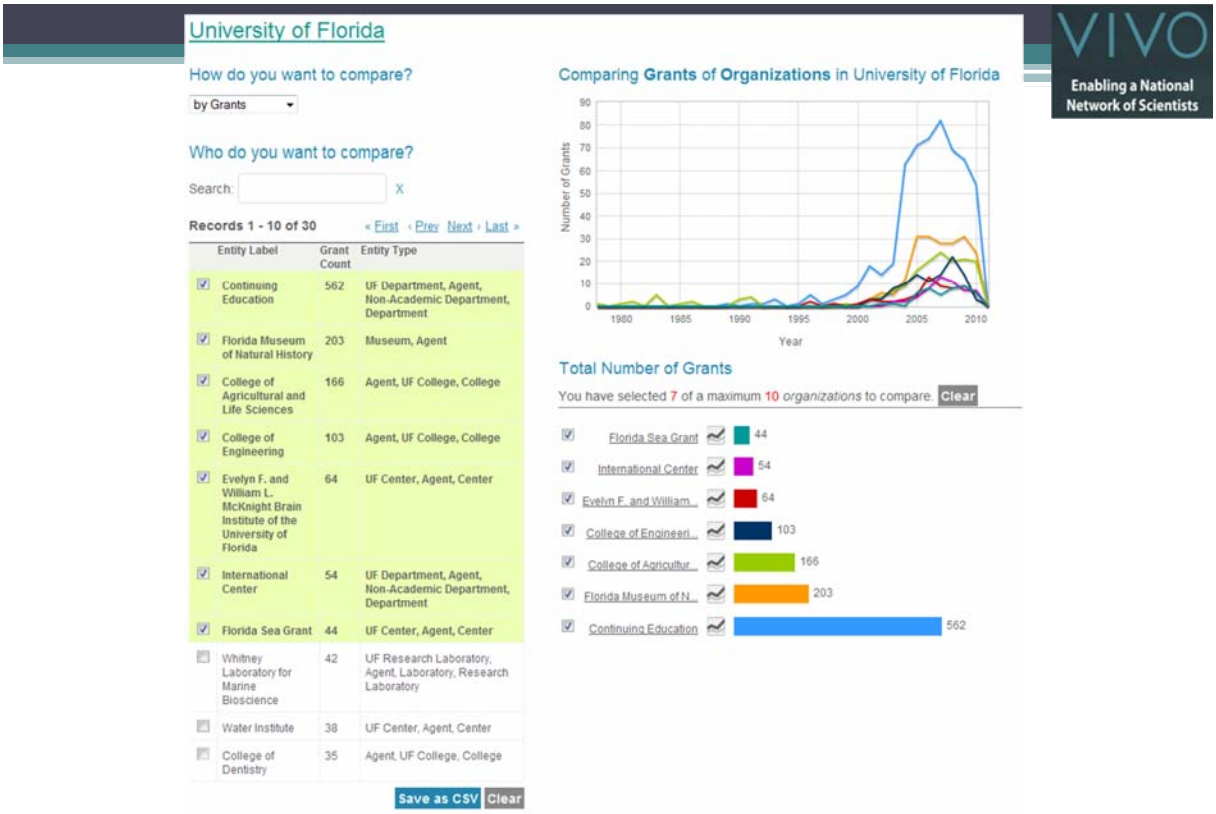


Funded by $12 million NIH award.

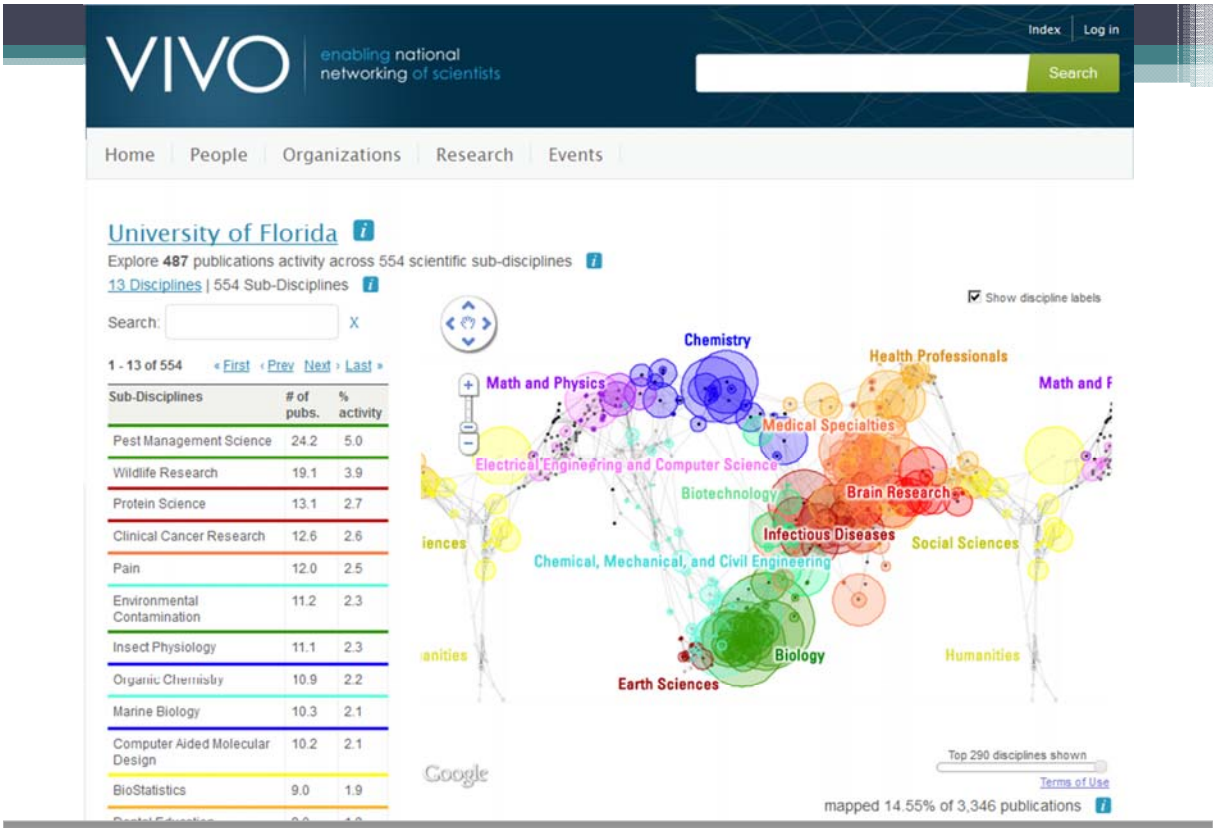
Cornell University: Dean Krafft (Cornell PI), Manolo Bevia, Jim Blake, Nick Cappadona, Brian Caruso, Jon Corson-Rikert, Elly Cramer, Medha Devare, John Fereira, Brian Lowe, Stella Mitchell, Holly Mistlebauer, Anup Sawant, Christopher Westling, Rebecca Younes. **University of Florida:** Mike Conlon (VIVO 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.



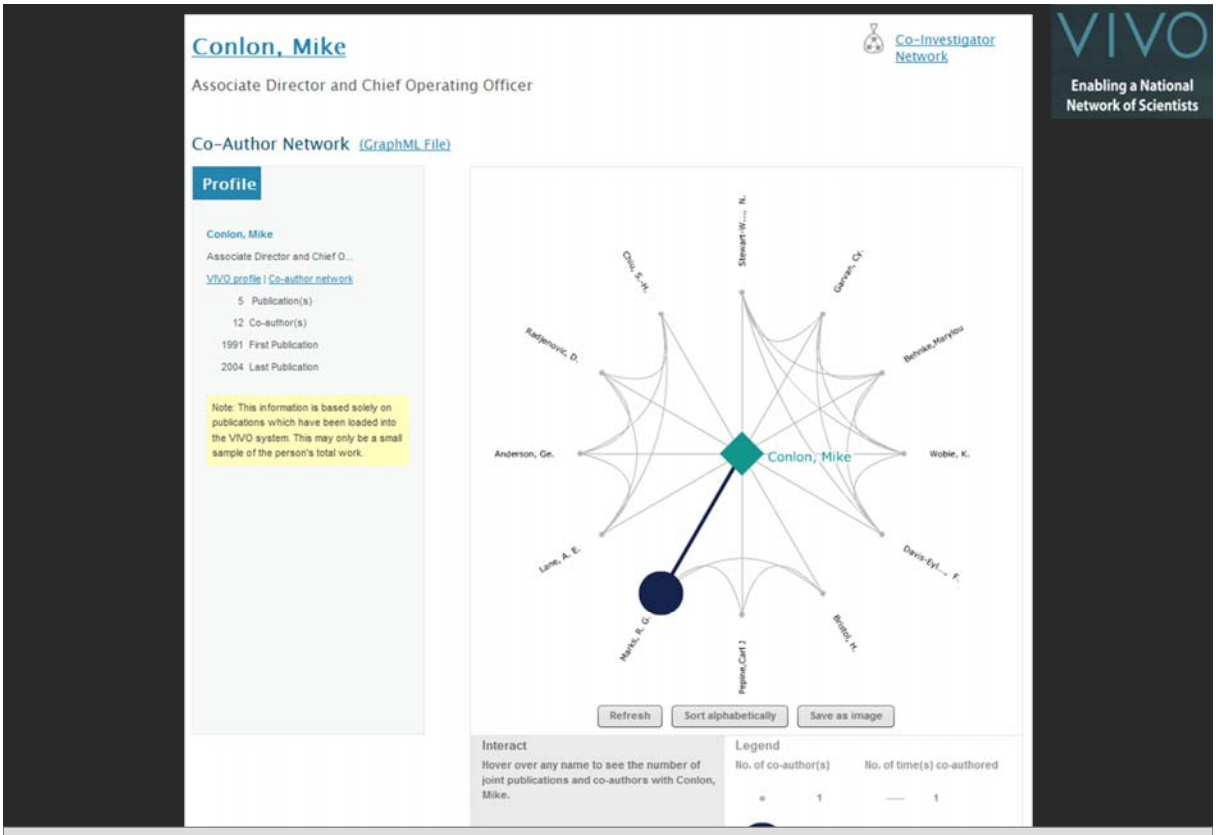
UF Clinical and Translational Science Institute
UNIVERSITY of FLORIDA



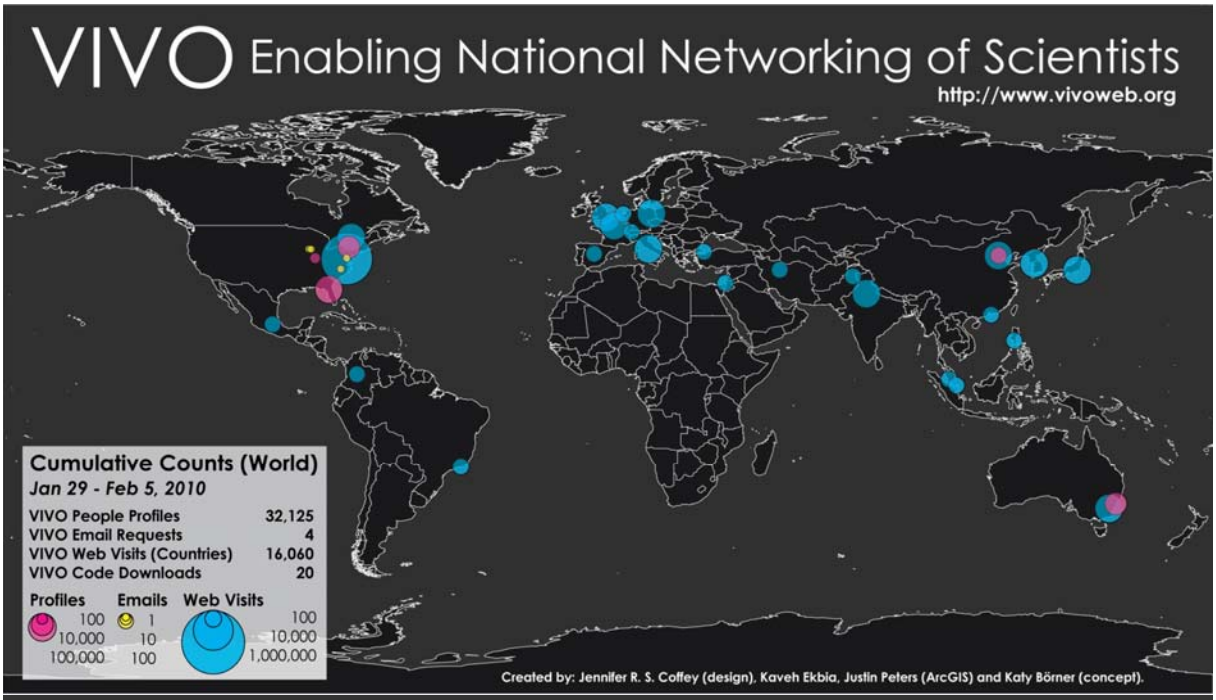
Temporal Analysis (When) Temporal visualizations of the number of papers/funding award at the institution, school, department, and people level



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

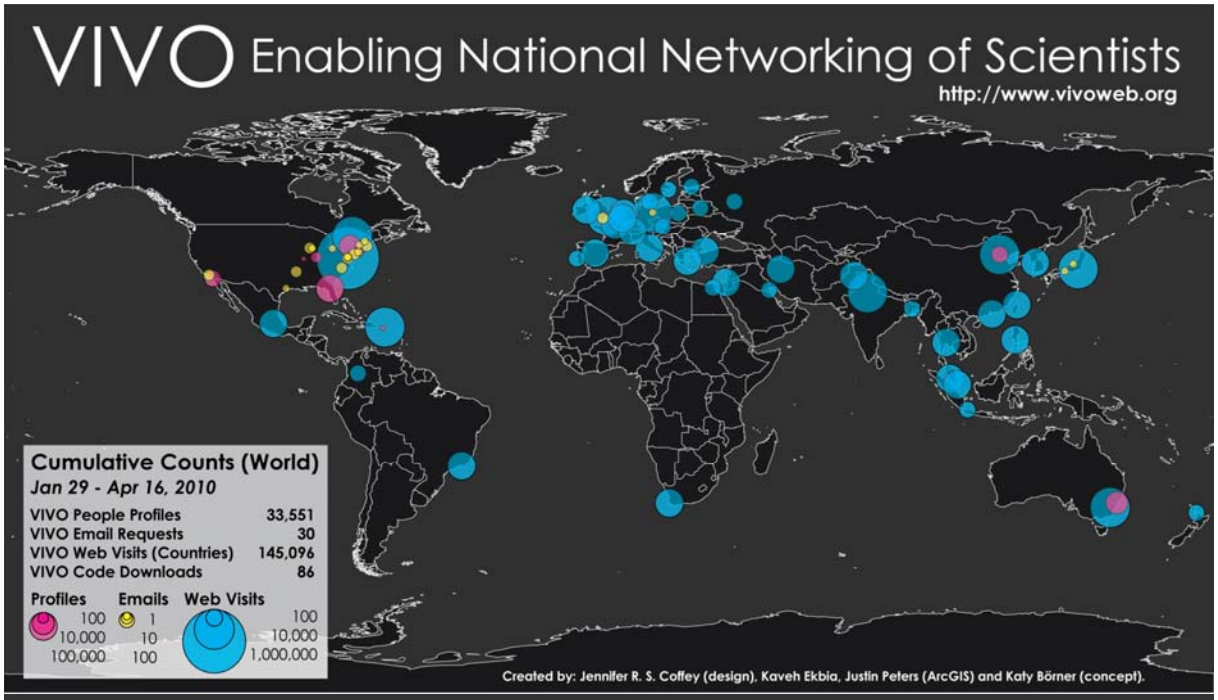


Network Analysis (With Whom?) Who is co-authoring, co-investigating, co-inventing with whom? What teams are most productive in what projects?



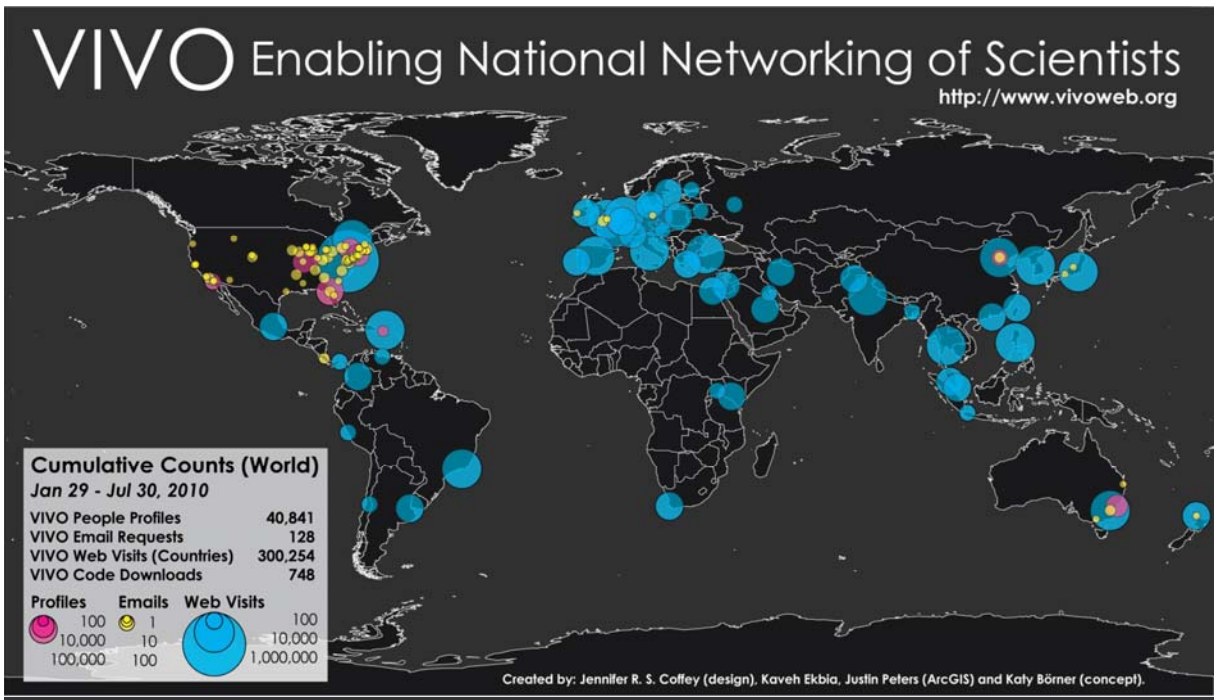
Science is global. World view of VIVO activity.
Web site visits are aggregated at the country level.

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



Shown are the
- Number of people profiles in the 7 different VIVO installation sites plus CAS and U Melbourne.
- Email contacts by data and service providers as well as institutions interested to adopt VIVO.
- The number of visitors on http://vivoweb.org

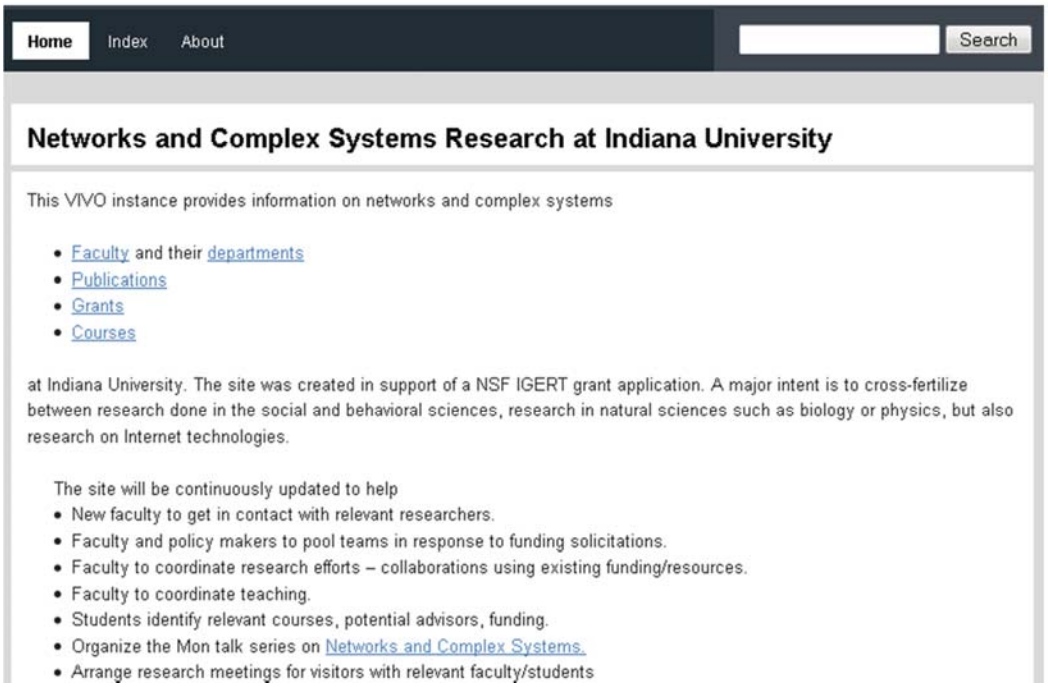
Circles are area size coded using a logarithmic scale.



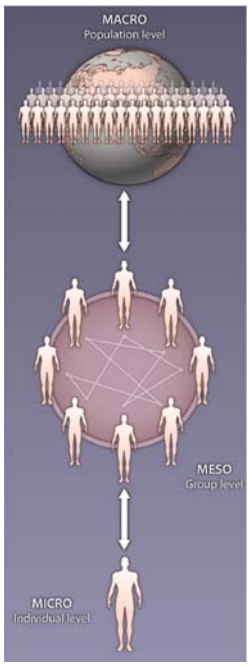
VIVO 1.0 source code was publicly released on April 14, 2010
87 downloads by June 11, 2010.
The more institutions adopt VIVO, the more high quality data will be available to understand, navigate, manage, utilize, and communicate progress in science and technology.

VIVO enabling national networking of scientists

VIVO Enabling a National Network of Scientists



http://vivo-netsci.cns.iu.edu



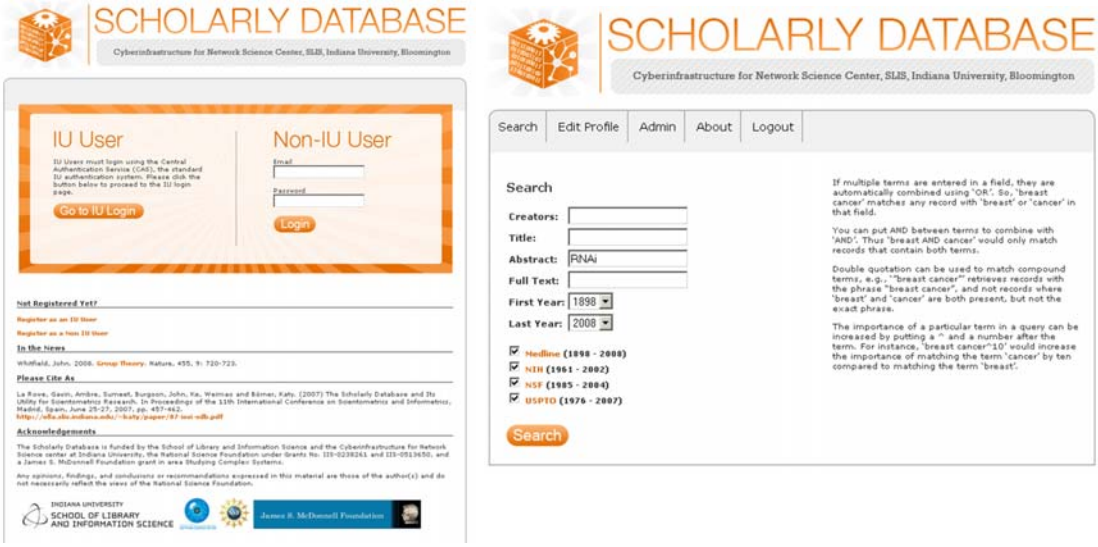
Data – find, access, interlink, unify,

merge, reformat, share them, e.g., using web sites analogous to http://www.diggingintodata.org/Repositories/tabid/167/Default.aspx, SDB, or LOD.

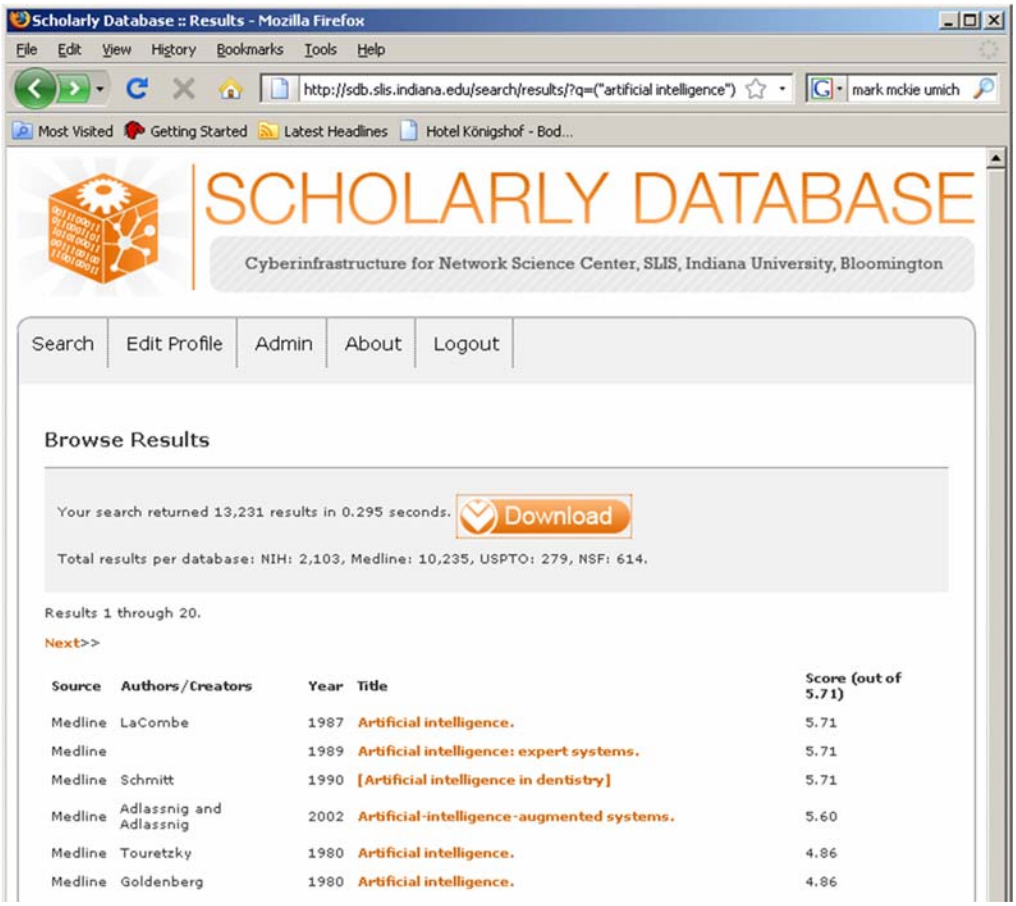
Scholarly Database at Indiana University

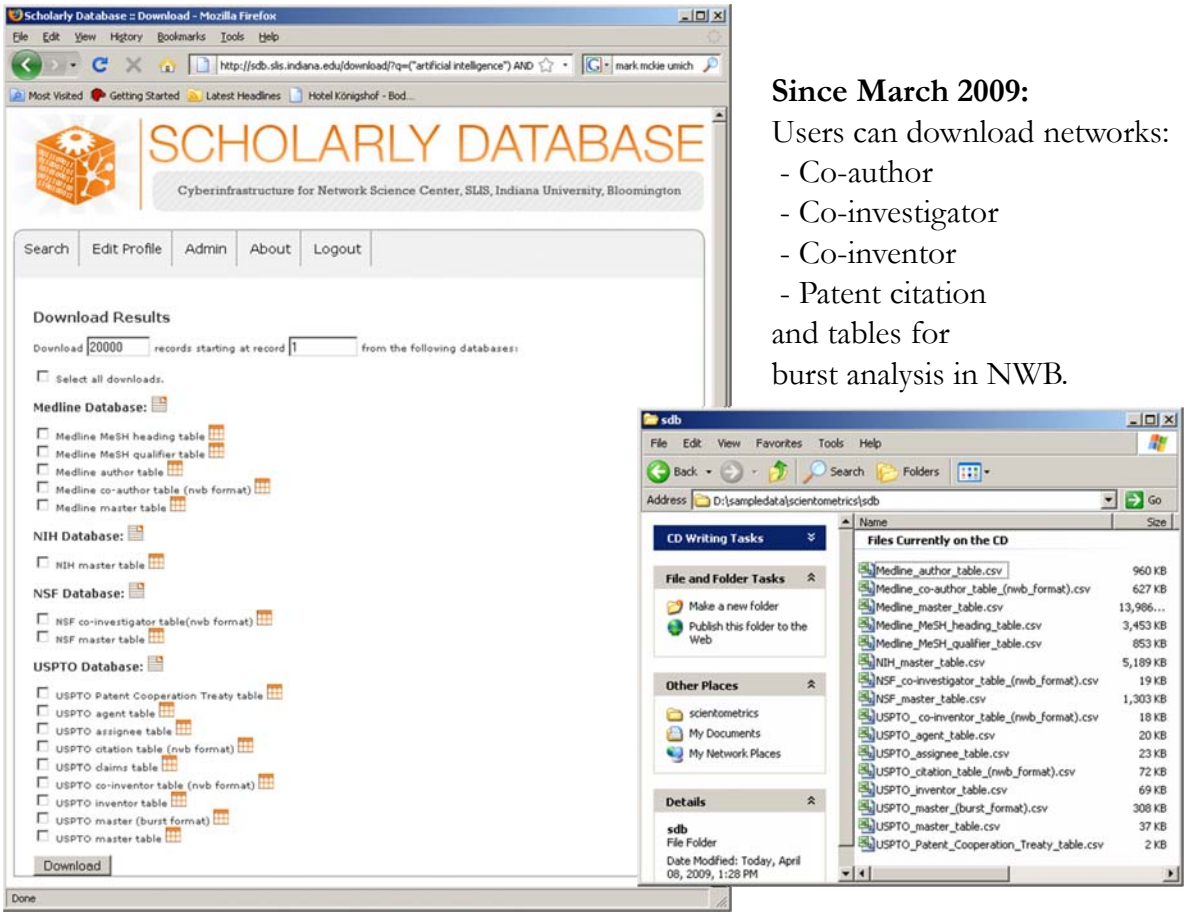
http://sdb.wiki.cns.iu.edu

Supports federated search of 25 million publication, patent, grant records.
Results can be downloaded as data dump and (evolving) co-author, paper-citation networks.



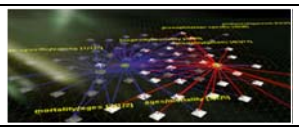
Register for free access at http://sdb.cns.iu.edu





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

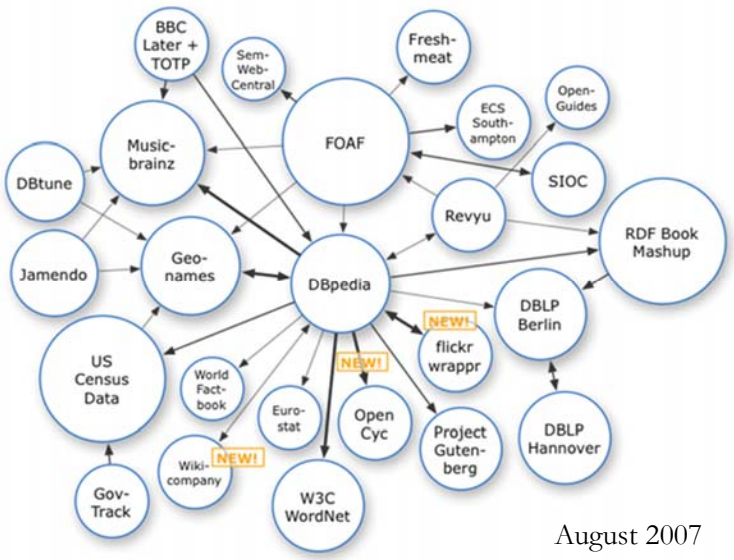
and tables for
burst analysis in NWB.



Semantic Web: Linked Open Data

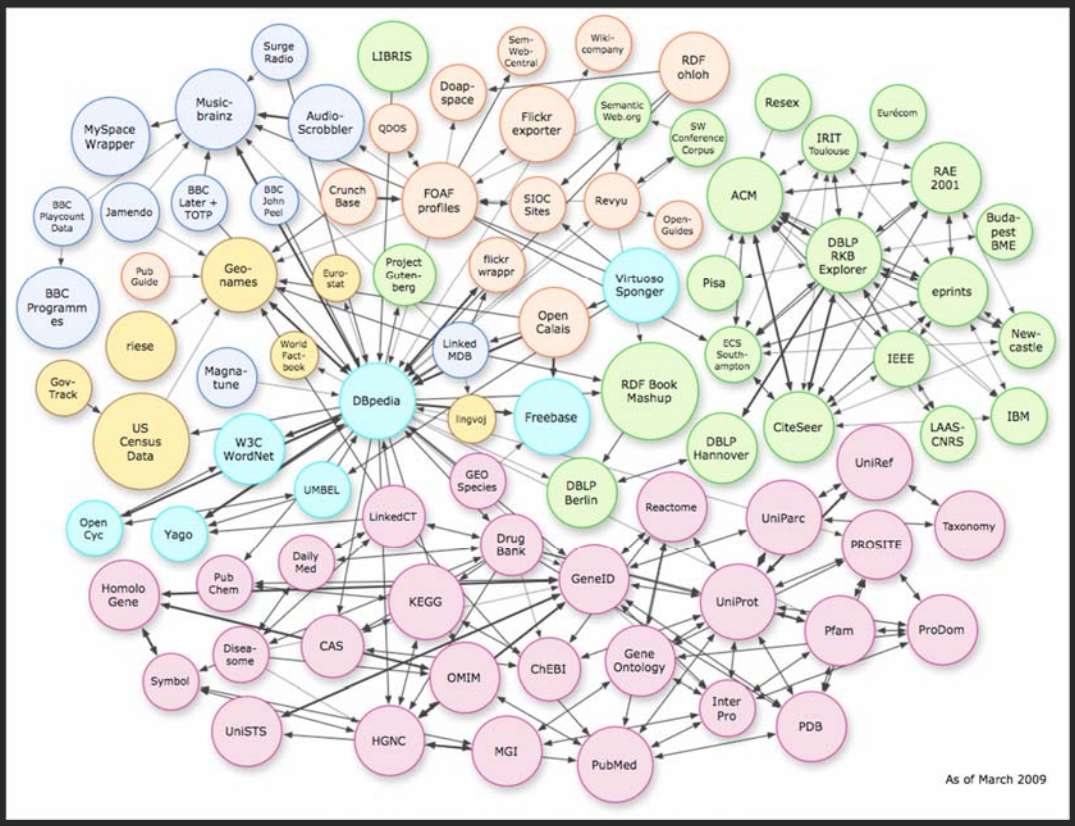
- Interlinking existing data silos and
- Exposing them as structured data
- Adding new high quality data relevant for S&T studies

http://linkeddata.org

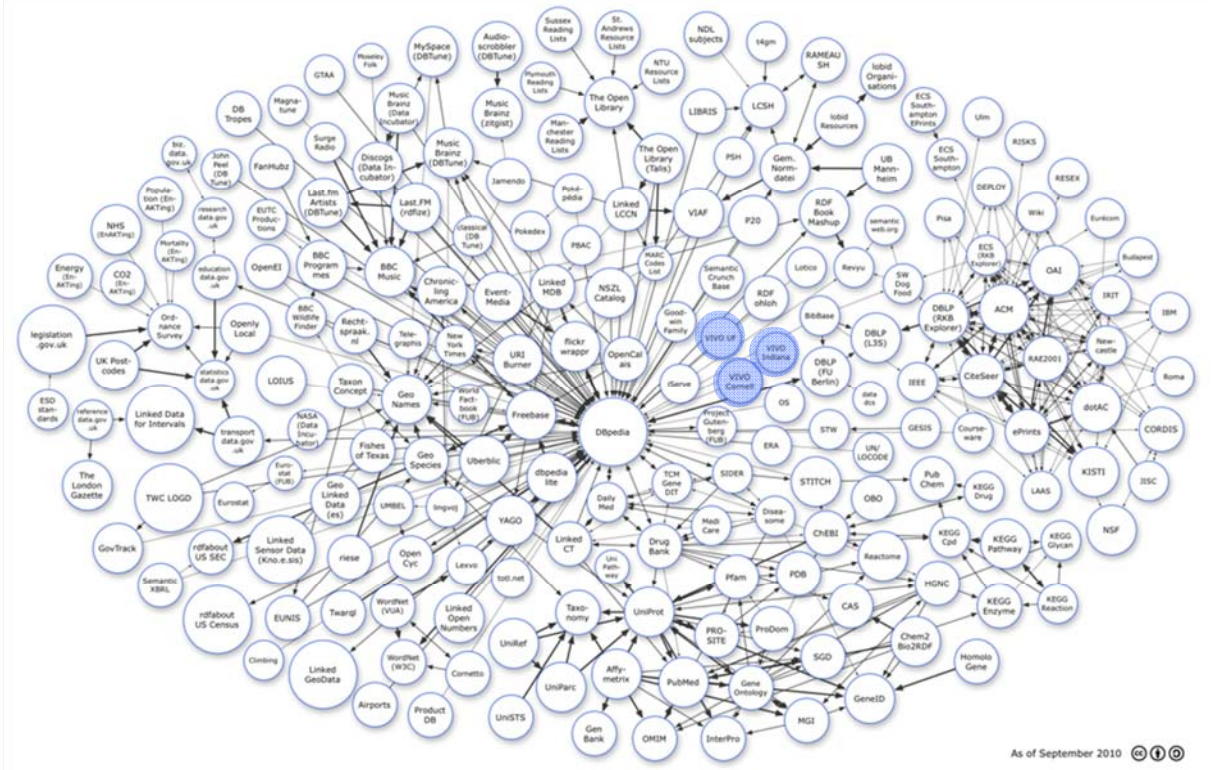


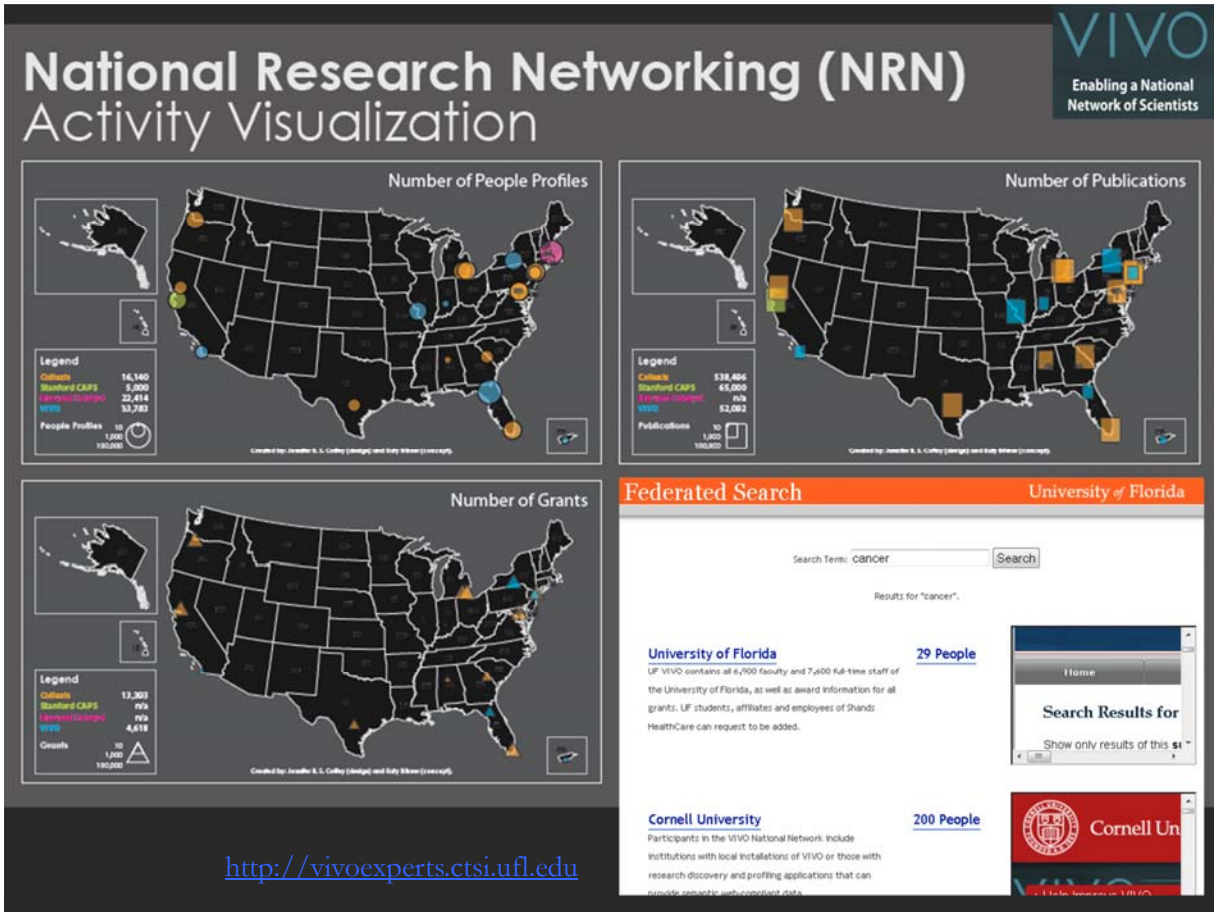
Save Data.gov, sign the petition at
http://om.ly/BRPRE

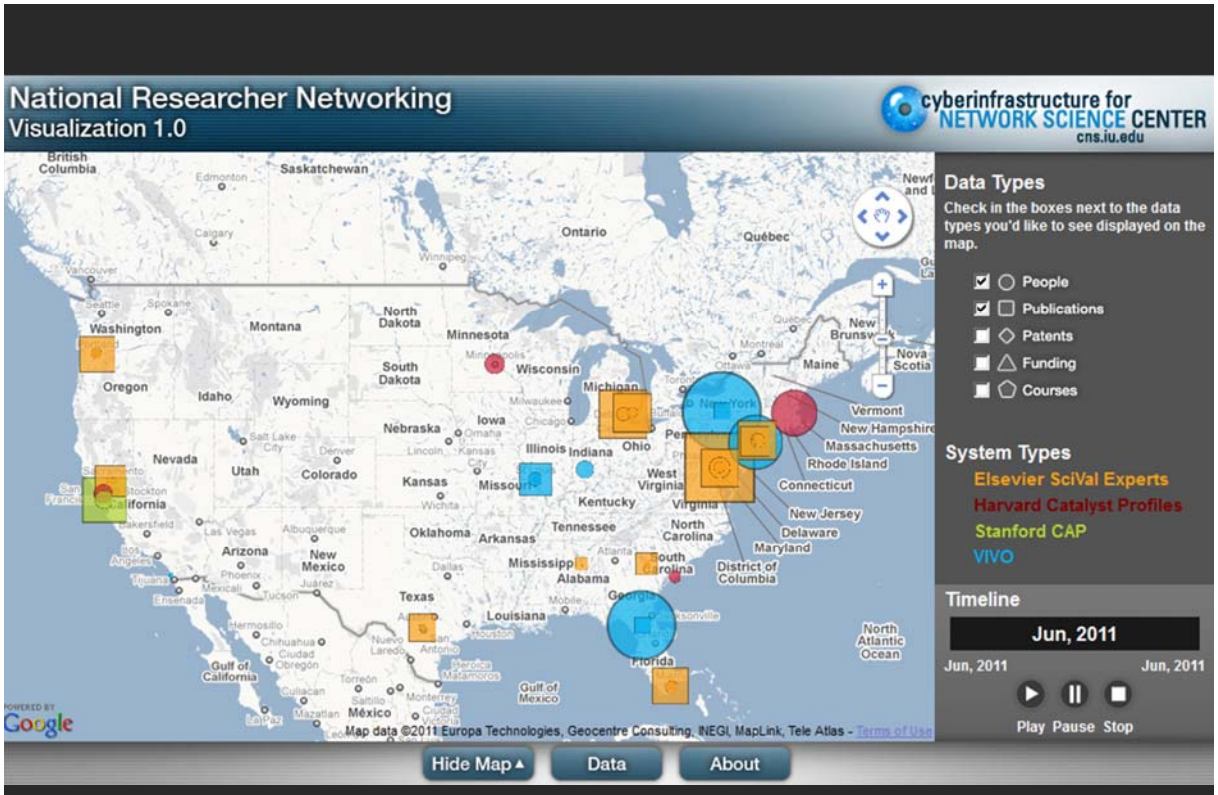
Twitter
#savethedata

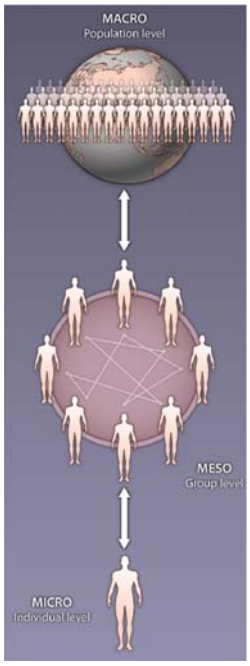


http://www4.wiwiss.fu-berlin.de/bizer/pub/lod-datasets_2009-03-05_colored.png



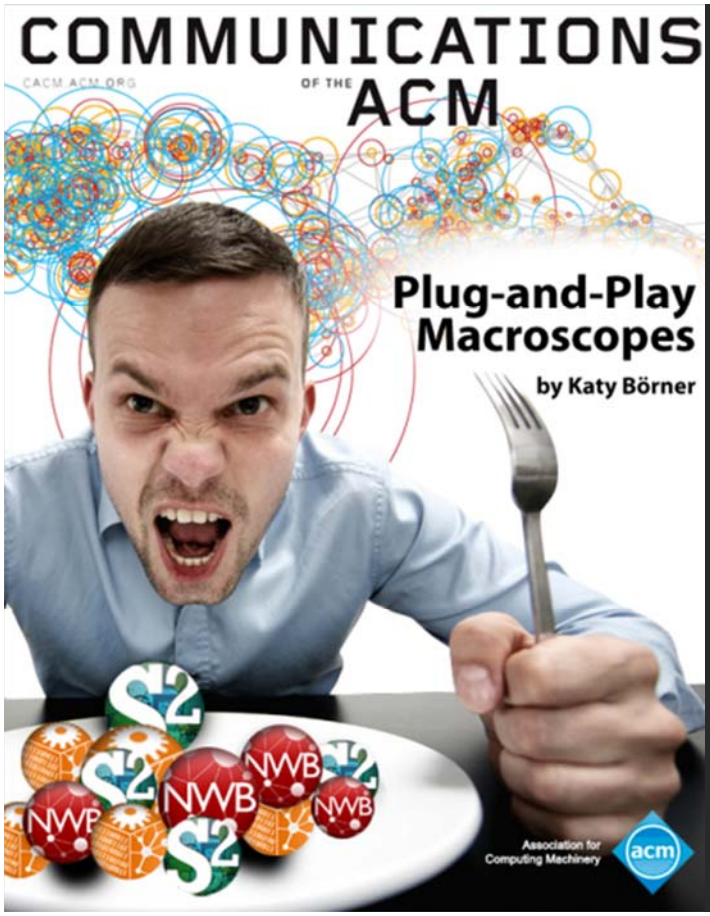

National Research Networking (NRN)
Activity Visualization
VIVO
Enabling a National Network of Scientists
Number of People Profiles
Number of Publications
Number of Grants
Federated Search
University of Florida
Search Term: cancer
Search
Results for "cancer".
University of Florida
29 People
Cornell University
200 People
http://vivoexperts.ctsi.ufl.edu


National Researcher Networking
Visualization 1.0
cyberinfrastructure for NETWORK SCIENCE CENTER
cns.iu.edu
Data Types
Check in the boxes next to the data types you'd like to see displayed on the map.
People
Publications
Patents
Funding
Courses
System Types
Elsevier SciVal Experts
Harvard Catalyst Profiles
Stanford CAP
VIVO
Timeline
Jun, 2011
Jun, 2011
Jun, 2011
Play Pause Stop
Hide Map
Data
About
http://nrn.cns.iu.edu



Tools – continuously identify, learn,

advance, share code, e.g., via Plug-and-Play Macroscopes



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

Designing "Dream Tools"

Many of the best micro-, tele-, and macroscopes are designed by **scientists keen to observe and comprehend what no one has seen or understood before.** Galileo Galilei (1564–1642) recognized the potential of a spyglass for the study of the heavens, ground and polished his own lenses, and used the improved optical instruments to make discoveries like the moons of Jupiter, providing quantitative evidence for the Copernican theory.

Today, scientists **repurpose, extend, and invent new hardware and software** to create **"macroscopes"** that may solve both local and global challenges.

Plug-and-play macroscopes **empower** me, my students, colleagues, and 100,000 others that downloaded them.

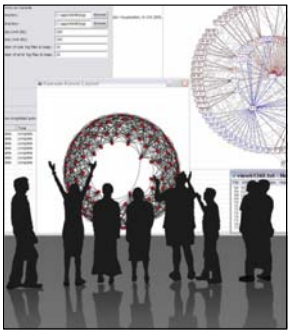
Macroscopes

Decision making in science, industry, and politics, as well as in daily life, requires that we make sense of data sets representing the structure and dynamics of complex systems. Analysis, navigation, and management of these continuously evolving data sets require a new kind of data-analysis and visualization tool we call a macroscope (from the Greek macros, or "great," and skopein, or "to observe") inspired by de Rosnay's futurist science writings.

Macroscopes provide a "vision of the whole," helping us "synthesize" the related elements and enabling us to detect patterns, trends, and outliers while granting access to myriad details. Rather than make things larger or smaller, **macroscopes let us observe what is at once too great, slow, or complex for the human eye and mind to notice and comprehend.**

Microscopes

Telescopes



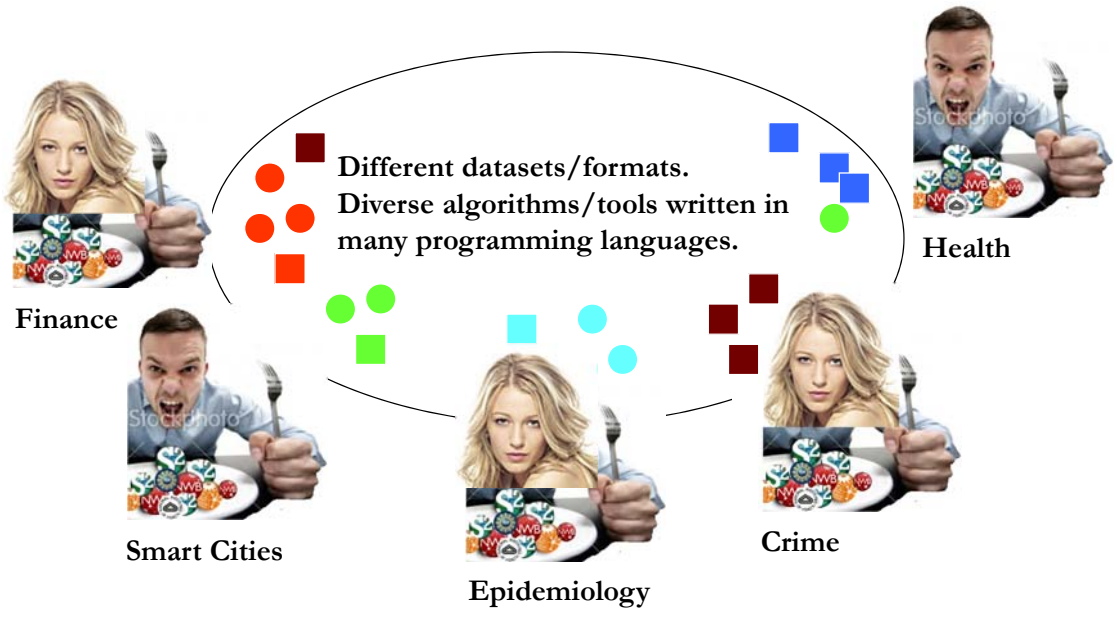
Macroscopes

Macroscopes cont.

While microscopes and telescopes are physical instruments, **macroscopes resemble continuously changing bundles of software plug-ins.** Macroscopes make it easy to select and combine algorithm and tool plug-ins but also interface plug-ins, workflow support, logging, scheduling, and other plug-ins needed for scientifically rigorous yet effective work.

They make it easy to share plug-ins via email, flash drives, or online. To use new plugins, simply copy the files into the plug-in directory, and they appear in the tool menu ready for use. No restart of the tool is necessary. **Sharing algorithm components, tools, or novel interfaces becomes as easy as sharing images on Flickr or videos on YouTube. Assembling custom tools is as quick as compiling your custom music collection.**

Macroscopes Serve the Changing Scientific Landscape



Related Work

Google Code and SourceForge.net provide special means for developing and distributing software

- In August 2009, SourceForge.net hosted more than 230,000 software projects by two million registered users (285,957 in January 2011);
- In August 2009 ProgrammableWeb.com hosted 1,366 application programming interfaces (APIs) and 4,092 mashups (2,699 APIs and 5,493 mashups in January 2011)

Cyberinfrastructures serving large biomedical communities

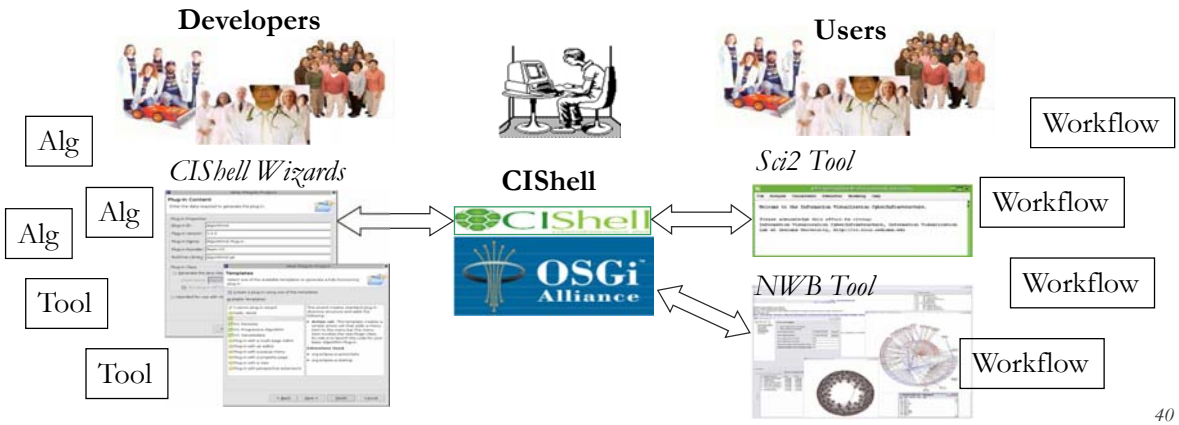
- Cancer Biomedical Informatics Grid (caBIG) (http://cabig.nci.nih.gov)
- Biomedical Informatics Research Network (BIRN) (http://nbirn.net)
- Informatics for Integrating Biology and the Bedside (i2b2) (https://www.i2b2.org)
- HUBzero (http://hubzero.org) platform for scientific collaboration uses
- myExperiment (http://myexperiment.org) supports the sharing of scientific workflows and other research objects.

Missing so far is a **common standard** for

- the design of **modular, compatible algorithm and tool plug-ins** (also called "modules" or "components")
- that can be **easily combined into scientific workflows** ("pipeline" or "composition"),
- and packaged as **custom tools.**

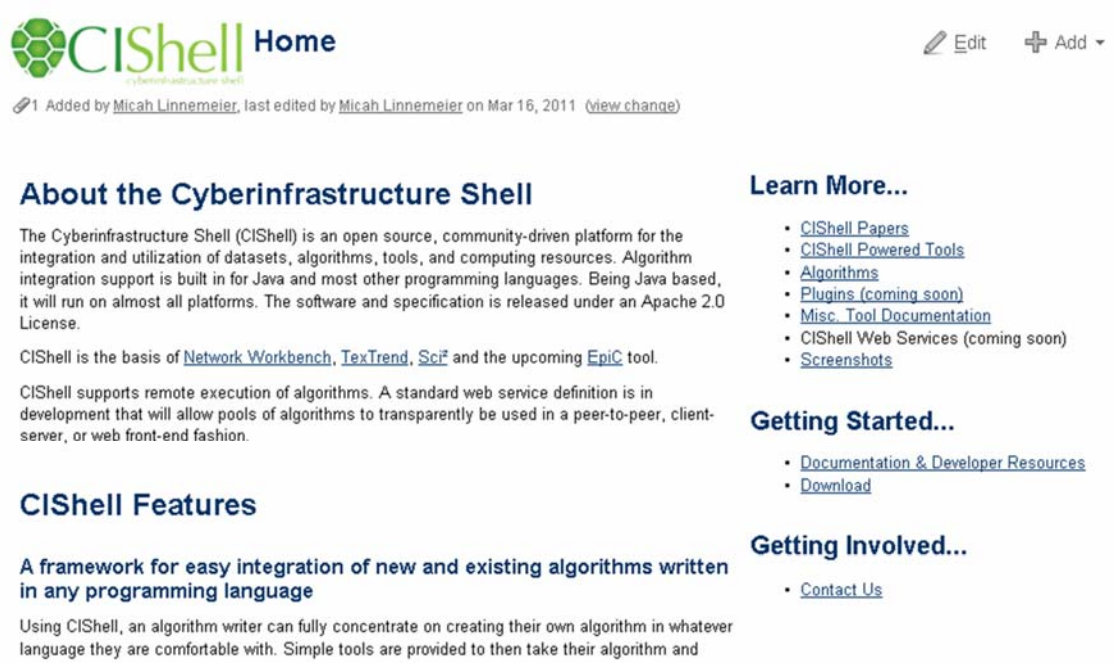
OSGi & CIShell

- 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.

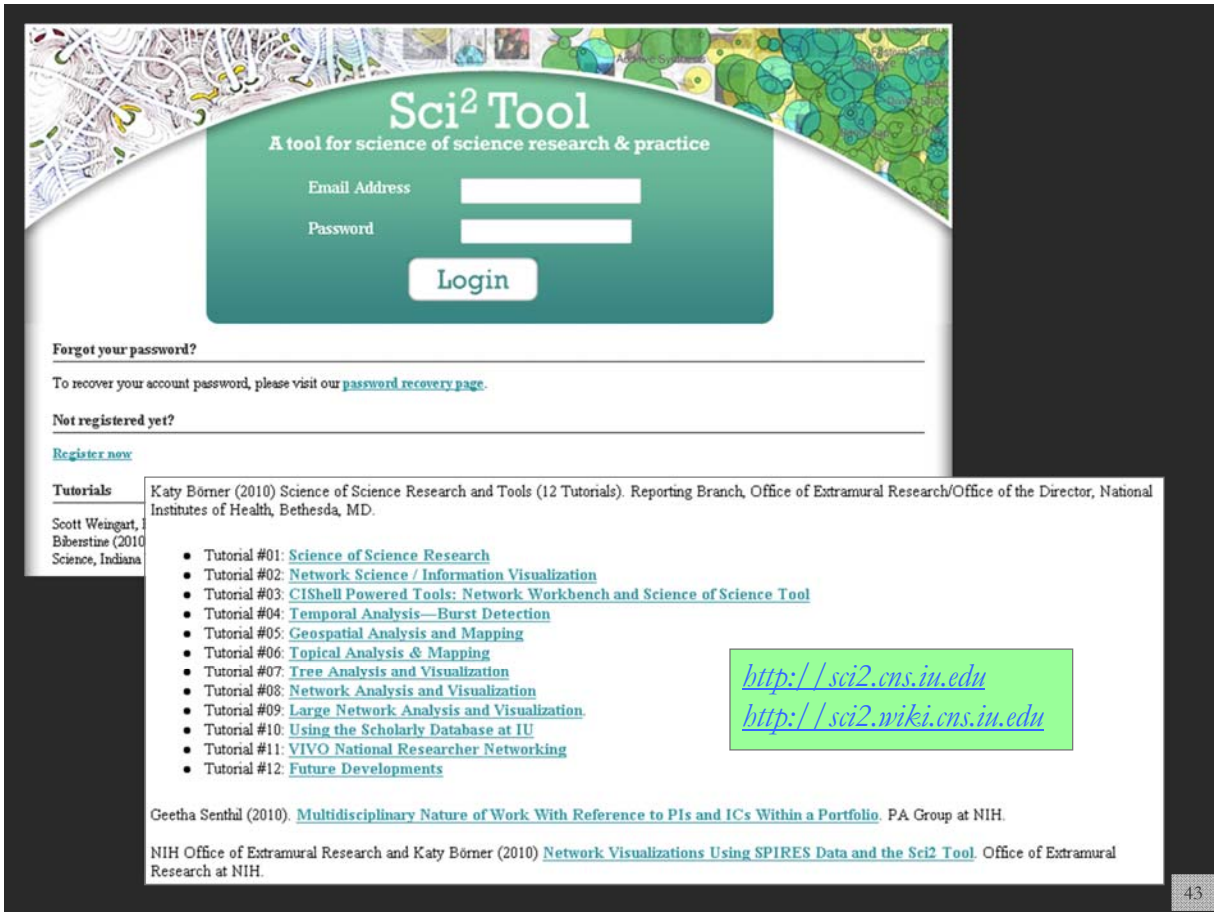


CIShell Developer Guide

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

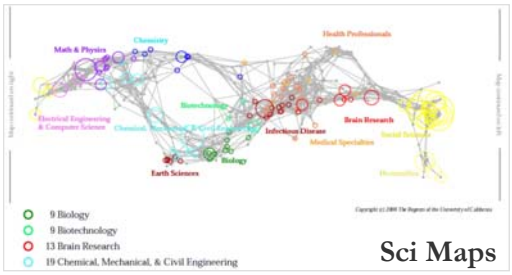


CIShell Portal (http://cishell.org)

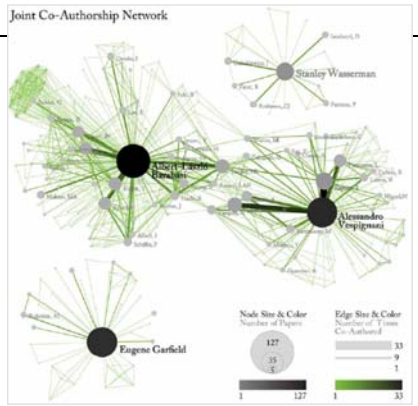


Sci² Tool – "Open Code for S&T Assessment"

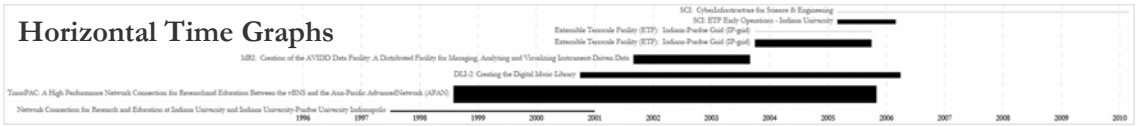
OSGi/CIShell powered tool with NWB plugins and many new scientometrics and visualizations plugins.



Sci Maps

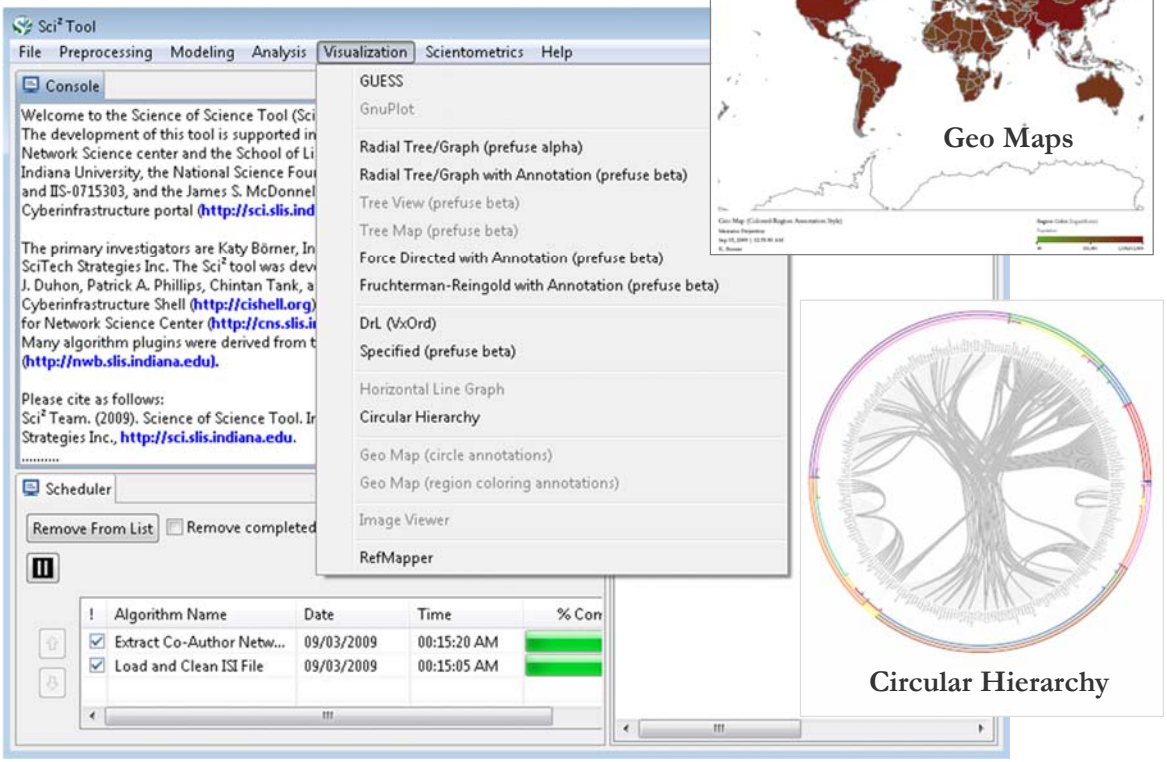


GUESS Network Vis



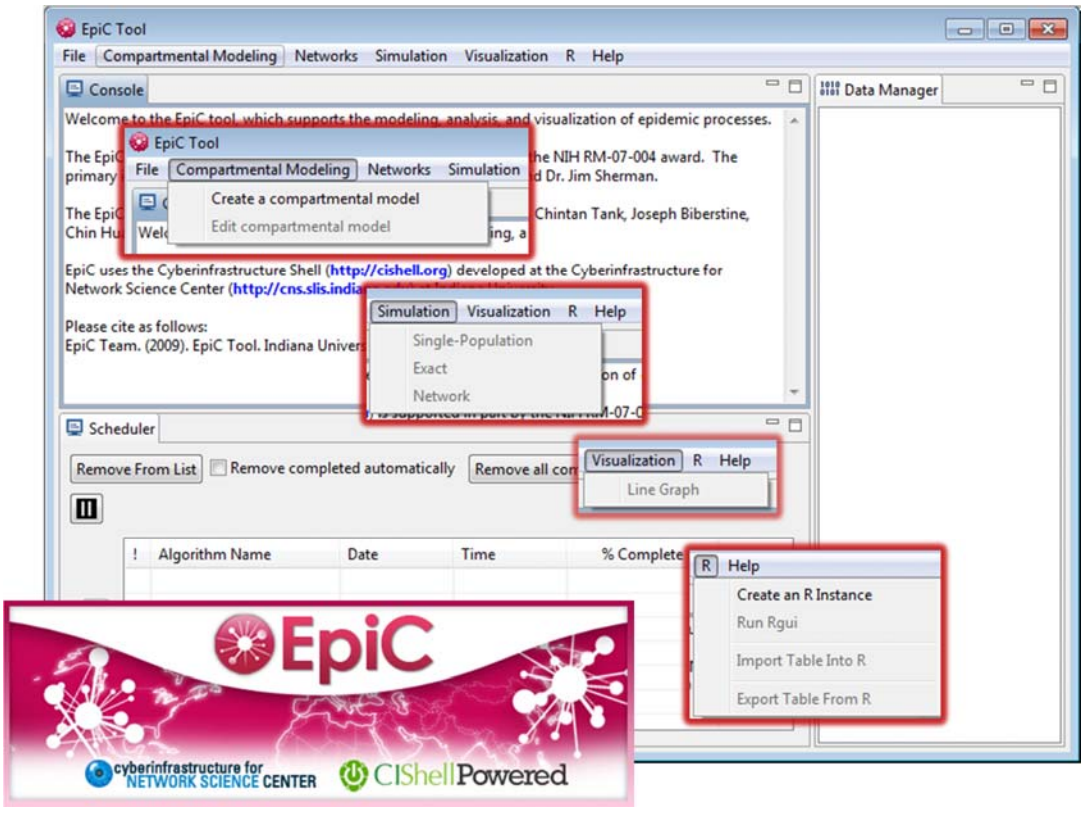
Börner, Katy, Huang, Weixia (Bonnie), Linnemeier, Micah, Duhon, Russell Jackson, Phillips, Patrick, Ma, Nianli, Zoss, Angela, Guo, Hanning & Price, Mark. (2009). Rete-Netzwerk-Red: Analyzing and Visualizing Scholarly Networks Using the Scholarly Database and the Network Workbench Tool. Proceedings of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

Sci² Tool


Sci² Tool
File Preprocessing Modeling Analysis Visualization Scientometrics Help
Console
GUESS
GnuPlot
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 Line Graph
Circular Hierarchy
Geo Map (circle annotations)
Geo Map (region coloring annotations)
Image Viewer
RefMapper
Scheduler
Remove From List
Remove completed
Algorithm Name
Date
Time
Extract Co-Author Netw...
09/03/2009
00:15:20 AM
Load and Clean ISI File
09/03/2009
00:15:05 AM

Geo Maps

Circular Hierarchy


EpiC Tool
File Compartmental Modeling Networks Simulation Visualization R Help
Console
Data Manager
Create a compartmental model
Edit compartmental model
Single-Population
Exact
Network
Visualization R Help
Line Graph
Scheduler
Remove From List
Remove completed automatically
Algorithm Name
Date
Time
% Complete
R Help
Create an R Instance
Run Rgui
Import Table Into R
Export Table From R
EpiC
cyberinfrastructure for NETWORK SCIENCE CENTER
CIShell Powered

OSGi/CIShell Adoption

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

USA

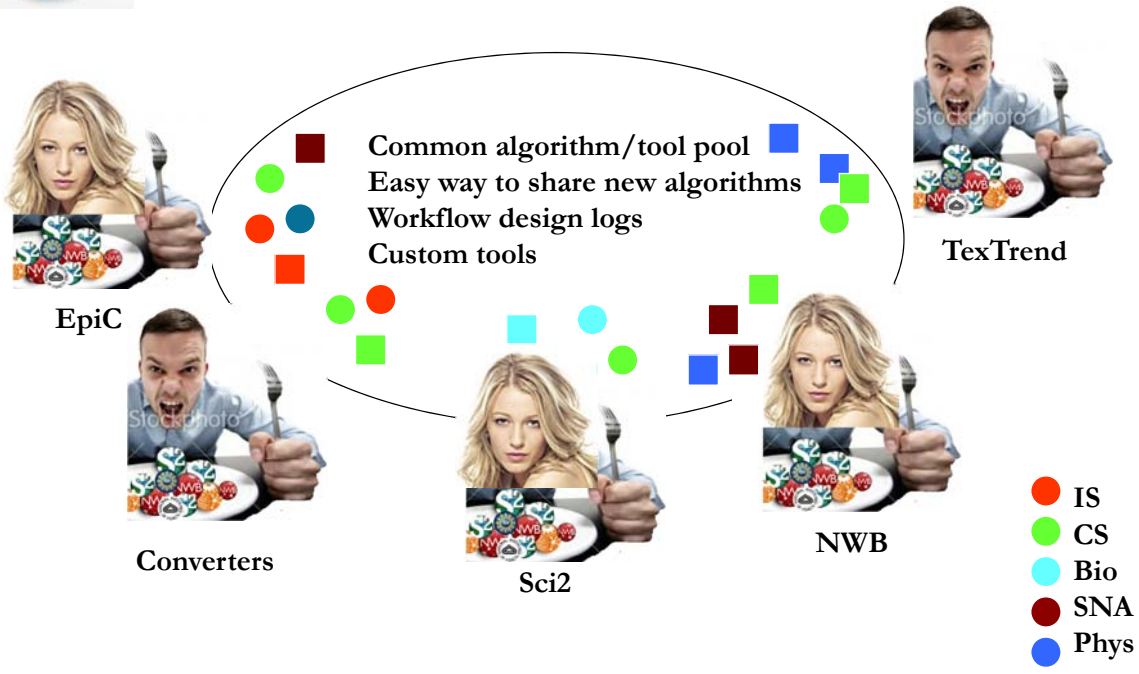
- *Cytoscape (http://cytoscape.org)* Led by Trey Ideker at the University of California, San Diego is an open source bioinformatics software platform for visualizing molecular interaction networks and integrating these interactions with gene expression profiles and other state data (Shannon et al., 2002).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

Embrace the Changing Scientific Landscape



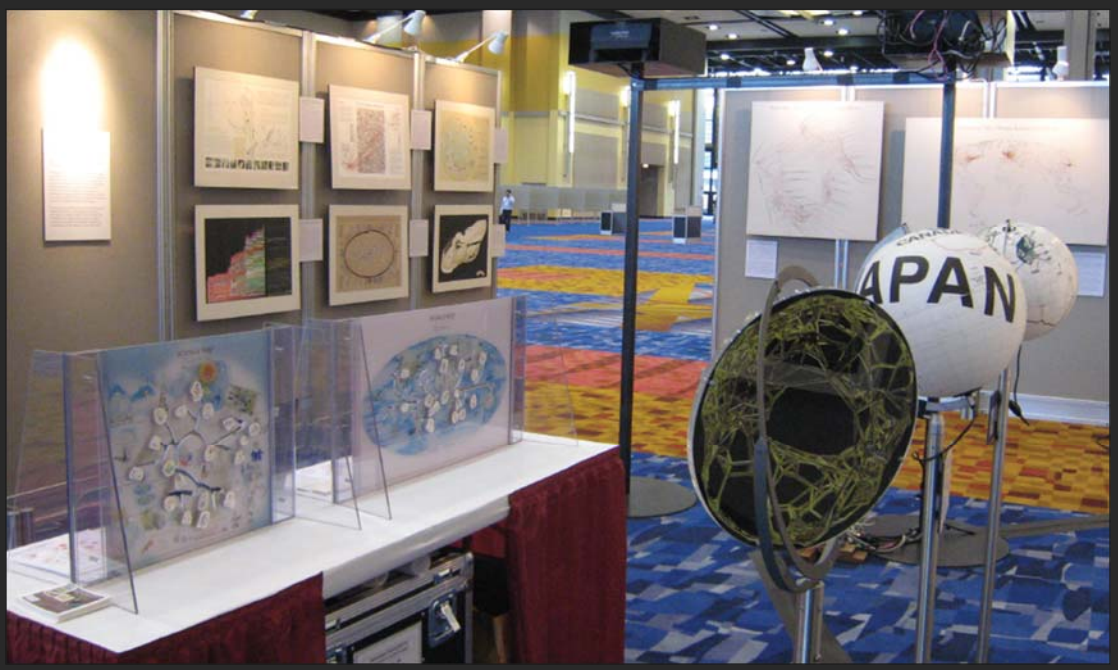
Few have access to or time to visit
"Visualization Domes"

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

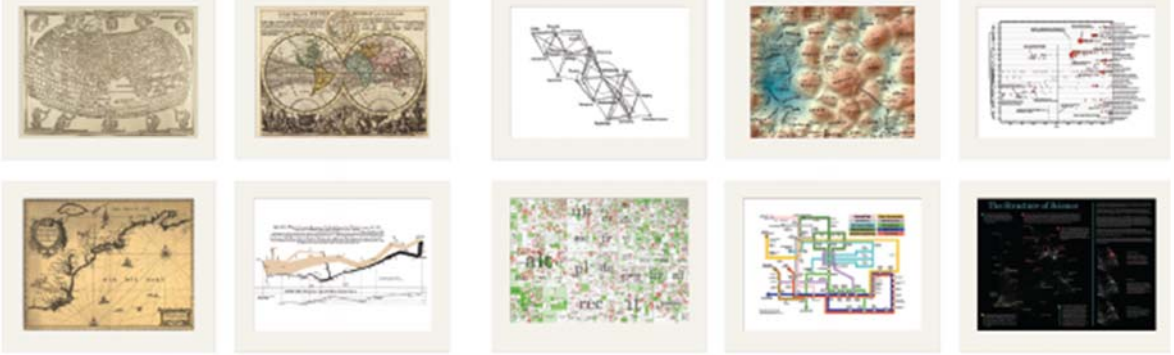
INDIANA UNIVERSITY

Mapping Science Exhibit – 10 Iterations in 10 years

http://scimaps.org/



The Power of Maps 2005



The Power of Reference Systems 2006

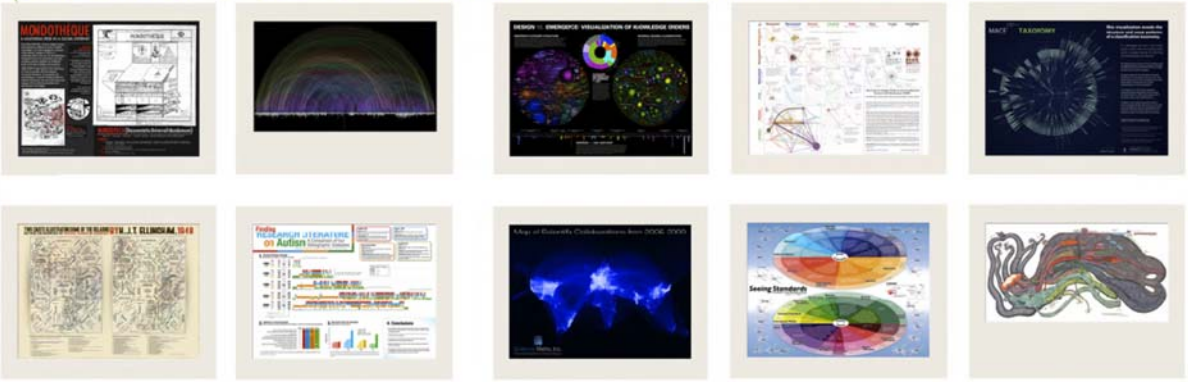
The Power of Forecasts 2007

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 Lieraries 2011



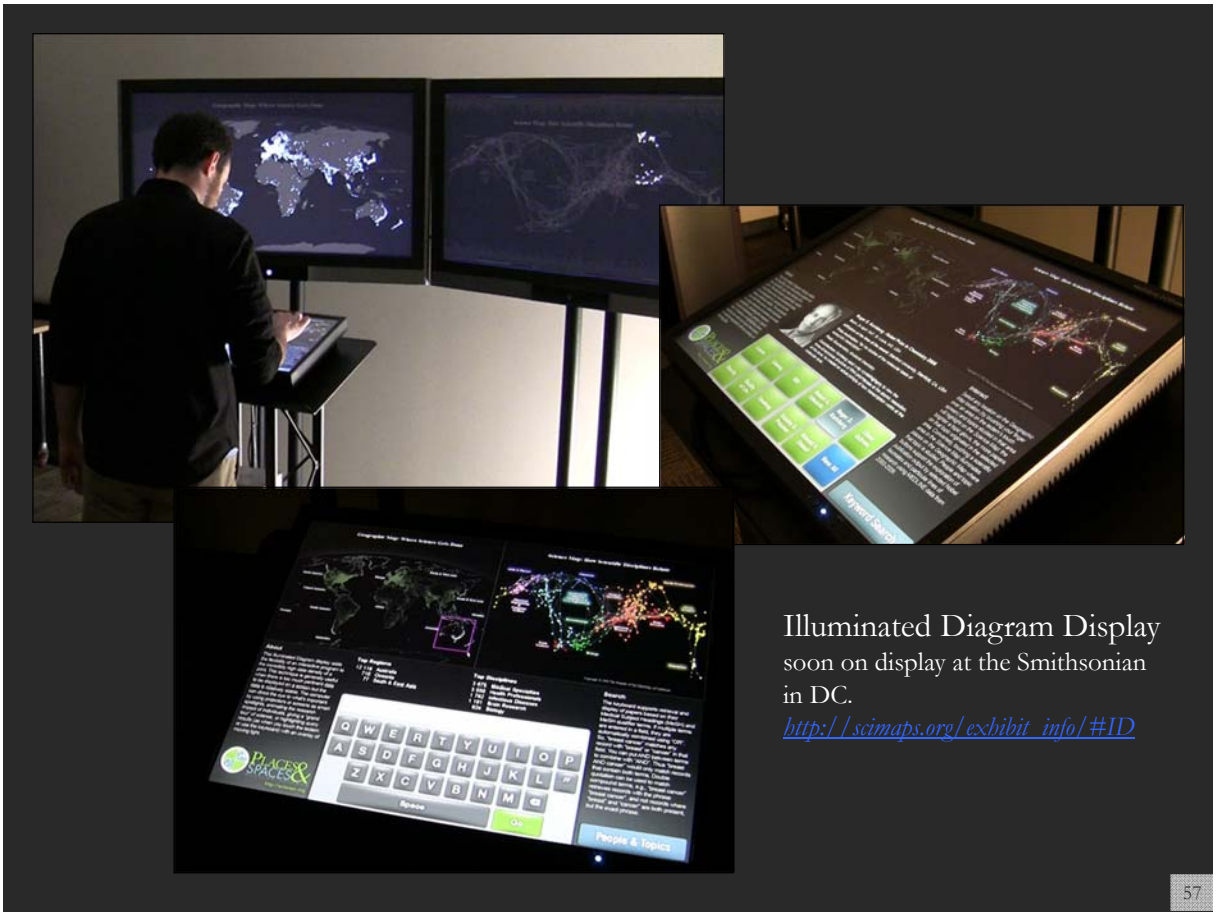
Read about and zoom into maps at http://scimaps.org/exhibit_info

Call for Maps for the 8th Iteration of the Places & Spaces: Mapping Science Exhibit on "Science Maps for Kids" (2012)

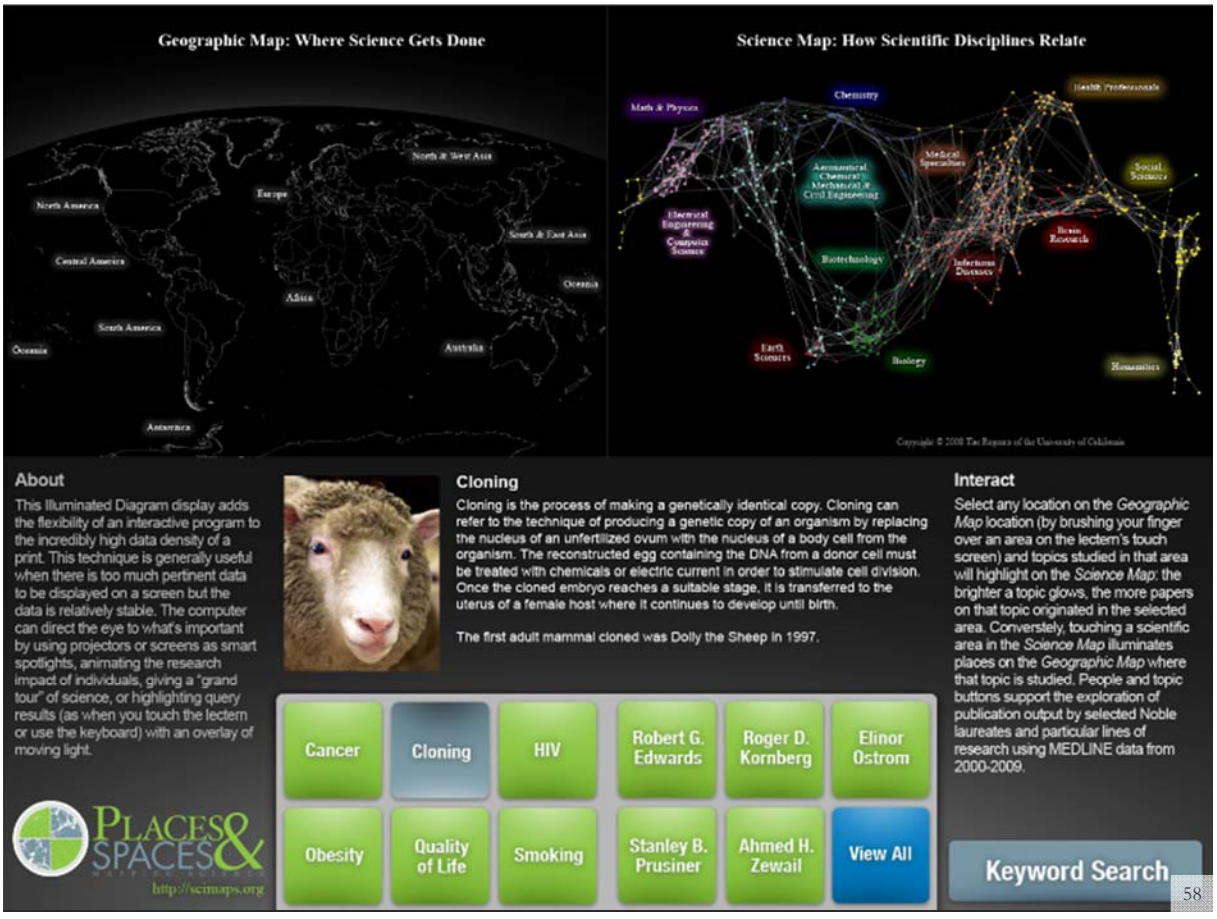
http://scimaps.org/call

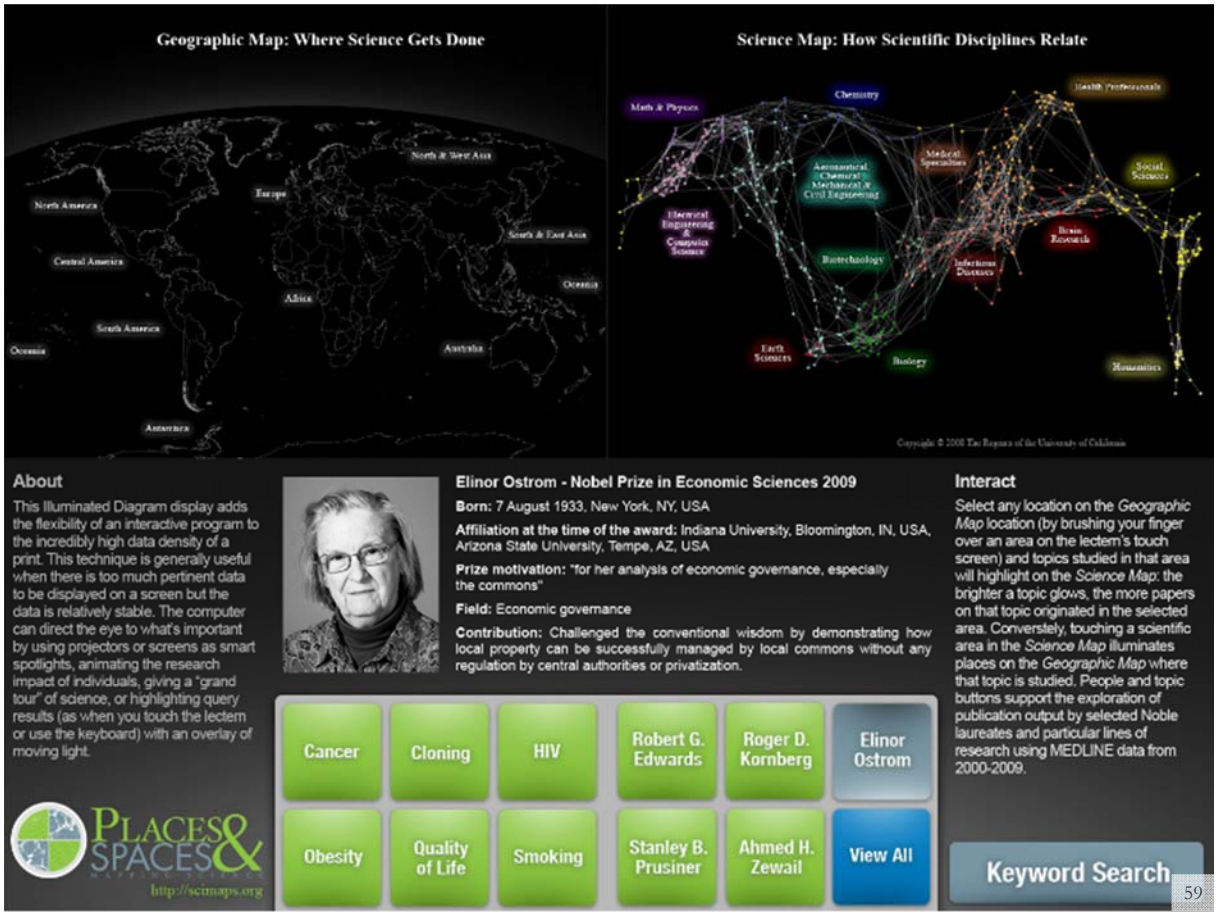
Mapping Science Exhibit at MEDIA X was on May 18, 2009 at Wallenberg Hall, Stanford University,
http://mediax.stanford.edu, *http://scaleindependentthought.typepad.com/photos/scimaps*

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




Geographic Map: Where Science Gets Done
North & West Asia
Europe
North America
South & East Asia
Central America
Africa
Oceania
South America
Oceania
Australia
Antarctica
Science Map: How Scientific Disciplines Relate
Math & Physics
Chemistry
Health Professionals
Aeronautical, Chemical, Mechanical & Civil Engineering
Medical Specialties
Social Sciences
Electrical Engineering & Computer Science
Brain Research
Biotechnology
Infectious Diseases
Earth Sciences
Biology
Humanities
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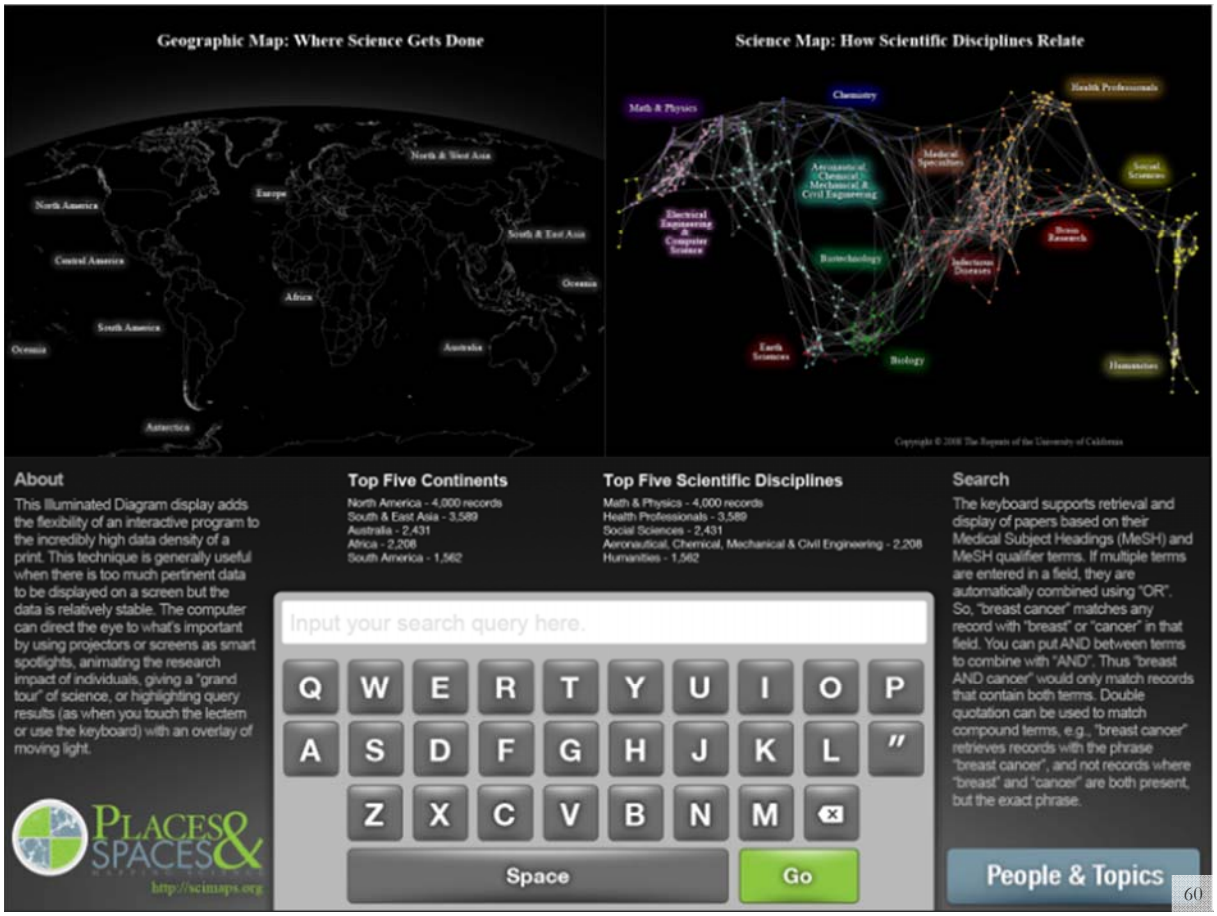
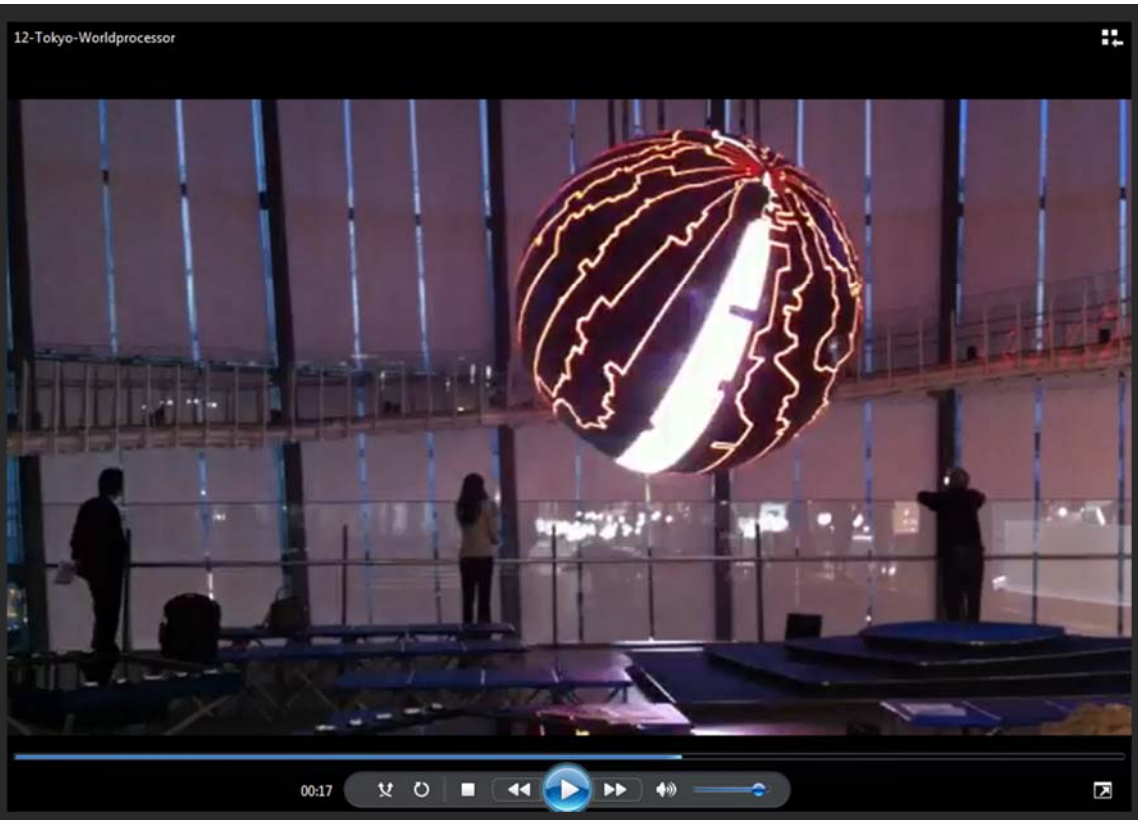
About
This Illuminated Diagram display adds the flexibility of an interactive program to the incredibly high data density of a print. This technique is generally useful when there is too much pertinent data to be displayed on a screen but the data is relatively stable. The computer can direct the eye to what's important by using projectors or screens as smart spotlights, animating the research impact of individuals, giving a "grand tour" of science, or highlighting query results (as when you touch the lectern or use the keyboard) with an overlay of moving light.
PLACES & SPACES
http://scimaps.org
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.
Cancer
Cloning
HIV
Robert G. Edwards
Roger D. Kornberg
Elinor Ostrom
Obesity
Quality of Life
Smoking
Stanley B. Prusiner
Ahmed H. Zewail
View All
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.
Keyword Search


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



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

References

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

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

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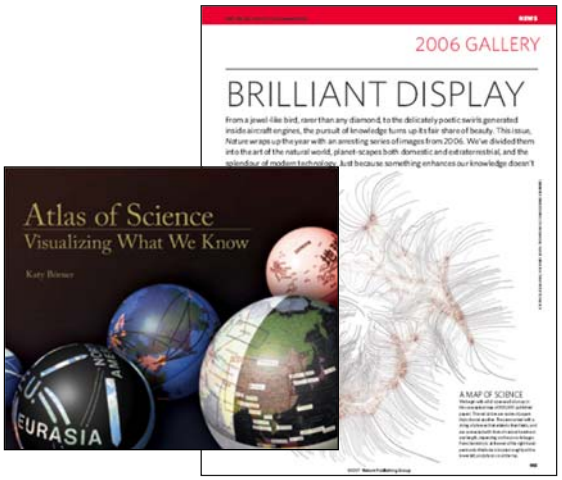
http://ivl.slis.indiana.edu/km/pub/2007-borner-arist.pdf

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.



Scientometrics (2011) 89:421–435
DOI 10.1007/s11192-011-0433-7

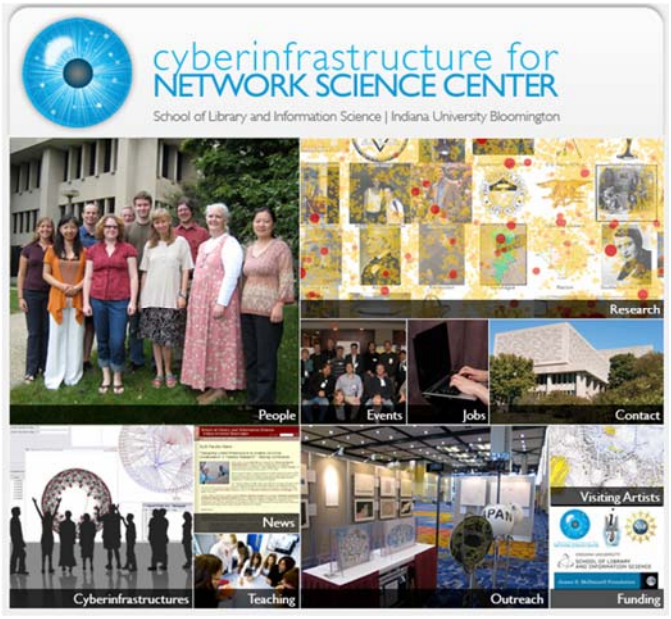
Mixed-indicators model for identifying emerging research areas

Hanning Guo · Scott Weingart · Katy Börner

Abstract This study presents a mixed model that combines different indicators to describe and predict key structural and dynamic features of emerging research areas. Three indicators are combined: sudden increases in the frequency of specific words; the number and speed by which new authors are attracted to an emerging research area, and changes in the interdisciplinarity of cited references. The mixed model is applied to four emerging research areas: RNAi, Nano, h-Index, and Impact Factor research using papers published in the *Proceedings of the National Academy of Sciences of the United States of America* (1982–2009) and in *Scientometrics* (1978–2009). Results are compared in terms of strengths and temporal dynamics. Results show that the indicators are indicative of emerging areas and they exhibit interesting temporal correlations: new authors enter the area first, then the interdisciplinarity of paper references increases, then word bursts occur. All workflows are reported in a manner that supports replication and extension by others.

Keywords Burst detection · Prediction · Emerging trend · Temporal dynamics · Science of science (Sci^2) tool

http://ivl.cns.iu.edu/km/pub/2011-guo-mixed-indicators.pdf



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