Bibliometrics Report:

A Bibliometric Analysis of NOAA PSL Publications, 2015-2019 (Calendar Year)

PREPARED FOR
NOAA Physical Sciences Laboratory

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Contents

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 is important to note that while bibliometric analyses provide quantitative data that 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 are intended to 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.

The Boulder Labs Library's Web of Science (WoS) search for PSL publications produced 606 titles (see Appendix II for details on method and data sources). This report analyzes those publications in the following areas:

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

PSL also generates assessments and datasets. While not included in this report's analysis, these important works are listed in Appendix III.

13,305
Sum of times cited

609
Total publications, 2015-2019

21.85
Average cites per publication

Part A. General Productivity

General productivity metrics for PSL publications for calendar years 2015-2019.

Summary Metrics	
Total number of publications	609
Total times cited/without self-citations	13,305 / 12,373
Total number of citing publications/without self-citations	9,787 / 9,436
Average citations per publication	21.85
Group h-index	50

Table 5. Common bibliometric indicators. An h-index of 50 indicates that this group of 609 publications includes 50 papers that have each received 50 or more citations (Hirsch 2005). Data pulled on Sep 15, 2020.

Figure 1. Reports, books, and certain journals (such as the Journal of Geoscience Education and EOS by the American Geophysical Union) are not indexed in Web of Science. Due to this fact, those publications and respective citations are not included in this 5-year analysis. *Current 2020 PSL publications estimate. These are not included in the bibliometric analysis.

Top Authors

Shupe, Matthew D.	44
Alexander, Michael A.	35
Hoerling, Martin P.	30
Fairall, Christopher W.	27
Hamill, Thomas M.	27
Persson, Ola (P.G.)	26
Wilczak, James M.	26
White, Allen B.	25
Hoell, Andrew (Andy)	24
Bianco, Laura	23
Cox, Christopher J.	21
Matrosov, Sergey Y.	21
Compo, Gilbert P.	20
de Boer, Gijs	20
Eischeid, Jon K.	20
Chen, Haonan	19
Kiladis, George N.	19
Kim, Jungho	19
Cifelli, Robert	17
Scheuerer, Michael	17
Pincus, Robert	16
Quan, Xiaowei	16
Whitaker, Jeffrey S.	16

Figure 2. Current PSL authors with more than 15 total publications from 2015 to 2019. Author data pulled on October 15, 2020. Full author list is in Appendix III.

PSL Highly Cited Papers

Highly cited papers fall in the top one percent of cited papers in a given research category (Clarivate Analytics, n.d.(a)). As of May/June 2020, twenty-nine of PSL's publications have this designation. Many of the publications with citations over 100 were published in 2015 and 2016. These higher citation rates in comparison to articles published between 2017 and 2019 have had more time to garner citations. Between 2015 and 2019, PSL had one hot paper, which is a paper published within the last two years that is receiving the most citations (top 0.1%) in the most recent two-month period when compared to peer papers (same field, same publication date). Altmetrics are metrics and qualitative data that are complementary to traditional, citation-based metrics. These metrics can include (but are not limited to) discussions on research blogs, mainstream media coverage, and mentions on social (Altmetric.com, n.d.). The Altmetrics Scores below are mostly attributed to the high number of news outlets picking up the article or a large number of Tweets about the publication.

Table 2. PSL Highly Cited Papers	**WoS Highly Cited Field**	**Times Cited**	**Altmetrics Score**
Pepin, N., R. S. Bradley, **H. F. Diaz**,...**I. Rangwala**, et al. 2015. Elevation-dependent warming in mountain regions of the world. *Nature Climate Change* 5(5):424-430. doi.org/10.1038/nclimate2563.	Environment/ Ecology	677	222
Newman, M., M. A. Alexander, T. R. Ault, K. M. Cobb, C. Deser, E. D. Lorenzo, N. Mantua, A. J. Miller, S. Minobe, H. Nakamura, N. Schneider, D. J. Vimont, A. S. Phillips, **J. D. Scott, C. A. Smith.** 2016. The Pacific Decadal Oscillation, Revisited. *Journal of Climate* 29(12):4399-4427. doi.org/10.1175/jcli-d-15-0508.1.	Geosciences	370	101
Capotondi, A., A. Wittenberg, **M. Newman**, et al. 2015. Understanding ENSO diversity. *Bulletin of the American Meteorological Society* 96(6):921-938. doi.org/10.1175/bams-d-13-00117.1.	Geosciences	354	34
Bony, S., B. Stevens,...**R. Pincus**, et al. 2015. Clouds, circulation and climate sensitivity. *Nature Geoscience* 8(4):261-268. doi.org/10.1038/ngeo2398.	Geosciences	305	77
Pershing, A. J., **M. A. Alexander,...J. D. Scott,** et al. 2015. Slow adaptation in the face of rapid warming leads to collapse of the Gulf of Maine cod fishery. *Science* 350(6262):809-812. doi.org/10.1126/science.aac9819.	Geosciences	303	615
Seager, R., **M. P. Hoerling**, S. Schubert, et al. 2015. Causes of the 2011–14 California Drought. *Journal of Climate* 28(18):6997-7024. doi.org/10.1175/jcli-d-14-00860.1.	Geosciences	164	66
Timmermann, A., S. I. An, J. S. Kug, F. F. Jin, W. Cai, **A. Capotondi**, et al. 2018. El Niño-Southern Oscillation complexity. *Nature* 559(7715):535-545. doi.org/10.1038/s41586-018-0252-6.	Geosciences. Web of Science Hot paper	152	164
Saba, V. S., S. M. Griffies, W. G. Anderson, M. Winton, **M. A. Alexander**, et al. 2016. Enhanced warming of the Northwest Atlantic Ocean under climate change. *Journal of Geophysical Research-Oceans* 121(1):118-132. doi.org/10.1002/2015jc011346.	Geosciences	150	130

Hare, J. A., W. E. Morrison, M. W. Nelson, M. M. Stachura, E. J. Teeters, R. B. Griffis, **M. A. Alexander, J. D. Scott**, et al. 2016. A Vulnerability Assessment of Fish and Invertebrates to Climate Change on the Northeast U.S. Continental Shelf. *PLOS ONE* 11(2). doi.org/10.1371/journal.pone.0146756.	Plant & Animal Science	147	190
Ruf, C. S., R. Atlas, P. S. Chang,...**V. U. Zavorotny.** 2016. New Ocean Winds Satellite Mission to Probe Hurricanes and Tropical Convection. *Bulletin of the American Meteorological Society* 97(3). doi.org/10.1175/bams-d-14-00218.1	Geosciences	121	6
Sun, L., C. Deser, R. A. Tomas. 2015. Mechanisms of Stratospheric and Tropospheric Circulation Response to Projected Arctic Sea Ice Loss. *Journal of Climate* 28(19):7824-7845. doi.org/10.1175/jcli-d-14-00860.1.	Geosciences	112	12
Gochis, D., R. Schumacher, K. Friedrich,...**S. Y. Matrosov**,...**K. M. Mahoney**, et al. 2015. The Great Colorado Flood of September 2013. *Bulletin of the American Meteorological Society* 96(9):1461-1487. doi.org/10.1175/bams-d-13-00241.1.	Geosciences	110	19
Fujiwara, M., J. S. Wright, G. L. Manney,...**G. P. Compo,**...**J. S. Whitaker,** C. Z. Zou. 2017. Introduction to the SPARC Reanalysis Intercomparison Project (S-RIP) and overview of the reanalysis systems. *Atmospheric Chemistry and Physics* 17(2):1417-1452. doi.org/10.5194/acp-17-1417-2017.	Geosciences	109	6
Freeman, E., S. D. Woodruff, S. J. Worley, **S. J. Lubker**, E. C. Kent, W. E. Angel, D. I. Berry, P. Brohan, R. Eastman, L. Gates, W. Gloeden, Z. Ji, J. Lawrimore, N. A. Rayner, G. Rosenhagen, S. R. Smith. 2017. ICOADS Release 3.0: a major update to the historical marine climate record. *International Journal of Climatology* 37(5):2211-223. doi.org/10.1002/joc.4775.	Geosciences	109	55
MacDonald, A. E., C. T. M. Clack, A. Alexander, A. Dunbar, **J. M. Wilczak**, Y. Xie. 2016. Future cost-competitive electricity systems and their impact on US CO2 emissions. *Nature Climate Change* 6(5):526-531. doi.org/10.1038/nclimate2921.	Environment/ Ecology	108	915
Sun, L., J. Perlwitz, M. P. Hoerling. 2016. What caused the recent "Warm Arctic, Cold Continents" trend pattern in winter temperatures? *Geophysical Research Letters* 43(10):5345-5352. doi.org/10.1002/2016gl069024.	Geosciences	104	77
Berner, J. U. Achatz, L. Batt,...**C. Penland**, et al. 2017. Stochastic Parameterization: Towards a new view of Weather and Climate Models. *Bulletin of the American Meteorological Society* 98(3):565-587. doi.org/10.1175/bams-d-15-00268.1.	Geosciences	95	43
Screen, J. A., C. Deser, D. M. Smith, X. Zhang, R. Blackport, P. J. Kushner, T. Oudar, K. E. McCusker, **L. Sun.** 2018. Consistency and discrepancy in the atmospheric response to Arctic sea-ice loss across climate models. *Nature Geoscience* 11(3):155. doi.org/10.1038/s41561-018-0059-y.	Geosciences	82	170
Tommasi, D., C. A. Stock, A. J. Hobday, R. Methot,...**M. A. Alexander**, et al. 2017. Managing living marine resources in a dynamic environment: The role of seasonal to decadal climate forecasts. *Progress in Oceanography* 152:15-49. doi.org/10.1016/j.pocean.2016.12.011.	Geosciences	72	30

White, C. J., H. Carlsen, A. W. Robertson,...**A. J. Ray**, et al. 2017. Potential applications of subseasonal-to-seasonal (S2S) predictions. *Meteorological Applications* 24(3):315-325. doi.org/10.1002/met.1654.	Geosciences	71	26
Mauritsen, T., J. Bader, T. Becker, J. Behrens,...**R. Pincus**, et al. 2019. Developments in the MPI-M Earth System Model version 1.2 (MP-ESM1.2) and Its Response to Increasing CO2. *Journal of Advances in Modeling Earth Systems* 11(4):998-1038. doi.org/10.1029/2018ms001400.	Geosciences	58	29
Driemel, A., J. Augustine, K. Behrens, S. Colle, **C. J. Cox**, et al. 2018. Baseline Surface Radiation Network (BSRN): structure and data description (1992-2017). *Earth System Science Data* 10(3):1491-1501. doi.org/10.5194/essd-10-1491-2018.	Geosciences	47	6
Shields, C. A., J. J. Rutz, L. Y. Leung, F. M. Ralph, M. Wehner,...**K. M. Mahoney**,...**G. A. Wick**, et al. 2018. Atmospheric River Tracking Method Intercomparison Project (ARTMIP): project goals and experimental design. *Geoscientific Model Development* 11(6):2455-2474. doi.org/10.5194/gmd-11-2455-2018.	Geosciences	46	20
Voronovich, AG; Zavorotny, VU. 2018. Bistatic Radar Equation for Signals of Opportunity Revisited. *IEEE Transactions on Geoscience and Remote Sensing* 56(4):1959-1968. doi.org/10.1109/TGRS.2017.2771253.	Geosciences	45	N/A
Le Bris, A., K. E. Mills, R. A. Wahle, Y. Chen, **M. A. Alexander,** A. J. Allyn, J. G. Schuetz, **J. D. Scott**, A. J. Pershing. 2018. Climate vulnerability and resilience in the most valuable North American fishery. *Proceedings of the National Academy of Sciences of the United States of America* 115(8):1831-1836. doi.org/10.1073/pnas.1711122115.	Plant & Animal Science	37	241
Wendisch M., A. Macke, A. Ehrlich, C. Lüpkes,...**M. D. Shupe**, et al. 2019. The Arctic Cloud Puzzle: Using ACLOUD/PASCAL Multiplatform Observations to Unravel the Role of Clouds and Aerosol Particles in Arctic Amplification. *Bulletin of the American Meteorological Society* 100(5):841-872. doi.org/10.1175/BAMS-D-18-0072.1.	Geosciences	28	16
White, AB; Moore, BJ; Gottas, DJ; Neiman, PJ. 2019. Winter Storm Conditions Leading to Excessive Runoff above California's Oroville Dam During January and February 2017. *Bulletin of the American Meteorological Society* 100(1):55-69. doi.org/10.1175/BAMS-D-18-0091.1.	Geosciences	21	39
Ralph, FM; Wilson, AM; Shulgina, T; Kawzenuk, B; Sellars, S; Rutz, JJ; Lamjiri, MA; Barnes, EA; Gershunov, A; Guan, B; Nardi, KM; Osborne, T; **Wick, GA.** 2019. ARTMIP-early start comparison of atmospheric river detection tools: how many atmospheric rivers hit northern California's Russian River watershed? *Climate Dynamics* 52(7-8):4973-4994. doi.org/10.1007/s00382-018-4427-5.	Geosciences	19	4
Cronin, M. F., C. L. Gentemann, J. Edson, I. Ueki,...**C. W. Fairall,** et al. 2019. Air-Sea Fluxes With a Focus on Heat and Momentum. *Frontiers in Marine Science* 6. doi.org/10.3389/fmars.2019.00430	Plant & Animal Science	17	6

Table 2. Highly Cited PSL Papers 2015-2019. Bolded authors are NOAA PSL employees. Source: Web of Science, as of Sep 15, 2020.

Top PSL Publications by Journal & Subject Areas

Figure 4 below lists the journals in which PSL has published more than five times. Figure 5 shows the top PSL subject areas (five or more). Subject areas are assigned by Web of Science, and are assigned to *journals*, not individual publications. A publication may be associated with several subject areas.

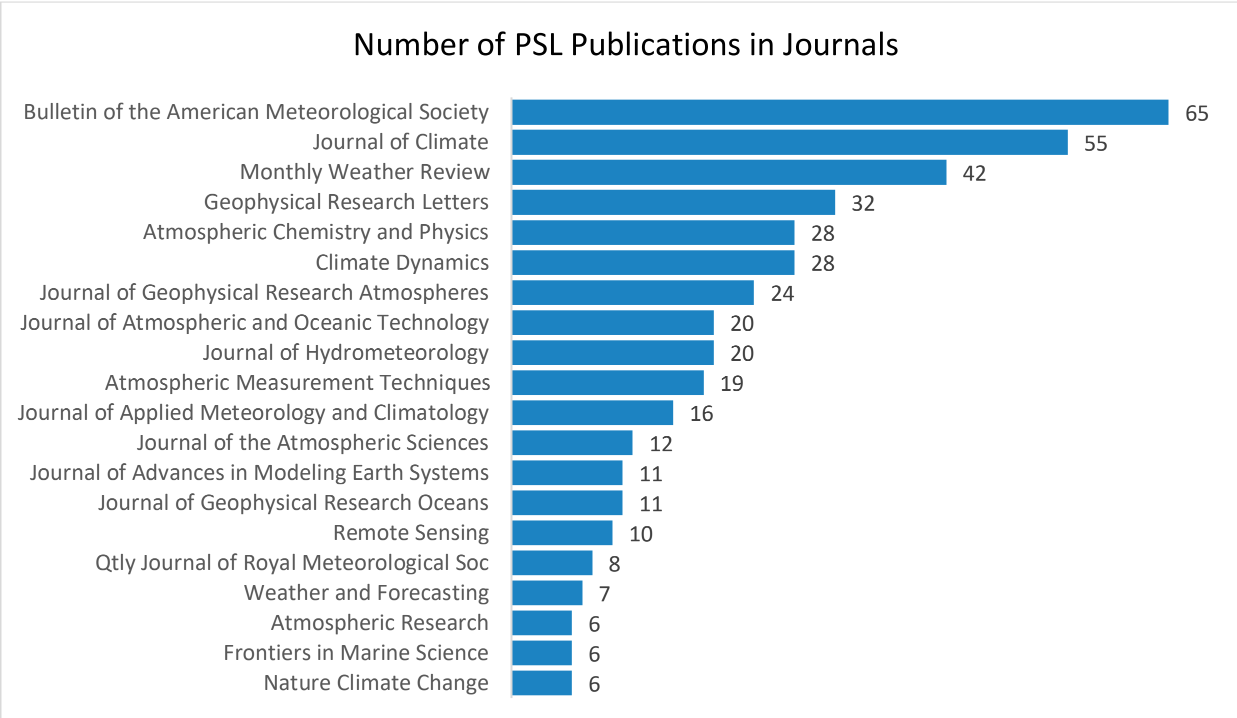

Figure 3. Journals in which PSL has published more than 5 times. Data pulled on Sep 15, 2020.

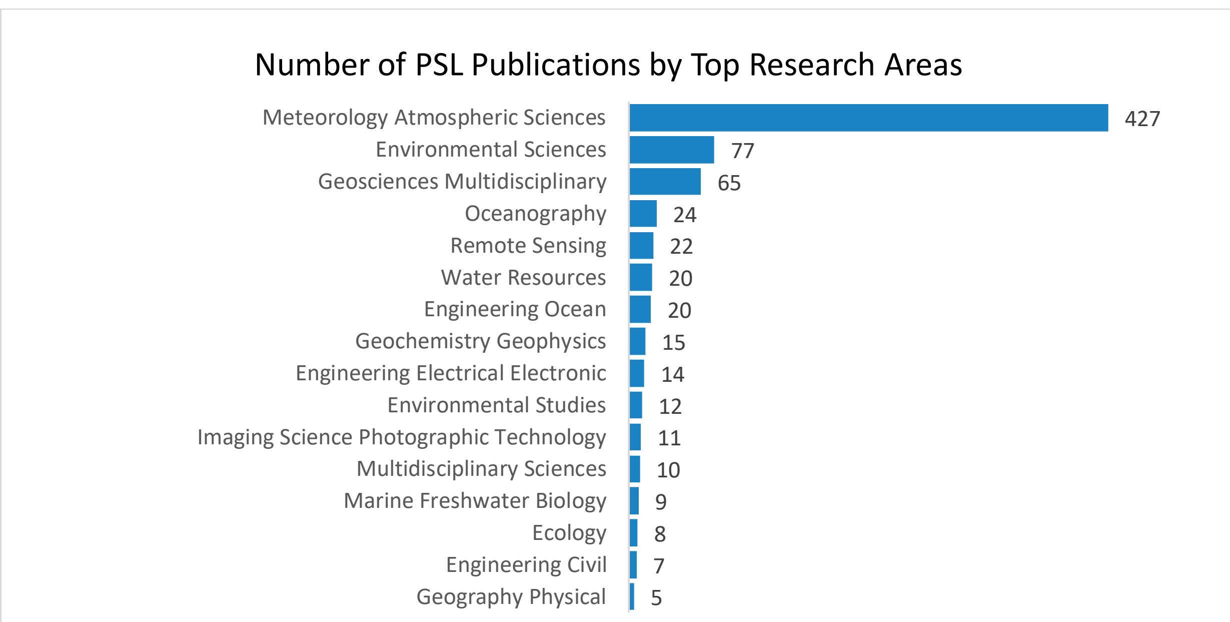

Figure 4. Top PSL research areas (5 or more publications). Data pulled on Sep 15, 2020.

Part B. Impact

In this section, we explore the citation data associated with PSL publications, for insights into the value and impact of PSL's research. Data pulled on Oct 15, 2020.

Citation Analysis

Top Authors Citing PSL Publications

Author Name	# of Citations
Ralph, F. Martin	54
Wang, Lei	44
Bronnimann, Stefan	40
Lamarque, Jean-Francois	40
Leung, L. Ruby	39
Stevens, Bjorn	39
Wang, J	38
Zhang, Y	37
Tilmes, Simone	35
Liu, Y	34
Chen, Y	32
Kumar, Arun	31
Li, Y	31
Lundquist, Julie K.	31
Cai, Wenju	30
Deser, Clara	30
Myhre, Gunnar	30
Fernando, Harindra Joseph S.	29
Sharma, Sangeeta	29
Wang, Y	29
Mcphaden, Michael J.	28
Turner, David D.	28
Singh, Vijay	27
Yang, Y	27
Boucher, Oliver	26
Xie, Shang-Ping	26
Andrews, Timothy	25
Kim, J	25
Yeh, Sang-Wook	25
Zhang, Qiang	25

Figure 5. Number of times individual authors have cited PSL publications. This data can help identify experts and potential collaborators.

Top Journals Citing PSL Publications

Journal Title	# of Citations
Geophysical Research Letters	562
Journal of Climate	543
Journal of Geophysical Research Atmospheres	448
Climate Dynamics	397
Atmospheric Chemistry and Physics	334
International Journal of Climatology	215
Monthly Weather Review	202
Remote Sensing	179
Atmosphere	149
Bulletin of the American Meteorological Society	149
Quarterly Journal of the Royal Meteorological Society	146
Scientific Reports	143
Journal of Advances In Modeling Earth Systems	142
Environmental Research Letters	139
Journal of Geophysical Research Oceans	139
Journal of Hydrometeorology	134
Atmospheric Measurement Techniques	116
Journal Of The Atmospheric Sciences	115
Water Resources Research	104

Figure 6. Top journals citing PSL publications, 2015-2019. This data may suggest new journals for publication, or unexpected applications of PSL's research. There are 1,190 titles in the complete list.

Institutional Affiliations of Authors Citing PSL Publications

This graph shows the institutional affiliations of authors citing PSL publications by citation count. This information shows which organizations are doing similar work, and may suggest potential collaborators or funding sources.

Figure 7. Topmost institutional affiliations of authors citing PSL publications by citation count. Data pulled on Oct 15, 2020, and reflects 200 or more citations.

Benchmarks

Whle 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 PSL'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, n.d.(a)).

- **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, n.d.(b)).

- **Hot Paper:** A paper published within the last two years that is receiving the most citations (top 0.1%) in the most recent two-month period when compared to peer papers (Clarivate Analytics, n.d.(c)).

Additionally, 68% of PSL'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 fiercely debated. By providing these metrics, we do not intend to suggest that OA is always the best choice for publishing research; other factors should be considered when choosing a journal for publication. To learn more about OA citation impact, see Davis 2011; Gaule & Maystre 2011; Piwowar, et al. 2018.

Overall PSL Publication Metrics	
% of publications cited	95%
Category Normalized Citation Index (CNCI)	1.98
% of publications in top 10% (by citation rate)	26%
% highly cited	4.8%

Table 3. Overall metrics for PSL publications. Data pulled on Oct 15, 2020.

References

Altmetric.com. n.d. "What Are Altmetrics?" Accessed October 19, 2020. www.altmetric.com/about-altmetrics/what-are-altmetrics

Clarivate Analytics. n.d.(a). InCites Help: Category Normalized Citation Impact. Accessed February 19, 2020. https://incites.help.clarivate.com/Content/Indicators-Handbook/ih-normalized-indicators.htm?Highlight=cnci

Clarivate Analytics. n.d.(b). InCites Help: Highly Cited Papers. Accessed February 19, 2020. https://incites.help.clarivate.com/Content/Indicators-Handbook/ih-glossary.htm?Highlight=highly%20cited%20paper

Clarivate Analytics. n.d.(c). InCites Help: Hot Paper. Accessed Septembler 15, 2020. https://incites.help.clarivate.com/Content/Indicators-Handbook/ih-glossary.htm?Highlight=hot%20paper

Davis, P.M. 2011. Open access, readership, citations: a randomized controlled trial of scientific journal publishing. *The FASEB Journal* 25(7):2129-2134, doi:10.1096/fj.11-183988.

Gaule, P. and N. Maystre. 2011. Getting cited: does open access help? *Research Policy* 40(10):1332-1338, doi:10.106/j.respol.2011.05.025.

Hirsch, J.E. 2005. An index to quantify an individual's scientific research output. *Proceedings of the National Academy of Sciences* 102(46):16569-16272, doi:10.1073%2Fpnas.0507655102.
Piwowar, H., J. Priem, V. Lariviere, J.P. Alperin, L. Matthias, B. Norlander, A. Farley, J. West, and S.

Haustein. 2018. The state of OA: a large-scale analysis of the prevalence and impact of Open Access articles. *PeerJ* 6:e4375, doi:10.7717/peerj.4375.

Appendix I: Responsible Use of Bibliometrics

Bibliometrics – the quantitative analysis of publication and citation data – is an evolving field that is gaining attention 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.

Aksnes, D. W., L. Langfeldt, & P. Wouters. 2019. Citations, Citation Indicators, and Research Quality: An Overview of Basic Concepts and Theories. *SAGE Open, 9*. doi:10.1177/2158244019829575.

Barnes, C. 2017. The *h*-index debate: An introduction for librarians. *The Journal of Academic Librarianship* 43:487-494, doi:10.1016/j.acalib.2017.08.013.

Belter, C.W. 2015. Bibliometric indicators: Opportunities and limits. *Journal of the Medical Library Association*. 103(4):219-221. doi:10.3163/1536-5050.103.4.014.

Clarivate Analytics. 2018a. InCites benchmarking & analytics: Responsible use of research metrics. http://clarivate.libguides.com/incites_ba/responsible-use. Accessed 10/31/2018.

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

Haustein, S., V. Lariviere. 2015. The use of bibliometrics for assessing research: Possibilities, limitations and adverse effects. In: Welpe IM, J. Wollersheim, S. Ringelhan, M. Osterloh, eds. *Incentives and performance*. Springer, Cham. Pg. 121–139. doi: 10.1007/978-3-319-09785-5_8.

Hicks, D., P. Wouters, L. Waltman, S. de Rijcke and I. Rafois. 2015. Bibliometrics: The Leiden Manifesto for research metrics. *Nature* 520:420-531. doi:10.1038/520429a.

Pendlebury, D.A. 2010. White paper: Using bibliometrics in evaluating research. Thomson Reuters, Philadelphia, PA. https://lib.guides.umd.edu/ld.php?content_id=13278687.

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: Methodology & Sources

This report provides a bibliometric analysis of publications produced by the NOAA ESRL Physical Sciences Lab (PSL) from 2015 to 2019. For the publication and author lists, the PSL Communication Specialist was consulted. For the current PSL author list, both the PSL Staff List (https://psl.noaa.gov/staff) and Boulder Labs Telecommunications Directory were also used. Publication data was pulled from Clarivate Analytics' Web of Science (WoS) database on September 15, 2020. Similarly, on October 15, 2020, author data was pulled from WoS and benchmarking indicators (in Part B) were pulled from Clarivate Analytics' InCites. Because of slight differences in indexing schedules and algorithms, citation data can vary slightly between WoS and InCites.

Boulder Labs Library uses the WoS analytical tools for bibliometric analyses. Therefore, PSL publications that do not appear in WoS have been omitted from the data analysis.

Although we have included publication and citation data through December 2019 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. Figure 1 does include the current 2020 PSL publications estimate; however, these publications are *not* included in the bibliometrics and citation analysis.

The full data sets are available through the Boulder Labs Library by contacting Anna McDevitt at anna.mcdevitt@noaa.gov.

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[1]Abramo, 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.

Appendix III: Data Tables

Table A1. Current PSL Authors List Ranked by H-Index

PSL Author	2015-2019 Publication Count	Total Lifetime Publications	2015-2019 Citation Count	Total Lifetime Citation Count	H-Index
Adler, Bianca	0	33	237	309	16
Akish, Elena	6	6	72	72	5
Albers, John R.	5	15	47	202	7
Alexander, Michael A.	35	122	1,737	8,427	51
Allured, Dave	5	15	40	645	11
Ayers, Thomas E.	1	4	23	23	4
Bao, Jian-wen	12	36	62	1,137	16
Bariteau, Ludovic	5	17	105	190	13
Barpanda, Pragallva	0	4	15	15	2
Barsugli, Joseph	9	33	122	1,346	19
Bates, Gary T.	2	34	27	3,918	21
Bedard, Alfred J.	3	27	9	524	13
Bellier, Joseph	0	6	29	195	4
Bengtsson, Lisa	4	12	125	324	8
Bianco, Laura	23	49	265	1,811	24
Biswas, Sounak K.	0	8	36	36	5
Blomquist, Byron	14	71	238	2,541	31
Bytheway, Janice L.	2	9	4	103	5
Capotondi, Antonietta	15	40	656	1,677	19
Chen, Haonan	19	45	133	359	11
Chen, Tse-Chun	0	5	27	72	3
Cheng, Yuan-Ming	1	21	3	578	11
Cifelli, Robert	17	57	204	1,774	22
Compo, Gilbert P.	20	49	481	10,497	27
Costa, David M.	1	1	6	6	1
Cox, Christopher J.	21	27	296	597	13
Darby, Lisa S.	5	37	79	1,001	18
de Boer, Gijs	20	40	187	1,203	16
DeLuisi, Barbara	1	1	10	10	1
Dias, Juliana	12	27	120	492	10
Ding, Hui	4	5	34	34	3
Djalalova, Irina V.	14	28	160	768	14
Draper, Clara S.	4	33	52	2,508	18
Eischeid, Jon K.	20	69	270	4,538	32
Fairall, Christopher W.	27	199	524	12,596	57
Fowler, Megan (M.) D.	0	5	37	37	3

Fredrick, Sherrie	0	2	58	83	2
Frolov, Sergey	0	20	95	307	13
Gallagher, Michael R.	1	2	5	7	2
Gehne, Maria	7	11	136	176	8
Gichamo, Tseganeh	0	6	1	93	2
Goodliff, Michael	0	6	58	58	4
Gorton, Brian K.	1	2	10	10	1
Gottas, Daniel J.	6	16	40	415	9
Grachev, Andrey A.	9	57	273	2,971	25
Grell, Evelyn D.	4	14	14	233	6
Hamill, Thomas M.	27	86	495	8,096	41
Hartten, Leslie M.	4	32	18	282	10
Hervieux, Gaelle	4	5	53	55	4
Hobbins, Micheal T.	11	27	243	1,618	18
Hoell, Andrew	24	55	334	1,615	23
Hoerling, Martin P.	30	115	914	9,347	55
Hughes, Mimi	15	36	260	1,057	19
Intrieri, Janet M.	6	28	96	1,840	19
Jackson, Darren L.	5	39	90	1,341	22
Jacox, Michael G.	7	49	53	801	17
Johnson, Lynn E.	4	13	42	114	5
Johnston, Paul E.	8	34	101	883	18
Jong, Bor-Ting	0	2	53	53	2
Kiladis, George N.	19	116	261	8,042	53
Kim, Jungho	19	28	55	95	4
Lataitis, Richard J.	2	35	11	602	14
Lawrence, Zachary D.	3	12	10	161	7
Leach, Jesse L.	1	1	0	0	0
Lillo, Samuel P.	0	9	14	47	4
Mahoney, Kelly M.	14	30	346	651	15
Matrosov, Sergey Y.	21	125	262	3,507	37
McColl, Chesley M.	4	6	94	122	3
Michelson, Sara A.	6	26	23	615	11
Moore, Benjamin J.	5	23	84	550	18
Moran, Kenneth P.	0	33	312	1,590	19
Morris, Sara M.	4	17	134	916	14
Murray, Donald (Don) R.	4	16	25	745	10
Neff, William D.	2	45	63	1,674	27
Newman, Matthew	13	29	909	3,620	30
Otto, William H.	1	25	10	626	15
Pegion, Philip J.	5	35	39	6,061	26
Penland, (M.) Cecile	10	52	175	2,631	25
Penny, Stephen G.	6	17	6	189	9

Perlwitz, Judith	15	66	376	5,410	37
Persson, Ola (P.G.)	26	38	559	5,215	39
Pezoa, Sergio A.	0	6	86	162	5
Pincus, Robert	16	56	775	5,993	35
Pulwarty, Roger S.	5	28	111	3,035	25
Quan, Xiaowei	16	40	263	2,066	21
Ray, Andrea J.	10	20	200	440	11
Sardeshmukh, Prashant D.	15	81	287	5,293	42
Scheuerer, Michael	17	27	445	649	13
Scott, James D.	11	49	1,036	3,138	29
Shin, Sang-Ik	2	30	7	740	16
Shlyaeva, Anna V.	2	2	2	2	1
Shupe, Matthew D.	44	123	638	5,534	45
Slivinski, Laura C.	7	10	60	83	5
Sluka, Travis C.	0	1	40	40	1
Smith, Catherine A.	6	14	515	989	21
Smith, Lesley L.	4	10	26	316	10
Solomon, Amy	12	42	149	1,210	16
Spencer, Lawrence J.	1	23	23	928	18
Starkweather, Sandra M.	5	8	96	247	6
Swales, Dustin J.	6	7	98	101	6
Switanek, Matthew B.	0	7	60	149	5
Thompson, Elizabeth J.	1	9	5	53	4
Tulich, Stefan N.	5	17	42	857	14
Uttal, Taneil A.	10	49	241	2,566	26
Viterbo, Francesca	0	2	7	8	1
Voronovich, Alexander G.	6	70	69	1,752	18
Walsh, Edward J.	5	106	37	3,309	29
Wang, Aaron	2	8	2	208	6
Wang, Yan	3	2	110	4	1
Watwood, Matthew	0	1	0	1	1
Webb, Robert S.	3	60	41	2,763	30
Weight, Elizabeth	0	1	3	8	1
Whitaker, Jeffrey S.	16	70	301	6,297	35
White, Allen B.	25	99	385	4,309	37
Wick, Gary A.	15	61	260	3,544	26
Wilczak, James M.	26	77	438	3,286	31
Wilde, Nicholas	0	2	0	0	0
Winterbottom, Henry	0	5	0	12	2
Wolding, Brandon	0	9	134	136	7

Total lifetime publications and citations reflect research conducted at both NOAA and other institutions, if author has worked at multiple institutions during their career.

Table A2. Table A2. Other PSL Publications: Books, Reports, & Datasets

PSL generates a number of assessments and datasets that utilize observational data and experiments with climate and hydrological models of different complexity to determine the physical factors that cause observed regional and seasonal climate trends and high-impact weather events. These assessments provide the best available science regarding factors causing high-impact weather and climate related extremes to allow policy makers to make informed decisions on how society should invest in critical infrastructure in risk-prone areas while ensuring resiliency.

PSL Other Publication	Document Type
Bariteau, Ludovic; Fairall, Christopher; Blomquist, Byron; Pezoa, Sergio (2018). *CAPRICORN 2016 Field campaign: surface meteorological data and turbulent fluxes collected from the RV Investigator by the National Oceanographic and Atmospheric Administration (NOAA) in the Indian and South Pacific Oceans from 2016-03-14 to 2016-04-15 (NCEI Accession 0170257).* Version 1.1. NOAA National Centers for Environmental Information. Dataset. https://doi.org/10.7289/v5q81bbc. Accessed September 15, 2020.	Dataset
Bariteau, Ludovic; Fairall, Christopher; Blomquist, Byron; Pezoa, Sergio (2019). *Surface meteorological data and turbulent fluxes collected by the NOAA as part of the Woods Hole Oceanographic Institute (WHOI) Hawaii Ocean Time-series Station (WHOTS) project in the North and Southeast Pacific Ocean from 2001-10-10 to 2018-04-12 (NCEI Accession 0186688).* NOAA National Centers for Environmental Information. Dataset. https://doi.org/10.25921/2dck-3068. Accessed September 15, 2020.	Dataset
Calvet J.C., DeRosnay, P.; **Penny, S.G.** Assimilation of Remote Sensing Data into Earth System Models. *Remote Sensing.* 2019, pp i-236.	Book
Capotondi, A, et al. Climate model biases and El Niño Southern Oscillation (ENSO) simulation. *Climate Variability and Predictability Program: Variations Newsletters*, 2015, usclivar.org/newsletter/newsletters.	Other
Capotondi, A, et al. ENSO Diversity and Its Implications for US West Coast Marine Ecosystems. *Climate Variability and Predictability Program: Variations Newsletters*, 2017, usclivar.org/newsletter/newsletters.	Other
Carlson, D., B. Dhalbäck, B. Meyer, L. Andersson, M. Siegert, J. Nymand Larsen, **T. Uttal**, N. Mikkelsen, P. Kujala, and T. Callaghan. (2017). *Norwegian Polar Research: an evaluation*. 10.13140/RG.2.2.25291.21284.	Report
Compo G. P., L. C. Slivinski, J. S. Whitaker, P. D. Sardeshmukh, C. McColl, P. Brohan, R. Allan, X. Yin, R. Vose, **L. J. Spencer**, et al (2018). *The International Surface Pressure Databank.* Version 4. NCAR UCAR Research Data Archive Computational & Information Systems Lab. Dataset. doi.org/10.5065/9EYR-TY90. Accessed September 15, 2020.	Dataset
Cox, Christopher; Wolfe, Daniel; Hartten, Leslie; Johnston, Paul (2017). *El Niño Rapid Response (ENRR) Field Campaign: Radiosonde Data (Level 2) from the NOAA Ship Ronald H. Brown, February-March 2016 (NCEI Accession 0161527).* Version 1.1. NOAA National Centers for Environmental Information. Dataset. doi.org/10.7289/V5X63K15. Accessed September 15, 2020.	Dataset
Cox, Christopher; Wolfe, Daniel; Hartten, Leslie; Johnston, Paul (2017). *El Niño Rapid Response (ENRR) Field Campaign: Surface Meteorological and Ship Data from the NOAA Ship Ronald H. Brown, February-March 2016 (NCEI Accession 0161528).* Version 1.1.	Dataset

NOAA National Centers for Environmental Information. Dataset. doi.org/10.7289/V5SF2T80. Accessed September 15, 2020.	
Erian W., **R. S. Pulwarty,** et al. United Nations Office for Disaster Risk Reduction, 2019. *Global Assessment Report on Disaster Risk Reduction (GAR),* www.undrr.org/publication/global-assessment-report-disaster-risk-reduction-2019.	Report
Fisichelli, N. A., G. W. Schuurman, A. Symstad, **A. J. Ray,** J. M. Friedman, B. Miller and E. Rowland. United States Geological Survey, 2016. *Resource management and operations in central North Dakota: Climate change scenario planning workshop summary. November 12-13, 2015, Bismarck, ND,* pubs.er.usgs.gov/publication/70176346.	Report
Goodman S., **R. S. Pulwarty,** L. Risi and A. King. *Improving Predictive Capabilities for Security Related Disruptive Water and Weather Events,* 2018.	Report
Gould W. A.,...**R. S. Pulwarty**, et al. *2018: Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II,* 2018.	Report
Hamill T. M. "Application of Post-Processing to Weather Forecasts." *Statistical Postprocessing of Ensemble Forecasts.* Edited by Stéphane Vannitsem, Daniel Wilks, Jakob Messner, Elsevier, 2018, pp 187-217.	Book
Hamill, T. M. and R. Swinbank. "Stochastic forcing, ensemble prediction systems, and TIGGE." *Seamless prediction of the Earth system.* World Meteorological Organization, 2015, pp 187-212.	Book
Hartten, Leslie; Johnston, Paul; Cox, Christopher; Wolfe, Daniel (2017). *El Niño Rapid Response (ENRR) Field Campaign: Radiosonde Data (Level 2) from Kiritimati Island, January-March 2016 (NCEI Accession 0161525).* Version 1.1. NOAA National Centers for Environmental Information. Dataset. doi.org/10.7289/V55Q4T5K. Accessed September 15, 2020.	Dataset
Hartten, Leslie; Johnston, Paul; Cox, Christopher; Wolfe, Daniel (2017). *El Niño Rapid Response (ENRR) Field Campaign: Surface Meteorological Data from Kiritimati Island, January-March 2016 (NCEI Accession 0161526).* Version 1. NOAA National Centers for Environmental Information. Dataset. https://doi.org/10.7289/v51z42h4. Accessed September 15, 2020.	Dataset
Herdman L., **J. Kim, L. E. Johnson, T. Coleman, R. Cifelli**, R. Martyr-Koller, J. Finzi-Hart, L. Erikson and P. Barnard. NOAA Institutional Repository, 2018. *San Francisco Bay Integrated Flood Forecasting Project - Summary Report,* doi.org/10.7289/V5/TM-OAR-PSD-317.	Report
Hobbins M. T., G. Senay, P. H. Gowda and G. Artan. "Evapotranspiration and Evaporative Demand." *Statistical Analysis of Hydrologic Variables.* American Society of Civil Engineers, 2019, pp 71-143.	Book
Hobbins M. T., I. Rangwala, J. J. Barsugli, C. Dewes. "Extremes in evaporative demand and their implications for drought and drought monitoring in the 21st Century." *Extreme Hydrology and Climate Variability.* Edited by Assefa M. Melesse, Wossenu Abtew and Gabriel Senay, Elsevier, 2019, pp 325-341.	Book
Hobbins, M.T., Barsugli, J.J., Dewes, C.F., and Rangwala, I., 2017, *Monthly Pan Evaporation Data across the Continental United States between 1950-2001*: https://doi.org/10.21429/C9MW25.	Dataset

Hoell A., J. Perlwitz and J. K. Eischeid. National Integrated Drought Information System, 2019. *The Causes, Predictability, and Historical Context of the 2017 U.S. Northern Great Plains Drought.*	Report
Jencso K., B. Parker, M. Downey, T. Hadwen, A. Howell, **A. Hoell**, et al. National Integrated Drought Information System, 2019. *Flash Drought: Lessons Learned from the 2017 Drought Across the U.S. Northern Plains and Canadian Prairies.*	Report
Johnson, L. E., C. Hsu, **R. J. Zamora and R. Cifelli.** NOAA Institutional Repository, 2016. *Assessment and Applications of Distributed Hydrologic Model - Russian-Napa River Basins, CA. https://repository.library.noaa.gov/view/noaa/9419*	Report
Johnson, L. E., R. Cifelli and A. B. White. NOAA Institutional Repository, 2015. *Benefits of an Advanced Quantitative Precipitation Information System: San Francisco Bay Area Case Study.* http://dx.doi.org/10.7289/V5WS8R6X.	Report
Lee, C. M., **M. Shupe**, C. Wilson, L. Sheffield Guy, H. V. Wiggins, M. Bennett, E. Hoy, R. Kwok, A. Nguyen, D. Payer, E. Schuur, **S. Starkweather,** L. Stearns. Arctic Research Consortium of the United States, 2015. *Arctic Observing Open Science Meeting 2015 - Report.*	Report
Lempert R., R. Arnold, **R. S. Pulwarty**, et al. National Climate Assessment (NCA), 2018. *San Francisco Bay Integrated Flood Forecasting Project - Summary Report*. doi.org/10.7930/NCA4.2018.	Report
Linkov I., M. Kurth, B. Trump and **R. S. Pulwarty.** *The Business Case For Resilience In Water Infrastructure Investment.* Roundtable on Financing Water, 2019.	Other
Mahoney K. M., E. James, T. Alcott and **R. Cifelli.** *Colorado – New Mexico Regional Extreme Precipitation Study Summary Report,* 2019.	Report
Mahoney K. M., J. J. Lukas and M. Mueller. *Colorado – New Mexico Regional Extreme Precipitation Study Summary Report, Volume VI: Considering Climate Change in the Estimation of Extreme Precipitation for Dam Safety*, 2018.	Report
Rabier, F., A. J. Thorpe, A. R. Brown,...**T. M. Hamill,** et al. "Global Environmental Prediction." *Seamless prediction of the Earth system.* World Meteorological Organization, 2015, pp 311 - 329.	Book
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Rangwala, I., **Smith, L.L.**, Senay, G., **Barsugli, J.**, Kagone, S., and **Hobbins, M.**, 2019, *Landscape Evaporative Response Index (LERI): A high resolution monitoring and assessment of evapotranspiration across the Contiguous United States:* U.S. Geological Survey ScienceBase, https://doi.org/10.21429/43r4-3q68.	Dataset
Ray A. J., B. Liebmann and D. Allured. "Climate Analysis." *Wyoming Basin Rapid Ecoregional Assessment* (Version 1.1). Edited by Carr N. B. and C. P. Melcher, U.S. Geological Survey, 2017, pp 165-203. https://doi.org/10.3133/ofr20151155.	Report
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Shupe, Matthew. 2018. *Ceilometer Cloud Base Height Measurements at Summit Station, Greenland*, *2018.* NSF Arctic Data Center. doi:10.18739/A2KP7TQ9P.	Dataset
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Shupe, Matthew. 2018. *Precipitation Occurrence Sensor System measurements taken at Summit Station, Greenland, 2018.* NSF Arctic Data Center. doi.org/10.18739/A20Z70W42.	Dataset
Shupe, Matthew. 2018. *SOnic Detection And Ranging (SODAR) measurements taken at Summit Station, Greenland, 2018.* NSF Arctic Data Center. doi.org/10.18739/A2QF8JJ3F.	Dataset
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Slivinski, L. C. *US CLIVAR Research Highlights,* 2019.	Other
Spencer L., C. McColl, P. Brohan, K. Wood, R. Allan and **G. P. Compo.** *OldWeather3 Marine Data for ICOADS Input,* 2019.	Dataset
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Yocum, H. M. "Equity Concerns in REDD+ Planning and Implementation: A Case Study from Malawi." *The Carbon Fix: Forest Carbon, Social Justice, and Environmental Governance.* Routledge, 2017.	Book

Bolded authors are NOAA PSL employees. These documents are not included in the bibliometrics and citation analysis in this report.