ISSI Newsletter

QUARTERLY E-NEWSLETTER OF THE INTERNATIONAL SOCIETY FOR SCIENTOMETRICS AND INFORMETRICS
ISSN 1998-5460

#62 / VOLUME 16 NUMBER 2
JUNE 2020

CONTENTS

IRINA V. MARSHAKOVA (1941—2019)

OBITUARY BY

VALENTINA MARKUSOVA[1] & WOLFGANG GLÄNZEL[2]

[1] VINITI of the RAS, Moscow, Russia

[2] ECOOM and Dept. MSI, KU Leuven, Belgium

The well-known scholar on scientometrics Dr. Irina V. Marshakova died suddenly on March 10, 2019, in Moscow. She was born on June 23, 1941. Dr. Marshakova received a Master's degree in Applied Mathematics from the State Institute on Geodesy and Cartography. Dr. Marshakova belonged to the first generation of Soviet specialists engaged in the citation analysis research. At that time, the term "scientometrics" was not well-known by the international community.

Irina Marshakova was a graduate student from the All Soviet Institute for Scientific and Technical Information (VINITI) of Academy of Sciences of the USSR in 1970-1973. Working as a graduate student, Irina Marshakova developed a method of co-citation analysis on lasers' documents indexed in SCI. This work was done independently from Dr. Henry Small at

ISSI e-Newsletter (ISSN 1998-5460) is published by ISSI (http://www.issi-society.org/).
Contributors to the newsletter should contact the editorial board by e-mail.

- **Wolfgang Glänzel**, *Editor-in-Chief:* wolfgang.glanzel[at]kuleuven.be
- **Balázs Schlemmer,** *Managing Editor:* balazs.schlemmer[at]gmail.com
- **Sarah Heeffer,** *Assistant Editor:* sarah.heeffer[at]kuleuven.be
- **Judit Bar-Ilan**
- **Sujit Bhattacharya**: sujit_academic[at]yahoo.com
- **María Bordons**: mbordons[at]cchs.csic.es
- **Juan Gorraiz:** juan.gorraiz[at]univie.ac.at
- **Jacqueline Leta**: jleta[at]bioqmed.ufrj.br
- **Olle Persson**: olle.persson[at]soc.umu.se
- **Ronald Rousseau**: ronald.rousseau[at]kuleuven.be
- **Dietmar Wolfram**: dwolfram[at]uwm.edu

Accepted contributions are moderated by the board. Guidelines for contributors can be found at http://www.issi-society.org/editorial.html. Opinions expressed by contributors to the Newsletter do not necessarily reflect the official position of ISSI. Although all published material is expected to conform to ethical standards, no responsibility is assumed by ISSI and the Editorial Board for any injury and/or damage to persons or property as a matter of products liability, negligence or otherwise, or from any use or operation of any methods, products, instructions or ideas contained in the material therein.

the Institute for Scientific Information (ISI, Philadelphia, PA, USA). The article "Relationship between documents based on citations indexed by SCI" was published in the "Scientific and Technical Information" (1973, ser. 2., N6, p. 3-8) journal in 1973. This article was highly regarded by Dr. E. Garfield and attracted great attention by the scientometrics community.

Dr. Marshakova defended her dissertation on "Algorithmic classifications of dynamic documentary dataset" (Алгоритмические классификации динамических документальных массивов информации) under the supervision of outstanding scholar Prof. Ylius Schreider in VINITI in 1975. She was awarded a Ph.D. degree in Information Science by State Qualification Committee in 1976.

Irina Marshakova defended her second degree Doctor of Philosophy (Доктор философских наук), and her research topic was "Methods of Quantitative Analysis of Scientific Knowledge" at the Institute of Philosophy of the Russian Academy of Sciences in 1993. She worked as a leading specialist in the institute until the last days of her life.

Continuing to perform research on scientometrics Dr. Marshakova spent few years teaching at the University of Silezia in Katowice (Uniwersytet Śląski w Katowicach) and at the Kazimierz Wielki University (Uniwersytet Kazimierza Wielkiego w Bydgoszczy) in 1995-2000.

Dr. Marshakova was awarded by few grants from the Russian Foundation on Humanities and the Russian Foundation for Basic Research during 2001-2013.

Last years of her life, her research was focused on bibliometric performance of social sciences and on development of normalized indicator for journals' evaluations.

Irina Marshakova was an active member of the International Society for Informetrics and Scientometrics – ISSI since its first conference in Berlin in 1993. She also participated in many COLLNET conferences. Dr. Marshakova enjoyed the well-deserved authority of many foreign and Russian colleagues. Throughout her life, we felt her presence and participation in the life of the national scientometrics and information science community, and we deeply mourn her sudden departure.

INTERNATIONAL CENTER FOR THE STUDY OF RESEARCH ANNOUNCES THE ICSR LAB

KRISTY JAMES

Elsevier, Amsterdam, The Netherlands

International Center for the Study of Research, Elsevier, Amsterdam, The Netherlands

ANDREW PLUME

Elsevier, The Boulevard, Oxford, UK

International Center for the Study of Research, Elsevier, Amsterdam, The Netherlands

The International Center for the Study of Research (ICSR; www.icsr.net) is pleased to announce the new data analysis platform ICSR Lab containing large Elsevier datasets that can be accessed at no cost for scholarly scientometrics research supporting ICSR's mission and research themes.

ICSR's mission is to further the study of research and thus to contribute to the evidence base supporting the practice of research strategy, evaluation and policy. ICSR delivers on this mission by identifying and addressing critical challenges and questions in research organized around seven research themes including Impact of research, Inclusivity, Open Science, Research careers, Research globalisation, Research practices and Sustainability. These themes were identified in close collaboration with the ICSR Advisory Board (https://www.elsevier.com/icsr/advisory-board) at the board's inaugural meeting in Rome in September 2019, coinciding with the ISSI 2019 conference.

Insights and recommendations emerging from studies conducted in association with the ICSR are shared through reports such as ICSR Perspectives (several are already freely available on the website) or

via peer-reviewed publications; co-created methods, metrics, and indicators will be available to the research community. While research questions within ICSR's scope may be addressed by qualitative and/or quantitative approaches, in March 2020 the ICSR Lab was launched to directly support researchers using quantitative methods.

ICSR Lab is a cloud-based computational platform which enables users to analyze large structured datasets, including those that power Elsevier solutions such as Scopus and PlumX. ICSR Lab supports scholarly research by giving access, at no cost, to powerful research metadata and metrics. The Lab is accessible through all major web browsers via the big data platform Databricks. Users can code in interactive notebooks in Python, SQL or R to explore and analyze the data, and can export their results for further downstream analysis and publication. The Lab's utility can be further extended by users bringing their own (or third-party) datasets into the Lab environment (with the appropriate rights).

The ICSR is already fostering a community of like-minded researchers: a shared Slack workspace accessible to current and former Lab users will become a place to ask a question (including to the Lab manager), share tips, learn new techniques and mentor or be mentored. Since the launch, the ICSR Lab has reviewed and approved more than 20 researchers to join the Lab for periods ranging from 3 months to 9 months (longer is possible) with a wide variety of research topics aligned with the seven ICSR research themes. Some users are already underway with their analysis as we write, and we are excited to share what they learn in due course.

Anyone can apply for access to ICSR Lab by submitting a short proposal via the website at www.icsr.net; all scientometrics professionals are invited to apply—when proposals are reviewed, special consideration is given for career stage and institutional background. We look forward to seeing you in the ICSR Lab!

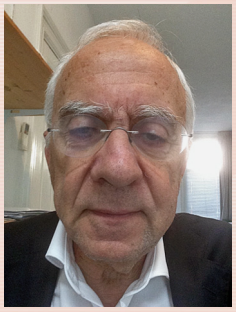
EXPONENTIAL GROWTH IN THE NUMBER OF ITEMS IN THE WOS

XIAOJUN HU

Medical Information Center, Zhejiang University School of Medicine, Hangzhou, China

Department of Neurology of Affiliated Hospital 2, Zhejiang University School of Medicine, Hangzhou China

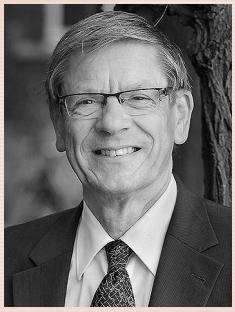
xjhu@zju.edu.cn



LOET LEYDESDORFF

University of Amsterdam, Amsterdam School of Communication Research (ASCoR), Amsterdam, The Netherlands

loet@leydesdorff.net



RONALD ROUSSEAU

KU Leuven, MSI and Facultair Onderzoekscentrum ECOOM, Leuven, Belgium

University of Antwerp, Faculty of Social Sciences, Antwerpen, Belgium

ronald.rousseau@kuleuven.be

ABSTRACT: In this note we explain how to find the yearly numbers of items in Clarivate's Web of Science (WoS) and its sub-databases. As a result we find that the WoS Core Collection grows exponentially during the period 1990-2019. We check and confirm that a simultaneous search at different locations leads to exactly the same results.

Keywords: Web of Science; Core Collection; counting publications

INTRODUCTION

In this note we explain how to find the yearly numbers of items in Clarivate's Web of Science (WoS). These numbers are useful when studying the absolute and relative growth of items covered by the WoS. These numbers are, for example, needed when one wishes to specify the percentage world-share of publications or citations of a country (Anderson et al., 1988; Leydesdorff, 1988; Zhou & Leydesdorff, 2006; Hu

et al., 2020). We explain how finding these numbers can be done if one has institutional access to the WoS.

CLARIVATE'S WEB OF SCIENCE AND ITS SUB-DATABASES

The WoS consists of different, partly overlapping sub-databases. Moreover, institutes can license these databases from a particular year onward and sometimes there are other restrictions. For example, not all universities have a license for the conference proceedings and relatively few have access to the SCI from 1900 onward.

We briefly recall the history and contents of the WoS (Rousseau et al., 2018; Birkle et al., 2020). The first Science Citation Index (in short: SCI) was published in 1963 and described the publications of the year 1961 in a set of 613 selected journals, leading to a total of 1.4 million references. Derek de Solla Price used this version for his studies during the 1960s (Price, 1965).

The SCI was followed in 1973 by a Social Sciences Citation Index (SSCI) (covering the year 1972) and in 1978 by the Arts & Humanities Citation Index (A&HCI). The Science Citation Index and the Social Sciences Citation Index were initially brought online at hosts (STN, Dialog, etc.). Since 1988 these two citation indices became available on CD-ROM and since 1997 it became possible to consult these citation indices via the Internet in the Web of Science (WoS). This led also to an expansion of the number of journals covered in the SCI, leading to SCIE (SCI-Expanded).

In 2009, version 5 of the WoS was a major update. Among other things, the Conference Proceedings Citation Index - Science (CPCI-S) and the Conference Proceedings Citation Index - Social Science & Humanities (CPCI-SSH), with back files dating back to 1990 were included.

In the year 2011 Thomson Reuters (the then owner of the WoS) launched a Book Citation Index (with back files dating from 2005). Similar to the conference proceedings, there are actually two book citation indices: one for the sciences (BKCI-S) and one for the social sciences and humanities (BKCI-SSH). In 2015 the Emerging Sources Citation Index (ESCI) was launched, extending the set of publications in the Web of Science to include more publications of regional importance and in emerging scientific fields. Backfills for the ESCI go back to 2005. ESCI does not overlap with any of the other sub-databases.

The eight databases: SCI-Expanded, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH and ESCI together form the WoS Core Collection. The Science Citation Index itself has been expanded retrospectively and goes back nowadays to the beginning of the 20th century (existing since 2005). The sub-database Century of Science describes the period 1900-1944, while also the period 1945-1960 has been included retrospectively. Similarly, there exists a Century of Social Sciences covering the period 1900-1955.

METHODS

We used four methods (more are feasible), to find out the number of publications included in the WoS for one particular publication year. One would expect that these methods would lead to the same numbers.

Method I) Using basic search; all years; target year as publication year (in Tables 1 and 2 we used only: 1990, 2000, 2010, 2015, and 2018)

Method II) Using basic search; custom year range set to: target year – target year, e.g. 1990-1990; and target year as publication year or, equivalently, one may use a search for accession number 0*.

Method III) Using advanced search; all years, PY=target year

Method IV) Using advanced search; custom year range set to: target year – target year; any search (we used: TS=Zipf). Then on the result page, completely below one finds a sentence "x records matched your query of the *number* in the data limits you selected", where *number* is the number of publications one searches.

Table 1. Results for SCI(Exp)-SSCI-A&HCI and for these databases to which ESCI has been added.

	SCI(EXP)-SSCI-A&HCI				+ ESCI			
METHOD	I	II	III	IV	I	II	III	IV
1990	881,500	881,500	881,500	881,505	881,500	881,500	881,500	881,505
2000	1,206,332	1,206,192	1,206,332	1,206,290	1,206,332	1,206,192	1,206,332	1,206,290
2010	1,784,526	1,784,526	1,784,526	1,784,526	1,960,445	1,960,445	1,960,445	1,960,445
2015	2,153,060	2,153,060	2,153,060	2,153,060	2,436,230	2,436,230	2,436,230	2,436,230
2018	2,374,806	2,373,952	2,374,806	2,373,952	2,698,186	2,697,275	2,698,186	2,697,275

Table 2. Results for the databases shown in Table 1 to which the Conference Proceedings (two databases) are added, and finally when, moreover the Book Citation Indices (two databases) are added.

	+ CONFERENCES				+ BOOK CITATION INDICES			
METHOD	I	II	III	IV	I	II	III	IV
1990	1,007,301	1,007,301	1,007,301	1,007,306	1,007,341	1,007,341	1,007,341	1,007,346
2000	1,348,803	1,348,663	1,348,803	1,348,761	1,348,899	1,348,759	1,348,899	1,348,857
2010	2,234,274	2,234,274	2,234,274	2,234,274	2,353,886	2,353,886	2,353,886	2,353,886
2015	2,808,982	2,808,982	2,808,982	2,808,982	2,936,100	2,936,100	2,936,100	2,936,100
2018	3,020,007	3,019,096	3,020,007	3,019,096	3,120,742	3,119,831	3,120,742	3,119,831

We also considered a fifth method, namely using advanced search; custom year range set to: target year – target year; search UT=0*. This gave the same results as method IV and we decided not to include this method.

Before showing the first results we point out that one must make sure that sub-databases, e.g. Emerging Sources Citation Index (ESCI) and from which year on (e.g., 2005 or 2015?), are indeed available for the target publication year, and this without any restriction.

Finally, we note that if an author writes a monograph with e.g. seven chapters, then this counts for eight items in the BCI: the book itself and each of the seven chapters.

PRELIMINARY RESULTS

We show the results of a search performed by RR with Google Chrome on April 28, 2020, between 10 and 11 AM, using the WoS as provided by KU Leuven. We already note that the next day some of these numbers, e.g. for 2015 had already increased, illustrating the dynamic aspect of the WoS. We recall that the last update "Data last updated ..." is indicated at the search page for both Basic and Advanced searches.

Continuing with adding more sub-databases we find the results shown in Table 2.

We see that methods I and III always yield the same result. A similar observation holds for methods II and IV, with the exception of year 2000. In two of the five years the four methods yield the same result and in the year 1990 this is almost the case (a difference of 5 for method IV). Except for this case, methods I and III yield the highest results. Differences are small though and of the order of a few hundredths of a percent.

In order to check if these results are place (university) independent these results were checked in Hangzhou (Zhejiang University) and in Amsterdam. Insofar as data were available – for example, Zhejiang University nor the University of Amsterdam subscribes to the Book Citation Indexes – results were exactly the same, see further.

A POSSIBLE EXPLANATION OF THE OBSERVED DIFFERENCE BETWEEN METHODS I-III AND METHODS II-IV-V

We searched again for the year 2000 (on May 7, 2020). Method I=III, leading to Set #1 yielded 1,348,899 items, while methods II=IV leading to Set #2 yielded 1,348,857 items.

Now #1 AND #2 leads to 1,348,759 items
#1 NOT #2 leads to 140 items
#2 NOT #1 leads to 98 items

And finally, as a check, #1 OR #2 leads to 1,348,997 items, the sum of the three previous results.

The 140 items in Set 1 and not in Set 2 were all officially published in the year 2000. They are published in a few journal issues (different journals) with series of consecutive accession numbers (there are some gaps). For instance between number 000166504300008 and 000166504300010, number 000166504300009 is missing in this list. Yet, this is an error in the WoS. The first number refers to an article in the *Journal of Thermal Analysis and Calorimetry*, p. 85-90, with publication year 2000; the second number refers to an article in the same journal, published on pages 105-116, with publication year 2000, while the missing number refers to an article in the same journal, on pages 91-104, but with publication year 2001. It can be found in the sets for the year 2001 (with the two essentially different methods).

When searching for the items with an accession number one smaller than those of the 140 and the one with an accession number one larger, we found two items that were published in 2001. This result suggests that these 140 items were added to the WoS database in the year 2001.

The 98 items in Set 2 and not in Set 1 were never published in the year 2000: most were officially published in 2001 or 2002, but a few were published in 1999. The trick with the accession number only worked partially. There was no item published just before the smallest accession number, but the item after the highest accession number was published in 2002.

All this suggests that methods I-III retrieve items with the correct official publication year, while we guess that methods II-IV may include items that were published before or after the official publication year, i.e. the year as indicated by the publisher. Of course, this official publication year is not necessarily the actual year of publication.

MAIN RESULTS

In this section we provide a complete list of numbers of publications in the WoS from 1990 to 2019 obtained with Method I (= Method III). On May 19, 2020 the three authors performed the same searches at the same time (10AM in Europe; 4PM in China). In Table 3 we present the results as shown via the institutional access of KU Leuven, because this institute has access to the most data. The University of Amsterdam does not have access to the Conference Proceedings and to the Book Citation Indexes; Zhejiang University has no access to the Book Citation Indexes and only access to the WoS from 1998 on. Finally, these two universities have access to the ESCI from 2015 on, while KU Leuven has access from 2005 on (this obviously includes a few items officially published before 2005).

When the authors had the same access, results were completely the same, except for the year 1998 (the first year of access for Zhejiang University) for which numbers in Zhejiang are slightly lower (1.162,282 versus 1,162,331 for items in SCI(Exp)-SSCI-A&HCI). One may see small differences with the searches performed on April 28, 2020, even for older years.

All sub-databases and hence also the whole WoS Core Collection, show a yearly increase, the year 2001 being an exception. Although increases are roughly linear (R2-values about 0.95), an exponential growth curve provides a better fit (using a non-linear least squares algorithm). Figure 1 shows the

Table 3. Number of publications in the WoS: 1990-2019.

	PUBL. YEAR	SCI(EXP)-SSCI-A&HCI	PLUS ESCI	PLUS CONFERENCES	PLUS BOOKS	ESCI ONLY
0	1990	881,500	881,500	1,007,301	1,007,341	0
1	1991	902,560	902,560	1,046,745	1,046,745	0
2	1992	922,537	922,537	1,060,892	1,060,892	0
3	1993	964,871	964,871	1,103,731	1,103,731	0
4	1994	1,016,384	1,016,384	1,161,694	1,161,694	0
5	1995	1,080,813	1,080,813	1,212,328	1,212,328	0
6	1996	1,133,243	1,133,243	1,272,301	1,272,301	0
7	1997	1,160,217	1,160,217	1,303,691	1,303,691	0
8	1998	1,162,331	1,162,331	1,315,388	1,315,388	0
9	1999	1,190,538	1,190,538	1,305,820	1,305,840	0
10	2000	1,206,333	1,206,333	1,348,804	1,348,900	0
11	2001	1,192,542	1,192,542	1,329,158	1,329,210	0
12	2002	1,236,380	1,236,390	1,374,262	1,374,523	10
13	2003	1,271,007	1,271,023	1,431,007	1,439,718	16
14	2004	1,359,228	1,359,351	1,524,677	1,535,602	123
15	2005	1,438,815	1,537,608	1,720,588	1,756,607	98,793
16	2006	1,503,814	1,614,484	1,813,101	1,860,068	110,670
17	2007	1,575,386	1,699,415	1,960,002	2,020,426	124,029
18	2008	1,663,384	1,803,013	2,074,367	2,153,488	139,629
19	2009	1,736,519	1,892,736	2,188,037	2,299,110	156,217
20	2010	1,784,515	1,960,433	2,234,262	2,353,927	175,918
21	2011	1,864,227	2,061,587	2,337,664	2,475,865	197,360
22	2012	1,945,680	2,169,943	2,484,861	2,605,969	224,263
23	2013	2,038,426	2,281,573	2,598,328	2,722,508	243,147
24	2014	2,091,461	2,356,208	2,711,807	2,848,468	264,747
25	2015	2,153,085	2,436,254	2,809,042	2,936,312	283,169
26	2016	2,245,502	2,543,463	2,933,230	3,069,922	297,961
27	2017	2,299,293	2,607,331	2,996,215	3,152,794	308,038
28	2018	2,375,882	2,698,569	3,022,226	3,124,279	322,687
29	2019	2,571,728	2,908,291	3,075,278	3,134,795	336,563

data for the SCI(Exp)-SSCI-A&HCI case with best-fitting curve: y(t) = 844,829 e0.0374t, with t = 0, .., 29, where t=0 corresponds to the year 1990 and t=29 with 2019; R2 = 0.991. Figure 2 shows the data for the WoS Core Collection. Here the best-fitting curve is y(t) = 924,739 e0.045t, R2 = 0.975. It is no surprise that the whole WoS Core Collection, consisting of several sub-databases, some with different starting data, leads to a slightly worse best fit. We also note that already in 2005 Jin & Rousseau (2005) observed an exponential growth for the SCI (period 1991-2003) with an exponent of 0.0326t.

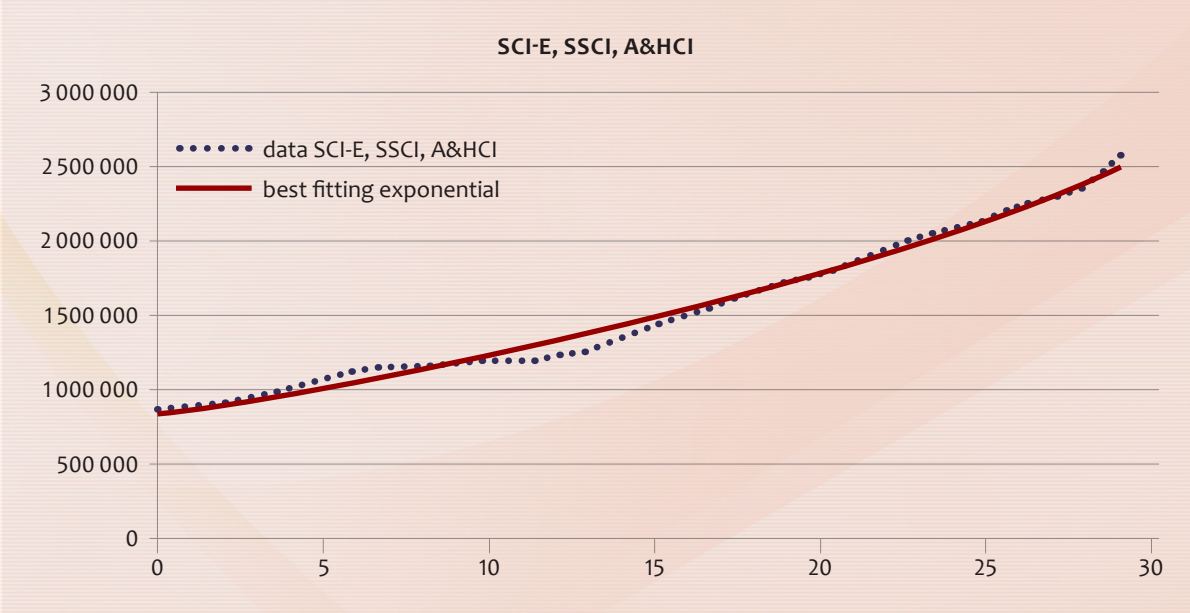


Figure 1. Data and best-fitting exponential for the SCI-E, SSCI and S&HCI (1990-2019).

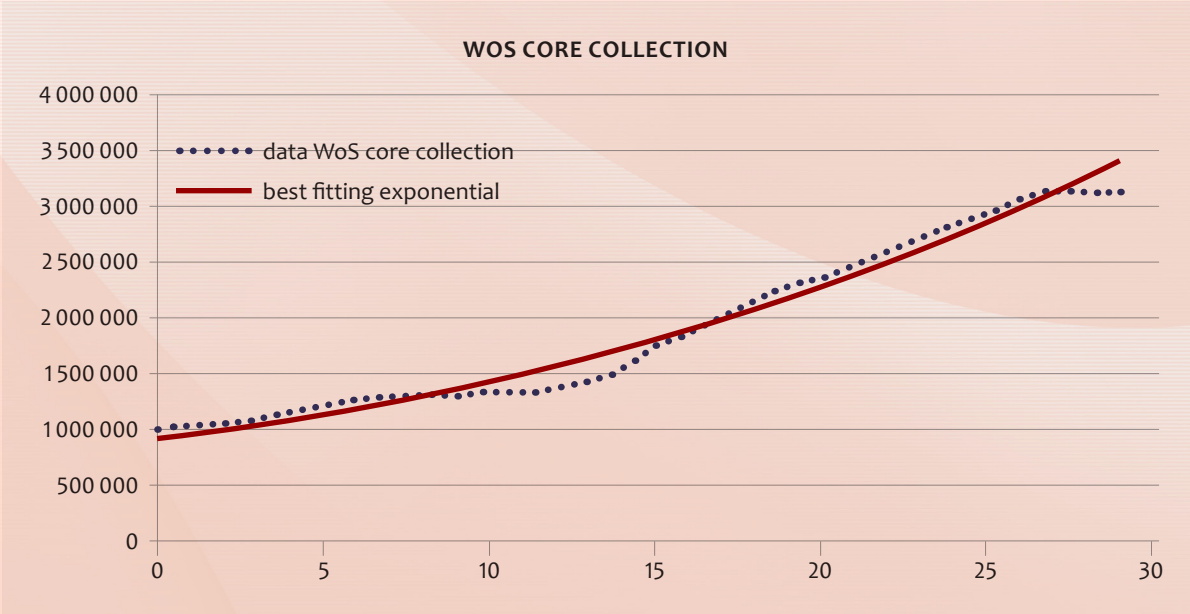


Figure 2. Data and best-fitting exponential for the WoS Core Collection (1990-2019)

A NOTE ON CITATIONS

This article is not meant to discuss citations but we would like to point out that when retrieving an article (Art) in the WoS one sees on the right "times cited: NUMBER". This NUMBER is the total number of citations in publications included in the WoS Core Collection. When downloading results, the number of citations is a subfield of the cited record (TC or "times cited"). If one clicks on the number of citations as shown on the results page one sees only the citing publications TO WHICH ONE HAS ACCESS. This number may be lower. If one does not have full access to the Core Collection from the date of the article's publication on, this list will often contain fewer items than that indicated by NUMBER. Of course, if one is really interested in the exact number of citations, one should search for additional stray citations, for which one has to search via a Cited Reference Search.

DISCUSSION AND CONCLUSION

When performing bibliometric investigations which include numbers of publications one should always state to which data one has access (or one has used). Relative publication (or citation) data should not be given with too many decimals: the next day the x-th decimal may already change. It is good practice to state at which day one has performed an investigation in the WoS, but readers/users will never find the exact same numbers, due to the dynamics of the WoS.

This is just a fact of life as the WoS is constructed to facilitate retrieval, not to facilitate bibliometric research. Birkle et al. (2020) duly note that the census date for each data download is significant as refreshed data sets have more records and revised versions of historical records.

When downloading citation results, the TC-column yields the total number of citations in the WoS Core Collection, whatever the sub-databases one has access to. If one uses this number and divides by the relevant total number of publications (possible citing items) this might be an overestimate of the true relative number of citations (if one does not have access to all sub-databases).

Some colleagues told us that results could be browser dependent. Topic models, for example, are sensitive to ongoing updates of hardware as well as software (Hecking & Leydesdorff, 2019, p. 265). Nevertheless, we cannot imagine how a browser can influence the results inside a database. Anyway, we tried out several browsers (Google Chrome, Firefox, Edge, 360se6) at different locations, but could not detect a browser-dependent effect.

ACKNOWLEDGEMENTS

The authors thank Wolfgang Glänzel (KU Leuven) and Raf Guns (UAntwerpen) for helpful suggestions. They also thank Xian Li and Yushuang Lü for help in data collection.

REFERENCES

Anderson, J., Collins, P. M. D., Irvine, J., Isard, P. A., Martin, B. R., Narin, F., & Stevens, K. (1988). On-line approaches to measuring national scientific output: A cautionary tale. *Science and Public Policy* 15(3), 153-161.

Birkle, C., Pendlebury, D.A., Schnell, J., & Adams, J. (2020). Web of Science as a data source for research on scientific and scholarly activity. *Quantitative Science Studies,* 1(1), 363-376.

Hecking, T., & Leydesdorff, L. (2019). Can topic models be used in research evaluations? Reproducibility, validity, and reliability when compared with semantic maps. *Research Evaluation*, 28(3), 263-272.

Hu, XJ., Li, X., & Rousseau, R. (2020). Describing citations as a function of time. *Journal of Data and Information Science*, 5(3). (To appear).

Jin, BH., & Rousseau, R. (2005). China's quantitative expansion phase: exponential growth but low impact. In: (P. Ingwersen & B. Larsen, Eds.), *Proceedings of ISSI 2005* (pp. 362-370), Stockholm: Karolinska University Press.

Leydesdorff, L. (1988). Problems with the 'measurement' of national scientific performance. *Science and Public Policy*, 15(3), 149-152.

Price, D. J. de Solla (1965). Networks of scientific papers. *Science*, 149(3683), 510- 515.

Rousseau, R., Egghe, L., & Guns, R. (2018). *Becoming Metric-Wise. A Bibliometric Guide for Researchers*. Kidlington etc.: Chandos (Elsevier).

Zhou, P., & Leydesdorff, L. (2006). The emergence of China as a leading nation in science. *Research Policy*, 35(1), 83-104.