Bibliometric Analysis for Papers on Topics Related to Particulate Matter (PM)

This is a bibliometric analysis of the papers prepared by intramural and extramural researchers of the U.S. Environmental Protection Agency (EPA) on topics related to particulate matter (PM). For this analysis, 904 papers were reviewed. These 904 papers, published from 1998 to 2005, were cited 9,578 times in the journals covered by Thomson's Web of Science.[1] Of these 904 papers, 723 (80%) have been cited at least once in a journal.

The analysis was completed using Thomson's Essential Science Indicators (ESI) and Journal Citation Reports (JCR) as benchmarks. ESI provides access to a unique and comprehensive compilation of essential science performance statistics and science trends data derived from Thomson's databases. The chief indicators of output, or productivity, are journal article publication counts. For influence and impact measures, ESI employs both total citation counts and cites per paper scores. The former reveals gross influence while the latter shows weighted influence, also called impact. JCR presents quantifiable statistical data that provide a systematic, objective way to evaluate the world's leading journals and their impact and influence in the global research community.

Summary of Analysis

More than one-quarter of the PM publications are highly cited papers. A review of the citations indicates that 258 (28.5%) of the PM papers qualify as highly cited when using the ESI criteria for the top 10% of highly cited publications. Forty-nine (5.4%) of the PM papers qualify as highly cited when using the criteria for the top 1%. Twelve (1.3%) of these papers qualify as very highly cited (in the top 0.1%), and two papers (0.2% of the papers analyzed) actually meet the top 0.01% threshold.

The PM papers are more highly cited than the average paper. Using the ESI average citation rates for papers published by field as the benchmark, in 10 of the 14 fields in which the EPA PM papers were published, the ratio of actual to expected cites is greater than 1, indicating that the PM papers are more highly cited than the average papers in those fields. For all 14 fields combined, the ratio of actual cites to expected cites is 2.3, indicating that the PM papers are more highly cited than the average paper.

Nearly one-third of the PM papers are published in very high impact journals. Two-hundred fifty-four (254) of 904 papers were published in the top 10% of journals ranked by JCR Impact Factor, representing 28% of EPA's PM papers. Nearly one-third of the PM papers are published in the top 10% of journals ranked by JCR Immediacy

[1] Thomson's *Web of Science* provides access to current and retrospective multidisciplinary information from approximately 8,700 of the most prestigious, high impact research journals in the world. *Web of Science* also provides cited reference searching.

Index. Two-hundred sixty-seven (267) of the 904 papers appear in the top 10% of journals, representing 29.5% of EPA's PM papers.

Seventeen of the PM papers qualify as hot papers. Using the hot paper thresholds established by ESI as a benchmark, 17 hot papers, representing 1.9% of the PM papers, were identified in the analysis.

The authors cite themselves less than the average author. Five hundred thirty-seven (537) of the 9,578 cites are author self-cites. This 5.6% author self-citation rate is below the accepted range of 10-30% author self-citation rate.

Highly Cited PM Publications

The 904 PM papers reviewed for this analysis covered 14 of the 22 ESI fields. The distribution of the papers among these 14 fields and the number of citations by field are presented in Table 1.

Table 1. PM Papers by ESI Fields

ESI Field	No. of Citations	No. of EPA PM Papers	Average Cites/Paper
Clinical Medicine	2,441	157	15.55
Environment/Ecology	2,102	171	12.29
Geosciences	1,607	170	9.45
Engineering	1,256	176	7.14
Pharmacology & Toxicology	1,166	123	9.48
Chemistry	372	50	7.44
Biology & Biochemistry	197	20	9.85
Multidisciplinary	157	4	39.25
Immunology	155	8	19.37
Physics	73	10	7.30
Neuroscience & Behavior	30	4	7.50
Plant & Animal Sciences	12	3	4.00
Mathematics	7	4	1.75
Social Sciences	3	4	0.75
	Total = 9,578	**Total = 904**	**10.6**

There were 258 (28.5% of the papers analyzed) highly cited EPA PM papers in 10 of the 14 fields in which the papers are published—Environment/Ecology, Engineering, Pharmacology & Toxicology, Clinical Medicine, Multidisciplinary, Biology & Biochemistry, Chemistry, Molecular Biology & Genetics, Immunology, and Mathematics—when using the ESI criteria for the **top 10% of papers**. Table 2 shows the number of EPA papers in those 10 fields that met the **top 10% threshold in ESI**. Forty-nine (5.4%) of the papers analyzed qualified as highly cited when using the ESI criteria for the **top 1% of papers**. These papers covered five fields—Clinical Medicine, Engineering, Environment/Ecology, Geosciences, and Multidisciplinary. Table 3 shows the 49 papers by field that met the **top 1% threshold in ESI**. The citations for these 49 papers are provided in Tables 4 through 8. There were 12 very highly cited EPA PM papers in three fields—Engineering, Environment/Ecology, and Clinical Medicine (see Table 9). These 12 papers met the **top 0.1% threshold in ESI** (1.3% of the papers analyzed). The citations for these 12 very highly cited papers are listed in Table 10. Two (0.2% of the papers analyzed) of the PM papers actually met the **top 0.01% threshold in ESI** (see Table 11). These papers are presented in Table 12.

Table 2. Number of Highly Cited PM Papers by Field (top 10%)

ESI Field	No. of Citations	No. of Papers	Average Cites/Paper	% of EPA Papers in Field
Environment/Ecology	1,593	70	22.8	40.9%
Clinical Medicine	1,459	26	56.1	16.6%
Geosciences	1,176	59	19.9	34.7%
Engineering	1,028	70	14.7	39.8%
Pharmacology & Toxicology	570	16	35.6	13.0%
Chemistry	193	8	24.1	16.0%
Multidisciplinary	153	3	51.0	75.0%
Immunology	119	3	39.7	37.5%
Biology & Biochemistry	28	1	28.0	5.0%
Mathematics	5	2	2.5	50.0%
	Total = 6,324	**Total = 258**	**24.51**	**28.5%**

Table 3. Number of Highly Cited PM Papers by Field (top 1%)

ESI Field	No. of Citations	No. of Papers	Average Cites/Paper	% of EPA Papers in Field
Clinical Medicine	619	4	154.8	2.6%
Engineering	615	26	23.6	14.8%
Environment/Ecology	446	12	37.2	7.0%
Geosciences	328	5	65.6	2.9%
Multidisciplinary	88	1	88.0	25.0%
	Total = 2,096	**Total = 49**	**42.8**	**5.4%**

Table 4. Highly Cited PM Papers in the Field of Clinical Medicine (top 1%)

No. of Cites	First Author	Paper
275	Pope CA	Lung cancer, cardiopulmonary mortality, and long-term exposure to fine particulate air pollution. *JAMA-Journal of the American Medical Association* 2002;287(9):1132-1141.
124	Abbey DE	Long-term inhalable particles and other air pollutants related to mortality in nonsmokers. *American Journal of Respiratory and Critical Care Medicine* 1999;159(2):373-382.
124	Gold DR	Ambient pollution and heart rate variability. *Circulation* 2000;101(11):1267-1273.
96	Peters A	Increased particulate air pollution and the triggering of myocardial infarction. *Circulation* 2001;103(23):2810-2815.

Table 5. Highly Cited PM Papers in the Field of Engineering (top 1%)

No. of Cites	First Author	Paper
75	Jayne JT	Development of an aerosol mass spectrometer for size and composition analysis of submicron particles. *Aerosol Science and Technology* 2000;33(1-2):49-70.
56	Weber RJ	A particle-into-liquid collector for rapid measurement of aerosol bulk chemical composition. *Aerosol Science and Technology* 2001;35(3):718-727.
50	Woo KS	Measurement of Atlanta aerosol size distributions: Observations of ultrafine particle events. *Aerosol Science and Technology* 2001;34(1):75-87.

No. of Cites	First Author	Paper
40	Long CM	Characterization of indoor particle sources using continuous mass and size monitors. *Journal of the Air & Waste Management Association* 2000;50(7):1236-1250.
40	Sarnat JA	Assessing the relationship between personal particulate and gaseous exposures of senior citizens living in Baltimore, MD. *Journal of the Air & Waste Management Association* 2000;50(7):1184-1198.
35	Zhu YF	Concentration and size distribution of ultrafine particles near a major highway. *Journal of the Air & Waste Management Association* 2002;52(9):1032-1042.
33	Zhang Y	Simulation of aerosol dynamics: A comparative review of algorithms used in air quality models. *Aerosol Science and Technology* 1999;31(6):487-514.
31	Lewtas J	Comparison of sampling methods for semi-volatile organic carbon associated with $PM_{2.5}$. *Aerosol Science and Technology* 2001;34 (1):9-22.
28	McMurry PH	The relationship between mass and mobility for atmospheric particles: A new technique for measuring particle density. *Aerosol Science and Technology* 2002;36(2):227-238.
26	Christoforou CS	Trends in fine particle concentration and chemical composition in Southern California. *Journal of the Air & Waste Management Association* 2000;50(1):43-53.
25	Mallina RV	High speed particle beam generation: A dynamic focusing mechanism for selecting ultrafine particles, *Aerosol Science and Technology* 2000;33(1-2):87-104.
23	Tolocka MP	East versus West in the US: Chemical characteristics of PM2.5 during the winter of 1999. *Aerosol Science and Technology* 2001;34(1):88-96.
21	Mosley RB	Penetration of ambient fine particles into the indoor environment. *Aerosol Science and Technology* 2001;34(1):127-136.
19	Vette AF	Characterization of indoor-outdoor aerosol concentration relationships during the Fresno PM exposure studies. *Aerosol Science and Technology* 2001;34(1):118-126.
15	Phares DJ	Performance of a single ultrafine particle mass spectrometer. *Aerosol Science and Technology* 2002;36(5):583-592.
14	Zhang XF	A numerical characterization of particle beam collimation by an aerodynamic lens-nozzle system: Part I. An individual lens or nozzle. *Aerosol Science and Technology* 2002;36(5):617-631.
13	Frey HC	Quantification of variability and uncertainty in lawn and garden equipment NOx and total hydrocarbon emission factors. *Journal of the Air & Waste Management Association* 2002;52(4):435-448.

No. of Cites	First Author	Paper
13	Kim S	Size distribution and diurnal and seasonal trends of ultrafine particles in source and receptor sites of the Los Angeles basin. *Journal of the Air & Waste Management Association* 2002;52(3):297-307.
12	Lewis CW	Source apportionment of phoenix PM2.5 aerosol with the Unmix receptor model. *Journal of the Air & Waste Management Association* 2003;53(3):325-338.
11	Drewnick F	Measurement of ambient aerosol composition during the PMTACS-NY 2001 using an aerosol mass spectrometer. Part I: Mass concentrations. *Aerosol Science and Technology* 2004;38 (Suppl 1):92-103.
8	Drewnick F	Measurement of ambient aerosol composition during the PMTACS-NY 2001 using an aerosol mass spectrometer. Part II: Chemically speciated mass distributions. *Aerosol Science and Technology* 2004;38(Suppl 1):104-117.
7	Cho AK	Determination of four quinones in diesel exhaust particles, SRM 1649a, an atmospheric $PM_{2.5}$. *Aerosol Science and Technology* 2004;38(Suppl 1):68-81.
6	Stanier CO	Nucleation events during the Pittsburgh air quality study: Description and relation to key meteorological, gas phase, and aerosol parameters. *Aerosol Science and Technology* 2004;38(Suppl 1):253-264.
6	Hogrefe O	Development, operation and applications of an aerosol generation, calibration and research facility. *Aerosol Science and Technology* 2004;38(Suppl 1):196-214.
5	Canagaratna MR	Chase studies of particulate emissions from in-use New York City vehicles. *Aerosol Science and Technology* 2004;38(6):555-573.
3	Stanier CO	A method for the in situ measurement of fine aerosol water content of ambient aerosols: The dry-ambient aerosol size spectrometer (DAASS). *Aerosol Science and Technology* 2004;38(Suppl 1):215-228.

Table 6. Highly Cited PM Papers in the Field of Environment/Ecology (top 1%)

No. of Cites	First Author	Paper
110	Liao DP	Daily variation of particulate air pollution and poor cardiac autonomic control in the elderly. *Environmental Health Perspectives* 1999;107(7):521-525.
96	Laden F	Association of fine particulate matter from different sources with daily mortality in six US cities. *Environmental Health Perspectives* 2000;108(10):941-947.

No. of Cites	First Author	Paper
69	Oberdorster G	Pulmonary effects of inhaled ultrafine particles. *International Archives of Occupational and Environmental Health* 2001;74 (1):1-8.
43	Dockery DW	Epidemiologic evidence of cardiovascular effects of particulate air pollution. *Environmental Health Perspectives* 2001;109(Suppl 4):483-486.
41	Li N	Ultrafine particulate pollutants induce oxidative stress and mitochondrial damage. *Environmental Health Perspectives* 2003;111(4):455-460.
32	Lioy PJ	Characterization of the dust/smoke aerosol that settled east of the World Trade Center (WTC) in Lower Manhattan after the collapse of the WTC 11 September 2001. *Environmental Health Perspectives* 2002;110(7):703-714.
20	Park K	Relationship between particle mass and mobility for diesel exhaust particles. *Environmental Science & Technology* 2003;37(3):577-583.
12	Offenberg JH	Persistent organic pollutants in the dusts that settled across lower Manhattan after September 11, 2001. *Environmental Science & Technology* 2003;37(3):502-508.
11	McGee JK	Chemical analysis of World Trade Center fine particulate matter for use in toxicologic assessment. *Environmental Health Perspectives* 2003;111(7):972-980.
4	DeMarini DM	Bioassay-directed fractionation and Salmonella mutagenicity of automobile and forklift diesel exhaust particles. *Environmental Health Perspectives* 2004;112(8):814-819.
4	Landrigan PJ	Health and environmental consequences of the World Trade Center disaster. *Environmental Health Perspectives* 2004;112(6):731-739.
4	Singh P	Sample characterization of automobile and forklift diesel exhaust particles and comparative pulmonary toxicity in mice. *Environmental Health Perspectives* 2004;112(8):820-825.

Table 7. Highly Cited PM Papers in the Field of Geosciences (top 1%)

No. of Cites	First Author	Paper
97	Yu JZ	Gas-phase ozone oxidation of monoterpenes gaseous and particulate products. *Journal of Atmospheric Chemistry* 1999;34(2):107-258.
92	Simoneit BRT	Levoglucosan, a tracer for cellulose in biomass burning and atmospheric particles. *Atmospheric Environment* 1999;33(2):173-182.

No. of Cites	First Author	Paper
86	Griffin RJ	Organic aerosol formation from the oxidation of biogenic carbons. *Journal of Geophysical Research – Atmospheres* 1999;104(D3):3555-3567.
32	Zhu YF	Study of ultrafine particles near a major highway with heavy-duty diesel traffic. *Atmospheric Environment* 2002;36(27):4323-4335.
21	Orsini DA	Refinements to the particle-into-liquid sampler (PILS) for ground and airborne measurements of water soluble aerosol composition. *Atmospheric Environment* 2003;37(9-10):1243-1259.

Table 8. Highly Cited PM Papers in the Field of Multidisciplinary (top 1%)

No. of Cites	First Author	Paper
88	Gard EE	Direct observation of heterogeneous chemistry in the atmosphere. *Science* 1998;279(5354):1184-1187.

Table 9. Number of Highly Cited PM Papers by Field (top 0.1%)

ESI Field	No. of Citations	No. of Papers	Average Cites/Paper	% of EPA Papers in Field
Clinical Medicine	275	1	275.0	%
Engineering	259	10	25.9	14.8%
Environment/Ecology	41	1	41.0	7.0%
	Total = 575	**Total = 12**	**47.9**	**1.3%**

Table 10. Very Highly Cited PM Papers (Top 0.1%)

Field	No. of Cites	First Author	Paper
Clinical Medicine	275	Pope CA	Lung cancer, cardiopulmonary mortality, and long-term exposure to fine particulate air pollution. *JAMA-Journal of the American Medical Association* 2002;287(9):1132-1141.
Engineering	75	Jayne JT	Development of an aerosol mass spectrometer for size and composition analysis of submicron particles. *Aerosol Science and Technology* 2000;33(1-2):49-70.

Field	No. of Cites	First Author	Paper
Engineering	56	Weber RJ	A particle-into-liquid collector for rapid measurement of aerosol bulk chemical composition. *Aerosol Science and Technology* 2001;35(3):718-727.
	50	Woo KS	Measurement of Atlanta aerosol size distributions: observations of ultrafine particle events. *Aerosol Science and Technology* 2001;34(1):75-87.
	35	Zhu YF	Concentration and size distribution of ultrafine particles near a major highway. *Journal of the Air & Waste Management Association* 2002;52(9):1032-1042.
	11	Drewnick	Measurement of ambient aerosol composition during the PMTACS-NY 2001 using an aerosol mass spectrometer. Part I: Mass concentrations. *Aerosol Science and Technology* 2004;38 (Suppl 1):92-103.
	8	Drewnick	Measurement of ambient aerosol composition during the PMTACS-NY 2001 using an aerosol mass spectrometer. Part II: Chemically speciated mass distributions. *Aerosol Science and Technology* 2004;38(Suppl 1):104-117.
	7	Cho AK	Determination of four quinones in diesel exhaust particles, SRM 1649a, an atmospheric $PM_{2.5}$. *Aerosol Science and Technology* 2004;38(Suppl 1):68-81.
	6	Hogrefe O	Development, operation and applications of an aerosol generation, calibration and research facility. *Aerosol Science and Technology* 2004;38(Suppl 1):196-214.
	6	Stanier CO	Nucleation events during the Pittsburgh air quality study: Description and relation to key meteorological, gas phase, and aerosol parameters. *Aerosol Science and Technology* 2004;38(Suppl 1):253-264.
	5	Canagaratna MR	Chase studies of particulate emissions from in-use New York City vehicles. *Aerosol Science and Technology* 2004;38(6):555-573.
Environment/ Ecology	41	Li N	Ultrafine particulate pollutants induce oxidative stress and mitochondrial damage. *Environmental Health Perspectives* 2003;111(4):455-460.

Table 11. Number of Extremely Highly Cited PM Papers by Field (top 0.01%)

ESI Field	No. of Citations	No. of Papers	Average Cites/Paper	% of EPA Papers in Field
Engineering	19	2	9.5	0.2%
	Total = 19	**Total = 2**	**9.5**	**0.2%**

Table 12. Extremely Highly Cited PM Papers (Top 0.01%)

Field	No. of Cites	First Author	Paper
Engineering	11	Drewnick	Measurement of ambient aerosol composition during the PMTACS-NY 2001 using an aerosol mass spectrometer. Part I: Mass concentrations. *Aerosol Science and Technology* 2004;38 (Suppl 1):92-103.
	8	Drewnick	Measurement of ambient aerosol composition during the PMTACS-NY 2001 using an aerosol mass spectrometer. Part II: Chemically speciated mass distributions. *Aerosol Science and Technology* 2004;38(Suppl 1):104-117.

Ratio of Actual Cites to Expected Citation Rates

The expected citation rate is the average number of cites that a paper published in the same journal in the same year and of the same document type (article, review, editorial, etc.) has received from the year of publication to the present. Using the ESI average citation rates for papers published by field as the benchmark, in 10 of the 14 fields in which the EPA PM papers were published, the ratio of actual to expected cites is greater than 1, indicating that the EPA papers are more highly cited than the average papers in those fields. For all 14 fields combined, the ratio of actual to expected cites (9,578 to 4,116.80) is 2.3, indicating that the PM papers are more highly cited than the average paper (see Table 13).

Table 13. Ratio of Average Cites to Expected Cites for PM Papers by Field

ESI Field	Total Cites	Expected Cite Rate	Ratio
Biology & Biochemistry	197	218.48	0.9
Chemistry	372	277.52	1.3
Clinical Medicine	2,441	1,003.49	2.4
Engineering	1,256	275.21	4.6
Environment/Ecology	2,102	713.18	2.9
Geosciences	1,607	665.28	2.4
Immunology	155	103.32	1.5
Mathematics	7	2.50	2.8
Multidisciplinary	157	21.22	7.4
Neuroscience & Behavior	30	34.01	0.9
Pharmacology & Toxicology	1,166	714.26	1.6
Physics	73	45.02	1.6
Plant & Animal Science	12	39.24	0.3
Social Sciences	3	4.07	0.7
Totals	**9,578**	**4,116.80**	**2.3**

JCR Benchmarks

The Impact Factor is a well known metric in citation analysis. It is a measure of the frequency with which the *average article* in a journal has been cited in a particular year. The Impact Factor helps evaluate a journal's relative importance, especially when compared to others in the same field. The Impact Factor is calculated by dividing the number of citations in the current year to articles published in the 2 previous years by the total number of articles published in the 2 previous years.

Table 14 indicates the number of PM papers published in the top 10% of journals, based on the JCR Impact Factor. Two hundred fifty-four (254) of 904 papers were published in the top 10% of journals, representing 28% of EPA's PM papers.

Table 14. PM Papers in Top 10% of Journals by JCR Impact Factor

EPA PM Papers in that Journal	Journal	Impact Factor (IF)	JCR IF Rank
64	Environmental Health Perspectives	3.408	538
62	Environmental Science & Technology	3.592	487
26	American Journal of Physiology-Lung Cellular and Molecular Physiology	3.735	435
20	Epidemiology	4.220	350
17	American Journal of Respiratory and Critical Care Medicine	8.876	100
17	American Journal of Respiratory Cell and Molecular Biology	4.015	380
7	Analytical Chemistry	5.250	248
5	Circulation	11.164	72
4	Journal of Biological Chemistry	6.482	179
4	Journal of Immunology	6.702	167
3	Science	29.781	11
3	Free Radical Biology and Medicine	5.063	260
3	American Journal of Epidemiology	4.486	310
3	Thorax	4.188	356
2	Lancet	18.316	28
2	Chest	3.264	585
2	Chemical Research in Toxicology	3.332	555
1	New England Journal of Medicine	34.833	5
1	JAMA-Journal of the American Medical Association	21.455	22
1	Journal of Clinical Investigation	14.307	44
1	Proceedings of the National Academy of Sciences	10.272	81
1	Cancer Research	8.649	105
1	FASEB Journal	7.172	149
1	Journal of Allergy and Clinical Immunology	6.831	162
1	Advanced Drug Delivery Reviews	6.588	170
1	Critical Care Medicine	4.195	353

EPA PM Papers in that Journal	Journal	Impact Factor (IF)	JCR IF Rank
1	Journal of Leukocyte Biology	4.180	357
Total = 254			

Immediacy Index

The journal Immediacy Index is a measure of how quickly the *average article* in a journal is cited. It indicates how often articles published in a journal are cited within the year they are published. The Immediacy Index is calculated by dividing the number of citations to articles published in a given year by the number of articles published in that year.

Table 15 indicates the number of EPA papers published in the top 10% of journals, based on the JCR Immediacy Index. Two-hundred sixty-seven (267) of the 904 papers appear in the top 10% of journals, representing 29.5% of EPA's PM papers.

Table 15. PM Papers in Top 10% of Journals by JCR Immediacy Index

EPA Papers in that Journal	Journal	Immediacy Index (II)	JCR II Rank
64	Environmental Health Perspectives	0.869	304
52	Journal of Geophysical Research - Atmospheres	0.827	334
26	American Journal of Physiology-Lung Cellular and Molecular Physiology	0.654	496
20	Epidemiology	0.938	264
19	Journal of Aerosol Science	0.686	462
17	American Journal of Respiratory Cell and Molecular Biology	0.623	546
17	American Journal of Respiratory and Critical Care Medicine	2.461	56
7	Analytical Chemistry	0.657	493
5	Circulation	1.946	82
4	Journal of Immunology	0.988	239
4	Philosophical Transactions of the Royal Society of London Series A-Mathematical Physical and Engineering Sciences	0.867	305
4	Journal of Biological Chemistry	1.231	160

EPA Papers in that Journal	Journal	Immediacy Index (II)	JCR II Rank
3	American Journal of Epidemiology	0.908	281
3	Free Radical Biology and Medicine	0.712	432
3	Thorax	1.237	158
3	Science	5.589	12
2	Biometals	0.717	424
2	Lancet	5.826	10
1	Journal of Chemical Physics	0.661	487
1	Journal of Clinical Investigation	2.946	41
1	Critical Care Medicine	1.103	192
1	Journal of Allergy and Clinical Immunology	1.465	123
1	Journal of Leukocyte Biology	0.671	473
1	Cancer Research	0.935	268
1	FASEB Journal	1.247	154
1	New England Journal of Medicine	11.719	2
1	Advanced Drug Delivery Reviews	0.805	352
1	Proceedings of the National Academy of Sciences	1.935	83
1	American Journal of Industrial Medicine	0.616	552
1	JAMA-Journal of the American Medical Association	6.048	9
Total = 267			

Hot Papers

ESI establishes citation thresholds for hot papers, which are selected from the highly cited papers in different fields, but the time frame for citing and cited papers is much shorter—papers must be cited within 2 years of publication and the citations must occur in a 2-month time period. Papers are assigned to 2-month periods and thresholds are set for each period and field to select 0.1% of papers. There were no hot papers identified for the current 2-month period (i.e., January-February 2005), but there were a number of hot papers identified from previous periods.

Using the hot paper thresholds established by ESI as a benchmark, 17 hot papers, representing 1.9% of the PM papers, were identified in four fields—Clinical Medicine,

Geosciences, Environment/Ecology, and Engineering. The hot papers are listed in Table 16.

Table 16. Hot Papers Identified Using ESI Thresholds

Field	ESI Hot Papers Threshold	No. of Cites in 2-Month Period	Paper
Clinical Medicine	12	15 cites in November-December 2003	Pope CA, et al. Lung cancer, cardiopulmonary mortality, and long-term exposure to fine particulate air pollution. *JAMA–Journal of the American Medical Association* 2002;287(9):1132-1141.
Geosciences	10	10 cites in June-July 2004	Orsini DA, et al. Refinements to the particle-into-liquid sampler (PILS) for ground and airborne measurements of water soluble aerosol composition. *Atmospheric Environment* 2003;37(9-10):1243-1259.
Environment/ Ecology	8	9 cites in May-June 2004	Li N, et al. Ultrafine particle pollutants induce oxidative stress and mitochondrial damage. *Environmental Health Perspectives* 2003;111(4):455-460.
	9	9 cites in September-October 2002	Laden F, et al. Association of fine particulate matter from different sources with daily mortality in six US cities. *Environmental Health Perspectives* 2000;108(10):941-947.
	8	9 cites in April-May 2004	Lioy PJ, et al. Characterization of the dust/smoke aerosol that settled east of the World Trade Center (WTC) in Lower Manhattan after the collapse of the WTC 11 September 2001. *Environmental Health Perspectives* 2002;110(7):703-714.
	7	7 cites in September-October 2003	Jang MS, Kamens RM. Atmospheric secondary aerosol formation by heterogeneous reactions of aldehydes in the presence of a sulfuric acid aerosol catalyst. *Environmental Science & Technology* 2001;35(24):4758-4766.
	3	4 cites in July-August 2000	Stolzenburg MR, Hering SV. Method for the automated measurement of fine particle nitrate in the atmosphere. *Environmental Science & Technology* 2000;34(5):907-914.
Engineering	4	4 cites in July 2002	Long CM, et al. Characterization of indoor particle sources using continuous mass and size monitors. *Journal of the Air & Waste Management Association* 2000;50(7):1236-1250.

Field	ESI Hot Papers Threshold	No. of Cites in 2-Month Period	Paper
Engineering	4	4 cites in May-June 2002	Jayne JT, et al. Development of an aerosol mass spectrometer for size and composition analysis of submicron particles. *Aerosol Science and Technology* 2000;33(1-2):49-70.
	4	4 cites in May 2002	Mallina RV, et al. High speed particle beam generation: a dynamic focusing mechanism for selecting ultrafine particles. *Aerosol Science and Technology* 2000;33(1-2):87-104.
	4	4 cites in November-December 2001	Christoforou CS, et al. Trends in fine particle concentration and chemical composition in Southern California. *Journal of the Air & Waste Management Association* 2000;50(1):43-53.
	4	4 cites in June-July 2002	Sarnat JA, et al. Assessing the relationship between personal particulate and gaseous exposures of senior citizens living in Baltimore, MD. *Journal of the Air & Waste Management Association* 2000;50(7):1184-1198.
	4	4 cites in February-March 2003	McMurry PH, et al. The relationship between mass and mobility for atmospheric particles: a new technique for measuring particle density. *Aerosol Science and Technology* 2002;36(2):227-238.
	5	6 cites in April-May 2004	Zhu YF, et al. Concentration and size distribution of ultrafine particles near a major highway. *Journal of the Air & Waste Management Association* 2002;52(9):1032-1042.
	4	4 cites in April-May 2004	Offenberg JH, et al. Persistent organic pollutants in the dusts that settled across lower Manhattan after September 11, 2001. *Environmental Science & Technology* 2003;37(3):502-508.
	3	4 cites in November 2004	Canagaratna MR, et al. Chase studies of particulate emissions from in-use New York City vehicles. *Aerosol Science and Technology* 2004;38(6):555-573.
	3	4 cites in November-December 2004	Drewnick F, et al. Measurement of ambient aerosol composition during the PMTACS-NY 2001 using an aerosol mass spectrometer, Part I: mass concentrations. *Aerosol Science and Technology* 2004;38(Suppl 1):92-103.

Author Self-Citation

Self-citations are journal article references to articles from that same author (i.e., the first author). Because higher author self-citation rates can inflate the number of citations, the author self-citation rate was calculated for the PM papers. Of the 9,578 total cites, 537 are author self-cites—a 5.6% author self-citation rate. Garfield and Sher[2] found that authors working in research-based disciplines tend to cite themselves on the average of 20% of the time. MacRoberts and MacRoberts[3] claim that approximately 10% to 30% of all the citations listed fall into the category of author self-citation. Therefore, the 5.6% self-cite rate for the PM papers is below the range for author self-citation.

[2] Garfield E, Sher IH. New factors in the evaluation of scientific literature through citation indexing. *American Documentation* 1963;18(July):195-201.

[3] MacRoberts MH, MacRoberts BR. Problems of citation analysis: a critical review. *Journal of the American Society of Information Science* 1989;40(5):342-349.