Macroscopes: Interactive Visualizations for Actionable Insights

Katy Börner* & Lisel Record   @katycns

*Victor H. Yngve Distinguished Professor of
Intelligent Systems Engineering & Information Science
Director, Cyberinfrastructure for Network Science Center
School of Informatics, Computing, and Engineering
Indiana University Network Science Institute (IUNI)
Indiana University, Bloomington, IN, USA

Sackler Collowuium
Beckman Center, Irvine, California

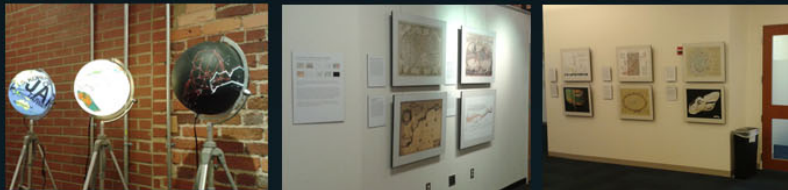*December 4, 2017*

Maps & Macroscopes

101st Annual Meeting of the Association of American Geographers, Denver, CO.
April 5th - 9th, 2005 (First showing of Places & Spaces)

University of Miami, Miami, FL.
September 4 - December 11, 2014.

Duke University, Durham, NC.
January 12 - April 10, 2015

The David J. Sencer CDC Museum, Atlanta, GA.
January 25 - June 17, 2016.

100 maps and 12 macroscopes by 215 experts on display at 354 venues in 28 countries.
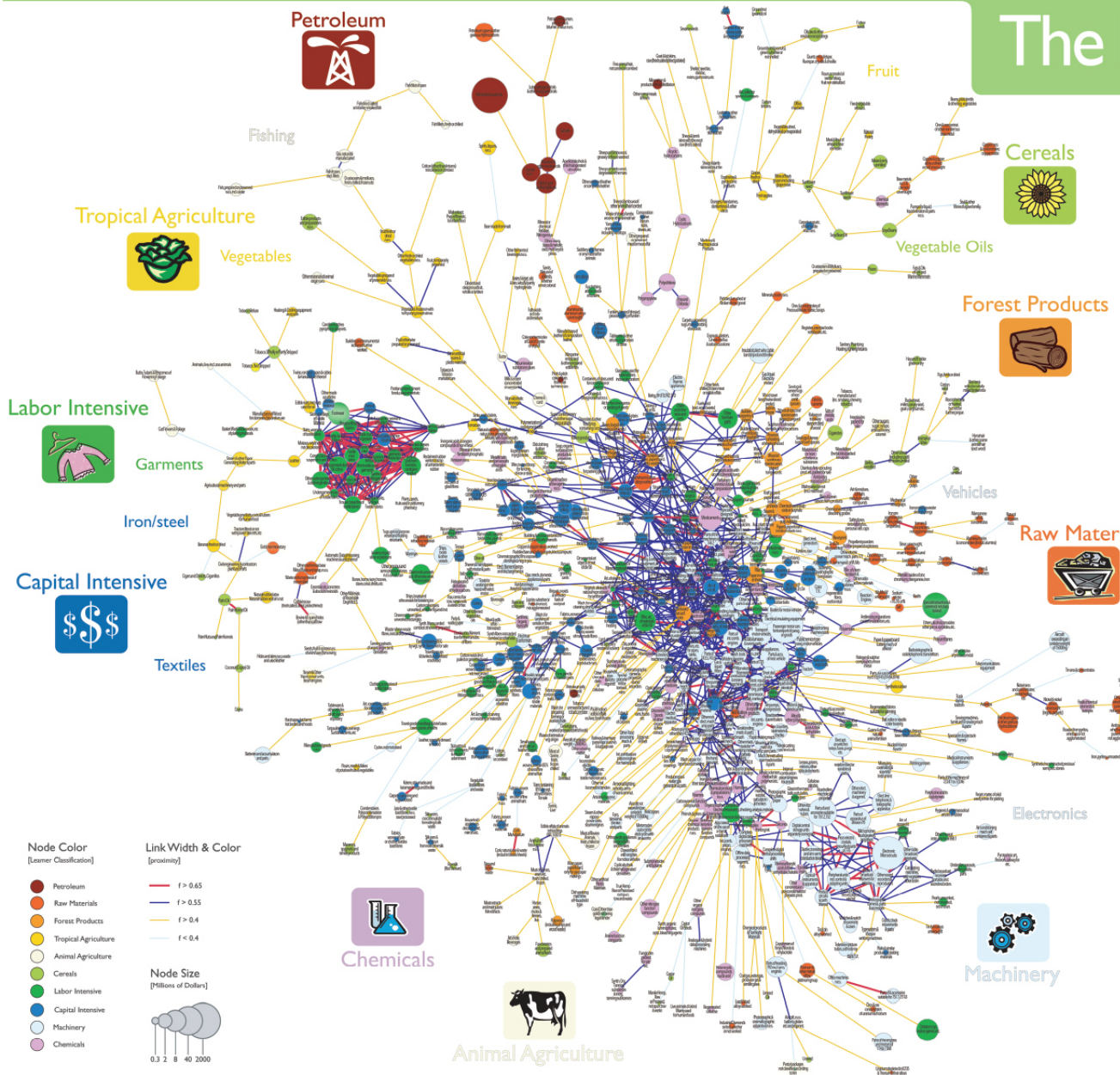
Map of Scientific Collaborations from 2005-2009

Computed Using Data from Elsevier's Scopus

Stream of Scientific Collaborations Between World Cities - Olivier H. Beauchesne - 2012

The Product Space

Petroleum

Fishing

Fruit

Cereals

Tropical Agriculture

Vegetables

Vegetable Oils

Forest Products

Labor Intensive

Garments

Iron/steel

Vehicles

Raw Materials

Capital Intensive

$$$

Textiles

Electronics

Chemicals

Machinery

Animal Agriculture

World trade flow data compiled by Feenstra et al. and available at the National Bureau of Economic Research were used to identify the complete co-export matrix of 775 industrial products for 1998-2000. A Maximum Spanning Tree (MST) algorithm was used to reduce the complete co-export matrix to less than 1% of the links. The resulting network, which combines the MST plus all links with a co-export frequency of at least 0.55, was laid out using a force-directed layout algorithm. Node sizes represent the value of traded products in millions of U.S. dollars. Their color corresponds to ten product groups identified using the Leamer classification. Each product class is labeled by an icon. Link color and width indicate the frequency of joint exports.

Economic Footprint

■ Indicate Relevant Exports

Industrialized Countries

East Asia Pacific

Latin America & the Caribbean

The network has a core-periphery structure with higher value product classes, e.g., machinery, and chemicals, in the core and lower quality classes, e.g., fishing and garments, in the periphery. Products at the core of the network are highly interconnected while products in the periphery are sparsely interlinked.

Each country has a certain product export footprint. Relevant exports by 'Industrialized Countries', 'East Asia Pacific' and 'Latin America & the Caribbean' are given on the right.

Traditional growth theory assumes that there is always a more sophisticated product within reach. However, given the core-periphery structure of the product space, the distances between products differ considerably.

Countries that operate at the core have capabilities to develop and manufacture a wide range of products. Yet, countries that mostly operate in the periphery of the product space have much fewer opportunities for diversification. A country's current footprint and the structure of the product space have a major impact on a country's future development.

Node Color
[Leamer Classification]

Link Width & Color
[proximity]

- f > 0.65
- f > 0.55
- f > 0.4
- f < 0.4

Node Size
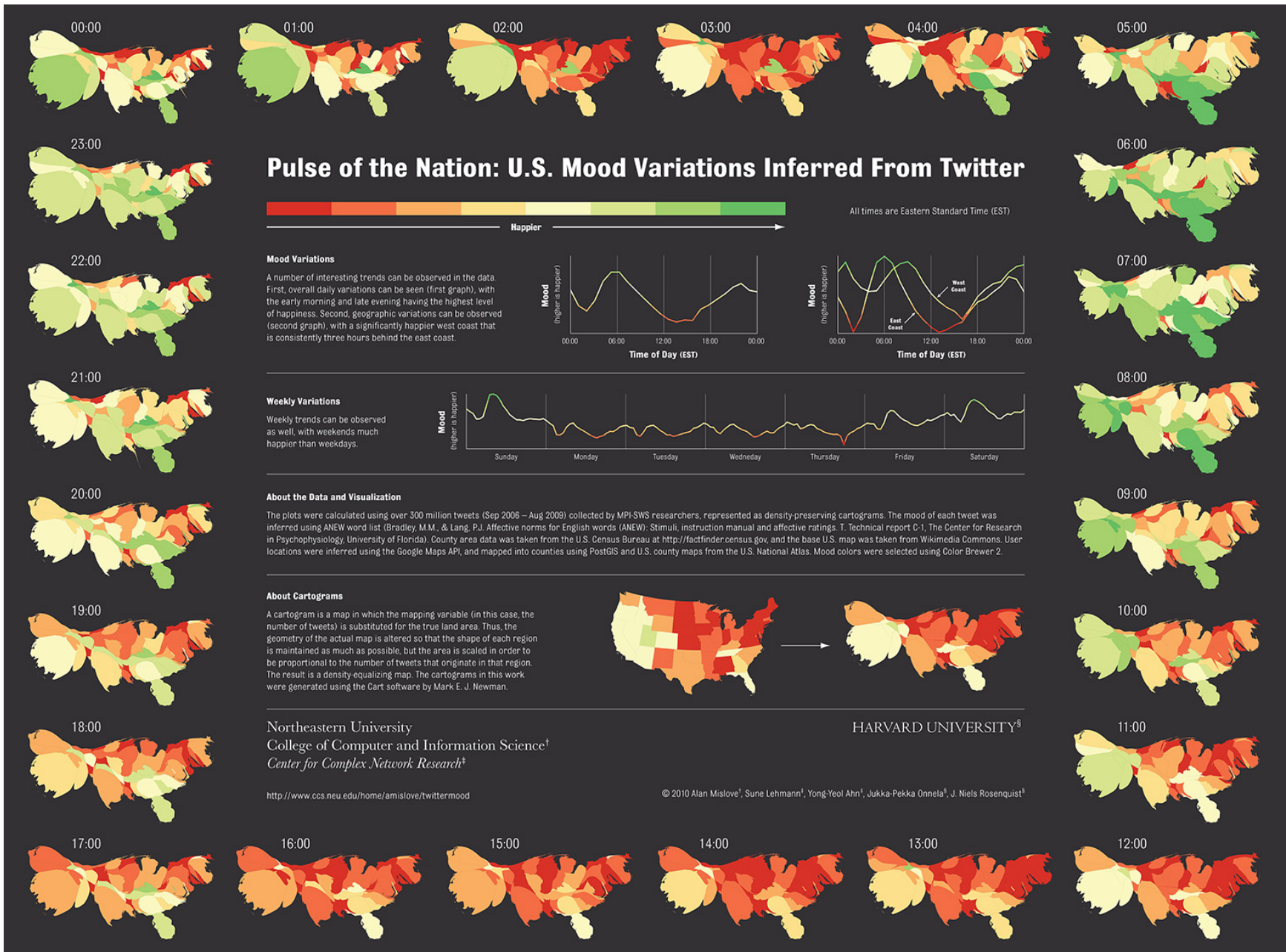[Millions of Dollars]

0.3 2 8 40 2000

- Petroleum
- Raw Materials
- Forest Products
- Tropical Agriculture
- Animal Agriculture
- Cereals
- Labor Intensive
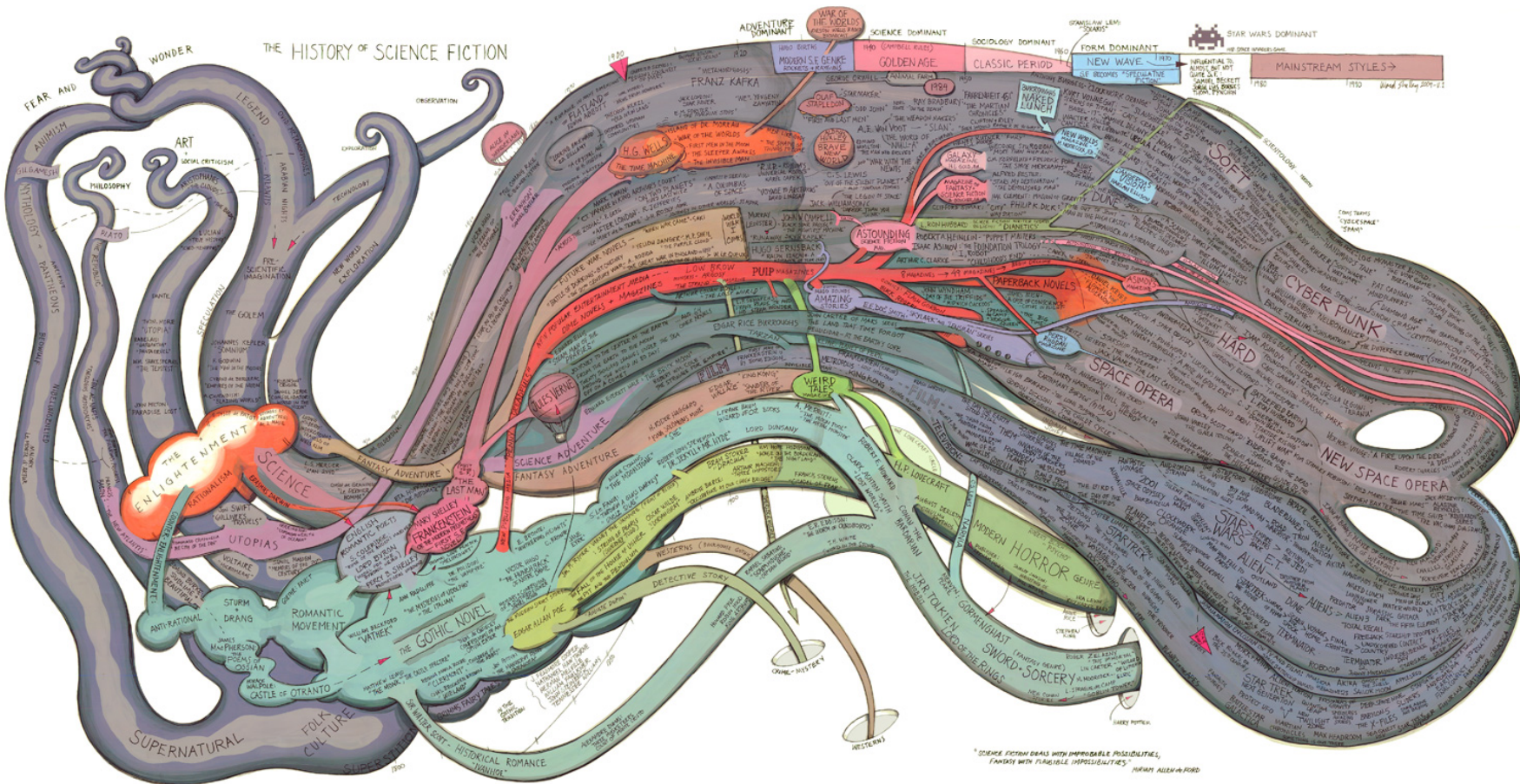- Capital Intensive
- Machinery
- Chemicals

IV.7 *The Product Space* - César A. Hidalgo, Bailey Klinger, Albert-László Barabási, Ricardo Hausmann - 2007

Pulse of the Nation: U.S. Mood Variations Inferred From Twitter

Happier →

All times are Eastern Standard Time (EST)

Mood Variations

A number of interesting trends can be observed in the data. First, overall daily variations can be seen (first graph), with the early morning and late evening having the highest level of happiness. Second, geographic variations can be observed (second graph), with a significantly happier west coast that is consistently three hours behind the east coast.

Mood (higher is happier)

Time of Day (EST)

West Coast

East Coast

Weekly Variations

Weekly trends can be observed as well, with weekends much happier than weekdays.

Mood (higher is happier)

Sunday   Monday   Tuesday   Wednesday   Thursday   Friday   Saturday

About the Data and Visualization

The plots were calculated using over 300 million tweets (Sep 2006 – Aug 2009) collected by MPI-SWS researchers, represented as density-preserving cartograms. The mood of each tweet was inferred using ANEW word list (Bradley, M.M., & Lang, P.J. Affective norms for English words (ANEW): Stimuli, instruction manual and affective ratings. T. Technical report C-1, The Center for Research in Psychophysiology, University of Florida). County area data was taken from the U.S. Census Bureau at http://factfinder.census.gov, and the base U.S. map was taken from Wikimedia Commons. User locations were inferred using the Google Maps API, and mapped into counties using PostGIS and U.S. county maps from the U.S. National Atlas. Mood colors were selected using Color Brewer 2.

About Cartograms

A cartogram is a map in which the mapping variable (in this case, the number of tweets) is substituted for the true land area. Thus, the geometry of the actual map is altered so that the shape of each region is maintained as much as possible, but the area is scaled in order to be proportional to the number of tweets that originate in that region. The result is a density-equalizing map. The cartograms in this work were generated using the Cart software by Mark E. J. Newman.

Northeastern University
College of Computer and Information Science[†]
Center for Complex Network Research[‡]

HARVARD UNIVERSITY[§]

http://www.ccs.neu.edu/home/amislove/twittermood

IX.4 *Pulse of the Nation* - Alan Mislove, Sune Lehmann, Yong-Yeol Ahn, Jukka-Pekka Onnela, and James Niels Rosenquist - 2010

The History of Science Fiction

VII.10 *History of Science Fiction* - Ward Shelley - 2011

Check out our Zoom Maps online!

Visit scimaps.org and check out all our maps in stunning detail!

MAPS
vs.
MACROSCOPES

Microscopes & Telescopes vs. MACROSCOPES
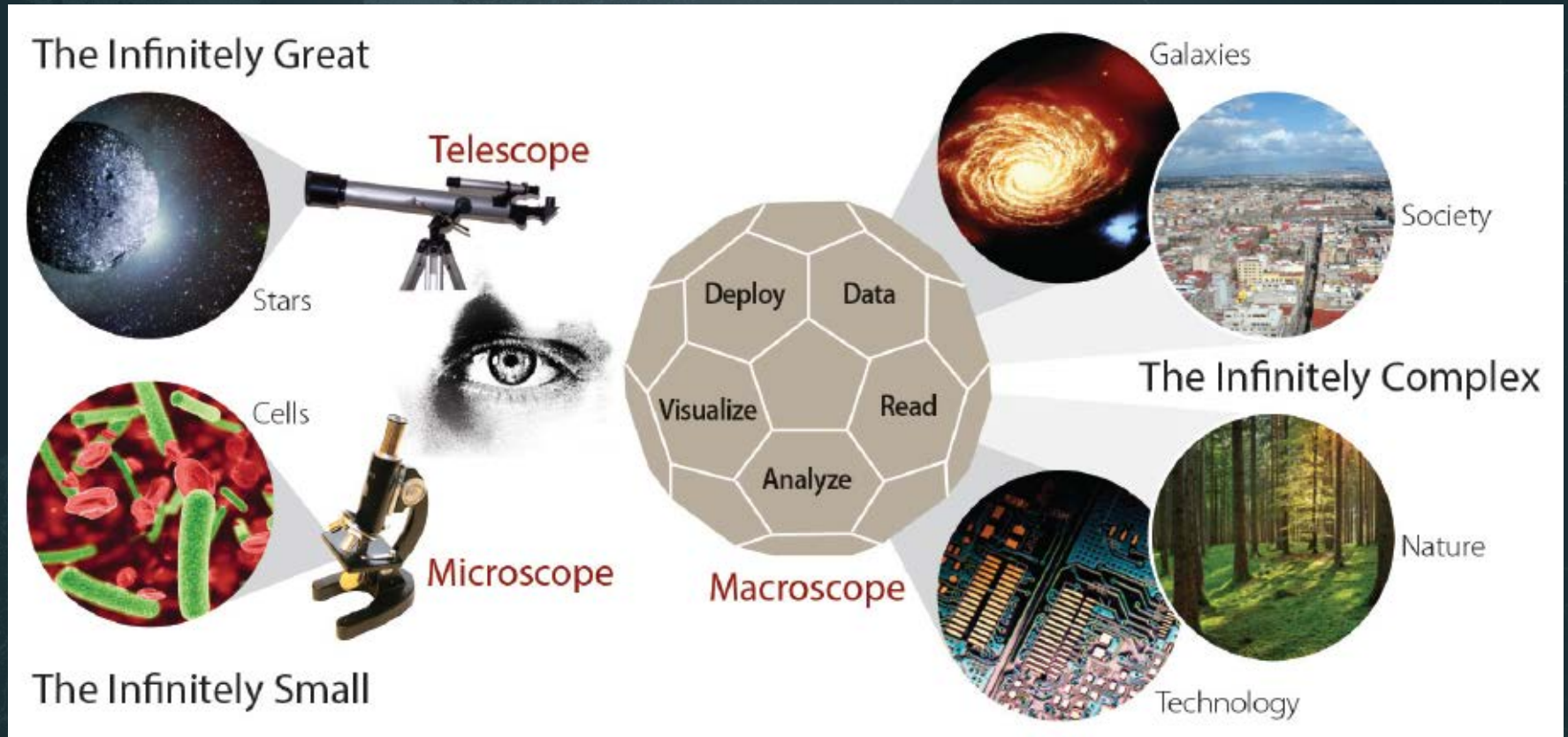
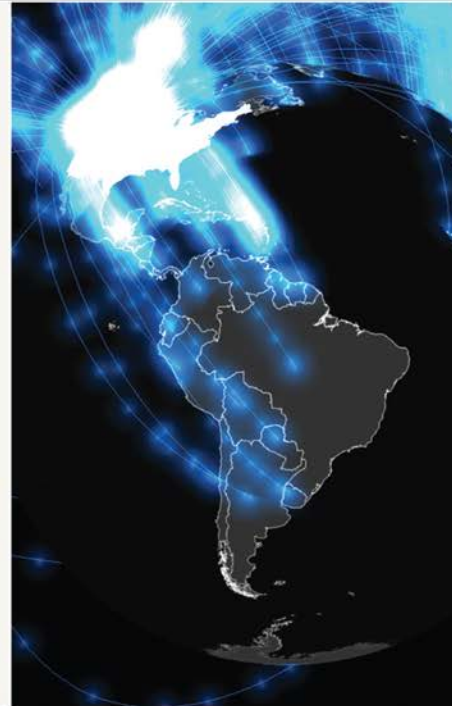**Iteration XI (2015): Macroscopes for Interacting with Science**
http://scimaps.org/iteration/11
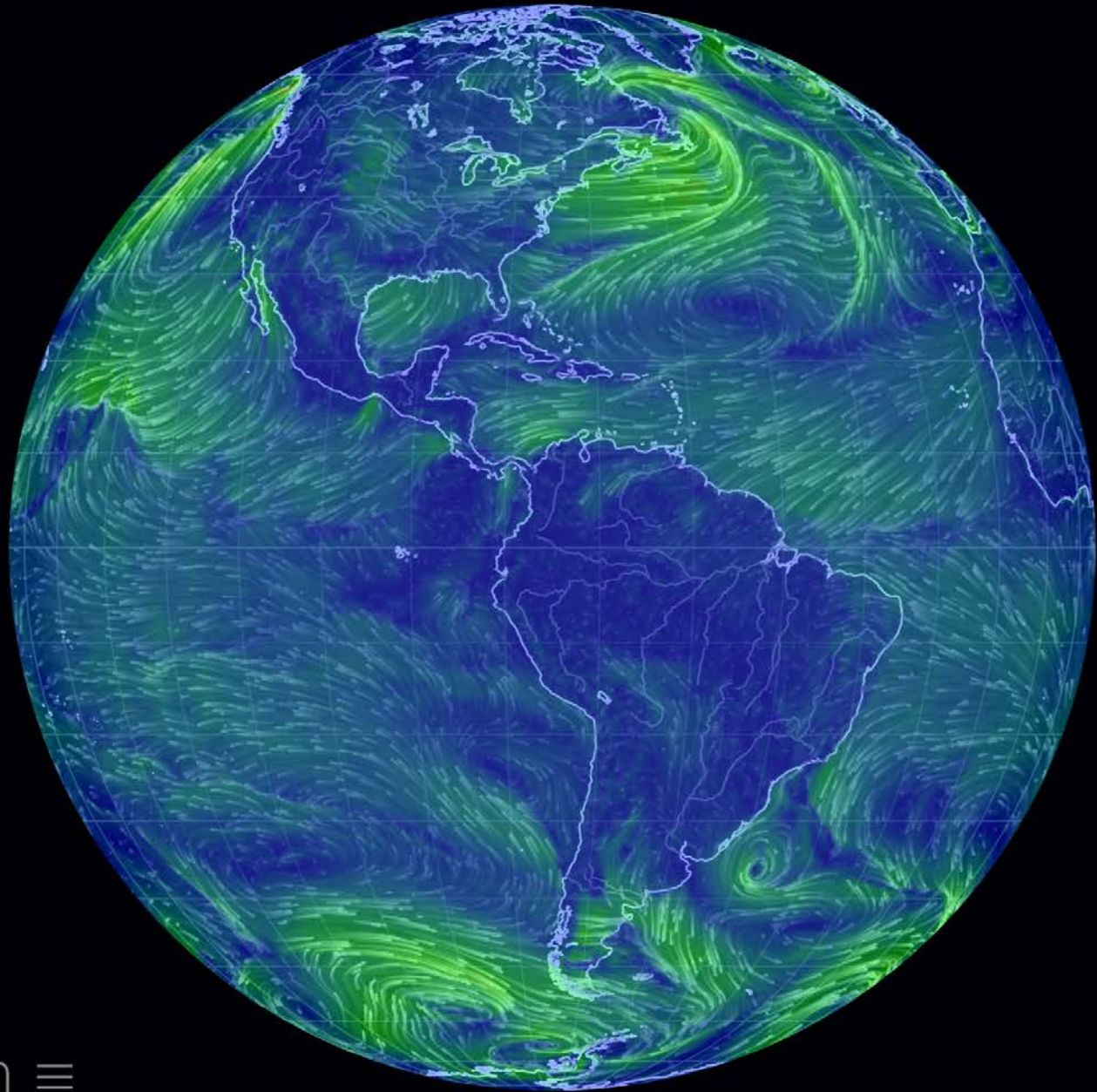
earth ≡

Earth – Cameron Beccario

AcademyScope – National Academy of the Sciences & CNS

Mapping Global Society –Kalev Leetaru

Iteration XII (2016): Macroscopes for Making Sense of Science
http://scimaps.org/iteration/12

Smelly Maps – Daniele Quercia, Rossano Schifanella, and Luca Maria Aiello – 2015

Megaregions of the US –Garrett Dash Nelson and Alasdair Rae – 2016
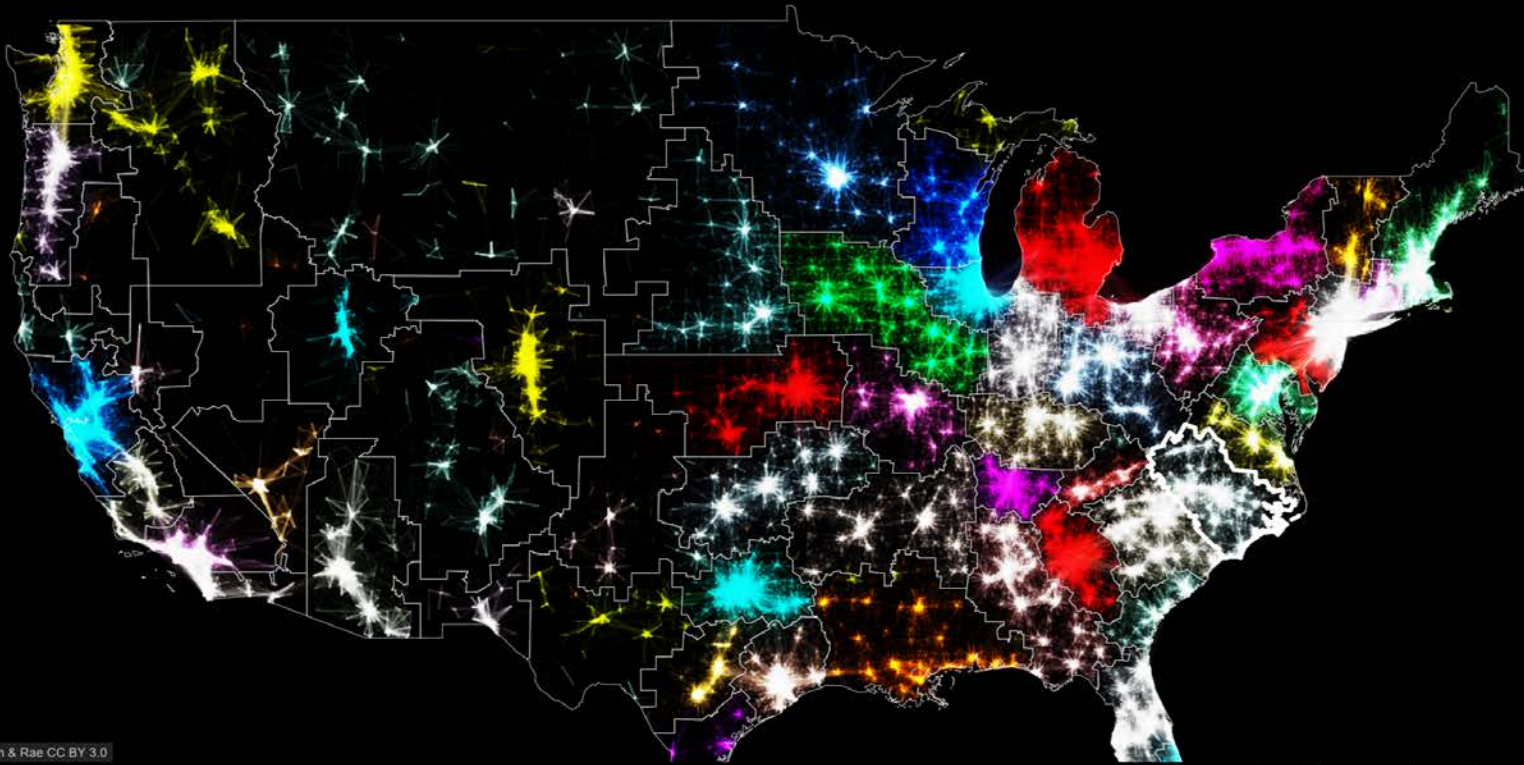
FleetMon Explorer – FleetMon – 2012

References

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

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

Börner, Katy (2010) **Atlas of Science: Visualizing What We Know**. The MIT Press. http://scimaps.org/atlas

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

Katy Börner, Michael Conlon, Jon Corson-Rikert, Cornell, Ying Ding (2012) **VIVO: A Semantic Approach to Scholarly Networking and Discovery**. Morgan & Claypool.

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

Börner, Katy (2015) **Atlas of Knowledge: Anyone Can Map**. The MIT Press. http://scimaps.org/atlas2