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What Do the Cited and Citing Environments Reveal about *Advances in Atmospheric Physics*?

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ABSTRACT

The networking status of journals reflects their academic influence among peer journals. This paper analyzes the cited and citing environments of this journal, *Advances in Atmospheric Sciences* (*Adv. Atmos. Sci.*), using methods from social network analysis. Since its initial publication, *Adv. Atmos. Sci.* has been actively participating in the international journal environment and international journals are frequently cited in *Adv. Atmos. Sci.* Particularly, this journal is intensely interrelated with its international peer journals in terms of their similar citing patterns. The international influence of *Adv. Atmos. Sci.* is comparatively bigger than other Chinese SCI journals in atmospheric sciences as reflected by total cites to *Adv. Atmos. Sci.* and the total number of international journals citing it. The academic visibility of *Adv. Atmos. Sci.* is continuing to improve in the international research community as the number of reference citation it receives in its peer journals internationally increases over time.

Key words: Chinese journal, citation, cited environment, citing environment, journal networking, *Advances in Atmospheric Sciences*

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1. Introduction

In the information era, researchers are now more concerned with the networking status of the journals in their respective disciplines. The networking status of a journal is determined by the the indegree of its cited environment (i.e., the number of and frequency with which the journal is cited in other journals) and the outdegree of its citing environment (i.e., the number and frequency of journals that are cited within it).

Since Price (1965) first mentioned the concept of "delineating the topography of current scientific literature" based on journal citations, researchers have been trying to find ways to optimize the maps of these activities. However, journal-to-journal relationships are complex, and the decomposition and aggregation of journal citation data has become an increasingly difficult task (Leydesdorff, 1986, 2006). Leydesdorff (2004) listed the four most challenging problems as follows: (1) the choice of a seed journal, (2) the choice of similarity criteria, (3) the choice of threshold levels, and (4) the application of a clustering algorithm. Based on social-network analysis methods, a tool for the visualization of the citation impact environment of a scientific journal has been made available on the internet (http://www.leydesdorff.net/jcr09). This tool facilitates the accurate delineation and animation of the networking tendencies of journals (e.g., http://www.leydesdorff.net/journals/nanotech).

Advances in Atmospheric Sciences (*Adv. Atmos. Sci.*) is devoted to the publication and distribution of the latest scientific achievements of researchers in this discipline in China and elsewhere. The journal's editorial staff has provided a convenient, reliable platform for online processing of papers (An updated platform with enhanced function supported by Thomson Reuters's ScholarOne is planned to be launched by the end of 2010.) and has made professional editing ser-

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vices available to its authors, thereby optimizing the readability of the published papers (Wu et al., 2008). These efforts have gained recognition: in May 2008, ScienceWatch.com named *Adv. Atmos. Sci.* a "Rising Star" among geosciences journals. According to the "Essential Science Indicators" of Thomson-Reuters, between 1 January 1998 and 29 February 2008 the journal's record includes 764 papers cited a total of 1658 times (Wu et al., 2008). *Adv. Atmos. Sci.* is gaining recognition elsewhere as well. Since 2009, 10 years after having first been indexed in the Expanded Science Citation Index (SCI-Expanded), the journal has also been included in the core of the Science Citation Index.

While *Adv. Atmos. Sci.* has become one of the leading atmospheric journals in China, its academic influence worldwide has not matched its regional prominence. According to the well-known Thomson-Reuters Journal Citation Report (JCR), the impact factor of *Adv. Atmos. Sci.* has fluctuated between 0.679 and 0.902 over the past 3 years (Thomson Reuters, 2008, 2009, 2010). The aim of this study is to explore the networking status and capacity of *Adv. Atmos. Sci.* in the dynamic cited/citing environment of atmospheric sciences journals and to examine the role the journal plays among its peer journals internationally. The journal's activities in terms of indegree and outdegree of citations has been delineated by comprehensive analysis in the form of citation maps and matrices presented here.

2. Method

Based on social-network analysis, Leydesdorff (2004) has addressed the four primary problems related to citation mapping of scientific journals as follows.

First, the choice of the seed journal has been put into the hands of end-users by the online analysis tool (at http://www.leydesdorff.net/jcr09). As research objectives vary, researchers are able to choose any journal as their focus and can begin clustering journals from that point.

Second, the indegree and outdegree data for the chosen journal comprise the cited/citing environment of the journal. The aggregated citing–cited (indegree–outdegree) relationships among journals form a citation matrix. To display a more representative citation map, the matrix threshold can be set to 1% to exclude the data of the journals whose indegree or outdegree totals are <1% of the totals of the seed journal, in this case *Adv. Amos. Sci.*

Third, the cosine of the two vectors (Salton and McGill, 1983; Ahlgren et al., 2003) provided the similarity measure between the distributions for the various journals included in the citation environment. Cosine values <0.2 were suppressed in this model to make the figures more clear.

And fourth, the citation data of each journal was normalized by the number of citation divided by the numbers of total citation in the cited/citing environment. In this way, journal's indegree citation data could be displayed as an ellipse in the citation environment of the seed journal composed of all journals that cite the seed journal. The length of the y-axis of the ellipse is the logarithm of the total indegree of cites (C_{i}) to the journal in the cited environment. The length of the x-axis of the journal is similar to that of y-axis, with the deduction of self-citations.

Likewise, each journal's outdegree citation data from the citing environment has been displayed as an ellipse: the length of the y-axis of the ellipse is proportionate to the logarithm of the total of citations of the journal ($C_{\circ}$) in the citing environment. The length of the x-axis of the journal is similar to that of y-axis, with the deduction of self-citations.

On one hand, the performance of a journal in the cited environment reflects its academic standing among peer journals. The extent of this impact is reflected by the total number of citing journals, and the depth of this impact is reflected by the frequency with which it is cited. These impacts, or the journal's indegree and outdegree performances, have been delineated using comprehensive analyses, and the results can be shown in graphic form as citation maps (Figs. 1 and 2).

3. Analysis of Adv. Atmos. Sci.

3.1 *The cited* (*indegree*) *environment of Adv. Atmos. Sci.*

Based on the 2009 Journal Citation Reports© (Thomson Reuters, 2010), with *Adv. Atmos. Sci.* as the seed journal, the cited (indegree) environment is presented in Fig. 1. From Fig. 1, it is easy to recognize that *J. Geophys. Res., Geophys. Res. Lett., J. Climate, Atmos. Environ.,* and *Mon. Wea. Rev.*, are the five most influential journals on the citation map; these journals occupy the core area of this map.

In a rare validation study, Bensman et al. (1998) compared the survey results of the chemistry department staff of Louisiana State University and journal-use frequency at the University of Illinois Chemistry Library, with impact factors and total cites, respectively. The author found that the correlations between

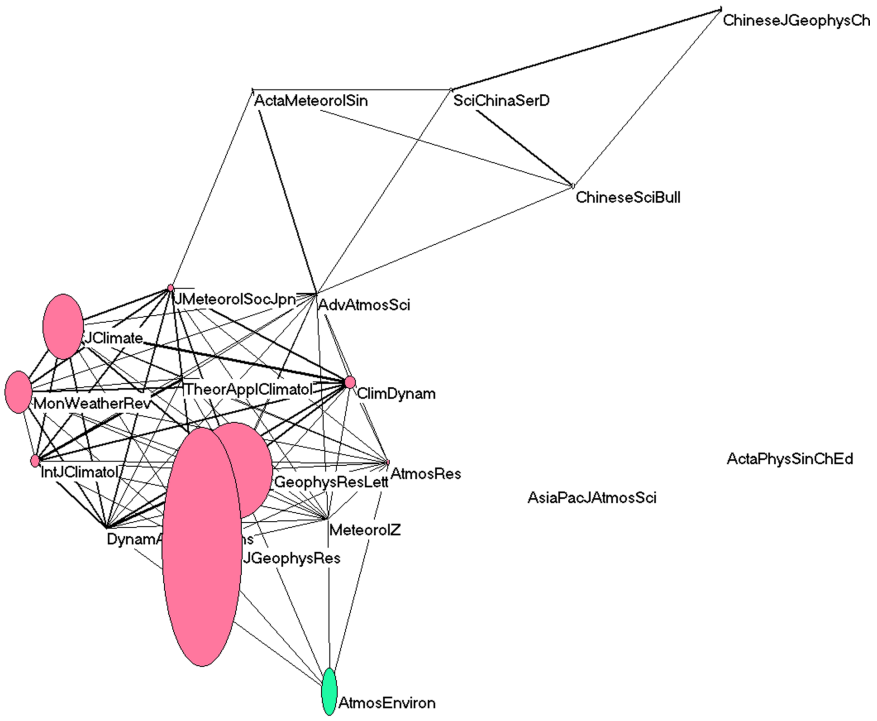

Fig. 1. The cited environment of *Adv. Atmos. Sci.*, composed of journals that cited *Adv. Atmos. Sci.*

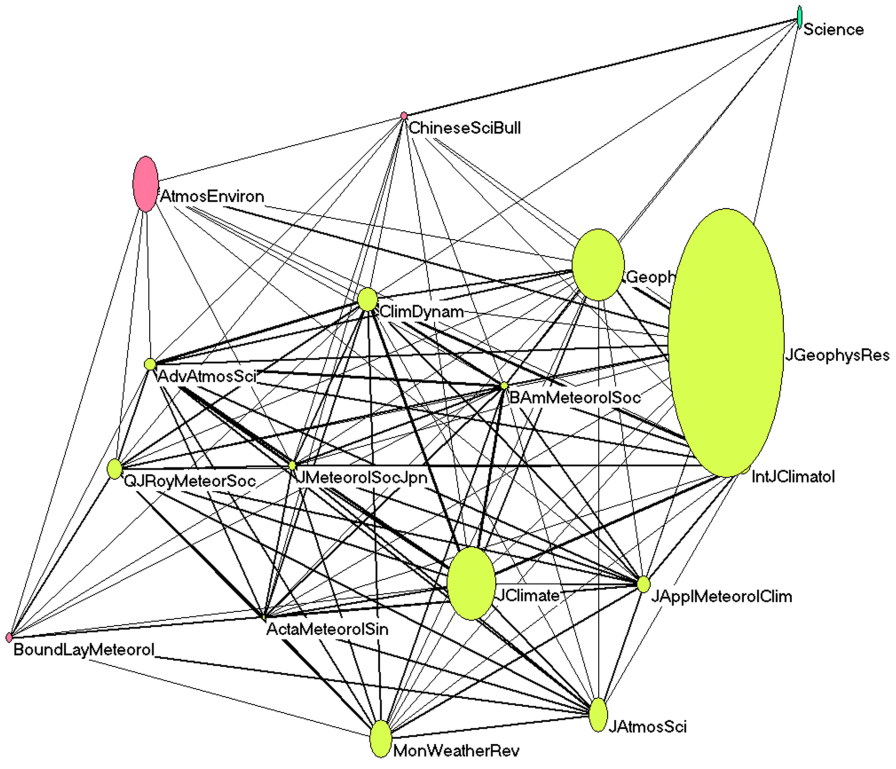

Fig. 2. The citing environment of *Adv. Atmos. Sci.*, composed of journals that were cited by *Adv. Atmos. Sci.*

"total cites" and the appreciation by users were significantly higher than the correlations between the impact factor and user appreciation.

A journal's impact factor is prone to calculation error, such as miscalculation of citable items and inauthentic citations (e.g., citations to journal's Chinese version are counted toward the journal's English version although they are literally different journals with the same English title), and fluctuates yearly. For this reason, it can be argued that total citations might be the more appropriate indicator of a journal's influence among its core journal aggregation. The ranks of the five most cited journals according to C_i values are highly correlated with their ranks according to total cites (r=99.0%, Table 1). In this case, both the total number of citations (indegree) and the C_i values indicate the journals' influence.

At some distance from the core journals mentioned, *Adv. Atmos. Sci.* and four other Chinese journals [*Acta Meteorol. Sin., Sci. China (D), Chinese J. Geophys.-CH, and Chinese Sci. Bull.*] are at the edge of the map. This shows that Chinese journals have a comparatively low impact on peer journals internationally. Two journals, *Adv. Atmos. Sci.* and *Acta Meteorol. Sin.*, function as bridges that connect the isolated Chinese journals with the international mainstream. Although *Chinese Sci. Bull.* is a basic and applied sciences journal, its realm of influence extends mainly to geosciences journals (Zhou et al., 2005). Therefore, five Chinese journals can be roughly classified as journals in geosciences. The indegree citation map (Fig. 1) shows that, although the Chinese journals have a comparatively weak international influence, they have formed a combined journal aggregation with growing Chinese power. This is rare among other Chinese journals indexed in SCI.

Although *Acta Phys. Sin.* received a comparatively higher C_i rating (3.738837) on the map, its self-citation rate is as high as 99.09% in this environment, and its apparent lack of citation relationships with other journals excluded it from the interrelated journal group as apparently this journal has different academic focus than other ones. Table 2 illustrates that, although *Acta Meteorol. Sin.* has the higher impact factor, *Adv. Atmos. Sci.* has a higher number of total indegree citations and a higher C_i value, which means that *Adv. Atmos. Sci.* has a different type of academic influence in this cited environment.

3.2 *The citing* (*outdegree*) *environment of Adv. Atmos. Sci.*

Based on the 2009 Journal Citation Reports©, the citing (outdegree) environment of *Adv. Atmos. Sci.* is presented in Fig. 2.

Similar to that of the cited (indegree) environment, *J. Geophys. Res., Geophys. Res. Lett., J. Climate, Mon. Wea. Rev., J. Atmos. Sci.,* and *Climate Dyn.* are the six most active journals on this map. In contrast to the cited environment, however, *Adv. Atmos. Sci.* is comparatively active in the citing environment, which indicates that the authors in the journal are sensitive in their citation behavior to the research published in high-impact international journals and consider these journals to be important, reliable, and primary sources of information.

For a statistical perspective of the citing behavior of each journal, the citation data for these 17 journals are presented in Table 3. The left column lists

Table 1. The five most cited journals in the *Adv. Atmos. Sci.*'s citation environment [journal usage data from the 2009 Journal Citation Reports© (Thomson Reuters, 2010)].

	J. Geophys. Res.	*Geophys. Res. Lett.*	*J. Climate*	*Atmos. Environ.*	*Mon. Wea. Rev.*
C_i value	40.866908	16.450265	11.37804	8.08881	7.431376
Impact factor	3.082	3.204	3.363	3.139	2.238
Total cites	144430	52131	20458	28524	15391

Table 2. The five Chinese journals in *Adv. Atmos. Sci.*'s cited environment [journal usage data from the 2009 Journal Citation Reports© (Thomson Reuters, 2010)].

	Chinese J. Geophys.-CH	*Chinese Sci. Bull.*	*Sci. China (D)*	*Adv. Atmos. Sci.*	*Acta Meteor. Sin.*
C_i value	1.159513	1.019589	0.602905	0.575127	0.488703
Impact factor	0.844	0.917	0.880	0.691	0.874
Total cites	1578	5116	2032	899	678

Table 3. The citing matrix of *Adv. Atmos. Sci.* (The left column lists the journal titles in the citing direction, and the numbers 1–17 in row 1 represent the journals in the cited direction, respectively).

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	*Acta Meteor. Sin.*	191	63	6	35	7	18	19	32	3	24	117	82	71	51	142	37	11
2	*Adv. Atmos. Sci.*	78	156	62	94	61	44	78	180	56	73	235	343	308	86	192	104	56
3	*Atmos. Environ.*	0	15	5216	70	119	18	16	722	20	193	114	54	2647	15	92	71	389
4	*Bull. Amer. Meteor. Soc.*	2	0	43	238	23	0	47	183	21	53	87	279	269	14	178	65	121
5	*Bound.-Layer Meteor.*	0	3	141	36	657	0	2	17	17	164	315	28	99	12	104	173	5
6	*Chinese Sci. Bull.*	28	31	59	19	0	544	25	97	0	0	42	37	255	23	28	0	483
7	*Climate Dyn.*	3	23	4	197	11	3	514	485	147	28	342	1127	474	71	366	209	228
8	*Geophys. Res. Lett.*	0	13	187	348	35	11	270	3150	136	104	621	1035	4651	101	327	200	1299
9	*Int. J. Climatol.*	5	14	33	211	22	3	163	374	685	86	125	811	350	37	244	92	124
10	*J. Appl. Meteor. Climatol.*	0	5	99	266	196	0	17	122	95	684	344	279	308	47	403	112	33
11	*J. Atmos. Sci.*	0	5	23	211	127	0	57	311	6	135	2832	443	612	120	708	542	99
12	*J. Climate*	0	51	15	768	16	4	640	1511	337	147	1358	4222	1415	284	1011	435	610
13	*J. Geophys. Res.*	0	62	1384	868	235	0	320	8117	279	643	1928	1753	26382	276	1098	725	2549
14	*J. Meteorol. Soc. Jpn.*	5	11	15	98	49	0	42	108	11	121	255	227	152	292	214	80	31
15	*Mon. Wea. Rev.*	4	11	6	406	53	0	54	196	35	221	1375	460	343	118	2581	696	50
16	*Q. J. Roy. Meteor. Soc.*	0	2	23	177	132	0	52	163	26	132	735	266	407	48	584	772	55
17	*Science*	0	0	20	0	0	0	25	227	0	0	0	75	437	0	0	0	3387

the journal titles in the citing direction, and the numbers 1–17 in row 1 represent the journals in the cited direction, respectively.

From this journal-citation matrix it can be inferred that Chinese journals intensively cite international journals, but they are not cited by international journals to the same extent, i.e., the outdegree of *Adv. Atmos. Sci.* significantly exceeds its indegree. The international journals serve as more primary sources, and Chinese journals have yet to be widely used by international researchers. Over time, the integration of Chinese research and data is likely to become an integral part of the international information landscape as researchers expand their study of global climate patterns to include Asia. As language and communication barriers continue to erode, more international scientists will hopefully discover the resources that Chinese geoscience journals provide.

Figure 2 shows different layers of citation concentration. To examine the citing patterns of *Adv. Atmos. Sci.*, a principal component analysis was applied (Table 4). A three-factor solution of the data matrix (explaining 64.9% of the variance) reveals that the citing pattern falls into three groups.

First, *Climate Dyn., J. Climate, Int. J. Climatol., Bull. Amer. Meteor. Soc.*, and *Adv. Atmos. Sci.* have similar citing patterns. *Quart. J. Roy. Meteor. Soc., J. Atmos. Sci., Mon. Wea. Rev., J. Meteorol. Soc. Jpn., J. Appl. Meteorol. Climatol.,* and *Bound.-Layer Meteor.* comprise a second grouping (designated as "Meteorology") with similar citing behavior. *J. Geophys. Res., Geophys. Res. Lett., Atmos. Environ.* and *Chinese Sci. Bull.* focus more on general geosciences in this citing environment and—as expected—they have similar citing patterns.

The authors whose work has been selected for publication in *Adv. Atmos. Sci.* actively cite publications in high-impact journals related to atmospheric

Table 4. Rotated component matrix of the citing (outdegree) journal matrix of *Adv. Atmos. Sci.* (Extraction method: Principal component analysis. Rotation method: Varimax with Kaiser normalization, and rotation converged in four iterations).

	Component		
	1. "Climatology"	2. "Meteorology"	3. "Geophysics"
Climate Dyn.	0.924	0.184	
J. Climate	0.921	0.244	
Int. J. Climatol.	0.86		
Bull. Amer. Meteor. Soc.	0.759	0.307	0.377
Adv. Atmos. Sci.	**0.742**	**0.521**	**0.218**
Quart. J. Roy. Meteor. Soc	0.141	0.856	
J. Atmos. Sci.		0.819	
Mon. Wea. Rev.	0.156	0.786	−0.166
J. Meteorol. Soc. Jpn.	0.421	0.671	−0.102
J. Appl. Meteor. Climatol.	0.138	0.649	
Bound.-Layer Meteor.	−0.421	0.513	
J. Geophys. Res.	0.312	0.208	0.824
Geophys. Res. Lett.	0.466	0.138	0.799
Atmos. Environ.	−0.141		0.601
Chinese Sci. Bull.		−0.348	0.59
Acta Meteor. Sin.	0.183	0.483	−0.234
Science		−0.292	0.481

sciences. The frequency of citation of those journals reveals intense interrelationship of *Adv. Atmos. Sci.* with these international journals. However, *Adv. Atmos. Sci.* is not cited by the other journals to the same extent as *vice versa* (Table 3), i.e., its outdegree exceeds its indegree. Yet, it has a wider academic influence internationally compared to other Chinese journals in this citing environment. Only two of the eleven high-impact international journals have not cited *Adv. Atmos. Sci.*

4. Conclusion

Although *Adv. Atmos. Sci.* has become one of the leading journals in China, its journey toward international academic acknowledgement has only just begun. Authors that publish in this journal tend to cite papers in high-impact international journals, making the journal's citing pattern similar to that of comparable international journals.

The number of Chinese journals indexed in the SCI has increased significantly; they total 114 in the 2009 JCR Report© (Thomson, 2010), compared to 75 in 2004 JCR Report© (Thomson, 2005). However, the international influence of Chinese journals is comparatively weak, as shown by their low indegree in the citation environment. In some fields, such as geosciences, the influence of these Chinese journals included in SCI is growing in the form of journal aggregations. However, this aggregation is an exception among Chinese journals of other disciplines also indexed in SCI.

The information age portends great opportunity for all sciences as language barriers are eliminated, as technology provides ever more rapid and easy exchange and access, and as scientific disciplines themselves continue to adopt greater global perspectives, both in terms of data and exchange among scientists. *Adv. Atmos. Sci.* is an enthusiastic member of the growing and important geosciences community, eager to meeting the challenges of increasing the journal's impact, accessibility, and desirability among our international peers in the short and long term. Assessing the journal's position in terms of citation matrices provides a benchmark of our success and basis for our goals.

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