An International Comparison of the Citation Impact of Chinese Journals with Priority Funding

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Abstract
We have investigated the citation impact of four pairs of journals in four subject categories including the category of multidisciplinary journals, journals in environmental sciences, applied mathematics, as well as metallurgy and metallurgical engineering. Each pair is composed of one Chinese journal and one leading international journal in the same subject category. Comparison is done between the selected Chinese and international journals in each pair. The four Chinese journals are selected because of priority funding by the Chinese CIU Plan in categories A and B. Compared with leading international journals in the same subject category, citation impacts of the four Chinese journals in their relevant environments are low, although they have been improving from 2004 to 2013. Leading international journals are more intensively and systematically cited than Chinese ones in the same subject category of the JCR. Regarding the CIU Plan, the level of funding seems not to follow exactly the citation impacts: Journals receiving larger amounts of funding do not necessarily perform better in citation impact, and journals receiving the same amount of subsidy may have different citation performances.

Keywords:
Citation and co-citation analysis

Introduction
Right after the United States, China has been the second largest producer of scientific publications since 2006 (Zhou & Leydesdorff, 2008; ISTIC, 2013). With citation impact rising continuously China jumped to the fifth position in 2013 in terms of national total citation impact from the eighth in 2010 (ISTIC, 2013), two years earlier in reaching the target set by the Ministry of Science and Technology (MOST) of China in the 12th National Plan for the Development of Science and Technology (NPDST). In terms of total citations received by disciplines, however, China's performance was not evenly distributed: chemistry, materials science, engineering technology, mathematics, computer science, and physics performed best by taking the second position in the world total (ISTIC, 2013).

In addition to being a second largest producer of academic papers, China is also the second largest publishing nation of academic journals. Of the 9,884 journals, approximately 5,300 are in science and technology (Liu, 2012; Yao et al., 2014). Nevertheless, international visibility of Chinese journals is still low (Jin & Rousseau, 2004; Leydesdorff & Jin, 2005; Zhou & Leydesdorff, 2007a, 2007b; ISTIC, 2014). In 2013, only 162 Chinese journals (i.e., about 3% of China's total S&T journals) were indexed in the Science Citation Index (SCI) of Thomson Reuters. Journals to be indexed in the SCI are required to satisfy basic criteria, and thus one can expect these 162 Chinese journals to be of relatively higher quality among the 5,300 Chinese S&T journals. Nevertheless, most of the SCI indexed Chinese journals do not perform well in terms of citation impact as measured by the Impact Factor. Take the data of 2011 for example, of the 114 Chinese journals indexed in the SCI, only four were in the first

quartile and 23 in the second of the corresponding subject categories of JCR 2011 (Liu, 2012).

The administrative structure of Chinese journals is special, and sometimes, confusing because of the involvement of both government agencies and the practical management by editorial boards. Administration at the national level is carried out by the General Administration of Press and Publication (GAPP) that is directly led by the State Council of China. At the provincial/regional level, the Administration of Press and Publication (APP) is responsible in each province or municipality. In addition to making regulations and policies relevant to journal publication and development, the GAPP is responsible for the approval of new journals and regular censorship; provincial APPs are responsible for administration and controls (including censorship) of local journals.

Practical management of Chinese academic journals is carried out by the editorial boards affiliated to research institutes, universities, and academic associations/societies. These institutions are affiliated to respective government agencies. Different governmental agencies are responsible for different sets of journals with different policies aiming at quality improvement with a special focus on international visibility. For example, at the national level are projects such as 'Journal Phalanx of China' of the GAPP, the 'Development Strategy Research for Competitive S&T Journals' of the Ministry of Science and Technology (MOST), and the 'Key Academic Specific Foundation' of the National Natural Science Foundation of China (NSFC). Years have passed since these projects were adopted, but the original targets of raising journal quality and international visibility have remained too far to reach.

In November 2013, in order to fasten the process towards international visibility of Chinese journals, six government agencies including the China Association for Science and Technology (CASST), the Ministry of Finance, the Ministry of Education (MOE), The State Press and Publication Administration (SPPA), the Chinese Academy of Sciences (CAS), and Chinese Academy of Engineering (CAE) jointly issued a unified standard of journal selection and funding: the International Impact Upgrading Plan for Chinese S&T Journals (abbreviated as CIU Plan). The CIU Plan is carried out in two steps. The objective of the first step is to raise the Journal Impact Factor (JIF) of a selected set of Chinese journals published in English to Quartile 1 and 2 of the Impact Factor in the Journal Citation Reports (JCR), by the end of the 12th Five-Year Plan (2011-2015), and to establish a journal set in the English language that can represent research frontiers or dominant fields of China, or in fields in which China does not yet have its own journals. The second step is to form a world top-journal set to which China has independent intellectual property rights by the year 2020.

Candidate journals must be in English and under the management of the above listed six government agencies. To ensure high-quality journals to be funded, the selection scheme combines bibliometric indicators, expert reviews, and a response by editorial boards. Journals being funded are classified into four categories, namely A, B, C and D. Those in categories A, B and C already have English version and are funded for three years. The funding amount in categories A, B, and C are respectively 2 million RMB or 322,092 US$, 1 million RMB (US$ 161,046), and 0.5 million RMB (US$ 85,230), respectively. Journals in category D are those that do not but will have an English edition; they receive 0.5 million RMB each. Of the nearly 5,300 scholarly journals in science and technology, only 76 are covered by the CIU Plan, among which 66 are in the categories of A, B, and C (Yao et al., 2014).

Journals receiving the largest funding are distributed among different Subject Categories and with different performances as measured by Journal Impact Factor (JIF) in the *Journal Citation Reports*. The rank of *Nano Research* is the highest whereas that of the *Journal of Zhejiang University-Science A* is the lowest. Questions arise such as: Are these journals selected because they outperform the rest of Chinese journals in the same subject category

based on the selection scheme mentioned above? How do they perform in comparison with their past, and their international counterparts?

Comparative studies between Chinese and international journals have been done before (Li, 2006; Zhou, et al., 2010; Jin & Leydesdorff, 2005; Zhou & Leydesdorff, 2007a, 2007b). Based on data of the *Journal Citation Reports* (*JCR*) of Thomson Reuters and the China Scientific and Technical Papers and Citations Database (CSTPCD) of the Institute of Scientific and Technological Information of China (ISTIC), Zhou and Leydesdorff (2007a, 2007b), for example, compared journal-journal citation relations from different perspectives, and found that international visibility of high-quality Chinese journals was low. These studies were based on data of ten or more years ago (i.e., *JCR* 2003 and 2004). The situation has changed given China's rapid development in science and technology and its increasing R&D investment during the last ten years (MOST, 2012; NBS, 2013). The CIU Plan further stimulated our interests in mapping an updated picture of the citation performance of Chinese journals in the international scholarly community. To highlight scholarly impact the current study mainly focuses on the citation impact environments of Chinese journals supported by the CIU Plan.

Methods and materials

We use routines developed by Leydesdorff & Cozzens (1992): aggregated journal-journal citation matrices of the environment of a seed journal can be harvested from *JCR* data. A seed journal is the one under investigation and acts as a starter to run the routines. Any journal indexed in the Science Citation Index (*SCI*) or Social Science Citation (*SSCI*) can be used as a seed. The relevant citation networks of the seed journal is determined by including all journals which cite or are cited by the seed journal to the extent of a contribution of (e.g.) 1% of its citation rate (He & Pao, 1986; Leydesdorff, 1986). By default the threshold is 1%, but this can be changed so as to include an appropriate number of journals in a local citation environment. For a network with too many journals, one may raise the threshold to reduce the size of the network, and vice versa.

Each journal in a network is represented by a node, which can be a circle or an ellipse in a Pajek map. The size of an ellipse is determined by the corresponding journal's contribution to the citing or citation impact environment in the year under investigation. The distinction of the vertical and horizontal size of the ellipse, informs the reader about the extent to which within-journal (self-) citations participate in the citation impact (Leydesdorff, 2007; Zhou & Leydesdorff, 2007). Note that within-journal citations can be author self-citations or citations among authors publishing in the same journal. Citation excluding journal self-citations can be considered as a measure of inter-journal communication.

In a citation impact environment, a journal's node size in the representation is determined by the logarithm of its contribution to the total number of citations in a local environment during the year under investigation. Citation counts are total of a journal during the current year; citation counts are combined for both the *SCI* and *SSCI*.

Many programs such as VOSviewer, Pajek, or Gephi can be used to visualize journal citation networks. In this study, we use Pajek because it serves the purpose of illustrating relative cited size of individual journals in local environments. Data of a citation impact environment can be imported into Pajek after being generated by the routines. The cosine between two vectors (Salton & McGill, 1983) is used to measure the similarity between the distributions for the various journals included in a citation environment (Leydesdorff, 2007). A visualized citation network showing strength of citation relations between journals in a local environment can thus be obtained.

Table 1. Journals to be investigated.

Journal Pair	*Journal Title*	*Country*	*Items in 2012*	*CIU Plan Category*	*JIF 2013*	*Rank in JIF*	*Quartile in Category*	*Category Name*
1	Chinese Science Bulletin	China	631	A	1.365	14/55	Q2	Multidisciplinary Sciences
	Science	USA	832		31.47	2/55	Q1	
2	Journal of Environmental Sciences-China	China	281	A	1.922	95/216	Q2	Environmental Sciences
	Environment International	USA	199		5.664	7/216	Q1	
3	Journal of Computational Mathematics	China	42	B	1.049	73/251	Q2	Mathematics, applied
	Foundations of Computational Mathematics	USA	23		2.152	13/251	Q1	
4	Acta Metallurgica Sinica	China	215	B	0.548	42/75	Q3	Metallurgy & Metallurgical Engineering
	Acta Materialia	USA	681		3.940	1/75	Q1	

In 2004, 71 Chinese journals were indexed in the *JCR*. Only a few journals satisfied the above three conditions; four journals were selected for the current study. For horizontal comparison, both Chinese and foreign journals must be in the same subject category of the *JCR*. Furthermore, the foreign journals do not have to be ranked first in the corresponding subject categories, but they should be in the first Quartile of Impact Factors and in the same subject category of the JCR as the selected Chinese journals. Table 1 lists journals satisfying the above conditions and will be used to study.

Results

Cited patterns of the selected journals will be investigated. The threshold is set at 1%, which means in a seed journal's citation environment, only journals contributing to 1% or more of the seed journal's total citations will be included. Due to the page limit of the ISSI 2015, only the results of the first two pairs of journals listed in Table 1 will be presented in detail. Conclusions and discussion, however, are based on the results of the four pairs of journals.

Chinese Science Bulletin versus Science

Chinese Science Bulletin. Only 10 journals contributed at least 1% of the total citation counts of *Chinese Science Bulletin* (*CSB*) in 2004, and these journals were all from China. In other words, visibility of *CSB* among foreign journals that were indexed in the *SCI*/*SSCI* was very low. As a multidisciplinary journal, citation impact of *CSB* was multidisciplinary with specific impacts in the geosciences, geology, and chemistry (Fig. 1a). In the citation impact environment of *CSB*, citation to *CSB* was highest even if within-journal citations were excluded. Within-journal citations of some Chinese journals took high proportions in their total citations, among which journals like *Acta Physica Sinca* and *Advances in Atmospheric*

Sciences were most obvious. In terms of Impact Factor, however, *Acta Geologica Sinica-English Edition* (2.150), *Science in China Series D – Earth Sciences* (0.909), *Acta Chimica Sinica* (0.895), and *Acta Petrologica Sinica* (0.805) performed relatively better than *CSB* (0.683) (Fig. 1a).

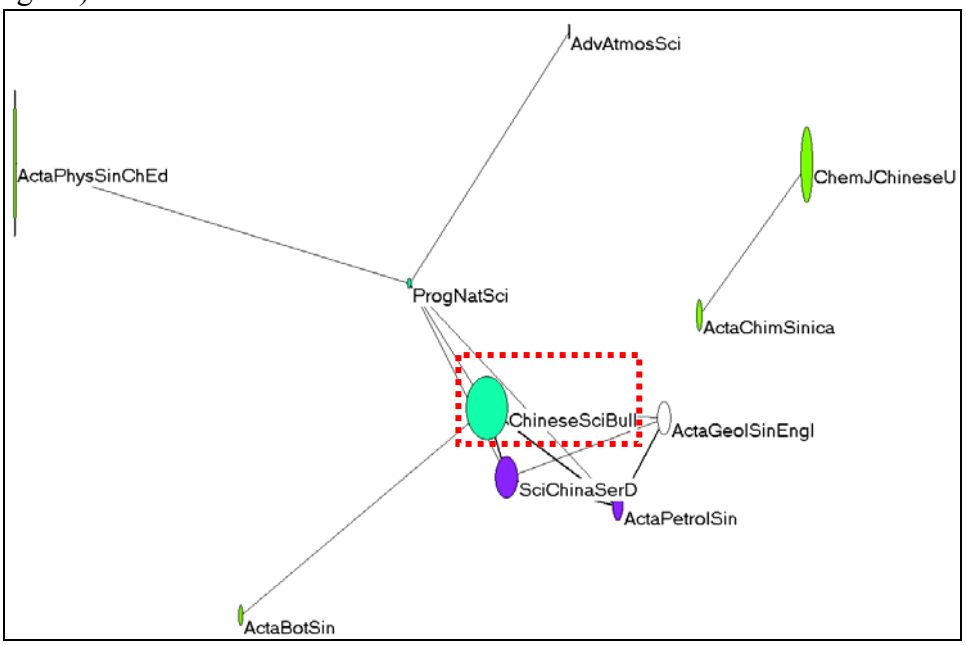

Figure 1a. Citation impact environment of *Chinese Science Bulletin* in 2004 (threshold = 1%, cosine ≥ 0.2).

Citation impact of *CSB* was enlarged to 13 journals in 2013 in terms of number of journals contributing at least 1% to the total citations of *CSB*. Most importantly, of these 13 journals eight were from other countries, which is a significant progress for Chinese journals in terms of citation impact on foreign journals compared to the year 2004. Within-journal citations contributed the most to the total citations of *CSB*. Citation impact of *CSB* on disciplines was similar to that in 2004 – involving multidisciplinary areas, geosciences, geology, and chemistry (Fig. 1b).

Impact Factor value of *CSB* were increased from 0.683 in 2004 to 1.365 in 2013.With the addition of foreign journals in the citation impact environment of *CSB*, journals with the highest citation impact is no longer *CSB* itself as in the year 2004; but instead, foreign journals such as the *Journal of Geophysical Research*, *Lithos*, and *Precambrian Research*, take the lead. In other words, in the citation impact environment of the Chinese journal *CSB*, citation impact of foreign journals was higher than that of Chinese journals. In terms of within-journal citations, *Journal of Geophysical Research* and *PLoS ONE* are most pronouncedly present. The heavy within-journal citations made the node of *PLoS ONE* a vertical line - citations from other journals in this environment were almost negligible (Fig. 1b).

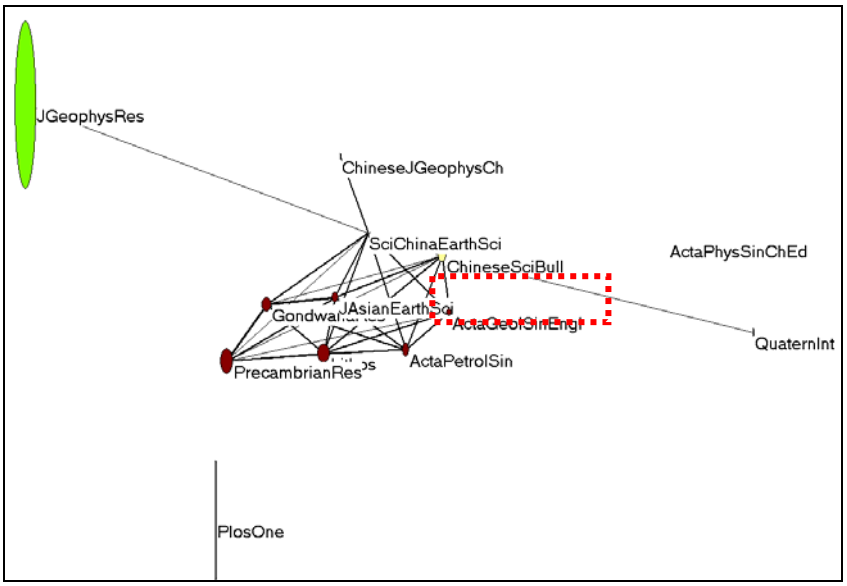

Figure 1b. Citation impact environment of *Chinese Science Bulletin* in 2013 (threshold = 1%, cosine ≥ 0.2).

Science. The citation impact network of *Science* was very much focused in 2004: Three journals contributed mostly to the citations of *Science*, and none of these three was from China. Except within journal citations of *Science*, the other two top contributors were *Journal of Biological Chemistry* (*JBC*) and *Proceedings of the National Academy of Sciences of the United States of America* (*PNAS*) (Fig. 2a). Unlike the multidisciplinary journal *Chinese Science Bulletin* with distinct impact on geosciences and geology, citation impact of *Science* was more in biochemistry, in addition to impact in multiple disciplines. In terms of citation impact in the citation environment of *Science*, all the three journals are high with *JBC* having the highest impact. When within-journal citations are excluded, however, *PNAS* performed the best, and *Science* came next. In other words, compared with *JBC*, *PNAS* and *Science* had higher visibility in other journals. The distinct performance of citation impact of *JBC* and *PNAS* might largely be attributed to their high volumes of publications. In 2003, publications of *JBC*, *PNAS*, and *Science* were 6,585, 3084, and 845, respectively. In terms of average citation impact measured by the Impact Factor, however, *Science* performed the best (IF = 31.85), and followed by *PNAS* (IF = 10.452) and *JBC* (IF = 6.355).

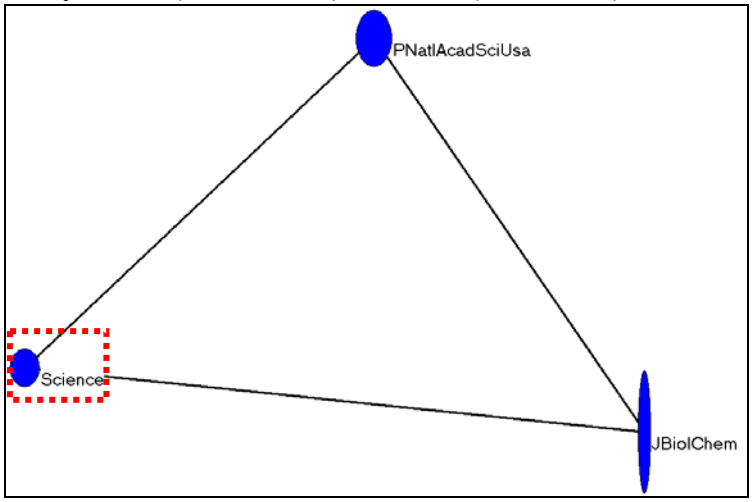

Figure 2a. Citation impact environment of *Science* in 2004 (threshold = 1%, cosine ≥ 0.2).

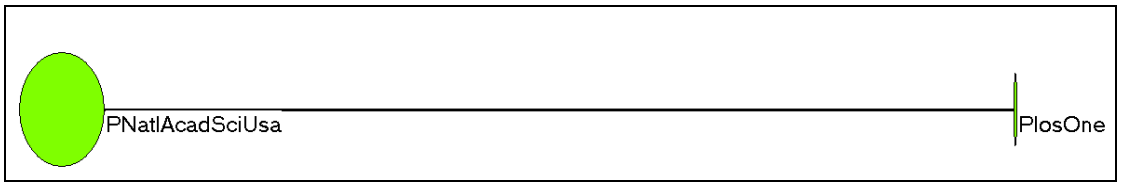

Figure 2b. Citation impact environment of *Science* in 2013 (threshold = 1%, cosine ≥ 0.2).

In the citation environment of *Science* in 2013, the percentage of within-journal citations of *Science* declined to less than 1% of its total citations. As a result, *Science* did not appear in its citation impact environment. In other words, the citation impact of *Science* was even more concentrated than in 2004. Impact Factor value of *Science* had increased from 31.853 in 2004 to 34.463 in 2013. Again, no Chinese journals appeared in this environment. *Science* was mostly cited by two multidisciplinary journals – *PNAS* and *PLoS ONE*, implying the multidisciplinary citation impact of *Science* with no distinct field emphasis like the situation in 2004. The high total citation impact of *PNAS* and *PLoS ONE* can be partially attributed to their high volume of publications: In 2013 *PLoS ONE* published 31,496 papers, which was eight times of that of the *PNAS* (3,901) and 37 times of that of *Science* (841). In terms of average citation impact (i.e., JIF), however, *Science* performed the best (31.477), and *PNAS* (9.809) came next. Average citation impact of *PLoS ONE* was the lowest (3.534), and furthermore, with heavy within-journal citations (Fig. 2b).

In summary, *Science* is widely cited in many journals in a range of different disciplines. When the threshold is set at 1%, however, only two or three journals are left in the citation impact environment of *Science*. In other words, these journals cited *Science* more intensively than other journals.

Journal of Environmental Sciences-China versus Environment International

Journal of Environmental Sciences-China. By 2004, the *Journal of Environmental Sciences-China* (*JES*) only received in total 193 citations of which 27 within-journal citations contributed the most; the other citations were scattered among journals in the environmental sciences, geosciences, chemistry, and biosciences. Although journals contributing 1% or more to *JES*'s total citation were mostly foreign and were as many as 26, these journals cited *JES* for only two or three times. In other words, except within-journal citations, there were no other journals citing *JES* systematically. Impact Factors of journals citing the *JES* were also low, between the highest of *Applied Catalysis B- Environmental* (4.042) citing *JES* six times in total and the lowest (0.172) of *Journal of the Chemical Society of Pakistan* citing *JES* four times (Fig. 3a). In other words, the *JES* had very low impact on other journals, citation impact in terms of Impact Factors of those citing *JES* occasionally was also very low.

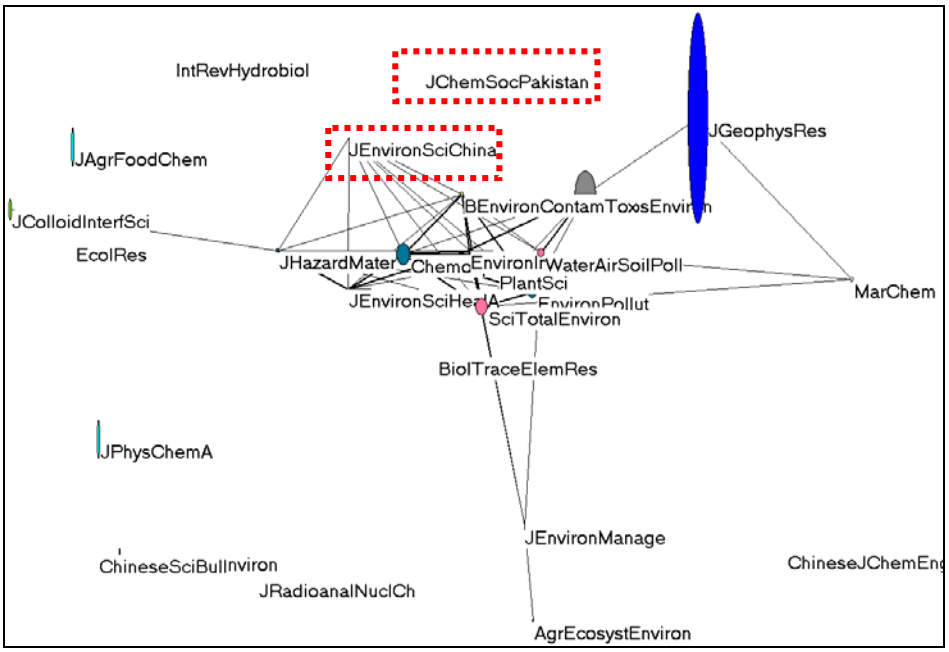

Figure 3a. Citation impact environment of *Journal of Environmental Sciences-China* in 2004 (threshold = 1%, cosine ≥ 0.2).

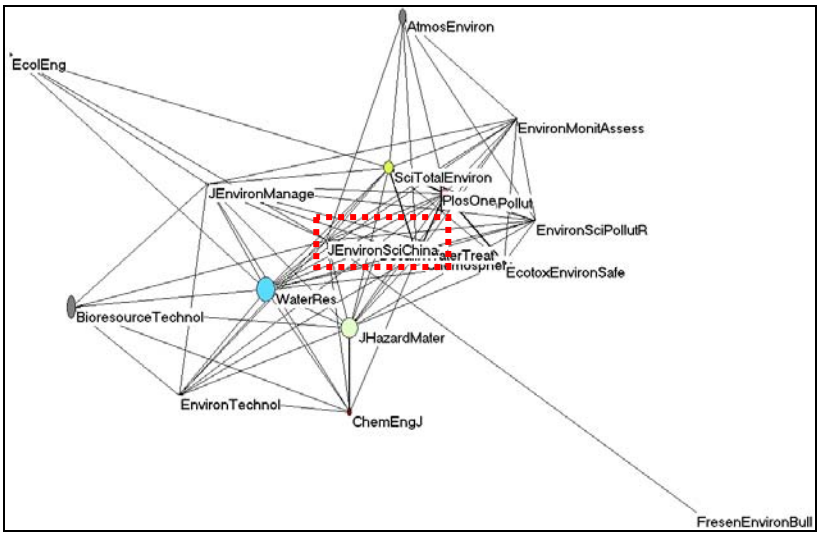

Figure 3b. Citation impact environment of *Journal of Environmental Sciences-China* in 2013 (threshold = 1%, cosine ≥ 0.2).

Performance of *JES* had been improved significantly in 2013, in addition to a large increase of the Impact Factor value from 0.254 in 2004 to 1.922 in 2013. Compared with the citation impact environment in 2004, the number of journals citing *JES* was less (i.e., 18 journals) but each contributed more citations. Journals citing *JES* were mostly foreign, although within-journal citations were still the first contributor. Instead of being cited occasionally like it was ten years ago, *JES* received more focused citation from other journals, and citation impact was more focused instead of scattering among different disciplines. For example, the foreign journal *Environmental Science and Pollution Research* contributed 28% of *JES*'s total citation by 2013, but did not appear in the citation environment of *JES* in 2004. Furthermore, journals citing *JES* had higher citation impact than those in 2004 ranging from 0.527 to 5.323. Citation relations among journals in the citation impact environment of *JES* formed closer relationship and thus interlinked with one another (Fig. 3b).

Environment International. In 2004, the citation impact of the *Environment International* was concentrated on environmental science. The journal contributing most to the total citations of *Environment International* was *Environmental Science & Technology*. Within-journal citations played much less a role than that of the *Journal of Environmental Sciences-China*. Impact Factors of journals citing the *Environment International* were much higher than those of the *Environment International*. For example, the Impact Factor of *Environmental Science & Technology,* the largest citation contributor to the citation impact of *Environment International*, was 3.557, which was even higher than that of *Environment International* (2.335). In other words, the *Environment International* had significant citation impact on high-quality journals. In the citation environment of *Environment International*, its citation impact was negligible whereas that of *Environmental Science & Technology* was highest (Fig. 4a).

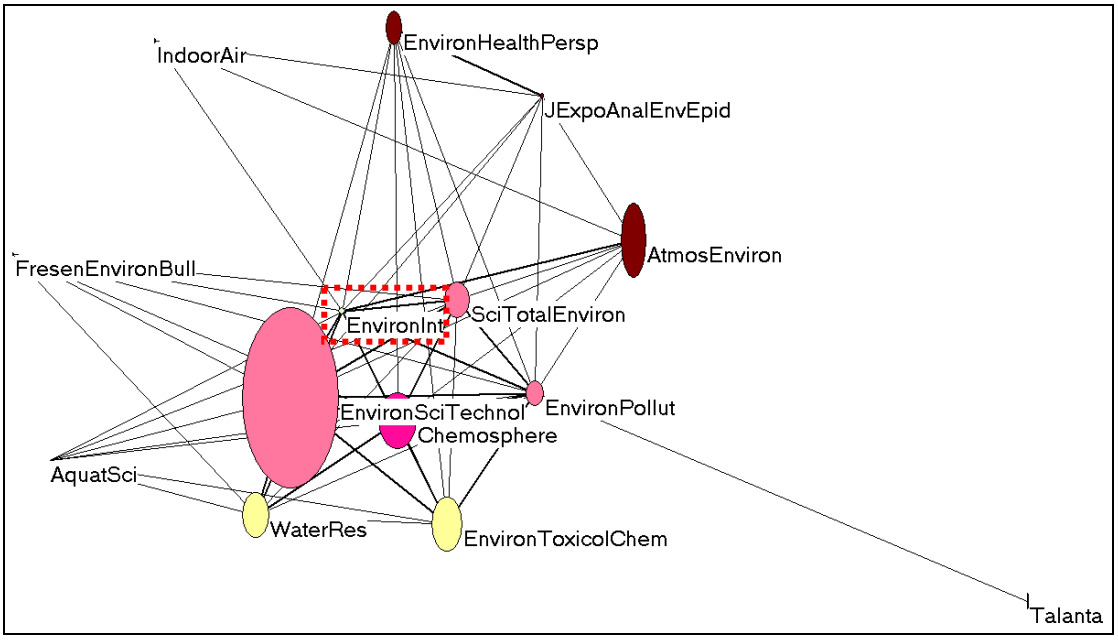

Figure 4a. Citation impact environment of *Environment International* in 2004 (threshold = 1%, cosine ≥ 0.2).

From 2004 to 2013, the Impact Factor value of *Environment International* increased from 2.335 to 5.664. Citation impact on number of journals extended from 14 to 18. Journals citing *Environment International* most frequently were *Chemosphere* (IF = 3.499) and *Science of the Total Environment* (IF = 3.163). Impact Factors of journals contributing at least 1% to the citation of *Environment International* were ranging from 1.679 to 5.664. In the citation impact environment of *Environment International*, the citation impact of *Environment International* itself became visible whereas that of *Environmental Science & Technology* was still the highest (Fig. 4b).

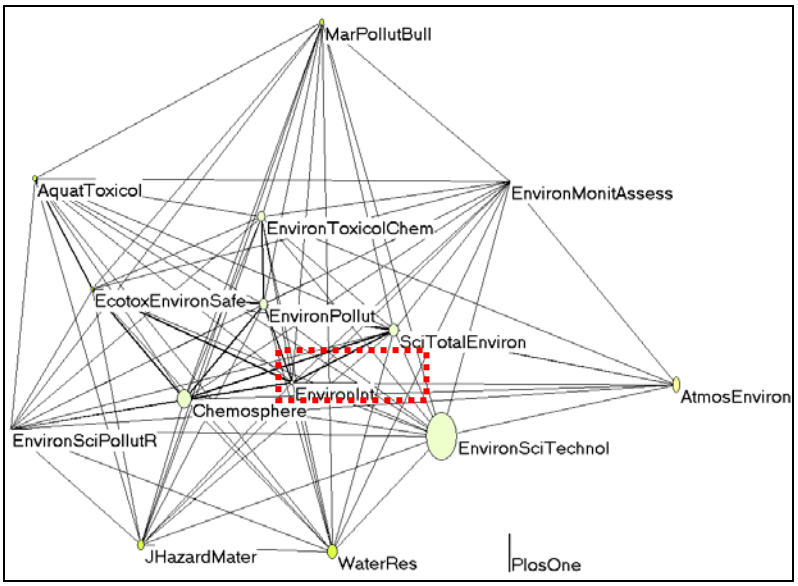

Figure 4b. Citation impact environment of *Environment International* in 2013 (threshold = 1%, cosine ≥ 0.2).

Conclusions and discussion

We have carried out a comparative study on journal citation impact between four pairs of journals in multiple disciplines, environmental sciences, applied mathematics, as well as metallurgy and metallurgical engineering. The four Chinese journals are selected because of additional funding by the Chinese CIU Plan in categories A and B. In Category A are *Chinese Science Bulletin* (*CSB*) and *Journal of Environmental Sciences-China* (*JES*), and in Category B are *Journal of Computational Mathematics* (*JCM*) and *Acta Metallurgica Sinica* (*AMS*). Leading foreign journals were used as matched pairs with the four Chinese journals. These are *Science*, *Environment International*, *Foundations of Computational Mathematics*, and *Acta Materialia* respectively.

International visibility of *CSB* was very low in 2004 although being indexed in the SCI and with a citation impact only on Chinese journals. The situation has been improved ten years later in 2013. More foreign journals cited *CSB*, but this may be by Chinese authors. Citation impact measured by Impact Factor of *CSB* has also been increased, but is still a long distance away from the best. Compared with *CSB*, *Science* has citation impact on higher quality journals measured by Impact Factor, and was cited more intensively with just two or three multidisciplinary journals contributing most to the citation counts of *Science*. By the year 2013, most citations to *Science* were from two multidisciplinary journals - *Proceedings of the National Academy of Sciences of the United States of America* (*PNAS*) and *PLoS ONE*.

Within-journal citations were the first contributor of *CSB*, whereas this is not the case for *Science*. As a multidisciplinary journal, *CSB* did not appear in the citation impact environment of *Science*, implying a weak contribution of references in *CSB* to *Science*. On the other hand, the absence of *Science* in the citation environment of *CSB* implies that *CSB* has a long way to go before coming into the sight of authors publishing in *Science*.

Although being cited by foreign journals in 2004, citations received by the *Journal of Environmental Sciences-China* (*JES*) remained occasional. The situation has improved ten years later in 2013. Citation impact of *JES* has been increased significantly, but is still far behind that of the leading foreign journals in the same subject category. Compared with the *JES*, *Environment International* has citation impact on journals with higher quality measured by Impact Factor. The citation impact of the *Environment International* was more focused: Fewer journals contributing to 1% of the total citations of *Environment International* but each

journal contributed more; within-journal citations of *Environment International* were less significant to total citation counts than that of the *JES*.

Similar to the *Journal of Environmental Sciences-China*, the citation impact of the *Journal of Computational Mathematics* (*JCM*) was very low and was distributed among many journals in 2004. The situation was improved in 2013 with citation impact of the *JCM* being increased significantly, but still far behind that of leading foreign journals in the same subject category. The starting point of *Foundations of Computational Mathematics* was not high in 2004 because of a short history of being indexed in the *SCI*. Compared with the *JCM*, *Foundations of Computational Mathematics* (*FCM*) has citation impact on journals with higher quality measured by Impact Factor. Citation impact of *FCM* is also more focused: Fewer journals contributing to 1% of the total citations. Within-journal citations of *Foundations of Computational Mathematics* contributed less to its total citation than that of the *JCM*.

In 2004 the citation impact of *Acta Metallurgica Sinica* (*AMS*) was low and scattered among many journals, most of which were from China. Within-journal citation was rather heavy and became even heavier in 2013. Citation impact had been improved slightly in 2013 but was still very low. Furthermore, journal quality measured by Impact Factors of journals citing *AMS* had not been improved during 2004-2013. In contrast to *AMS*, *Acta Materialia* was able to generate citation impact in journals with higher quality measured by Impact Factors. Similar to *Acta Metallurgica Sinica*, within-journal citations of *Acta Materialia* also contributed first to its own total citation.

In general, the citation impact of leading Chinese journals has improved during the period 2004-2013, but there is still a long distance to catch up with leading foreign journals. Although being funded under Category B in the CIU Plan, *Journal of Computational Mathematics* performed as well as the other two in a higher rank of category – Category A of the CIU Plan. Being funded at the same level under Category B, the *Journal of Computational Mathematics* performed better than *Acta Metallurgica Sinica*. Foreign journals of higher Impact Factor are more intensively cited than Chinese journals at a given threshold (e.g., 1%) in the same subject category of the JCR, which may imply a positive correlation between journal quality and citation intensity in a specialist citation environment. In other words, journals with higher Impact Factor in the same subject category may be cited more intensively, or by a relatively stable number of journals in their citation impact environment across different years.

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