Jointly published by Akadémiai Kiadó, Budapest and Springer, Dordrecht

Scientometrics, Vol. 73, No. 1 (2007) 3–17
DOI: 10.1007/s11192-005-1523-1

Bibliometric analysis of tsunami research

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The use of the bibilometric analytical technique for examining tsunami research does not exist in the literature. The objective of the study was to perform a bibliometric analysis of all tsunami-related publications in the Science Citation Index (SCI). Analyzed parameters included document type, language of publication, publication output, authorship, publication patterns, distribution of subject category, distribution of author keywords, country of publication, most-frequently cited article, and document distribution after the Indonesia tsunami. The US and Japan produced 53% of the total output where the seven major industrial countries accounted for the majority of the total production. English was the dominant language, comprising 95% of articles. A simulation model was applied to describe the relationship between the number of authors and the number of articles, the number of journals and the number of articles, and the percentage of total articles and the number of times a certain keyword was used. Moreover the tsunami publication patterns in the first 8 months after the Indonesia tsunami occurred on 26 December 2004 indicated a high percentage of non-article publications and more documents being published in journals with higher impact factors.

Introduction

A tsunami is a series of long waves generated by a sudden displacement of a large volume of water. Tsunamis are triggered by submarine earthquakes, submarine volcanic

Received September 9, 2005

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0138–9130/US $ 20.00

eruptions, underwater landslides or slumps of large volumes of earth, meteor impacts, and even onshore slope failures that fall into the ocean or a bay (NATIONAL TSUNAMI HAZARD MITIGATION PROGRAM, 2001). Tsunamis sometimes inflict severe damage to property and pose a threat to life in coastal communities. Tsunamis have long been recorded in literature since the end of the 15th century (NGDC Tsunami Database). LANDER et al. (2002) analyzed 157 global tsunamis that occurred during the period from 1983 to 2001. Only 19 tsunamis originated in the Pacific area. Of the 157 tsunamis, 30 caused damage and 16 caused fatalities. On 26 December 2004, the Indonesia tsunami, the most powerful earthquake in recorded history occurred. Table 1 shows 16 global tsunamis with earthquake magnitudes of ≥ 8.0, which are recorded in the literatures (NGDC Tsunami Database).

Table 1. Global tsunamis with an earthquake magnitude ≥ 8.0 in recorded history

Year	Month	AR	Country	Name	Ms	Deaths
2004	12	104	Indonesia	Off the west Coast of Sumatra	9.0	150,000
1906	1	7	Colombia	Off the coast of Colombia	8.9	500
1812	2	1	USA	New Madrid, Missouri	8.8	–
1861	2	9	Indonesia	SW Sumatra	8.5	905
1811	12	1	USA	NE Arkansas	8.5	–
1900	10	3	Venezuela	Venezuela	8.4	0
1812	1	1	USA	New Madrid, Missouri	8.4	–
1843	2	1	Guadeloupe	Guadeloupe	8.3	0
1833	11	3	Indonesia	SW Sumatra	8.2	0
1946	8	7	Dominican Republic	Dominican Republic, Haiti, and Puerto Rico	8.1	1790
1941	6	2	India	Andaman Sea, E Coast India	8.1	5000
1882	9	1	Costa Rica	Costa Rica-Panama	8.0	0
1811	12	1	USA	NE Arkansas	8.0	–
1797	2	1	Indonesia	SW Sumatra	8.0	300
1755	11	29	Portugal	Off the coast of Lisbon	8.0	–
1690	4	2	West Indies	Leeward Islands/Virgin Islands	8.0	0

AR: Associated runups, the total number of runup links display the runup locations associated with a particular tsunami event; Country: source country, i.e., the country where the tsunami source occurred; Name: source location name, i.e., the country, state, province, or island where the tsunami source occurred; Ms: earthquake magnitude on the Richter scale; Deaths: whenever possible, the estimated number of deaths from the tsunami are listed; may also include deaths from the earthquake that triggered the tsunami.

Evaluating the performance of each research topic is necessary in order to indicate the impact of and contribution of authors to their respective fields. Our purpose was to study the tsunami research performance based on 1027 documents published in Science Citation Index (SCI)-indexed periodicals between 1991 and 2004. These documents were analyzed and evaluated according to publication distribution and were used to determine the quantitative characteristics of tsunami research. In addition, this study also attempted to analyze significant tsunami publication patterns, especially in document type and authors' country of origin after the Indonesia tsunami on 26 December 2004.

Methods

The 2004 edition of the *Journal Citation Reports* (JCR), published by the Institute for Scientific Information (ISI), lists 5968 journals in the Science Citation Index (SCI). Documents used in this study were based on the databases of the SCI which was accessed from the ISI Web of Science, Philadelphia, PA, USA. Tsunami, tsunamic, tsunamis, tsunamigenesis, tsunamigenic, tsunamiites, tsunamite, tsunamites, and tsunamitsu were used as keywords to search titles, abstracts, and keywords. Articles, biographical items, book reviews, corrections, addition corrections, editorial materials, letters, meeting abstracts, news items, notes, and reviews were obtained from the results of the search for document types. Articles originating from England, Scotland, Northern Ireland, and Wales were grouped under the UK heading. The impact factor (IF) of a journal was determined for each document as reported in the JCR 2004. Collaboration type was determined by the address of each author, where 'independent' was assigned if no collaboration was presented. 'International collaboration' was assigned if the paper was cosigned by researchers from more than one country.

Documents were analyzed according to their type, language of publication, publication output, authorship, publication patterns, distribution of subject category, distribution of author keywords, country of publication, most frequently cited articles, and document distribution after the Indonesia tsunami.

Results and discussion

Language of publication

Four languages were used for all SCI publications in this study. The languages in which the documents were published were dominated by English (976; 95%) followed distantly by Russian (43; 4.2%), French (7; 0.68%), and Spanish (1; 0.10%). GARFIELD & WELLJAMSDOROF (1992) reported that English is the main language of microbiology research, accounting for 90%~95% of all SCI papers. Publications on pediatric anesthesia also indicated high proportions of articles written in English which originated in the US and UK (BRAMBRINK et al., 2000). English remains the dominant language as it is the main language in many fields (ADLER & JOHNSON, 2000; HSIEH et al., 2004). However in the case of homeopathy research, English remains the dominant language, but it comprised only 76%, because homeopathy was begun in Germany, and therefore much research has been published in German and other European languages (CHIU & HO, 2005). In addition, it could be expected that a higher percentage of English would be used because more journals listed in ISI was published in English.

Type of document

The distribution of document type identified by the ISI was analyzed. From this analysis, 11 document types were found. The article was the most-frequently used document type comprising 88% (903) of the total production, followed distantly by reviews (50; 4.9%). Editorial materials (30; 2.9%), news items (20; 1.9%), notes (11; 1.1%), letters (6; 0.58%), corrections (2, 0.19%), meeting abstracts (2, 0.19%), biographical items (1, 0.10%), book reviews (1, 0.10%), and corrections additions (1, 0.10%) showed much-lesser significance than articles. Articles were the most-commonly contributed document type, and 903 articles were analyzed in the following study.

Publication output

For the period from 1991 to 2004, the cumulative number of articles increased smoothly. In 1991, 22 articles were published, while in 2004 the cumulative number of articles was 903. Figure 1 shows that a significant correlation between yearly cumulative number of publications and the year published was made, with the two relations having a high coefficient of determination (> 0.990).

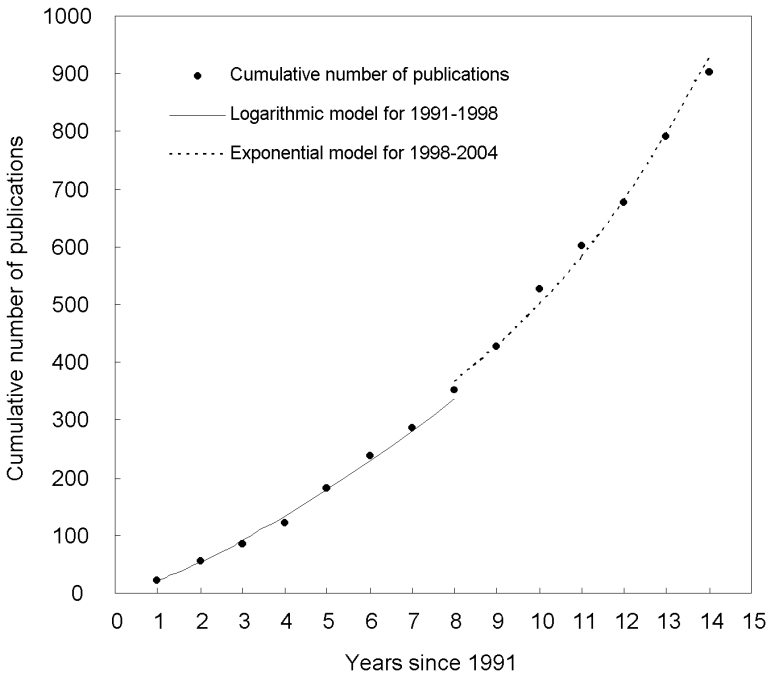

Figure 1. Cumulative number of publications by year

The difference in the cumulative trend was significant between the two periods from 1991 to 1998 and 1998 to 2004, which were respectively expressed using logarithmic and exponential models. Both logarithmic and exponential curve fitting methods showed that yearly publications had a high growth rate. The relationship between the cumulative number of publications and year was also applied to the quantitative trend of patent ductus arteriosus (PDA) surgery treatment research (HSIEH et al. 2004) and homeopathy research (CHIU & HO, 2005). The logarithmic and exponential fitting curves for tsunami research were found to be:

$C = 21.2Y^{1.33}$ and $C = \exp(0.154Y + 4.67)$, respectively, where C is the cumulative number of publications, and Y is the number of years since 1991.

Authorship

The average number of authors per article from 1991 to 2004, was 3.1. Of the 903 articles, 268 (30%) were written by 2 authors, 197 (22%) by 3 authors, and 170 (19%) by a single author. The number of articles with collaborative authorship other than the most-frequent number of authors of 1 to 4, accounting for 760 (84%) articles, was much fewer. Of the 903 articles that were published, there were 1768 authors, however there were 2 articles where no author information was available. Therefore the 2 articles were omitted from the remainder of the author analysis. Of the 901 articles with author information, 1374 authors (78%) were credited in 1 article, followed distantly by 205 (12%) in 2 articles. A model can be used to describe the relationship between the numbers of authors and articles. Figure 2 shows a significant correlation with a logarithmic model. A double logarithmic plot of the data showed that there was a linear relation with a high coefficient of determination (0.982) in the number of authors from 1 to 11 and the number of articles. Satake contributed the highest number with 44 (4.9%), followed by Tanioka with 27 (3.0%) and Tinti with 24 (2.7%). A bias would appear in the analysis of authorship of authors who use the same name and those who use different names in their publications. It is strongly recommended that an "international identity number" for all authors when they published their first paper in an ISI-listed journal.

An analysis of the corresponding author (reprint author) and the countries were undertaken for the articles. Eight hundred seventy articles with records of the corresponding author in the ISI were analyzed. Four hundred forty-one (51%) authors published only 1 article as the corresponding author and 73 (8.4%) authors published 2 articles. Table 2 shows the top 10 most-productive corresponding authors between 1991 and 2004.

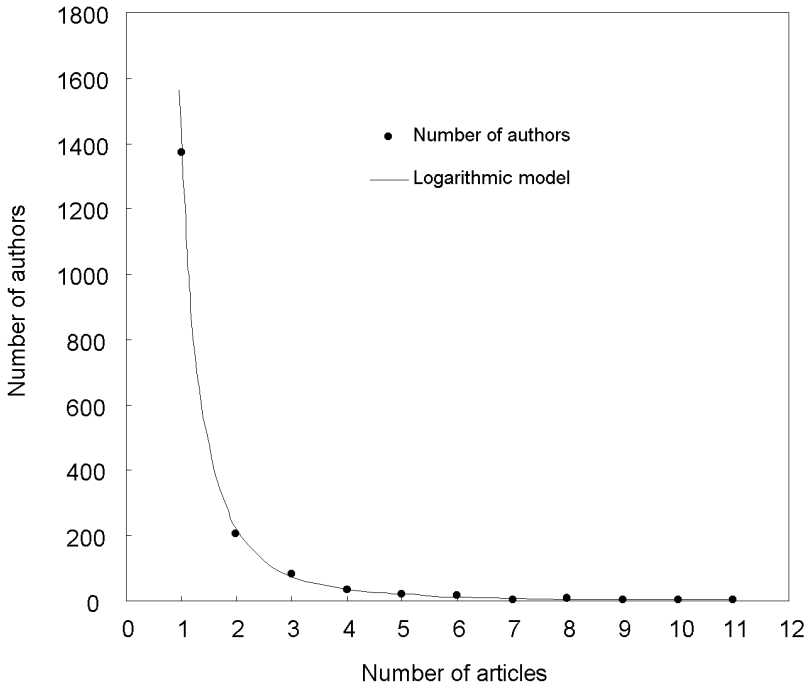

Figure 2. Relationships between the number of authors and their articles with a simulated model

Table 2. The 10 most-productive corresponding authors between 1991 and 2004

Ranking	Corresponding author	P	Country
1	Tanioka, Y	15	Japan
1	Tinti, S	15	Italy
3	Okal, EA	13	USA
4	Satake, K	12	Japan
5	Beuchat, LR	8	USA
5	Dotsenko, SF	8	Russia
5	Rabinovich, AB	8	Canada
8	Bryant, EA	7	Australia
8	Johnson, JM	7	USA
10	Clague, JJ	6	Canada
10	Dawson, AG	6	UK
10	Goff, JR	6	New Zealand
10	Nott, J	6	Australia
10	Ward, SN	6	USA

P: Number of publications.

Four of these corresponding authors were from the US, and two were from Japan, Canada, and Australia respectively. Tanioka from Japan and Tinti from Italy with 15 articles dominated publications as the corresponding author, followed by Okal from US and Satake from Japan, who had 13 and 12 corresponding author articles, respectively. Eight hundred seventy articles were recorded with 578 corresponding authors who were from 49 countries. Authors from 17 countries published only 1 article as the corresponding country, and 6 published 2 articles. One hundred and eighty-four corresponding authors were from the US, 69 from Japan, 44 from Russia, 30 from France, and 28 from Canada. Furthermore, all of the G7 countries (the US, Japan, Germany, U.K., France, Italy, and Canada) were ranked in the top 10.

Publication patterns

In total, 903 articles were published in 219 journals listed in the SCI. Out of the 219 journals, 125 (57%) journals contained only 1 article, and 58 (26%) journals contained 2 articles. Figure 3 shows a significant correlation with a logarithmic model to describe the relationship between the numbers of journals and articles. A double logarithmic plot of the data showed that there was a linear relation with a high coefficient of determination (0.968) in the number of articles of from 1 to 4. Table 3 shows the 10 most-productive journals with their impact factors, the ISI category of the journal, the position of the journal in its category, the number of papers, and percentage of total articles. Three hundred and ninety articles (43%) were published in the 10 most-productive journals, listed in the SCI. *Pure and Applied Geophysics* published the most papers (73; 8.1%), followed by *Geophysical Research Letters* (66; 7.3%), *Natural Hazards* (45; 5.0%), *Marine Geology* (39; 4.3%), and *Journal of Geophysical Research-Solid Earth* (38; 4.2%). The impact factor (IF) of a journal is defined by the JCR, and is derived by dividing the number of current citations to articles published in the 2 previous years by the total number of articles published in the 2 previous years. It is a measure of the frequency with which an average article in a journal has been cited in a particular year. The impact factor is used to evaluate a journal's relative importance, especially when compared to others in the same field. The distribution of articles by reference to their IF issued in 2004 was as follows: 2.3% of total articles had an IF of > 10; 3.4% had an IF of 3 ~ 10; 21.5% had an IF of 2 ~ 3; 26% had an IF of 1 ~ 2; 33% had an IF of < 1; and 9.3% had no information on IF. Sixty percent of articles were published in journals with an IF of lower than 2. The journal with the highest impact factor (32.182) was *Nature*.

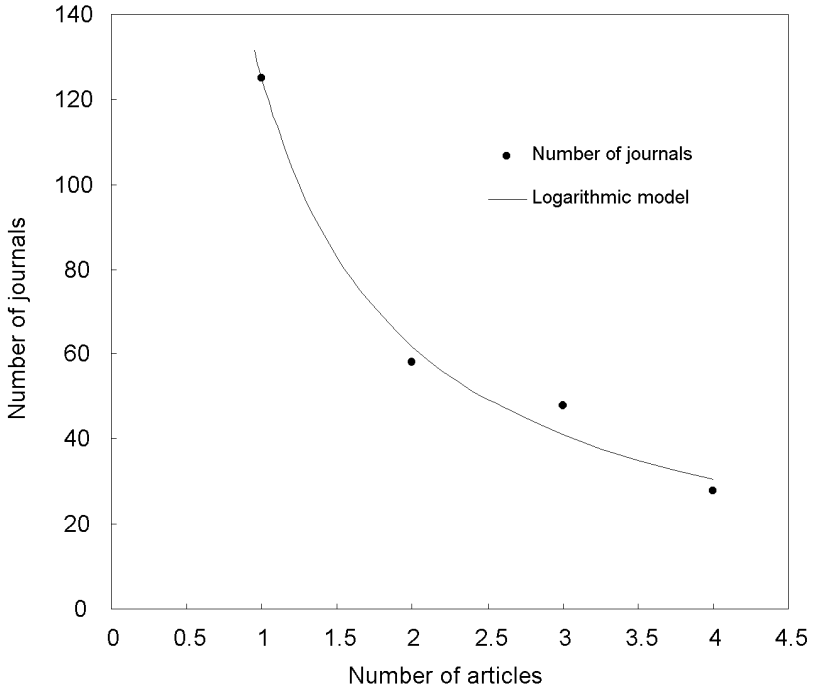

Figure 3. Relationships between the number of journals and articles with a simulated model

Table 3. The 10 most-active journals with the number of articles, impact factor (IF), ISI category of journals, and the position of the journal in its category

Journal	IF	P (%)	ISI category	Position
Pure and Applied Geophysics	0.84	73 (8.1)	Geochemistry & Geophysics	32/50
Geophysical Research Letters	2.378	66 (7.3)	Geosciences, Multidisciplinary	10/128
	0.709	45 (5.0)	Geosciences, Multidisciplinary	89/128
			Meteorology & Atmospheric Sciences	36/45
Natural Hazards			Water Resources	29/55
	1.818	39 (4.3)	Geosciences, Multidisciplinary	25/128
Marine Geology			Oceanography	9/41
Journal of Geophysical Research – Solid Earth	2.839	38 (4.2)	Geosciences, Multidisciplinary	6/128
Sedimentary Geology	1.342	35 (3.9)	Geology	8/35
Geology	2.925	31 (3.4)	Geology	1/35
Bulletin of the Seismological Society of America	1.812	27 (3.0)	Geochemistry & Geophysics	18/50
Geophysical Journal International	2.014	18 (2.0)	Geochemistry & Geophysics	13/50
Journal of Geophysical Research – Oceans	2.839	18 (2.0)	Geosciences, Multidisciplinary	6/128

Distribution of subject category

In total, 903 articles were published in 76 ISI subject categories. Out of the 76 ISI subject categories, 30 (39%) subject categories contained only 1 article, and 12 (16%) subject categories contained 2 articles. There were 348 articles (26%) published in the category of multidisciplinary geosciences, and 222 (16%) in the category of geochemistry & geophysics. Table 4 shows the 10 ISI subject categories with the most publications including the number of articles and percentage of total articles.

Table 4. Ten ISI subject categories with the most publications

Ranking	Subject category	P	%P
1	Geosciences, Multidisciplinary	348	26
2	Geochemistry & Geophysics	222	16
3	Oceanography	115	8.5
4	Geology	95	7.0
5	Water Resources	78	5.7
6	Meteorology & Atmospheric Sciences	70	5.1
7	Geography, Physical	68	5.0
8	Multidisciplinary Sciences	40	2.9
9	Engineering, Civil	29	2.1
9	Engineering, Ocean	29	2.1

P: Number of publications.

Distribution of author keywords

An analysis of the author keywords was undertaken for articles from 1991 to 2004. Four hundred forty-five articles with records of author keywords in the SCI database were analyzed. There were 2345 keywords listed by authors, 1200 (51%) keywords were used only once, and 138 (5.9%) keywords were used 2 times. 'Tsunami', 'tsunamis', 'earthquakes', and 'earthquake' were the most-frequently used keywords which were used 255 times (11%), followed by 'holocene' 21 times, 'diatoms' 14 times, 'landslide' 14 times, 'landslides' 12 times, and 'paleoseismology' 12 times. Figure 4 shows a significant correlation with a logarithmic model to describe the relationship between the percentage of total articles and the number of times a keyword was used. A double logarithmic plot of the data showed that there was a linear relation with a high coefficient of determination (0.993) in the number of times a keyword was used 1 to 7 times.

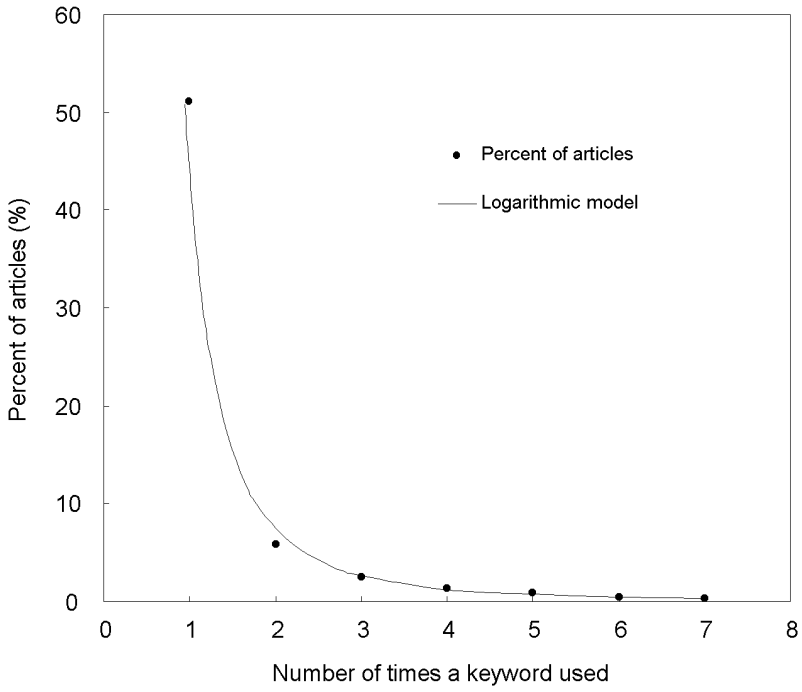

Figure 4. Relationship between the percentage of total articles and the times a keyword was used

Country of publication

There were 148 (20%) articles without author address information on the ISI Web of Science. For this reason, not all of the 903 articles were included in this analysis. Among the 755 articles with author address information published from 1991 to 2004, 168 (22%) articles were international collaborations and 587 (78%) were independent publications, but they were diverse, covering 54 different countries, with the most articles originating from the US (262; 35%) and Japan (114; 15%). It is not surprising because the US had more tsunamis (Ms ≥ 8.0) and is a country with active research. Japan ranked second in publication position which is a better ranking than seen in other research fields. 'Tsunami' is a Japanese word, and tsunamis had killed more people and done more damage in Japan than anywhere else before the Indonesia tsunami in 2004 (LINDLEY & SWINBANKS, 1987). Japan is also located in an earthquake zone, and more investigations have been carried out in Japan. The 7 major industrial countries (G7: Canada, France, Germany, Italy, Japan, the UK, and the US) were all ranked in the top 10 of publications.

Table 5. Publication activity of countries from 1991 to 2004

Country	IP	%IP	CP	%CP	TP	%TP
USA	211	36	51	30	262	35
Japan	90	15	24	14	114	15
Russia	31	5.3	23	14	54	7.2
Italy	36	6.1	15	8.9	51	6.8
France	16	2.7	25	15	41	5.4
UK	19	3.2	22	13	41	5.4
Canada	31	5.3	7	4.2	38	5.0
Australia	24	4.1	12	7.1	36	4.8
Germany	12	2.0	16	9.5	28	3.7
Norway	16	2.7	8	4.8	24	3.2
New Zealand	15	2.6	8	4.8	23	3.0
Spain	5	0.85	12	7.1	17	2.3
Mexico	6	1.0	8	4.8	14	1.9
Portugal	7	1.2	7	4.2	14	1.9
Turkey	5	0.85	8	4.8	13	1.7
Greece	7	1.2	4	2.4	11	1.5
Indonesia	2	0.34	7	4.2	9	1.2
South Korea	4	0.68	5	3.0	9	1.2
Chile	6	1.0	2	1.2	8	1.1
Switzerland	0	0	8	4.8	8	1.1
Brazil	6	1.0	1	0.60	7	0.93
Netherlands	4	0.68	3	1.8	7	0.93
Sweden	3	0.51	3	1.8	6	0.79
Papua New Guinea	1	0.17	4	2.4	5	0.66
Taiwan	3	0.51	1	0.60	4	0.53
Ukraine	1	0.17	3	1.8	4	0.53
Denmark	1	0.17	2	1.2	3	0.40
French Polynesia	0	0	3	1.8	3	0.40
Peru	0	0	3	1.8	3	0.40
Philippines	1	0.17	2	1.2	3	0.40
USSR	2	0.34	1	0.60	3	0.40
Byelarus	1	0.17	1	0.60	2	0.26
Costa Rica	2	0.34	0	0	2	0.26
Egypt	0	0	2	1.19	2	0.26
India	2	0.34	0	0	2	0.26
Ireland	0	0	2	1.19	2	0.26
Israel	1	0.17	1	0.60	2	0.26
New Caledonia	0	0	2	1.2	2	0.26
China	1	0.17	1	0.60	2	0.26
Singapore	0	0	2	1.2	2	0.26
Thailand	0	0	2	1.2	2	0.26
Belgium	0	0	1	0.60	1	0.13
Croatia	1	0.17	0	0	1	0.13
Colombia	1	0.17	0	0	1	0.13
Cuba	0	0	1	0.60	1	0.13
Fiji	0	0	1	0.60	1	0.13
Finland	0	0	1	0.60	1	0.13
Guatemala	0	0	1	0.60	1	0.13
Poland	0	0	1	0.60	1	0.13
Syria	0	0	1	0.60	1	0.13
Vanuatu	0	0	1	0.60	1	0.13
Hong Kong	0	0	1	0.60	1	0.13
Kuwait	0	0	1	0.60	1	0.13
South Africa	1	0.17	0	0	1	0.13

TP: Total publications; IP: single country publications; CP: international collaboration publications.

The G7 had high productivity on this topic, which included 566 (75% of 755 articles) publications. Eighteen countries had no independent and 5 countries had no collaborative articles. Fourteen countries contributed only 1 or 2 independent publications, and 24 countries contributed only 1 or 2 collaborative publications (Table 5). The US had the most independent articles at 35% of all independent publications followed by Japan with 15%. The US was also the most-frequent partner accounting for 30% of the international collaborative publications followed by France with 15%. Because tsunamis affect huge areas when they occur, the geographic distribution of publications was also broad. The results shown in Table 6, that 337 articles were from the Americas (45% by 10 countries), 236 were from Europe (35%; by 19 countries), 222 were from Asia (29%; by 16 countries), 71 were from Oceania (9.0%; by 7 countries), and 3 were from Africa (0.26%; by 2 countries).

Table 6. Publication distribution by region

	No. Country	IP	%IP	CP	%CP	TP	%TP
Americas	10	263	45	74	43	337	45
Europe	19	129	22	134	81	263	35
Asia	16	142	24	80	46	222	29
Oceania	7	40	7.0	31	16	71	9.0
Africa	2	1	0	2	1.2	3	0.26

TP: Total publications; IP: single country publications; CP: international collaborative publications.

Most-frequently cited article

The total citation count was obtained from the Web of Science, and it shows the total number of times that a particular article has been cited by all of the journals listed in the database. The number of citations does not actually indicate the quality of an article, but is a measure of its impact or visibility. Among tsunami articles, the most-frequently cited was 'Tektite-bearing, deep-water clastic unit at the cretaceous-tertiary boundary in northeastern Mexico'. This article by SMIT et al. (1992) was published in 1992 in *Geology* (with an IF of 2.925) and was cited 117 times since its publication in 1992 to 2004. Figure 5 shows the relationship between article life and times cited each year. The times cited suddenly rose in the beginning year and reached a maximum after 2 years, after which a decline was visible, and the number rose in later years. This differs from most other cases, in the beginning year (zero year here), it was lower because all articles appeared in that publication year (HSIEH et al., 2004).

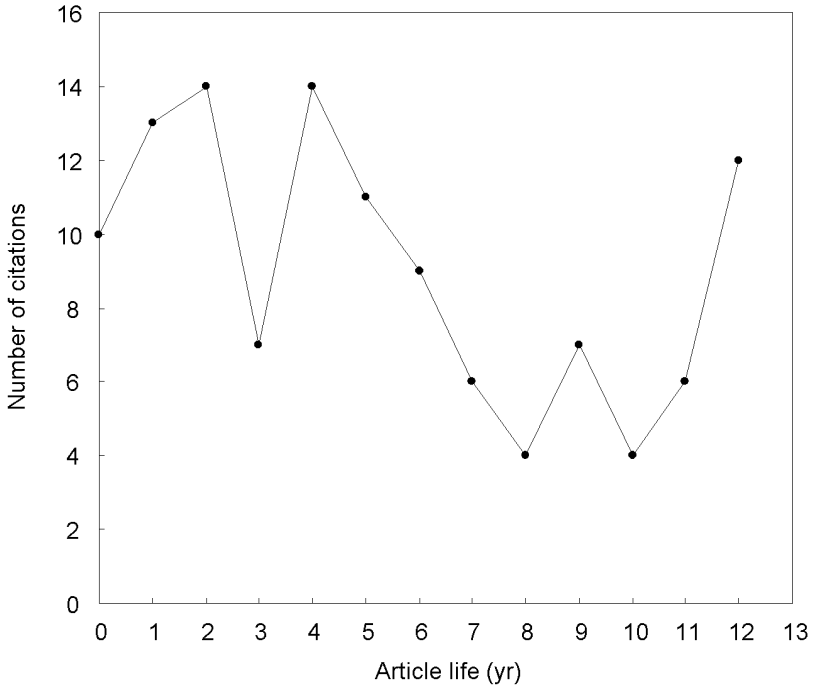

Figure 5. Citation history of the most-frequently cited articles

Document distribution after the Indonesian tsunami

Further study focused on publications after the Indonesian tsunami on 26 December 2004. Three hundred sixteen papers were found to have been published in 2005 from a search of SCI on 8 August 2005. Total production was 316 papers by 38 countries, with 36% having no recorded address. Forty-four percent of the total share was published as articles, 23% as news items, 20% as editorial materials, 9.2% as letters, 1.6% as reviews, 0.32% as reprints, and 0.63% each as corrections and meeting abstracts. Similar to the finding of a study on the early stage of SARS-related research, the quantity of tsunami articles was found to be low (CHIU et al., 2004). The high percentage share of news item indicates that this might have been a faster way of communication after the Indonesia tsunami occurred. The distribution of document types was similar for tsunami- and SARS-related research.

Figure 6 shows the distribution of all document types of publications by reference to their IF in 2 periods, 2001 to 2004 and the first 8 mouths in 2005 after the Indonesia tsunami occurred. It is clear that after Indonesia tsunami occurred more documents

published in higher-impact factor journals. During this period, 316 documents were published in 133 journals listed in the SCI. Nine journals had impact factors of higher than 10, and 13 journals had impact factors of between 3 and 10. Inversely, during 2001 to 2004, 1027 documents were published in 258 journals of which 6 journals had impact factors of higher than 10, and 17 journals had impact factors of between 3 and 10. English, Finnish, French, German, Rumanian, and Spanish languages were used for all publications after the Indonesia tsunami occurred. Only 1 document each was published in the Finnish, French, German, Rumanian, and Spanish languages. In analyzing 202 documents with recorded addresses, the US dominated the production with 32% of the total share followed distantly by India with 15% and the UK with 11%. Out of 38 document-producing countries, Australia, Belgium, Indonesia, the Netherlands, Denmark, Kenya, Mexico, South Africa, Byelarus, Chile, the Philippines, Seychelles, and Trinidad and Tobago had no independent publications. Indonesia, Sri Lanka, India, and Thailand located in the zone of the Indonesia tsunami all produced publication.

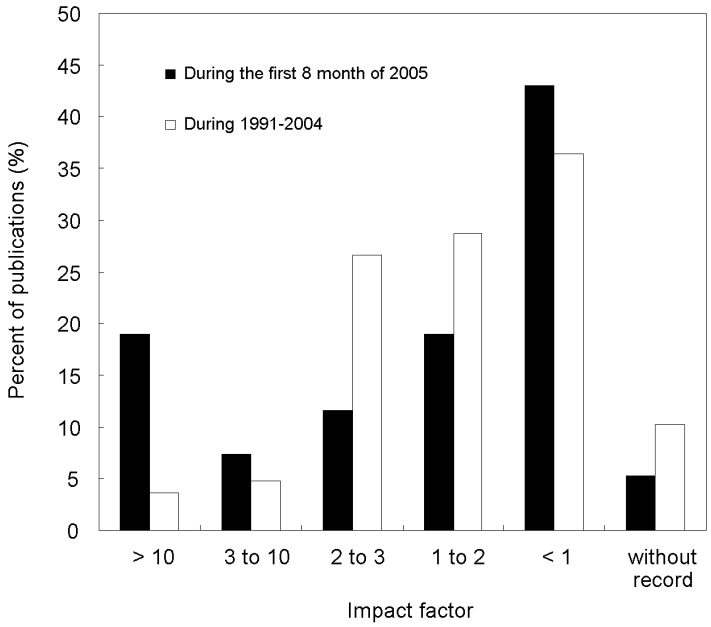

Figure 6. Distribution of publication by reference to their impact factors in 2 periods, 2001 to 2004 and the first 8 mouths of 2005 after the Indonesian tsunami occurred

Conclusions

For tsunami research, logarithmic and exponential relations between yearly cumulative number of publications and year were obtained for the periods from 1991 to 1998 and 1998 to 2004 revealing that yearly publications sustained a constant growth rate. The logarithmic model was successfully applied to describe the relationship of number of authors and the number of articles, the number of journals and the number articles, and the percentage of total articles and the number of times a keyword was used. English was the dominant language. The US dominated publication production followed by Japan, and the seven major industrial countries still comprised the majority of the total production. The most-frequently published article was published in *Pure and Applied Geophysics* and in the ISI category of Multidisciplinary Geosciences. Moreover the tsunami publication pattern in the first 8 months after the Indonesia tsunami occurred on 26 December 2004 indicated a high percentage of non-article publications, more documents being published in higher-impact factor journals, and the English language and the US dominating production.

References

ADLER, M. D., JOHNSON, K. B. (2000), Quantifying the literature of computer-aided instruction in medical education. *Academic Medicine*, 75 (10) : 1025–1028.

BRAMBRINK, A. M., EHRLER, D., DICK, W. F. (2000), Publications on paediatric anaesthesia: A quantitative analysis of publication activity and international recognition. *British Journal of Anaesthesia*, 85 (4) : 556-562.

CHIU, W. T., HO, Y. S. (2005), Bibliometric analysis of homeopathy research during the period of 1991 to 2003. *Scientometrics*, 63 (1) : 3–23.

GARFIELD, E., WELLJAMSDOROF, A. (1992), The microbiology literature: Languages of publication and their relative citation impact. *FEMS Microbiology Letters*, 100 (1-3) : 33–37.

HSIEH, W. H., CHIU, W. T., LEE, Y. S., HO, Y. S. (2004), Bibliometric analysis of patent ductus arteriosus treatments. *Scientometrics*, 60 (2) : 205–215.

LANDER, J. F., WHITESIDE, L. S., LOCKRIDGE, P. A. (2002), Two decades of global tsunamis – 1982–2002. *Science of Tsunami Hazards*, 21 (3) : 3–88.

LINDLEY, D., SWINBANKS, D. (1987), Satellite-linked tsunami warning to avoid Pacific disasters. *Nature*, 330 (6146) : 305.

NATIONAL GEOPHYSICAL DATA CENTER (NGDC) *Tsunami Database*. Accessed 8 August 2005, Available at http://www.ngdc.noaa.gov/seg/hazard/tsu.shtml

NATIONAL TSUNAMI HAZARD MITIGATION PROGRAM, *Designing for Tsunamis: Seven Principles for Planning and Designing for Tsunami Hazards, March 2001*, NOAA, USGS, FEMA, NSF, Alaska, California, Hawaii, Oregon, and Washington. Accessed 8 Auguest 2005, Available at http://www.pmel.noaa.gov/tsunami-hazard/Designing_for_Tsunamis.pdf

SMIT, J., MONTANARI, A., SWINBURNE, N. H. M., ALVAREZ, W., HILDEBRAND, A. R., MARGOLIS, S. V., CLAEYS, P., LOWRIE, W., ASARO, F. (1992), Tektite-bearing, deep-water clastic unit at the cretaceous-tertiary boundary in northeastern Mexico. *Geology*, 20 (2) : 99–103.