Aerosols and Soot Research Publication Output on Global Perspective: A Scientometric Study

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Abstract

A scientometric study of aerosols and soot research literature from the year 2011 to 2016 is carried out to find out the growth in aerosols and soot research, authors' productivity, the top ranking source journal, and the country-wise productivity. The data for the study is obtained from the Web of Science database. 1075 number of results retrieved are analyzed using excel worksheets. It is found that aerosols and soot research literature have seen an explosive growth during the period of study. Authorship pattern shows that highest number of articles is contributed by more than four authors (149) and multi authored papers are more than single authored papers. The degree of Collaboration is 0.98 in this study. The journal Atmospheric chemistry and physics contribute 139 articles with the first position and Chinese Academic Science topped the institution list with 95 publications (TLCS 240, TGCS 1096). USA placed in the first position with 421 publications (TLCS 1298, TGCS 6778) and it covers 39.2% of the total research output.

Keywords

Scientometric study; bibliometrics study; publication growth; citation; aerosols; soot

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INTRODUCTION

As we all know that our planet is warming from the North Pole to the South Pole. Since 1906, the global average surface temperature has increased between 1.1 and 1.6 degrees Fahrenheit (0.6 to 0.9 degrees Celsius) and more in sensitive polar regions. The signs of the effects of global warming are appearing such as the heat is melting glaciers and sea ice, shifting precipitation patterns, and setting animals on the move[1]. Global warming is already having significant and costly effects on our communities, our health, and our climate. Unless we take immediate action to reduce global warming emissions, these impacts will continue to intensify, grow ever more costly and damaging, and increasingly affect the entire planet including our community and our family. Some of the impacts of Global warming are rising temperature, precipitation (rain and snow fall) increased, across the globe and some invasive species are thriving. Climate change is a significant threat to the health of the people and the impacts of human-induced climate change are increasing nationwide. Rising greenhouse gas concentrations result in increases in temperature, changes in precipitation, increases in the frequency and intensity of some extreme weather events, and rising sea levels. These climate change impacts endanger our health by affecting our food and water sources, the air we breathe, the weather we experience, and our interactions with the built and natural environments. In this study, we tried to analyze the aerosols and soot research output in the field of global warming worldwide[2]. Aerosols are tiny particles in the air that can be produced when we burn different types of fossil fuels like coal, petroleum, wood, and biofuels in different ways. A significant man-made source of aerosols is pollution from cars, factories and also be produced naturally, for example, through being given off from trees or burning vegetation. Aerosols have a profound impact on the climate because just like greenhouse gases, they are able to change the Earth's radiated, or energy, balance. Aerosols can control how much energy from the sun reaches the planet's surface by changing the amount that is absorbed in the atmosphere and the amount that is scattered back out to space. Soot, also called black carbon (BC), contributes to climate warming in two ways. First, black soot particles in the air absorb sunlight and directly heat the surrounding air. Second, soot falling on snow or ice changes those reflecting surfaces into absorbing ones, that is, soot decreases the albedo[3]. Therefore, soot deposits increase the melting rate of snow and ice, including glaciers and the Arctic ice.

Nowadays Scientometrics has become an important field of study to monitor the progress in the scientific performance of a research group, a department, a university etc[4].This study analyzed the research output of aerosols and soot research publication globally output.

REVIEW OF LITERATURE

Chaman Sab, M, Kumar P[5](2017) analyzed the research activities of India in biomedicine during 2012–2016. The result shows that a total number of 2712 publications is indexed and there is an insignificant growth in Biomedicine literature published from India. Gupta B M, Adarsh, Bala[6](2011) studied the research output of India in asthma during the period from 1999 till 2008. They analyzed the growth, rank and global publications share, citation impact, the share of international collaborative papers, the contribution of major collaborative partner countries and contribution of various subject fields. Madhu Bansal, Ritu Gupta[7](2017) presented the analysis of 14317 world papers in celiac disease and experiencing an annual average growth rate of 5.20% and citation impact of 12.53. They concluded that individual countries must foster global research and development, by way of providing increased investment in research and development.

METHODOLOGY

The data collected for the present study is from Web of Science. With the Web of Science platform, we can access an unrivaled breadth of world-class research literature linked to a rigorously selected core of journals and uniquely discover new information through meticulously captured metadata and citation connections. The Web of Science platform connects the Web of Science Core Collection to regional citation indexes, patent data, specialized subject indexes, and an index of research data sets, all in all totaling over 33,000 journals

OBJECTIVES OF THE STUDY

- Find out the author wise distribution of documents.
- Find out the authorship pattern and degree of collaboration.
- Find out journal wise distribution and keyword wise analysis.
- Find out the year wise analysis and document wise distribution
- Find out Institution wise and language wise distribution of documents
- Country wise and cited reference wise distribution of documents.

ANALYSIS AND FINDINGS

Author wise distribution of Documents

Top 20 productive authors are discussed in this table. The most productive authors are Kondo Y with 27 records related to aerosols and soot publications and all papers published in the area of research. Most of the authors preferred research journals for their publication. Onasch T B, Cao J J followed the 2nd and 3rd position with 23 and 20 records.

Table 1: Author wise distribution of Documents

S. No	Author	Records	Percent	TLCS	TLCS/t	TLCSx	TGCS	TGCS/t	TLCR	TLCSb	TLCSe
1	Kondo Y	27	2.5	96	25.35	50	388	97.15	92	13	0
2	Onasch TB	23	2.1	234	60.53	140	606	168.10	108	1	0
3	Cao JJ	20	1.9	50	18.30	21	205	77.12	91	0	0
4	Moteki N	20	1.9	57	17.67	28	199	62.03	87	3	0
5	Schwarz JP	19	1.8	80	23.30	49	376	111.40	60	0	0
6	Coe H	18	1.7	158	37.43	111	478	123.60	88	26	18
7	Wiedensohler A	18	1.7	134	28.78	97	600	134.13	49	27	3
8	Worsnop DR	18	1.7	197	46.87	123	539	156.10	71	0	0
9	Chen H	16	1.5	68	23.60	22	130	50.58	135	3	0
10	Wang J	16	1.5	35	11.83	10	179	46.33	55	1	0
11	Chakrabarty RK	15	1.4	30	8.20	18	144	44.12	49	2	0
12	Niessner R	15	1.4	90	20.37	49	203	59.70	37	0	0
13	Gysel M	14	1.3	209	45.07	145	465	100.57	80	11	20
14	Prevot ASH	14	1.3	45	12.42	32	247	95.92	56	1	0

15	Zhang Q	14	1.3	35	8.45	13	219	76.02	72	0	0
16	Adachi K	13	1.2	54	15.22	29	217	54.18	54	1	0
17	Chen JM	13	1.2	26	8.83	12	117	51.67	68	3	0
18	McMeeking GR	13	1.2	68	16.87	44	289	77.77	76	14	10
19	Takegawa N	13	1.2	43	8.68	26	249	51.32	33	11	0
20	Thomson MJ	13	1.2	73	17.45	29	267	72.00	47	3	9

Authorship Pattern

The authorship pattern of collaboration by year-wise is shown in table 2. Out of 1075 documents contributed, 24(2.23%) articles are published by single authors, 96(8.93%) articles by two authors, 145(13.49%) are of three authors, etc. It is clear from the below table that the highest number documents were contributed by more than 4 authors (149) and the contributions of multi-authored papers (96) are more than that of single authored papers (24).From this analysis, we got a conclusion that recent period more articles are published by multi authors.

Table 2: Authorship Pattern

Authors	No of Records	Cumulative	(%)
1	24	24	2.23
2	96	120	8.93
3	145	265	13.49
4	149	414	13.86
5	127	541	11.81
6	121	662	11.26
7	83	745	7.72
8	96	841	8.93
9	44	885	4.09
10	49	934	4.56
More than 10	141	1075	13.12
Total	1075	-	100.00

Degree of Collaboration

Subramanyam17 developed the DC (Degree of Collaboration) measure that was derived by the simple calculation of the proportion of multiple authors to the total papers.

The formula is as follows,

Where, C=Degree of Collaboration
Nm= Number of multi-authored contributions
Ns= Number of single-authored contributions
C=Nm/Nm+Ns
In the present study, the value of
Here, Nm= 1051; Ns= 24; C =1051/1051+24

So here the degree of collaboration is 0.98

Table 3: Degree of Collaboration

S. No	Authors	Contribution
1	Single authors	24.00
2	Multi authors	1051.00
Degree of Collaboration		0.98

Journal wise Distribution of Documents

Most productive journals where the aerosols and soot research articles are published is discussed in this table 4. The most productive Journal is Atmospheric chemistry and physics with 139 articles dealing with aerosols and soot research and 12.9% articles are published in this journal. Aerosol science and technology and Atmospheric environment where the 2nd and 3rd ranking journals were mostly published journals are present**.**

Table 4: Journal wise Distribution of Documents

S. No	Journal	Records	Percent	TLCS	TLCS/t	TGCS	TGCS/t	TLC
1	Atmospheric chemistry and physics	139	12.9	606	152.38	3027	797.68	487
2	Aerosol science and technology	100	9.3	389	104.63	922	267.58	275
3	Atmospheric environment	87	8.1	148	39.93	1113	323.03	165
4	Journal of geophysical research-atmospheres	71	6.6	120	40.25	1060	276.45	250
5	Journal of aerosol science	46	4.3	107	33.00	416	122.12	119
6	Environmental science & technology	40	3.7	112	31.62	500	172.78	115
7	Combustion and flame	35	3.3	96	25.97	511	173.15	60

8	Atmospheric measurement techniques	30	2.8	234	49.43	502	113.20	138
9	Journal of quantitative spectroscopy & radiative transfer	28	2.6	101	31.33	260	85.75	116
10	Aerosol and air quality research	23	2.1	18	4.57	261	80.73	40
11	Geophysical research letters	23	2.1	40	15.25	366	94.65	66
12	Atmospheric research	18	1.7	24	6.57	270	82.03	36
13	Science of the total environment	17	1.6	20	6.67	132	51.33	41
14	Journal of physical chemistry a	14	1.3	18	5.73	152	45.67	34
15	Energy & fuels	13	1.2	32	6.67	123	27.98	13
16	Fuel	11	1.0	3	1.00	57	25.50	7
17	Analytical chemistry	10	0.9	26	5.82	99	22.37	19
18	Scientific reports	10	0.9	0	0.00	87	35.75	49
19	Proceedings of the combustion institute	9	0.8	12	3.92	87	31.42	9
20	Atmosphere	8	0.7	3	1.50	20	9.83	15

Keyword wise analysis of Documents

The high-frequency keywords will enable us to understand the various aspects of searching of aerosols and soot research output. Table 5 shows the high frequency keywords were: carbon(TLCS 928 TGCS 4038)),soot(TLCS 1028 TGCS 3122),aerosol(TLCS 556,TGCS 3122), black(TLCS 817 TGCS 3196) etc.

Table 5: Keyword wise analysis of Documents

S. No	Word	Records	Percent	TLCS	TGCS
1	Carbon	265	24.7	928	4038
2	Soot	259	24.1	1028	3122
3	Aerosol	232	21.6	556	3122
4	Black	209	19.4	817	3196
5	Particles	188	17.5	415	2560
6	Particle	158	14.7	490	1746
7	Aerosols	120	11.2	226	1664
8	Properties	106	9.9	357	1094
9	Characterization	81	7.5	212	992
10	Using	78	7.3	152	755
11	Optical	74	6.9	213	734
12	Size	72	6.7	145	739
13	Mass	69	6.4	261	893
14	Light	65	6.0	166	735
15	Absorption	62	5.8	267	1065
16	Emissions	62	5.8	117	821
17	Measurements	61	5.7	209	894
18	Atmospheric	59	5.5	171	1232
19	Combustion	59	5.5	134	565
20	Particulate	59	5.5	94	621

Year wise Analysis of Documents

During 2011 – 2016 a total of 1075 publications were published in aerosols and soot research field. The highest number of publications 222 was produced in 2016.Table 6 has given the year wise growth and collaboration rate in aerosols and soot research field. It can be clearly visualized that growth of the literature was increased from the year 2011 to 2016.The least publication output was noticed in the year 2011 with 150 records.

Table 6: Year wise Analysis of Documents

S. No	Publication Year	Records	Percent	TLCS	TGCS	Mean
1	2011	150	14.0	513	3553	179.16
2	2012	177	16.5	715	4016	
3	2013	170	15.8	606	2528	
4	2014	179	16.7	410	2087	
5	2015	177	16.5	204	1075	
6	2016	222	20.7	47	612	

Document wise Distribution

During 2011-2016 a total of 1075publications were published in aerosols and soot research publication output. The highest number of publications 1032was published mainly in the form of articles and it covers 96%.Followed by articles conference proceedings placed in the second position with 21 records (2%).From the below table we can summarize that most of the authors prefer to publish their documents as articles in scientific journals.

Table 7: Document wise Distribution

S. No	Document Type	Records	Percent	TLCS	TGCS
1	Article	1032	96.0	2408	12871
2	Article; Proceedings Paper	21	2.0	12	107
3	Review	14	1.3	65	819
4	Editorial Material	2	0.2	3	38
5	Letter	2	0.2	6	16
6	Article; Retracted Publication	1	0.1	1	9
7	Correction	1	0.1	0	0
8	Meeting Abstract	1	0.1	0	0
9	Review; Book Chapter	1	0.1	0	11

Language wise distribution of Documents

Table 8 shows the language wise distribution of documents in the aerosols and soot research publication. English (1068 TLCS 2492 TGCS 13854) language has I first selected language in which most authors prefer to publish their articles. Followed by English, Chinese (3 TLCS 3 TGCS 16), Polish (3 TLCS TGCS 1) and German (1 TLCS 0 TGCS 0) were placed.

Table 8: Language wise distribution of Documents

S. No	Language	Records	Percent	TLCS	TGCS
1	English	1068	99.3	2492	13854
2	Chinese	3	0.3	3	16
3	Polish	3	0.3	0	1
4	German	1	0.1	0	0

Institution wise distribution of Documents

Table 9 provides the publication productivity of top 20 institutions. Chinese Academic Science topped the list with 95 publications (TLCS 240, TGCS 1096) followed by University of Colorado and NASA with 45 and 41 publications (TLCS 254 TGCS 1280 & TLCS 124, TGCS 603) respectively.

Table 9: Institution wise distribution of Documents

S. No	Institution	Records	Percent	TLCS	TGCS
1	Chinese Acad Sci	95	8.8	240	1096
2	Univ Colorado	45	4.2	254	1280
3	NASA	41	3.8	124	603
4	Paul Scherrer Inst	41	3.8	361	1184
5	Aerodyne Res Inc	39	3.6	177	539
6	NOAA	38	3.5	258	918
7	Univ Tokyo	32	3.0	110	451
8	Peking Univ	30	2.8	95	566
9	Stockholm Univ	29	2.7	63	370
10	Univ Toronto	27	2.5	125	522
11	Univ Helsinki	26	2.4	139	556
12	Max Planck Inst Chem	25	2.3	72	484
13	Univ Manchester	25	2.3	209	626
14	Pacific NW Natl Lab	23	2.1	149	632
15	ETH	22	2.0	109	392
16	Leibniz Inst Tropospher Res	22	2.0	179	667
17	Lund Univ	22	2.0	115	401
18	Univ Calif Davis	20	1.9	119	534
19	Texas A&M Univ	19	1.8	84	319
20	CNRS	18	1.7	14	161

Country wise distribution of Documents

Table 10 reveals the records of aerosols and soot research publication output world wide.USA placed in the first position with 421 publications(TLCS 1298, TGCS 6778) and it covers 39.2% of the total research output,.Peoples R China is the second most producing country with 215 records(TLCS 505, TGCS 2729) and it covers 20% 0f the total output.

Table 10: Country wise distribution of Documents

S. No	Country	Records	Percent	TLCS	TGCS
1	USA	421	39.2	1298	6778
2	Peoples R China	215	20.0	505	2729
3	Germany	141	13.1	521	2733
4	Canada	88	8.2	481	1529
5	Japan	88	8.2	287	1292
6	France	78	7.3	266	1047
7	UK	75	7.0	298	1597
8	Switzerland	74	6.9	425	1554
9	Sweden	67	6.2	215	1008
10	Finland	46	4.3	162	775
11	Italy	45	4.2	171	828
12	India	44	4.1	39	555
13	Norway	29	2.7	175	732
14	South Korea	27	2.5	32	240
15	Russia	25	2.3	95	252

16	Spain	22	2.0	85	367
17	Austria	21	2.0	40	245
18	Australia	16	1.5	23	201
19	Greece	16	1.5	83	374
20	Taiwan	15	1.4	17	144

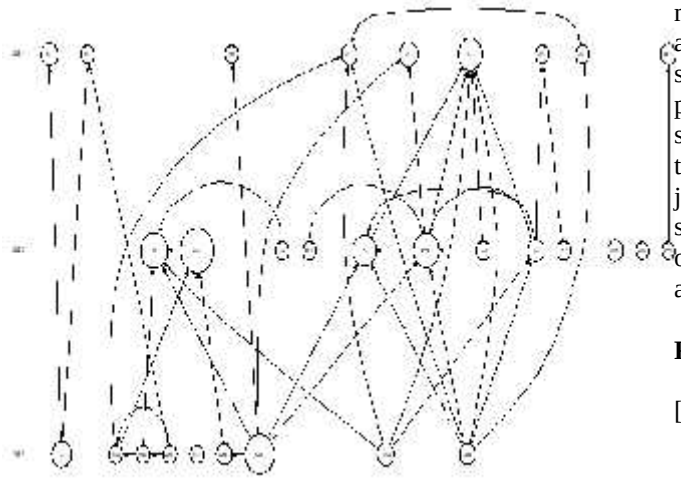
Cited reference wise documents distribution

The most cited reference is Bond TC, 2013, J GEOPHYS RES-ATMOS, V118, P5380, DOI 10.1002/jgrd.50171 with 190 papers dealing with aerosols and soot research. 17.7 % of all papers published in this research field. The cited reference of the seminal publication on aerosols and soot research have given in Table 11, appeared on rank 2 and Ramanathan V, 2008, NAT GEOSCI, V1, P221, DOI 10.1038/ngeo156 and Bond TC, 2006, AEROSOL SCI TECH, V40, P27, DOI 10.1080/02786820500421521 respectively. It was clearly depicted in the below table.

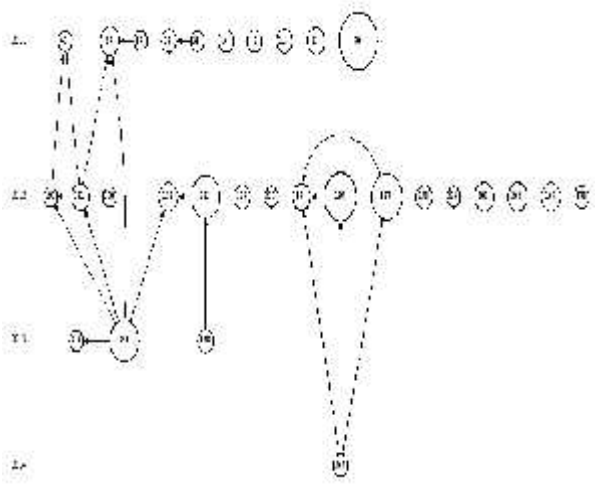
Table 11: Cited reference wise documents distribution

S. No	Author / Year / Journal	Records	Percent
1	Bond TC, 2013, J GEOPHYS RES-ATMOS, V118, P5380, DOI 10.1002/jgrd.50171	190	17.7
2	Ramanathan V, 2008, NAT GEOSCI, V1, P221, DOI 10.1038/ngeo156	189	17.6
3	Bond TC, 2006, AEROSOL SCI TECH, V40, P27, DOI 10.1080/02786820500421521	186	17.3
4	Jacobson MZ, 2001, NATURE, V409, P695, DOI 10.1038/35055518	166	15.4
5	Zhang RY, 2008, P NATL ACAD SCI USA, V105, P10291, DOI 10.1073/pnas.0804860105	145	13.5
6	Andreae MO, 2006, ATMOS CHEM PHYS, V6, P3131	110	10.2
7	Schwarz JP, 2006, J GEOPHYS RES-ATMOS, V111, DOI 10.1029/2006JD007076	105	9.8
8	Bond TC, 2006, J GEOPHYS RES-ATMOS, V111, DOI 10.1029/2006JD007315	83	7.7
9	Cappa CD, 2012, SCIENCE, V337, P1078, DOI 10.1126/science.1223447	77	7.2
10	Moffet RC, 2009, P NATL ACAD SCI USA, V106, P11872, DOI 10.1073/pnas.0900040106	77	7.2
11	Bond TC, 2004, J GEOPHYS RES-ATMOS, V109, DOI 10.1029/2003JD003697	76	7.1
12	Adachi K, 2010, J GEOPHYS RES-ATMOS, V115, DOI 10.1029/2009JD012868	75	7.0
13	Hansen J, 2004, P NATL ACAD SCI USA, V101, P423, DOI 10.1073/pnas.2237157100	72	6.7
14	Sorensen CM, 2001, AEROSOL SCI TECH, V35, P648, DOI 10.1080/02786820117868	69	6.4
15	Slowik JG, 2007, AEROSOL SCI TECH, V41, P295, DOI 10.1080/02786820701197078	68	6.3
16	Cross ES, 2010, AEROSOL SCI TECH, V44, P592, DOI 10.1080/02786826.2010.482113	67	6.2
17	Kirchstetter TW, 2004, J GEOPHYS RES-ATMOS, V109, DOI 10.1029/2004JD004999	67	6.2
18	Moteki N, 2007, AEROSOL SCI TECH, V41, P398, DOI 10.1080/02786820701199728	67	6.2
19	Park K, 2003, ENVIRON SCI TECHNOL, V37, P577, DOI 10.1021/es025960v	67	6.2
20	Schwarz JP, 2008, GEOPHYS RES LETT, V35, DOI 10.1029/2008GL033968	67	6.2

Nodes: 30, Links: 43
LCS, top 30; Min: 14, Max: 77 (LCS scaled)



Nodes: 30, Links: 19
GCS, top 30; Min: 50, Max: 344 (GCS scaled)



CONCLUSION

This paper has investigated 1075 publications on aerosols and soot research literature from the year 2011 to 2016 that cited within the web of science database. The most productive author is Kondo Y with 27 records (2.5%) related to aerosols and soot literature and all papers published in the area of research. Most of the research findings are published in the form of scientific articles. Authorship pattern shows that highest number of articles is contributed by more than four authors (149) and multi authored papers are more than single authored papers. The degree of Collaboration is 0.98 in this study. The most productive Journal is Atmospheric chemistry and physics with 139 articles dealing aerosols and soot research literature and 12.9% articles are published in this journal. Environmental earth sciences and Journal of Environmental Biology were the 2nd and 3rd ranking journals were most published journals are present. The most published articles are seen in the year 2016.The study has given the outline of the research output of scientists in the field of aerosols and soot research literature.

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