Visualizing science using VOSviewer

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Visual Insights Talk Series
Indiana University Bloomington
January 29, 2018

Outline

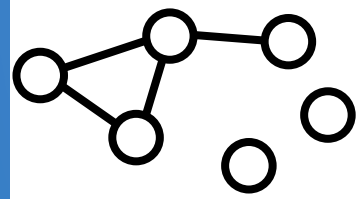
- Introduction to VOSviewer
- Application
- Lessons learned

My research into bibliometric visualization and the development of VOSviewer is joint work with CWTS colleague Nees Jan van Eck

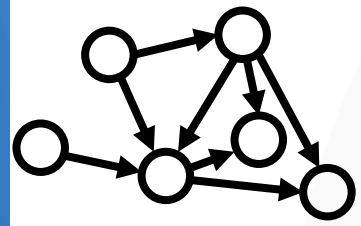
Introduction to VOSviewer

Bibliometric networks

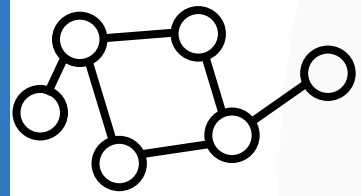
Bibliographic data source



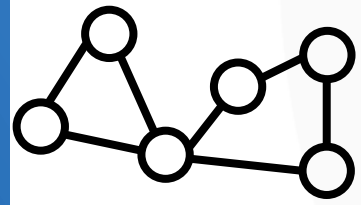
Co-authorship networks



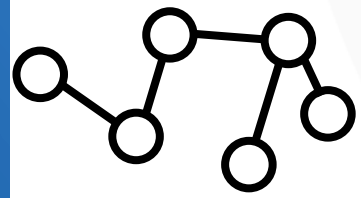
Citation networks



Bibliographic coupling networks



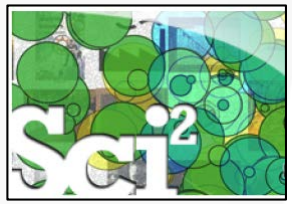
Co-citation networks

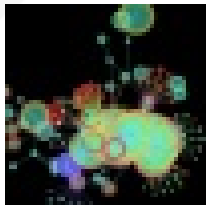


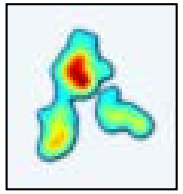
Co-occurrence networks

Software tools for bibliometric network analysis

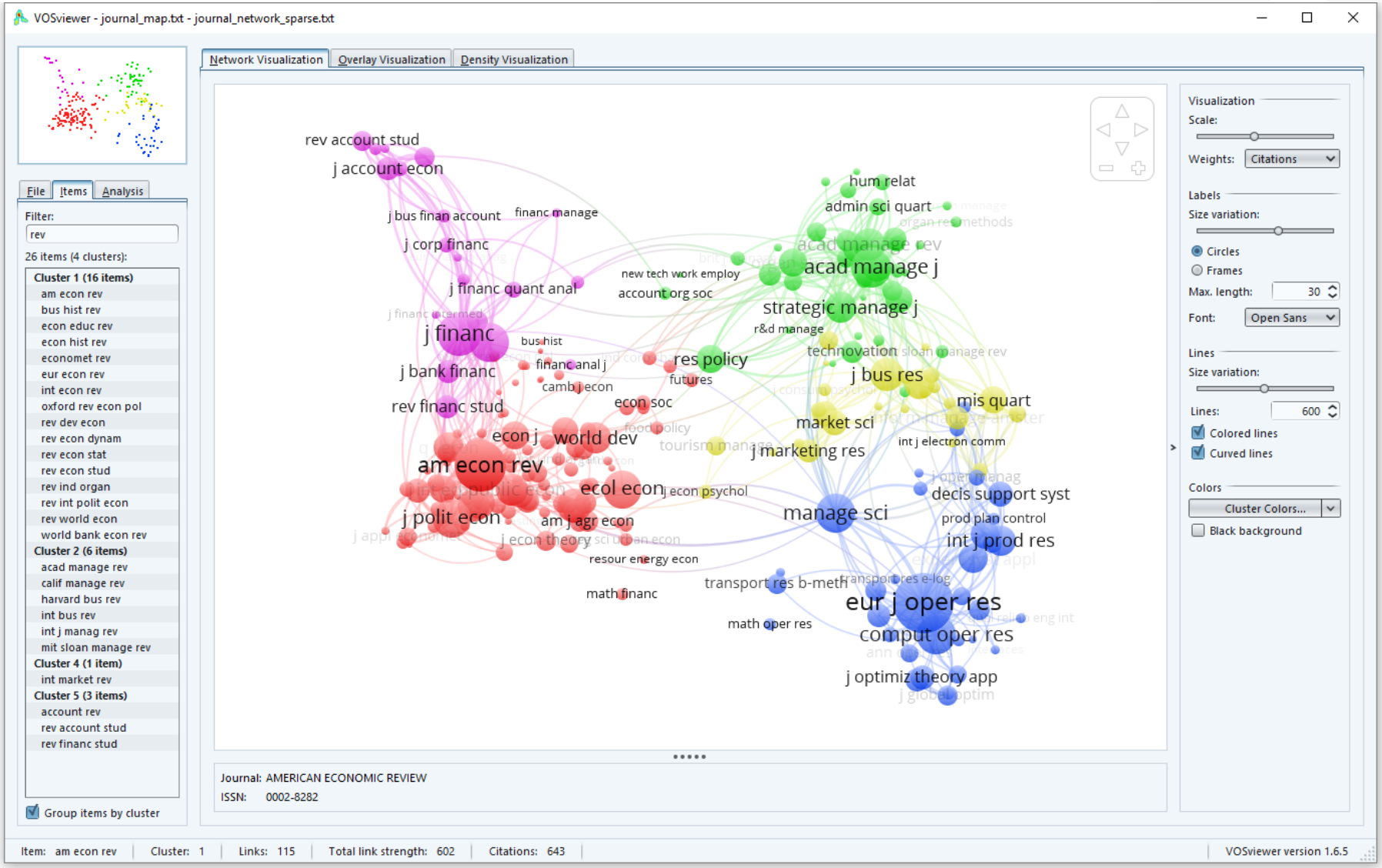
- General network analysis tools:
  - Gephi (http://gephi.org)
  - Pajek (http://pajek.imfm.si)
- Bibliometric network analysis tools:
  - BibExcel (http://www8.umu.se/inforsk/Bibexcel/)
  - CiteSpace (http://cluster.cis.drexel.edu/~cchen/citespace/)
  - Science of Science (Sci^2) Tool (https://sci2.cns.iu.edu)
  - VOSviewer (www.vosviewer.com)
- Tools for analyzing citation networks:
  - HistCite (www.histcite.com)
  - CitNetExplorer (www.citnetexplorer.nl)







VOSviewer


VOSviewer - journal_map.txt - journal_network_sparse.txt
Network Visualization
Overlay Visualization
Density Visualization
File
Items
Analysis
Filter:
rev
26 items (4 clusters):
Cluster 1 (16 items)
am econ rev
bus hist rev
econ educ rev
econ hist rev
economet rev
eur econ rev
int econ rev
oxford rev econ pol
rev dev econ
rev econ dynam
rev econ stat
rev econ stud
rev ind organ
rev int polit econ
rev world econ
world bank econ rev
Cluster 2 (6 items)
acad manage rev
calif manage rev
harvard bus rev
int bus rev
int j manag rev
mit sloan manage rev
Cluster 4 (1 item)
int market rev
Cluster 5 (3 items)
account rev
rev account stud
rev financ stud
Group items by cluster
rev account stud
j account econ
j bus finan account
financ manage
j corp financ
j financ quant anal
new tech work employ
account org soc
j financ
bus hist
financ anal j
j bank financ
camb j econ
rev financ stud
econ soc
res policy
futures
econ j
world dev
am econ rev
ecol econ
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technovation
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math oper res
comput oper res
j optimiz theory app
Journal: AMERICAN ECONOMIC REVIEW
ISSN: 0002-8282
Visualization
Scale:
Weights: Citations
Labels
Size variation:
Circles
Frames
Max. length: 30
Font: Open Sans
Lines
Size variation:
Lines: 600
Colored lines
Curved lines
Colors
Cluster Colors...
Black background
Item: am econ rev
Cluster: 1
Links: 115
Total link strength: 602
Citations: 643
VOSviewer version 1.6.5

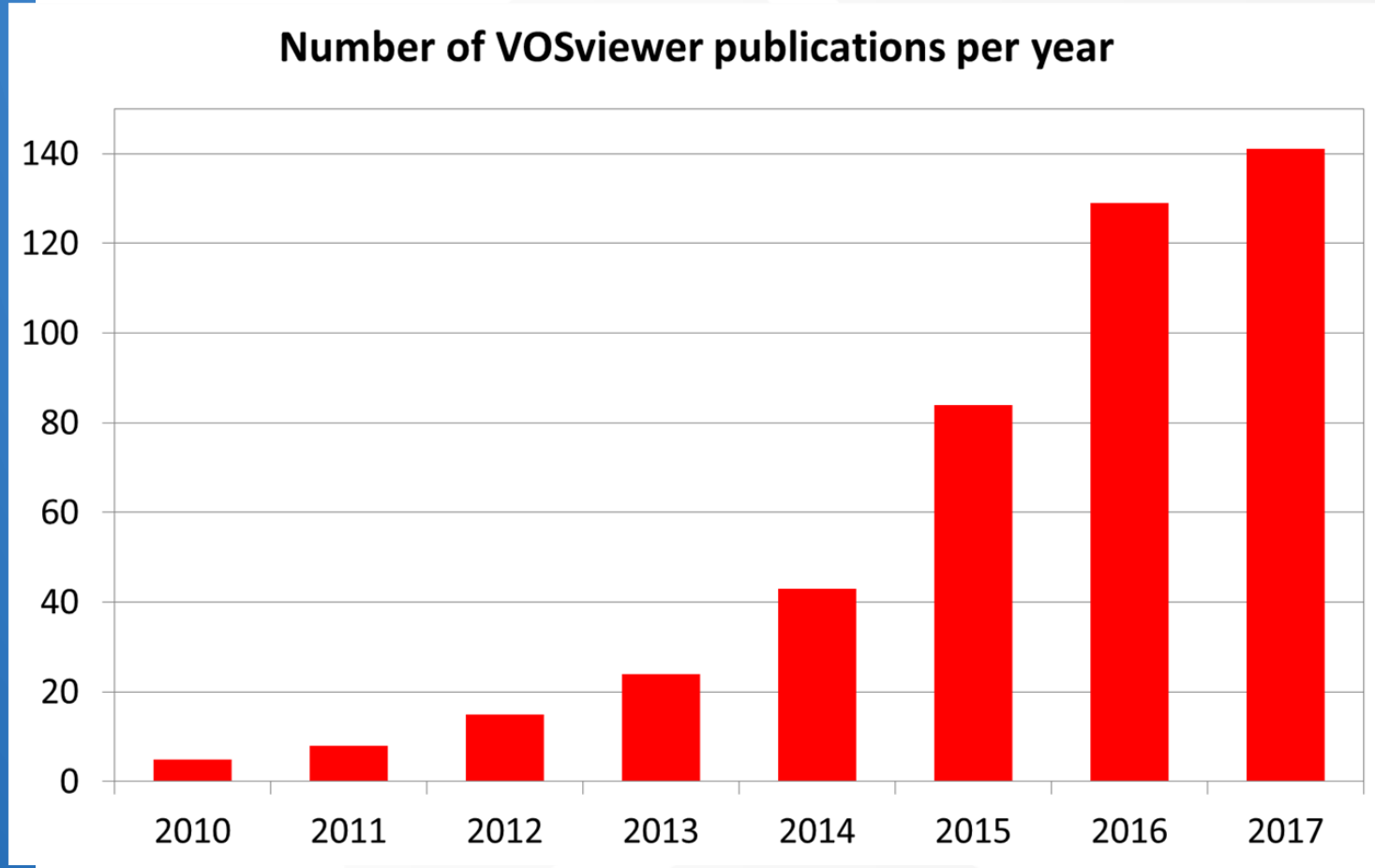
VOSviewer

- Visualization of (bibliometric) networks
- Construction of bibliometric networks based on popular d
  Science, Sco
- Advanced vi
  - VOS layout te
  - Smart labeling algorithm
  - Overlay visualization
  - Density visualization ('heat map')
- Text mining functionality
- Easy to use, but limited possibilities for in-depth analysis

VOSviewer version 1.6.6
can be freely downloaded from
www.vosviewer.com

VOSviewer users

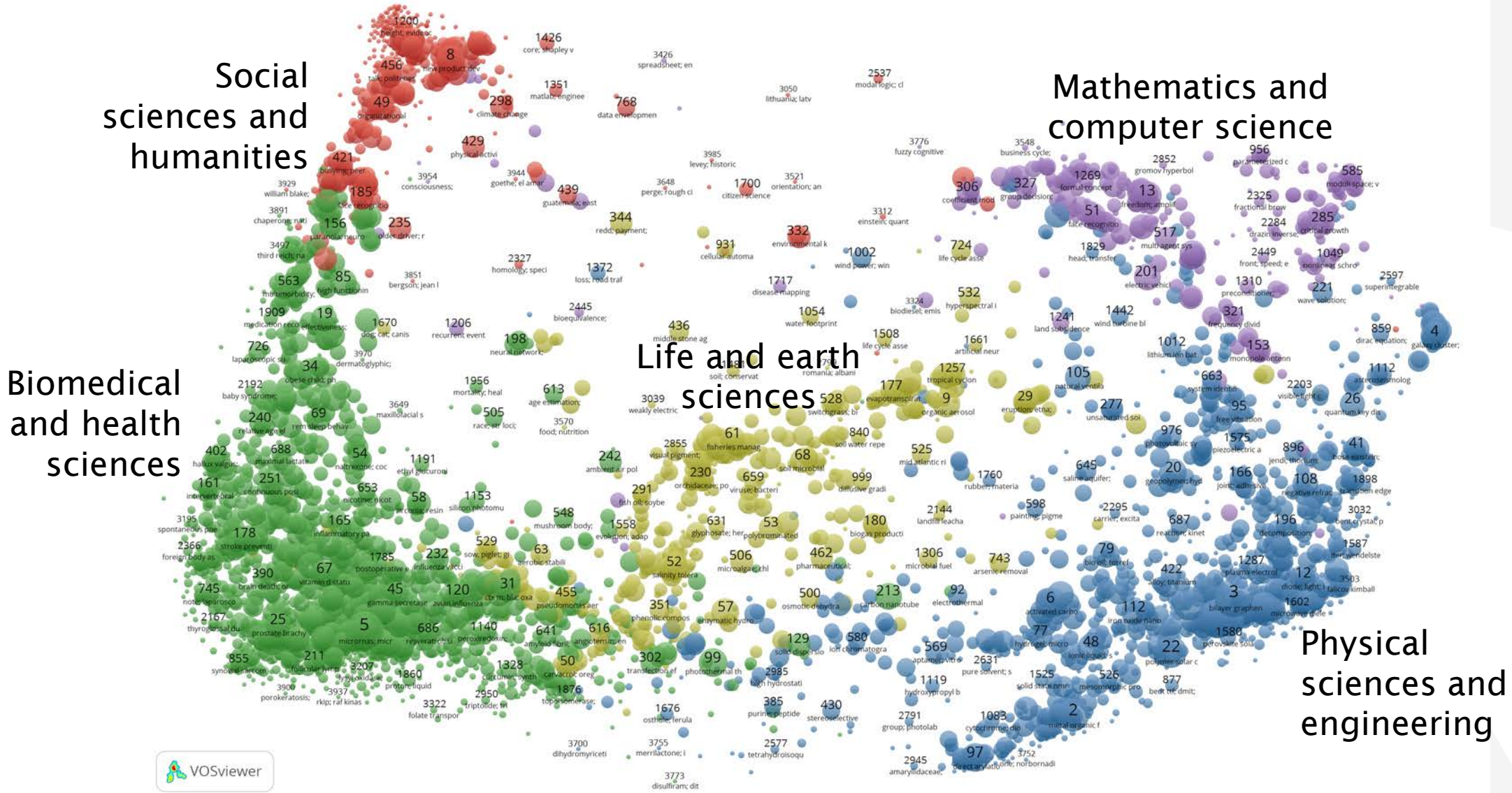
- Researchers
- Research institutions
- Research funders
- Scientific publishers



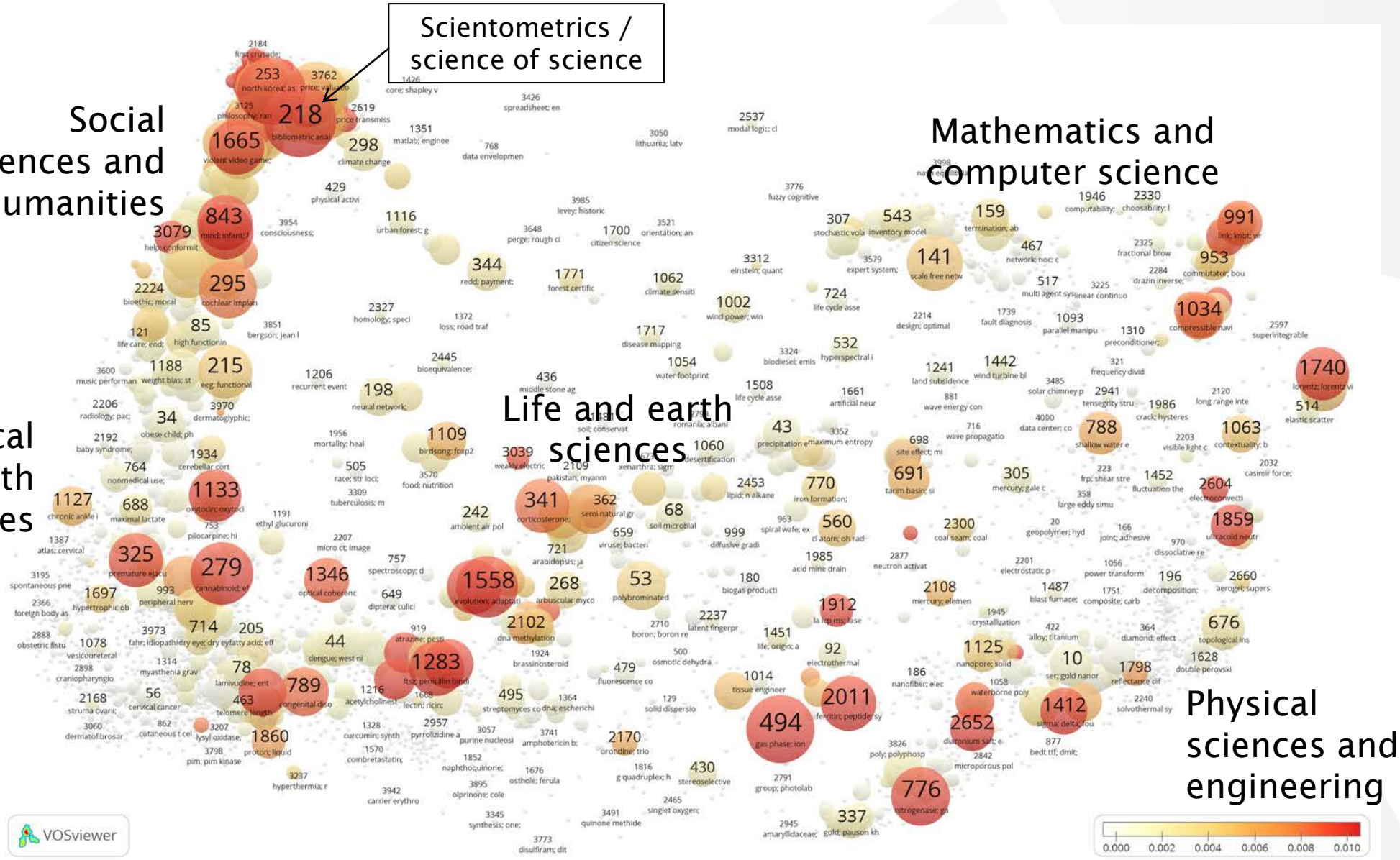
Demonstration

Application

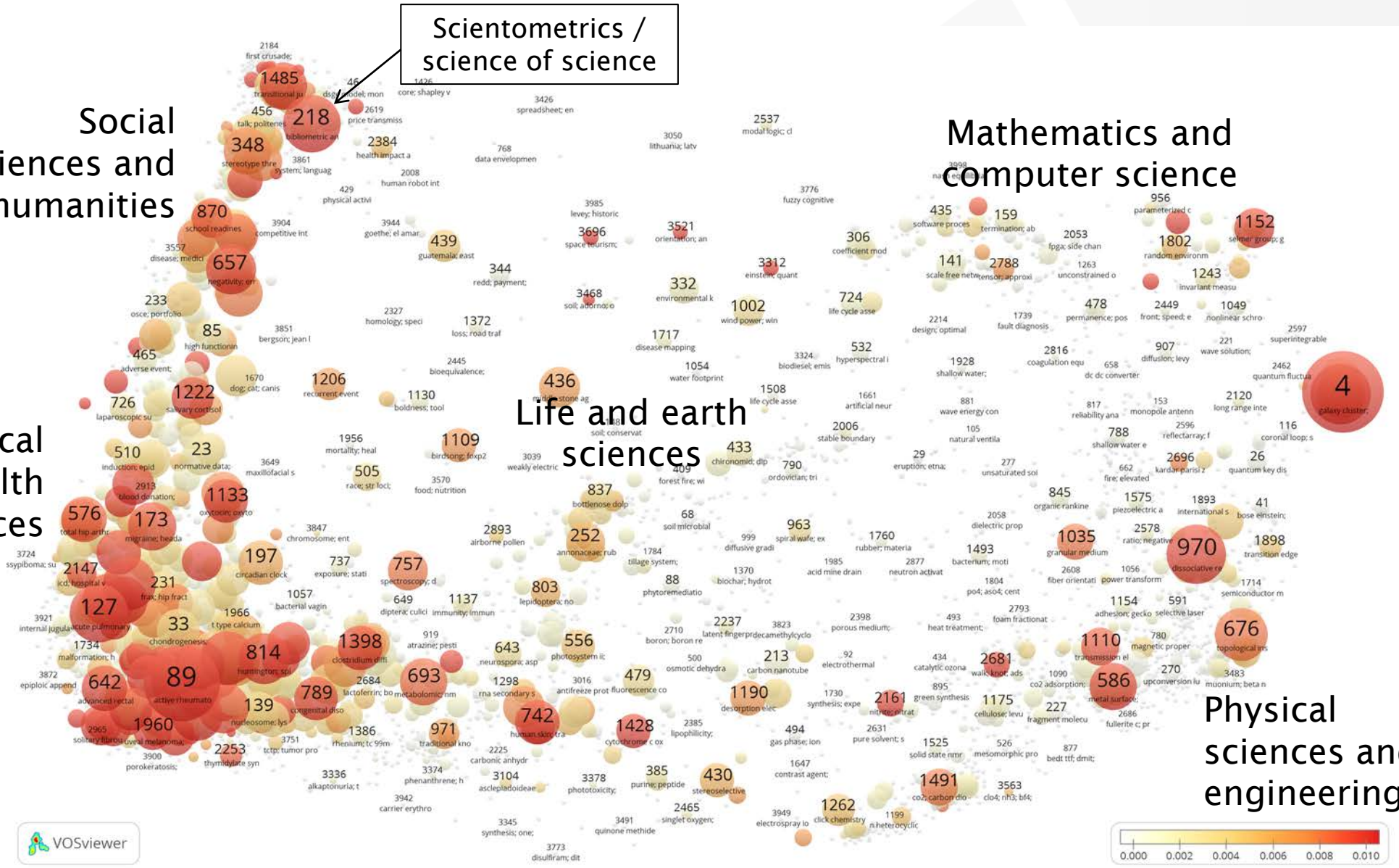
Micro-level scientific fields



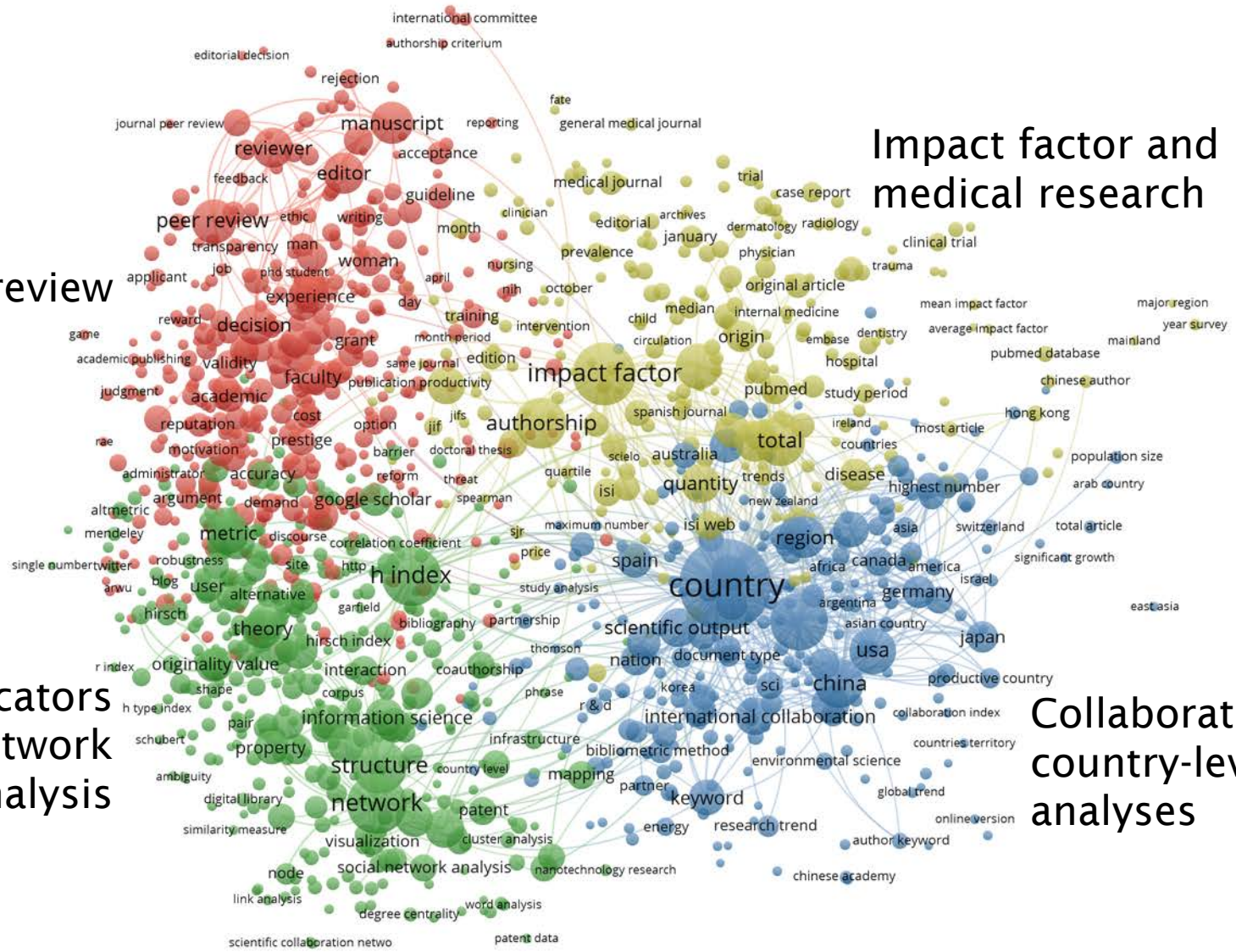
Activity of Indiana University Bloomington



Activity of Leiden University



Scientometrics / science of science



Impact factor and medical research

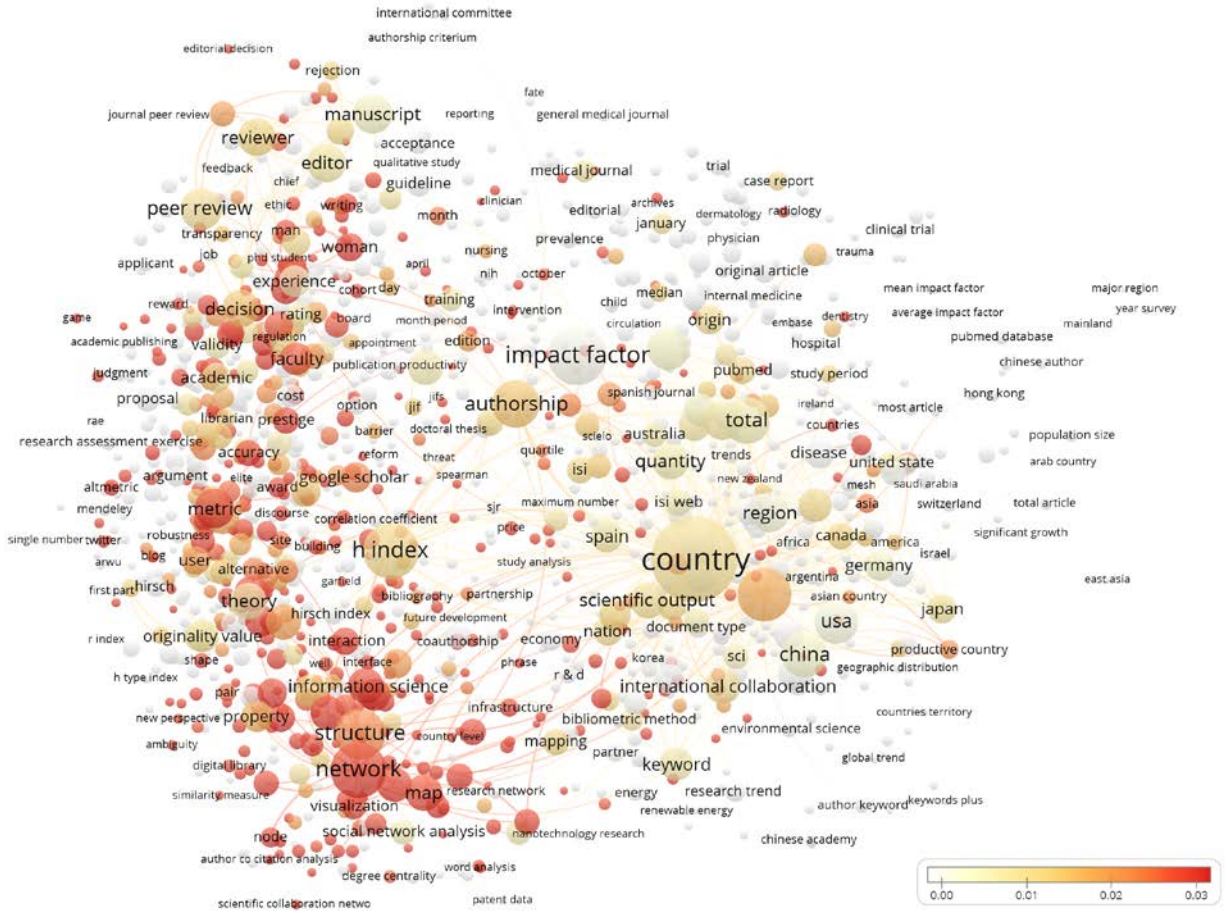
Peer review

Indicators and network analysis

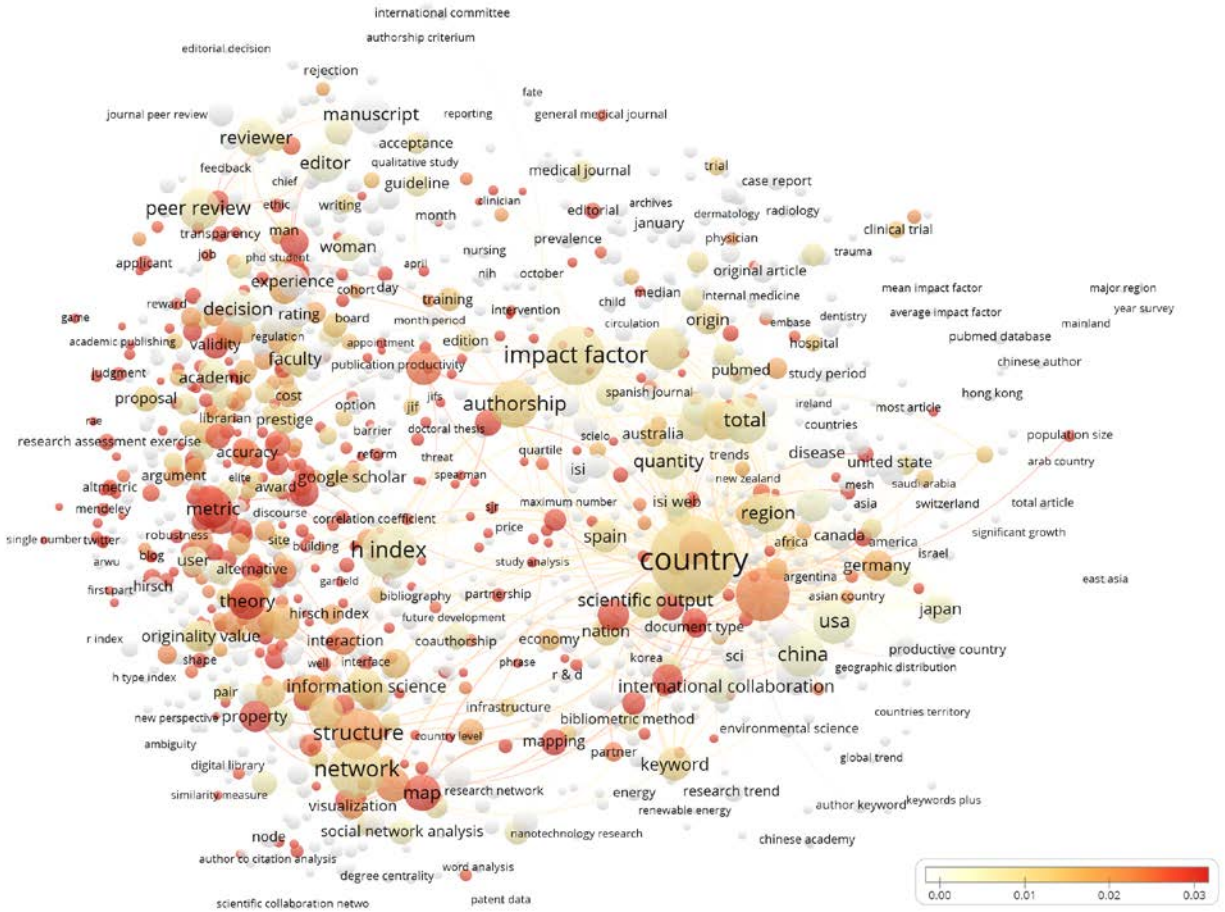
Collaboration and country-level analyses

VOSviewer

Activity of Indiana University Bloomington and Leiden University



Activity of Indiana University Bloomington

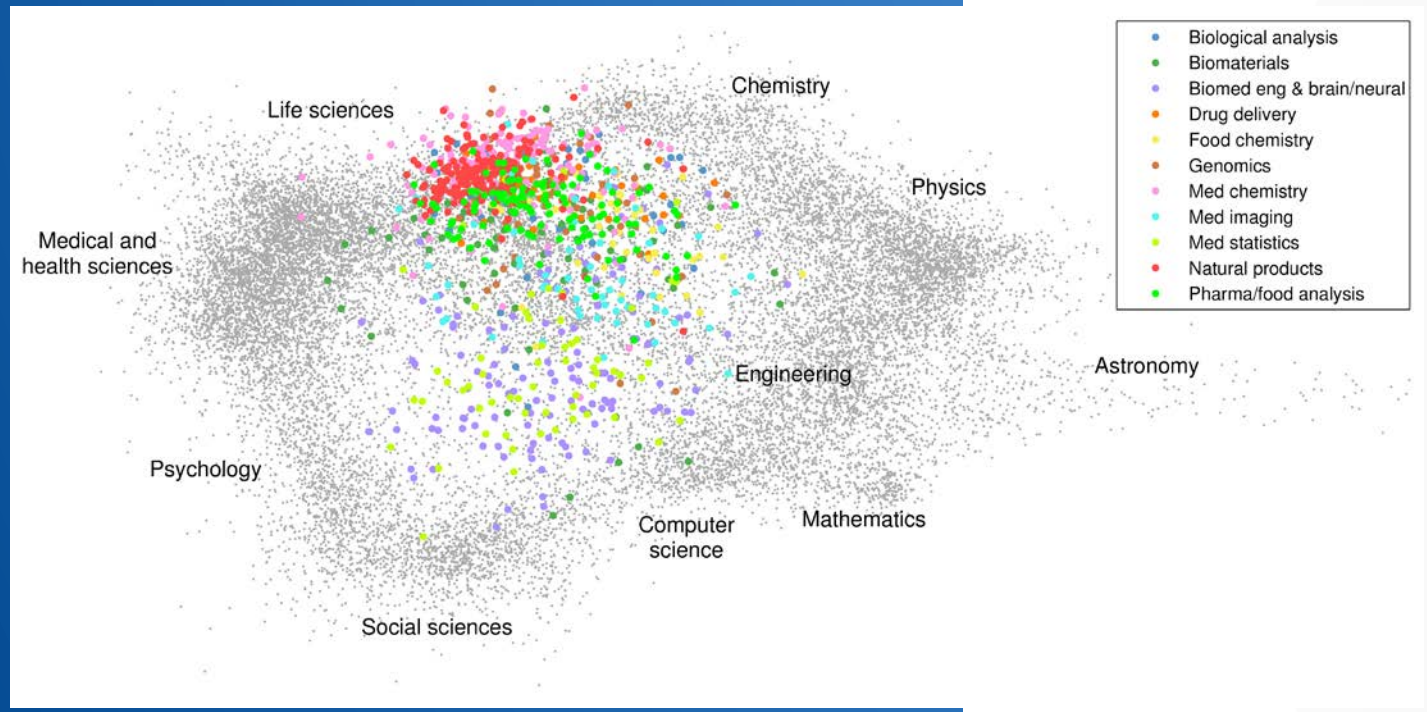


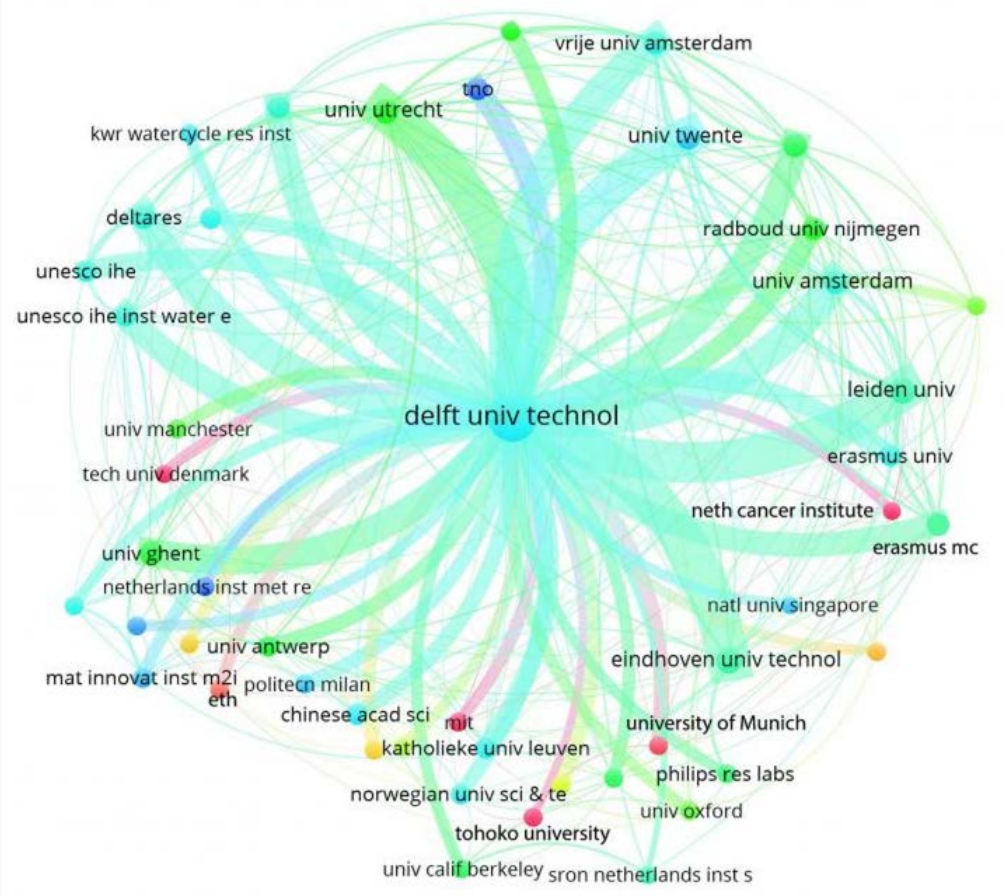
Activity of Leiden University

Lessons learned

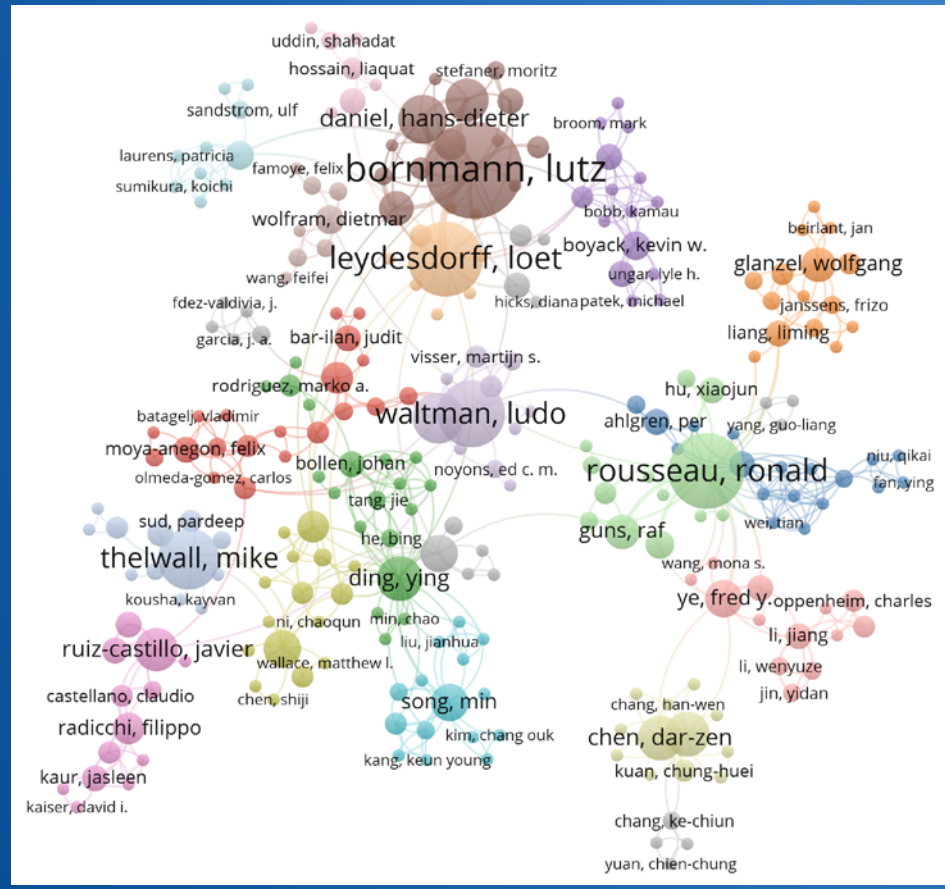
Acknowledge different use cases of visualizations

We tend to think about visualizations as a useful tool for getting an understanding of large data sets, but visualizations also serve other purposes

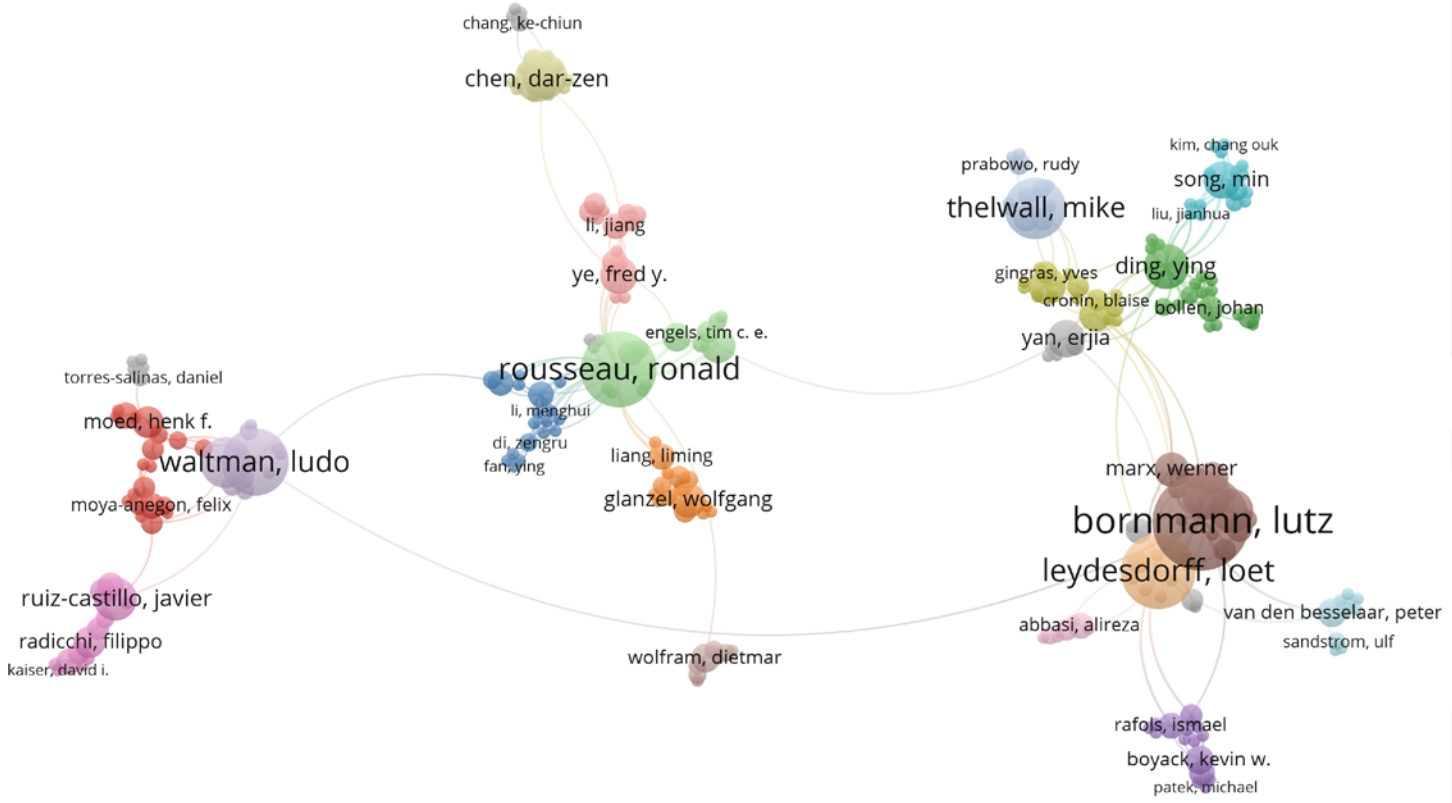




Adjust visualizations to mode of presentation

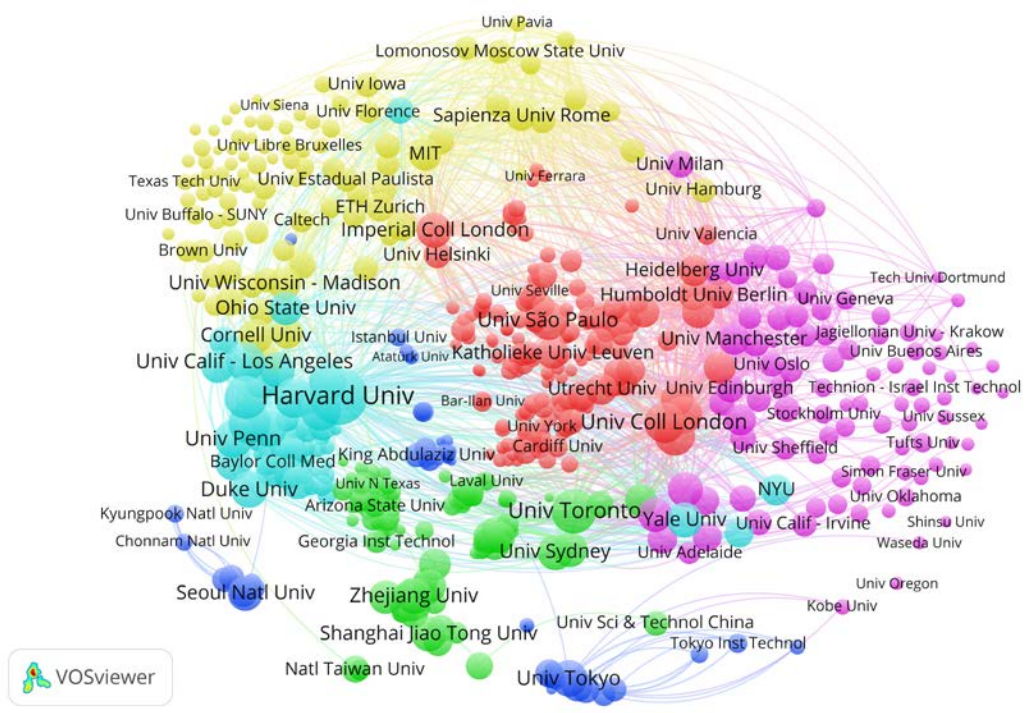


Co-authorship network (static visualization)

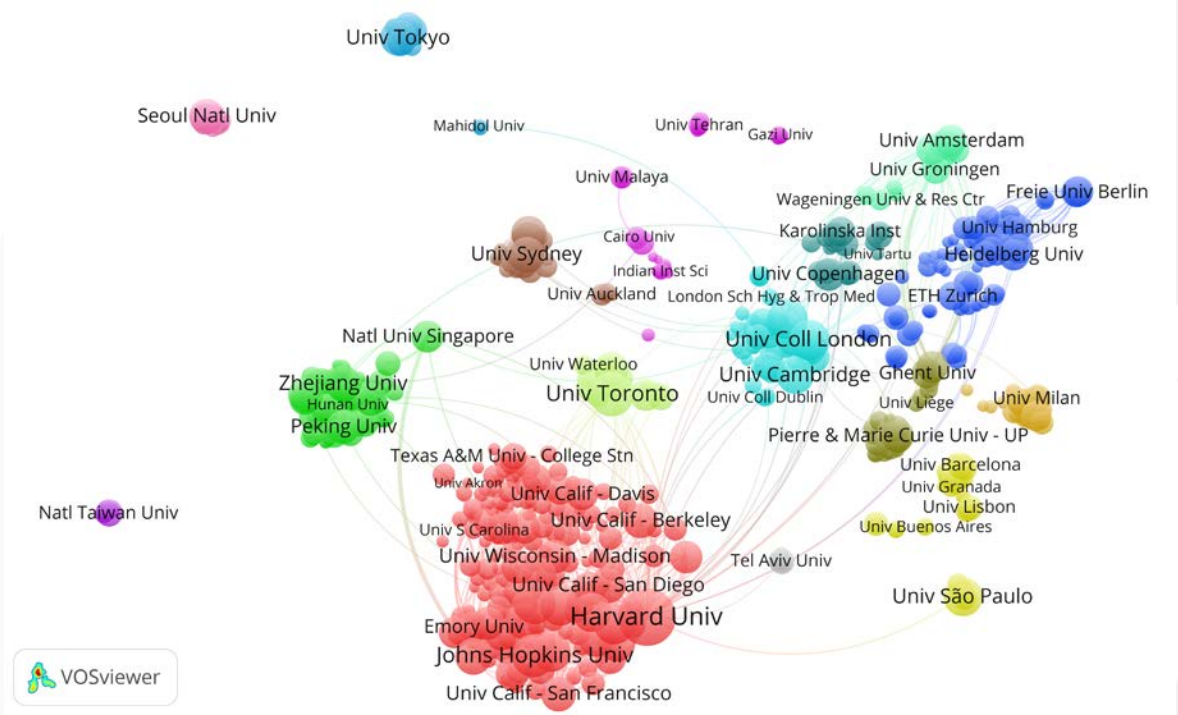


Co-authorship network (interactive visualization)

Balance technical sophistication against methodological transparency



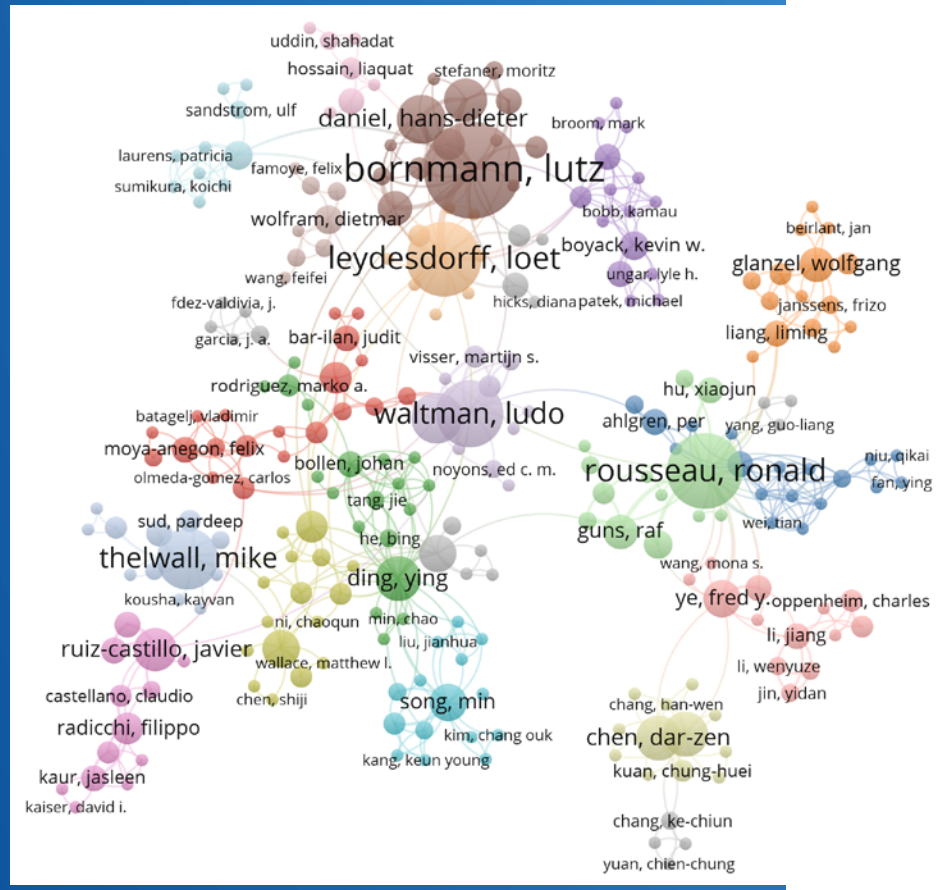
University co-authorship network based on full counting



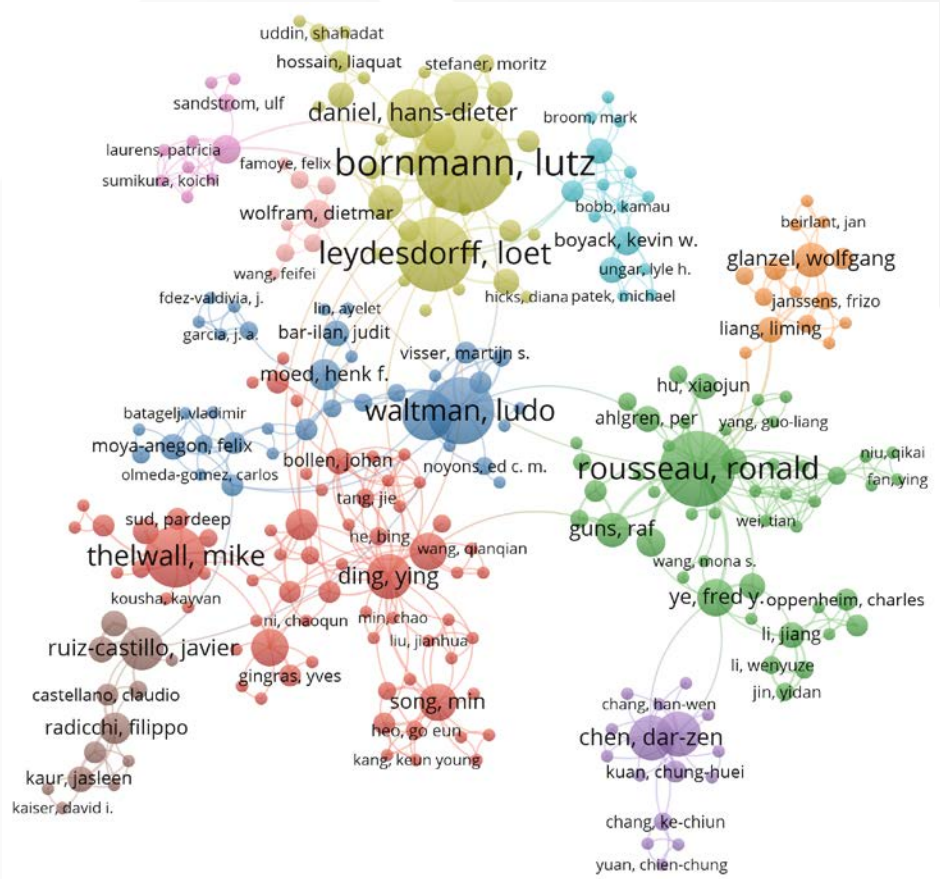
University co-authorship network based on fractional counting

Source: Perianes-Rodriguez, Waltman, & Van Eck (2016)

Test sensitivity of visualizations to methodological choices; handle these choices pragmatically

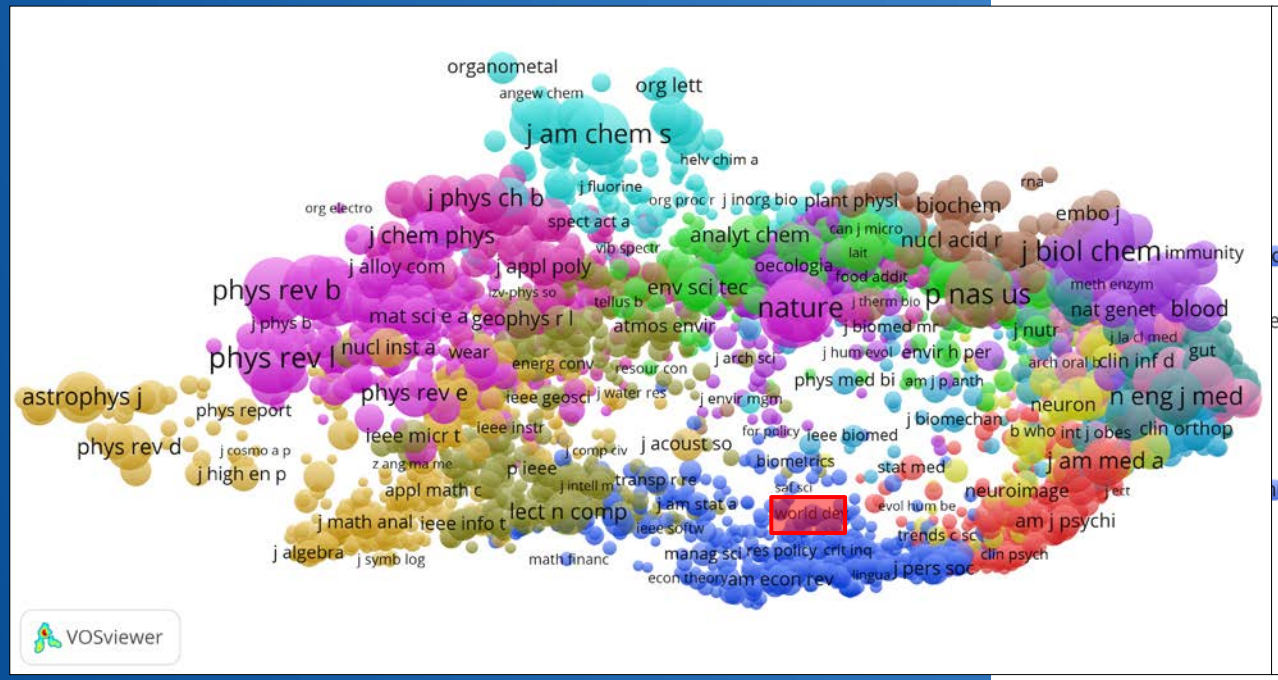


Co-authorship network (24 clusters)



Co-authorship network (10 clusters)

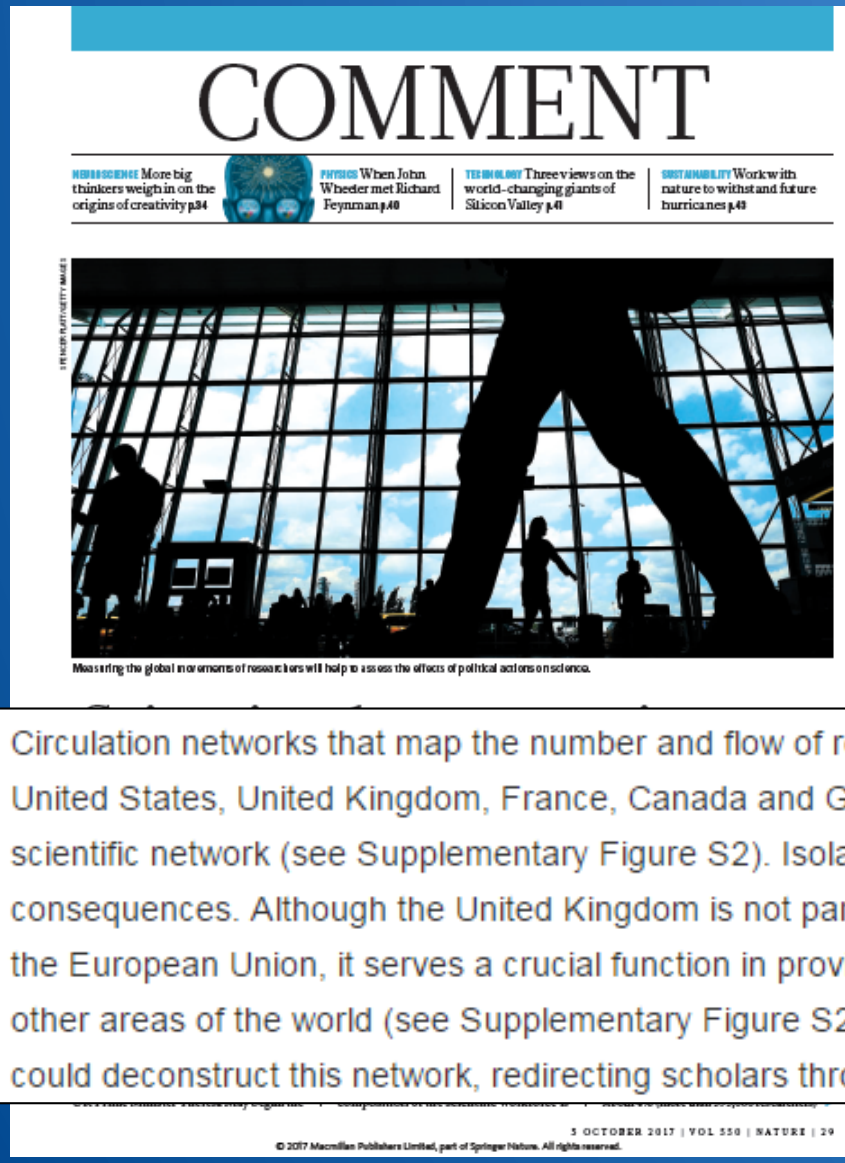
Be aware that visualizations give a simplified representation of your data



Co-citation network of scientific journals

Zooming in on *Scientometrics* and its environment

Combine visualizations with other evidence



COMMENT

NEUROSCIENCE More big thinkers weigh in on the origins of creativity p.34 | PHYSICS When John Wheeler met Richard Feynman p.40 | TECHNOLOGY Three views on the world-changing giants of Silicon Valley p.41 | SUSTAINABILITY Work with nature to withstand future hurricanes p.43

Measuring the global movements of researchers will help to assess the effects of political actions on science.

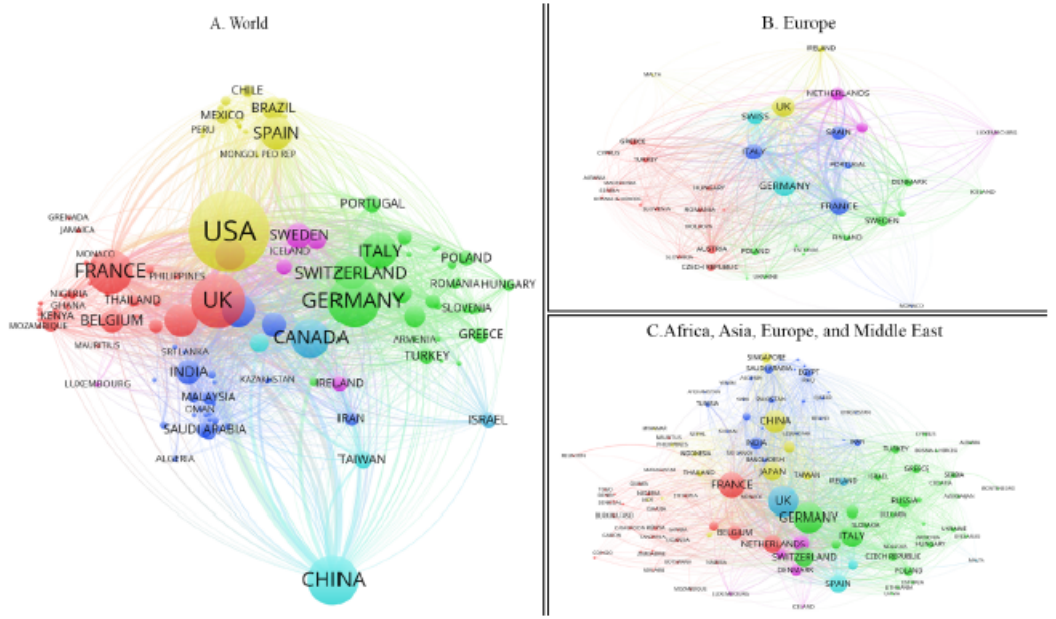


Fig. S2. Weighted mobility networks for countries with at least 500 researchers publishing between 2008-2015. Node size represents total number of links for a country. Link width represents the number of researchers affiliated with a pair of countries (either at the same time or sequentially). The colors denote community clusters (based on VOSviewer's clustering technique). (n=15,931,221)

Circulation networks that map the number and flow of researchers reveal the importance of the United States, United Kingdom, France, Canada and Germany as prominent nodes in the global scientific network (see Supplementary Figure S2). Isolation of these countries would have dramatic consequences. Although the United Kingdom is not particularly central to researcher migration in the European Union, it serves a crucial function in providing a bridge for European scientists to other areas of the world (see Supplementary Figure S2). Isolationist policies in the United Kingdom could deconstruct this network, redirecting scholars through other countries.

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Tab. S1. Betweenness and closeness of countries for the world map

Country	Closeness	Rank	Betweenness	Rank
USA	0.98484848	1	0.05158627	1
UNITED KINGDOM	0.94660194	2	0.03857314	2
FRANCE	0.9375	3	0.03718456	3
CANADA	0.91121495	4	0.03130858	4
GERMANY	0.91121495	5	0.02838484	6
SWITZERLAND	0.89041096	6	0.02389162	8
ITALY	0.88636364	7	0.03050356	5
NETHERLANDS	0.88636364	8	0.02430296	7
AUSTRALIA	0.87053571	9	0.0216997	9
BELGIUM	0.84782609	10	0.01914646	11
SPAIN	0.83333333	11	0.02077365	10

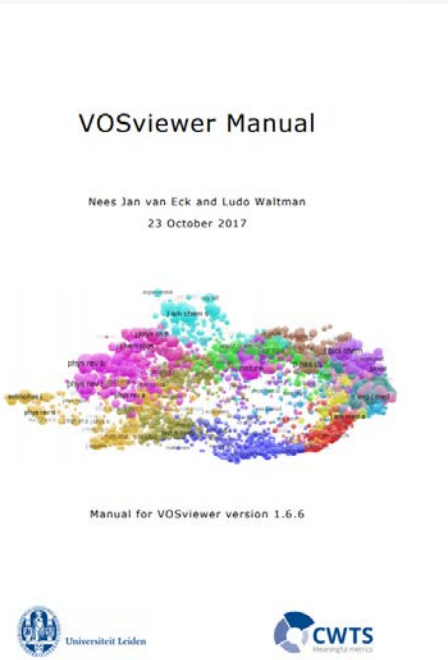
Challenges for bibliometric visualization

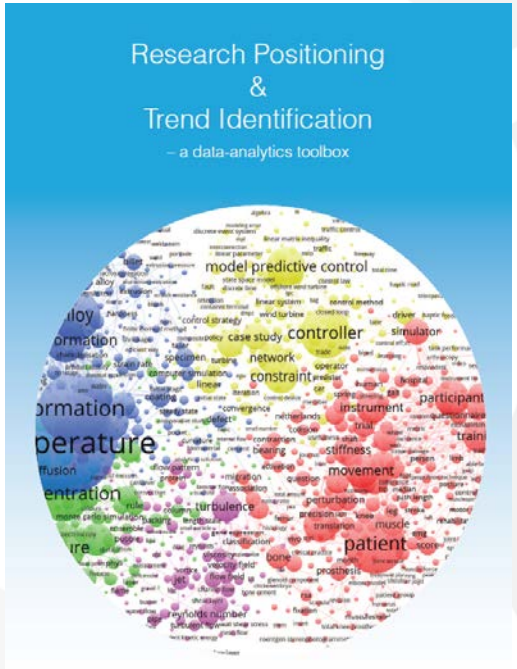
- How to better link interactive visualizations to the underlying bibliometric data?
- How to better handle large bibliometric data sets?
- How to improve visualization literacy in bibliometrics?

Do it yourself!

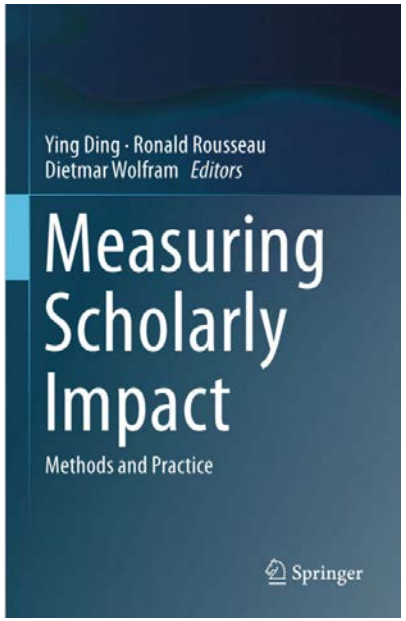
www.vosviewer.com

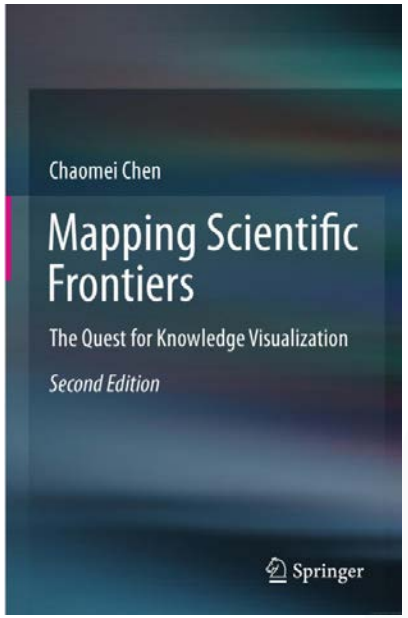
- Freely available VOSviewer software
- Examples of VOSviewer visualizations
- Documentation and tutorials
- Questions and answers
- List of publications in which VOSviewer is used

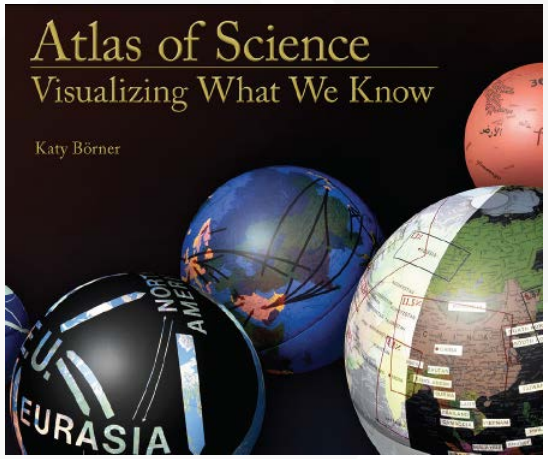


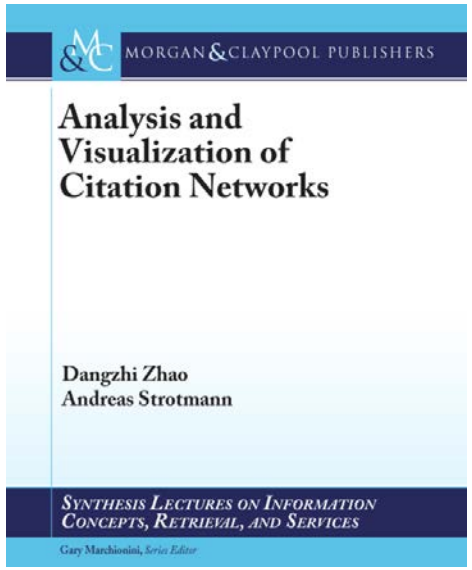


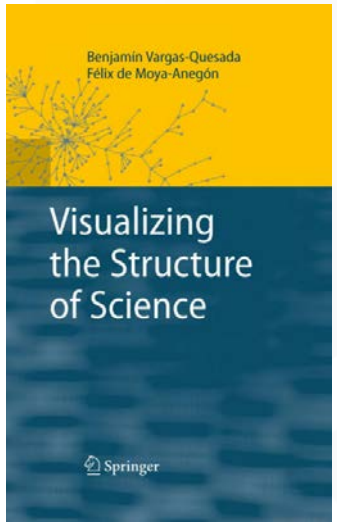
Further reading

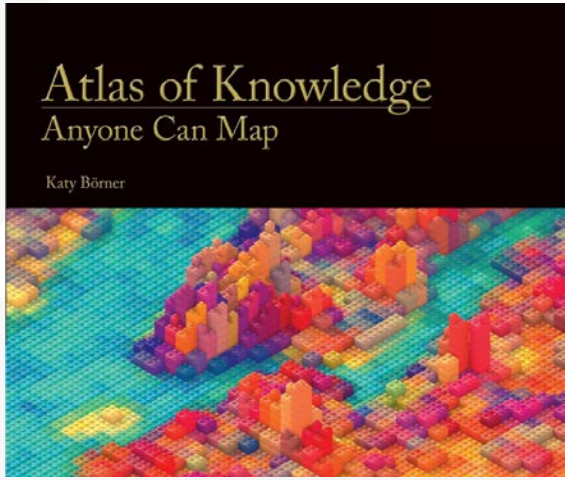












Thank you for your attention!