



BIBLIOMETRICS REPORT

A Bibliometric Analysis of NOAA CSL Publications

2015 – 2020

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Introduction

Bibliometrics is the quantitative analysis of scholarly publications and citations, used to provide insights into the value and influence of published research. Using publication and citation data, bibliometric analysis can be used to evaluate impact, identify collaborators and experts, choose the best journals for publishing research, inform research priorities, and reveal emerging research trends.

For researchers, bibliometrics can answer the following questions:

- Who is using our research?
- Is there evidence of our research impact?
- Which institutions are funding research in our subject areas?
- Are we publishing in the right journals?
- How do our metrics compare to our peers in the field?

It must be noted that while bibliometric analyses can be useful in evaluating research impact, there are inherent limitations to this type of analysis. Bibliometric indicators are often taken out of context and applied without a full understanding of what they measure. Bibliometrics should always be used in conjunction with other forms of evaluation, such as peer review. See Appendix I for more about the responsible use of bibliometrics.

This report analyzes publication and citation data for NOAA's Chemical Sciences Laboratory (CSL) from January 1, 2015 through November 30, 2020. Our Web of Science (WoS) search for CSL publications in that time period produced 713 titles (see Appendix II for details on method and data sources). CSL titles not indexed in WoS are excluded from this analysis.

This bibliometrics report analyzes CSL publications in the following areas:

- General Productivity: Presents a summary of basic publication metrics.
- Collaboration: Shows coauthor and institutional relationships.
- Citation Impact: Explores publication and citation data for insights into the value and impact of CSL's work, in two sections:
 - Citation analysis (Where, by whom, and how often CSL's publications are cited).
 - Benchmarking (How CSL's citation metrics compare to those of their peers in the field).



Part A. General Productivity

General productivity metrics for CSL publications, Jan. 2015 – Nov. 2020.

Summary Metrics	
Total number of publications	713
Total times cited	17,400
Average citations per publication	24
Group h-index	63
Number of papers with CSL first author	141

Table 1. Common bibliometric indicators.

An h-index of 63 indicates that this group of 713 publications includes 63 papers that have each received 63 or more citations (Hirsch 2005). Note that this is not an average of CSL researcher h-indices, but the collective h-index for this set of 713 papers.



Figure 1. Number of CSL publications per year, 2015 – 2020

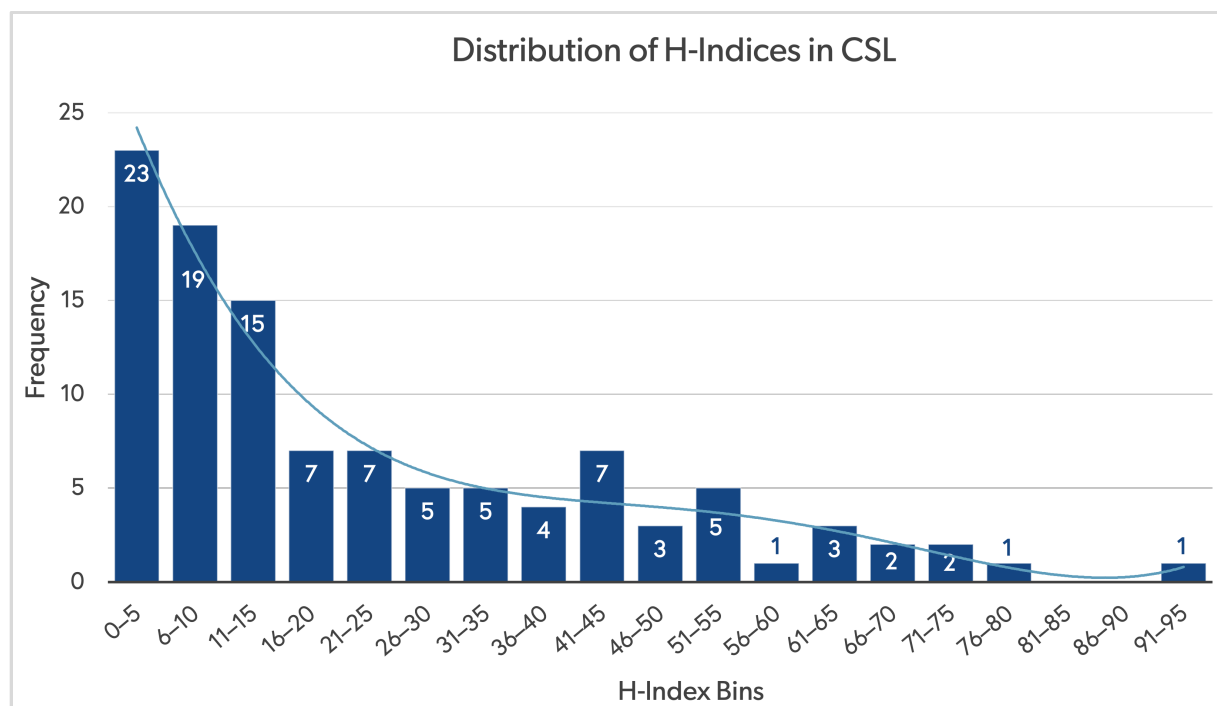


Figure 2. Distribution of H-Indices of CSL Scientists

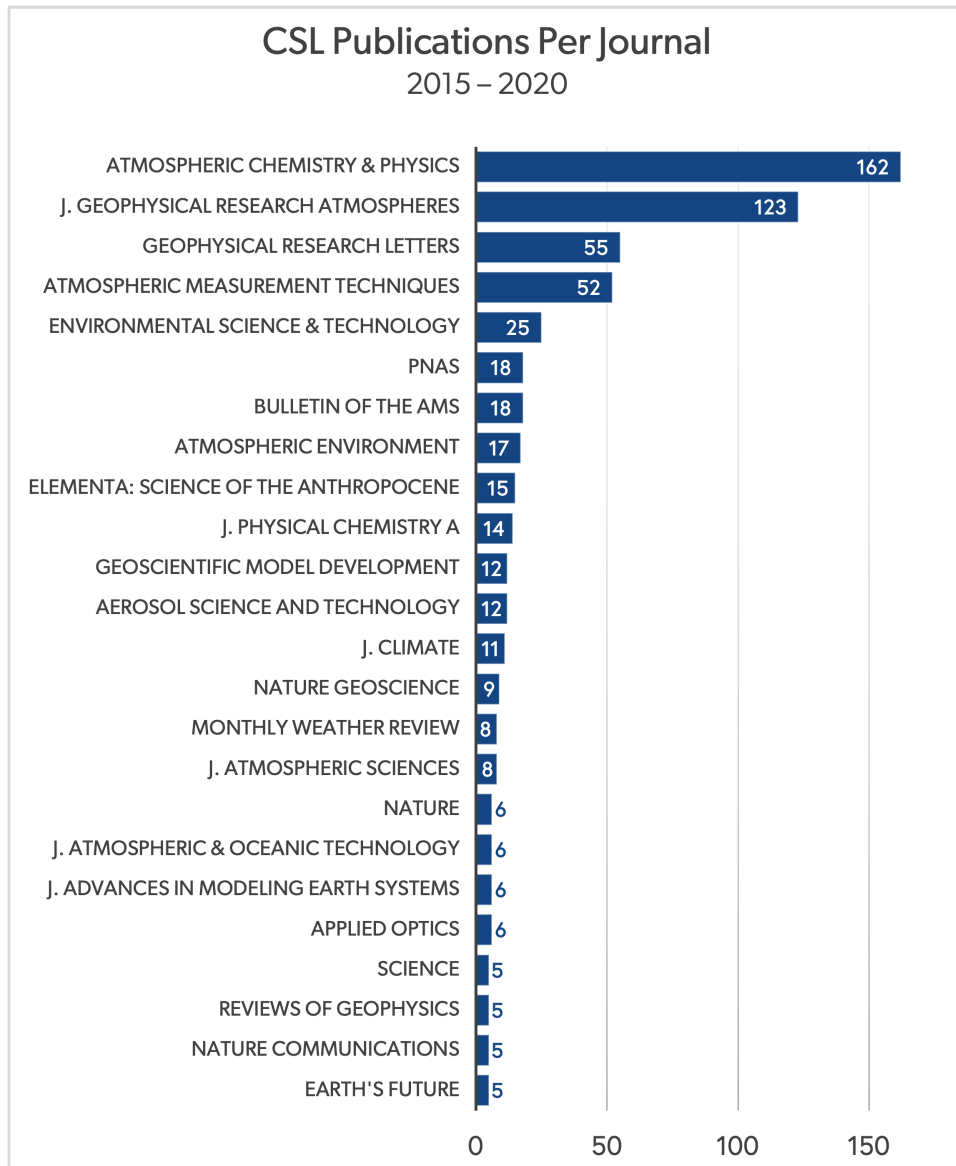


Figure 3. Journals in which CSL has published five or more times.

Table 2. CSL top-cited papers 2015-2020	Times cited	Highly cited
Stanaway, J.D., and A. Afshin, and E. Gakidou, and S.S. Lim, and D. Abate, and K.H. Abate, . . . C.J.L. Murray, 2018: Global, regional, and national comparative risk assessment of 84 behavioural, environmental and occupational, and metabolic risks or clusters of risks for 195 countries and territories, 1990-2017: a systematic analysis for the Global Burden of Disease Study 2017. <i>Lancet</i> , 392, 1923-1994. doi:10.1016/s0140-6736(18)32225-6.	711	
Monks, P.S., A.T. Archibald, A. Colette, O. Cooper, M. Coyle, R. Derwent, . . . M.L. Williams, 2015: Tropospheric ozone and its precursors from the urban to the global scale from air quality to short-lived climate forcer. <i>Atmospheric Chemistry and Physics</i> , 15, 8889-8973. doi:10.5194/acp-15-8889-2015.	366	✓
Janssens-Maenhout, G., M. Crippa, D. Guizzardi, F. Dentener, M. Muntean, G. Pouliot, . . . M. Li, 2015: HTAP_v2.2: a mosaic of regional and global emission grid maps for 2008 and 2010 to study hemispheric transport of air pollution. <i>Atmospheric Chemistry and Physics</i> , 15, 11411-11432. doi:10.5194/acp-15-11411-2015.	290	✓
Xu, L., H.Y. Guo, C.M. Boyd, M. Klein, A. Bougiatioti, K.M. Cerully, . . . N.L. Ng, 2015: Effects of anthropogenic emissions on aerosol formation from isoprene and monoterpenes in the southeastern United States. <i>Proceedings of the National Academy of Sciences of the United States of America</i> , 112, 37-42. doi:10.1073/pnas.1417609112.	283	✓
Trostl, J., W.K. Chuang, H. Gordon, M. Heinritzi, C. Yan, U. Molteni, . . . U. Baltensperger, 2016: The role of low-volatility organic compounds in initial particle growth in the atmosphere. <i>Nature</i> , 533, 527-+. doi:10.1038/nature18271.	263	✓
McDonald, B.C., J.A. de Gouw, J.B. Gilman, S.H. Jathar, A. Akherati, C.D. Cappa, . . . M. Trainer, 2018: Volatile chemical products emerging as largest petrochemical source of urban organic emissions. <i>Science</i> , 359, 760-764. doi:10.1126/science.aaq0524.	188	✓
Seinfeld, J.H., C. Bretherton, K.S. Carslaw, H. Coe, P.J. DeMott, E.J. Dunlea, . . . R. Wood, 2016: Improving our fundamental understanding of the role of aerosol-cloud interactions in the climate system. <i>Proceedings of the National Academy of Sciences of the United States of America</i> , 113, 5781-5790. doi:10.1073/pnas.1514043113.	184	✓
Travis, K.R., D.J. Jacob, J.A. Fisher, P.S. Kim, E.A. Marais, L. Zhu, . . . X.L. Zhou, 2016: Why do models overestimate surface ozone in the Southeast United States? <i>Atmospheric Chemistry and Physics</i> , 16, 13561-13577. doi:10.5194/acp-16-13561-2016.	170	✓
Simpson, W.R., S.S. Brown, A. Saiz-Lopez, J.A. Thornton, and R. von Glasow, 2015: Tropospheric Halogen Chemistry: Sources, Cycling, and Impacts. <i>Chemical Reviews</i> , 115, 4035-4062. doi:10.1021/cr5006638.	163	✓
Alvarez, R.A., D. Zavala-Araiza, D.R. Lyon, D.T. Allen, Z.R. Barkley, A.R. Brandt, . . . S.P. Hamburg, 2018: Assessment of methane emissions from the US oil and gas supply chain. <i>Science</i> , 361, 186-188. doi:10.1126/science.aar7204.	151	✓
Butler, A.H., D.J. Seidel, S.C. Hardiman, N. Butchart, T. Birner, and A. Match, 2015: Defining Sudden Stratospheric Warmings. <i>Bulletin of the American Meteorological Society</i> , 96, 1913-1928. doi:10.1175/bams-d-13-00173.1.	146	✓

Table 2. CSL top-cited papers 2015-2020 (continued)	Times cited	Highly cited
West, J.J., A. Cohen, F. Dentener, B. Brunekreef, T. Zhu, B. Armstrong, . . . C. Wiedinmyer, 2016: What We Breathe Impacts Our Health: Improving Understanding of the Link between Air Pollution and Health. <i>Environmental Science & Technology</i> , 50, 4895-4904. doi:10.1021/acs.est.5b03827.	145	✓
Forrister, H., J. Liu, E. Scheuer, J. Dibb, L. Ziemba, K.L. Thornhill, . . . R.J. Weber, 2015: Evolution of brown carbon in wildfire plumes. <i>Geophysical Research Letters</i> , 42, 4623-4630. doi:10.1002/2015gl063897.	139	✓
Gentner, D.R., S.H. Jathar, T.D. Gordon, R. Bahreini, D.A. Day, I. El Haddad, . . . A.L. Robinson, 2017: Review of Urban Secondary Organic Aerosol Formation from Gasoline and Diesel Motor Vehicle Emissions. <i>Environmental Science & Technology</i> , 51, 1074-1093. doi:10.1021/acs.est.6b04509.	139	✓
Ng, N.L., S.S. Brown, A.T. Archibald, E. Atlas, R.C. Cohen, J.N. Crowley, . . . R.A. Zaveri, 2017: Nitrate radicals and biogenic volatile organic compounds: oxidation, mechanisms, and organic aerosol. <i>Atmospheric Chemistry and Physics</i> , 17, 2103-2162. doi:10.5194/acp-17-2103-2017.	133	✓
Stockwell, C.E., P.R. Veres, J. Williams, and R.J. Yokelson, 2015: Characterization of biomass burning emissions from cooking fires, peat, crop residue, and other fuels with high-resolution proton-transfer-reaction time-of-flight mass spectrometry. <i>Atmospheric Chemistry and Physics</i> , 15, 845-865. doi:10.5194/acp-15-845-2015.	127	✓
Lee, B.H., C. Mohr, F.D. Lopez-Hilfiker, A. Lutz, M. Hallquist, L. Lee, . . . J.A. Thornton, 2016: Highly functionalized organic nitrates in the southeast United States: Contribution to secondary organic aerosol and reactive nitrogen budgets. <i>Proceedings of the National Academy of Sciences of the United States of America</i> , 113, 1516-1521. doi:10.1073/pnas.1508108113.	125	✓
Crippa, M., G. Janssens-Maenhout, F. Dentener, D. Guizzardi, K. Sindelarova, M. Muntean, . . . C. Granier, 2016: Forty years of improvements in European air quality: regional policy-industry interactions with global impacts. <i>Atmospheric Chemistry and Physics</i> , 16, 3825-3841. doi:10.5194/acp-16-3825-2016.	125	✓
Marais, E.A., D.J. Jacob, J.L. Jimenez, P. Campuzano-Jost, D.A. Day, W. Hu, . . . V.F. McNeill, 2016: Aqueous-phase mechanism for secondary organic aerosol formation from isoprene: application to the southeast United States and co-benefit of SO ₂ emission controls. <i>Atmospheric Chemistry and Physics</i> , 16, 1603-1618. doi:10.5194/acp-16-1603-2016.	124	✓
Ervens, B., 2015: Modeling the Processing of Aerosol and Trace Gases in Clouds and Fogs. <i>Chemical Reviews</i> , 115, 4157-4198. doi:10.1021/cr5005887.	121	
Kim, P.S., D.J. Jacob, J.A. Fisher, K. Travis, K. Yu, L. Zhu, . . . A.E. Perring, 2015: Sources, seasonality, and trends of southeast US aerosol: an integrated analysis of surface, aircraft, and satellite observations with the GEOS-Chem chemical transport model. <i>Atmospheric Chemistry and Physics</i> , 15, 10411-10433. doi:10.5194/acp-15-10411-2015.	121	✓

Table 2. CSL's 20 highest-cited papers 2015-2020.

"Highly cited" papers are those in the top 1% of cited papers in a given research category (Clarivate Analytics, 2020(a,b)). Citation counts as of November 30, 2020.

Table 3. CSL top-cited papers, 2010-2014	Times cited as of 12/31/2020
Bond, T.C., S.J. Doherty, D.W. Fahey, P.M. Forster, T. Berntsen, B.J. DeAngelo, . . . C.S. Zender, 2013: Bounding the role of black carbon in the climate system: A scientific assessment. <i>Journal of Geophysical Research-Atmospheres</i> , 118, 5380-5552. doi:10.1002/jgrd.50171.	2513
Meinshausen, M., S.J. Smith, K. Calvin, J.S. Daniel, M.L.T. Kainuma, J.F. Lamarque, . . . D.P.P. van Vuuren, 2011: The RCP greenhouse gas concentrations and their extensions from 1765 to 2300. <i>Climatic Change</i> , 109, 213-241. doi:10.1007/s10584-011-0156-z.	1809
Lamarque, J.F., T.C. Bond, V. Eyring, C. Granier, A. Heil, Z. Klimont, . . . D.P. van Vuuren, 2010: Historical (1850-2000) gridded anthropogenic and biomass burning emissions of reactive gases and aerosols: methodology and application. <i>Atmospheric Chemistry and Physics</i> , 10, 7017-7039. doi:10.5194/acp-10-7017-2010.	1313
Emmons, L.K., S. Walters, P.G. Hess, J.F. Lamarque, G.G. Pfister, D. Fillmore, . . . S. Kloster, 2010: Description and evaluation of the Model for Ozone and Related chemical Tracers, version 4 (MOZART-4). <i>Geoscientific Model Development</i> , 3, 43-67. doi:10.5194/gmd-3-43-2010.	938
Solomon, S., K.H. Rosenlof, R.W. Portmann, J.S. Daniel, S.M. Davis, T.J. Sanford, and G.K. Plattner, 2010: Contributions of Stratospheric Water Vapor to Decadal Changes in the Rate of Global Warming. <i>Science</i> , 327, 1219-1223. doi:10.1126/science.1182488.	663
Ervens, B., B.J. Turpin, and R.J. Weber, 2011: Secondary organic aerosol formation in cloud droplets and aqueous particles (aqSOA): a review of laboratory, field and model studies. <i>Atmospheric Chemistry and Physics</i> , 11, 11069-11102. doi:10.5194/acp-11-11069-2011.	630
Ng, N.L., M.R. Canagaratna, Q. Zhang, J.L. Jimenez, J. Tian, I.M. Ulbrich, . . . D.R. Worsnop, 2010: Organic aerosol components observed in Northern Hemispheric datasets from Aerosol Mass Spectrometry. <i>Atmospheric Chemistry and Physics</i> , 10, 4625-4641. doi:10.5194/acp-10-4625-2010.	546
Wunch, D., G.C. Toon, J.F.L. Blavier, R.A. Washenfelder, J. Notholt, B.J. Connor, . . . P.O. Wennberg, 2011: The Total Carbon Column Observing Network. <i>Philosophical Transactions of the Royal Society a-Mathematical Physical and Engineering Sciences</i> , 369, 2087-2112. doi:10.1098/rsta.2010.0240.	511
Thompson, D.W.J., S. Solomon, P.J. Kushner, M.H. England, K.M. Grise, and D.J. Karoly, 2011: Signatures of the Antarctic ozone hole in Southern Hemisphere surface climate change. <i>Nature Geoscience</i> , 4, 741-749. doi:10.1038/ngeo1296.	498
Granier, C., B. Bessagnet, T. Bond, A. D'Angiola, H.D. van der Gon, G.J. Frost, . . . D.P. van Vuuren, 2011: Evolution of anthropogenic and biomass burning emissions of air pollutants at global and regional scales during the 1980-2010 period. <i>Climatic Change</i> , 109, 163-190. doi:10.1007/s10584-011-0154-1.	463

Table 3. CSL's 10 highest-cited papers 2010-2014.

CSL publications from the prior review period continue to be highly cited. Citation counts as of December 31, 2020.

Table 4. Top 20 Altmetric Scores	Altmetric Attention Score	Policy document citations *
Alvarez, R.A., D. Zavala-Araiza, D.R. Lyon, D.T. Allen, Z.R. Barkley, A.R. Brandt, . . . S.P. Hamburg, 2018: Assessment of methane emissions from the US oil and gas supply chain. <i>Science</i> , 361, 186-188. doi:10.1126/science.aar7204.	2662	11
McDonald, B.C., J.A. de Gouw, J.B. Gilman, S.H. Jathar, A. Akherati, C.D. Cappa, . . . M. Trainer, 2018: Volatile chemical products emerging as largest petrochemical source of urban organic emissions. <i>Science</i> , 359, 760-764. doi:10.1126/science.aaq0524.	2366	4
Montzka, S.A., G.S. Dutton, P.F. Yu, E. Ray, R.W. Portmann, J.S. Daniel, . . . J.W. Elkins, 2018: An unexpected and persistent increase in global emissions of ozone-depleting CFC-11. <i>Nature</i> , 557, 413-+. doi:10.1038/s41586-018-0106-2.	2250	5
Ball, W.T., J. Alsing, D.J. Mortlock, J. Staehelin, J.D. Haigh, T. Peter, . . . E.V. Rozanov, 2018: Evidence for a continuous decline in lower stratospheric ozone offsetting ozone layer recovery. <i>Atmospheric Chemistry and Physics</i> , 18, 1379-1394. doi:10.5194/acp-18-1379-2018.	1114	3
Jiang, Z., B.C. McDonald, H. Worden, J.R. Worden, K. Miyazaki, Z. Qu, . . . K.F. Boersma, 2018: Unexpected slowdown of US pollutant emission reduction in the past decade. <i>Proceedings of the National Academy of Sciences of the United States of America</i> , 115, 5099-5104. doi:10.1073/pnas.1801191115.	954	0
Banerjee, A., J.C. Fyfe, L.M. Polvani, D. Waugh, and K.L. Chang, 2020: A pause in Southern Hemisphere circulation trends due to the Montreal Protocol. <i>Nature</i> , 579, 544-548. doi:10.1038/s41586-020-2120-4.	858	0
Murray, C.J.L., and A.Y. Aravkin, and P. Zheng, and C. Abbafati, and K.M. Abbas, and M. Abbasi-Kangevari, . . . G.B.D.R. Factors, 2020: Global burden of 87 risk factors in 204 countries and territories, 1990-2019: a systematic analysis for the Global Burden of Disease Study 2019. <i>Lancet</i> , 396, 1223-1249.	801	0
Conley, S., G. Franco, I. Faloon, D.R. Blake, J. Peischl, and T.B. Ryerson, 2016: Methane emissions from the 2015 Aliso Canyon blowout in Los Angeles, CA. <i>Science</i> , 351, 1317-1320. doi:10.1126/science.aaf2348.	746	5
Stanaway, J.D., and A. Afshin, and E. Gakidou, and S.S. Lim, and D. Abate, and K.H. Abate, . . . C.J.L. Murray, 2018: Global, regional, and national comparative risk assessment of 84 behavioural, environmental and occupational, and metabolic risks or clusters of risks for 195 countries and territories, 1990-2017: a systematic analysis for the Global Burden of Disease Study 2017. <i>Lancet</i> , 392, 1923-1994. doi:10.1016/s0140-6736(18)32225-6.	649	26
Yu, P.F., O.B. Toon, C.G. Bardeen, Y.Q. Zhu, K.H. Rosenlof, R.W. Portmann, . . . A. Robock, 2019: Black carbon lofts wildfire smoke high into the stratosphere to form a persistent plume. <i>Science</i> , 365, 587-590. doi:10.1126/science.aax1748.	568	0
Liu, X.X., L.G. Huey, R.J. Yokelson, V. Selimovic, I.J. Simpson, M. Muller, . . . G.M. Wolfe, 2017: Airborne measurements of western US wildfire emissions: Comparison with prescribed burning and air quality implications. <i>Journal of Geophysical Research-Atmospheres</i> , 122, 6108-6129. doi:10.1002/2016jd026315.	486	2
Trostrl, J., W.K. Chuang, H. Gordon, M. Heinritzi, C. Yan, U. Molteni, . . . U. Baltensperger, 2016: The role of low-volatility organic compounds in initial particle growth in the atmosphere. <i>Nature</i> , 533, 527-+. doi:10.1038/nature18271.	407	1

Table 4. Top 20 Altmetric Scores	Altmetric Attention Score	Policy document citations *
Coggon, M.M., B.C. McDonald, A. Vlasenko, P.R. Veres, F. Bernard, A.R. Koss, . . . J.A. de Gouw, 2018: Diurnal Variability and Emission Pattern of Decamethylcyclopentasiloxane (D-5) from the Application of Personal Care Products in Two North American Cities. <i>Environmental Science & Technology</i> , 52, 5610-5618. doi:10.1021/acs.est.8b00506.	358	0
Platt, S.M., I. El Haddad, S.M. Pieber, A.A. Zardini, R. Suarez-Bertoa, M. Clairotte, . . . A.S.H. Prevot, 2017: Gasoline cars produce more carbonaceous particulate matter than modern filter-equipped diesel cars. <i>Scientific Reports</i> , 7, 9. doi:10.1038/s41598-017-03714-9.	316	1
Staten, P.W., J. Lu, K.M. Grise, S.M. Davis, and T. Birner, 2018: Re-examining tropical expansion. <i>Nature Climate Change</i> , 8, 768-775. doi:10.1038/s41558-018-0246-2.	293	0
Lickley, M., S. Solomon, S. Fletcher, G.J.M. Velders, J. Daniel, M. Rigby, . . . K. Stone, 2020: Quantifying contributions of chlorofluorocarbon banks to emissions and impacts on the ozone layer and climate. <i>Nature Communications</i> , 11, 11. doi:10.1038/s41467-020-15162-7.	266	0
Scott, C.E., S.A. Monks, D.V. Spracklen, S.R. Arnold, P.M. Forster, A. Rap, . . . C. Wilson, 2018: Impact on short-lived climate forcers increases projected warming due to deforestation. <i>Nature Communications</i> , 9, 9. doi:10.1038/s41467-017-02412-4.	251	0
Fleming, Z.L., R.M. Doherty, E. von Schneidmesser, C.S. Malley, O.R. Cooper, J.P. Pinto, . . . Z.Z. Feng, 2018: Tropospheric Ozone Assessment Report: Present-day ozone distribution and trends relevant to human health. <i>Elementa-Science of the Anthropocene</i> , 6, 41. doi:10.1525/elementa.273.	232	0
Ditas, J., N. Ma, Y. Zhang, D. Assmann, M. Neumaier, H. Riede, . . . Y.F. Cheng, 2018: Strong impact of wildfires on the abundance and aging of black carbon in the lowermost stratosphere. <i>Proceedings of the National Academy of Sciences of the United States of America</i> , 115, E11595-E11603. doi:10.1073/pnas.1806868115.	229	0
Gaudel, A., O.R. Cooper, K.L. Chang, I. Bourgeois, J.R. Ziemke, S.A. Strode, . . . C. Granier, 2020: Aircraft observations since the 1990s reveal increases of tropospheric ozone at multiple locations across the Northern Hemisphere. <i>Science Advances</i> , 6, 11. doi:10.1126/sciadv.aba8272.	215	0

Table 4. Altmetrics.

Alternative metrics are complementary to traditional citation-based metrics and include social media mentions, blog posts, online news stories, and more. The Altmetric Attention Score, provided by Altmetric.com, is a weighted count of online attention. Although it is difficult to determine what constitutes a “good” Altmetric score, all of the above scores are described as being in the “top 5% of all research outputs scored by Altmetric.” (Altmetric.com, n.d.) It is worth noting that 13 of the top 20 papers are from *Science*, *Nature*, or *Nature Communications*. It is perhaps not surprising that these widely-read, multidisciplinary journals attract more media and online attention. Furthermore, papers with high scores are usually those with subject matter that resonates with the public and taps into current issues such as climate change and wildfire impacts.

*Altmetric counts mentions in policy documents produced by organizations such as the World Health Organization, the World Bank, the United Nations, and other national and international institutions.

Table 5. Patent citations.

Patent citation data, provided by Lens.org, was acquired by searching CSL DOI's in the Lens database. The completeness of this data has not been verified and may under-represent CSL's patent citations.

Patent	Cited CSL publication
Volkamer R., Baidar S., Thomson D., inventors; University of Colorado Boulder, assignee. Mobile devices for tracking a radiation disk light source and methods using same. United States patent US 10,379,194. 2019 Aug 13.	Baidar, S., N. Kille, I. Ortega, R. Sinreich, D. Thomson, J. Hannigan, and R. Volkamer, 2016: Development of a digital mobile solar tracker. <i>Atmospheric Measurement Techniques</i> , 9, 963-972. doi:10.5194/amt-9-963-2016.
Yalin A.P., inventor; Colorado State University Research Foundation, assignee. Laser sensor for trace gas detection. United States patent application US 15/987,779. 2018 Sep 20.	Gordon, T.D., N.L. Wagner, M.S. Richardson, D.C. Law, D. Wolfe, E.W. Eloranta, C.A. Brock, F. Erdesz, and D.M. Murphy, 2015: Design of a Novel Open-Path Aerosol Extinction Cavity Ringdown Spectrometer. <i>Aerosol Science and Technology</i> , 49, 716-725. doi:10.1080/02786826.2015.1066753
Katz M., Young C., VandenBoer T., Ryan M.D., MacInnis J.J., inventors; Memorial University of Newfoundland, assignee. Method for the conversion of nitrous acid to dinitrogen gas. United States patent US 10,406,513. 2019 Sep 10.	VandenBoer, T.C., C.J. Young, R.K. Talukdar, M.Z. Markovic, S.S. Brown, J.M. Roberts, and J.G. Murphy, 2015: Nocturnal loss and daytime source of nitrous acid through reactive uptake and displacement. <i>Nature Geoscience</i> , 8, 55-60. doi:10.1038/ngeo2298.
Stokes M., Beall C.M., inventors. Ice nucleating particle spectrometer. United States patent US 10,557,810. 2020 Feb 11.	Seinfeld, J.H., C. Bretherton, K.S. Carslaw, H. Coe, P.J. DeMott, E.J. Dunlea, G. Feingold. . . R. Wood, 2016: Improving our fundamental understanding of the role of aerosol-cloud interactions in the climate system. <i>Proceedings of the National Academy of Sciences of the United States of America</i> , 113, 5781-5790. doi:10.1073/pnas.1514043113.
Miller-Lionberg, D.D., Quinn C.W., L'Orange C.C., Pierce J.R., Wendt E.A., Volckens J., inventors and applicants. Colorado State University Research Foundation and Access Sensor Technologies LLC, applicants. Portable atmospheric monitor. WIPO patent application WO 2020/210530 A1. 2020 Oct 15.	Murphy, D.M., H. Telg, T.F. Eck, J. Rodriguez, S.E. Stalin, and T.S. Bates, 2016: A miniature scanning sun photometer for vertical profiles and mobile platforms. <i>Aerosol Science and Technology</i> , 50, 11-16. doi:10.1080/02786826.2015.1121200.
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Part B. Collaboration

This section explores coauthor and institutional relationships.

Institutional affiliation	Number of occurrences
National Oceanic Atmospheric Admin*	699
University Of Colorado System	591
National Center Atmospheric Research	162
University Of California System	147
NASA Goddard Space Flight Center	121
NASA Langley Research Center	88
Us Department Of Energy	86
Colorado State University	85
California Institute Of Technology	81
Helmholtz Association	77
Harvard University	74
Centre National De La Recherche Scientifique CNRS	70
University Of Innsbruck	66
University Of Washington	63
University System Of Georgia	61
University System Of Maryland	59
Pacific Northwest National Laboratory	50
Aerodyne Research	48
NASA Ames Research Center	44
NASA Jet Propulsion Laboratory	44
Pennsylvania Commonwealth System Of Higher Education PCSHE	44
University Of Leeds	44
Science Systems And Applications Inc	43
Environment Climate Change Canada	37
Cooperat Inst Res Environm Sci CIRES	34
Massachusetts Institute Of Technology	34
University Of Wisconsin System	34
Universities Space Research Association USRA	32
Max Planck Society	31
Karlsruhe Institute Of Technology	30
Universite Paris Saclay	30
University Of Toronto	30
University System Of New Hampshire	30

Table 6. Top institutional affiliations of collaborating authors on CSL publications.
*Includes CSL authors.

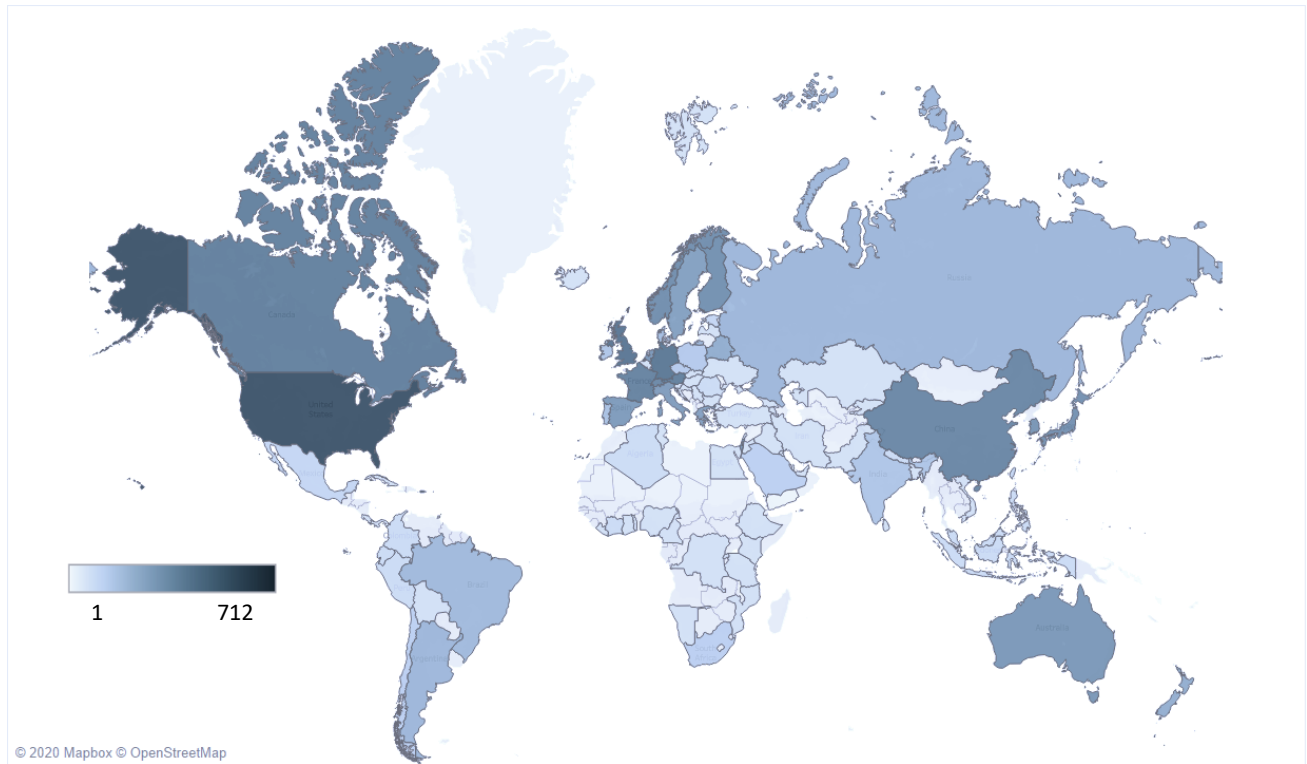


Figure 4. Country affiliations of coauthors of CSL publications. This map, highlighting 100 countries, illustrates the global collaboration of CSL researchers.

Country	Number of occurrences	Country	Number of occurrences
USA	712	Australia	36
United Kingdom	147	Netherlands	34
Germany	139	Israel	33
Canada	97	Spain	31
Austria	93	Italy	29
France	86	Greece	25
China	71	Sweden	24
Switzerland	70	Belgium	15
Norway	50	New Zealand	14
Finland	46	Argentina	10
Japan	45	Russia	10
South Korea	39	Brazil	9

Table 7. Top countries collaborating with CSL.

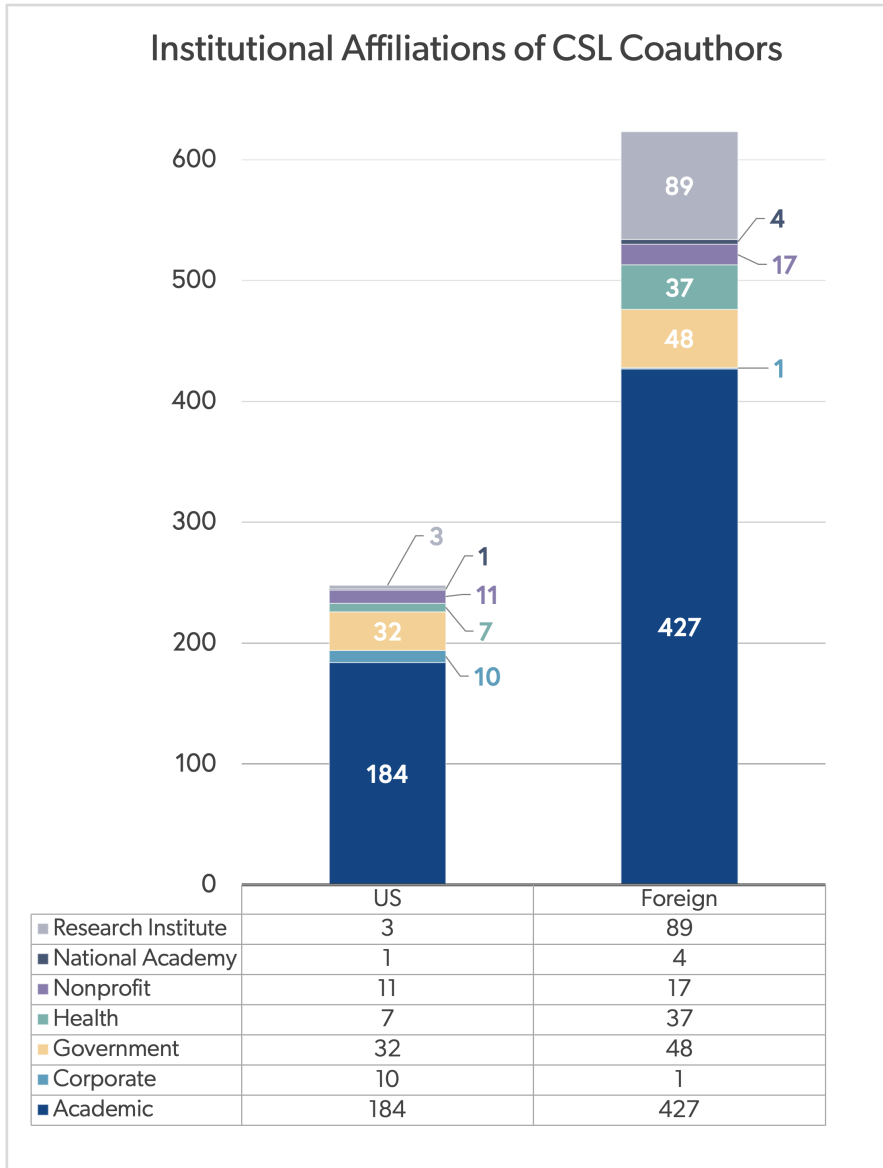


Figure 5. Count of organizations affiliated with CSL coauthors sorted by type.

Part C. Impact

In this section, we explore the citation data associated with CSL publications, for insights into the value and impact of CSL's research.

Section 1. Citation Analysis

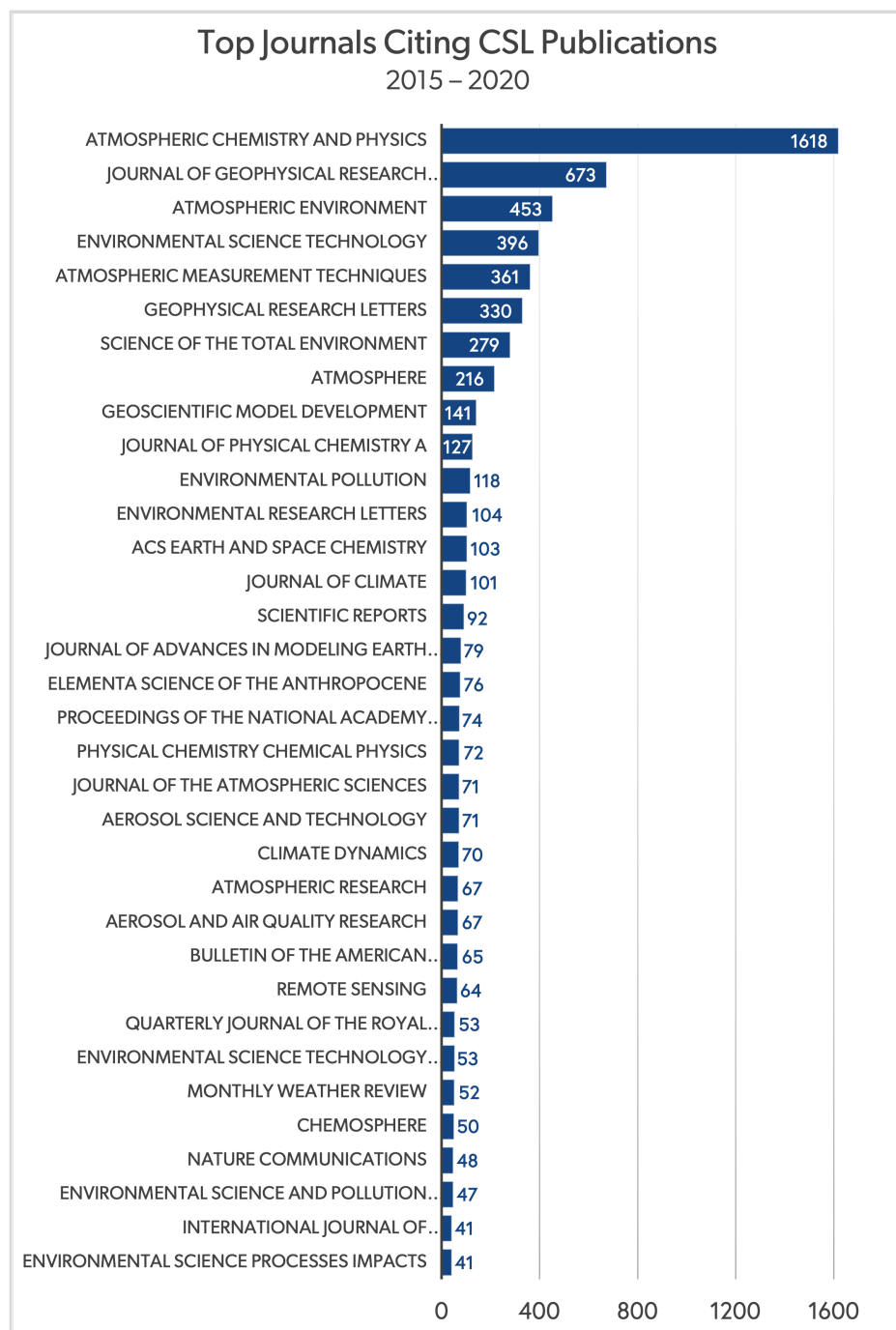


Figure 6. Journals that have cited CSL publications 40 or more times. There are over 1200 titles in the complete list.

Table 8. Top Institutional affiliations of authors citing CSL publications.

Citing Organizations	Number of Occurrences
National Oceanic Atmospheric Admin	1037
University Of Colorado	1000
University Of California	885
Chinese Academy Of Sciences	821
Centre National De La Recherche Scientifique CNRS	657
Helmholtz Association	611
National Center Atmospheric Research	610
US Department Of Energy	545
NASA Goddard Space Flight Center	507
Harvard University	431
California Institute Of Technology	387
Max Planck Society	352
Colorado State University	340
Peking University	323
University Of Washington	322
University System Of Maryland	308
Universite Paris Saclay	306
University Of Chinese Academy Of Sciences CAS	305
NASA Jet Propulsion Laboratory	285
UK Research Innovation UKRI	282
Nanjing University Of Information Science Technology	279
Universite De Versailles Saint Quentin En Yvelines	279
NASA Langley Research Center	273
NERC Natural Environment Research Council	271
University Of Helsinki	270
University System Of Georgia	268
Institute Of Atmospheric Physics CAS	266
Pacific Northwest National Laboratory	266
Environment Climate Change Canada	237
NERC National Centre For Atmospheric Science	234
Sorbonne Universite	234

Section 2. Benchmarks

While publication and citation counts measure productivity, they do not help the reader understand how those metrics compare to the performance of other researchers, research groups, or disciplines. The following section uses normalized indicators to provide context for CSL’s publication metrics.

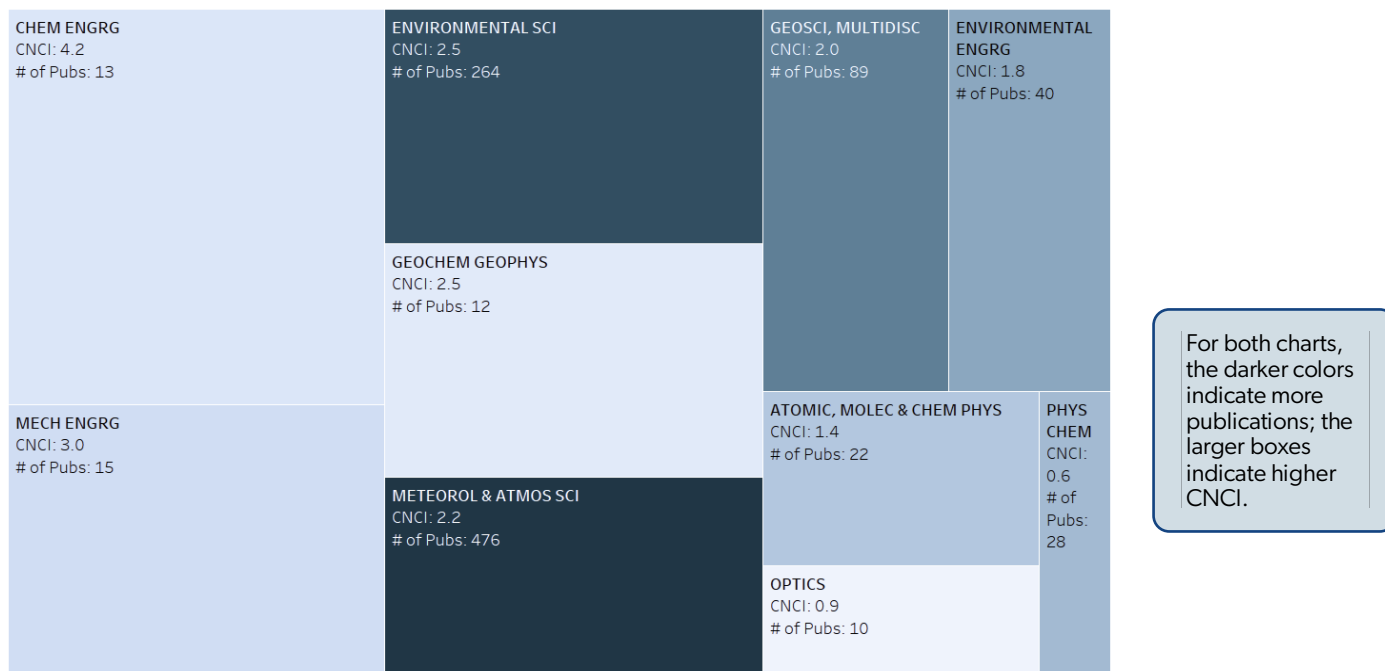
- Category Normalized Citation Index (CNCI): A normalized metric that allows comparisons between researchers at different career stages, entities of different sizes, and different subject mixes. “A CNCI value of 1 represents performance at par with the world average; values above 1 are considered above average and values below 1 are considered below average” for citation rates within a given category (Clarivate Analytics, 2020(c)).
- Highly Cited Papers: The top one percent of cited papers in a given research category are designated “highly cited.” Highly Cited Papers “are considered to be indicators of scientific excellence and top performance and can be used to benchmark research performance against field baselines worldwide.” (Clarivate Analytics, 2020(a,b)).

CSL benchmark metrics	January 2020 All CSL / OA*
% of publications cited	91% / 98%
Category Normalized Citation Index (CNCI)	2.3 / 2.4
% of publications in top 10% (by citation rate)	33% / 35%
% highly cited	7% / 9%

Table 9. Benchmark metrics for CSL publications

*535 (75%) of CSL’s papers are open access (OA), meaning they are freely available online. Some research has shown that OA publications are cited at a higher rate than those behind a paywall. However, the causes and implications of this “citation advantage” are hotly debated. By providing these metrics, we do not intend to suggest that OA is always the best choice for publishing research; a variety of factors should be considered when choosing a journal for publication. To learn more about the OA citation advantage (OACA), see Davis 2011; Gaule & Maystre 2011; Piwowar, et al. 2018.

CNCI



For both charts, the darker colors indicate more publications; the larger boxes indicate higher CNCI.

Figure 7. CNCI by subject area. Among CSL’s top subject areas, the highest CNCI is in Chemical Engineering, at 4.2 – over four times the average citation rate in that category. In Meteorology & Atmospheric Sciences, where CSL has the most publications, the CNCI is 2.2 – over twice the average citation rate.

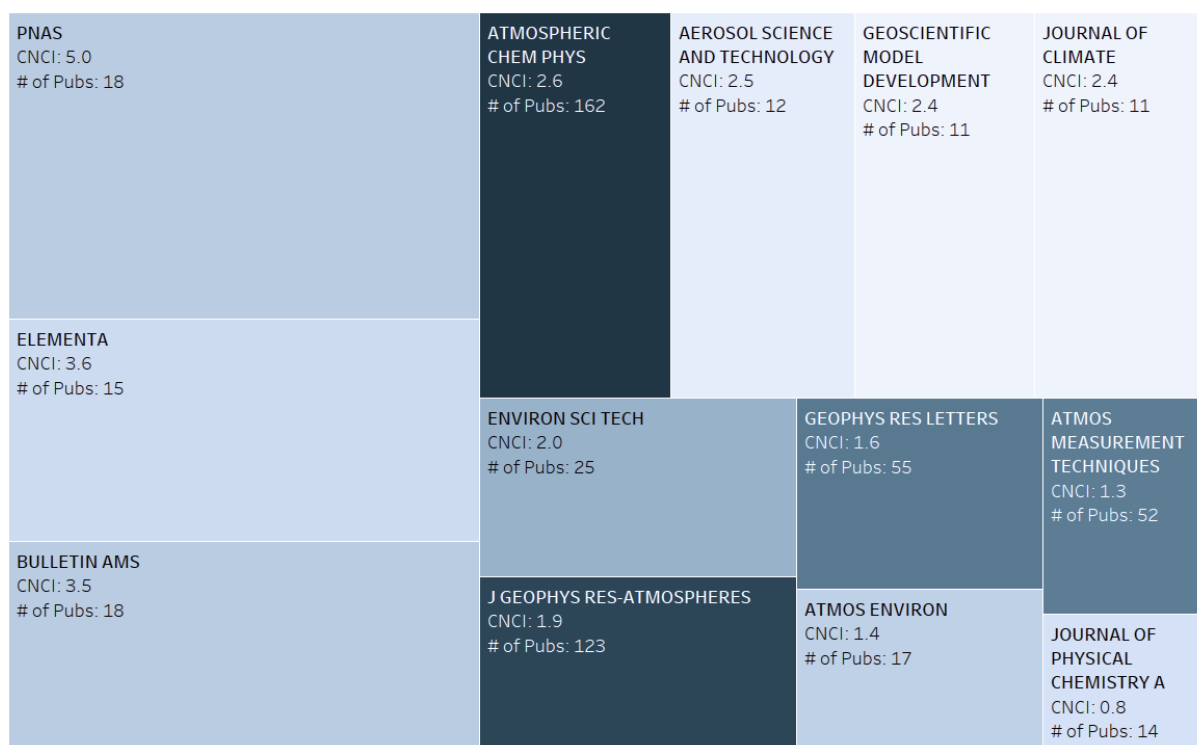


Figure 8. CNCI by journal. Among CLS’s top journals, the highest CNCI is for The Proceedings of the National Academy of Sciences of the USA (PNAS), at 5.0 – that is, five times the average citation rate for that journal. For Atmospheric Chemistry & Physics, where CSL has the most publications, the CNCI is 2.6, over two and a half times the average citation rate for that journal.

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Appendix I: Responsible Use of Bibliometrics

Bibliometrics – the quantitative analysis of publication and citation data – is an evolving field that is increasingly relied upon among administrators as a means of measuring scientific value and impact. When used in conjunction with other evaluative measures, bibliometrics can be a useful tool for evaluating research. However, there are inherent limitations to these analyses. Bibliometric indicators are often taken out of context and applied without a full understanding of what they are intended to measure. Bibliometrics should never be used as the sole basis for evaluations or decision-making. See below for further reading on the responsible use of bibliometrics.

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Some Pros and Cons of Bibliometrics

Pros

- Inexpensive, simple to produce
- Easily updated
- Scalable, from individual- to country-level
- Quantitative, objective, reproducible
- Easy to understand
- Ideal for measuring research productivity

Cons

- Datasets available from standard databases may represent only a portion of existing publications
- Raw citation counts may not represent quality (e.g., “negative” citations)
- Vulnerable to manipulation by authors & publishers
- May be skewed by choices made during analysis
- Pursuit of metrics may drive research decisions; may provide inappropriate incentives
- Measurement of research impact is elusive

Appendix II: Method & Sources

This report provides a bibliometric analysis of publications produced by the NOAA Chemical Sciences Laboratory (CSL) from January 2015 to November 30, 2020. For our data source, we were provided with CSL's EndNote library of CSL publications. We also conducted searches in Web of Science using search terms such as "Chem Sci Lab," "Chem Sci Div," CSD, and CSL in the address field. Results of these searches were reviewed by CSL personnel for accuracy. Because we use the WoS analytical tools for our bibliometric analyses, CSL publications that do not appear in WoS have been omitted from the data set. Bibliographic citations and citation data were downloaded from WoS; the benchmarking indicators used in Part C were acquired from Clarivate Analytics' InCites.

The list of current CSL authors, for the h-index histogram, was provided by CSL. H-indices were acquired from WoS using author ResearcherIDs.

Although we have included publication and citation data through November 2020 in our data set, it is generally agreed that publications must be at least two years old for citation reporting to be meaningful.¹ Therefore it should be noted that the citation data for the more recent publications is preliminary and is most likely not indicative of their eventual impact.

Publication and citation data were downloaded from Web of Science and InCites on November 30, 2020. Because of slight differences in indexing schedules and algorithms, citation data can vary slightly between WoS and InCites. The full publication list and data sets are available in the accompanying Excel data file, or from sue.visser@noaa.gov.

¹Abramo, G., T. Cicero, and C.A. D'Angelo. 2011. Assessing the varying level of impact measurement accuracy as a function of the citation window length. *Journal of Informetrics* 5:659-667, doi:10.1016/j.joi.2011.06.004; Clarivate Analytics. 2018b. Web of Science Core Collection Help: Essential Science Indicators – Highly Cited Papers. Accessed February 19, 2020. http://images.webofknowledge.com/WOKRS530AR16/help/WOS/hp_highly_cited_papers.html.