AGU ADVANCING EARTH AND SPACE SCIENCES

AGU Advances

EDITORIAL

10.1029/2024AV001334

Challenges Facing Scientific Publishing in the Field of Earth & Space Sciences

AGU Editorial Network[1]

[1]See Appendix A

Key Points:

- As editors of American Geophysical Union (AGU) journals and books, we remain confident in the fundamental foundations of scientific publishing
- The scientific publishing landscape is evolving rapidly, contributing to personal anxiety and fatigue for authors, reviewers, and editors
- We are committed to improving AGU journals and books, and to do so, we need your input

Citation:

AGU Editorial Network (2024). Challenges facing scientific publishing in the field of Earth & space sciences. *AGU Advances*, *5*, e2024AV001334. https://doi.org/10.1029/2024AV001334

Received 21 MAY 2024
Accepted 31 MAY 2024

Abstract The scientific publishing landscape is evolving rapidly. This evolution is driven by a confluence of internal and external forces, including the growth of metrics-based evaluation of scientists; an increasing volume of manuscripts combined with expectations for rapid review and publication; an increasing number of journals, including *for-profit* Open Access publications; and the adoption of preprint servers across a growing range of disciplines. Many of these forces are contributing to personal anxiety and fatigue for authors, reviewers, and editors. Collectively, they are placing substantial stress on scientific publishing, which is a foundational pillar of the scientific enterprise. As editors of American Geophysical Union journals and books, we remain confident in the fundamental foundations of scientific publishing, but we are concerned about the impact of these increasing stressors. By affirming and investing in editorial values, respecting scientific integrity and credibility, and committing to accessibility, transparency, and accountability, we can fortify the foundations of the scientific enterprise during a time of rapid change.

Science is a rigorous framework designed to advance our understanding and prediction of processes that govern the universe. Peer review plays a crucial role as a mechanism for independent experts to assess and provide feedback on new work. Journals operated by non-profit scientific societies, which are dedicated to advancing scientific inquiry rather than maximizing profit, play a crucial role in maintaining peer-review processes that prioritize fairness and rigor while improving accessibility, transparency, and equity. Based on our experience as editors of American Geophysical Union (AGU) journals (Appendix A), we believe that the system of scientific publishing by scientific societies continues to work well in the vast majority of cases. However, a number of challenges are impacting both AGU journals and the scientific enterprise more broadly.

1. Increasing Pressures on Authors, Reviewers and Editors

Scientists continue to face pressure to publish more papers, in higher-profile journals, with an emphasis on accumulating larger numbers of citations (Grimes et al., 2018; Rawat & Meena, 2014; Yeo-Teh & Tang, 2022). The propensity for research institutions to increasingly emphasize publication metrics (Wilsdon, 2016) is contributing to cynical practices such as gift authorships and the fragmentation of studies into "least publishable units." This trend also fosters the unrealistic expectation that every research effort must culminate in a groundbreaking scientific discovery, which may paradoxically diminish the likelihood that papers push the boundaries of science in new directions (Park et al., 2023).

The pressure on authors has compounding effects on editors and reviewers. Increasing numbers of authors and a proliferation of journals create a larger total number of manuscripts to manage. In addition, journals are increasing the allowable manuscript length and supplemental material, while also requiring reviews to be completed in a shorter amount of time. As a result, in our experience, finding subject matter experts to give careful, balanced, timely reviews has become one of the most challenging steps in the peer-review process.

At AGU journals, the total number of manuscripts has increased in recent years (Figure 1a). This is driven more by the number of authors submitting manuscripts (which has increased) than the submissions per author (which has varied within a relatively narrow range) (Figure 1b). While the total number of distinct reviewers has also increased (Figure 1c), the fraction of manuscripts sent for review has decreased (Figure 1a)—leading to a slight decline in reviews per reviewer (Figure 1d). However, it is common for editors at AGU journals to make numerous requests to secure the two or three reviews that are the standard expectation at most AGU journals (Figures 1e and 1f). For example, 25% of manuscripts sent for review in 2023 required eight or more requests (Figure 1f).

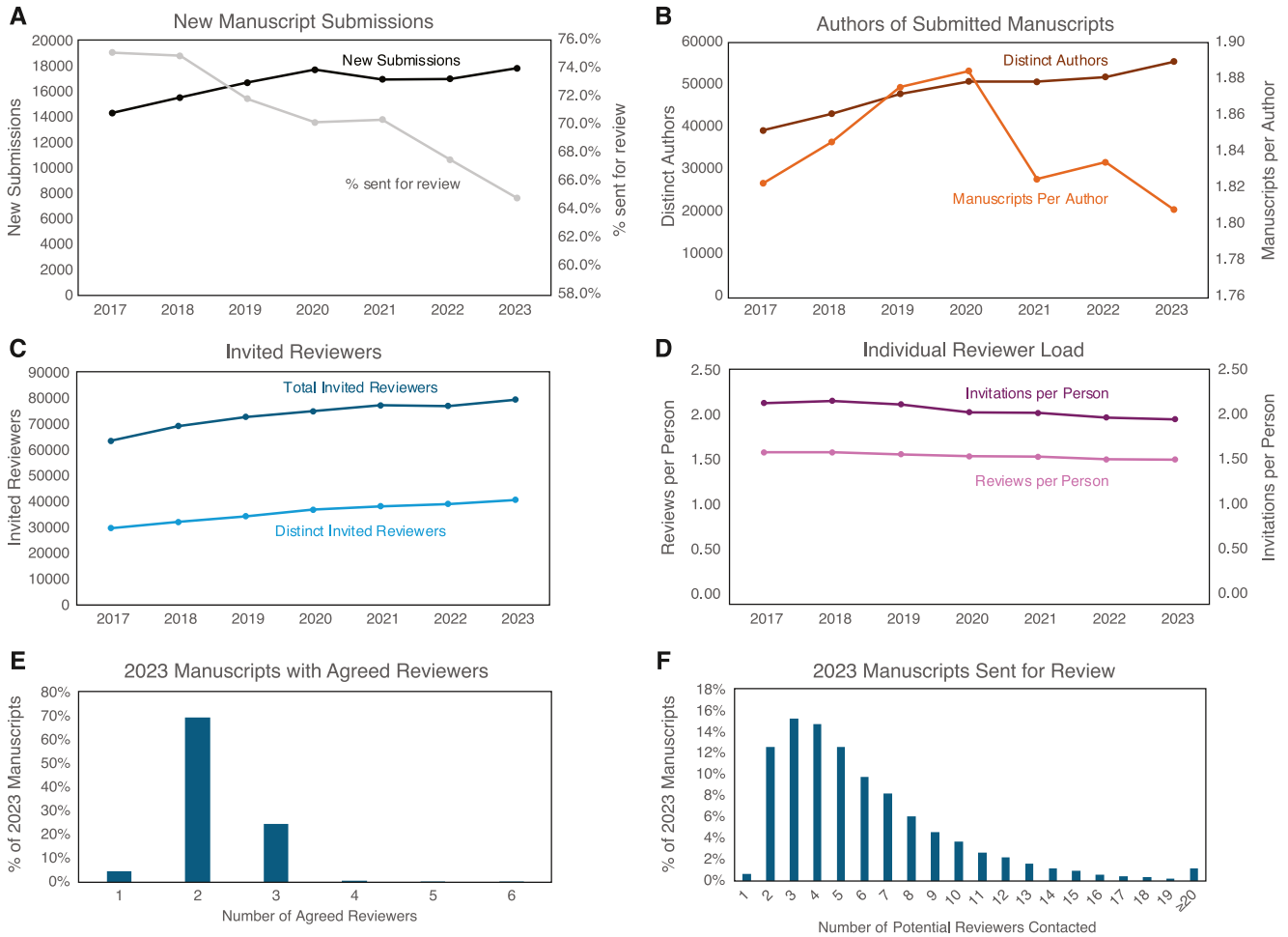

Figure 1. *Manuscript submission and review data for new manuscripts during the 2017–2023 period, pooled across American Geophysical Union (AGU) journals*. (a) Annual total number of new manuscript submissions to AGU journals, and the percent of those initial submissions sent for peer review in each year. (b) Annual total number of distinct authors listed on new manuscripts, and the mean number of new manuscripts per author in each year. (c) Annual total number of invited reviewers for new manuscripts, and the annual total number of distinct invited reviewers. (d) Annual mean number of reviewer invitations per person invited to review for AGU journals, and the annual rate of agreement for those invited to review. (e) Histogram of number of agreed reviewers on manuscripts sent for review by AGU journals in 2023. (f) Histogram of number of potential reviewers contacted on manuscripts sent for review by AGU journals in 2023.

One influence on the escalating pressure on authors, reviewers, and editors is the evaluation system for hiring and personnel reviews in academia and other research institutions. While scientific journals are not responsible for this evaluation system, journal publications are a critical element of most evaluations in the Earth and space sciences. Many journals contribute to the culture of metrics by promoting timeliness statistics, impact factors, citations and downloads.

A second influence is the *for-profit* Open Access (OA) business model. The OA model has many clear benefits, including providing more equal access to scientific papers. However, financing the OA model in an equitable fashion is more challenging, particularly given the advent of *for-profit* OA journals. In contrast to the institutional subscription model, the OA model generates revenue only from authors and only when a paper is published (e.g., Paytan, 2017). The *for-profit* motive creates an imperative to publish without a balancing imperative for quality, creating an inherent conflict with rigorous peer-review standards. The costs can also be prohibitive for authors from institutions that lack the resources to pay OA fees, which can often be considerably higher than standard publication fees in society journals (as standard fees are generally subsidized by institutional subscriptions).

Although AGU and other non-profit societies are working to increase their OA offerings and develop funds for authors in need, the rapid growth of *for-profit* OA journals—many of which have been identified as "predatory" (Grudniewicz et al., 2019; Hanson & Lunn, 2017; Van Noorden, 2023)—paired with increasing reliance on

publication metrics for career advancement, has facilitated an unfortunate trend toward "quantity over quality" (up to and including outright fraud; Joelving & Retraction, 2024). In our experience, this trend is contributing to reviewer burnout, eroding the scientific community's confidence in the peer-review process, and undermining public trust in scientific research (Van Noorden, 2023). These pressures may be particularly harmful to researchers early in their careers and/or from less-resourced countries or institutions, who are working to build their research programs.

2. Opportunities for Improvement

While we remain confident in scientific publication as a foundation of the scientific enterprise, it is critical to address the growing pressures on authors, reviewers, and editors. At the broadest level, this means shifting the professional reward system away from quantity and toward quality and innovation. The most direct pathway is through the criteria for appointment, evaluation, and promotion at individual research institutions. While scientific journals do not have direct influence on these criteria, publishers can play a role. As a signatory of the Declaration of Research Assessment (DORA; https://sfdora.org/), AGU seeks to promote a variety of journal-based metrics that provide a richer view of journal performance (AGU, 2024c; Wiley, 2024). AGU Honors has also worked to de-emphasize publication metrics in the nomination and evaluation process for various AGU awards, including introducing a new nomination practice where supporters answer pre-defined questions about the nominee's alignment with the specific award criteria.

Journals also have direct influence on the quality of papers that are published. Editors can help to increase manuscript quality and reduce reviewer burden by declining to seek reviews for manuscripts that are not sufficiently developed, substantive, and/or innovative. Indeed, part of why individual reviewer load has not increased at AGU journals (Figure 1d) in the face of growing total manuscript submissions (Figure 1a) is that the fraction of manuscripts sent for review has decreased (Figure 1a). The decision not to send a manuscript for review is difficult, and requires additional effort and attention from editors. It is also most helpful to authors when it is accompanied by specific feedback for improvement.

The growing challenge in securing reviewers also calls for expanding the pool of excellent reviewers and transforming in how they are incentivized. One mechanism is to increase recognition of the value of peer review. Some progress has been made by making contributions to anonymous review more visible, both through annual acknowledgments by individual journals and by offering the option for completed reviews to be reported to Web of Science or ORCID. There have also been efforts to broaden the reviewer pool through fellowships that engage early-career reviewers (e.g., Gradoville & Deemer, 2022). While AGU journals already recognize a small subset of outstanding reviewers (Giampoala & Frost, 2023), official recognitions could be elevated through the AGU Honors program. Research institutions could also establish a more structured system for recognizing and rewarding reviewer contributions, beyond the common practice of tracking the annual number of reviews. For example, more institutions could adopt the practice of asking candidates for promotion to recommend an editor who can substantively comment on their reviewer contributions. In addition, editors need to make broader use of experts at institutions outside the US and Europe, who remain underrepresented relative to their presence as authors. Finally, compensating reviewers is a topic of ongoing debate, whether through payment or by reducing publication fees and/or conference costs. What is clear is that, just as AGU supports editors through honoraria and conference support (AGU, 2024d), AGU needs to think hard about how to better support the community in providing quality peer review.

As the pressure to publish increases, so does the importance of robust publishing standards, practices, and institutions. It is thus necessary for AGU to expand initiatives it has already undertaken. For example, the peer-review process relies on each participant acting honestly and ethically (AGU, 2023). In cases where there is evidence of research misconduct, AGU has processes for taking appropriate action, up to and including retraction (AGU, 2023, 2024a). In addition, innovations like Findability, Accessibility, Interoperability, and Reusability standards for data and reproducibility (Wilkinson et al., 2016) are helping to ensure research integrity. AGU has also been a leader in compiling and releasing data about the publication process (AGU, 2022b), as well as in integrating pre-print archiving with the manuscript submission system. Continuing to expand these practices will increase transparency, accountability, and reproducibility. Finally, while AGU has adopted initial policies about declaration of the use of artificial intelligence (AI) tools in manuscript preparation (AGU, 2024a), the rapid growth of generative AI and its increasing use in the writing of both manuscripts (Liang, Zhang, et al., 2024) and

peer reviews (Liang, Izzo, et al., 2024) means that novel challenges for which journals are not currently prepared are likely to emerge in the coming years.

There are also improvements that AGU can make to existing practices. For example, ensuring open debate requires making it easier to raise and address concerns through the journal. Currently, the process for retracting published papers can be both difficult and slow. Likewise, authors seeking to publish a Comment can experience long delays as the Comment and Reply move through the review process. While this process needs to be made more efficient, the community should know that there are multiple existing mechanisms for critiquing papers published in AGU journals, including encouraging a Correction or submitting a stand-alone manuscript. In addition, while manuscripts posted on ESS Open Archive can receive open comments, more AGU journals should consider adopting existing practices in which reviews and author responses are published along with the final paper, reviewers are invited to comment on each other's reviews prior to editorial decisions, and the broader community is able to comment during the review phase.

A lack of diversity among editors can also negatively impact scientific publishing (e.g., Vila-Concejo et al., 2018; Witze, 2016; Wooden & Ricci, 2023). Diversity among editors and reviewers is crucial for reducing bias and promoting fairness, objectivity, and inclusivity, and can help to expand the pool of available reviewers. It also contributes to a more comprehensive scientific understanding by ensuring that a wide range of perspectives and ideas are considered and represented. AGU is working to address these issues through the "Diversity, Equity, Inclusion, and Accessibility (DEIA) at AGU Publications" initiative (AGU, 2024b). While substantial progress has been made (e.g., AGU, 2022a), this must remain an area of emphasis for AGU Publications (Wooden & Ricci, 2023).

3. Strengthening the Foundation of Community Journals

It is a privilege to serve our community as editors of AGU journals and books. While the system of scientific publication faces a number of challenges, we believe that the peer-review process at AGU publications stands as robust, rigorous, and healthy, providing a strong foundation for responding to these challenges. This commendable state is attributable to the selfless commitment of all who contribute to upholding the integrity of AGU's publication efforts, whether as reviewers, editors, associate editors, or staff. Their dedication ensures the quality and reliability of the scientific contributions that pass through our journals. We wholeheartedly commit to working to alleviate the burdens on authors and reviewers while enhancing clarity, fairness, objectivity, transparency, and accountability in the review and editorial process. And we express sincere gratitude to all contributors who play a vital role in making this continuous improvement possible.

The standard manuscript acceptance email from AGU journals concludes with a statement thanking the authors for sending their best work to the journal. This is not a platitude. AGU journals are community journals: they exist for the benefit of the Earth and space sciences community, and editors of AGU journals and books are active members of that community. Our community's journals are strongest when our community sends its best work to those journals, and when our community is willing to serve those journals as editors and reviewers.

It is thus crucial that we hear from the community about how we can improve. What are the barriers and challenges that we have not yet identified? What are the solutions that we have not yet foreseen? Please provide your feedback in the Comments of the ESSOAr version of this manuscript (https://essopenarchive.org/doi/full/10.22541/essoar.172043872.20078706/v1). We are committed to improving AGU journals and books, and to do so, we need your input!

APPENDIX A AGU Editorial Network Group Authorship

Name	Institution	AGU publication
Amir AghaKouchak	University of California, Irvine	Earth's Future
Anantha Aiyyer	North Carolina State University	Geophysical Research Letters
Mikael Attal	University of Edinburgh, UK	JGR—Earth Surface
Lisa M. Beal	Rosenstiel School of Marine, Atmospheric, and Earth Science, University of Miami	JGR—Oceans
Whitney Behr	Department of Earth Sciences, ETH Zürich, Switzerland	G-Cubed
M. Bayani Cardenas	University of Texas at Austin	AGU Advances

Appendix A
Continued

Ben Bond-Lamberty	Pacific Northwest National Laboratory (JGCRI)	JGR—Biogeosciences
Suzana J. Camargo	Lamont-Doherty Earth Observatory, Columbia University, Palisades, NY	Geophysical Research Letters
Brett A. Carter	School of Science, RMIT University, Melbourne, Australia	Space Weather
Kelly Caylor	University of California, Santa Barbara	Earth's Future
Cinzia Cervato	Iowa State University	Earth and Space Science
Léon Chafik	Department of Meteorology, Stockholm University, Stockholm, Sweden	JGR—Oceans
Yafang Cheng	Max Planck Institute for Chemistry, 55128 Mainz, Germany	JGR—Atmospheres
Carole Dalin	CNRS, ENS-PSL, France and University College London, UK	Earth's Future
Eric A. Davidson	University of Maryland Center for Environmental Science	AGU Advances
Mark J. Dekkers	Department of Earth Sciences, Utrecht University	JGR Solid Earth
Ankur R. Desai	University of Wisconsin-Madison	JGR—Biogeosciences
Georgia Destouni	(a) Department of Physical Geography, Stockholm University, Stockholm, Sweden, and (b) Department of Sustainable Development, Environmental Science and Engineering, Sustainability Assessment and Management, KTH Royal Institute of Technology, Stockholm, Sweden	Water Resources Research
Sagnik Dey	Center for Atmospheric Sciences, Indian Institute of Technology Delhi, India—110016	GeoHealth
Noah S. Diffenbaugh	Doerr School of Sustainability, Stanford University	Earth's Future
Amy E. East	American Geophysical Union	JGR—Earth Surface
Jiwen Fan	Argonne National Laboratory	Journal of Advances in Modeling Earth Systems
Sarah J. Feakins	Department of Earth Sciences, University of Southern California	Geophysical Research Letters
Joshua M. Feinberg	University of Minnesota	Geochemistry, Geophysics, Geosystems/Reviews of Geophysics
Gabriel M. Filippelli	Indiana University indianapolis	GeoHealth
Fabio Florindo	Istituto Nazionale di Geofisica e Vulcanologia, Rome, Italy	Reviews of Geophysics
Rong Fu	University of California, Los Angeles	JGR—Atmospheres
Nathalie F. Goodkin	American Museum of Natural History	JGR—Oceans
Stephen M. Griffies	NOAA Geophysical Fluid Dynamics Laboratory + Princeton University Atmospheric and Oceanic Sciences Program	Journal of Advances in Modeling Earth Systems
Matthew Huber	Earth, Atmospheric, and Planetary Sciences Department, Purdue University	Paleoceanography and Paleoclimatology
Valeriy Y. Ivanov	University of Michigan	Geophysical Research Letters
Xianzhe Jia	Department of Climate and Space Sciences and Engineering University of Michigan, Ann Arbor	AGU Books
Kristopher B. Karnauskas	University of Colorado Boulder	Geophysical Research Letters
Robert E. Kopp	Rutgers University	Earth's Future
Kate Lajtha	Dept. Crop and Soil Sciences. Oregon State University. Corvallis OR 97331	AGU Books
Xin-Zhong Liang	Department of Atmospheric & Oceanic Science and Earth System Science Interdisciplinary Center, University of Maryland College Park	JGR—Atmospheres

Appendix A
Continued

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Anni Määttänen	LATMOS/IPSL, Sorbonne Université, UVSQ Université Paris-Saclay, CNRS, Paris, France	JGR Planets
Natasha MacBean	Western University (University of Western Ontario)	Journal of Advances in Modeling Earth Systems
Gudrun Magnusdottir	University of California Irvine	Geophysical Research Letters
Katsumi Matsumoto	University of Minnesota	Global Biogeochemical Cycles
Astrid Maute	CIRES/University of Colorado Boulder	Earth and Space Science
Mathieu Morlighem	Department of Earth Sciences, Dartmouth College, Hanover NH 03755	Geophysical Research Letters
Adina Paytan	Earth and Planetary Science, University of California, Santa Cruz	GeoHealth
Hannah E. Power	School of Environmental and Life Sciences, University of Newcastle, Australia	JGR—Oceans
S. C. Pryor	Cornell University	Earth and Space Science
Yun Qian	Pacific Northwest Northwest National Lab, Richland, WA, USA	JGR—Atmospheres
Nicole Riemer	Department of Climate, Meteorology, and Atmospheric Sciences, University of Illinois Urbana-Champaign	JGR—Atmospheres
Alan Robock	Department of Environmental Sciences, Rutgers University, New Brunswick, New Jersey	Reviews of Geophysics
Lynn M. Russell	Scripps Institution of Oceanography, UCSD	JGR—Atmospheres
David Schimel	Jet Propulsion Lab, California Institute of Technology	AGU Advances
Tapio Schneider	Caltech	Journal of Advances in Modeling Earth Systems
Arvind Singh	Physical Research Laboratory, Ahmedabad, India, 380009	JGR—Oceans
Kamini Singha	Colorado School of Mines	Water Resources Research
Hang Su	Institute of Atmospheric Physics, Chinese Academy of Sciences	AGU Advances
Hui Su	Department of Civil and Environmental Engineering, the Hong Kong University of Science and Technology, Clear Water Bay, Hong Kong SAR, China	Geophysical Research Letters
Susan Trumbore	Max Planck Institute for Biogeochemistry	AGU Advances
Lars Umlauf	Leibniz Institute for Baltic Sea Research, Warnemünde, Germany	JGR—Oceans
Xin Zhang	University of Maryland Center for Environmental Science	Earth's Future
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Anna Wåhlin	Department of Marine Sciences, University of Gothenburg	JGR—Oceans
Caitlin B. Whalen	Applied Physics Laboratory, University of Washington	Geophysical Research Letters
Angelicque E. White	University of Hawaii at Manoa	Geophysical Research Letters
Branwen Williams	Kravis Department of Integrated Sciences, Claremont McKenna College	Geochemistry, Geophysics, Geosystems
Don Wuebbles	University of Illinois	AGU Advances
Marguerite A. Xenopoulos	Department of Biology, Trent University, Peterborough, ON, Canada	JGR: Biogeosciences

Acknowledgments
We thank Kevin Jewett and Paige Wooden for assembling the data shown in Figure 1, and Matthew Giampoala for helpful feedback. We also thank all of the staff at AGU Publications for their deep and sustained effort and commitment supporting authors, reviewers and editors of AGU journals and books.

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