Bibliometrics Report:

A Bibliometric Analysis of NOAA GSL Publications, 2015-2020

PREPARED FOR
NOAA Global Systems Laboratory

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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 Global Systems Laboratory (GSL) from January 1, 2015 through December 31, 2020. Our Web of Science (WoS) search for GSL publications in that time period produced 244 titles (see Appendix II for details on method and data sources). GSL titles not indexed in WoS are excluded from this analysis.

This bibliometrics report analyzes GSL 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 GSL's work via citation analysis and benchmark metrics.
- Evidence in the scientific literature of the impact of GSL forecasting models.

3,547
Sum of times cited

244
Total GSL publications, Jan. 2015-Dec. 2020

15
Average cites per publication

Part A. General Productivity

General productivity metrics for GSL publications, Jan. 2015-Dec. 2020.

Summary Metrics	
Total number of publications	244
Total times cited	3,547
Average citations per publication	15
Group h-index 2015-2020	28
Group h-index 2010-2020	49

Table 1. Common bibliometric indicators. An h-index of 28 indicates that this group of 244 publications includes 28 papers that have each received 28 or more citations (Hirsch 2005). Note that this is not an *average* of GSL researcher h-indices, but the collective h-index for this set of 244 papers.

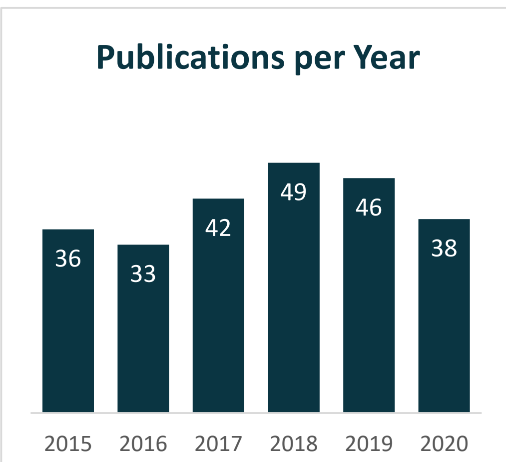


Figure 1. Number of GSL publications per year, 2015-2020. Because of lag times in database indexing, 2020 count should be considered preliminary.

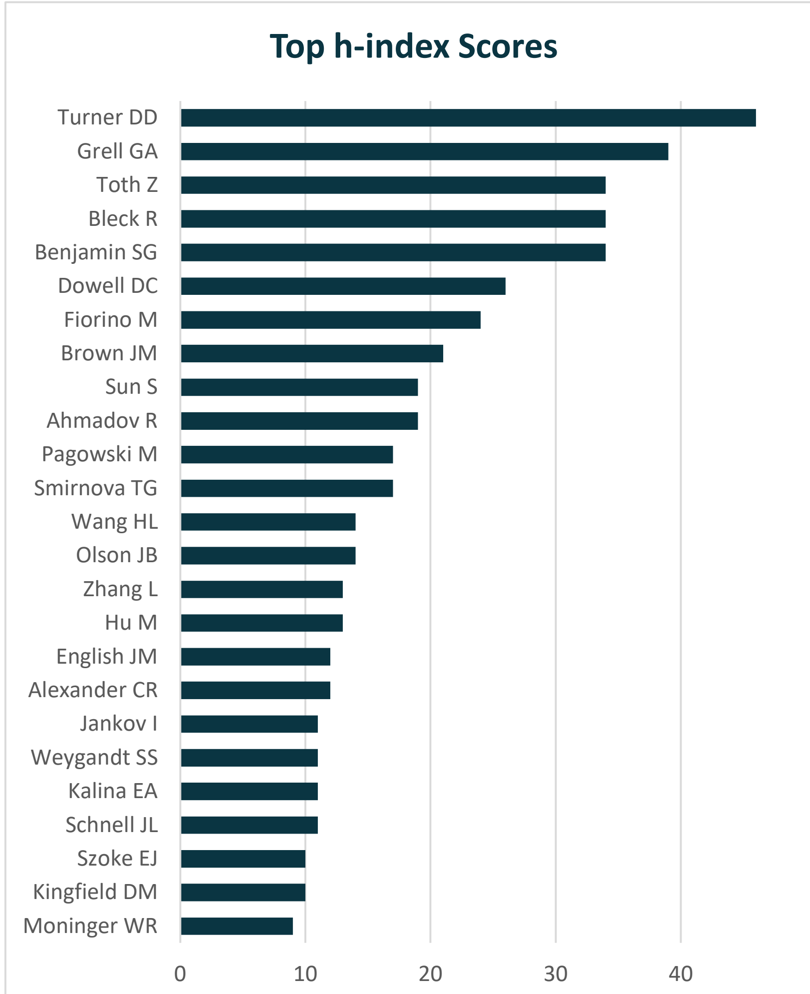


Figure 2. Top h-index scores for GSL researchers. An h-index of 46 indicates that that a researcher has 46 publications that have received at least 46 citations (Hirsch 2005). It is important to note that the h-index favors career length; it is constrained by number of publications, such that a researcher with five publications can only have an h-index of 5, whether those publications have received 5 citations each or 100 citations each. Furthermore, the h-index never goes down, and continues to incrase as citations accumulate over time, regardless of how long it has been since a researcher's last publication. Due to these and other known limitations, the h-index should always be considered in conjunction with other indicators of excellence and impact.

Figure 3. Publications per GSL author, 2015-2020.

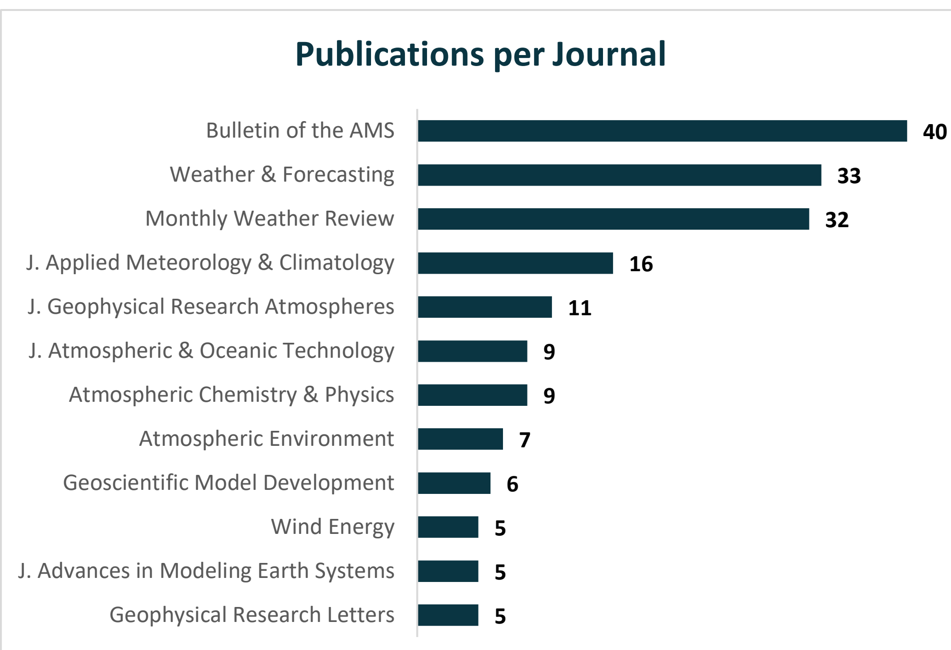


Figure 4. Journals in which GSL has published five or more times, 2015-2020.

GSL top-cited papers 2015-2020	Times cited	Highly cited
Benjamin, S.G., S.S. Weygandt, J.M. Brown, M. Hu, C.R. Alexander, T.G. Smirnova, . . . G.S. Manikin, 2016: A North American Hourly Assimilation and Model Forecast Cycle: The Rapid Refresh. *Monthly Weather Review*, 144, 1669-1694. doi:10.1175/mwr-d-15-0242.1.	351	✓
Powers, J.G., J.B. Klemp, W.C. Skamarock, C.A. Davis, J. Dudhia, D.O. Gill, . . . M.G. Duda, 2017: The Weather Research and Forecasting Model overview, system efforts, and future directions. *Bulletin of the American Meteorological Society*, 98, 1717-1737. doi:10.1175/bams-d-15-00308.1.	234	✓
MacDonald, A.E., C.T.M. Clack, A. Alexander, A. Dunbar, J. Wilczak, and Y.F. Xie, 2016: Future cost-competitive electricity systems and their impact on US CO2 emissions. *Nature Climate Change*, 6, 526-531. doi:10.1038/nclimate2921.	124	✓
Bocquet, M., H. Elbern, H. Eskes, M. Hirtl, R. Zabkar, G.R. Carmichael, . . . C. Seigneur, 2015: Data assimilation in atmospheric chemistry models: current status and future prospects for coupled chemistry meteorology models. *Atmospheric Chemistry and Physics*, 15, 5325-5358. doi:10.5194/acp-15-5325-2015.	107	
Danabasoglu, G., S.G. Yeager, W.M. Kim, E. Behrens, M. Bentsen, D.H. Bi, . . . I. Yashayaev, 2016: North Atlantic simulations in Coordinated Ocean-ice Reference Experiments phase II (CORE-II). Part II: Inter-annual to decadal variability. *Ocean Modelling*, 97, 65-90. doi:10.1016/j.ocemod.2015.11.007.	91	
Ahmadov, R., S. McKeen, M. Trainer, R. Banta, A. Brewer, S. Brown, . . . R. Zamora, 2015: Understanding high wintertime ozone pollution events in an oil- and natural gas-producing region of the western US. *Atmospheric Chemistry and Physics*, 15, 411-429. doi:10.5194/acp-15-411-2015.	86	
Kravitz, B., A. Robock, S. Tilmes, O. Boucher, J.M. English, P.J. Irvine, . . . S. Watanabe, 2015: The Geoengineering Model Intercomparison Project Phase 6 (GeoMIP6): simulation design and preliminary results. *Geoscientific Model Development*, 8, 3379-3392. doi:10.5194/gmd-8-3379-2015.	66	
Gustafsson, N., T. Janjic, C. Schraff, D. Leuenberger, M. Weissmann, H. Reich, . . . T. Fujita, 2018: Survey of data assimilation methods for convective-scale numerical weather prediction at operational centres. *Quarterly Journal of the Royal Meteorological Society*, 144, 1218-1256. doi:10.1002/qj.3179.	65	✓
Smith, T.M., V. Lakshmanan, G.J. Stumpf, K.L. Ortega, K. Hondl, K. Cooper, . . . J. Brogden, 2016: Multi-radar multi-sensor (MRMS) severe weather and aviation products: Initial operating capabilities. *Bulletin of the American Meteorological Society*, 97, 1617+. doi:10.1175/bams-d-14-00173.1.	64	
Wang, K., Y. Zhang, K. Yahya, S.Y. Wu, and G. Grell, 2015: Implementation and initial application of new chemistry-aerosol options in WRF/Chem for simulating secondary organic aerosols and aerosol indirect effects for regional air quality. *Atmospheric Environment*, 115, 716-732. doi:10.1016/j.atmosenv.2014.12.007.	51	

Table 2. GSL's 10 highest-cited papers 2015-2020. "Highly cited" papers are those in the top 1% by citation rate in a given research category (Clarivate Analytics, 2020(a,b)). Citation counts as of December 31, 2020.

GSL top-cited papers, 2010-2014	Times cited as of 01/31/21	Highly cited
Grell, G.A., and S.R. Freitas, 2014: A scale and aerosol aware stochastic convective parameterization for weather and air quality modeling. *Atmospheric Chemistry and Physics*, 14, 5233-5250. doi:10.5194/acp-14-5233-2014.	2985	✓
vanZanten, M.C., B. Stevens, L. Nuijens, A.P. Siebesma, A.S. Ackerman, F. Burnet, . . . A. Wyszogrodzki, 2011: Controls on precipitation and cloudiness in simulations of trade-wind cumulus as observed during RICO. *Journal of Advances in Modeling Earth Systems*, 3, 19. doi:10.1029/2011ms000056.	363	✓
Dowell, D.C., L.J. Wicker, and C. Snyder, 2011: Ensemble Kalman Filter Assimilation of Radar Observations of the 8 May 2003 Oklahoma City Supercell: Influences of Reflectivity Observations on Storm-Scale Analyses. *Monthly Weather Review*, 139, 272-294. doi:10.1175/2010mwr3438.1.	224	
Fitch, A.C., J.B. Olson, J.K. Lundquist, J. Dudhia, A.K. Gupta, J. Michalakes, and I. Barstad, 2012: Local and Mesoscale Impacts of Wind Farms as Parameterized in a Mesoscale NWP Model. *Monthly Weather Review*, 140, 3017-3038. doi:10.1175/mwr-d-11-00352.1.	198	✓
Solazzo, E., R. Bianconi, R. Vautard, K.W. Appel, M.D. Moran, C. Hogrefe, . . . S. Galmarini, 2012: Model evaluation and ensemble modelling of surface-level ozone in Europe and North America in the context of AQMEII. *Atmospheric Environment*, 53, 60-74. doi:10.1016/j.atmosenv.2012.01.003.	175	
Hamill, T.M., G.T. Bates, J.S. Whitaker, D.R. Murray, M. Fiorino, T.J. Galarneau, . . . W. Lapenta, 2013: NOAA'S second-generation global medium-range ensemble reforecast dataset. *Bulletin of the American Meteorological Society*, 94, 1553-1565. doi:10.1175/bams-d-12-00014.1.	166	✓
Baklanov, A., K. Schlunzen, P. Suppan, J. Baldasano, D. Brunner, S. Aksoyoglu, . . . Y. Zhang, 2014: Online coupled regional meteorology chemistry models in Europe: current status and prospects. *Atmospheric Chemistry and Physics*, 14, 317-398. doi:10.5194/acp-14-317-2014.	133	
Solazzo, E., R. Bianconi, G. Pirovano, V. Matthias, R. Vautard, M.D. Moran, . . . S. Galmarini, 2012: Operational model evaluation for particulate matter in Europe and North America in the context of AQMEII. *Atmospheric Environment*, 53, 75-92. doi:10.1016/j.atmosenv.2012.02.045.	125	
Saha, S., S. Moorthi, H.L. Pan, X.R. Wu, J.D. Wang, S. Nadiga, . . . M. Goldberg, 2010: The NCEP climate forecast system reanalysis. *Bulletin of the American Meteorological Society*, 91, 1015-1057. doi:10.1175/2010bams3001.1.	120	
Bougeault, P., Z. Toth, C. Bishop, B. Brown, D. Burridge, D.H. Chen, . . . S. Worley, 2010: The THORPEX Interactive Grand Global Ensemble. *Bulletin of the American Meteorological Society*, 91, 1059-1072. doi:10.1175/2010bams2853.1.	116	

Table 3. GSL's 10 highest-cited papers 2010-2014. Because it takes at least three years for citations to accumulate (Aksnes, et al. 2019), the 2015-2020 time window is not ideal for showing citation impact. This table gives a more accurate representation of eventual impact of GSL top publications.

Top 10 Altmetric Scores	Altmetric Attention Score	Rank*
MacDonald, A.E., C.T.M. Clack, A. Alexander, A. Dunbar, J. Wilczak, and Y.F. Xie, 2016: Future cost-competitive electricity systems and their impact on US CO2 emissions. *Nature Climate Change*, 6, 526-531. doi:10.1038/nclimate2921.	926	3 / 93
Veers, P., K. Dykes, E. Lantz, S. Barth, C.L. Bottasso, O. Carlson, . . . R. Wiser, 2019: Grand challenges in the science of wind energy. *Science*, 366, 443+. doi:10.1126/science.aau2027.	184	113 / 925
Hammer, M.S., A. van Donkelaar, C. Li, A. Lyapustin, A.M. Sayer, N.C. Hsu, . . . R.V. Martin, 2020: Global Estimates and Long-Term Trends of Fine Particulate Matter Concentrations (1998-2018). *Environmental Science & Technology*, 54, 7879-7890. doi:10.1021/acs.est.0c01764.	122	6 / 366
Feldman, D.R., W.D. Collins, S.C. Biraud, M.D. Risser, D.D. Turner, P.J. Gero, . . . M.S. Torn, 2018: Observationally derived rise in methane surface forcing mediated by water vapour trends. *Nature Geoscience*, 11, 238+. doi:10.1038/s41561-018-0085-9.	120	14 / 58
Trenberth, K.E., M. Marquis, and S. Zebiak, 2016: The vital need for a climate information system. *Nature Climate Change*, 6, 1057-1059. doi:10.1038/nclimate3170.	110	20 / 71
Weatherhead, E.C., B.A. Wielicki, V. Ramaswamy, M. Abbott, T.P. Ackerman, R. Atlas, . . . D. Wuebbles, 2018: Designing the Climate Observing System of the Future. *Earths Future*, 6, 80-102. doi:10.1002/2017ef000627.	89	6 / 30
Pettersen, C., R. Bennartz, A.J. Merrelli, M.D. Shupe, D.D. Turner, and V.P. Walden, 2018: Precipitation regimes over central Greenland inferred from 5 years of ICECAPS observations. *Atmospheric Chemistry and Physics*, 18, 4715-4735. doi:10.5194/acp-18-4715-2018.	77	2 / 394
Langford, A.O., R.B. Pierce, and P.J. Schultz, 2015: Stratospheric intrusions, the Santa Ana winds, and wildland fires in Southern California. *Geophysical Research Letters*, 42, 6091-6097. doi:10.1002/2015gl064964.	74	14 / 351
Merryfield, W.J., J. Baehr, L. Batte, E.J. Becker, A.H. Butler, C.A.S. Coelho, . . . S. Yeager, 2020: Current and Emerging Developments in Subseasonal to Decadal Prediction. *Bulletin of the American Meteorological Society*, 101, E869-E896. doi:10.1175/bams-d-19-0037.1.	55	n/a
James, E.P., and S.G. Benjamin, 2017: Observation System Experiments with the Hourly Updating Rapid Refresh Model Using GSI Hybrid Ensemble-Variational Data Assimilation. *Monthly Weather Review*, 145, 2897-2918. doi:10.1175/mwr-d-16-0398.1.	52	2 / 35

Table 4. Altmetrics. Alternative metrics are complementary to traditional citation-based metrics and include social media mentions, blog posts, online news stories, and more. They help quantify early interest in a publication, before traditional citations have had time to accumulate. The Altmetric Attention Score, provided by Altmetric.com, is a weighted count of online attention (Altmetrics.com, n.d.). Papers with high scores are usually those with subject matter that resonates with the larger scientific community or the public, or that which taps into current issues such as climate change and energy production.

*Although it is difficult to say what is a “good” Altmetric score, Altmetric provides a rank derived from a document’s score compared to other publications from the same journal, within the same three-month period (e.g., MacDonald, et al. has the third highest Altmetric score out of 93 publications of the same age from the same journal) (Altmetrics.com, 2020).

Part B. Collaboration

This section explores coauthor and institutional relationships.

Institutional affiliation	Number of occurrences	Institutional affiliation	Number of occurrences
National Oceanic Atmospheric Administration	233*	University of California System	16
University of Colorado System	131	State University of New York System	15
National Center Atmospheric Research	64	Centre National De La Recherche Scientifique	14
Colorado State University	43	NASA Jet Propulsion Laboratory	10
University of Oklahoma System	35	Developmental Testbed Center	9
National Aeronautics Space Administration	33	Helmholtz Association	9
US Department of Energy	32	University System of Maryland	9
University of Miami	23	Argonne National Laboratory	8
Atlantic Oceanographic Meteorological Laboratory	18	California Institute of Technology	8
NASA Goddard Space Flight Center	18	NASA Langley Research Center	8
Pacific Northwest National Laboratory	18	National Renewable Energy Laboratory USA	8
University of Wisconsin System	17	University of Chicago	8

Table 5. Top institutional affiliations of collaborating authors on GSL publications. *Includes GSL authors.

Types of Collaborating Organizations

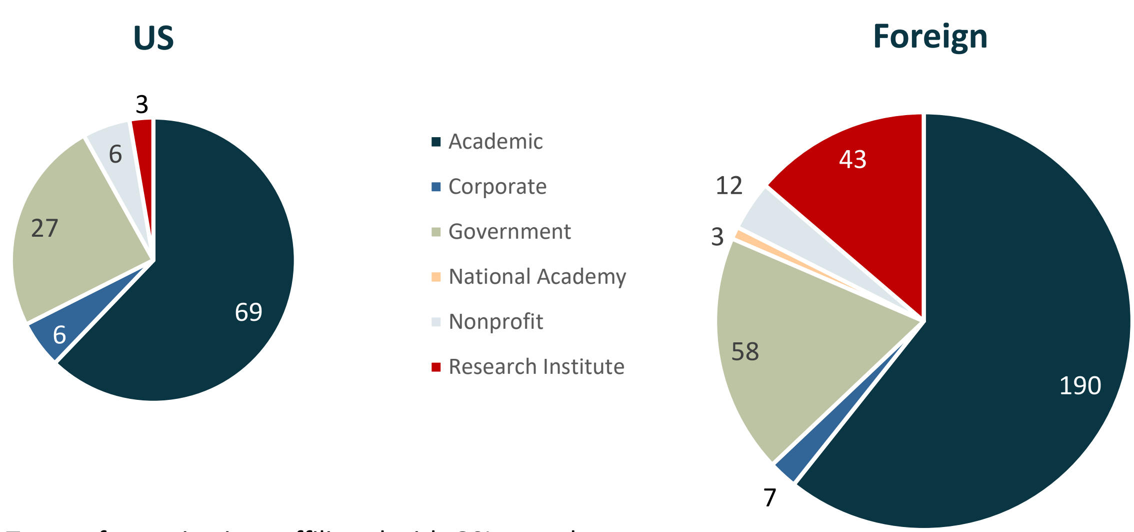


Figure 5. Types of organizations affiliated with GSL coauthors.

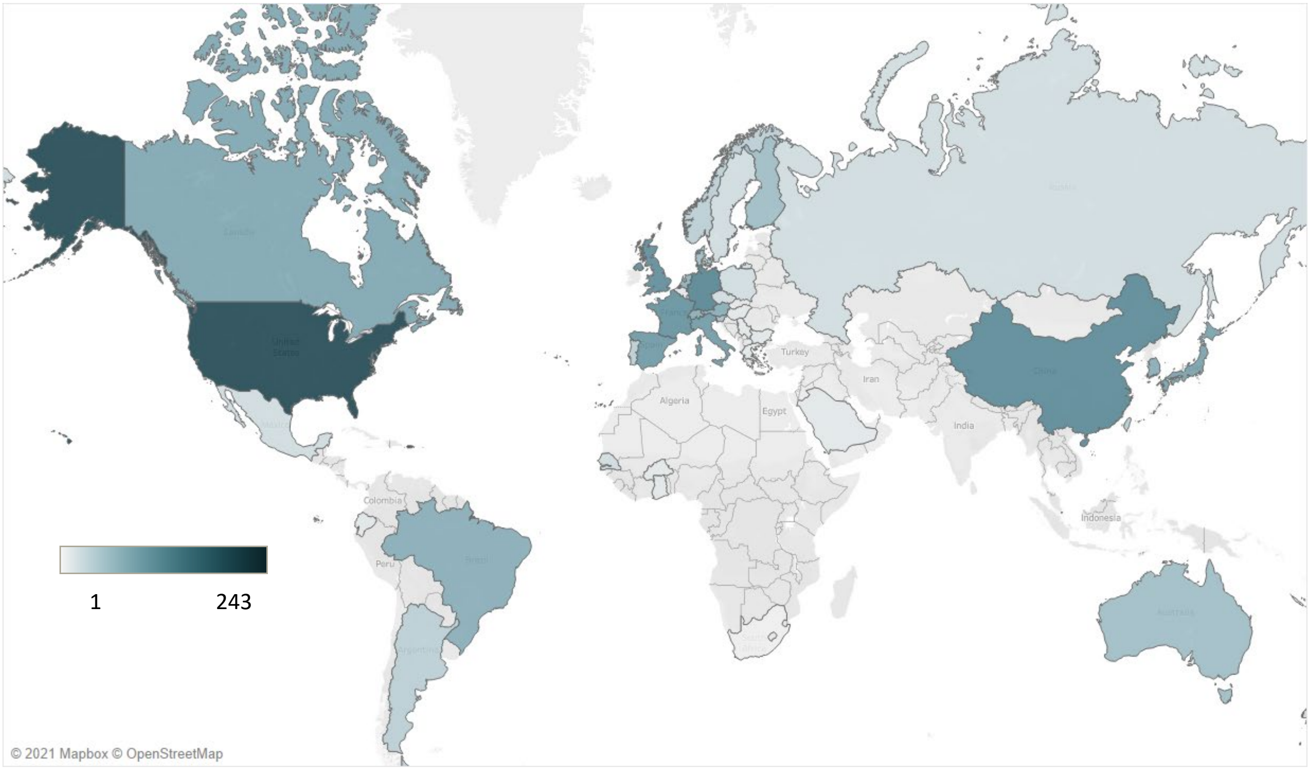


Figure 6. Country affiliations of coauthors of GSL publications. This map, highlighting 42 countries, illustrates the global collaboration of GSL researchers.

Country	Number of occurrences	Country	Number of occurrences
USA	243	Japan	11
Germany	28	Canada	10
China	24	Austria	8
United Kingdom	22	Brazil	8
France	19	South Korea	8
Spain	15	Switzerland	8
Italy	14	Netherlands	7

Table 6. Top countries collaborating with GSL.

Part C. Impact

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

Section 1. Citation Analysis

Figure 7. Journals that have cited GSL publications 20 or more times. In addition to the expected meteorology-related titles, GSL publications have been cited in interdisciplinary journals such as *Journal of Peace Research*, *Sustainable Cities and Society*, *Climate Policy*, and *Energy Strategy Reviews.*

Citing Organizations	Number of Occurrences
National Oceanic Atmospheric Admin	560*
National Center Atmospheric Research	345
University of Colorado System	284
National Aeronautics Space Administration	219
University of Oklahoma System	189
US Department of Energy	183
Chinese Academy of Sciences	177
University of California System	168
Centre National De La Recherche Scientifique	160
Helmholtz Association	125
NASA Goddard Space Flight Center	116
Colorado State University	107
California Institute of Technology	91
NASA Jet Propulsion Laboratory	86
University System of Maryland	86
Nanjing University of Information Science Technology	82
Met Office UK	80
Environment Climate Change Canada	78
Pacific Northwest National Laboratory	78
University of Wisconsin System	78
China Meteorological Administration	75
Pennsylvania Commonwealth System of Higher Ed	72
Institute of Atmospheric Physics CAS	69
University of Chinese Academy of Sciences CAS	64
University of Reading	64
Sorbonne Universite	63
State University of New York System	63
Max Planck Society	61
University of North Carolina	61
Columbia University	59
Meteo France	56
Russian Academy of Sciences	55
European Centre for Medium Range Weather Forecasts	54
North Carolina State University	52
University of Washington	52
Universite Paris Saclay	51
Utah System of Higher Education	51

Table 7. Top Institutional affiliations of authors citing GSL publications.
*Includes GSL authors

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 GSL'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)).

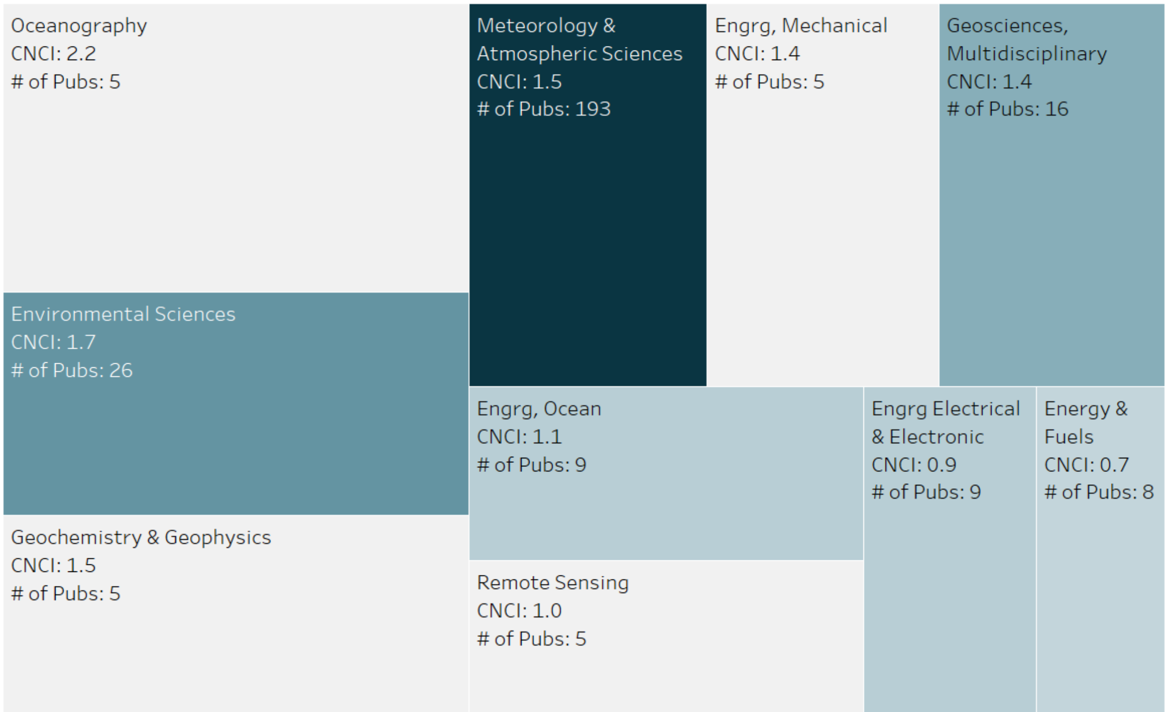
- **Highly Cited Papers:** The top one percent of cited papers in a given research category are designated "highly cited." Highly Cited Papers "are considered to be indicators of scientific excellence and top performance and can be used to benchmark research performance against field baselines worldwide." (Clarivate Analytics, 2020(a,b)).

GSL benchmark metrics	December 2020 All GSL / OA*
% of publications cited	86% / 92%
Category Normalized Citation Index (CNCI)	1.5 / 1.7
% of publications in top 10% (by citation rate)	15% / 17%
% highly cited	2.5% / 3%

Table 8. Benchmark metrics for GSL publications. A CNCI of 1.5 indicates that GSL publications are cited at 1.5 times the average rate for publications in the same date range and subject matter.

*66% of GSL'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 , 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 8. CNCI by subject area. Among GSL's top subject areas, the highest CNCI is in **Oceanography**, at 2.2 – more than twice the average citation rate in that category. In **Meteorology & Atmospheric Sciences**, where GSL has the most publications, the CNCI is 1.5 – or, one-and-a-half times the average citation rate.

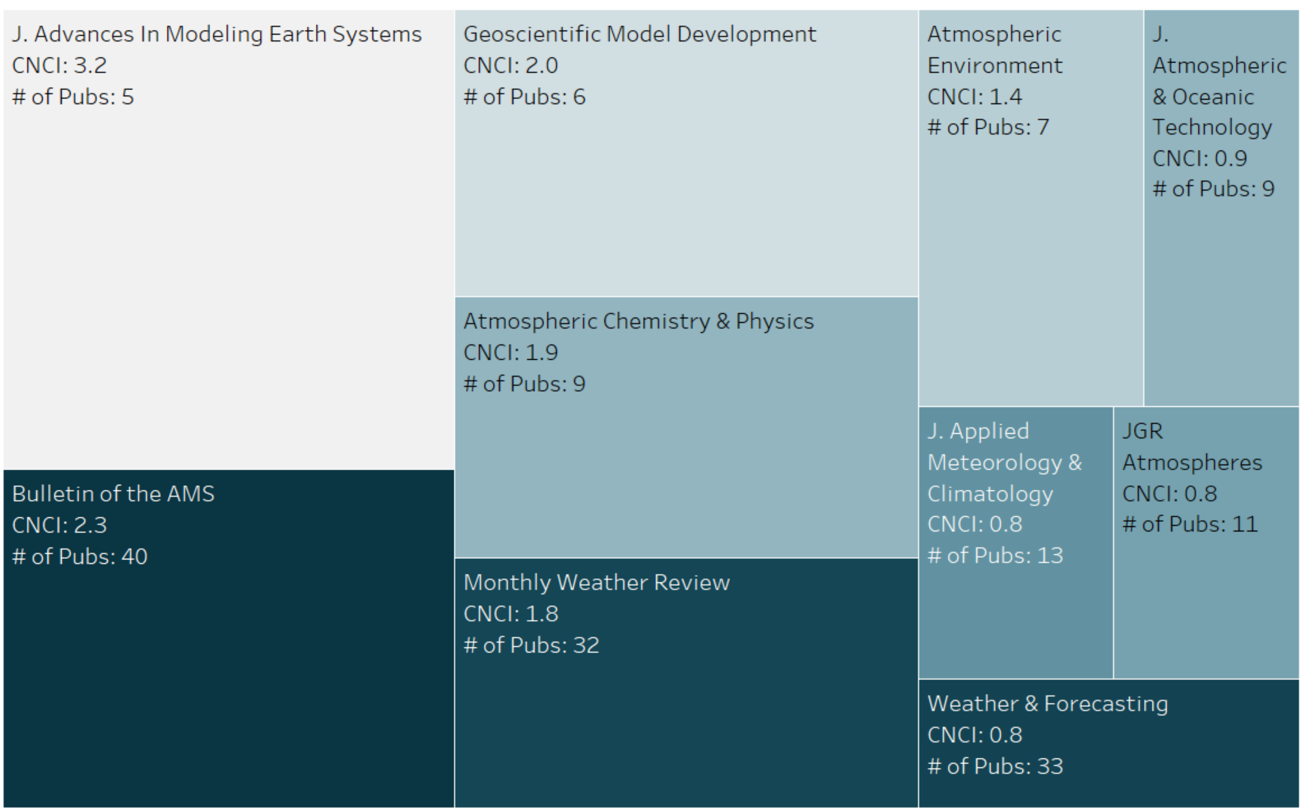


Figure 9. CNCI by journal. Among GSL's top journals, the highest CNCI is for *Journal of Advances in Modleing Earth Systems,* at 3.2 – that is, more than three times the average citation rate for that journal. For *Bulletin of the American Meteorological Society*, where GSL has the most publications, the CNCI is 2.3, over two times the average citation rate for that journal.

Part D. GSL Models

While publication and citation data are readily acquired from standardized databases, data on the impact and usage of GSL's weather prediction models are much harder to collect. When researchers rely on GSL model data in their publications, the model is rarely cited in the reference section. More often, the model is mentioned in the introduction, methods section, acknowledgements, or perhaps simply in the caption to a data table. For this reason, traditional databases like Web of Science, which search only the title, abstract, and keywords are poorly suited for this type of search. Full text searching, on the other hand, is more likely to capture mentions of GSL's models, but the imprecise nature of full text searching carries uncertainty regarding the relevance of search results.

The table below provides *estimates* of the number of mentions in published literature for several of GSL's widely-used forecasting models. These estimates are based on searches perfomed in the WoS and Dimensions databases, with search results adjusted based on previous analyses of the relevance of full text searching. It is very likely that these estimates under-represent the usage of GSL models; the searches do not capture times when the use of GSL data does not result in a published paper, or when it is published in other document types, such as trade journals and conference papers.

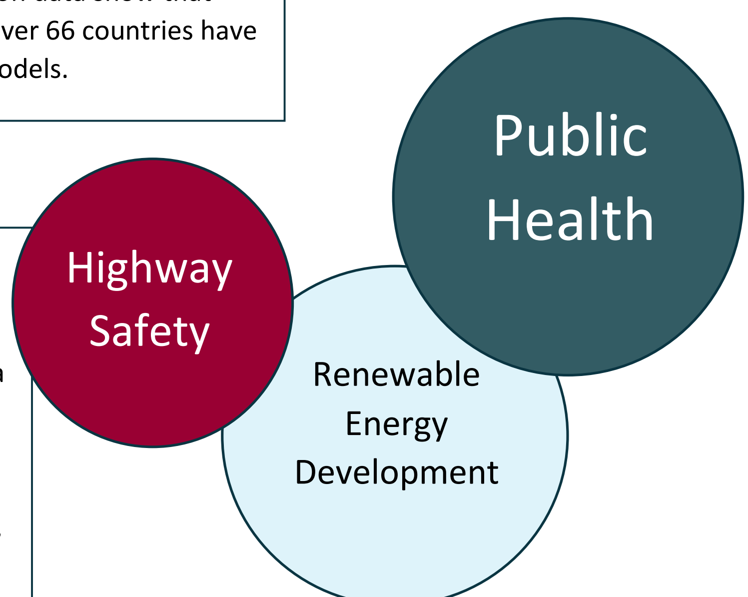
Model	Adjusted Total Estimate
AWIPS	388 mentions in published literature from 1986-present
MADIS	155 mentions in published literature from 2015-present
RAP/HRRR*	688 mentions in published literature from 2012--present
WRF-Chem	1385 mentions in published literature from 2006-present

Table 10. Estimated mentions in the literature for selected GSL models.
*Because RAP & HRRR are often mentioned together, search results have been combined.

66
countries

Country affiliation data show that researchers in over 66 countries have relied on GSL models.

In addition to the expected subject areas of atmospheric chemistry, remote sensing, and environmental science, GSL model data are used in a wide range of applications, affecting public health, highway safety, sustainable development, urban building design, telecommunications, and more.



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Altmetric.com. n.d. "What Are Altmetrics?" Accessed December 16, 2020. www.altmetric.com/about-altmetrics/what-are-altmetrics/.

Altmetrics.com. 2020. "Putting the Altmetric Attention Score in context." Accessed February 18, 2021. https://help.altmetric.com/support/solutions/articles/6000233313-putting-the-altmetric-attention-score-in-context.

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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 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 Global Systems Laboratory (GSL) from January 2015 to December 31, 2020. For our data source, we used GSL's current list of publications. Because we use the Web of Science analytical tools for our bibliometric analyses, GSL 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.

Although we have included publication and citation data through December 2020 in our data set, it is generally agreed that publications must be at least two to three years old for citation reporting to be meaningful (Aksnes, et al. 2019). 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, InCites, Dimensions and Altmetric in February, 2021. 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.