

A Scientometric Study of Literature output on Geophysics from 2010-2019

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ABSTRACT

The present chapter is aimed at analyzing the global publication trends on geophysics using Web of Science database for the period 2010-2019. A total of 3304 publications were published in the field and the average number of publications published per year was 330.4. The highest number of publications 329 was published in 2019 and the lowest number of publications 129 in 2011. Relative Growth Rate is decreasing throughout the study period and corresponding Doubling time is increasing. Average RGR is 0.22 and corresponding Doubling time is 4.62. The web of science database allows us to refine the results in terms of types of publications, publication years, top authors, top countries, top organizations, most influential source titles, language and subjects.

KEYWORDS: Geophysics, Scientometric Analysis, RGR and DT

1. INTRODUCTION

Geophysics is a non-destructive and non-invasive Earth Science that uses the very latest science and technology in instrumentation, data acquisition and advanced computer modeling and interpretation in subsurface exploration. Geophysics is an interdisciplinary physical science concerned with the nature of the earth and its environment and as such seeks to apply the knowledge and techniques of physics, mathematics and chemistry to understand the structure and dynamic behavior of the earth and its environment. Geophysics is applied to societal needs, such as [mineral resources](#), mitigation of [natural hazards](#) and [environmental protection](#), [Geophysical survey](#) data are used to analyze potential petroleum reservoirs and mineral deposits, locate groundwater, find archaeological relics, determine the thickness of glaciers and soils, and assess sites for environmental remediation.

The use of geophysical technology is not limited to the resources industry. It's also used in many other areas of scientific research and exploration. In Archaeology, geophysics is used to uncover the remains of buried cities, walls, ancient water courses and graves among other things. Ground penetrating radar and resistivity profiling are two of the many methods used here. In Oceanography and Atmospherics geophysics is used to analyse the structure and motion of the atmosphere and oceans. Today, geophysical methods are used extensively in subsurface

exploration because they produce fast and accurate results and are, more importantly, non-destructive and non-invasive. Therefore, the present study has been undertaken in order to know the growth and development of publications in the field of geophysics research as indexed in web of science database.

2. OBJECTIVES FOR THE STUDY

The objective of the study was to perform a scientometric analysis of all geophysics publications in the world. The parameters studied include:

- Form of Publications
- Annual growth rate, compound growth rate of publications
- Highly prolific authors
- Highly productive countries
- Highly productive institutes
- Most preferred source titles for publication
- Language-wise distribution of publications
- High productive subject areas

3. METHODOLOGY

The data for the present study was retrieved from Web of Science database which is published by Thomson Reuters. This is one of the largest-established and best known bibliographic databases for science, social science, arts and humanities and it covers more than 90 million records referencing 256 disciplines of journals, conference materials and technical reports dating from 1900. A total of 3304 records were downloaded from the Web of Science database during 2010-2019 and analysed by using the spread sheet application as per the objectives of the study.

4 DATA ANALYSIS AND INTERPRETATIONS

4.1 Forms of publications

Table 1 Forms of publications

S. No.	Form of publications	No. of publications	Percentage
1	Journal articles	2825	85.50
2	Review	195	5.90
3	Editorial Material	142	4.30
4	Proceeding Papers	94	2.84
5	News Item	15	0.45
6	Book Review	12	0.36
7	Book Chapter	11	0.33
8	Biographical Item	6	0.18
9	Meeting Abstract	5	0.15
Total		3304	100

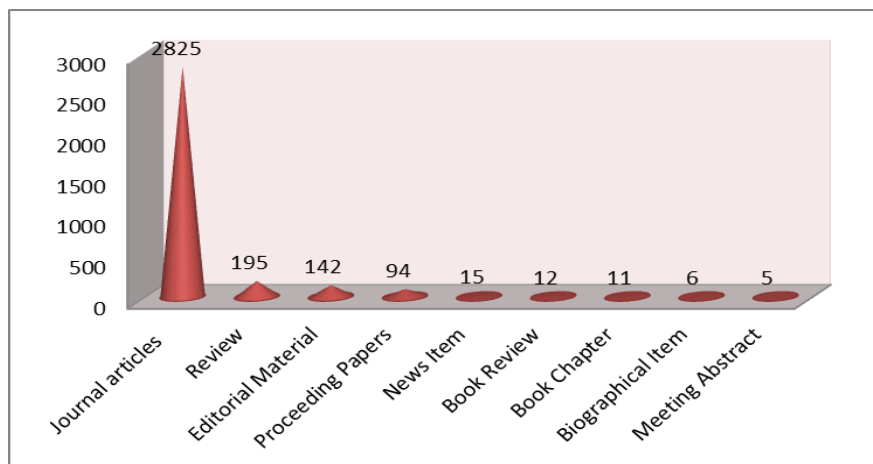


Figure 1 Form of publications

The table 1 reveals that the major source of publications covered by web of science databases on geophysics research is Journal Articles with 2,825 publications (85.50%) followed by Review with 195 publications (5.90%). Editorial Material ranks the third position with 142 publications (4.30%), Proceeding papers with 94 publications (2.84%) and remaining forms are less than one percentage as seen in the table. The results indicate that the research outputs on the subject of the period covered by the study are mostly published in the form of journal articles.

4.2 Growth of publications

Table 2 provides the AGR of the number of documents for period 2010 to 2019.

$$\text{AGR} = \frac{\text{End Value} - \text{First Value}}{\text{First Value}} \times 100$$

Table 2 AGR and CAGR of Publications

Year	No. of publications	Cumulative total	Annual growth rate (AGR)
2010	238	238	-
2011	229	467	-3.78
2012	310	777	35.37
2013	300	1077	-3.23
2014	323	1400	7.67
2015	331	1731	2.48
2016	339	2070	2.42
2017	365	2435	7.67
2018	399	2834	9.32
2019	470	3304	17.79

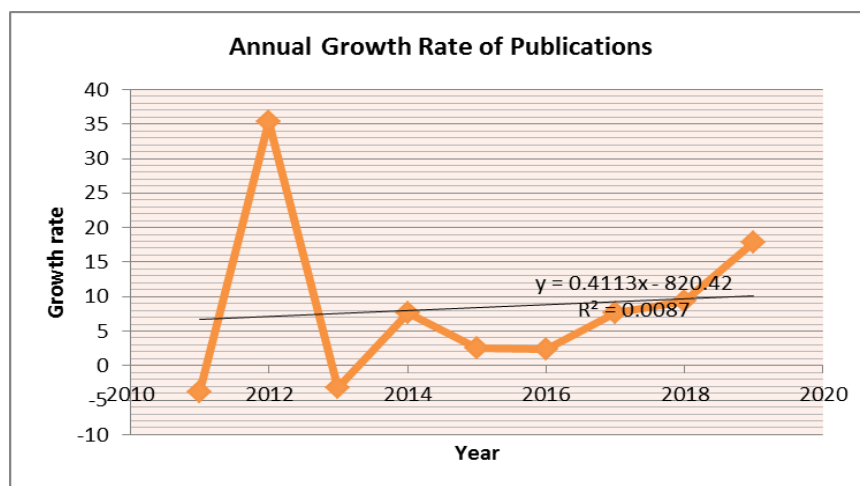


Figure 2 Annual growth rate of publications

The table 2 and figure 2 reveal that during the period of 2010 to 2019, a total of 3,304 publications were published on geophysics research. The highest number of publications is 470 was published in 2019. The lowest publications of 229 are published in 2011. The average number of publications published per year was 330.4. The table 2 also shows that the annual growth rate of the total publications calculated year wise. AGR reveals that it has decreased from -3.78 in 2011 to 17.79 in 2019. There is an increasing trend in the growth rate in the study period.

4.3 Relative Growth Rate (RGR) and Doubling Time

The Relative Growth Rate (RGR) is the increase in number of articles or pages per unit of time. This definition derived from the definition of relative growth rates in the study of growth analysis in the field of geophysics. The mean relative growth rate (R) over the specific period of interval can be calculated from the following equation.

Relative Growth Rate (RGR)

$$1 - 2R = \frac{\log W_2 - \log W_1}{T_2 - T_1}$$

Whereas

1-2 R- mean relative growth rate over the specific period of interval

Log_e W₁ - log of initial number of articles

Log_e W₂ - log of final number of articles after a specific period of interval

T₂-T₁- the unit difference between the initial time and the final time

The year can be taken here as the unit of time.

$$\text{Doubling Time (DT)} = 0.693/R$$

Table 3 Relative growth rate (RGR) and Doubling time (DT) of publications

Year	No. of Publications	Cumulative Total	W1	W2	RGR	DT
2010	238	238	-	5.47	-	-
2011	229	467	5.47	6.15	0.68	1.02
2012	310	777	6.15	6.66	0.51	1.36
2013	300	1077	6.66	6.98	0.32	2.17
2014	323	1400	6.98	7.24	0.26	2.67

2015	331	1731	7.24	7.46	0.22	3.15
2016	339	2070	7.46	7.64	0.18	3.85
2017	365	2435	7.64	7.80	0.16	4.33
2018	399	2834	7.80	7.95	0.15	4.62
2019	470	3304	7.95	8.10	0.15	4.62

The year wise RGR is found to be in the range of 0.68 to 0.15. Year wise calculation of RGR reveals that it has gradually decreased from 2011 to 2019. The highest value 0.68 corresponds to the year 2011, whereas the lowest value 0.15 for the year 2018 and 2019

Doubling time too has a trend similar to that of RGR. A year wise increase is seen during the periods of the study, the DT has shown a year wise increase from 1.02 to 4.62.

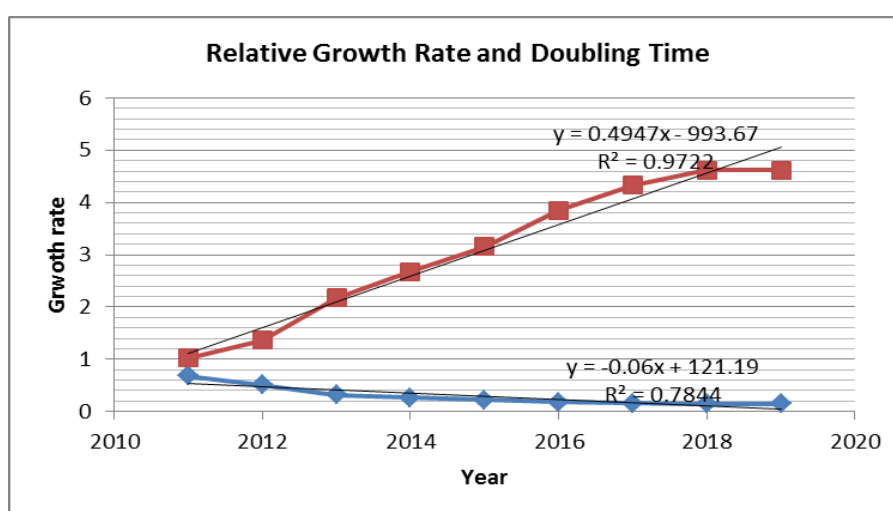


Figure 3 Relative growth rate for research output

4.4 Identification of most prolific authors

Table 4 Identification of most prolific authors

Rank	Author	No. of publications	Percentage
1	Pringle, J K	20	(0.61%)
2	Revil, A	18	(0.54%)
3	Oldenburg, D W	14	(0.42%)
4	Auken, E	12	(0.36%)
5	Liu, L B	12	(0.36%)
6	Anonymous	11	(0.33%)
7	Zuber, M T	11	(0.33%)
8	Alley, R B	10	(0.30%)
8	Comax, X	10	(0.30%)
10	Grott, M	10	(0.30%)
11	Linares, R	10	(0.30%)

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The authors having 10 or more publications during 2010-2019 are shown in table 4. Pringle, J K is the most productive author with 20 (0.61%) publications followed by Revil, A with 18 (0.54%) publications, Oldenburg, D W with 14 (0.42%) publications, Auken, E and Liu, L B each with 12 (0.36%) publications, Anonymous and Zuber, M T each with 11 (0.33%) publications respectively. And a total of 11,251 authors are contributed entire research output of the period under study.

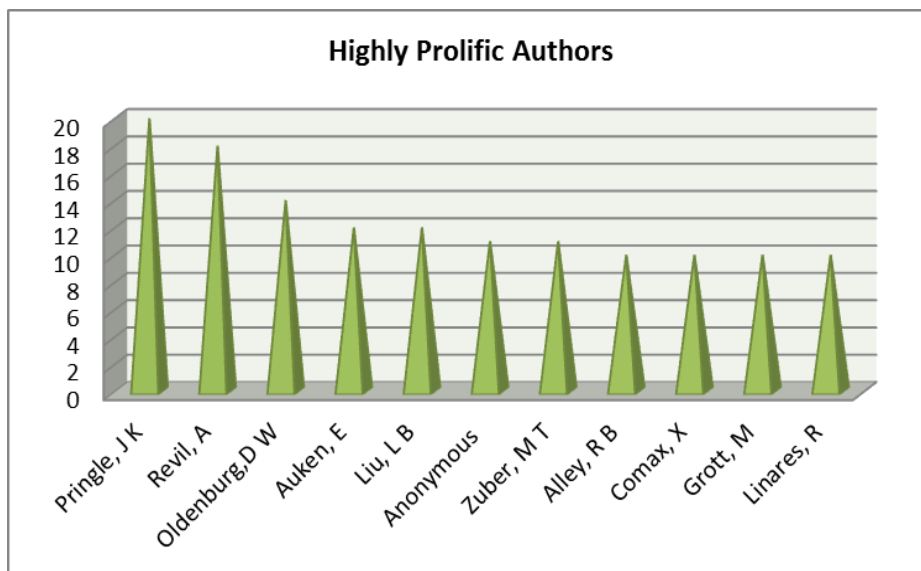


Figure 4 High prolific authors

4.5 Highly productive institutes

Table 5 Highly productive institutes

Rank	Institutions	Country	No. of Publications
1	Centre National de la Recherché Scientifique	France	216
2	Chinese Academy of Sciences	China	128
3	Russian Academy of Sciences	Russia	124
4	University of California System	USA	109
5	Helmholtz Association	Germany	103
6	Institut De Recherche Pour Le Developpement	France	77
7	National Aeronautics Space Administration NASA	USA	74
8	United States Department of Energy DOE	USA	66
9	California Institute of Technology	USA	62
10	CNRS National Institute for Earth Sciences Astronomy	France	60
11	Consiglio Nazionale Delle Ricerche	USA	60
12	Communauté Université Grenoble Alpes	France	59

A total of 2862 institutions are contributed entire research output of the study. The scientometric profile of top 11 institutions is presented in table 5. Among these top 11 institutions, 5 are from USA, 4 are from France and each 1 from Russia, China and Germany. Findings revealed that Centre National de la Recherché Scientifique, France with 216 (6.54%) publications is the most productive institutions in the field of geophysics research followed by Chinese

Academy of Science, China with 128 (3.87%) publications, Russian Academy of Sciences, Russia with 124 (3.75%) publications, University of California System, USA with 109 (3.30%) publications, Helmholtz Association, Germany with 103 (3.12%) publications, Institut De Recherche Pour Le Developpement IRD, France 77 (2.33%) publications and National Aeronautics Space Administration NASA, USA with 74 (2.24%) publications.

4.6 Highly productive countries

Table 6 Highly productive countries

Rank	Country	Total Publications (%)	Rank	Country	Total Publications (%)
1	USA	895 (27.09%)	7	Canada	192 (5.81%)
2	China	456 (13.80%)	8	Australia	176 (5.33%)
3	France	345 (10.44%)	9	Russia	173 (5.24%)
4	Germany	300 (9.08%)	10	Spain	128 (3.87%)
5	Italy	285 (8.63%)	11	Switzerland	100 (3.03%)
6	England	269 (8.14%)	12	India	83 (2.51%)

In all, there were 112 countries involved in the research in geophysics; however, USA topped the list with highest share (27.09%) of publications. China ranked second with 13.80% share of publications followed by France 10.44% share of publications, Germany with 9.08% share of publications, England with 7.72% share of publications, Italy with 7.66% share of publications, Italy with 8.63% share of publications, England with 8.14% share of publications, Canada with 5.81% share of publications, Russia with 5.24% share of publications and the remaining countries are publishing less than 4% of the research output in this study period. The publication share of highly productive countries (≥ 80 publications) on geophysics is given in Table 6.

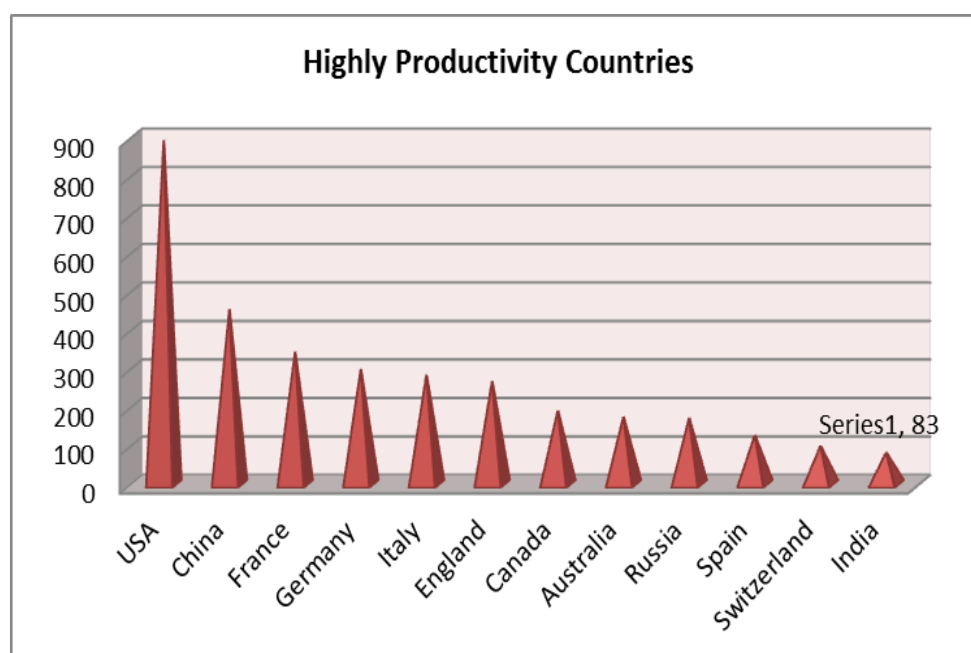


Figure 5 Highly productive countries

4.7 Language wise distributions

Table 7 Language wise distributions

Rank	Language	No. of Publications
1	English	3177
2	Chinese	92
3	French	9
4	German	8
5	Spanish	7
6	Russian	2
7	Swedish	2
8	Czech	2
9	Portuguese	1
10	Slovak	1
11	Croatian	1
12	Italian	1
13	Slovenian	1

Publications on geophysics are spread over 13 languages. The study reveals that the maximum number of publications have been published in English language with 3177 (96.16%) publications, followed by Chinese language with 92 (2.78%) publications, French language ranks third position with 9 (0.27%) publications, German language with 8 (0.24%) publications, Spanish language with 7 (0.21%) publications, Czech language with 2 (0.06%) publications Russian language with 2 (0.06%) publications and Swedish with 2 (0.06%) publications. And the remaining languages such as Portuguese, Slovak, and other languages are constituted in negligible percentage. The English language superiority was found in every year in total productivity on the subject during the study period.

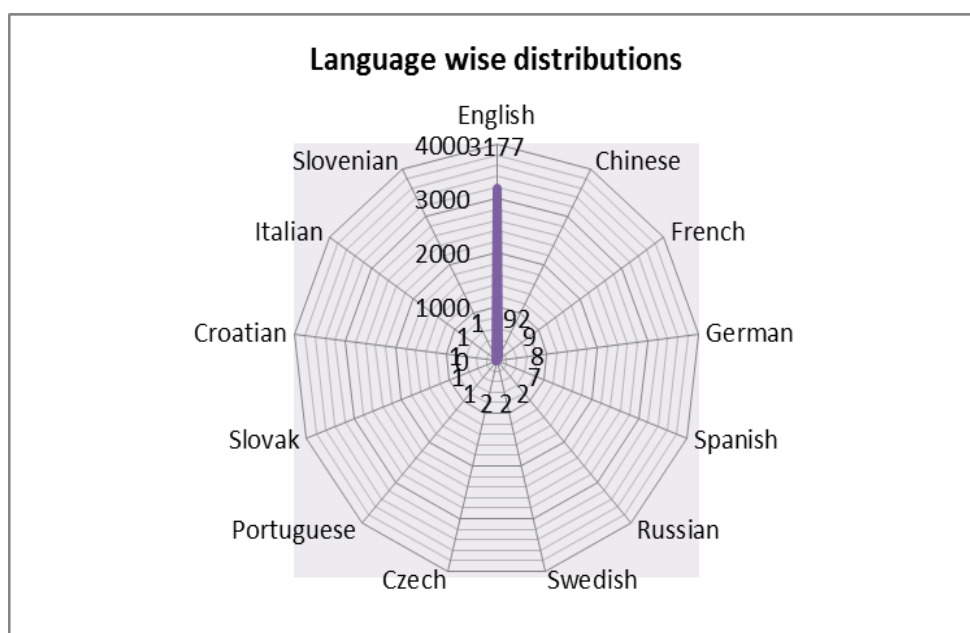


Figure 6 Language wise distributions

4.8 Most preferred source titles

Table 8 Source Title of Publications

Rank	Source title	No. of publications	Percentage
1	ICARUS	111	3.36
2	Geophysics	107	3.24
3	Journal of applied geophysics	104	3.15
4	Geophysical Prospecting	94	2.85
5	Chinese Journal of Geophysics Chinese Edition	67	2.03
6	Archaeological Prospection	52	1.57
7	Computers Geosciences	45	1.36
8	Geophysical Journal International	39	1.18
9	Environmental Earth Sciences	36	1.09
10	Exploration Geophysics	35	1.06
11	Pure and Applied Geophysics	33	1.00
12	Surveys in Geophysics	33	1.00
13	Arabian Journal of Geosciences	31	0.94

The publication share of most productive source titles (≥ 30 publications) on geophysics is given in Table 8. The scientific literature on geophysics is spread over 851 different source journals. It reveals that ICARUS the list with the highest number of publications 111 (3.36%), followed by Geophysics with a share of 107 (3.24%) publications. Journal of applied geophysics occupies the third position with 104 (3.15%) publications. The fourth highest source title is Geophysical Prospecting with 94 (2.85%) publications, Chinese journal of geophysics Chinese edition with 67 (2.03%) publications and Archaeological Prospection with 52 (1.57%) publications.

4.9 High productivity subject areas

Table 9 High productivity subject areas

Rank	Subject	No. of Articles	Percentage
1	Geology	1079	32.66
2	Geochemistry geophysics	889	26.91
3	Engineering	380	11.50
4	Physics	279	8.44
5	Astronomy astrophysics	235	7.11
6	Water resources	179	5.42
7	Mathematics	168	5.08
8	Environmental sciences ecology	162	4.90
9	Meteorology atmospheric sciences	148	4.48
10	Mining mineral processing	135	4.09
11	Physical Geography	133	4.02

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Table 9 shows high productivity subjects which are contributing more than 130 articles. It is found that Geology has highest number of articles with 1079 (32.66%) followed by Geochemistry geophysics contributing 889 (26.91%) articles. Engineering occupies the third position with 380 (11.50%) articles. The fourth highest articles belonged to the subject Physics with 279 (8.44%), Astronomy astrophysics with 235 (7.11%) and Water resources with 179 (5.42%) articles respectively.

CONCLUSIONS

The present chapter attempted to highlight the growth and development of research production on geophysics. A total of 3304 publications were published during 2010-2019 and the average number of publications per year was 330.4. There was a fluctuations trend in the growth of publications during the study period. USA topped the list with highest share (27.09%) of publications. China ranked second with 13.80% share of publications followed by France 10.44% share of publications and Germany with 9.08% share of publications. Publications on geophysics are spread over 13 languages. Centre National de la Recherche Scientifique, France with 216 (6.54%) publications is the most productive institutions followed by Chinese Academy of Science, China with 128 (3.87%) publications, Russian Academy of Sciences, Russia with 124 (3.75%) publications. The scientific literature on geophysics is spread over 851 different source journals. The most preference journals for publications were ICARUS with 111 publications followed by Geophysics with 107 publications and Journal of applied geophysics with 104 publications.

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