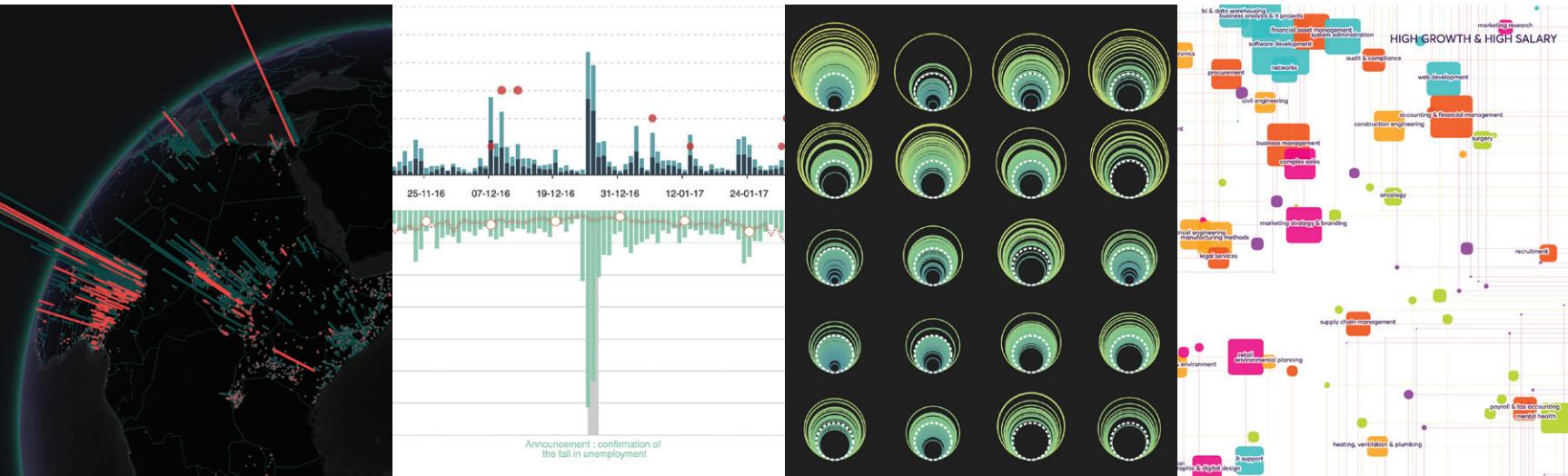




PLACES &  
SPACES  
MAPPING SCIENCE

# TRACKING THE FLOW OF RESOURCES

ANNUAL REPORT 2019



# Letter from the Curators



Curators Katy Börner (left) and Lisel Record (right).

The phenomenon examined by this year's iteration of *Places & Spaces*—the movement of social, political, and economic resources—is a perfect example of a topic that macrosopes are particularly equipped to analyze and illuminate. The large-scale global connections, massive datasets, and complicated trajectories associated with resource flow would be impossible to comprehend without the wide-angle view that macrosopes afford. We know you will find them informative, challenging, and inspiring.

As curators of *Places & Spaces*, we are privileged to work with those who believe that data visualization literacy is a critical skill and that visualizations are a highly effective way to render data into actionable knowledge. Every year, we select submissions from experts around the globe and work with them to bring to the public macrosopes that both inform and inspire. Thanks are due to a number of exceptional people who have worked very hard to bring the 15th iteration of the exhibition to fruition, beginning with those who have graciously allowed us to include their work in the exhibit. Additionally, we are deeply grateful to the women and men who serve on the Advisory Board or as exhibit ambassadors throughout the world. This effort is larger than each one of us, and we could not do it without you.

# Special Thanks



Exhibit Assistant Esmé Middlebaugh.

funded project and as data media and data analytics intern at National Public Radio (NPR), have made Esmé a perfect fit for our exhibit team. On any given day, you may find her coordinating with exhibit venues, crafting marketing materials, interviewing exhibit ambassadors, leading macroscope tours, arranging map displays, and so much more. Aside from her interest in data science, Esmé has a deep love for baking, the results of which she often shares with her grateful colleagues here at *Places & Spaces*.

Our special thanks goes out to Esmé Middlebaugh, whose work on the exhibit over the past year has been invaluable. Esmé came to Indiana University to pursue her MS in Data Science after receiving her BA in Information Science and Arts from the University of Arizona in 2017. In the fall of 2020, she'll be headed to Europe on an Erasmus Mundus scholarship to study cartography at universities in Munich, Vienna, Dresden, and Twente. Her academic pursuits, along with her previous experience as research assistant on an NSF-

## How long have you been involved with the P&S exhibit?

June 2018 through May 2020.

## What were some of your chief responsibilities?

Reaching out to venues, prepping materials, updating the website, working with macroscope makers, and helping to coordinate installations. During half of that time, I also worked for CNS as a research assistant on the Opioid Addictions Grand Challenge.

## What did you enjoy most about your time with the exhibit?

I really enjoyed seeking out new visualizations and macrosopes for the exhibit, but mostly all the people that keep the exhibit going. And of course, baking for and indulging at Cake Days.

## Do you have a particular memory involving the exhibit that you'd like to share?

Planning and designing some of the materials for advertising the installation at Wells Library was really fun. It was also cool seeing the 15th iteration debut at the IEEE VIS Conference in Vancouver, BC.

## What are you involved with now?

I'm currently working full-time as a data visualization architect at an information governance company in DC. In the fall, I'll be headed to Germany on an Erasmus Mundus scholarship for a master's in cartography—which I actually found out about while doing research for the exhibit!

# 2019 Macroscopes

## Introduction

The *Places & Spaces: Mapping Science* exhibit, which operates as an outreach activity of the Cyberinfrastructure for Network Science Center (CNS), arises from CNS's core belief that the ability to make sense of data is as critical as the ability to read and write. New tools to assist people in this endeavor are continually evolving, and this progress is evident in the quality of interactive science visualizations being developed today.

The exhibit continues to evolve each year. It includes 100 maps of science, 20 interactive macroscopes, three of Ingo Günther's *WorldProcessor Globes*, two hands-on science maps for kids, the *Illuminated Diagram*, and the award-winning film *Humanexus*. *Places & Spaces* was first shown at the annual meeting of the Association of American Geographers in 2005. Since then, the exhibition has traveled to 396 venues in 28 countries on 6 continents, showcasing the work of 215 mapmakers and 49 microscope makers.

Macroscopes are software tools that help people focus on patterns in data that are too large or complex to see unaided. The world is a complex place, and macroscopes help us understand and manage that complexity. They are powerful lenses we can use to see patterns and trends in large volumes of data.

## Iteration XV (2019): Macroscopes for Tracking the Flow of Resources

Understanding the flow of financial and human resources is crucial for making smart economic, political, and ethical decisions. The four macroscopes that comprise the 15th Iteration of *Places & Spaces* track resource trajectories that would be impossible to understand without the wide-angle view that macroscopes are uniquely capable of providing. Through their lenses, we can view the complex flow of political opinion, the movement of refugees, changes in workplace demands, and the geography of income inequality.



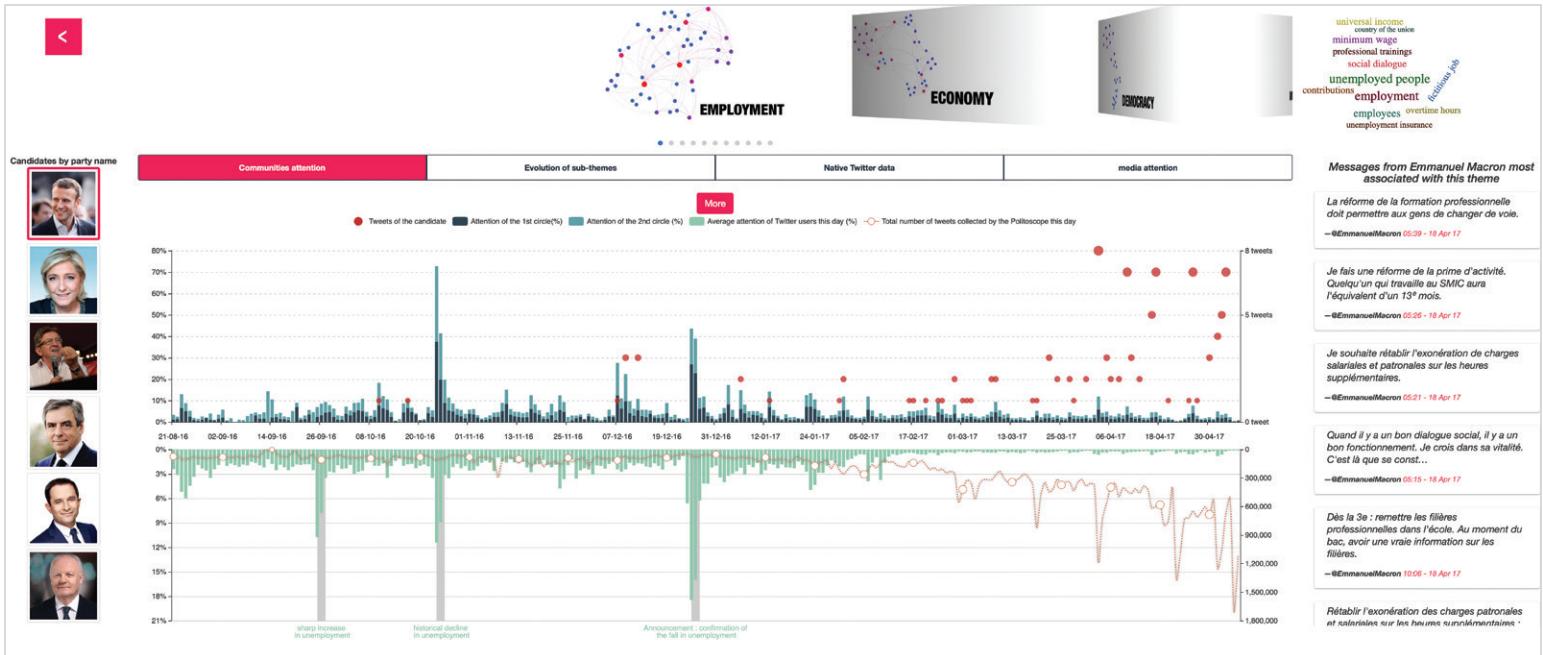
Exploring the Earth microscope at the IU Art Museum.



## Refugee Flow

Beginning in 2015, Europe saw a dramatic increase in the number of people seeking refuge from drought, poverty, and violence. Many crossed the Mediterranean Sea or traveled by land through Southeast Europe from the Middle East and Africa. Created by Abin Abraham and Will (Jiahao) Su, *Refugee Flow* is a tool for the exploratory investigation of this migration crisis. Combining multiple data sets with interactive visualizations, the project aims to increase understanding of human

trajectories. *Refugee Flow* draws on data from the Armed Conflict Location & Event Data Project (ACLED) to visualize factors that cause people to leave their home countries. This data is combined with the International Organization for Migration's Missing Migrants data set to visualize causes of death for those en route. A third data set connects adverse outcomes upon arrival with news stories of struggles faced by migrants.



## Politoscope

Designed for the 2017 French presidential election, *Politoscope* has since been on display in the *Terra Data* exhibit at the Cité des Sciences, the biggest science museum in Europe. Created by Mazyar Panahi, Noé Gaumont, and David Chavalarias, *Politoscope* provided a way for the public to take the pulse of online communities during the last month of the 2017 French presidential election, and provided access to the candidates' positions on major political issues over several months.

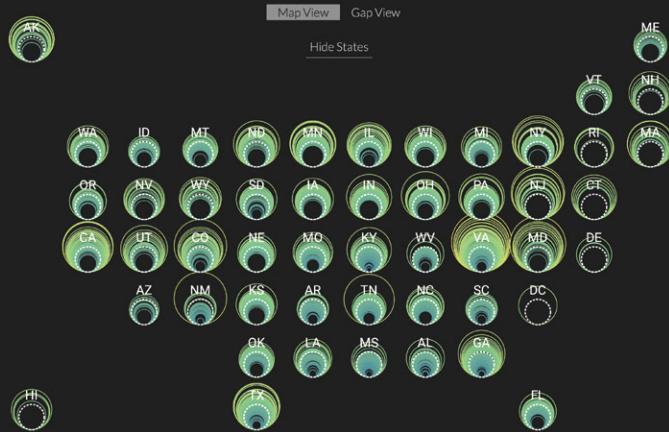
*Politoscope* uses millions of political and media tweets to visualize socio-semantic trends using a new methodology to reconstruct the socio-semantic dynamics of political activist Twitter networks. The macroscope makers are convinced of the need to make this kind of analysis of social media available to regular citizens as well as political elites. How do you feel about the connection between social networks and electoral processes worldwide? Has real-time analysis of social media ever influenced your political opinion? Should it?

## Income Disparity in The States

In 2016, how was the income distributed in the United States? Many higher-income counties are located in Virginia, Maryland, New Jersey, New York and California State. While many counties in Virginia have a median household income above the national average, this hides the fact that Virginia has the largest income gap between the lowest-income county and highest-income county of any state. Almost all counties in Massachusetts, New Jersey, Connecticut, Rhode Island, Delaware and Hawaii have an income above average. Counties with relatively low income are mostly in middle-south of the US. Hover over circles to see more details.

Source: median household income data from American Community Survey

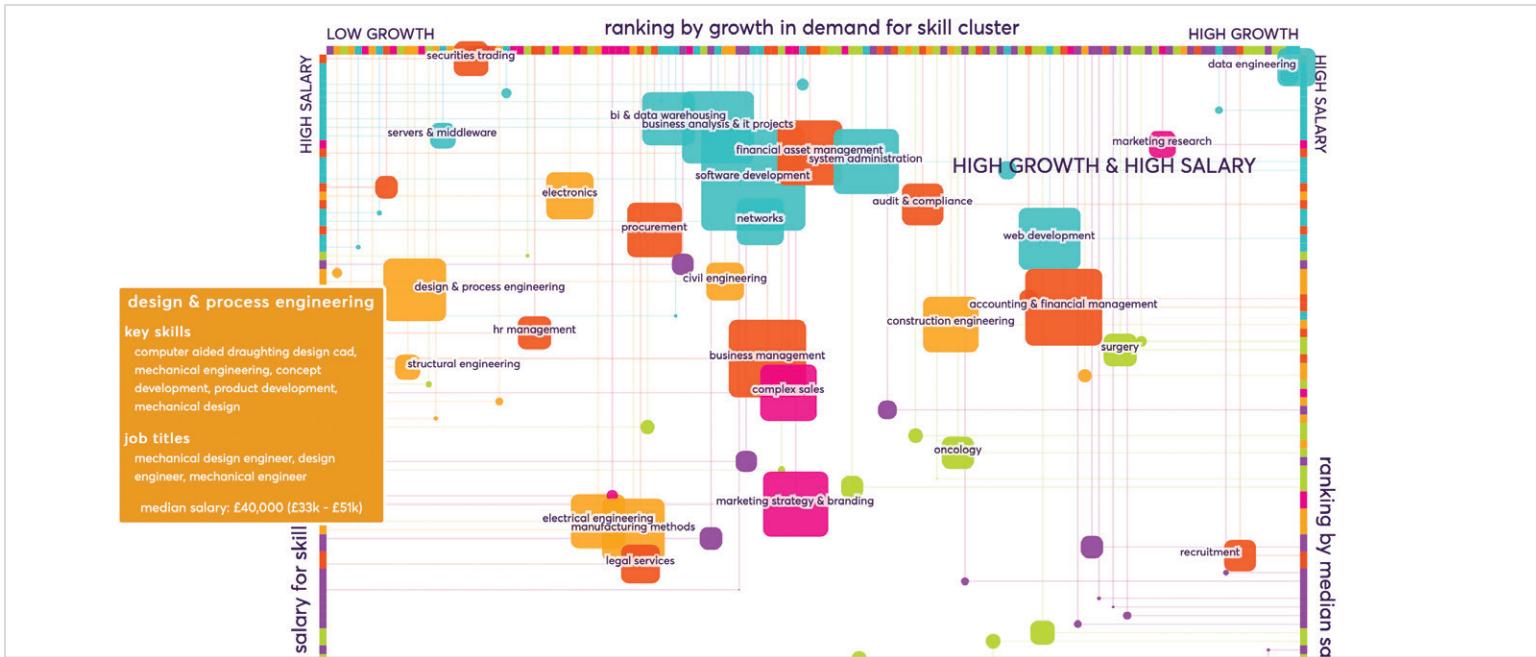
Higher-income County  
National average  
Lower-income County



## Income Disparity

Before getting into the world of data visualization, Sing-yun Chiang worked for two years as a journalist and assistant editor. This prior experience informs Chiang's *Income Disparity*, an interactive visualization that encourages viewers to search for the facts behind recent economic headlines. This macroscope shows, county by county and state by state, how median household incomes compare. Although Virginia has a median income above the national

average, it has the largest difference between high income and low income counties. Data presented here is drawn from the American Community Survey, an ongoing annual survey conducted by the United States Census Bureau. It is used for many purposes, including community planning for hospitals, schools, bridges, and new business ventures. Do you see any trends? If you reorder the states based on the difference between high earning counties and low earning counties, where does Arkansas fall?



## Making Sense of Skills

The skills needed in the workplace are changing. With the development of artificial intelligence and advances in robotics, what skills will remain valuable in the job market? Using machine learning, Cath Sleeman and Jyldyz Djumalieva of Nesta (funded by ESCoE) built a skills taxonomy to group skills based on how often they appeared together in job descriptions across the UK. The more frequently two skills appeared in the same advertisement, the more likely it is that they ended up in

the same branch of the taxonomy. Skills were then clustered based on growth in demand and on salary. The interactive visualizations lets users explore high-growth and high-salary jobs such as 'data engineering' (top right). They can focus in on jobs that have large area size such as 'business management' (middle). Or, they can click on a job and retrieve details, as seen here on the left with 'design & process engineering.' Search the resulting matrix to see which skills are in high demand and which are waning. Where does your dream job fall in this visualization?

# Venues

As in previous years, the exhibit's travel itinerary in 2019 was on a global scale. It began the year in Lauta, Germany, for the IBS Workshop on Media Computing, and ended the year in Dalian, China, where featured speaker Katy Börner presented *Places & Spaces* to attendees of the 15th Annual Conference of Webometrics, Informetrics, and Scientometrics.

In between that time, exhibit works and representatives could be found in Brighton, UK, at the European Meeting on Applied Evolutionary Economics, in Santa Fe, New Mexico, at the Interplanetary Festival, and at several events in and around our home base of Bloomington, Indiana.

In the fall, thousands of individuals from academia, government, and the private sector gathered in Vancouver, Canada, for the IEEE VIS 2019 conference. The premier forum for advances in theory, methods, and applications of visualization and visual analytics, IEEE VIS 2019 was also the setting of the debut of the *Places & Spaces* exhibit's 15th iteration. Keynote speaker Katy Börner was on hand to unveil the new macroscopes, which were on display as part of the IEEE VIS Arts Program (VISAP).

From November 4th to December 8th, *Places & Spaces* was on display at Kennesaw State University in Kennesaw, Georgia. Hosted by the Department of Geography and Anthropology and the College of Humanities and Social Sciences, the exhibit coincided with Geography Awareness Week and served as the catalyst for several related events.

*"The exhibit highlights the many ways in which geography, cartography, and geographic information science transcend the social sciences, humanities, and natural sciences."*

—Dr. Paul McDaniel, Assistant Professor of Geography, Kennesaw State University



Clockwise from top-left: Kennesaw State University; Geography Awareness Week at Kennesaw State; Data Day at the Indiana State House; Dalian University of Technology.

# 2019 Highlights



First Thursdays at Indiana University.



Collaborative learning at the microscope kiosk.



Science Fest 2019, Bloomington, IN.

## Promoting Data Visualization Literacy (DVL)

Helping to understand and promote data visualization literacy is the goal of *Data Visualization Literacy: Research and Tools that Advance Public Understanding of Scientific Data*. The project is funded by the NSF's Advancing Informal STEM Learning (AISL) program, and it teams CNS with science museums in Ohio, Minnesota, and New York and with Dr. Kylie Peppler's learning science team at Creativity Labs at the University of California Irvine. The project's research will seek to advance the state of the art in visualization technology. This will have broad implications for the teaching and learning of scientific data in both informal and formal learning environments.

The Data Visualization Literacy project has resulted in several significant publications in *Science*, *Scientometrics*, and *PLoS One*. In May, the *Proceedings of the National Academy of Sciences of the United States of America (PNAS)*, one of the most influential forums for scientific thought, published a research paper with some of the project's guiding principles and theoretical framework. Written by Katy Börner, Andreas Bueckle, and Michael Ginda, "Data Visualization Literacy: Definitions, Conceptual Frameworks, Exercises, and Assessments" both argues for the necessity of DVL and proposes a framework for defining, teaching, and assessing it.



Indiana governor Eric Holcomb meets Amatria.



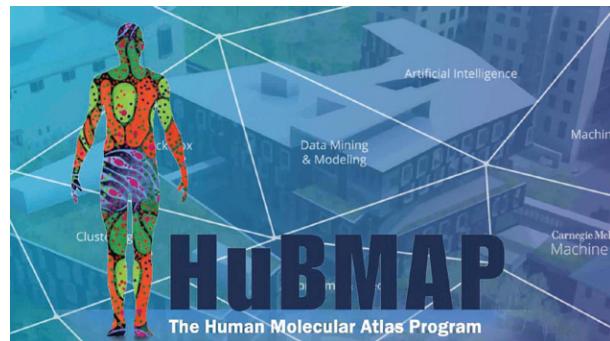
Science maps at the Career Fair.



Macroscope kiosk.

## Introducing HuBMAP

In October, an article co-authored by several leading biologists, geneticists, computer scientists, medical researchers, information scientists, and visualization experts appeared in the journal *Nature*. It announced to the world the beginning of an enormous scientific undertaking, the goal of which is to develop an accessible framework for comprehensively mapping the human body at single-cell resolution. Funded by the NIH, the Human BioMolecular Atlas Project (HuBMAP) brings together an interdisciplinary group of scholars, researchers, and practitioners from all over the United States. Here at Indiana University, the CNS Center leads the design and implementation of a common coordinate framework (CCF) within the HIVE technology core. The ultimate goal of this mapping effort is to develop a CCF for the healthy human body that captures cell types and interactions within anatomical structures. The resulting atlas will help us understand what happens as bodies age, and will provide a reference of the healthy human body than can be used to understand what goes wrong when disease strikes.



Human BioMolecular Atlas Project (HuBMAP).



L-R: Katy Börner, Dean Raj Acharya (Luddy School), Dean Peg Faimon (SOAA+D), Philip Beesley, Dean David B. Allison (School of Public Health), and IU First Lady Laurie Burns McRobbie.



Modeling an IoT wearable.



One of the many symposium designs.

## IoT Wearables Symposium

In April, exhibit curators Katy Börner and Lisel Record and colleagues organized the Internet of Things (IoT) Wearables in Motion Symposium. The event was developed in close collaboration with Innovate Indiana, the IU Research and Technology Corp., The Mill, and the Indiana IoT Lab. The symposium brought together thought leaders and innovative product developers that design IoT wearables for fashion, athletics, medical, and military applications.

Topics addressed included: novel sensors and actuators, scalable and secure cyberinfrastructures, ownership of generated data, fashion trends in wearables, visual analytics of IoT data, and more. Keynote talks by John Wechsler & Jason Pennington, Indiana IOT and Philip Beesley, Living Architecture Group, Toronto, Canada, presentations by IU's First Lady Laurie Burns McRobbie, and deans Raj Acharya (Luddy School), Peg Faimon (SOAA+D), and David B. Allison (School of Public Health), research facility tours, brainstorming sessions, and demonstrations of cutting-edge technology made the event unique and memorable.

# An Interview with New P&S Ambassador Mariana Espinosa Aldama



Mariana Espinosa Aldama with co-curators Lisel Record and Katy Börner.

## How did you first learn about *Places & Spaces*?

I learned about *Places & Spaces* and the *Atlas of Knowledge* while taking my first data visualization course, the IVMOOC, and learning how to use the Sci2Tool. The IVMOOC allowed me to do quick and easy visualizations of scientific data.

## Visualization encompasses a lot of different areas. Where does your work fall in the vast array?

I'm interested in the development of theories of gravitation, astronomy, and cosmology. I have done several citation and reference networks of papers in gravitation; concept lattices to visualize internal theoretic and intertheoretical relations; word co-occurrence networks in Mexican publications on astronomy; co-authorship networks for several Mexican scientific institutes, including the Astronomy Institute and the Complex Science Center at UNAM.

## What excites you about data visualization and *Places & Spaces* in particular?

I think better with images. They stick in my memory and facilitate the management of a great deal of information. I believe they are one of the best ways to communicate ideas and relations and to tell stories based on data. *Places & Spaces* comprises some of the best examples of data visualization. It has been excellently curated, and it is easy to share.

## As exhibit ambassador for Mexico, where would you like to take the exhibit to?

We all know *Places & Spaces* is perfect for exhibitions in scientific research institutes, universities, and science museums. But besides these obvious sites, I would like to inspire people in the arts and humanities departments, where data visualizations are not normally in their scope. Visualizations may be done in an artistic fashion and evoke feelings of understanding and accessibility.

# Exhibit Advisors

The Indiana University exhibit team benefits greatly from the expert input it receives from this international advisory board. Advisory board members review exhibition submissions and provide their expertise and guidance to the exhibit on many levels.



**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). For eight years, he served as the Spatial Ontology Community of Practice (SOCoP) Executive Secretariat helping to run workshops and vocabulary development efforts to advance the field. Currently, Berg-Cross serves as a consulting knowledge engineer on earth science projects and is co-organizer of the annual Ontology Summit hosted at NSF and NIST. [Potomac, MD, 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 Vincis. [Urbana-Champaign, IL, USA]



**Bonnie DeVarco** writes and lectures on design science, virtual worlds, next-generation geographic information systems, information visualization, and the culture of cyberspace. Previously, DeVarco was a Distinguished Visiting Scholar with the Media X Research Network at Stanford University (2009-2012) and served as chief archivist for the Buckminster Fuller Archives. Currently, DeVarco is completing a book on Buckminster Fuller and is coauthor with Eileen Clegg of *Shape of Thought*, on the history and evolution of visual language. [Palo Alto, CA, USA]



**Ingo Günther** has tried to cross-infuse journalism and art even before he founded the first independent TV station in Eastern Europe (Leipzig's Channel X) in 1989. That same year he began the Worldprocessor project, which has resulted in well over 1,000 modified thematic globes that not only reside in museum collections but have also graced the covers and pages of political magazines (Foresight, Harper's). His works have appeared in museums all over the world, including the Nationalgalerie Berlin, the Guggenheim Museum, Kunsthalle Düsseldorf, Espacio Buenos Aires, Iwaki City Art Museum, Somerset House in London, Hood Museum at Dartmouth, and the MIT Museum. [Karlsruhe, Germany]



**Francis Harvey** is head of the Department of Cartography and Visual Communication at the Leibniz Institute for Regional Geography and professor of Visual Communication in Geography at the University of Leipzig, Germany. His research and teaching activities center around geographic information systems (GIS), particularly their technologies, applications, ethical dimensions, and societal implications. Harvey's *Primer of GIS: Fundamental Geographic and Cartographic Concepts* (Guilford, 2015) is now in its second edition. [Leipzig, Germany]



**Peter A. Hook** is head of digital and scholarly services, LawArXiv administrator, and adjunct professor of law at the Cornell University Law School. He received his doctorate from the Luddy School of Informatics, Computing, and Engineering at Indiana University where his primary research focus was 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. [Ithaca, NY, USA]



**Lev Manovich** is professor at the City University of New York (CUNY) Graduate Center and author of several books on digital culture, including *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]



**Elijah Meeks** is the executive director of the Data Visualization Society and a data visualization engineer at Apple. His prior experience includes working in the digital humanities at Stanford and developing data visualization applications at Netflix. He is the author of D3.js in Action, the data visualization library Semiotic, and various essays on the subject of modern professional data visualization. His work includes the development of data visualization libraries, tools and exploratory applications. [Los Gatos, 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](http://moritz.stefaner.eu). [Lilienthal, Germany]



**Olga Subirós** is an architect, exhibition designer, and founder of Olga Subirós Studios. Recently, she co-curated (with José Luis de Vicente) Big Bang Data, a major exhibition of data-driven artworks and objects that provide crucial insight into the world of big data. Since 2014, the exhibit has toured worldwide, appearing at the Centre de Cultura Contemporànea de Barcelona (CCCB), Fundación Telefónica in Madrid, Somerset House London, ArtScience Museum Singapore, Centro de Cultura Digital in Mexico, and the DOX Centre for Contemporary Art in Prague. [Barcelona, Spain]



**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]

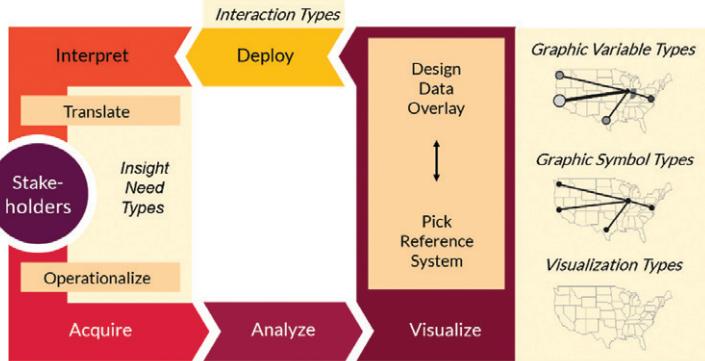


**Benjamin Wiederkehr** is founding partner and managing director of the Zürich-based design and data visualization studio, Interactive Things. He is also part of the Open Government Data task force in Switzerland and helps to facilitate open access to government data for everyone. On [Datavisualization.ch](http://Datavisualization.ch),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

# Visual Analytics Certificate

In a job market that can be unpredictable, one constant has been the strong demand for high-quality, easy-to-use data visualizations. Whether one plans for a job in government, academia, or the private sector, data visualization literacy will continue to be a crucial skill to possess in a competitive market. Developed with these needs in mind, the Visual Analytics Certificate officially launched in fall 2019.

The six-week online course combines theoretical knowledge and hands-on experience to help students implement a successful, user-centered visualization design process. Along the way, experts in the field introduce key concepts, real-world case studies, and powerful industry-standard tools. Designed with the schedules of busy professionals in mind, the Visual Analytics Certificate is delivered entirely online, so students can move at their own pace. Visit [visanalytics.cns.iu.edu](http://visanalytics.cns.iu.edu) for more information on enrollment and availability.



The Data Visualization Literacy Framework (DVL-FW)

*“The demand for data analysis skills has never been as strong as it is now, with industry transformation rapidly accelerating. Through this course, specifically designed for the working professionals, participants will learn how to evaluate data and data visualizations as well as how to more effectively communicate insights across a variety of business and government settings.”*

—Andreas Bueckle, assistant instructor for the VAC course and PhD candidate in Information Science at Indiana University

# Host the Exhibit

Put your institution on the map by hosting *Places & Spaces*. The exhibit consists of 100 framed, high-resolution maps, and 20 interactive macroscopes that travel on a touchscreen kiosk. Ingo Günther's *WorldProcessor Globes*, hands-on science maps for kids, the *Illuminated Diagram*, and the award-winning film *Humanexus* are also included. Give your audience the chance to play with data and make sense of science and technology developments.

The *Places & Spaces* exhibit travels in a variety of formats to fit every space and budget. Explore our all-digital options, purchase individual maps, or purchase a poster version of the exhibit. Our digital display is a high-resolution slide show of 100 exhibit maps, optimized for showing the full breadth of the exhibit on one screen. The majority of our exhibit maps are also available for individual purchase or as an archival set. All maps are 24" x 30" (61 x 76 cm) and can be ordered as inkjet prints, high-quality archival prints, and framed prints. Visit our website to explore the many ways you can bring the exhibit to your space ([scimaps.org/store](http://scimaps.org/store)).

Contact us at [recorde@indiana.edu](mailto:recorde@indiana.edu) for a quote and to check availability for your exhibition dates.



Ingo Günther's *WorldProcessor Globes*.



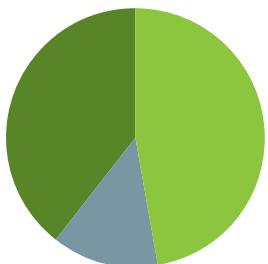
The high-definition touchscreen microscope kiosk.

# Exhibit in Numbers

## Finances

Exhibit finances are managed by the Cyberinfrastructure for Network Science Center at the School of Informatics, Computing, and Engineering at Indiana University. Shown below are exhibit income expenditures for January 1–December 31, 2019.

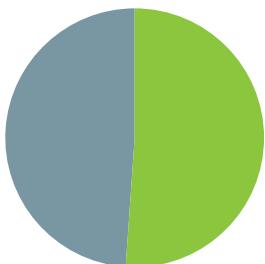
2019 EXPENSES



Total: \$13,875.06

Compensation	\$6,565.09
Travel	\$1,868.81
Supplies and Expenses	\$5,441.16

2019 INCOME



Total: \$13,875.06

CNS Support	\$7,120.06
Map Sales and Venue Revenue	\$6,755.00

100

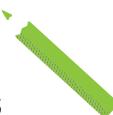
## MAPS

in large format, full color, and high resolution.

215

## MAPMAKERS

from fields as disparate as art, urban planning, engineering, and the history of science.



49



## MACROSCOPE MAKERS

including one whose job title is “Truth and Beauty Operator.”

20

## MACROSCOPES

for touching all kinds of data.

396

## DISPLAY VENUES

from the Cannes Film Festival to the World Economic Forum.



221

## PRESS ITEMS

including articles in *Nature*, *Science*, *USA Today*, and *Wired*.

36



## WORKSHOPS ORGANIZED

6,086,047

## WEBSITE VISITS

# Resources

## Books and Essays

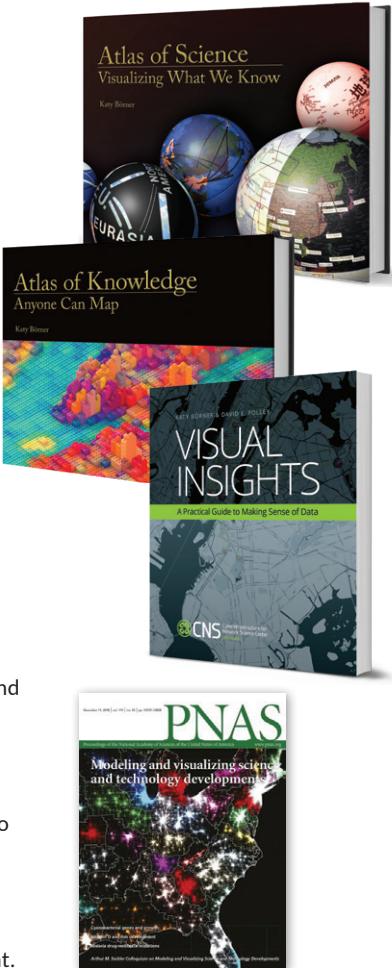
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## Tools

Science of Science (Sci2) Tool ([sci2.cns.iu.edu](http://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.

## Courses

The Visual Analytics Certificate (VAC) ([visanalytics.cns.iu.edu](http://visanalytics.cns.iu.edu)) course provides an overview about the state of the art in information visualization. It teaches the process of producing effective visualizations that take the needs of users into account.





*Places & Spaces: Mapping Science*

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