Forschungsevaluation – die Messung der Wirkung von Publikationen

Lutz Bornmann

Bibliometrics-based heuristics

- Definition of bibliometrics: use of publication and citation data to measure science
- The European Commission on Research and Innovation has defined bibliometrics as “a statistical or mathematical method for counting the number of academic publications, citations and authorship” (Directorate-General for Research, 2010)
- Definition is far from being satisfactory: it focusses on the used data
- Interpretation of bibliometrics in the fast-and-frugal heuristics approach
- Heuristics are decision strategies that use part of the available information and ignore the rest
- Bibliometrics-based heuristics are adaptive judgement strategies that ignore information about some performance aspects (e.g., amount of third-party funds raised or assessments of single publications by experts), thereby allowing quick (and robust) decisions in research evaluation

Bornmann, L., & Marewski, J. N. (2019). Heuristics as conceptual lens for understanding and studying the usage of bibliometrics in research evaluation. *Scientometrics, 120*(2), 419–459.

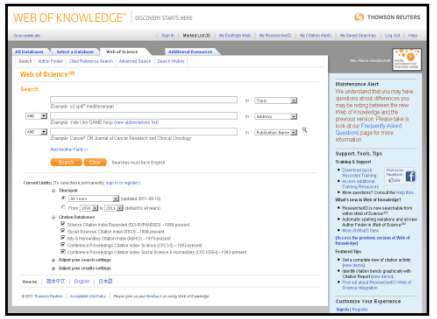
Use of bibliometric indicators in national research assessment exercises

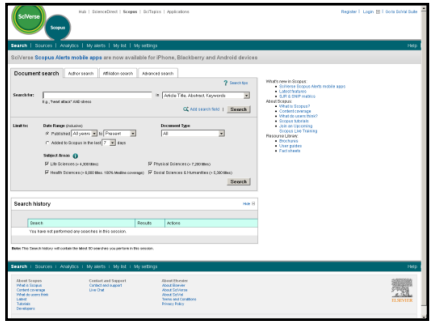
		Belgium /FL	Czech Republic	Denmark	Finland	Italy (VQR)	New Zealand	Norway	Sweden	UK
Output indicators	Academic outputs	√	√	√	√	√	√	√	√	√
	Non-academic outputs		√			√			√	√
	Innovation-related outputs (IPR)		√			√				√
External funding indicators	Competitive funding / national			√	√	√	√	√	√	√
	Competitive funding / international			√	√	√	√	√	√	√
	Contract research funding			√		√	√		√	√
	Non-competitive funding			√		√	√			√
Outcomes/ impact indicators	Academic impacts (citations)	√	√			√			√	
	Socio-economic outcomes/impacts (e.g. spin- offs)					√				√

Department for Business; Energy; Industrial Strategy. (2016). *Building on Success and Learning from Experience An Independent Review of the Research Excellence Framework*. London, UK: Department for Business, Energy & Industrial Strategy.

Databases for citation analyses

Database	Papers	Citations
Web of Science (WoS) – especially Science Citation Index	1898-	1900-
Scopus Database (Elsevier)	1823-	1996-
Chemical Abstracts Service (CAS) Database	1898-	1996-
INSPEC database for Physics, Electronics & Computing	1897-	2012-
Physical Review Online Archive (PROLA)	1893-	1983-
Google Scholar Citations	???	???
Microsoft Academic	???	???
Dimensions	???	???





Necessity to have high-quality data for research evaluation

NEW METHOD FOR HIGH-ACCURACY DETERMINATION OF THE FINE-STRUCTURE CONSTANT BASED ON QUANTIZED HALL RESISTANCE

By: VONKLITZING, K (VONKLITZING, K); DORDA, G (DORDA, G); PEPPER, M (PEPPER, M)

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VOLUME 45, NUMBER 6 PHYSICAL REVIEW LETTERS 11 AUGUST 1980

New Method for High-Accuracy Determination of the Fine-Structure Constant Based on Quantized Hall Resistance

K. v. Klitzing
Physikalisches Institut der Universität Würzburg, D-8700 Würzburg, Federal Republic of Germany, and Hochfeld-Magnetlabor des Max-Planck-Instituts für Festkörperforschung, F-38042 Grenoble, France

- Paper which leads to the Nobel Prize in physics for Klaus von Klitzing
- Research has been done in the Max Planck Society (outpost of the Max Planck Institute for Solid State Research in Grenoble)
- Klaus von Klitzing was affiliated with the Universität Würzburg

Bibliometric indicators

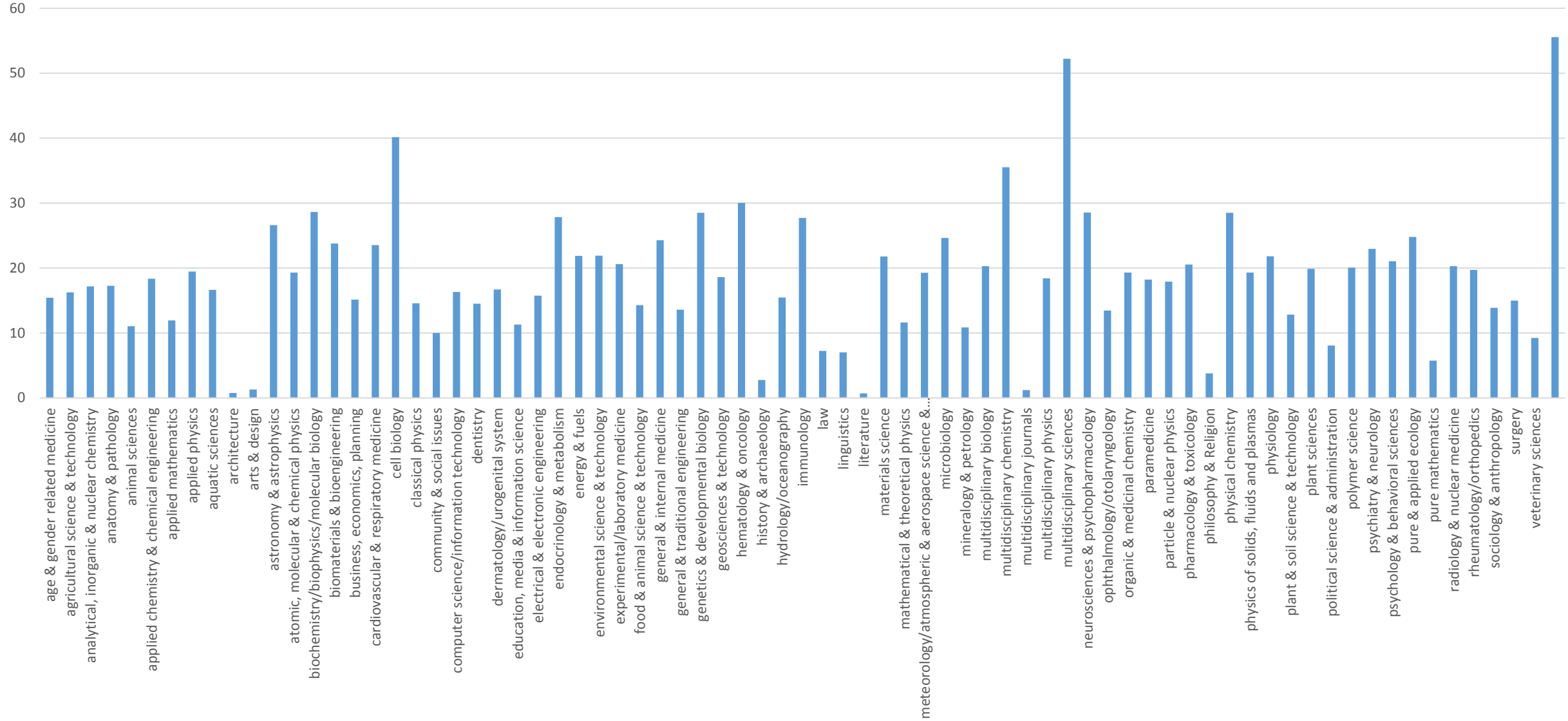
Basic indicators	Number of publications Number of citations Citations per publications (citation rate) Number of not-cited publications	Researcher Institution Country
h index-based indicators	*h* index and approximately 40 variants *m* quotient	Researcher
Normalized indicators	Field- and time-normalized indicators Cited-side and citing-side normalization	Researcher Institution Country
Technology-indicators	Number of publications cited in patents Number of patents cited in publications	Institution Country
Social indicators	Co-authorship networks	Researcher Institution Country
Journal-indicators	Journal Impact Factor SNIP	Journals
Mapping-indicators	Co-citations	Institution Country

Citizen bibliometrics vs. professional bibliometrics

Citizen bibliometrics	Professional bibliometrics
• Do-it-yourself bibliometrics by researchers and research managers	• Bibliometric analyses supported by professional bibliometricians and specialized bibliometric software tools
• Publication and citation counts, impact factor, h-index	• Field-normalized indicators
• Web of Science, Scopus, Google Scholar	• Web of Science, Scopus
• Mainly with small datasets (e.g. young researchers)	• Mainly with large datasets (e.g. institutions)

Leydesdorff, L., Wouters, P., & Bornmann, L. (2016). Professional and citizen bibliometrics: complementarities and ambivalences in the development and use of indicators—a state-of-the-art report. *Scientometrics*, 109(3), 2129-2150.

Why do we need normalized indicators? Citation counts are field-dependent (papers published in 2010)



Normalized impact (NI)

- Normalized Impact (NI) = Ratio of observed citations (WoS: “times cited”) to expected citation rate
- The expected citation rate is the mean impact of the following publications:

  - published in a journal of the same subject category

  - published in the same year

    - Suppose a publication from 2010 in an oncology journal
    - The publication has 45 citations until the end of 2015
    - On average, publications from 2010 in oncology journals have 15 citations in the same time period
    - Normalized citation score of the publication is 45 / 15 = 3

- NI values

  NI = 1.0 : Average impact

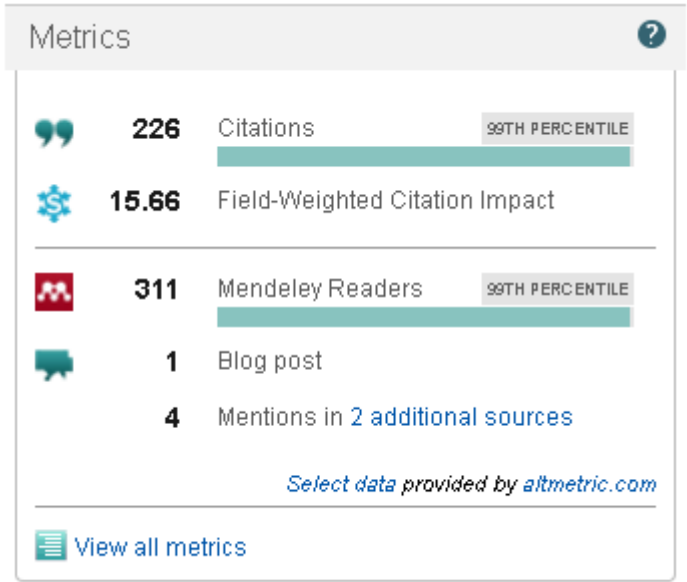
  NI = 1.2 : 20% above average

Adoption of standard field normalization approach

SciVal

InCites™

Scopus®

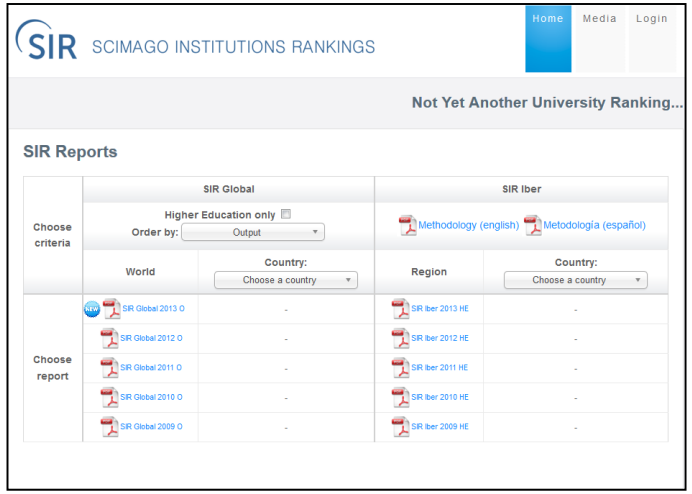


BEST GLOBAL UNIVERSITIES
U.S.News & WORLD REPORT
2016

TIMES HIGHER EDUCATION
THE WORLD UNIVERSITY RANKINGS

SCImago: country/institutions ranking 2019
Publication years: 2003 to 2018

	Output	NI
Germany	2,415,808	1.29
Japan	2,054,367	0.87
Max Planck Society	185,372	1.88
TU Munich	74,778	1.69
Fraunhofer Gesellschaft	53,932	1.32
LMU Munich	67,694	1.74
RIKEN	48,514	1.38
Harvard University	305,272	2.33



NI = 0.4 – 0.6 very poor

NI = 0.6 – 0.8 poor

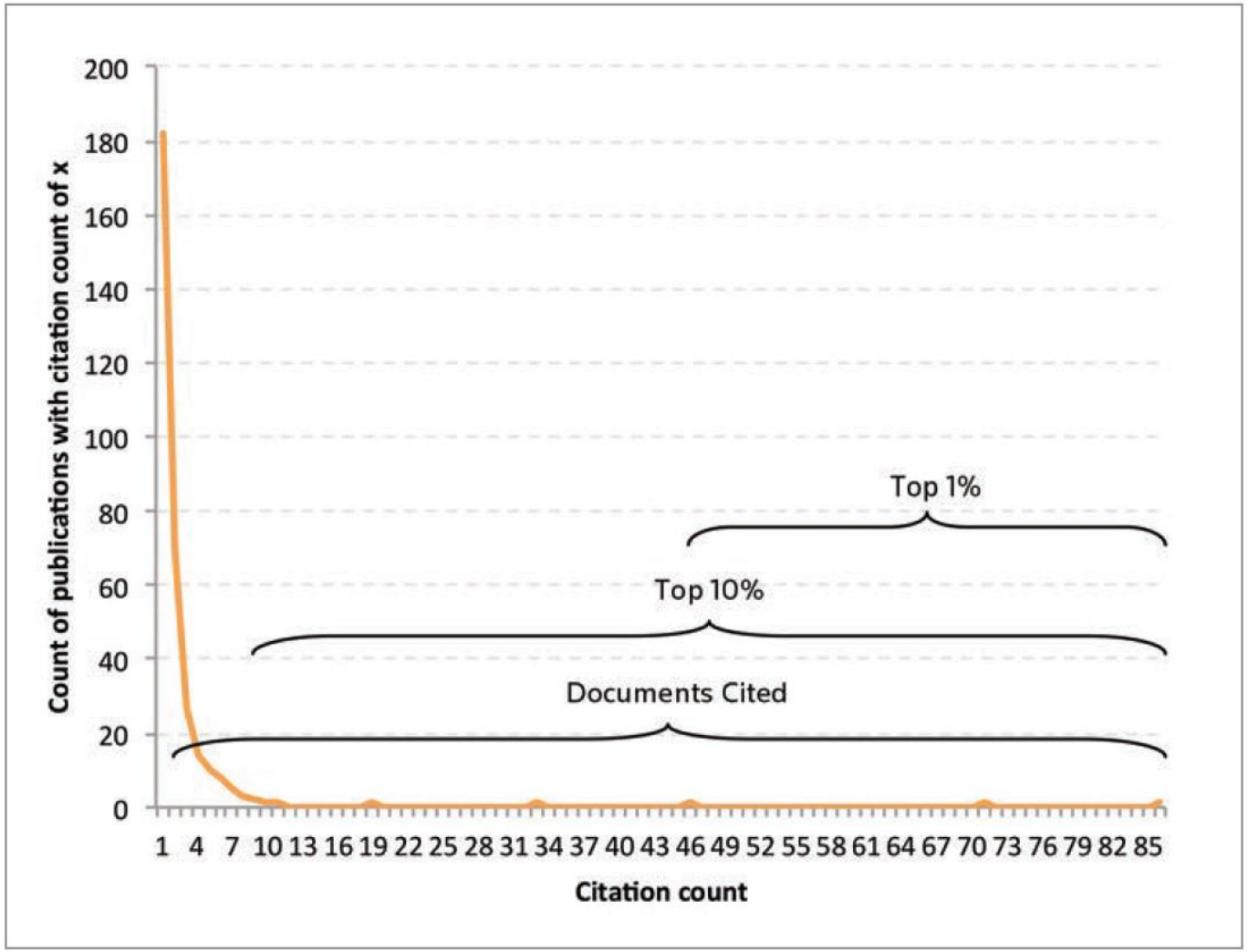
NI = 0.8 – 1.2 average

NI = 1.2 – 1.4 good

NI = 1.4 – 1.6 very good

NI = 1.6 – 2.0 excellent

Problem for calculation of NI: skewed distribution of citation data



A small number of highly cited papers and many papers with relatively few or no citations (source: Thomson Reuters. (2015). *InCites Indicators Handbook*. Philadelphia, PA, USA: Thomson Reuters)

The use of percentiles as an alternative to the NI

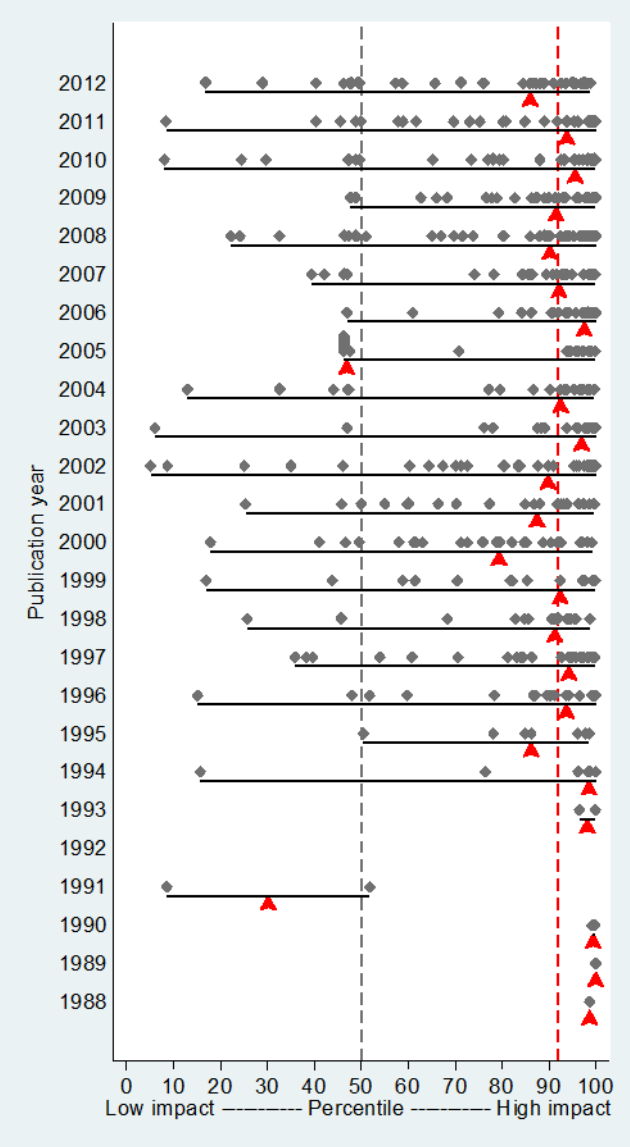
- Problem of the NI: A few highly-cited papers significantly influence the result
- Leiden Ranking 2013: University of Göttingen on ranking position two, because of only one highly-cited paper
- Solution: Calculation of percentiles
- Procedure: Sort papers in a set in decreasing order; then, the ranking position of each paper is divided by the total number of papers in the set and multiplied by 100
- The use of ranking positions avoids the problem with outliers
- Percentiles can be used very flexible (e.g. top-x%)
- The use of percentiles is recommended in the Leiden Manifesto

Overview of the scientific performance of three researchers

Impact	Researcher 1	Researcher 2	Researcher 3
Total citations	15,192	3,796	7,828
Number of citations per publication (arithmetic average)	83	52	89
Proportion of self-citations in total citations	3.4%	6%	5.8%
Average percentile (median)	15.9	6.2	8.3
$P_{top\ 10\%}$	70	31	48
$PP_{top\ 10\%}$	39.3%	52.5%	57.8%
$P_{top\ 10\%}$ quotient	2.2	2.8	1.6
Q1 indicator	25%	46%	33%

Q1 indicator: Proportion of papers published in a journal which belongs to the 25% journals with the highest JIF in its field and publication year

Beamplots: measuring the performance of single researchers

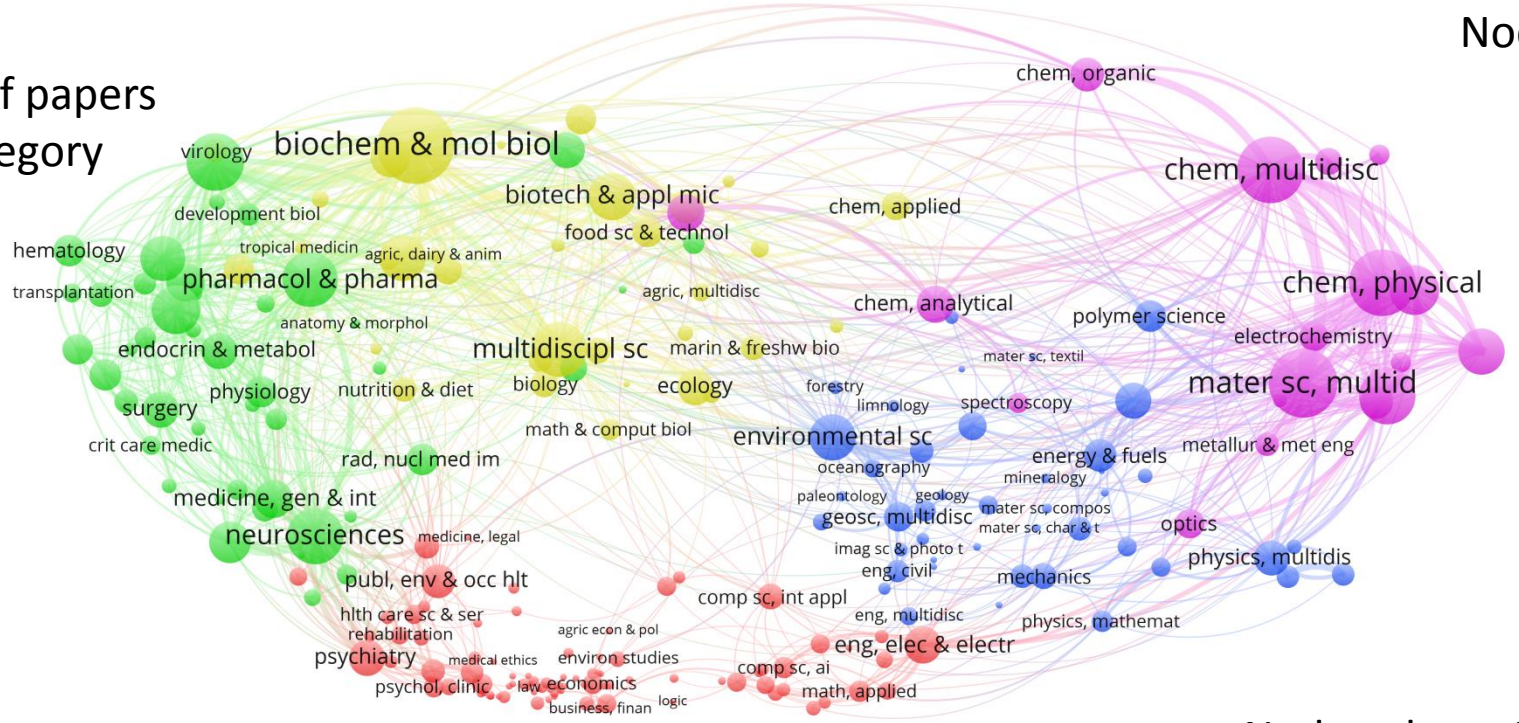


- Grey diamonds: impact of single papers
- Grey lines: impact range of papers in one year
- Red triangle: median impact in one year
- Grey dotted line: worldwide average impact
- Red dotted line: median impact over all years

Basic map: direct citation-relations of single subject categories (based on WoS data)

Node size: number of papers in the subject category

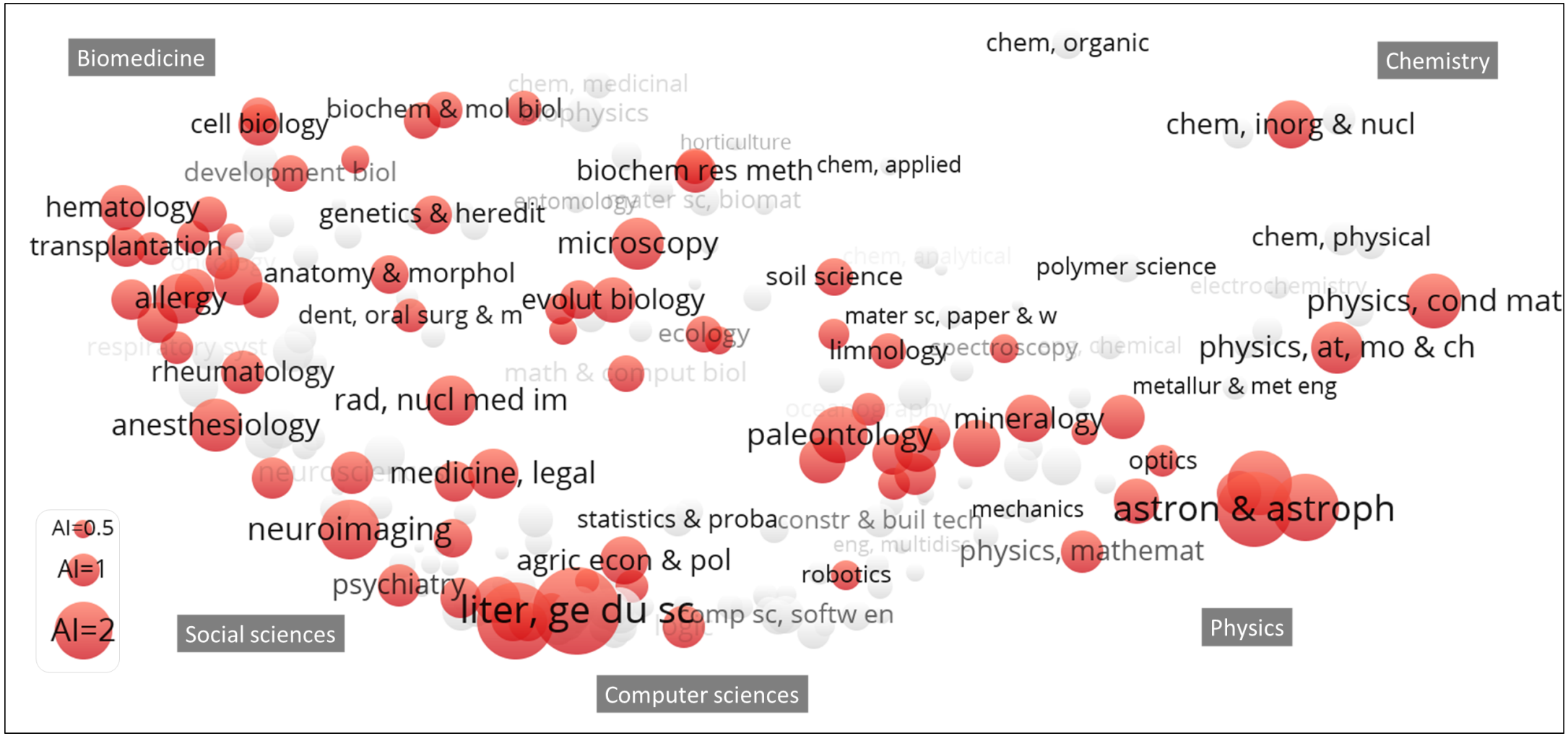
Node position: Many citation relations lead to closely positioned nodes



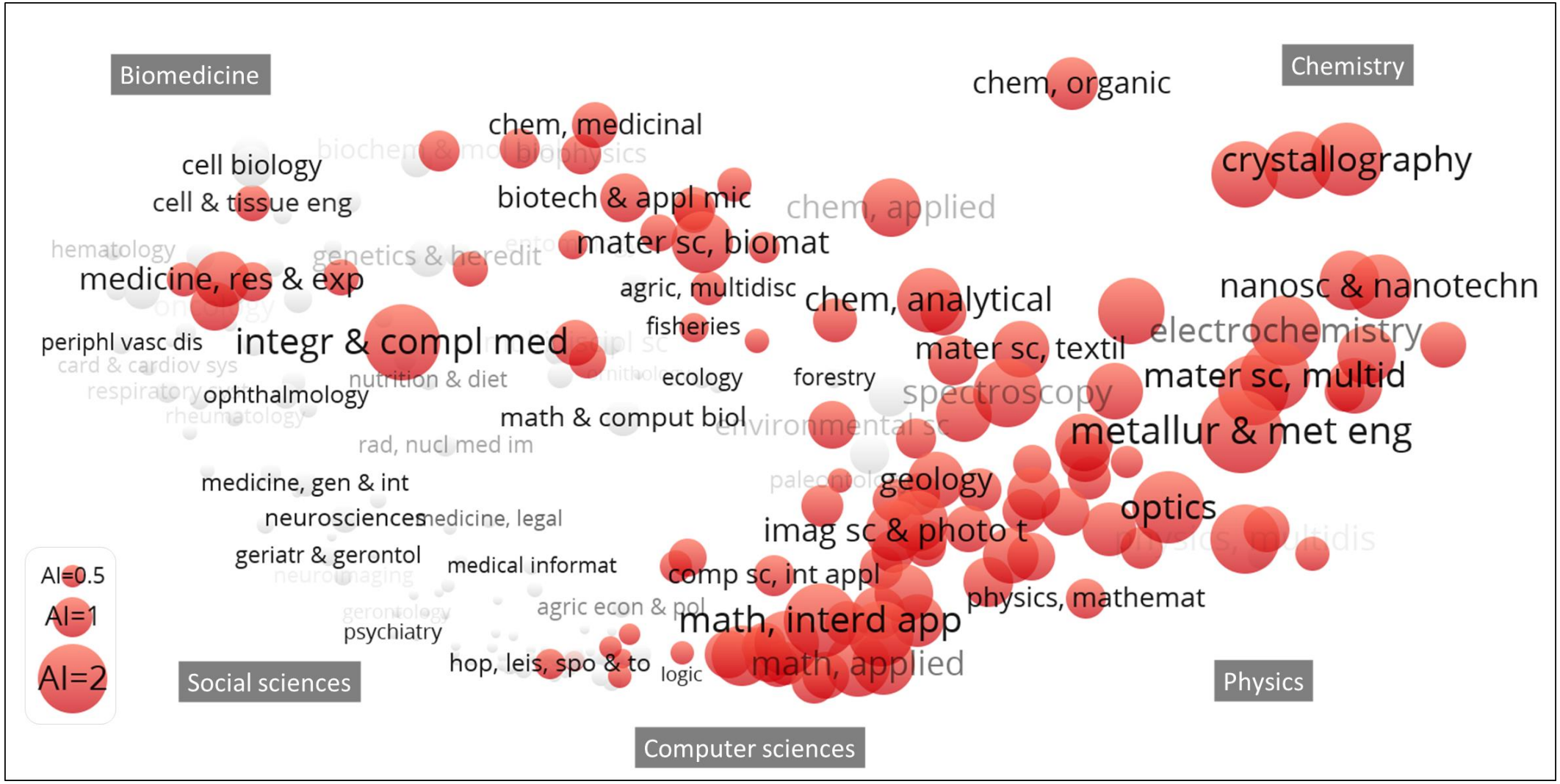
Database: Articles and reviews from 2003 to 2013 and their cited references in the same period

Node colour: Cluster algorithm assigns subject categories to the same colour, if they are frequently co-cited

Subject categories with more than 10% papers from **Germany**. The number of papers are shown which belong to the 10% most frequently cited papers in their subject category (2010 - 2015)



Subject categories with more than 10% papers from **China**. The number of papers are shown which belong to the 10% most frequently cited papers in their subject category (2010 - 2015)



Current research line: Alternative metrics

- Alternative metrics (altmetrics) are seen as promising possibility to measure broader (societal) impact
- Altmetrics are views, downloads, clicks, notes, saves, tweets, shares, likes, recommends, tags, posts, trackbacks, discussions, bookmarks, and comments
- They focus on mentions of publications in social media and networks
- The most frequently used sources of altmetrics are Twitter and Mendeley
- Altmetrics can be similarly statistically analyzed as citations

Problems with altmetrics

- The meaning of altmetrics is not clear: What does a tweet claim about research? Do we measure significant impact or noise with Facebook counts?
- Cases of scientific misconduct will produce high Twitter/ Facebook counts. Are they suitable for research evaluation?
- Sources of altmetrics can be manipulated (without any greater problems)
- Data quality is unclear: How many publications are mentioned in tweets, blogs etc. but without clear links?
- Tendency to use composite indicators (e.g. the Altmetric attention score) which are black boxes

Measuring of target-oriented and field-normalized impact using altmetrics

- Future of altmetrics is in measuring impact target-oriented and field normalized for selected altmetrics (e.g. Mendeley counts)
- Altmetrics are field-dependent (similar to citations). Thus, field-normalization techniques from bibliometrics should be used
- Two possibilities of target-oriented measurements:

(1) Mendeley-data can be used to analyze the impact of papers on different status groups (e.g. professors, students, journalists)

(2) The impact on certain sections of society can be measured by statistically analyzing certain documents (good examples are citations in patents, clinical guidelines or policy documents)

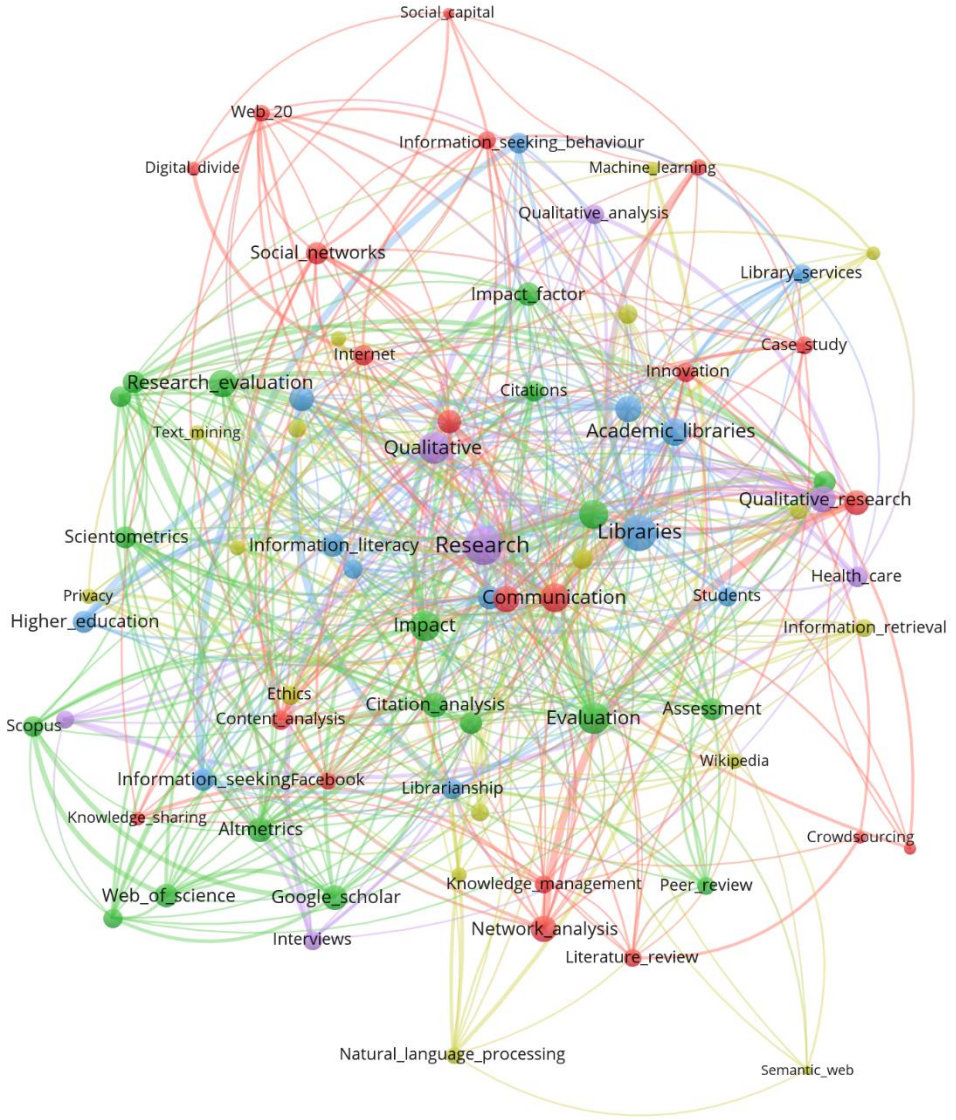
Measuring societal impact target-oriented: an example

Ten institutions in Germany with the highest $MNRS_{BS}$ (including institutions with at least 1,000 papers in 2014 and decreasingly sorted by $MNRS_{BS}$). The $MNRS_{ED}$ is added for comparison.

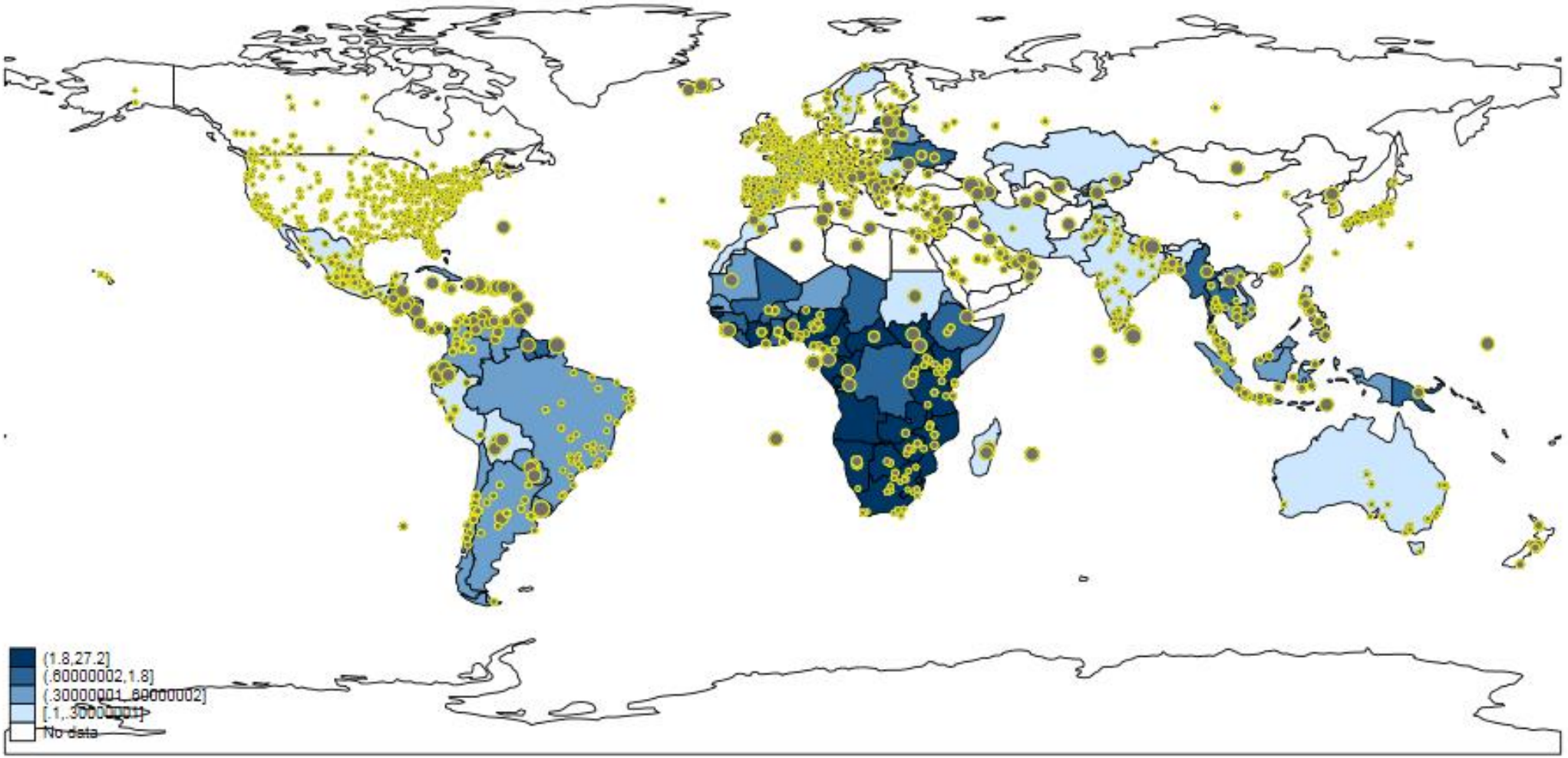
Institution in Germany	Number of papers	$MNRS_{BS}$	$MNRS_{ED}$
Universität Bonn	1,493	1.39	1.52
Universität Göttingen	1,550	1.34	1.50
Bayerische Julius-Maximilians Universität Würzburg	1,138	1.24	1.27
Universität Heidelberg	2,446	1.23	1.34
Rheinisch-Westfälische Technische Hochschule (RWTH)	1,190	1.21	1.28
LMU München	2,809	1.21	1.38
Goethe University Frankfurt	1,313	1.21	1.26
Universität Freiburg	1,583	1.20	1.46
Charité - Universitätsmedizin Berlin	2,060	1.19	1.36
TU München	2,058	1.18	1.56

Bornmann, L. & Haunschild, R. (2017). Measuring field-normalized impact of papers on specific societal groups: An altmetrics study based on Mendeley data. *Research Evaluation, 26*(3), 230–241

Top-author keywords of LIS papers tweeted and published between 2011 and 2017



Use of Twitter data as social sensors (National HIV rates versus weighted tweets of papers)



Tools of possible interest

- Web application which visualizes research excellence worldwide in several subject areas:

  www.excellencemapping.net

- Web application which visualizes how successful universities or research-focused institutions collaborate:

  www.excellence-networks.net

- CRExplorer: A program for identifying citation classics and landmark papers of fields:

  www.crexplorer.net