Addendum to: A Bibliometric Analysis of GMD Publications, 2010-2018

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S. Visser[1,2]
[1]FedWriters, Fairfax, VA 22030; 303-497-5750, E-mail: sue.visser@noaa.gov
[2]NOAA Earth System Research Laboratory (ESRL), Boulder Labs Library, Boulder, CO 80305

I. Introduction

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 qualitative measures such as peer review, bibliometrics is a useful tool for evaluating research.

Bibliometrics assumes that citation counts are a reasonable proxy for research quality. While quality is a complex notion that cannot easily be quantified, a substantial body of research has shown a weak to strong correlation between citation data and peer review (1,2).

The Boulder Labs Library analysis of 712 peer-reviewed publications authored by NOAA's Global Monitoring Division demonstrates that GMD's research has a significant influence not only in the scientific community, but also in many areas of human life and society.

II. Methodology

The data used in this investigation were acquired from the Web of Science, Science Citation Index Expanded (WoS). Publications were identified by searching WoS for titles listed in GMD's publications list (www.esrl.noaa.gov/gmd/publications). GMD publications not indexed in WoS were not included in this analysis.
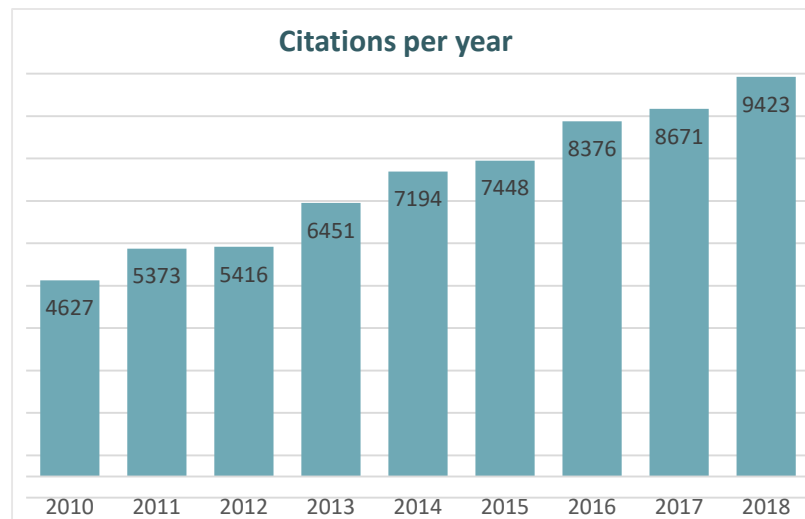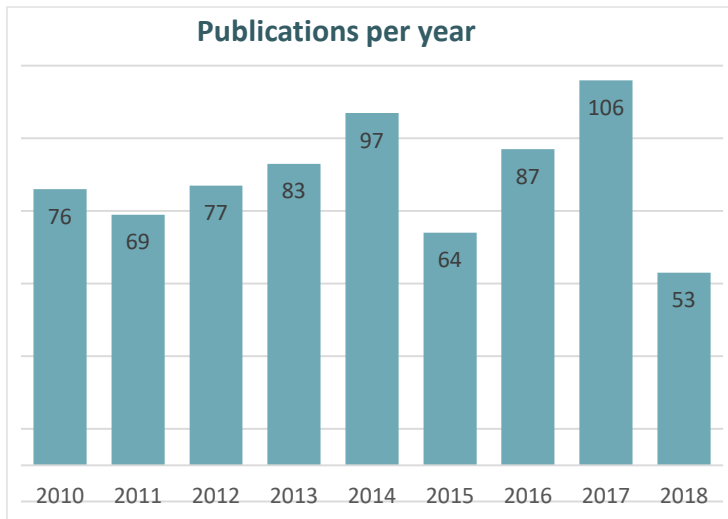
The data for the evaluative indicators were acquired from Clarivate Analytics' InCites, using the publication set identified in WoS. All data were downloaded March-April 2019.

III. Results

1. Standard indicators.

   Standard indicators of productivity. Note that due to lag times in reporting and indexing, 2018 data are preliminary and likely not indicative of the total number of publications and citations for that year. **Citations per year** includes citations to **all GMD publications**, published from 1972-2018.

Summary Metrics	
Total number of publications	712
Average citations per publication	36
Group h-index	76
Total times cited / minus self-citations	25,649 / 22,941
Total number of citing publications / minus self-citations	14,175 / 13,613

Publications per year

Year	Publications
2010	76
2011	69
2012	77
2013	83
2014	97
2015	64
2016	87
2017	106
2018	53

Citations per year

Year	Citations
2010	4627
2011	5373
2012	5416
2013	6451
2014	7194
2015	7448
2016	8376
2017	8671
2018	9423

2. Evaluative indicators.

Standard productivity indicators measure research output, but they lack context. These evaluative indicators help us understand how GMD's metrics compare to other research groups in the same discipline. Baseline metrics are derived from the average citation performance of all papers in the same research category, for the same time period. In nearly all categories and metrics, **GMD's performance significantly exceeds the baseline**.
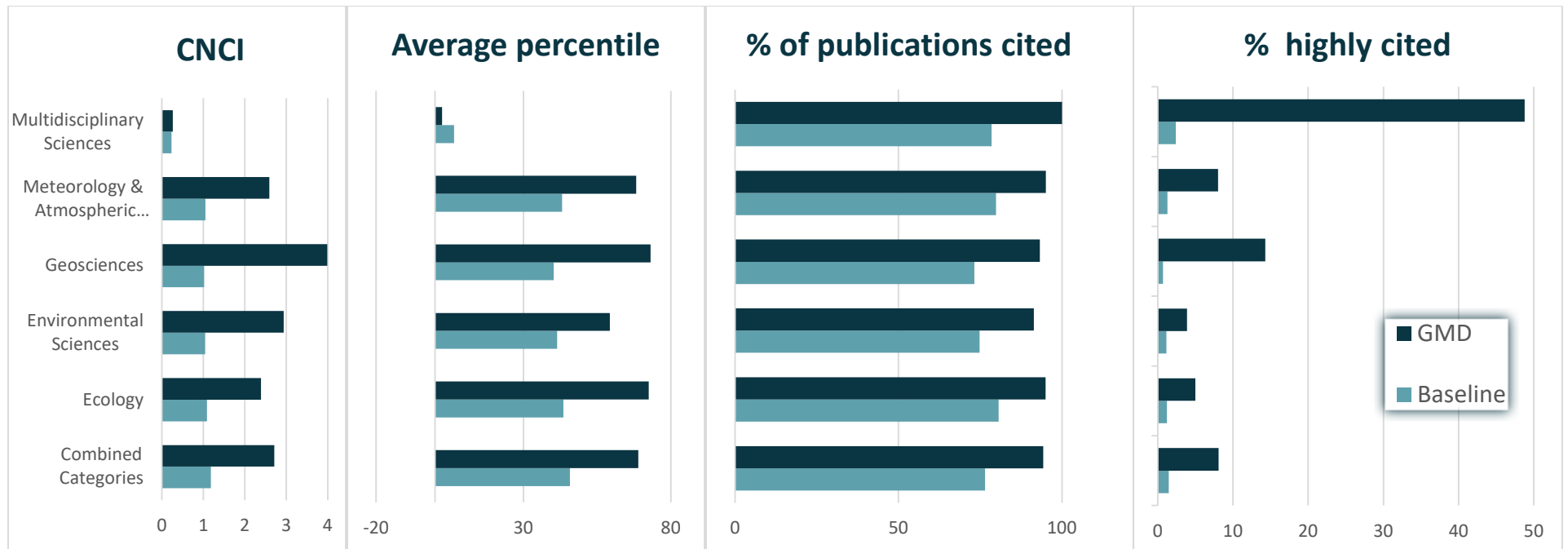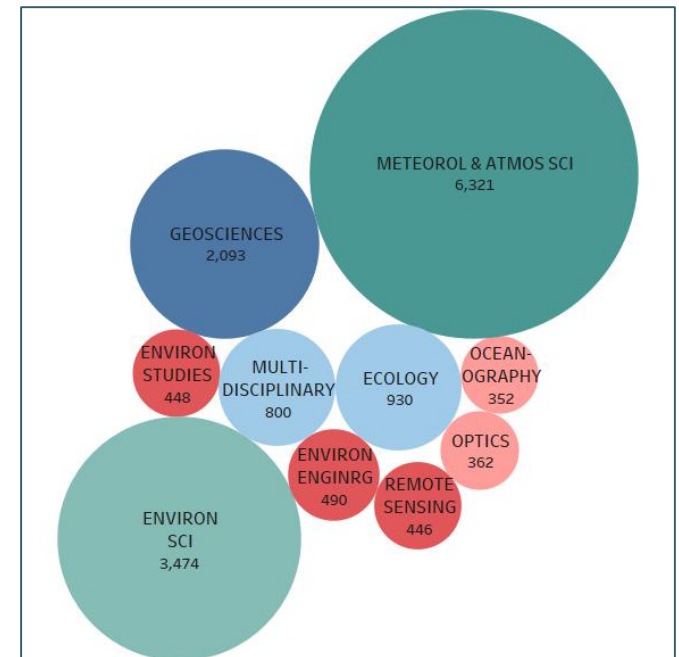

• **Category normalized citation index (CNCI)** is calculated by dividing the actual count of citing items by the expected citation rate. A CNCI value of 1 indicates a performance at par with the world average; a value above 1 indicates a performance above average.

• **Average percentile** is determined by creating a citation frequency distribution in a set of publications and determining the percentage of papers at each level of citation.

• **Highly cited** publications are those in the top 10% by citation rate (3).

• The **baseline** for each metric represents the average for all publications in the same category and time period.

3. Interdisciplinary impact

    Citations to GMD research are plentiful in the expected scientific categories, but also appear in a wide range of disciplines such as:

Citations to GMD's top ten research categories

• **public health** (*Environmental variables associated with vacationers' sun protection …,* 2016)

• **hospitality & tourism** (*Communicating sustainability priorities in the museum sector*, 2015)

• **law** (*Remedying regulatory diseconomies of scale,* 2014)

• **food industry** (*Monitoring gas-phase CO2 in the headspace of champagne glasses...,* 2018)

• **political science** (*Climate science and slow violence: A view from political geography…,* 2016).

METEOROL & ATMOS SCI
6,321

GEOSCIENCES
2,093

ENVIRON
STUDIES
448

MULTI-
DISCIPLINARY
800

ECOLOGY
930

OCEAN-
OGRAPHY
352

OPTICS
362

ENVIRON
ENGINRG
490

REMOTE
SENSING
446

ENVIRON
SCI
3,474

IV. Snapshot

GMD's highest-cited paper is "Climate forcing by anthropogenic aerosols" (Charlson, R.J., et al., 1992, *Science* 255:423-430), with 2,379 citations as of April, 2019.
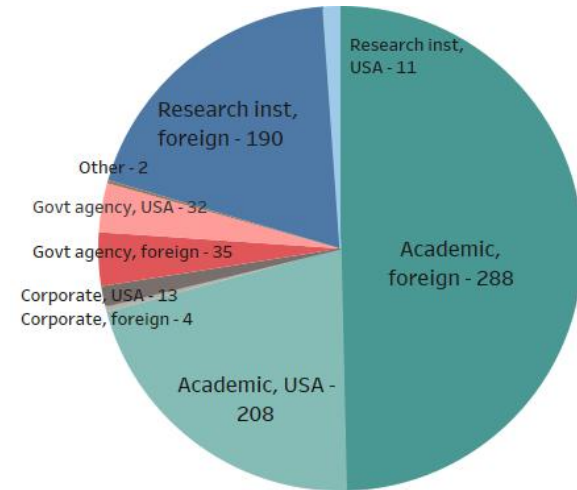
Since publication, this paper has been cited:
• an average of 98 times per year
• by authors in 85 countries
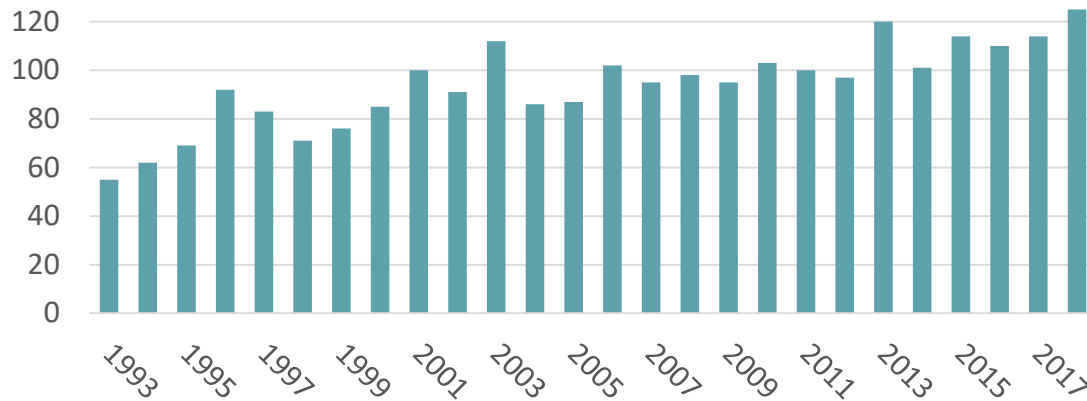• in over 400 journals.

It has been mentioned in reports and policy documents by organizations such as the National Research Council, the IPCC, and the European Union, as well as textbooks, dissertations, and encyclopedias.

This close look at just one of GMD's publications clearly shows the far-reaching impact of this important research.

Types of citing organizations

Research inst, USA - 11
Research inst, foreign - 190
Other - 2
Govt agency, USA - 32
Govt agency, foreign - 35
Corporate, USA - 13
Corporate, foreign - 4
Academic, foreign - 288
Academic, USA - 208

Citations per year

V. Responsible Use of Bibliometrics

Bibliometrics are transparent and reproducible, easily calculated, and perceived by some to be more objective than peer review. Nonetheless, when improperly or unethically applied, bibliometrics can be misleading. Among other limitations, not all citations are equal; a raw citation count is not an indicator of actual contribution to science; and bibliometric norms vary widely across disciplines.

Furthermore, the h-index and other measures can be manipulated by unethical publishing practices, or, taken out of context, they are used to make comparisons they are not capable of making(4). Bibliometrics should always be used in combination with other means of evaluation such as peer review.

For additional reading on responsible use of bibliometrics, see Clarivate Analytics 2018a; Haustein and Lariviere 2015; and Hicks, et al. 2015(5,6,7).

> **About the h-index**
>
> H-index is a simple formula, intended to characterize a researcher's output with a single number. An h-index of 10 means that the researcher has 10 publications with at least 10 citations each(8). While the h-index is a convenient snapshot of a researcher's performance, it has some well-documented shortcomings and should never be used as the sole measure of performance.

VI. References

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