# Global Monitoring Division

## Indicators of Preeminence 1: Bibliometrics, h-Index, Citations and Publications

### 2018 Review

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**Part 2. Indicators of Preeminence 2:**

# GMD BIBLIOMETRICS REPORT

## h-Index, Category Normalized Citation Impact (CNC), Percentile Analysis, Times Cited and Percent of Documents Cited.

PREPARED FOR

GMD: Global Monitoring Division

BY

Aurelia Mandani, Technology Services Librarian, Boulder Laboratories

March 05, 2018

***Note:*** *The following information is abstracted from the above titled report based upon Web of Science data and software. Web of Science identified 486 reviewed scientific papers from GMD in 2013-17. As a caveat, the use of Web of Science for article collection means that book chapters, technical reports, and some journal articles are not included. Consequently, the publication counts presented in this report are under counts of the actual number of publications produced by GMD. However, despite these limitations, the collections of articles analyzed herein constitute a representative sample of the articles published by GMD between 2013 and 2017.*

## h-Index, Category Normalized Citation Impact and Percentile Analyses

NOAA suggests that in addition to presenting an (i) h-Index, the preeminence analysis include (ii) Category Normalized Citation Impact (CNCI), (iii) percent of documents cited, and (iv) percentile analysis. Unlike the h-Index which provides an absolute impact analysis without regard to context, these additional results provide a robust picture of a division's performance and ensure they are not evaluated in a vacuum.

## h-Index

The h-index is a metric that is used to measure the "productivity and influence" of a researcher or group of researchers (Hirsch, 2005). The h-index can be used to measure an individual author or the author's institution/research group's impact of the field. The h-index is a time-dependent measure and is based on the total number of publications, citations and citation impact group or entity's h-index (Hirsch,2005).

**T*ypical h-indexes for members of the American Physical Society are:***

| | |
|---|---|
| *Faculty at a research university* | *~12* |
| *Full Professor* | *~18* |
| *Consideration to be a Fellow* | *~20* |
| *Nobel Prize winner* | *~35* |
| *Membership in the NAS* | *~46* |

The individual h-indexes for **59** GMD publishing scientists are presented on a following page in graphical form. **Seven GMD scientists have an h-Index over 40 and 20 have an h-Index of 30 and above.**

The total number of career publications of current GMD scientists to December 31, 2017 is **3,874 with 189,921 citations.**

From the Web of Science, the **486** recognized GMD publications for 2013-17 have **10,792** citations with an average of **22** per publication.

The h-Index for GMD as a whole unit, over the same period, is **50.**

## Category Normalized Citation Impact (CNCI)

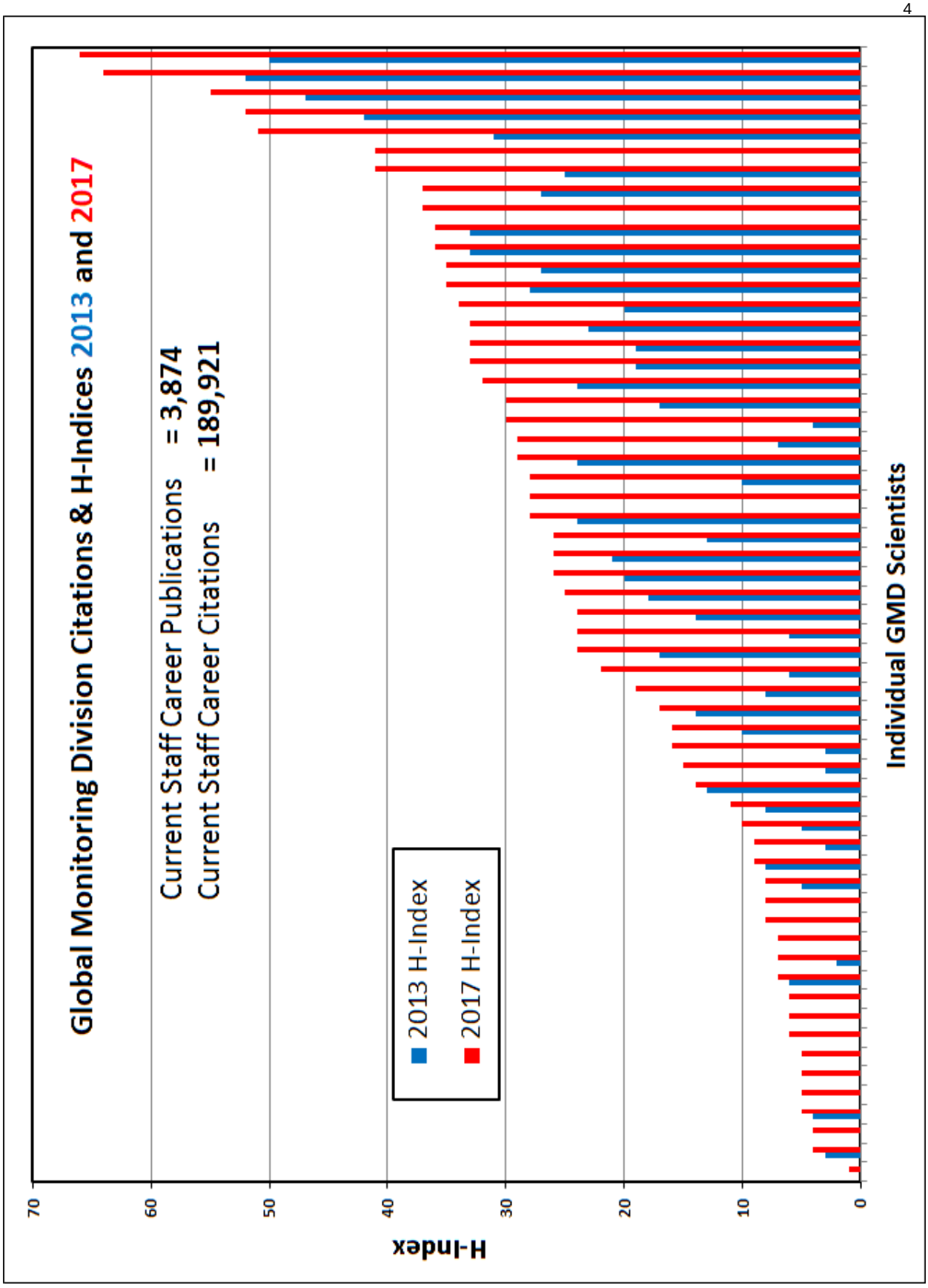
The Category Normalized Citation Impact (CNCI) of documents is calculated by dividing the actual count of citing items by the expected citation rate for documents with the same document type, year of publication, and subject area. When a document is assigned to more than one subject area, an average of the ratios of the actual to expected citations is used. The CNCI of a set of documents for a division is the average of the CNCI values for all the documents in the set.

The CNCI is a valuable and unbiased indicator of impact irrespective of age, subject focus, or document type and it allows comparisons between entities of different sizes and different subject mixes.

A CNCI value of one represents performance at par with world average, values above one (1) are considered above average and values below one (1) are considered below average. A CNCI value of two (2) is considered twice world average; above three (3) is considered world class.

## There are known issues with using the CNCI:

- When dealing with small sets of publications, the CNCI value may be inflated by a single highly cited paper.
- Because it is an average, even when looking at larger sets of publications, such as the collected works of an institution, very highly cited papers can have an unduly large influence on the CNCI value.
- The baseline values for current year can be very low (there is a lag between publication and citation) and therefore the CNCI values for current the year can fluctuate more than expected.


Global Monitoring Division Citations & H-Indices 2013 and 2017
Current Staff Career Publications = 3,874
Current Staff Career Citations = 189,921
2013 H-Index
2017 H-Index
H-Index
0
10
20
30
40
50
60
70
Individual GMD Scientists

# Category Normalized Citation Impact (CNCI): 2013-2017

**(1 is average, > 1 is above average, >3 is World Class)**

| Top 5 GMD Research Categories (5 year average) | CNCI |
|---|---|
| Geosciences | 4.32 |
| Chemistry | 4.27 |
| Oceanography | 3.82 |
| Environmental | 3.44 |
| Studies Optics | 2.88 |

| Top 5 Journals GMD Published In (best year in 2013-17) | CNCI |
|---|---|
| Scien | 35.68 |
| ce | 15.68 |
| Nature | 12.96 |
| Proceedings, National Academy of | 13.23 |
| Sciences Earth System Science | 8.19 |

From the above table it is clear that GMD authorship in *Nature, Science* and *Proceedings of the Nation Academy of Sciences* is highly cited. This is also borne out in the following table presenting GMD authorship percentile statistics.

## Complementary Indicators alongside the CNCI: Citation Statistics

The NOAA Library Services Bibliometric Study showed that for 2013-17 the **486** papers Web of Science credited to GMD authorship, the **10,792** citations (average of 22/publication) were distributed as shown below.

## GMD Citation Statistics from Web of Science: 2013-2017

| | % Cited |
|---|---|
| Chemistry | 100 |
| Oceanography | 100 |
| Physics | 94 |
| Geosciences | 88 |
| Mathematics | 83 |

| Top 5 Journals GMD Published in (5 year average) | % Cited |
|---|---|
| Global Biogeochemical Cycles | 100 |
| Nature Geoscience | 100 |
| Atmospheric Physics and Chemistry | 93 |
| Journal of Geophysical Research | 85 |
| Geophysical Research Letters | 83 |

## GMD Authorship in the Top 10% of Web of Science Categories: Percentile Analysis

Percentile analysis provides the percent of documents published by GMD that are among the top 10% of the most cited documents in a given subject, year, and published type. For instance, a score of 10% indicates that 10% of its publications are in the top 10% in the world, which means a laboratory or division is performing about average.

The Web of Science assigns publications into many categories, most which are not at the core of GMD science themes. As such, some influential GMD publications appear in categories such as Oceanography, Biodiversity, and Optics where a small number of GMD authorships have an outsized number of citations in the field.

The tabulation below covers **8 categories** in Web of Science in which GMD authors are well above the top 10% threshold of cited scientific authorship in a particular category averaged over the five years, 2013-17.

1. Geosciences, has **62** Web of Science documents and **51.56%** of documents are in the top 10%;

2. Oceanography, has **5** Web of Science documents and **40%** of documents are in the top 10%;

3. Environmental Studies, has **6** Web of Science documents and **33.33%** of documents are in the top 10%; based on one highly cited paper;

4. Physics, Atomic, Molecular, & Chemical has **3** Web of Science documents **33.33%** of documents are in the top 10%, based on one highly cited paper;

5. Biodiversity, Conservation has **3** Web of Science documents and **33.33%** of documents are in the top 10%, based on one highly cited paper;

6. Optics has **3** Web of Science documents and **33.33%** of documents are in the top 10%; based on one highly cited paper;

7. Meteorology and Atmospheric Sciences, has **297** Web of Science documents and **29.63%** of documents are in the top 10%;

8. Environmental Sciences, has **60** Web of Science documents and **21.67%** of documents are in the top 10%.

In addition to the thousands of distinct data sets the Global Monitoring Division produces that are used by scientists around the world, GMD scientists also publish reviewed scientific papers.

Based on the number of Ph.D.s in the respective OAR laboratories/divisions and the number of publications the laboratory/division produced in 2017, GMD leads by a wide margin.

| Division/Laboratory | No. of publications | No. of Ph.D.s | Pubs/Ph.D.s |
|---|---|---|---|
| GMD | 119 | 32 | 3.7 |
| PMEL | 151 | 54 | 2.7 |
| CSD | 191 | 83 | 2.3 |
| GFDL | 212 | 91 | 2.3 |
| AOML | 109 | 57 | 1.9 |
| PSD | 122 | 73 | 1.7 |

# Publications Linked to Observatory Data Sets

PREPARED FOR
GMD: Global Monitoring Division
BY
Sue Visser, Public Services and Bibliometrics Librarian, Boulder Libraries

Date
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**Objective:** The purpose of these literature searches is to determine how many published, peer-reviewed papers have relied on data from the atmospheric observatories operated by GMD. The six observatories included in these searches were:

- Barrow Observatory, Barrow, AK
- Mauna Loa Observatory, Hilo, HI
- Samoa Observatory, American Samoa
- South Pole Observatory, Antarctica
- Summit Observatory, Greenland

**Summary:**

| Observatory | Estimated number of published papers that mention this observatory and data, 2013-2017. | Number of publications from the inception of the observatory to 2013. | Estimated total publications from inception of the observatory to 2017. |
|---|---|---|---|
| Trinidad Head | 157 | 81 | 238 |
| Barrow | 343 | 853 | 1,196 |
| Mauna Loa | 1,032 | 1,735 | 2,767 |
| Samoa | 181 | 512 | 693 |
| South Pole | 246 | 966 | 1,212 |
| Summit | 149 | 62 | 211 |

As described in detail below, these estimates are based on a random sampling of full text papers from our search results. The numbers provided here are the centers of the 95% confidence intervals for each observatory. Below we have provided both the 95% and 99% intervals.

**Search Strategy:** These searches present some unique challenges in that the key terms (i.e., the names of the observatories) are not usually mentioned in the titles or abstracts of the papers that rely on data from the observatories. More often, the observatories are mentioned in a table, figure, methods section, or acknowledgements. For this reason, traditional indexed databases like Web of Science (WoS) are poorly suited for these searches, because such databases usually search only in the “basic index”, which consists of titles, abstracts, and keywords.

Full text searching is more likely to capture all of the mentions of the observatories in published papers. For full text searching we must turn to Google Scholar (GS), which *searches* full text, but does not allow us to *see* the full text unless we have subscription access to a given publication. However, searching GS presents its own set of challenges.

Because of the imprecise nature of full-text searching, and because GS is an undisciplined, unindexed tool with limited search capabilities, our searches will return large numbers of results, many of which will be irrelevant. The only way to determine the relevancy of a particular publication is to view the full text of the publication for the context in which our search terms appear. Unfortunately, with our search results numbering in the thousands, it would be impractical to examine every record.

Our challenge, then, is to determine what percentage of the GS results is relevant to our search. We downloaded a random sample of full text PDFs from the search results for each observatory, and scored them for relevancy based on the following scoring criteria:

| **Score** | **Criteria** |
|---|---|
| 0 | Some of our downloaded results did not contain the key terms at all. This is most likely due to anomalies in the metadata attached to the document. |
| 1 | Not relevant: the terms appear in the document, but in a context unrelated to our search. |
| 2 | Very low relevance: the terms appear only in the titles of cited documents; the terms are mentioned in passing (e.g. “We did not use data from Trinidad Head because it did not cover the time period of our investigation”). |
| 3 | Relevant: The observatory is listed as a data source for the paper. |
| 4 | Highly relevant: The observatory is mentioned multiple times in the text; the observatory one of only a few data sources for the paper; the observatory is used to calibrate a model or validate data. The paper relies heavily on data from the observatory. |

For our searches, we searched Web of Science, Meteorological and Geoastrophysical Abstracts, and Google Scholar. We combined the results of the searches in an Excel file, removed duplicates, and then performed a random sort of the list of titles. We then downloaded the first 25% of the randomized titles, skipping those to which we did not have subscription access.

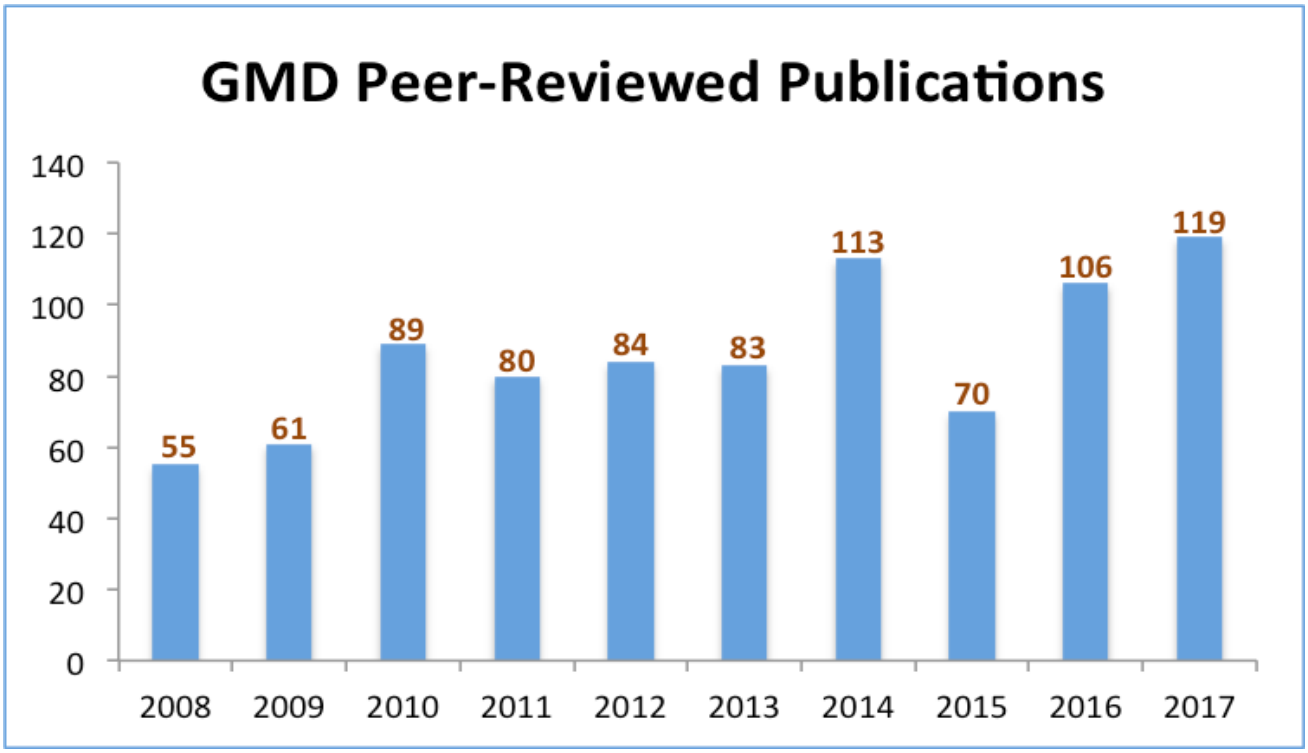
All of our searches were limited to 2013-2017, as requested by GMD.
We calculated 95% and 99% confidence intervals for each observatory, based on the results of our sampling. The results of our analyses are below:

| Observatory | Number of records in search results | # of PDFs reviewed | % of records reviewed | % of sample receiving relevancy score of 3 or 4 | # of relevant records in search results, based on sample results; 95% confidence interval | # of relevant records in search results, based on sample results; 99% confidence interval) | Number of records listed in the 2013 GMD 5-year review |
|---|---|---|---|---|---|---|---|
| **Trinidad Head** | 191 | 50 | 26% | 82% | 136-178 | 130-183 | 81 |
| **Barrow** | 881 | 220 | 25% | 39%* | 291-396 | 273-414 | 853 |
| **Mauna Loa** | 1521 | 305 | 20%* | 67% | 938-1126 | 897-1156 | 1735 |
| **Samoa** | 327 | 86 | 25% | 55% | 147-216 | 134-226 | 512 |
| **South Pole** | 1016 | 250 | 25% | 34%* | 300-392 | 286-406 | 966 |
| **Summit** | 213 | 83 | 25% | 70% | 128-170 | 120-177 | 62 |

*We used a 20% sample for MLO due to time constraints and the size of the set.

Sientific publications from *Google Scholar* mentioning a specific Global Monitoring Division data set. *Please note that the majority of non-GMD authored publications using GMD data do not mention the specific data set.*

**2013-2017: 1337 acknowledgements of specific GMD data sets used.**



# Scientific Publications Using Global Monitoring Division Observatory Data Sets

# A. Publications Using Observatory Data Prior to 2013 and in 2013 - 2017.

# B. Publications by Coop Programs using MLO Data or Facilities from Project Inception to 2013 and 2013-2017.

| (A) Publications Referencing Observatory Data | To 2013 | 2013-2017 |
|---|---|---|
| Barrow Observatory, Barrow , Alaska (Established 1974) | 843 | 343 |
| Mauna Loa Observatory, Hilo, Hawaii (Established 1956) | 1,735 | 1,032 |
| Samoa Observatory, American Samoa(Established 1974) | 512 | 181 |
| South Pole Observatory, Antarctica (Established 1956) | 966 | 246 |
| Trinidad Head Observatory, California (Established 2002) | 81 | 157 |
| Summit Observatory, Greenland (Established 2003) | 62 | 149 |
| | **4,199** | **2,108** |
| **(B) Cooperative Programs at MLO Using Data** | | |
| AERONET | 136 | 156 |
| ARL | 23 | 123 |
| Climate Reference Network | 22 | 6 |
| Colorado State University | 56 | 50 |
| CSIRO | 118 | 151 |
| Environment and Climate Change Canada | 128 | 93 |
| EPA | 116 | 66 |
| FAA | 21 | 6 |
| Global Oscillation Network Group | 102 | 3 |
| Goddard Space Flight Center | 170 | 268 |
| JPL | 117 | 154 |
| Naval Research Laboratories | 21 | 28 |
| NCAR HAO | 123 | 261 |
| Network for Detection of Atmospheric Composition Change | 97 | 137 |
| New Mexico State | 25 | 3 |
| NIES, Japan | 99 | 75 |
| NIWA | 29 | 51 |
| NIWA, New Zealand | 60 | 51 |
| Pacific Northwest National Laboratory | 12 | 27 |
| Scripps Institution of Oceanography | 116 | 154 |
| Stanford University | 32 | 9 |
| SUNY | 25 | 7 |
| University of California | 184 | 86 |
| University of Denver | 54 | 31 |
| University of Hawaii | 80 | 31 |
| US Air Force | 38 | 16 |
| US Army Research | 38 | 6 |
| US Navy | 49 | 5 |
| USGS | 9 | 63 |
| | **2100** | **2117** |

# Global Monitoring Division

## Reviewed Scientific Publications

Arranged by Themes within each year:

- Each paper has one or more Global Monitoring Division authors
- The number has increased ~9 per year since the prior GMD review in 2014
- GMD staff has decreased nearly 9% over the same time
- There are 59 GMD contributing authors, 32 with Ph.Ds.

7.

## Theme 1. Tracking Greenhouse Gases and Understanding Carbon Cycle Feedbacks

### Year of Publication: 2017

**Andrews, Arlyn**, (2017), Strengthening the Observational Basis for Carbon Science, Policy, *Eos*, 98, 10.1029/2017EO080609.

Bagley, Justin E., Seongeun Jeong, Xinguang Cui, Sally Newman, Jingsong Zhang, Chad Priest, Mixtli Campos-Pineda, **Arlyn E. Andrews**, Laura Bianco, Matthew Lloyd, Neil Lareau, Craig Clements and Marc L. Fischer, (2017), Assessment of an atmospheric transport model for annual inverse estimates of California greenhouse gas emissions, *Journal of Geophysical Research: Atmospheres*, 122, 3, 1901-1918, 10.1002/2016JD025361.

Ballantyne, Ashley, William Smith, William Anderegg, Pekka Kauppi, Jorge Sarmiento, **Pieter Tans**, Elena Shevliakova, Yude Pan, Benjamin Poulter, Alessandro Anav, Pierre Friedlingstein, Richard Houghton and Steven Running, (2017), Accelerating net terrestrial carbon uptake during the warming hiatus due to reduced respiration, *Nature Climate Change*, 7, 2,148-152, 10.1038/nclimate3204.

Barkley, Zachary R., Thomas Lauvaux, Kenneth J. Davis, Aijun Deng, Natasha L. Miles, Scott J. Richardson, Yanni Cao, **Colm Sweeney**, Anna Karion, MacKenzie Smith, Eric A. Kort, Stefan Schwietzke, Thomas Murphy, Guido Cervone, Douglas Martins and Joannes D. Maasakkers, (2017), Quantifying methane emissions from natural gas production in north-eastern Pennsylvania, *Atmospheric Chemistry and Physics*, 17, 22, 13941-13966, 10.5194/acp-17-13941-2017.

**Basu, Sourish**, David F. Baker, Frédéric Chevallier, Prabir K. Patra, Junjie Liu and **John B. Miller**, (2017), The Impact of Transport Model Differences on CO2 Surface Flux Estimates from OCO-2 Retrievals of Column Average CO2, *Atmospheric Chemistry and Physics Discussions*, 1-32, 10.5194/acp-2017-1158.

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Campbell, J. E., M. E. Whelan, J. A. Berry, T. W. Hilton, A. Zumkehr, J. Stinecipher, Y. Lu, A. Kornfeld, U. Seibt, T. E. Dawson, **S. A. Montzka**, I. T. Baker, S. Kulkarni, Y. Wang, S. C. Herndon, M. S. Zahniser, R. Commane and M. E. Loik, (2017), Plant Uptake of Atmospheric Carbonyl Sulfide in Coast Redwood Forests, *Journal of Geophysical Research: Biogeosciences*, 10.1002/2016JG003703.

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Conley, Stephen, Ian Faloona, Shobhit Mehrotra, Maxime Suard, Donald H. Lenschow, **Colm Sweeney**, Scott Herndon, **Stefan Schwietzke**, **Gabrielle Pétron**, Justin Pifer, Eric A. Kort and **Russell Schnell**, (2017), Application of Gauss's theorem to quantify localized surface emissions from airborne measurements of wind and trace gases, *Atmospheric Measurement Techniques*, 10, 9, 3345-3358, 10.5194/amt-10-3345-2017.

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Johnson, Matthew R., David R. Tyner, Stephen Conley, **Stefan Schwietzke** and Daniel Zavala-Araiza, (2017), Comparisons of Airborne Measurements and Inventory Estimates of Methane Emissions in the Alberta Upstream Oil and Gas Sector, *Environmental Science & Technology*, 51, 21, 13008-13017, 10.1021/acs.est.7b03525.

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# Theme 1. Tracking Greenhouse Gases and Understanding Carbon Cycle Feedbacks

## Year of Publication: 2016

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# Theme 1. Tracking Greenhouse Gases and Understanding Carbon Cycle Feedbacks

## Year of Publication: 2014

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# Theme 1. Tracking Greenhouse Gases and Understanding Carbon Cycle Feedbacks

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## Theme 2: Monitoring and Understanding Changes in Surface Radiation, Clouds and Aerosol Distributions

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## Theme 2. Monitoring and Understanding Changes in Surface Radiation, Clouds and Aerosol Distributions

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## Theme 2. Monitoring and Understanding Changes in Surface Radiation, Clouds and Aerosol Distributions

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### Year of Publication: 2014

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## Theme 2. Monitoring and Understanding Changes in Surface Radiation, Clouds and Aerosol Distributions

### Year of Publication: 2013

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# Theme 3. Guiding Recovery of the Ozone Layer

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## Theme 3. Guiding Recovery of the Ozone Layer

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Ziska, F., B. Quack, K. Abrahamsson, S. D. Archer, E. Atlas, T. Bell, **J. H. Butler**, L. J. Carpenter, C. E. Jones, N. R. P. Harris, H. Hepach, K. G. Heumann, C. Hughes, J. Kuss, K. Krüger, P. Liss, R. M. Moore, A. Orlikowska, S. Raimund, C. E. Reeves, W. Reifenhäuser, A. D. Robinson, C. Schall, T. Tanhua, S. Tegtmeier, S. Turner, L. Wang, D. Wallace, J. Williams, H. Yamamoto, S. Yvon-Lewis and Y. Yokouchi, (2013), Global sea-to-air flux climatology for bromoform, dibromomethane and methyl iodide, *Atmospheric Chemistry and Physics*, 13, 17, 8915-8934, 10.5194/acp-13-8915-2013.

# Global Monitoring Division

## Indicators of Preeminence 2: Leadership, Public Outreach, Awards and Retired GMD Staff Mentoring/Publications.


**Contents:**

# GLOBAL MONITORING DIVISION

## Leadership Roles 2013-present

### Editorships

- Arlyn Andrews, Panelist, Decadal Survey for Earth Science and Applications from Space, Climate Variability and Change: Seasonal to Centennial Panel, 2016-2018.
- Charles Long, Team Leader for the review of Chapter 8 of the AR5 IPCC WG1 report (Anthropogenic and Natural Radiative Forcing), 2012-2014.
- Dale Hurst, Chapter Editor for the Bulletin of the American Meteorological Society (BAMS) State of the Climate Reports, 2013-2016.
- Dale Hurst, Expert Reviewer for the Intergovernmental Panel for Climate Change (IPCC) Fifth Assessment Report (AR5), Chapter 2, 2013.
- Diane Stanitski, Chapter Editor for the BAMS State of the Climate Report, 2017
- Diane Stanitski, Invited Editor, Special issue on Arctic Indicators, Environmental Research Letters, 2018.
- Gabrielle Petron, Journal guest editor, Elementa Science of the Anthropocene, Oil and Natural Gas Special Forum, 2015-2016.
- Irina Petropavlovskikh, associate editor for the ACP special issue “Quadrennial Ozone Symposium 2016 – Status and trends of atmospheric ozone”, 2016-2018.
- Irina Petropavlovskikh, Editor of the special issue "Quadrennial Ozone Symposium 2016 – Status and trends of atmospheric ozone" (ACP/AMT inter-journal SI), 2017-2018.
- Irina Petropavlovskikh, Editor of the special issue of the Symposium for the 30th Anniversary of the Montreal Protocol proceedings, published under the umbrella of the Geoscience series of French Academy of Sciences, hosted by the Elsevier publishing company, 2018.
- Irina Petropavlovskikh, invited editor for special issue in the Geosciences journal, “Proceedings of Symposium for the 30th Anniversary of the Montreal Protocol”, 2017-2018.
- John Ogren, Editorial Board Member, Aerosol and Air Quality Research (http://aaqr.org/), 2014-2016.
- Lei Hu, Reviewer, Scientific Assessment of Ozone Depletion: Chapter 1, 2018 Oil and Natural Gas Special Forum 2016-present.
- Patrick Sheridan, Board Member, Aerosol and Air Quality Research (http://aaqr.org/), 2014-2016.
- Pieter Tans, Editor of "Expert recommendations for GHG measurement techniques" following WMO/GAW biannual meetings, 2013 and 2015.
- Pieter Tans, Editorial Board Member, Tellus B, 2013-present.
- Pieter Tans, Review Editor of Chapter 6 (Carbon and other biogeochemical cycles) of IPCC 5th Assessment, 2013.

- Stefan Schwietzke, Journal guest editor, Elementa Science of the Anthropocene, Oil and Natural Gas Special Forum, 2016–present.
- Steve Montzka, Co-Chair for Chapter 2 (HFCs) of WMO/UNEP Scientific Assessment of Ozone Depletion International report, 2018.
- Steve Montzka, Review Editor for Chapter 1 (ODSs) of the WMO/UNEP Scientific Assessment of Ozone Depletion International report, 2014.

## Authorship Contributors to National and International Assessments and Reports

- Andy Jacobson, Lead chapter author, 2nd State of the Carbon Cycle Report, 2016-2018.
- Arlyn Andrews, Chapter Lead, North American Carbon Program Science Implementation Plan, 2018 (ongoing).
- Bradley Hall, Co-Author, Scientific Assessment of Stratospheric Ozone (Chapter 1: Long-lived Ozone-Depleting Substances), 2013-2014; 2017-2018.
- Dale Hurst, Contributing Author for the Scientific Assessment of Ozone Depletion, Chapter 4, 2014.
- Irina Petropavlovskikh, co-author of Chapter 2 of the WMO/UNEP Ozone Assessment, 2014; co-author of Chapter 3 of the WMO/UNEP Ozone Assessment, 2012-2018.
- Irina Petropavlovskikh, co-author of the SPARC LOTUS report “Long term trends and uncertainties in Stratosphere”, 2018 (under review, expected publication date May 2018).
- Irina Petropavlovskikh, Contributor/Author, Bulletin of the Meteorological Society (BAMS) State of the Climate Report, 2016-2018.
- John Miller, co-lead author of Atmospheric chapter of the Second State of the Carbon Cycle Report (SOCCR-2), 2016-2018.
- Kathy Lantz, Contributor/Author Bulletin of the Meteorological Society (BAMS) State of the Climate Report, 2013-2015
- Lei Hu, Co-Author, SPARC Report on the Mystery of Carbon Tetrachloride, 2016
- Steve Montzka co-author of the SPARC Report on the Mystery of Carbon Tetrachloride, Q. Liang, P. Newman, and S. Reimann, eds., 2016.

## Collaboration Teams

International

- Irina Petropavlovskikh, "LOTUS – Long-term Ozone Trends and Uncertainties in the Stratosphere" activity leader for the SPARC (Stratosphere-troposphere Processes And their Role in Climate), core project of the World Climate Research Programme, 2017-present.
- Irina Petropavlovskikh, ”OCTAV-UTLS – Observed Composition Trends And Variability in the Upper Troposphere and Lower Stratosphere " activity leader for the SPARC (Stratosphere-troposphere Processes And their Role in Climate), core project of the World Climate Research Programme, 2017-present.

- Irina Petropavlovskikh, Dobson/Brewer working group representative, Network for the Detection Atmospheric Composition Change (NDACC), 2015-present.
- James Elkins, HATS Cooperating Network Liaison, Advance Global Atmospheric Gas Experiment (AGAGE), 1986-present.
- James Elkins, HATS Cooperating Network Liaison, Network for the Detection Atmospheric Composition Change (NDACC), 2008-present.
- Russell Schnell, NOAA Pacific Island Regional Collaboration Team, 2013-2016.

U.S.

- Allison McComiskey, Co-Chair, Aerosol Measurement Science Group, DOE Atmospheric Radiation Measurement Climate Research Facility, 2014-present.
- Allison McComiskey, Co-Chair, Atmosphere Collaboration Team, Interagency Arctic Research Policy Committee, 2014-2017.
- Andy Jacobson, Orbiting Carbon Observatory-2 science team, 2011-present.
- Arlyn Andrews, Organizer, Sustained Observations for Carbon Cycle Science and Decision Support Workshop; Boulder, Colorado, 2016.
- Diane Stanitski, Co-chair, Symposium on Education, American Meteorological Society, 2015-2018.
- Diane Stanitski, Member, National Preparedness Science Technology (NPST) Meteorological Hazards Task Force (multiagency), 2015.
- Gabrielle Petron, co-PI for DOE-RPSEA Methane project, 2014-2016.
- John Barnes served on the NASA SAGE III ISS Scientific Utilization Team from 2012 through the launch of the satellite instrument in 2017.
- John Miller, Member of NASA Carbon Monitoring System (CMS) Science Team, 2012-present.
- John Miller, Member of NASA Orbiting Carbon Observatory-2 (OCO-2) Science Team, 2011-present.

NOAA

- Brian Vasel, NOAA Ionizing Radiation Safety Committee, 2012-present.
- Brian Vasel, NOAA/OAR NEPA Team, 2013-present.
- Bryan Thomas, NOAA/OAR Diversity & Inclusion Advisory Council, 2017-present.
- Chris Cornwall, Chair of the NOAA Boulder IT Council (BITC), reporting to the NOAA Boulder Directors Council (NBDC), 2012-present.
- Darryl Kuniyuki, NOAA Pacific Region Executive Board, 2016-present.
- Irina Petropavlovskikh, Co-chair of the Trace Gases working group for the IASOA (International Arctic Systems for Observing the Atmopsher), 2016-present.
- Irina Petropavlovskikh, OMPS (Ozone Mapping and Profiler Suite) Operational Algorithm Team (OOAT) Advisor and member of validation team for NOAA JPSS operational ozone products, 2001-present.
- James Elkins, NOAA Arctic Regional Collaboration Team (ARCTic), 2006-present

## Steering and Working Group Committees

- Allison McComiskey, Commissioner, International Radiation Commission, 2017-present.
- Allison McComiskey, Gordon Research Conference for Radiation and Climate, Vice-Chair 2019, Chair 2021.
- Allison McComiskey, Member, Radiation Committee of the American Meteorological Society, 2013-2015, 2017-present.
- Andy Jacobson, North American Carbon Program science steering group, 2011-2015.
- Arlyn Andrews, Member, Carbon Cycle Science Steering Group, 2013-2015.
- Bradley Hall, Member, Working Group: Gas Analysis Working Group (under the Consultative Committee for Amount of Substance: Metrology in Chemistry and Biology), 2013-present.
- Brain Vasel, NSF/OPP McMurdo Area Users Committee, 2007-present.
- Brain Vasel, NSF/OPP South Pole Area Users Committee, 2007-present.
- Brain Vasel, NSF/OPP Summit Greenland Long Range Planning Team, 2007-present.
- Brian Vasel, NSF/OPP Palmer Area Users Committee, 2007-present.
- Bryan Johnson, Member of the Assessment of Standard Operating Procedures for Ozone Sondes panel, 2012-present.
- Bryan Johnson, Steering committee for NDAAC (Network for Detection of Atmospheric Composition Change), Ozone & Aerosol Sonde working group, 2010-present.
- Dale Hurst, Contributing Author for the Stratosphere-Troposphere Processes and their Role in Climate (SPARC) second Water Vapor Assessment (WAVAS-2), 2013-present.
- Dale Hurst, External Water Vapor Measurement Expert for the In-Service Aircraft for a Global Observing System (IAGOS), 2015-present.
- Dale Hurst, Member of the Global Climate Observing System (GCOS) Atmospheric Observation Panel for Climate (AOPC), 2017-present.
- Dale Hurst, Member of the Working Group and a co-chair of the Task Team of Site Representatives of the GCOS Reference Upper Air Network (GRUAN), 2010-present.
- Dale Hurst, Sonde Working Group Representative on the Steering Committee of the Network for the Detection of Atmospheric Composition Change (NDACC), 2016-present.
- Diane Stanitski, Member, Observations Interagency Working Group (ObsIWG), U.S. Global Change Research Program, 2014-present.
- Diane Stanitski, Member, Surface Radiation and Cloud Working Group, International Arctic Systems for Observing the Atmosphere (IASOA), 2016-present.

- Diane Stanitski, NOAA Deputy Representative to the U.S. Global Change Research Program, Subcommittee on Global Change Research, 2013-present.
- Diane Stanitski, Selection Committee for SOARS Portages, UCAR Significant Opportunities in Atmospheric Research and Science (SOARS) program, 2017-2018.
- Diane Stanitski, Steering Committee Member, UCAR Significant Opportunities in Atmospheric Research and Science (SOARS) program, 2016-present.
- Edward Dlugokencky, External advisory board member for EU VERIFY project ("Observation-based system for monitoring and verification of greenhouse gases"), 2018.
- Irina Petropavlovskikh, Secretary of International Ozone Commission ($IO_3C$) under the IAMAS (International association of Meteorology and Atmospheric Sciences), 2016-present.
- Irina Petropavlovskikh, Steering committee for NDAAC (Network for Detection of Atmospheric Composition Change), Dobson/Brewer working group, 2014-present.
- James Butler, Carbon Cycle Interagency Working Group (CCIWG) in support of the U.S. Climate Change Science Program, 2005-present.
- James Butler, Chair, Science Advisory Board, IAGOS, 2014-present.
- James Butler, Member, Nominating Committee, American Association for the Advancement of Science, 2011-2013.
- James Butler, Member, Science Advisory Board, IGAS (IAGOS for the GMES Atmospheric Service), 2014-2016.
- James Butler, Member, Science Advisory Board, Integrated Carbon Observing System (ICOS), 2016-present.
- James Butler, Member, Science Advisory Board, In-service Aircraft Global Observing System (IAGOS), 2011-present.
- John Miller, Chair of the Users Working Group of the Oak Ridge National Laboratory Distributed Active Archive Center (ORNL/DAAC) for Biogeochemical Dynamics, 2012-present.
- John Ogren, Aerosols, Clouds, and Trace gases Research InfraStructure Network (ACTRIS), Advisory Board Member, 2011-2015.
- Kathy Lantz, Chair Baseline Surface Radiation Network (BSRN) Spectral Working Group, 2016-present.
- Lori Bruhwiler, Chapter Lead, 2nd SOCCR Report, 2017-2018.
- Lori Bruhwiler, Chapter Lead, Arctic Monitoring and Assessment Program, $CH_4$ Report, 2013-2015.
- Lori Bruhwiler, National Academy of Sciences U.S. Methane Report, 2017-2018
- Patrick Sheridan, Director of the NOAA Federated Aerosol Network, 2013-present.

- Russell Schnell, Department of State, National Council for International Visitors, 2013-present.
- Russell Schnell, Kazakhstan-U.S. Joint Commission on Scientific and Technological Cooperation, 2013-present.
- Russell Schnell, Member, Swedish Research Council: Review Panel on Large Research Infrastructure Proposals, 2015.
- Russell Schnell, U.S. State Department International Climate Change Bi-lateral Agreement Implementation Teams for China, India, Japan, and Korea, 2013-present.
- Russell Schnell, NDAAC Steering Committee, 2013-present.
- Russell Schnell, NOAA Bi-lateral Joint Working Group with China CMA, 2013-18.
- Russell Schnell, NOAA Bi-lateral Joint Working Group with Korea KMA, 2013-18.
- Russell Schnell, NOAA Pacific Island Regional Collaboration team, 2013-date.
- Russell Schnell, NOAA–European Commission JRC Implementing Arrangement Steering Committee, 2013-present.
- Russell, Schnell, Canada Foundation for Innovation: Chair, Review panel for Arctic Funding Proposals, 2014-2016.
- Stefan Schwietzke, CICERO, Oslo, Norway, 2017-present.
- Stefan Schwietzke, Institute for Atmospheric and Climate Science, ETH Zurich, Switzerland, 2016-present.
- Stefan Schwietzke, Istituto Nazionale di Geofisica e Vulcanologia, Rome, Italy, 2014-present.

## Implementation Panels, Teams, Councils, Advisory Groups - International and National

- Bradley Hall, Member, Scientific Advisory Group, WMO Global Atmosphere Watch (GAW), Greenhouse Gases, 2013-present.
- Charles Long, Member, CINDY/DYNAMO International Science Committee, 2009-2014.
- Charles Long, Member, Global Energy Balance Working Group of the International Radiation Commission, 2010-present.
- Charles Long, Member, Surface Radiation and Cloud Working Group, International Arctic Systems for Observing the Atmosphere (IASOA), 2014-date.
- Charles Long, World Meteorological Organization (WMO) International Baseline Surface Radiation Network (BSRN) Project Manager, 2015-present.
- Edward Dlugokencky, Chair, WMO GAW Scientific Advisory Group for Greenhouse Gases, 2013-2015.
- Edward Dlugokencky, Ex-officio member, WMO GAW Scientific Advisory Group for Greenhouse Gases, 2015-present.
- Edward Dlugokencky, WMO, Member, Executive Team on World Data Centers (ET-WDC), 2017-present.

- James Butler, GCOS Atmospheric Observation Panel for Climate (AOPC), World Meteorological Organization, Geneva, 2005-2017.
- James Butler, U.S. Lead Representative, World Meteorological Organization Commission for Atmospheric Sciences, 2009-2017.
- John Barnes, Stratospheric Sulfur and its Role in Climate. (SSiRC) Implementation Panel, International Space Science Institute (ISSI), Bern, Switzerland, 2012-present.
- John Ogren, Chairman, WMO/GAW Aerosol Science Advisory Group, 2009-15.
- Kathy Lantz, World Meteorological Organization (WMO) UV Instrumentation Working Group 2000-present
- Steve Montzka, Member, International Ozone Commission, 2016.

## International Advisory Roles and Advisor or Committee Member for Ph.D. Candidates and Post-doctoral Students

- Diane Stanitski, Ph.D. Committee for student Meghan Helmberger, University of Colorado at Boulder, 2017-present.
- Gabrielle Petron, Advisor of Ingrid Mielke-Maday, Ph.D. student, 2014-present.
- Gabrielle Petron, Defense committee for Joanna Gordon-Casey, 2015-2017.
- John Ogren, co-Advisor for Héctor Rivera Vázquez, Ph.D. candidate, University of Puerto Rico, 2010-present.
- Pieter Tans, Co-advisor of Stefan Schwietzke, Xin Lan, and Isaac Vimont (postdocs).
- Russell Schnell, Advisor, Japan, Mount Fuji Atmospheric Observatory, 2013- present.
- Russell Schnell, Advisor, Mexico, Sierra Negro Atmospheric Observatory, 2013- present.
- Russell Schnell, Advisor, Taiwan, Mount LuLin Baseline Observatory, 2013- present.
- Russell Schnell, Advisor, Tiksi, Russia Atmospheric Observatory Building Implementation (NSF), 2013-2016.
- Russell Schnell, OAR Representative, U.S.-China Science and Technology Secretariat, 2016-17.
- Russell Schnell, Advisory Panel, Alberta Environment and Parks: Environmental Monitoring and Science Division, 2014-present.
- Russell Schnell, Mentored five post-doctoral students, 2013-2018.

## Fellows and other Roles

- Stephen Montzka, CIRES Fellow, 2011-present.
- Pieter Tans, CIRA Fellow, 2010-present.
- Pieter Tans, AGU Fellow, 2004-present.
- Pieter Tans, AAAS Fellow, 2011-present.

## Patents

- John Barnes, U.S. Patent #8,531,516, Imaging Polar Nephelometer, 2013
- Pieter Tans, U.S. patent 9,310,346 (12 April 2016), together with scientists from Picarro, Pumped AirCore Used as a Tape Recorder for Air Measurements.

# AWARDS

**2013**

- DOC Bronze Medal Award: **Elkins (NOAA), J. W., Hall (NOAA), B.D.**, Fahey, D.W., Ciciora, S., Gao, R., Rosenlof, K.: For the successful demonstration of the Global Hawk Unmanned Aircraft Systems for NOAA's Climate Goal.

- American Geophysical Union Excellence in Refereeing Award: **John Augustine.**

- CIRES Bronze Medal Award: **Geoffrey Dutton, Emrys Hall, Eric Hintsa, Dale Hurst, Allen Jordan, Fred Moore, Samuel Oltmans** and **Audra McClure (all CIRES)**. For the successful demonstration of the Global Hawk Unmanned Aircraft Systems for NOAA's Climate Goal.

- Yorum J. Kaufman Award for Unselfish Cooperation for Research, American Geophysical Union, **Samuel J. Oltmans (CIRES). For being the *preeminent* leader of in situ monitoring of tropospheric and stratospheric ozone and water vapor while multiplying the impact of this work though unmatched national and international collaborations.**

**2014**

- NOAA Administrator's Award**, Barnes, J. (NOAA)**For highly productive scientific and educational outreach programs at Mauna Loa Observatory above and beyond his full time management duties.

- Colorado Governor's Award for High-Impact Research: **Stephen A. Montzka**, **Gabrielle Petron, Russell C. Schnell.** For Atmospheric Impacts of Rapidly Expanding Oil & Gas Development across the West.

- NOAA and CIRES Silver Medal Award. For establishing an international, cooperative network to make coordinated long-term measurements of aerosol climate forcing properties. **Betsy Andrews** (CIRES), **Derek Hageman** (CIRES), **Anne Jefferson** (CIRES), **John Ogren**, and **Patrick Sheridan**.

**2015**

- Honorary Doctor of Science**, Russell C. Schnell,** University of Alberta, Canada.

- **Steve Montzka,** Nominated into the Montreal Protocol's Who's Who

- NOAA Technology Transfer Award. For Developing a small and robust instrument to monitor light absorption by atmospheric aerosols and recruiting a manufacturer to produce it commercially. **Patrick Sheridan, James Wendell**, and **John Ogren**.

- NOAA Research Employee of the Year. **Ann Thorne**. For Exceptional Service to NOAA's Global Monitoring Division and Earth System Research Laboratory, and an unsurpassed spirit and dedication to the NOAA Boulder Student Program.

**2016**

- National Aeronautics and Space Administration (NASA) Achievement Award for participation in the Discover-AQ Science Team. **Kathleen Lantz (CIRES), Joseph Michalsky (NOAA), Gary Hodges (CIRES, Emiel Hall (CIRES) and James Wendell (NOAA).** For outstanding achievement conducting airborne field studies to improve the diagnosis of near-surface air quality from space.

- 2016-06-28 – NASA Group Achievement Award – Airborne Tropical Tropopause Experiment (ATTREX) – For the outstanding achievement in advancing the understanding of the physical processes of the tropical tropopause layer and its role in the Earth's climate. Awardees : **Eric Hinsta, James Elkins, Fred Moore, Jeff Dutton, Brad Hall and Dave Nance.**

- Elected member of the International Ozone Commission, **Irina Petropavlovskihk.**

- Professor Vilho Väisälä Award for Outstanding Research Paper, World Meteorological Organization. Dirksen, R.J., M. Sommer, F.J. Immler, **D.F. Hurst** (CIRES) R. Kivi, and H. Vömel, Reference quality upper-air measurements: GRUAN data processing for the Vaisala RS92 radiosonde, *Atmos. Meas. Tech.*, *7*, 4463–4490, doi:10.5194/amt-7-4463-2014, 2014.

- Governor's Award for High Impact Research. **Brad Hall.** *For Preparing and Maintaining Critical Greenhouse Gas Calibration Standards and Methods Used in the Worldwide Monitoring of these Critical Atmospheric Gases.*

- Excellence in Refereeing Editor's Citation, **Steve Montzka**, Geophysical Research Letters.

**2017**

- NOAA Technology Transfer Award, **Allison McComiskey.** For improving forecasts of turbine height winds and solar irradiance from their High Resolution Rapid Refresh weather model to improve usage of renewable power by industry.

- Utility Variable Generation Integration Group Achievement Award for Solar Forecasting, **Chuck Long and Kathleen Lantz (CIRES)**.

- CIRES Technology Transfer Award to **Derek Hageman.** For improving forecasts of turbine-height winds and solar irradiance from their HRRR weather model to improve usage of renewal power by industry.

- 2017-06-15 – NASA Group Achievement Award – Pacific Oxidants, Sulfur, Ice, Dehydration, and Convection (POSIDON) – For outstanding achievement of the Pacific Oxidants, Sulfur, Ice, Dehydration, and Convection (POSIDON) airborne Earth Science Mission Team. **James W. Elkins, Geoff Dutton, Brad Hall ,Eric Hintsa, Fred Moore, Jon D. Nance, Dale Hurst, Emrys Hall, Allen Jordan.**

# ESRL GLOBAL MONITORING DIVISION OUTREACH (Tours and EEO) 2013-2017

## 2013:

- **5483 visitors to the GMD** demonstration and interpretation site in the David Skaggs Research Center. Each group is given an escorted 20 minute GMD presentation in the one hour tour. Participants include school, teacher, senior center, international and unidentified groups such as scouts, service organizations and church affiliated.

- **405 visitors to the Mauna Loa Baseline Observatory,** Island of Hawaii. These tours last 2-3 hours and range from students, scientists, government officials and politician including **Senators Schatz (D, Hawaii) and Bill Nelson (D, Florida).**

- **213 visitors to Barrow Baseline Observatory**, Barrow Alaska. These tours last 1- 2 hours and include students, NOAA leadership, politicians and scientists.

- **49 visitors to American Samoa Baseline Observatory**, American Samoa. These tours last from 1-2 hours and are generally students from the island.

- **35 visitors to South Pole Baseline** Observatory. These visitors are various politicians, government funding agency representatives and science program managers brought to the South Pole by the National Science Foundation.

- **Summit Observatory,** the only visitors are guests of the NSF that come to the GMD instrument building on a tour of the site. Over the period 2013-2017 these numbered **245,** not broken down by year.

## 2014

- **5573 visitors to the GMD** demonstration and interpretation site in the David Skaggs Research Center.

- **401 visitors to the Mauna Loa Baseline Observatory,** Island of Hawaii.

- **100 visitors to Barrow Baseline Observatory,** Barrow Alaska.

- **45 visitors to American Samoa Baseline Observatory,** American Samoa.

- **59 visitors to South Pole Baseline Observatory.**

## 2015

- **6629 visitors to the GMD** demonstration and interpretation site in the David Skaggs Research Center.
- **377 visitors to the Mauna Loa Baseline Observatory**, Island of Hawaii.
- **147 visitors to Barrow Baseline Observatory**, Barrow Alaska.
- 56 visitors to American Samoa Baseline Observatory, American Samoa.
- 25 visitors to South Pole Baseline Observatory.

## 2016

- **5960 visitors to the GMD** demonstration and interpretation site in the David Skaggs Research Center.
- **573 visitors to the Mauna Loa Baseline Observatory,** Island of Hawaii.
- 152 **visitors to Barrow Baseline Observatory**, Barrow Alaska.
- **53 visitors to American Samoa** Baseline Observatory, American Samoa.
- **9 visitors to South Pole Baseline Observatory**.

## 2017

- **5840 visitors to the GMD** demonstration and interpretation site in the David Skaggs Research Center.
- **486 visitors to the Mauna Loa Baseline Observatory**, Island of Hawaii.
- **151 visitors to Barrow (Utqiaġvik) Baseline Observatory**, Barrow Alaska. In May, Lamar Smith (House, R) led a 10 member US House of Representatives delegation to a visit of observatory along with 15 additional staffers and aides. *(The town of barrow changed its name back to the original Iñupiat name in 2017).*
- **43 visitors to American Samoa Baseline Observatory,** American Samoa.
- **13 visitors to South Pole Baseline Observatory**.

Craig McClean, NOAA DAA for Research taking a souvenir $CO_2$ air sample, MLO.


Suzanne Case, Director, Hawaii Department of Land and Natural Resources and 3 staff.

Senators Nelson (D, Florida) and Schatz (D, Hawaii) on the Radiation deck, MLO.

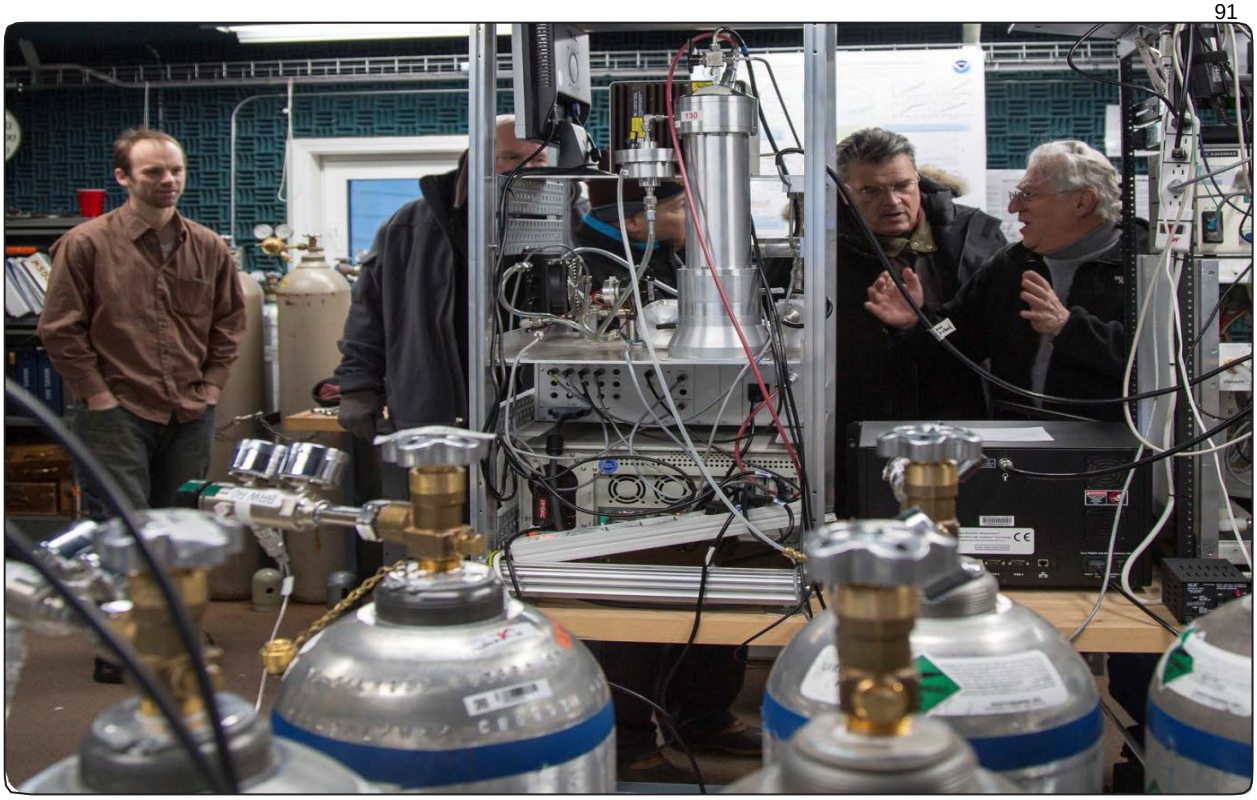
John Chin MLO (ret) and Ralph Keeling. John operated the Dave Keeling $CO_2$ measurements at MLO for 40 years.

Delegation of Korean Meteorological Agency (KMA) scientists, administrators and interpreter (emphasizing with right hand) and MLO engineer Aidan Colton MLO scientist guiding the tour.


Morristown-Beard High School students, Morristown, NJ visit to MLO.


Participants, AGAGE 52 Conference, Kona, HI on a day visit to MLO, December 2015.

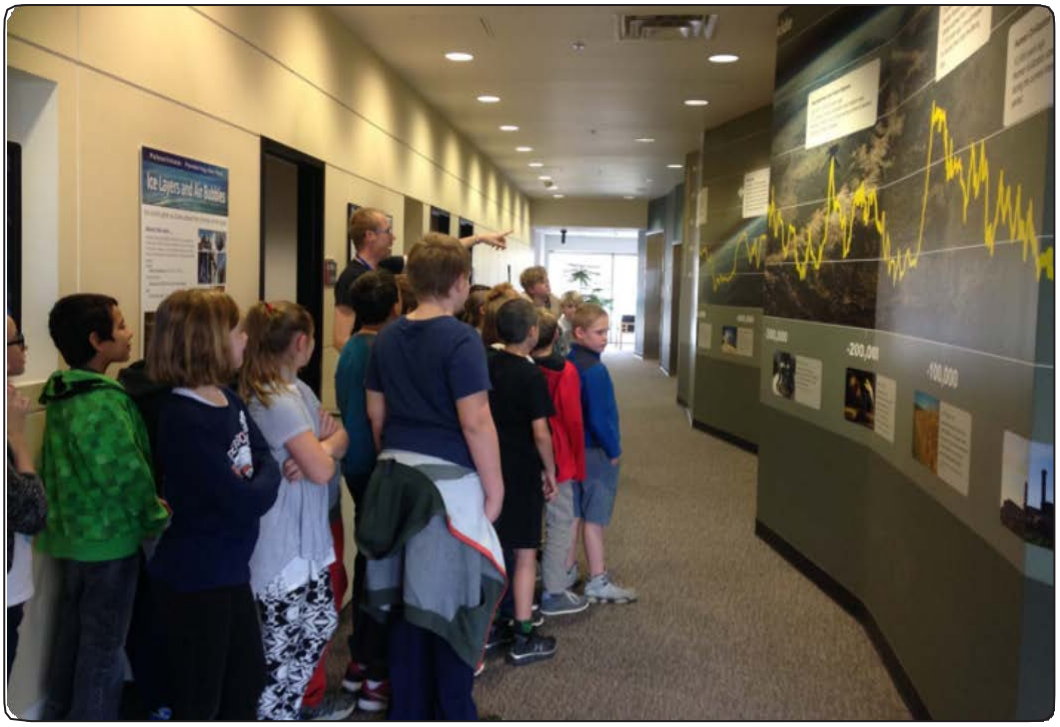
Utqiaġvik high school students setting up air sampling equipment on a day visit and training at the Barrow Observatory, on a hot summer day in 2017.



Marty Martinsen (Barrow Observatory); David Kennedy, Rick Spinrad and Craig McLean (NOAA); and Russ Schnell (GMD) in front of aerosol instruments.

Norwegian Prime Minister, Jens Stoltenberg, filling bottles of air at the South Pole Observatory, 2013.

Julie Singewald demonstrating an ozonesonde balloon launch to 2nd graders at the David Skaggs Research Center, October 2014. Balloon with a letter to the students holding the 200 ft. tail landed in eastern Colorado.



Steve Rackley, visiting teacher from Great Britain, giving a demo of the GMD tour stop including the $CO_2$ wall mural, November 2017. **29,485 visitors have received the 20 minute GMD presentation** in 2013-17.

Russ Schnell, GMD, explaining that Utqiaġvik (Barrow Observatory) is downwind of Russia to Lamar Smith (R, Texas) Chairman, Committee on Science, Space, and Technology (second person to the left) and other members of a 10 person US House of Representatives delegation visiting the Barrow Atmospheric Baseline Observatory, May 2017.

# RETIRED GMD EMPLOYEE MENTORING AND PUBLICATIONS

**Background:** Employees of the Global Monitoring Division, for the most part, spend their entire career in the division conducting, analyzing and publishing long term observations. After they retire, some stay involved in their specialization and continue to conduct data analyses, mentoring and scientific publications on their own time.

GMD provides a work space for such retirees and access to computers, data and the Internet. Below is a listing of 6 such retirees with their date of retirement and subsequent service to science and the public. Each still comes in to mentor and write papers, some 3-4 days a week.

- **John Barnes** – 6 publications since 2015; mentoring Jalal Butt, Chris Orville, Amir Kabir, Marie McKenzie, Amit Pandit, Nimmi Sharma and Ryan Neely.

- **Bob Evans** – 2 publications since 2016; mentoring Koji Miyagawa.

- **Joe Michalsky** – 9 publications since 2014; mentoring Gary Hodges, Emiel Hall, John Augustine and Patrick Disterhoft.

- **John Ogren** – 11 publications since 2015**;** supporting collaborator in Puerto Rico Professor Olga Mayol-Bracero recover from the devastation caused by Hurricane Maria. That help has included contributing to proposals for funding to replace damaged/destroyed equipment and infrastructure, advising on purchasing those replacements, and assembling/testing replacement measurement systems in the GMD aerosol lab; mentoring Katy Sun and Alex McPherson.

- **Sam Oltmans** – 45 publications since 2011; mentoring Lucy Cheadle and Chance Sterling**.**

- **Bob Stone** – 7 publications since 2014; mentoring Diane Stanitski, Christopher Cox and Sara Morris.

## Papers published since retirement.

**John Barnes**

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Together, GMD scientists who have retired in the past 7 years and continue to come into the office have produced 80 peer reviewed publications and mentored 20 scientists/technicians/students.