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Why and How to Write a High-Impact Review Paper: Lessons from Eight Years of Editorial Board Service to Reviews of Geophysics

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High impact review papers describe and synthesize the current state-of-the-art, the open questions and controversies, and provide ideas for future investigations. They are written not only for a specific scientific discipline, but also for the broader Earth and space science community. They not only summarize the literature, but they also create a framework from which to understand the progress, problems and connections between different communities, observations, models and approaches. Here we describe how to write a high-impact review paper, and why you should consider writing one for *Reviews of Geophysics*.

Why write a review article in the first place and what distinguishes high-impact review papers from “old fashion” review papers?

There are many reasons to write a high-impact review paper including an opportunity to have a major influence on scientific communication and education, moving a research area forward, and the many citations that you will get for the paper. An impactful review paper not only summarizes what has been done in an area of research (the “old fashion” style of review), but also provides a synthesis of current understanding and an analysis of future directions.

Students, early career researchers and experienced researchers use review papers to come up to speed on an area or view their own fields through different lenses. Though review papers are often cited as a proxy for previous studies as opposed to citing the original work, good review papers also help bring structure and understanding to the often disjointed and contradictory work that is at the forefront of a research field. The clear statement of the current-state-of-the-art understanding of a problem, a description of the different models, approaches, data sets and interpretations, and discussion of possible ways to resolve controversies or future directions make good review papers an important piece of the scientific literature. Reviews are not just *Cliffs Notes* (short summaries of a story); they often tell a unique story and often provide original research. In this way, reviews not only contribute as short textbooks, but they can actually move a field forward by developing a new conceptual approach to an area of research, make new connections to other disciplines or approaches, or provide new understanding or tools for researchers to move forward.

Why publish a review paper in *Reviews of Geophysics*?

The Reviews of Geophysics editorial process

One advantage of *Reviews of Geophysics* is that it is an invitation-only journal that requires author teams to work with the editorial board on a review paper proposal prior to invitation and submission of the manuscript. This enables an initial scope assessment and requires the author teams to think about placing their work into broader context. Building on this unique journal policy, the first procedure that we implemented was to discuss each proposal (solicited or unsolicited) as an editorial board. The new procedure encourages comments and discussion from the entire editorial board (including the Associate Editors). The editors with the most expertise in the area can provide detailed questions and comments to the author team, while the rest of the editorial board helps to ensure that the importance and accessibility of the work is high. The Editor-in-Chief (EiC) can then work with the author teams so that they address any concerns. We also instituted a formalized proposal format to allow the board to make a more informed decision and to decrease the amount of questions sent back to author teams. The proposal should include the proposed paper title, list of potential authors, abstract, outline, an analysis of recent similar review articles, and should explain how the journal's target audience might benefit from the article. While reviews may be technical, they must be fundamentally accessible to geoscientists from all major disciplines. The final procedure that was instituted was that each editor often read the manuscripts that they handle and the EiC acted as a third (or fourth) referee for each paper. The EiC referee report typically provides non-expert feedback, while the topical editor and referees provide detailed technical comments. Other attractive features of *Reviews of Geophysics* include no page or figure limits, and no page charges. Also because of the high profile nature of the papers, AGU and editors develop enhanced

content features such as Commentary, Editor Highlights and opportunities for the author teams to present a Q&A piece describing the importance of the work that are all featured in Eos.org and on AGU social media platforms.

Journal Quality Metrics

For the discussion here, we equate “high-impact” with citation count. When considering in which journal to publish, the Journal Impact Factor (JIF) is often used to assess the “quality” of the refereed journal. The JIF is a proprietary metric from [Clarivate Analytics](#) (formerly part of Thomson Reuters) that is determined by the number of citations to articles published in the previous two-year interval in that journal divided by the number of papers published during that two-year interval. For example, the 2016 JIF takes the number of citations to articles published in 2014 and 2015 by papers published in 2016 (numerator) divided by the total number of “citable items” (includes research articles and reviews) published in 2014 and 2015 (denominator)) (see <http://wokinfo.com/essays/impact-factor/>).

Review journals usually have a much higher JIF than topical research journals because they publish fewer papers (impacting the denominator) and because good review papers routinely attract more citations (increasing the numerator) [*The Plos Medicine Editors*, 2006]. That being said, when we became the editorial board of AGU's *Review of Geophysics* in 2009, one of our goals was to increase the visibility, usefulness and impact of the journal. The JIF is one measure of these qualities, but we wanted to avoid the “journal impact factor game” [e.g., *The Plos Medicine Editors*, 2006] of manipulating the editorial process to artificially inflate the JIF [e.g., *Falagas and Alexiou*, 2008]. We worked to increase the number of papers published each year into the 20-25 range from the previous average (2002-2009) of just under 16

papers per year. In this way, an increasing JIF along with an increasing number of papers published indicates that each paper is attracting more citations. An analysis done by the Editor-in-Chief at the beginning of our term showed that our JIF (ranging from 6 to 8 in the three years prior to our term) was primarily determined by a handful of high-citation papers, while most papers had few or even zero citations. The data show that we have been effective in increasing our JIF (to 12.34 in 2016), while at the same time increasing our number of papers published in the journal (22 in 2016) (see Figure 1 for the year-to-year trend and note the significant year-to-year variability).

Attributes of high-impact Reviews of Geophysics papers

If a paper is published in a journal with a high impact factor, it clearly does not mean that the paper is a high impact paper. It just means that the “average paper” published in that journal during a two-year interval was cited significantly in the following year. Using the JIF to evaluate individual papers is essentially meaningless (e.g., *Hanson et al.*, 2017), as high citation papers significantly impact the JIF (the citation statistics of individual papers do not follow a normal distribution). To investigate what makes a high impact paper within the distribution of papers, we looked at approximately the top and bottom quartiles of papers published in 2010-2015 ($n = 122$) to examine if there are characteristics of review papers that are different between the two populations. For *Reviews of Geophysics* during this interval the top quartile ($n = 31$) contained 21 papers that were “Highly Cited Papers”, which are designated as papers as of January/February 2017 that received enough citations to place them in the top 1% of its academic field based on a highly cited threshold for the field and publication year. We pulled the citation statistics on June 20, 2017 from the Web-of-Science. An additional 10 papers in the middle of the

total citation distribution were also Highly Cited Papers (this designation depends on the publication date, so more recent papers are compared with papers published in the similar timeframe so they could have fewer citations than papers in the 2010-2015 interval absolutely, but still be in the top 1% of their cohort). The Web-of-Science webpage designates these papers with orange “trophy” badges. Thirty-one of the 122 papers (25.4%) published in *Reviews of Geophysics* during this interval are Highly Cited Papers and the h-index for the journal is 46 with an average number of citations per paper of 60.23 (7348 total citations). The highest cited paper in this interval is *Hansen et al.* [2010] with 763 citations, while the lowest citation count is 2 (this paper was published at the end of 2015). The bottom quartile papers (n=35, 18 of which were published in 2015)) have an average citation count of 11.43 (median of 11 with a range from 2 to 18). The h-10 of the entire distribution is 107 (h-10 is the number of papers that have 10 or more citations) indicating that 87.7% of the papers published have garnered double-digit citations. Therefore even the bottom quartile citation papers have significant numbers of citations and the only significantly different attribute is that they were more recently published.

How to write a high-impact review paper for *Reviews of Geophysics*

In the past, old-fashioned review papers just summarized the literature (“so and so did this and found that, while so and so found this”). But an impactful review paper should be more than this. A high-impact review provides a solid conceptual framework of the fundamental problems being addressed and describes how the different approaches and methodologies fit together and contribute to our current understanding. Good reviews provide context for current work by describing and synthesizing past work, including the seminal contributions. The bulk of the cited

references should be to current work, but clear connections to past foundational work should be provided. *Mukherjee et al.* [2017] found that high impact papers' cited references had a low mean age (e.g., preferentially cited "new" work) and a high mean age variance (also cited seminal work from the past). High-impact review papers follow this formula and communicate to the reader the driving questions that motivated the studies, not only what they did and what they found. Many high-impact review papers have also developed schematics that place the work being reviewed into broader context. These usually colorful graphics often become iconic figures for the discipline. In addition, many high-impact review papers create new figures that bring together results from a variety of studies, experiments, and models. These new figures clearly show where the field has made significant progress (where data and models agree) and often show where future research is needed (where there are large uncertainties, no observations or where there is significant discrepancy between models and observations).

The editorial board welcomes your ideas for high-impact review papers at any time. Prospective author teams should prepare and submit a proposal to *Reviews of Geophysics* guided by instructions found at [http://agupubs.onlinelibrary.wiley.com/hub/journal/10.1002/\(ISSN\)1944-9208/journal-menu/submit-an-article.html](http://agupubs.onlinelibrary.wiley.com/hub/journal/10.1002/(ISSN)1944-9208/journal-menu/submit-an-article.html)

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Figure 1. The Journal Impact Factor and the number of papers published each year (2002-2016) for *Reviews of Geophysics*. Our editorial board term began in 2009 and the Editor-in-Chief and Editors have served two, four-year terms.

