Original Research Article

Progress of meteorology and atmospheric science research publications in India: A scientometric analysis

Md. Nurul Alam[1,*], Archana Shukla[2]

[1]Library and Information Science, Physical Research Laboratory, Navrangpura, Ahmedabad, [2]Faculty of Library & Information Science, School of Social Sciences, Room no.143, Block F, IGNOU, Maidan Garhi

*Corresponding Author:
Email: alamprl@gmail.com

Abstract

The present study explores the characteristics of the literature and growth of Meteorology and Atmospheric Science (MAS) research in India during 1960-2014, based on Web of Science (WoS) database and make quantitative and qualitative assessment by using the scientometric techniques. A total of 5015 literature were published on Meteorology and Atmospheric, which received total 46282 citations. The average number of publications per year was 119.40 and the average number of citations per publication was 9.23. The publications peaked in the year 2014 with 504 publications and the highest number of citations (3248) was in 2006. This study analyzes the research studies based on year of publication, journal, international collaboration, spatial distribution and keyword occurrence frequency. Publications on Meteorology and Atmospheric research appeared in 162 journals of which most active journal was "Atmospheric Environment" published by Elsevier from UK and 469 (9.352%) of the total 5015 publications. A total of 7654 authors contributed on Meteorology and Atmospheric research. The most active author was Moorthy, K K produced maximum no. of publications (96) of total publications. A total of 2078 institutions contributed of which Ministry of Earth Sciences; Hyderabad is the most productive institution. There were 112 Countries/territories which participated in Meteorology and Atmospheric research. USA produced maximum publications 482 that is 9.611 % of total publication with higher citations (8234). A Keyword analysis reveals that El-nino, Aerosol, Climate, Monson, Rainfall are the most used keywords.

Keywords: Meteorology and Atmospheric Science, Scientometric, Bibliometrics Indicators, Citation Indicators, INDIA.

Introduction

The study of the atmosphere is grounded in observation, theory, and modeling. As a pioneer of weather forecasting, Lewis Fry Richardson knew very well the challenges of atmospheric modeling and his quote reflects the complexity of the atmosphere's behavior, which results from interactions between the atmosphere and the other climate system components: the hydrosphere, the cryosphere, the biosphere, and the land surface. The traditional division in the atmospheric sciences has been between meteorology and climatology. The former has historically focused on forecasting while the latter has addressed longer-term trends and variability.[7]

In India, the field of atmospheric sciences has changed dramatically during the past 50 years. These changes have occurred on account of new knowledge obtained through new observation techniques created by revolutions in satellite, communication and computer technologies. Over the last few decades there has been a growing interest of MAS but a question arises what is the present status of Meteorology and Atmospheric Science research. There is a need to be an evaluation of what has been achieved during the past decades or so years in order to use hindsight to look a little into the future and try to predict the probable course of this branch of chemistry in the 1970's.[4]

In 1969, Vassily V. Nalimov & Z. M. Mulchenko coined the Russian equivalent of the term 'scientometrics' ('naukometriya'). The term is mainly used for the study of all aspects of the literature of science and technology. Scientometrics Analysis includes all quantitative aspects of the science of science, communication in science, and science policy.[2] The term had gained wide recognition in recent year to evaluate scholarly productivity, research trends, collaboration etc. To address these question an attempts to provide a qualitative as well as quantitative assessment of the current status and progress of Meteorology and Atmospheric Research by using Scientometric technique. In this study the primary objectives is to: identify publication pattern, citation pattern, growth trends, etc. which will help to understand the progress of Meteorology and Atmospheric Research and future direction.

Material & Methods

Database and Scope: To assess the trend of research publication on Meteorology and Atmospheric Science and locate and collect the literature, Web of Science (WoS) was used. The Search Strategy used to conduct Web of Science (WoS) search is as mentioned below:
TS= "Meteorology" OR "Atmos*" = (Search Term) ; Where TS is a topic search that retrieves occurrences of the search term in the article title, abstract, keywords within a time span of 1960-2014, were used to locate publications that contained these words in publications' titles, abstracts, and keyword lists.

Filtering process: An extensive search of the Web of Science (WoS) database with the above mentioned Keywords produced vast amount of data. Resulting

articles were filtered by Subject category- Meteorology and Atmospheric Science followed by Document Types: (Article), and Languages: (English). The filtered articles were again filtered by Countries/Territories: (INDIA). This final round of filtering produced 5015 (Meteorology and Atmospheric Science) articles with which analysis was preceded.

Results and Discussions

There were 5015 articles that met the selection criteria which appeared in the WoS database during 1960-2014 and these were analyzed. The specific characteristics of the publications such as no. of publications, the no. authors involved in the production of these publication, institutions, journals etc. were taken into consideration.

Publication Characteristics:

Table 1: Bibliographic Records of MAS research in India during 1960-2014

Bibliometric Indicators	No.
Total No. of Articles	5015
Total No. of Contributing Countries	112
Total No. of Contributing Authors	7959
Total No. of Contributing Institutions	2078
Total No. of Journals appeared	162
Total No. of Keywords (raw) appeared	26419

Source: WoS

The Table 1 & 2 show the publication characteristics of the output of 5015 papers, which received a total of 46282 citations during the period of study, with an average of 9.23 citations per paper. The average number of publications per year is 119.40 and Compound Annual Growth rate (CAGR) is 0.09%.

Table 2: Citation Metrics of MAS research in India during 1960-2014

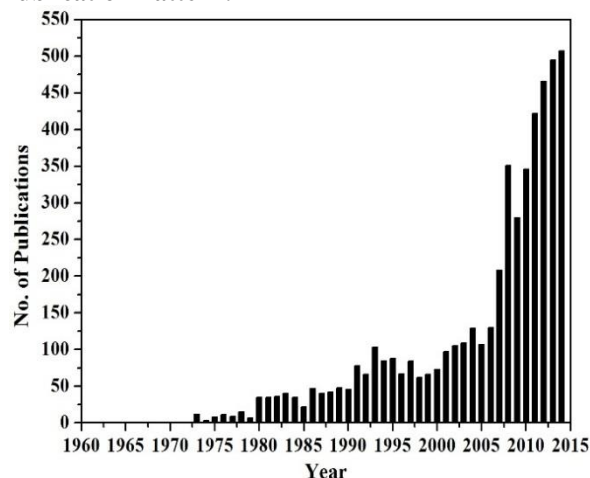| Citation-based Indicators	No.
Sum of the Times Cited	46282
Sum of Times Cited without self-citations	35223
Citing Articles	25536
Citing Articles without self-citations	22856
Average Citations per paper	9.23
h-index	70

Source: WoS
Publication Pattern:

Fig. 1: Publication Pattern of MAS research in India during 1960-2014. From the period 1960-1972, no publication appeared in the WoS database

Publication pattern of MAS research from 1960 to 2014 is presented in Fig. 1. The lowest (3) and highest (504) number of publications appear in 1974 and 2014 respectively. It is important to mention that the initial publication appears in the year 1973. A near about 42 time's increase is observed over the study period, (from 12 in 1973 to 507 in 2014).

Growth Trend:

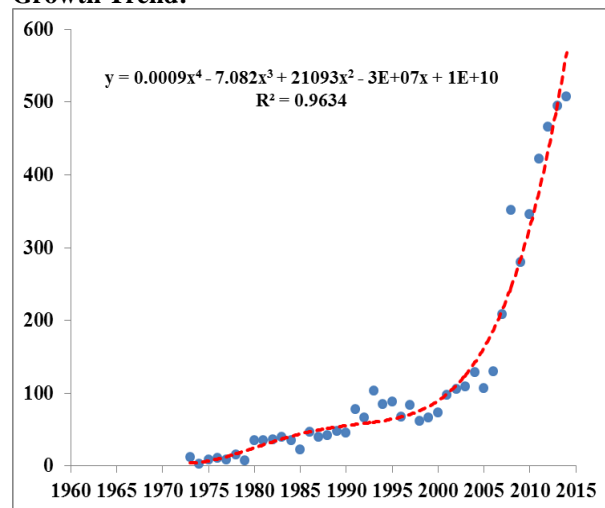$$y = 0.0009x^4 - 7.082x^3 + 21093x^2 - 3E+07x + 1E+10$$
$$R^2 = 0.9634$$

Fig. 2: Growth Trend of MAS research in India during 1960-2014. Blue dot describes the distribution of publications (observed value) and red dashed line describes the correlation of distribution of publications where regression coefficient R^2 = 0.963

The cumulative progression is represented by a 4th degree power law distribution during 1960-2014 giving an idea of the polynomial growth curve as shown in Fig. 2. To choose the best fit growth model, various regression types with regression coefficient has been tested as shown in Table 3. The best fit model is 4th degree polynomial curve to the collected data set where $R^2 = 0.963$. The polynomial best fit for MAS research is found to be: $y = 0.0009 x4 - 7.082 x3 + 21093 x2 - 3E+07x + 1E+10$, where y is the cumulative number of publications and x is the number of years. The growth of literature shown in Fig. 2 can be divided into two parts, 1st part (1960-1972), there is no literature published by Indian authors and in 2nd part (1973-2014), trend follows a polynomial growth curve.

Table 3: Different Regression Types with Regression Coefficient (R^2) of MAS research

Regression Type	Equation	(R^2)
Exponential	$y = 1E\text{-}80e^{0.0943x}$	0.8902
Linear	$y = 9.344x - 18509$	0.6577
Logarithmic	$y = 18598\ln(x) - 14118$	0.6556
Polynomial	$y = 0.0009x4 - 7.082x3 + 21093x2 - 3E+07x + 1E+10$	0.9634
Power	$y = 0x^{188.06}$	0.8904

Citation Pattern:

Fig. 3 & 4 represent the year wise growth of citations and citation pattern vs publication pattern, per year during 1960-2014 on MAS research. The total 5015 articles from WoS related to MAS research publication received a total of 46282 citations.
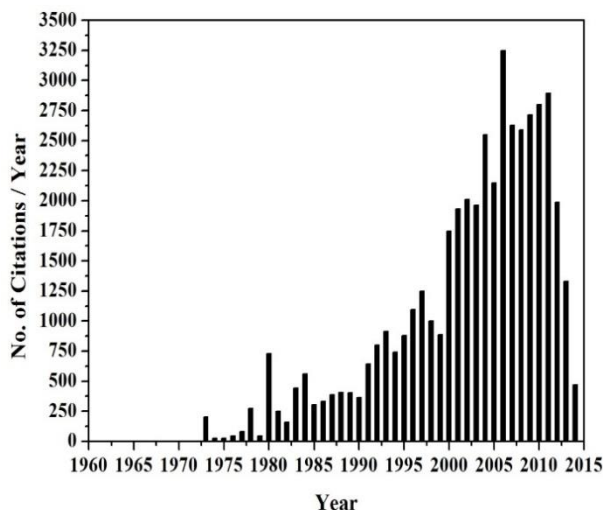

Fig. 3: Citation Pattern of MAS research in India during 1960-2014. From 1960-1972, no citation received as no publication appeared in the WoS database

The pattern of citations received during the said year is very fluctuating. In the starting year 1973, the total number of citations received is 203 with an average citation of 16.92.The minimum citations received in the year 1974 is twenty six (26) with an average citation of 8.67. The maximum citations received in the year 2006 are 3248 with an average citation of 24.98. It is observed

that after the year 2011, citations decrease while publications continue to increase.
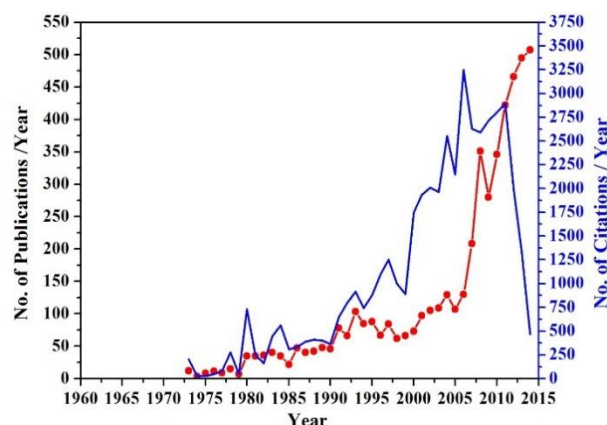

Fig. 4: Citation Pattern Vs Publication Pattern of MAS in India during 1960-2014: Blue line (right Y axis) indicates the citations pattern against red line (left Y axis) that describes the publications pattern

Top Institutions and their research impact:

A total of 5015 articles on MAS research appeared from 2078 institutions. Table 4 shows the top 20 productive institutions during the last 54 years, 1960-2014. Out of these top 20, 18 are Indian. Ministry of Earth Sciences which contributed highest publications has published 1205 papers followed by Indian Institute of Tropical Meteorology (755), Indian Meteorological Department (334), Vikram Sarabhai Space Center (279) and Indian Institute of Technology Delhi (260) publications each. The other two are foreign institutions, among these one is from the USA viz. National Aeronautics Space Administration with 90 publications and another to France i.e. Centre National De La Recherché Scientifique (CNRS) with 94 publications.

Table 4: Top institutions on MAS research and their research impact, 1960- 2014

Institution	Region	TP (%)	TC	AvgCPA	h-index
Ministry of Earth Sciences	India	1205(24.028)	12628	10.48	47
Indian Institute of Tropical Meteorology	India	755(15.055)	10231	13.55	45
India Meteorological Department	India	334(6.660)	2034	6.09	22
Vikram Sarabhai Space Center	India	279(5.563)	3577	12.82	30
Indian Institute Of Technology IIT Delhi	India	260(5.184)	2605	10.02	26
Physical Research Laboratory	India	240(4.786)	3214	13.39	30
Indian Institute of Science	India	185(3.689)	3928	21.23	31
National Physics Laboratory	India	176(3.509)	1713	9.73	21
National Atmospheric Research Laboratory	India	109(2.173)	631	5.79	14
Indian Institute of Technology IIT Kanpur	India	105(2.094)	2152	20.5	26
Andhra University	India	105(2.094)	857	8.16	15
Banaras Hindu University	India	104(2.074)	961	9.24	15
Indian Institute of Technology IIT Bombay	India	97(1.934)	1689	17.41	22
Bhabha Atomic Research Center	India	95(1.894)	941	9.91	18
Centre National De La Recherche Scientifique	France	94(1.874)	1708	18.17	22
University of Calcutta	India	93(1.854)	515	5.54	13
National Aeronautics Space Administration NASA	USA	90(1.795)	2304	25.6	25
National Centre For Medium Range Weather Forecasting	India	88(1.755)	696	7.91	13
Indian Institute of Technology IIT Kharagpur	India	87(1.735)	548	6.3	13
National Institute of Oceanography	India	85(1.695)	776	9.13	13

TP= Total no. of MAS related articles published by an institution; TC = Total no. of citation received; Avg CPA= Average no. of citations per article; h-index=defined by the no. of h papers among an institution's no. of publications that have at least h citations each.

Source: WoS.

Table 4 reveals the impact of research in terms of the quality of papers. It is seen from the Table 4 that MAS research related articles authored by NASA, USA has the highest average impact (Avg CPA=25.60). Among the Indian institutions, Indian Institute of Science (IISc) has the highest average impact (Avg CPA=21.23) in Avg CPA index.

Top Journals and their research impact:

MAS research papers have appeared in 162 journals. Papers have appeared in highest number in the journal "Atmospheric Environment" published by Elsevier from UK. Table 5 shows the top 20 productive journals. These 20 out of the 162 journals have published 3843 of the total 5015 articles. The 'Atmospheric Environment' ranked first with 469 (9.35%); 'Journal of Agrometeorology 403(8.03%)', 'Journal of Geophysical Research Atmospheres 347 (6.91%)', 'Mausam 318 (6.34%)' and 'Natural Hazards 297 (5.92%)' are ranked at 2nd, 3rd, 4th, and 5th respectively.

Table 5: Top Journals on MAS research and their research impact, 1960-2014

Journal	TP(%)	TC	Avg CPA	Journal Metrics (2013)			Country
				SJR	IPP	SNIP	
Atmospheric Environment	469(9.352)	8709	18.57	1.431	3.406	1.537	UK
Journal of Agrometeorology	403(8.036)	179	0.44	0.103	0.036	0.073	India
Journal of Geophysical Research Atmospheres	347(6.919)	6887	19.85	-	-	-	USA

Mausam	318(6.341)	237	0.75	0.252	0.265	0.686	India
Natural Hazards	297(5.922)	1245	4.91	0.767	1.812	1.193	Netherlands
Indian Journal of Radio Space Physics	280(5.583)	548	1.96	0.408	0.604	0.487	Indian
Advances in Space Research	227(4.526)	895	3.94	0.727	1.506	1.237	UK
Journal of Atmospheric and Solar Terrestrial Physics	176(3.509)	965	5.48	0.89	1.397	0.889	UK
Atmospheric Research	163(3.250)	1464	8.98	1.232	2.905	1.61	Netherlands
International Journal of Climatology	158(3.151)	1710	10.82	1.694	2.906	1.413	UK
Meteorology and Atmospheric Physics	144(2.871)	699	4.85	0.654	1.175	0.702	Austria
Theoretical and Applied Climatology	125(2.493)	978	7.82	-	-	-	Austria
Annales Geophysicae	123(2.453)	1060	8.62	0.996	1.441	0.855	Germany
Atmospheric Chemistry and Physics	76(1.515)	1278	16.82	3.022	5.054	1.574	Germany
Climate Dynamics	68(1.356)	967	14.22	3.036	3.801	1.279	Germany
Boundary Layer Meteorology	67(1.336)	487	7.27	1.517	2.522	1.673	USA
Monthly Weather Review	61(1.216)	1444	23.67	3.081	3.309	1.594	USA
Climatic Change	58(1.157)	1191	20.53	2.116	3.847	1.512	Netherlands
Meteorological Applications	55(1.097)	353	6.42	0.807	1.361	1.022	UK
Agricultural and Forest Meteorology	51(1.017)	1012	19.84	1.828	4.135	1.801	Netherlands

TP= Total no. of MAS research related articles published by a Journal; TC = Total no. of citation received; Avg CPA= Average no. of citations that MAS related articles in a journal received; h-index= no. of h papers among a journal's no. of publications that have at least h citations each. SJR = SCImago Journal Rank; IPP = Impact per Publication; SNIP = Source Normalized Impact per Paper; Source: WoS and SCOPUS.

Table 5 also shows the citation impact of top 20 journals. The Avg CPA and h-index are used to identify which journals have the largest number of high quality articles in the MAS research. It is seen from the Table 5 that the journal "Monthly Weather Review" published by the American Meteorological Society in the USA has the highest average impact (Avg CPA = 23.67) although the journal 'Atmospheric Environment' has the highest number of publications but ranked 5th in the Agv CPA index.

Top Authors and their research impact:

A total of 5015 articles included the author addresses having India as the country of affiliation. Articles on MAS research have been contributed by 7959 authors. Table 6 shows the top 20 productive authors during the last 54 years, 1960-2014. Top 20 productive authors are ranked based on the decreasing productivity of total publications. Moorthy, K. K. ranked 1st with 96 publications which is 1.91 % of total publications. Mohanty, U. C., Kumar, A., Devara, P. C. S. and Babu, S. S. ranked 2nd, 3rd, 4th and 5th respectively.

Table 6: Top Authors of MAS research and their research impact, 1960-2014

Author	TP(%)	TC	TC woSC	CI	CIwoSC	AvgCPA	h-index
Moorthy, KK	96(1.914)	2203	165	872	782	22.95	27
Mohanty, UC	87(1.735)	801	712	610	560	9.21	14
Kumar, A	82(1.635)	396	369	349	330	4.83	11
Devara, PCS	74(1.476)	791	644	480	430	10.69	15
Babu, SS	64(1.276)	990	718	478	423	15.47	18
Kamra, AK	55(1.097)	436	345	258	220	7.93	12
Rao, DN	53(1.057)	540	483	385	354	10.19	14
Tripathi, SN	51(1.017)	1371	1163	748	705	26.88	20
Goswami, BN	51(1.017)	891	812	683	649	17.47	14
Singh, R	50(0.997)	344	322	298	281	6.88	9
Parameswaran, K	49(0.977)	532	449	392	359	10.86	13
Singh, D	48(0.957)	179	166	162	150	3.73	7
Singh, S	47(0.937)	454	412	324	311	9.66	13
Lal, S	47(0.937)	676	578	400	367	14.38	13
Kumar, S	47(0.937)	252	249	241	238	5.36	8
Pal, PK	46(0.917)	234	209	170	152	5.09	8
Satheesh,SK	45(0.897)	1362	1243	660	623	30.27	20
Ratnam, MV	45(0.897)	288	228	199	169	6.4	11
Ramachandran,S	45(0.897)	733	622	489	449	16.29	17
Pandithurai, G	45(0.897)	514	453	365	338	11.42	13

TP: Total no. of MAS related articles published by a author; TC: Total no. of citation; TC woSc: Sum of Times Cited without self-citations; CI: Citing Articles; CIwoSC: Citing Articles without self-citations; AvgCPA: Average Citations per Article; h-index: no. of h papers among a author's no. of publications that have at least h citations each. Source: WoS.

Table 6 reveals the impact of research in terms of quality of papers by means of AvgCPA and the h-index. It is seen from the Table 6 that MAS research articles authored by Satheesh, S. K. have the highest average impact (AvgCPA = 30.27) followed by Tripathi, S.N. (AvgCPA = 26.88) although Moorthy, K. K. has the maximum number of publications but ranks 3rd in the AvgCPA index.

Collaboration Pattern: Continents:

Based on the author attributions, world-wide collaboration of MAS research publications can be mapped. As shown in Fig. 5, the major spatial clusters of research collaborations are located in Asia, followed by Europe, Africa, South America and North America. Several minor clusters are distributed in other parts of the world.
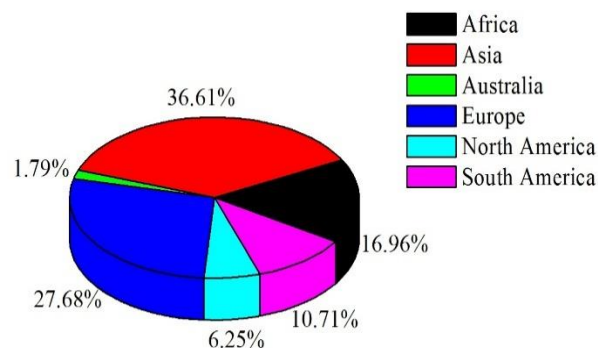

Fig. 5: Continent wise Collaboration pattern of MAS research

Collaboration Pattern and research impact: Countries

There are 112 collaborating Countries/territories which participated in research on MAS research. As shown in Table 7, top 20 countries /territories are ranked based on the number of total articles, along with the citations and percentage of international collaboration. Out of these 20 countries / territories, the USA produced 482 publications which are 9.611% of the total publications with 8234 citations. It is seen from the Table 7 that MAS research related articles authored in collaboration with Netherlands (Europe) have the highest average impact (AvgCPA=48.41) followed by Australia AvgCPA=41.41 although USA ranked 12th in the AvgCPA index.

Table 7: Country wise collaboration Pattern and research impact of MAS research

Country	Continent	TP(%)	TC	AvgCPA	h-index
USA	North America	482(9.611)	8234	17.08	43
Japan	Asia	165(3.290)	2470	14.97	26
Germany	Europe	129(2.572)	2507	19.43	28
France	Europe	121(2.413)	2102	17.37	23
England	Europe	89(1.775)	2906	32.65	27
Canada	North America	73(1.456)	1996	27.34	20
Peoples R China Asia	Asia	56(1.117)	1950	34.82	20
South Korea	Asia	48(0.957)	627	13.06	13
Italy	Europe	44(0.877)	951	21.61	16
Brazil	South America	42(0.837)	675	16.07	13
Taiwan	Asia	37(0.738)	420	11.35	11
Netherlands	Europe	37(0.738)	1791	48.41	15
Sweden	Europe	34(0.678)	546	16.06	13
Australia	Australia	34(0.678)	1408	41.41	16
Finland	Europe	32(0.638)	712	22.25	14
Greece	Europe	30(0.598)	579	19.3	13
South Africa	Africa	28(0.558)	536	19.14	10
Thailand	Asia	25(0.499)	447	17.88	12
Austria	Europe	23(0.459)	672	29.22	10
Russia	Europe	20(0.399)	331	16.55	10

TP= Total no. of MAS related articles published by a country; TC = Total no. of citation received; AvgCPA= Average no. of citations per Article; h-index= no. of h papers among a country's no. of publications that have at least h citations each. Source: WoS

Keyword Analysis:

The process of keyword analysis has been described by various authors in many ways. Li and Zhao performed the keyword analysis to demonstrate research trends and frontiers. The keywords analysis in their study utilised author keywords, which were provided by article authors as part of the articles and termed as Keywords.[3] Another such analysis was used in a study by Montoya et al., 2014 in order to follow and search the trends in the science and engineering.[5] Yanhuaet al.[8] used keyword analysis to reveal the trends and identify hot topics that draw most research efforts. In another study, the authors mention that the keywords provide a reasonable description of an article's theme and could reveal the profile of an author's research preferences.

A total of 26419 different keywords have been identified in the field of MAS research during the period 1960 to 2014. The number of analysed publications during the study period was 5015. Of them only 4146 provided keywords. While the rest (869) did not have any keywords. To obtain the accurate results, the keywords were pre-processed by merging the singular and plural forms of the same terminology, and those keywords with the same meaning while using different expressions. 23747 unique Keywords have been obtained. Among these unique keywords 10274 (43.26 %) appear once or twice at the most.

Hotspots: An analysis of the keywords was undertaken to pick out the research hotspots that have attracted most research attention and to reveal the research tendencies in the MAS research. The top most frequently used keywords for the study period are listed in Table 8. The five most frequently used keywords were 'El-nino', 'Aerosol', 'Rain' and 'Monsoon'.

Table 8: Top most frequently used keywords in MAS research

Keyword	No.	%	Ranking
Aerosol	671	2.82	2
Climate	480	2.02	6
Cloud	323	1.36	9
Convection	215	0.9	15
El-nino	1860	7.83	1
Emissions	219	0.92	14
Monsoon	562	2.36	4
Ocean	499	2.1	5
Oscillation	221	0.93	13
Ozone	208	0.87	17
Pollution	237	0.99	12
Prediction	250	1.05	11
Radar	213	0.89	16
Rain	643	2.7	3
Rainfall	417	1.75	7
Simulation	219	0.92	14
Summer	323	1.36	9
Water	384	1.61	8
Weather	155	0.65	18
Wind	262	1.1	10

No.: Number of time occurrences; R: rank Source: WoS

Quick Rising Themes: The Compound Annual Growth Rate (CAGR) was used to identify the top most frequently used keywords and to select quick rising themes of MAS research, which could be indicators of future research directions. The Compound Annual Growth Rate (CAGR) of top keywords were separately calculated based on the following formula:

$$\text{CAGR}(t_0, t_n) = (V(t_n)/V(t_0))^{\frac{1}{t_n - t_0}} - 1$$

$V(t_0)$: Initial observed value, $V(t_n)$: last observed value, $t_n - t_0$: number of years (Compound annual growth rate, n.d.).

The CAGR provides smoothed growth rates free from the annual fluctuations of keywords occurrences during the study period. Table 9 lists the top keywords according to the CAGR and sorted them by their rank. The ranks in Table 9 show that 'Black carbon', 'El-nino' and 'Rain' are three leading hot issues that continue to attract broad attention. 'El-nino' kept its dominance in terms of total quantity and CAGR (0.20%).

Table 9: Top quick rising themes in MAS research

Keyword	V(t0)	V(tn)	t0	tn	CAGR (%)	R
Absorption	1	22	1993	2014	0.158	15
Aerosol	2	84	1991	2014	0.176	9
Black carbon	1	21	2000	2014	0.242	1
Climate	3	88	1992	2014	0.166	12
Cloud	1	31	1992	2014	0.168	10
Convection	1	42	1991	2014	0.176	9
El-nino	3	280	1990	2014	0.208	2
Emissions	1	36	1993	2014	0.186	7
Monsoon	4	97	1991	2014	0.148	16
Ocean	1	57	1991	2014	0.192	6
Optical-properties	1	30	1995	2014	0.196	5
Prediction	1	39	1990	2014	0.164	13
Radar	1	35	1991	2014	0.167	11
Rain	1	91	1990	2014	0.206	3
Simulation	1	41	1994	2014	0.204	4
Stratosphere	1	11	1995	2014	0.134	18
Summer	2	61	1991	2014	0.160	14
Surface temperature	1	14	1993	2014	0.133	19
Tropical cyclone	1	14	1994	2014	0.141	17
Water	1	53	1990	2014	0.179	8
Weather	2	31	1992	2014	0.132	20

t_0: the Initial (first) year (The Year in which no. of keywords occurrence first time;t_n: the last year (No. of keywords occurrence); $V(t_0)$: Initial observed value (no. of keywords occurrence); $V(t_n)$: last observed value (no. of keywords occurrence); CAGR: Compound Annual Growth Rate; R: Rank. Source: WoS

Summary

A total of 5015 publications were published on MAS, which received total 46282 citations. The average number of publications per year was 119.40 and the average number of citations per publication was 9.23. Publications on MAS appeared in 162 journals of which most active journal was 'Atmospheric Environment' published by Elsevier from UK and 469 (9.352%) of the total publications. A total of 7654 authors contributed to MAS research. The most active author is Moorthy, K.K. who produced maximum number of publications (96) of total publications. A total of 2078 institutions contributed of which Ministry of Earth Sciences, Hyderabad is the most productive institution. For globalization of MAS Research in India, the results show that there are 112 Countries/territories which participated in MAS research. The USA produced maximum publications with 482 i.e. 9.611 % of total publication with 8234 citations. A Keyword analysis reveals that El-nino, Aerosol, Climate, Monson, Rainfall are the most frequently used keywords.

References

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