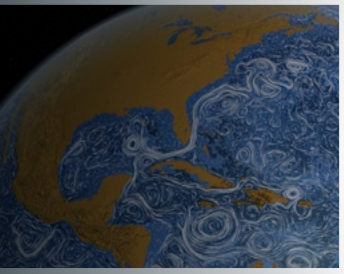
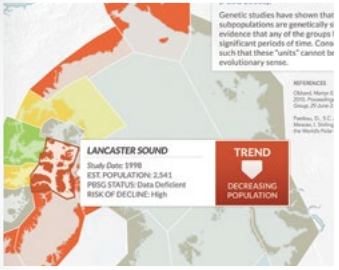
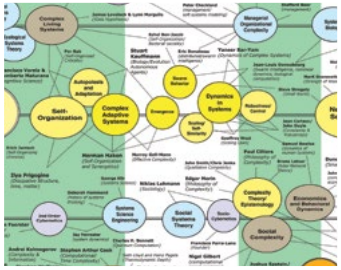
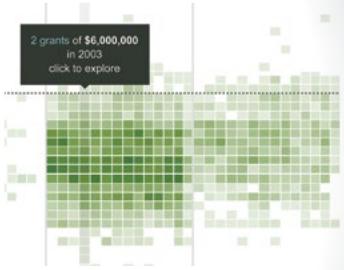
PLACES & SPACES

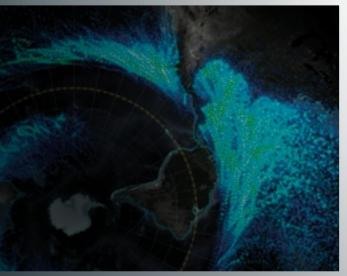
MAPPING SCIENCE

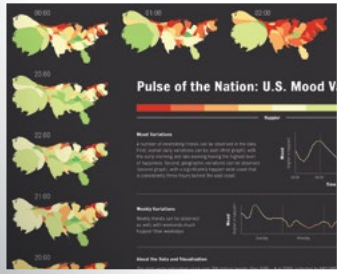


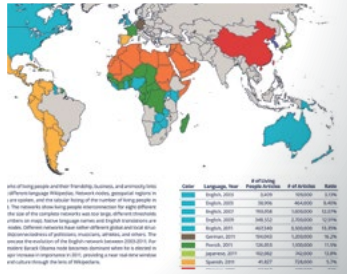


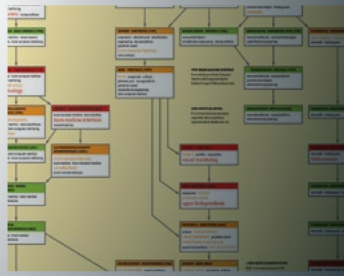












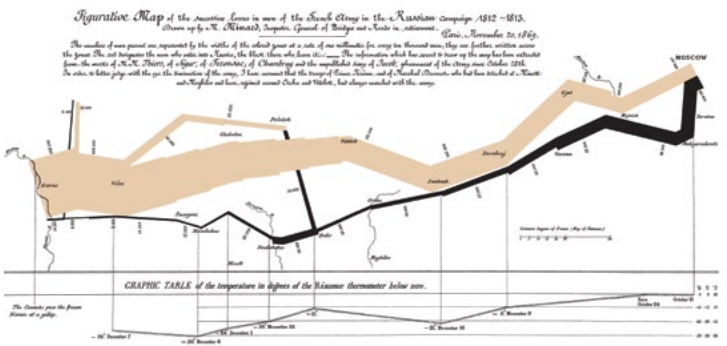
ANNUAL REPORT 2013

Introduction

For centuries, cartographic maps of land and water have guided human exploration. They have marked the border separating the known from the unknown, firing the imagination and fueling the desire for new knowledge and new experience. Over time, geographic maps have become more accurate, more sophisticated, but the thirst for discovery, along with the need for maps to guide our travels and efforts, remains undiminished.

Geoffrey West, Distinguished Professor and Past President, Santa Fe Institute introduces Katy Borner's Betazone presentation at the World Economic Forum.

Today, opportunities for discovery and innovation arise less from the exploration of physical places than from abstract spaces of data, information, and knowledge. The size and complexity of these abstract spaces is vast, and, like the teeming, mysterious oceans found on our earliest maps of the known world, they have the potential to bring riches or death. Currently, the most efficient tool we have for navigating our collective digitized knowledge is the search engine. But while search engines are highly useful when fishing



Napoleon's March to Moscow, by Charles Joseph Minard

for facts, they simply cannot answer larger questions concerning the seascape as a whole: How big is this ocean of knowledge? How can we navigate to islands that hold answers to specific questions? How are knowledge and expertise interlinked on a global scale? In which areas is it worth investing our time, effort, and resources?

Drawing from across cultures and across scholarly disciplines, the *Places & Spaces: Mapping Science* exhibit demonstrates the power of maps to address these vital questions about the contours and content of human knowledge. Created by leading experts in the natural, physical, and social sciences, scientometrics, visual arts, science policy, and the humanities, the maps in *Places & Spaces* allow us to better grasp the abstract contexts, relationships, and dynamism of science, technology, and collective intelligence. Individually and as a whole, the maps of *Places & Spaces* allow data to tell stories which both the scientist and the layperson can understand and appreciate.

Now entering its tenth year, the exhibit has traced the evolution of science maps, featuring the best examples of knowledge domain mapping, novel

location-based cartographies, data visualizations, and science-inspired artistry. Along the way, *Places & Spaces* has featured historically significant firsts in science mapping, including the very first map of science, Henry G. Small's "1996 Map of Science" (see Iteration I, Map 5 of the exhibit), the first map of "Science-Related Wikipedian Activity" (see III.8), and the first "Clickstream Map of Science" (V.8). The exhibit has also brought to life the history and evolution of data visualization with Charles Joseph Minard's landmark "Napoleon's March to Moscow" (I.4), Wattenberg and Viégas' "History Flow Visualization of the Wikipedia Entry on 'Abortion'" (II.6), the SENSEable City Lab's "Mobile Landscapes: Using Location Data from Cell Phones for Urban Analysis" (V.4), and the recent exploration of national mood as reflected by Twitter activity, "Pulse of the Nation" (IX.4).

The process of selecting the exhibit's pieces begins each year with a call for maps corresponding to a particular theme or addressing the needs of a particular audience. Once the submissions have been gathered, a team of international reviewers and exhibit advisors select the 10 most stunning and innovative maps for entry into *Places & Spaces*. Next, the chosen maps are prepared for viewing by a general audience through large-format, high-resolution printing. Since many of the exhibit's maps were originally designed for inclusion in scientific papers, PowerPoint slides, or online tools, this can be quite a dramatic transformation. Finally, the finished maps are included in an exhibition for public display at libraries, science museums, national science academies, and other venues.

From left to right: Lisel Record, Katy Börner, and Todd Theriault

Overseeing this process is an exhibit team comprised of two curators and an exhibit manager based at Indiana University in Bloomington, Indiana. The team manages the map submission and review process, coordinates the display of maps at various venues, organizes workshops and events (see page 10), and facilitates the archiving of the exhibit maps at major libraries around the world. In all of these activities, the exhibit team benefits from expert input by an international advisory board (see pages 13-14).

Funding for *Places & Spaces* is provided by the National Science Foundation under grants IIS-0238261, CHE-0524661, IIS-0534909, IIS-0715303, and ISE DRL-1223698; the James S. McDonnell Foundation; and Thomson Reuters. Additional funding comes from the Cyberinfrastructure for Network Science Center, University Information Technology Services, and the School of Informatics and Computing—all three located at Indiana University. Some of the data used to generate science maps is from Thomson Reuters and Elsevier. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation or other sponsors.

THOMSON REUTERS

NSF

James S. McDonnell Foundation

CNS Cyberinfrastructure for Network Science Center

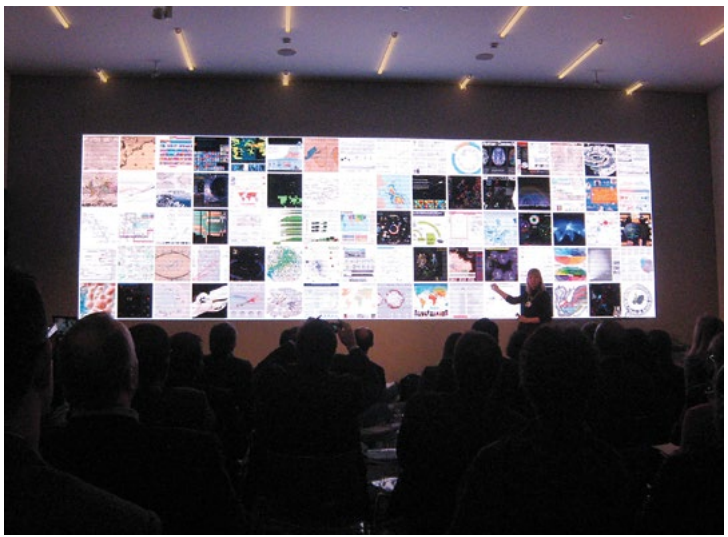
INDIANA UNIVERSITY BLOOMINGTON

Letter from the Curators

Exhibit Curators Todd Theriault and Katy Börner

It is a happy coincidence that, at the beginning of 2013, the *Places & Spaces: Mapping Science* exhibit participated in two simultaneous events that, taken together, are emblematic of both the success and the commitment of this exhibit. Towards the end of January, maps from *Places & Spaces* were featured in Katy Börner's presentation at the World Economic Forum in Davos, Switzerland, an annual meeting attended by a who's who of political leaders, business entrepreneurs, and noted intellectuals from around the globe. At the same time (albeit 4,600 miles away), maps from the exhibit's 8th iteration, "Science Maps for Kids," were inspiring and educating young attendees of the Wonderlab's Martin Luther King Jr. Day celebration in Bloomington, Indiana, a yearly event that brings hands-on science activities to the children of our local community—the children of our friends, family, colleagues, and neighbors.

Now make no mistake, we are extremely honored and very excited to be invited to an event like the World Economic Forum. After all, who wouldn't want the chance to share their passions with heads of state and Fortune 500 CEOs? As world-significant an event as this was, however, we truly believe in the phrase "think globally, act locally," and the energy and joy that arises when working with kids is hard to match and too great a learning and teaching opportunity to miss. Events like the one we attended at our local Wonderlab allow the maps of *Places & Spaces* to expand the understandings of young viewers, empowering them to move in their thinking from local to global, short-term to long-term, individual to societal, and present to future. This will be beneficial when, a generation from now, today's kids are the ones determining the issues and championing the causes put forth at venues like Davos.



Katy Börner presents Places & Spaces *at the World Economic Forum*

The Educational Imperative

For the past ten years, *Places & Spaces* has been committed to teaching as wide an audience as possible about the power and potential of science mapping. This educational imperative has taken us to museums, libraries, conference halls, classrooms, and boardrooms all around the globe (see **scimaps.org/exhibitions** for a complete list of venues). We've illuminated exhibit maps on screens both big (like the large-screen display walls at North Carolina State and Brandeis University) and small (the millions of home computers, tablets, and smartphones with which the interested may explore exhibit maps from our website, Facebook, Flickr, or Pinterest). We've been happy to have our maps hanging in venues ranging from the stately (this year's six-month residency at the newly renovated National Academy of Sciences building in Washington D.C., for instance) to the unconventional

Visitors check out Places & Spaces *aboard the Science Express Train*

Places & Spaces *on display at the National Academy of Sciences*

(2009's literally moving experience aboard the Science Express Train, which visited 62 German cities in 7 months). In the end, what all these diverse venues and vehicles allow us to do is to communicate in different vernaculars the intellectual beauty of these maps of science. And while many of these maps are aesthetically striking, we regard the qualifier "intellectual" to be of utmost importance, as it is our deep conviction that these maps provide not just candy for the eye but, first and foremost, food for the brain.

Where We've Been... and Where We're Going

An annual report is typically a retrospective exercise, a travelling back over the past year to point out the vistas and landmarks that made that year special. And we'll do our share of that in the pages that follow. We would like, however, to take a moment to share our excitement concerning the future of *Places & Spaces*. As many of you may know, the exhibit was originally planned in 2005 as a ten-year effort, ending in 2014 with a set of 100 maps and several additional elements that have opened many people's minds and hearts to the importance and beauty of our collective S&T knowledge and efforts.

Polnet Conference, Indiana University, June 26-29, 2013

Letter from the Curators

We believe this Phase I was essential to create an international and interdisciplinary network of mapmakers, users, and supporters. The success of this endeavor warrants a much more ambitious Phase II effort: namely, to empower many individuals to not only READ but to MAKE maps of S&T data, knowledge, and expertise. In fact, some Phase II efforts are already underway. For instance, the IVMOOC is currently being taught for the second time to students from more than 100 countries. Also, the accompanying textbook *Visual Insights: A Practical Guide to Making Sense of Data* (2014) written by Börner and David E. Polley and published by MIT Press provides a timely introduction to answering "when," "where," "what," and "with whom" questions using temporal, geospatial, topical, and network analysis techniques. Furthermore, the forthcoming *Atlas of Knowledge: Anyone Can Map* by MIT Press introduces a timeless visualization framework that draws from and aims to unify works from many different areas of research. Using this framework, the *Atlas of Knowledge* aims to empower readers at all levels to render data into insights. It also features exhibit maps from the fourth through the seventh iterations of the exhibit that serve the needs of economic decision makers, science policy makers, scholars, and library staff and users.

NSF Pathways *workshop participants pose for a quick photo*

Katy Börner greets visitors to the Science Café presentation of Places & Spaces

In collaboration with colleagues from the Ohio Center of Science and Industry, the New York Hall of Science, and the Science Museum of Minnesota, we recently examined the data visualization literacy of over 900 youth and adult visitors across six U.S. science museums as part of the NSF-funded project *Pathways: Sense-Making of Big Data*. Study results create a foundation for the design of museum exhibits and educational programs that teach museum visitors how to explore, engage, and make better sense of big data. Several museums in Europe and Asia expressed interest to replicate these studies, and an international comparison of data visualization literacy seems highly desirable.

The IVMOOC, the textbook, the forthcoming *Atlas*, and the Pathways project all utilize maps from *Places & Spaces* as pedagogical tools to provide state-of-the-art examples of information visualization and teach the process of producing effective and need-sensitive visualizations.

While the 100 maps created over the last 10 years are static, many of the new visual depictions of S&T activities are highly interactive and online. And while exhibit lovers have learned to read and use the maps in their daily decision making, the future will empower them to visualize their very own data and to see themselves in the global S&T landscape.

Over the past years, the critical value of data analysis and visualization has become widely recognized. Over that same short period of time, the amount of information available to us has grown to staggering capacities. Will we

1st International Conference on Internet Science, Brussels, Belgium. April 10-11, 2013

Homo Communicativus: Contemporary Faces of Communication and Information, Toruń, Poland

be able to use this rich resource for our betterment, or will our abilities to discern and analyze become overwhelmed by the vast breadth and scope of our fields of inquiry? We here at *Places & Spaces* feel that the time has never been more propitious, the need never more urgent for agile, elegant, and intelligent tools to navigate, understand and manage the S&T landscape. And to the many friends this exhibit has collected over the years, we would like to say that it is our deep pleasure and profound privilege to engage in this important and rewarding work with you.

Katy Börner & Todd Theriault

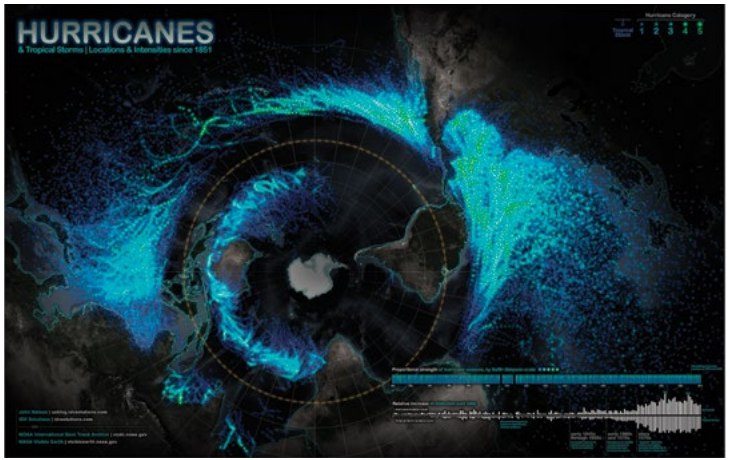
9th Iteration: Science Maps Showing Trends and Dynamics

In our current cultural moment, the spotting and analyzing of trends has become downright trendy, and it's not uncommon to hear of everything from headlines to haircuts described as "trending." Yet long before Twitter informed us all of "What's Trending," humans have been fascinated by trends—not in the sense of popularity but in the sense of temporal patterns. Confronted with the many complex and interconnected events we encounter, we have always struggled to find patterns and direction. Out of what appears to be the chaos of creation, we have sought to understand the principles of development.

It is this human preoccupation with patterns and dynamics that is celebrated in the 9th iteration of the *Places & Spaces: Mapping Science* exhibit. Since 2005, *Places & Spaces* has established its own pattern of releasing a new iteration of the exhibit on an annual basis. Each iteration consists of 10 science maps grouped around a particular theme (2011's "Science Maps as Visual Interfaces to Digital Libraries," for instance) or tailored to the needs of a particular audience (last year's "Science Maps for Kids," for example). For its 9th iteration, the exhibit called on the science community for "Maps Showing Trends and Dynamics," and the response has provided *Places & Spaces* with its most exciting and wide-ranging iteration to date.

At first blush, there might not be much pattern detectable in an iteration that includes everything from polar bear habitats to the habits of Twitter-users, but a closer look at the iteration will reveal that each of the ten maps concerns itself with observable ebb and flow—the way ideas, behaviors, and natural phenomena move in patterns of power and purpose. Each map takes as its starting point a dauntingly large data set (20 million articles from the Scopus database, for instance, or the $4.01 billion worth of grants made by the Hewlett Foundation) and attempts to reveal the patterns and trends running through that mass of information.

And it is in that moment of revelation that one may truly appreciate the power of visualizing information. Certainly, one could read about, say, hurricane activity over the past 160 years. But to see the movements of these hurricanes dramatically plotted onto a view of the Earth from the South Pole—as they are in this iteration's stunning "Hurricanes & Tropical Storms"—is to understand the information on intellectual, visceral, and emotional levels. Trends and dynamics are inherently dramatic and they are uniquely suited to visual display. Observing the rise and fall of polar bear populations over the years ("State of the Polar Bear") or the lifting and sinking of the national mood over the period of a day ("Pulse of the Nation") can be a powerful and enlightening experience.



Hurricanes & Tropical Storms—Locations and Intensities since 1851, by John Nelson

Visualizing information can also reveal connections and relations that may be obscured due to the size of the data. In "Visualizing Trends and Dynamics: 30 Years of Scientific Development," mapmakers used three decades of science and social science publications from the Web of Science bibliographic database. From this mass of information, they were able to produce word clouds that clearly delineate the most important concerns in a given field at a given

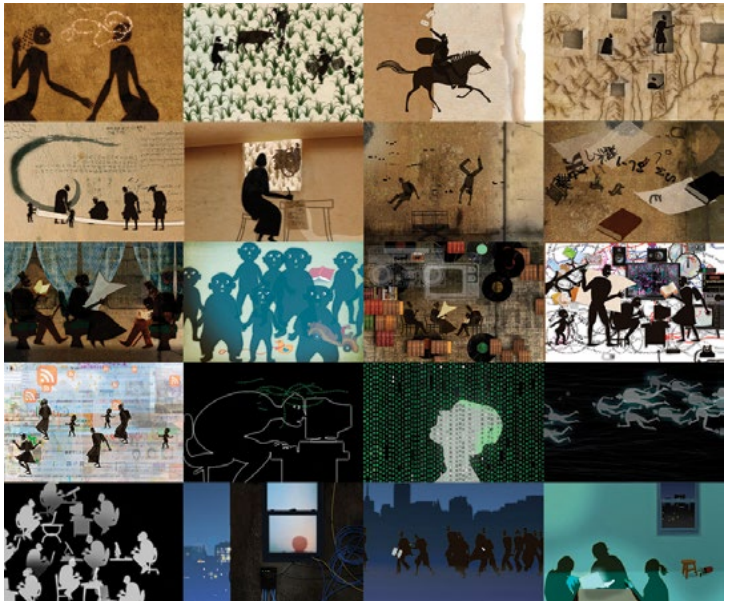
moment. Elsewhere, the "Map of Complexity Science" traces influences and relationships among topics and individuals over the history of this field. By doing so, the map visualizes connections of thought in a way that makes the history of complexity science a bit less complex.

To see all ten of these novel maps, and to explore the 80 maps that the exhibit has featured previously, visit **scimaps.org**. Not only will you be able to zoom in on individual maps for detailed examination, but you will also be able to learn more about the individuals who made them and the tools they used to create these amazing works.

Humanexus

2013's additional element to the exhibit was the animated film *Humanexus: Knowledge and Communication through the Ages*, an unforgettable depiction of the ever-accelerating spread of information and communication over the course of human history. *Humanexus* is the product of a close collaboration between visual artist Ying-Fang Shen (formerly an IU Fine Arts student, now a tenure-track Professor at the Department of Communication Arts, Virginia Commonwealth University), composer and sound designer Norbert Herber from IU's Department of Telecommunications, and Katy Börner, who suggested the initial story and provided guidance and resources along the way, effectively acting as a producer. Viewers of *Humanexus* will be struck by the evocative relationship between Shen's visuals and the rich aural landscape created by Herber that track the evolution of human communication from cave scrawls to Twitter feeds. And while the film captures the giddy exhilaration of discovery and creation, it also strikes darker notes as it imagines the crucial point at which humanity finds itself, a decisive moment that pivots between a path of continued creativity and innovation and one of information overload and communication breakdown. Ultimately, however, *Humanexus* argues that the question of "What kind of future do we want?" is one that each of us has the power to address.

Throughout 2013, *Humanexus* received much acclaim as it traveled the circuit of film events around the globe. It has been chosen as an "Official Selection" at over 30 international film festivals and has won 13 awards to date. Among these



Still images from the award-winning Humanexus *film*

are the Award of Excellence from the Best Short Competition, Best Original Screenplay from the Unofficial Google+ Film Festival, and Best Short Animation from both the Richmond International Film Festival and the Albany Film Fest. Recently, the film was featured at the AAAS Annual Meeting in Chicago, and it will be shown in two venues at the Cannes Film Festival in May of 2014. Such recognition serves as testimony to both the relevance of the film's message and the artistic vision through which that message is conveyed. To see a complete list of awards and to learn more about the film itself, visit the *Humanexus* websites **cns.iu.edu/humanexus** and **yfshen.info/humanexus**.

Accomplishments

Venues

In 2013, *Places & Spaces* started on a very big stage: the World Economic Forum in Davos, Switzerland. The maps appeared as part of Katy Börner's presentation, "Visualizing What We Know," and they generated a great deal of discussion and interest from those in attendance.

Katy Börner sits among her fellow panelists at the World Economic Forum

Later that year, the exhibit took not one but two trips to South America: the first to Santiago, Chile, for COINS, the Collaborative Innovation Networks Conference, and the second to Sao Paulo, Brazil, for the SciELO 15 Years Conference. The former was particularly exciting for us in that it was not only the first public showing of the exhibit's 9th iteration, but also the first visit of *Places & Spaces* to the lovely and hospitable country of Chile.

Physical, large-scale maps were on display at the Upstairs Gallery of the newly restored National Academy of Sciences building from January to June 2013. In April, Katy Börner and mapmaker Ward Shelley had a chance to visit the maps and discuss the topic of data visualization as part of the NAS-hosted DASER series, a monthly forum bringing together scientists and artists to explore vital connections between the two communities and promote interdisciplinary work. The third presenter in this DASER event was Stephen Mautner from the National Academy Press who featured the CNS-designed AcademyScope in his talk, among other topics.

From October 14th through the 27th, the *Places & Spaces* exhibit was featured on the iPearl Immersion Theater located in North Carolina State University's Hunt Library. With its 7x16-foot Christie® MicroTiles® digital display, the theater surrounds viewers with larger-than-life maps of science that are visually arresting from afar and amazingly sharp up close. With media

Katy Börner presents "Maps & Macroscopes" at TEDxBloomington

outlets like *Time* magazine, *Ploughshares*, *Architect* magazine, and others placing it at the forefront of a renaissance in library design and capabilities, the Hunt Library was the perfect cutting-edge venue to feature the groundbreaking work of *Places & Spaces: Mapping Science*.

Assistance from our much-appreciated team of exhibit ambassadors allowed maps to travel to the Institute for Advanced Studies IMT in Lucca, Italy, to the Homo Communicativus Conference in Torún, Poland, and to the one-of-a-kind Palais des Congrés in Montréal, Canada, for the World Social Science Forum. In addition to the exhibit's busy international travel schedule, *Places & Spaces* participated in some exciting events closer to home. Exhibit maps were featured in Katy's talk at TEDxBloomington, and science mapping was the topic of Katy and Todd's presentation in Bloomington's own Science Café series. Finally, all 90 maps were displayed prominently at the reception held to mark the official merging into one entity of Indiana University's School of Library and Information Science (our home base for the past nine years) and the School of Informatics and Computing.

Be sure to check out the pictures for these and the many other venues visited by *Places & Spaces* in 2013 at **scimaps.org/exhibitions**.

Workshops

Our first workshop of the year, **Exploiting Big Data Semantics for Translational Medicine**, took place on March 25-26, 2013. It was a focused workshop that brought together leading practitioners in semantic technologies, network science and visualization, and computational translational medicine to identify the most critical areas for collaboration between these fields to maximize impact on the next generation of disease treatments. In the summer, a workshop on **Standards for Science Mapping and Classification** took place at the 14th International Society of Scientometrics and Informetrics Conference in Vienna, Austria, on July 15. It was attended by researchers and practitioners interested in the scientific development and proper usage of science classifications and science maps. In November, two back-to-back conferences took place on the Indiana University campus.

Science Mapping Standards Workshop, CNS, IUB

The first, **Science Mapping Standards**, discussed scientifically sound standards for aligning existing science maps to each other and to other major classification systems. This set the ground work for the design of a Science, Technology and Humanities (STH) basemap of science that will cover more than 100 years of publication data, including conference proceedings and books as well as Latin American data from the SciELO database. The second, **Plug-and-Play Macroscopes**, was designed for programmers and power users of major visual analytics/science of science tools and discussed improved integration and collaboration between existing tools and developers. For more information about these events, or to find out more about upcoming workshops, please visit **cns.iu.edu/workshops**.

Goals for 2014

The theme of our 10th iteration is "The Future of Science Mapping." Map submissions will be judged by our *Places & Spaces* advisory board (see pages 13-14) as well as individuals whose fingers rest on the pulse of where science is at today and where it might travel in the years to come. Thus, in addition to the luminous group of experts, many of whom have been with the exhibit since day one, the review team welcomed Karl-Heinz Steinmüller, the noted science fiction author and Scientific Director of Z-punkt, a leading strategy and foresight consultancy that specializes in identifying future economic and socio-political trends. He was joined by Olga Brazhnik, Computer Scientist at the National Center for Advancing Translational Science (NCATS) of the National Institutes of Health, and James Burke, host of the BBC series *Connections* and spearhead of the KnowledgeWeb Project.

Places & Spaces *on display at the National Academy of Sciences Upstairs Gallery*

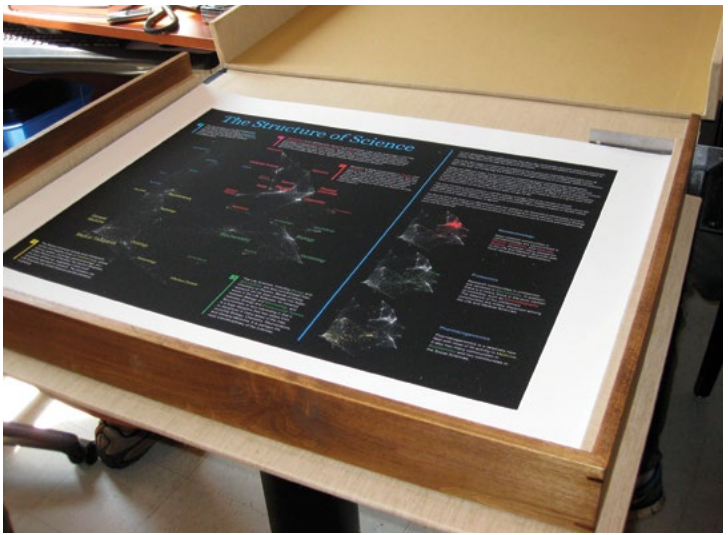
Science Café, Bloomington, IN, December 3, 2013

In 2014, a transformative update of the exhibit's site (**scimaps.org**) is planned—with improved navigation of all 100 maps, translations of map descriptions into several languages, and a deeper integration with social media streams. Check out our Facebook page (**facebook.com/mappingscience**) for updates on exhibit displays, activities, and other exhibit announcements.

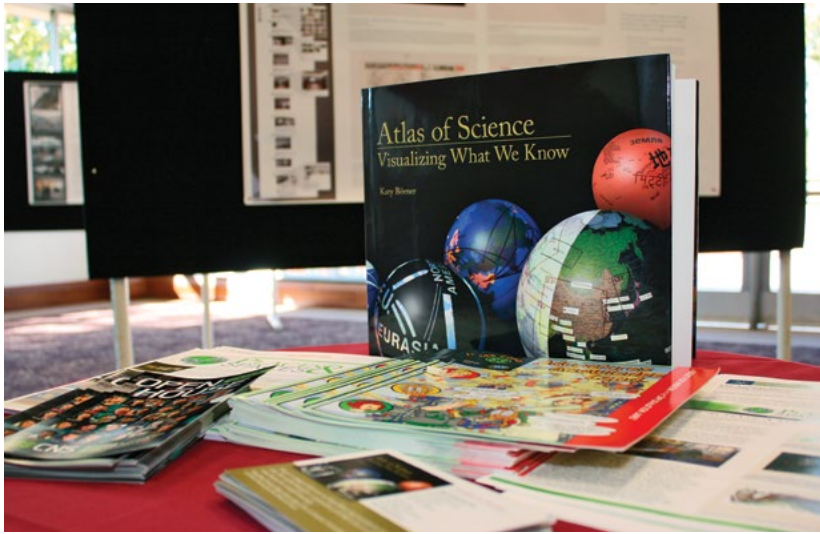
Three workshops are planned so far for 2014. The first is the **OECD-Experts Dialogue on Scientometrics: Improving the Use of Bibliometric Indicators and Analysis for Policy-Making**, which will take place in Paris, France, on March 25th. The second is the **Visualization Frameworks** workshop that

invites visual perception researchers, cognitive scientists, and visualization experts to discuss unifying approaches to classify, name, and design the diverse temporal, geospatial, topical, and network visualizations in existence today. The third is the **Plug-and-Play Macroscopes** workshop on November 5-6 in Bloomington, Indiana. This workshop—the fifth in this series—will bring together programmers and power users of major visual analytics and science of science tools to discuss improving integration and collaboration between existing tools and developers.

2014 will also see us continue our efforts toward archiving the exhibit maps, accompanying books, and digital files in major map libraries around the globe. *Places & Spaces* maps have been part of The New York Public Library's collection (Call # Map Div. 06-1420) since 2006, and those maps originally part of the David Rumsey collection were moved to Stanford University's archive in 2009. More recently, the University of Michigan, the American University of Beirut, and the Library of Congress have all added *Places & Spaces* to their collections. This will ensure that interested patrons can examine high-resolution prints up close and that the maps are preserved for future generations.



One of the clam shell boxes that will hold archival Places & Spaces *map prints*



Atlas of Science *is the first book in Börner's three-part Atlas series*

Last but not least, look for the *Atlas of Knowledge: Anyone Can Map* to become available at the end of the year. Like the *Atlas of Science*, this book promises to be both a visual delight and an accessible, engaging journey through the information visualization landscape.

Exhibit Advisors

Gary Berg-Cross is a cognitive psychologist (PhD, SUNY–Stony Brook) who has taught at a number of institutions over his career (SUNY, Widener, University of Delaware, George Washington, George Mason University, and others). Currently, Berg-Cross is a Co-Principal Investigator on a four-year, NSF-sponsored study entitled Spatial Ontology Community of Practice: An Interdisciplinary Network to Support Geospatial Data Sharing, Integration and Interoperability (SOCoP-INTEROP Project). [Potomac, MD, USA]

Bob Bishop is chairman and founder of BBWORLD Consulting Services Sàrl and president and founder of the ICES Foundation. In addition, Bishop is involved in a range of global initiatives: he is a Fellow of the Australian Davos Connection (ADC), an elected member of the Swiss Academy of Engineering Sciences (SATW), and serves on the advisory panels for the École Polytechnique Fédérale de Lausanne's Blue Brain Project and Human Brain Project. [Geneva, Switzerland]

Kevin Boyack is president of SciTech Strategies, Inc., where his work centers on developing more accurate global maps of science. He has published nearly 30 articles on various aspects of science mapping and related metrics. Current interests include the detailed mapping of the structure and dynamics of science and technology, the application of full text to science mapping and bibliometrics, and the identification of emerging topics. [Albuquerque, NM, USA]

Donna J. Cox is the first Michael Aiken Chair, director of the Advanced Visualization Laboratory (AVL) at the National Center for Supercomputing Applications, and director of the Illinois eDream Institute, all at the University of Illinois at Urbana-Champaign. She is a recognized pioneer in Renaissance Teams and supercomputer visualizations for public outreach, and in 2006 she was selected by the Chicago Museum of Science as one of 40 modern-day Leonardo da Vinci's. [Urbana-Champaign, IL, USA]

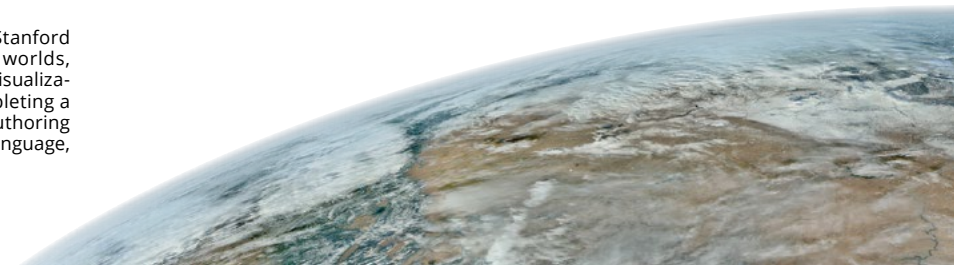
Bonnie DeVarco is a Media X Distinguished Visiting Scholar at Stanford University. She writes and lectures on design science, virtual worlds, next-generation geographic information systems, information visualization, and the culture of cyberspace. Currently, DeVarco is completing a book on Buckminster Fuller entitled *Invisible Architecture II*, co-authoring *Shape of Thought*, a work on the history and evolution of visual language, and co-editing a book on Ludic Cartography. [Palo Alto, CA, USA]

Sara Irina Fabrikant is a professor of geography and head of the Geographic Information Visualization and Analysis (GIVA) group at the GIScience Center at the Geography Department of the University of Zürich, Switzerland. She is the elected chair of the Cognitive Visualization Commission of the International Cartographic Association, and she serves on the editorial boards of eight of the leading journals in GIScience and cartography. [Zürich, Switzerland]

Marjorie M.K. Hlava is president, chairman, and founder of Access Innovations, Inc. Positions she has held in the international information arena include founding chair of the new SLA Taxomony Division, president of NFAIS (National Federation of Advanced Information Services), president of ASIST (American Society for Information Science and Technology), and many others. She has been awarded both the SLA President's Award and the ASIST's prestigious Watson Davis Award. [Albuquerque, NM, USA]

Peter A. Hook is a doctoral student at the School of Informatics and Computing at Indiana University. His primary research focus is information visualization, particularly the visualization of knowledge organization systems, concept mapping, and the spatial navigation of bibliographic data in which the underlying structural organization of the domain is conveyed to the user. [Bloomington, IN, USA]

Manuel Lima is a Fellow of the Royal Society of Arts, a senior user experience design lead at Microsoft Bing, and the founder of VisualComplexity.com—a visual exploration of mapping complex networks. Nominated by *Creativity* magazine as "one of the 50 most creative and influential minds of 2009," Lima is a leading voice on information visualization and a frequent speaker at conferences and schools around the world. [New York, NY, USA]



Deborah MacPherson works in specifications and research at Cannon Design, an architectural / engineering firm specializing in healthcare, research laboratories, universities, and sports facilities. She is also projects director for the 501(c)(3) nonprofit organization Accuracy & Aesthetics, and immediate past president of the Northern Virginia Construction Specifications Institute (CSI) chapter. [Vienna, VA, USA]

Lev Manovich is professor at the City University of New York (CUNY) Graduate Center and author of several books on digital culture, including the recent *Software Takes Command* (Bloomsbury Academic, 2013). In 2007, Manovich founded the Software Studies Initiative in order to develop a new paradigm of Cultural Analytics through data analysis and interactive visualization of patterns and trends in media and visual cultures. [New York, NY, USA]

Carlo Ratti, an architect and engineer by training, practices in Italy and teaches at the Massachusetts Institute of Technology, where he directs the SENSEable City Lab. Ratti has co-authored over 200 publications, exhibited his work at venues around the world, and holds several patents. He has been included in *Esquire* magazine's "Best and Brightest" list, *Blueprint* magazine's "25 People Who Will Change the World of Design" and *Forbes* magazine's "People You Need to Know in 2011." [Cambridge, MA, USA]

Eric Rodenbeck is founder and creative director of the San Francisco-based design and technology studio, Stamen Design. Since 1997, he has worked with interactive design to extend the boundaries of online media and live information visualization. In 2008, he was named one of *Esquire* magazine's "Best and Brightest" new designers and thinkers, and one of *i-D* magazine's top 40 designers to watch. [San Francisco, CA, USA]

André Skupin, professor of geography at San Diego State University, is interested in the application of geographic metaphors, cartographic principles, and computational methods to the visualization of non-geographic information. His research is interdisciplinary, aimed at increased cross-fertilization between geography, information science, and computer science. Recent work includes novel methods for visualizing human movement and demographic change as trajectories in n-dimensional attribute space. [San Diego, CA, USA]

Moritz Stefaner is a freelance designer on the crossroads of data visualization, information aesthetics, and user interface design. With a background in cognitive science and interface design, Stefaner's work beautifully balances analytical and aesthetic aspects in mapping abstract and complex phenomena. In 2010, he was nominated for the Design Award of the Federal Republic of Germany, and his work has been exhibited at SIGGRAPH and Ars Electronica. Portfolio at **moritz.stefaner.eu** [Lilenthal, Germany]

Stephen Uzzo is vice president of science and technology for the New York Hall of Science where he works on exhibit and program development projects related to STEM learning, scientific visualization, sustainability, and network science. Uzzo also serves on the faculty of the New York Institute of Technology Graduate School of Education, where he teaches STEM teaching and learning. [Queens, NY, USA]

Caroline Wagner holds the Wolf Chair at Ohio State University's John Glenn School of Public Affairs and is an expert in the field of science and technology and its association to policy, society, and innovation. She has served as a professional staff member for the U.S. Congress Committee on Science, Space, and Technology, the Congressional Office of Technology Assessment, and the State Department and as advisor to the European Commission, World Bank, U.S. National Science Foundation, and others. [Columbus, OH, USA]

Benjamin Wiederkehr is founding partner and managing director of the Zürich-based design and data visualization studio, Interactive Things. He is also part of the Open Government Data task force in Switzerland and helps to facilitate open access to government data for everyone. On **Datavisualization.ch**, Wiederkehr provides insight into his research and working process and documents topical use cases in the field of data visualization. [Zürich, Switzerland]

Bring the Exhibit Home

Bring *Places & Spaces* to Your Institution

Put your institution on the map by hosting *Places & Spaces* at your university, museum, or library. The exhibit consists of high-resolution maps (90 currently, 100 in Fall 2014), map labels, and introductory panels for each iteration. Included as well are additional elements such as the Illuminated Diagram, Ingo Günther's WorldProcessor Globes, the Hands-on Science Maps for Kids, and the *Humanexus* movie. Exhibit curators will be happy to speak with you about the benefits of hosting *Places & Spaces* and the logistics involved in doing so.

Share these educational science maps with your whole school or institution by becoming an official exhibit host!

Potential hosts concerned about space should know that while the exhibit is at its best when displayed as a cohesive whole in a continuous space, it has also been presented to great effect as smaller conceptual units in separate (but not too distant) spaces. We can discuss with you the arrangements that best suit your situation in order to arrive at the perfect communion between exhibit and venue.

Over its ten-year history, *Places & Spaces* has appeared at some of the world's most renowned institutes of knowledge and learning, including the National Academy of Sciences in the U.S., the New York Public Library, the Chinese Academy of Sciences, the Royal Netherlands Academy of Arts and Sciences, and many more universities, libraries, and museums around the globe (see **scimaps.org/exhibitions** for a complete list of venues). Contact us at **cns@indiana.edu** today to begin the process of bringing *Places & Spaces* to your own valuable institution.

Places & Spaces *at the National Academy of Sciences in Washington, D.C.*

Places & Spaces *Digital Display in North Carolina State's brand new Immersion Theater*

Think Outside the Frame!

Our designers have worked with IT experts from universities around the country to create an exhibit experience that is truly larger than life. The *Places & Spaces* Digital Display is a dazzling showcase for these stunning maps of science, taking the viewer through the evolution of science mapping from its earliest beginnings to its most cutting-edge developments.

Don't have enough wall space for the physical exhibit? You can display the complete exhibit on a single wall!

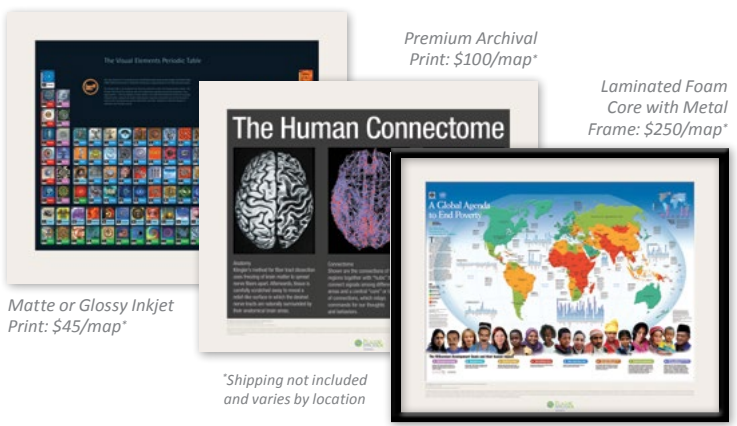
In bringing *Places & Spaces* to the big screen, great care has been taken to preserve the maps' rich color and clarity. Thus, the large-screen display offers a presentation that is grand in scale, but without sacrificing the qualities that audiences of the exhibit have come to treasure and expect. You can display the maps on your institution's digital wall, or project them onto a light surface for an equally impressive experience. We'll work closely with you on customizing the display to perfectly fit your space.

This unique production had its debut in 2012 at the IQ-Wall in the Herman B Wells Library at Indiana University. It has also been on display at Brandeis University and North Carolina State University's state-of-the-art Immersion Theater in the newly opened James B. Hunt Jr. Library. To learn how to bring the *Places & Spaces* Digital Display to a screen near you, please contact us at **cns@indiana.edu**.

Purchase a Map of Science

Any visit to the *Places & Spaces* exhibit is sure to be memorable, but many attendees find themselves wanting to take with them something more tangible than memories. Those individuals will be delighted to learn that the majority of our exhibit maps are available for purchase at our online store (**scimaps.org/store**). All maps are 24" x 30" (61 x 76 cm) and come in three quality levels to choose from: high-quality matte or glossy inkjet, a higher-quality version printed with premium archival ink on archival paper, and a highest-quality option mounted on foam core and edged with black metal framing.

In addition, some fans of the exhibit find the theme of a particular iteration especially relevant to their personal interests or to the interests of their institution. To meet this need, poster versions of each iteration are also available at the *Places & Spaces* online store. They consist of two posters per iteration, with each poster measuring around 67" x 36" (170 x 92 cm). The posters feature all ten maps from the iteration, their descriptions, colorful photos, and interesting exhibit information.



*Premium Archival Print: $100/map**

*Laminated Foam Core with Metal Frame: $250/map**

*Matte or Glossy Inkjet Print: $45/map**

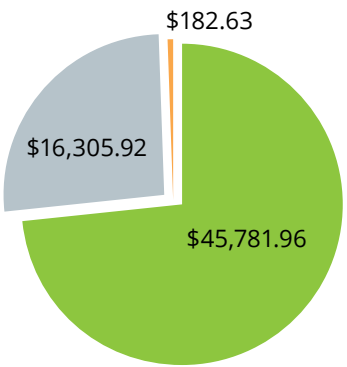
**Shipping not included and varies by location*

Finances & Numbers

Finances

Exhibit finances are managed by the Cyberinfrastructure for Network Science Center at the Department of Information and Library Science at the School of Informatics and Computing, Indiana University. Shown below are exhibit income expenditures for 2013. Exhibit revenues come from map sales, venue contributions, and support by the Cyberinfrstructure for Network Science Center.

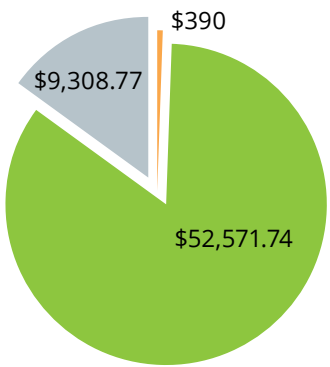
2013 Expenses*



Total: $62,270.51

- Salaries
- Design & Venue Acquisition
- Workshops & Events

2013 Revenue*



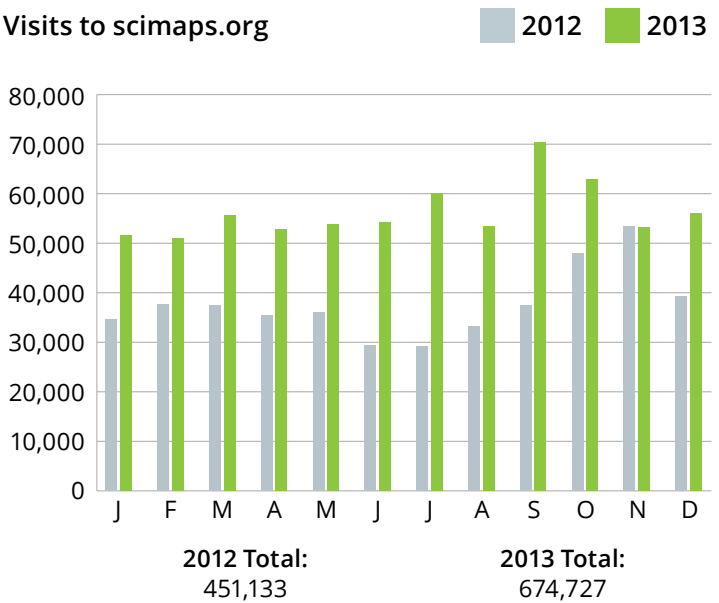
Total: $62,270.51

- CNS Support
- Map Sales
- Venue Contributions

Exhibit in Numbers (since 2005)

Exhibit Maps: 90
Map Makers: 237
Display Venues: 247
Press Items: 175
Workshops Organized: 26
Website Visits: 3,252,836

Visits to scimaps.org



2012 Total: 451,133

2013 Total: 674,727

*This report covers the exhibit's 2013 fiscal year: Jan 1 - Dec 31, 2013.

References

Books

Börner, Katy. 2010. *Atlas of Science: Visualizing What We Know*. Cambridge, MA: The MIT Press. More information at: **scimaps.org/atlas**.

Börner, Katy. (forthcoming). *Atlas of Knowledge: Anyone Can Map*. Cambridge, MA: The MIT Press.

Börner, Katy, and David E. Polley. 2014. *Visual Insights: A Practical Guide to Making Sense of Data*. Cambridge, MA: The MIT Press.

Börner, Katy, Mike Conlon, Jon Corson-Rikert, and Ying Ding, eds. 2012. *VIVO: A Semantic Approach to Scholarly Networking and Discovery*. San Francisco, CA: Morgan & Claypool Publishers LLC.

Scharnhorst, Andrea, Katy Börner, and Peter van den Besselaar, eds. 2012. *Models of Science Dynamics: Encounters Between Complexity Theory and Information Sciences*. Berlin: Springer-Verlag.

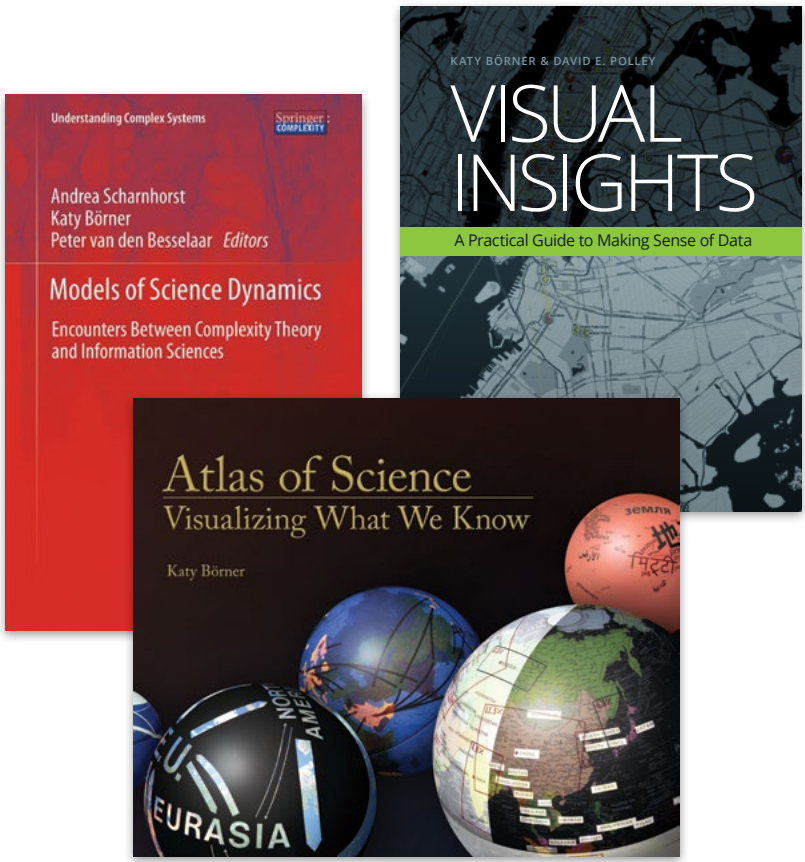
Shiffrin, Richard M., and Katy Börner, eds. 2004. "Mapping Knowledge Domains." Special issue of *PNAS* 101 (Suppl. 1). Available online at **pnas.org/content/101/suppl.1**.

Tools

Science of Science (Sci2) Tool (**sci2.cns.iu.edu**) is a desktop application that was specifically designed for the study of science. It supports the temporal, geospatial, topical, and network analysis and visualization of data sets at the micro (individual), meso (local), and macro (global) levels.

Data

The Scholarly Database (**sdb.cns.iu.edu**) provides easy access to more than 26,300,000 papers, patents, and grants from major databases such as MEDLINE, U.S. Patent and Trademark Office, National Science Foundation, National Institutes of Health and National Endowment for the Humanities Awards as well as Clinical Trials. Users can register for free to cross-search these databases and to download result sets as dumps for science of science research and science policy practice.



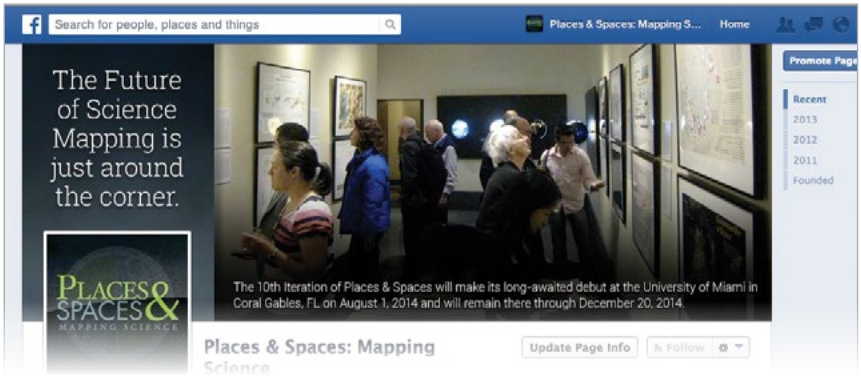
Connect With Us

Cyberinfrastructure for Network Science (CNS) Center
School of Informatics and Computing
Indiana University
Wells Library 020, 1320 E. 10th Street
Bloomington, IN 47405, USA

PHONE 812.855.7034 or 812.855.5120
FAX 812.855.6166
EMAIL **cns@indiana.edu**
WEB **scimaps.org**

Friend us on Facebook!

/mappingscience



Follow us on Twitter!

@mappingscience