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Impactful Datasets in Earth, Space, and Environmental Sciences: Highlighting the Data That Transform Research

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COMMENTARY

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Impactful Datasets in Earth, Space, and Environmental Sciences: Highlighting the Data That Transform Research

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Special Collection:
Impactful Datasets in Earth, Space, and Environmental Sciences

Peer Review The peer review history for this article is available as a PDF in the Supporting Information.

Key Points:

- American Geophysical Union announces the new living collection "Impactful Datasets in Earth, Space, and Environmental Sciences"
- Nominators submit datasets impactful to their work along with personal stories on how they interact with the dataset
- New nominations are being accepted, and the spreadsheet will be updated periodically

Supporting Information:

Supporting Information may be found in the online version of this article.

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Abstract The American Geophysical Union (AGU) announces the new living collection "Impactful Datasets in Earth, Space, and Environmental Sciences" which recognizes the creation and curation of datasets enabling research, analysis, and decision making beyond what is captured by traditional academic impact metrics. The collection highlights datasets through the dimensions of People, Planet, and Prosperity, and includes a curated set of nominated datasets and accompanying special collection of data papers. Developed with the Earth Science Information Partners (ESIP) community, the nomination and review process initially invites contributors from across research, operations, and public service, to nominate datasets important to their work, and then submit a data paper that expands upon the nomination text for inclusion in the special collection. This commentary highlights the rationale for the living collection, and the process of nomination. The collection serves as a living reference that strengthens data culture, supports reproducible geoscience, and provides enduring access to critical information for science and society.

Plain Language Summary The American Geophysical Union is launching a new living collection called "Impactful Datasets in Earth, Space, and Environmental Sciences." The goal is to celebrate datasets that have had a significant impact on science and society by supporting research, analysis, and informed decisions. Many important datasets do not receive recognition through traditional academic metrics, so this collection provides a way to highlight their contributions. This commentary describes the purpose of the collection and explains how to nominate a dataset.

1. Introduction

The "Impactful Datasets in Earth, Space, and Environmental Sciences" collection comprises two complimentary components: a publicly available collection of nominated datasets (Sedora & Stall, 2026) and a special collection of data papers that expand upon the nomination text submitted for each dataset. Together, these components recognize the creation, stewardship, and use of impactful datasets, that is, of those datasets that demonstrably support a broad spectrum of research work, analysis, and decision making. Well-curated data underpin geoscience research, inform responses to global challenges, and enable transparent, reproducible science beyond traditional bibliometrics. The special collection is hosted by the journal *Earth and Space Science,* and comprises papers that highlight the impact of datasets in the Earth, space, and environmental science domains.

The dataset nomination form and vetting process were developed by members of the Earth Science Information Partners (ESIP) community. Researchers from the Earth, space and environmental science communities were invited to nominate datasets that are impactful in their work. It was important to the participants that the value of the data be measured by actual and potential impact, and not by usage metrics and citations, which are limited in collection and commonly inaccurate compared to actual use. The term "data" does not have limitations, allowing submitters to freely interpret the term based on their needs. The essential criterion is that the data are shared according to the FAIR principles: findable, accessible, interoperable, and reusable (Wilkinson et al., 2016).

To ensure inclusiveness across all relevant fields, AGU invites nominations of an impactful dataset most valuable to the work of the nominator. This is not limited to researchers, but includes anyone who uses or manages publicly available datasets. As part of the nomination process, the nominators describe why the datasets are impactful using the dimensions of people, planet, or prosperity. Details about the dataset are provided at the time of nomination, including the names of the dataset creators, name of the data repository where it is hosted, a brief description of the dataset, names of the dataset curator team, and a persistent identifier to the dataset (e.g., a Digital Object Identifier) or URL. In addition to the description of the impact that data have, the nominators also

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provide a more personal understanding of how they interact with the dataset. These first-hand stories are critical when we consider the value of a dataset.

The project pilot, and first nomination window, was July–October 2025. Each dataset submission was reviewed for their compliance with FAIR and nomination requirements. The total number of submissions was 164. As some were duplicates, there were 133 total datasets. The accepted nominations are included in the dataset titled *Impactful Datasets in the Earth, Space, and Environmental Sciences* (Sedora & Stall, 2026). The nominators are included as co-authors of this commentary.

The nominators for each accepted dataset have an open invitation to form an author team to submit a data paper featuring the dataset to the new special collection. The author team should include the nominator, other dataset users, curators of the dataset, and/or individuals and organizations responsible for the creation and maintenance of the dataset. As this is a living collection, additional impactful dataset nominations are welcome. AGU will host and maintain the nomination form here (https://docs.google.com/forms/d/e/1FAIpQLSf0Tlb1a29C2I-lNyl8qf_1oG1tFBosYW5qGBBj70D42Nhn_w/viewform). Newly accepted nominators are then welcome to submit a data paper to the special collection.

In this commentary we explain the rationale behind the initiative, provide a working definition of "impactful dataset" and outline the required attributes, introduce the initial classification by grouping of the datasets, and highlight the significance and impact of the special collection.

2. Rationale and Background

"Preserving open data as a world heritage to secure our future" is the preamble to the AGU Position Statement of Data (Elger et al., 2024). The AGU community has asserted a position on Earth, space, and environmental science data since 1997. The cornerstones to this statement include: **equitable access** to data and infrastructure, promoting **a culture that values data contributions**, and encouraging **adoption of standards** around describing and documenting data across disciplines and domains. This position statement helps us to move together toward a more global vision where data are an asset and the infrastructure that supports discovery, access, and interoperability is sustainable and enduring. Global challenges such as natural hazards and climate change require us to ensure long-term preservation and analysis-ready data formats.

In recent months, specifically in the US, but also globally, research infrastructure has been defunded (de Sherbinin, 2026) with particular impact to the personnel that understand complex earth observing data and data systems (AAAS, 2026). The community is working to mitigate the situation, and in doing so, AGU was asked to highlight the value of our global research data. The response to the nomination request was heartening. The personal stories about how datasets impact the lives, research, and decision making globally reinforce the importance of long-term preservation.

Sharing and reviewing data are core aspects of the process of interpretation and understanding that forms the foundation of the work of geoscientists. Thus, the preservation of datasets in public and permanent repositories, accessible to scientists and to the organizations and professionals who need them, is vital. In this context, the impact of well-curated datasets goes beyond established academic metrics based on bibliometric indicators (Belter, 2014): data curation is a fundamental part of science, enabling knowledge creation from the observation of nature, the quantification of physical processes, and the transparent communication of investigation results.

3. Impactful Datasets

To define "impactful" we refer to the report "Geoscience in Action: Advancing Sustainable Development" (Capello et al., 2023) (https://geoscienceinaction.org/) developed under the leadership of UNESCO and AGU. Three sustainability dimensions highlight the positive impact of the geosciences. We re-interpreted the three dimensions specific to data as an inspiration for the nominators.

1. People Dimension—Positive impact on Individuals: education, training, disaster response, and prediction
2. Planet Dimension—Positive impact on physical systems: geophysical phenomena, conservation, climate, environmental indicators
3. Prosperity Dimension—Positive impact on socioeconomic systems: economic good, social equity, humanitarian relief, community resilience

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Nominations could range from the smallest dataset used for a thesis to foundational data products that support world-affecting decisions, from identifying fruitful pathways for research to helping people make informed decisions on protecting their families and neighbors from the effects of a changing climate.

4. Datasets: Groupings

To facilitate navigation of the impactful datasets, they are organized in broad disciplinary groups:

1. Space and Planetary Science
2. Atmospheric Science, Space Weather
3. Earth's Interior, Geodesy
4. Ocean Science, Hydrology, Cryosphere
5. Earth Surface, Natural Hazards, Geology, Near Surface Geophysics
6. Global Environmental Change, Paleoceanography and Paleoclimatology, Biogeoscience
7. Nonlinear Geophysics, Machine Learning, Informatics
8. Geohealth, Society, Education
9. Earth and Planetary Materials

It is understood that there are wide overlaps among the disciplines, not only within each group, but also across the groups. This is not only acknowledged, but also desirable, as the impact of each dataset increases with their utilization in multidisciplinary projects. Given the main emphasis on the utilization of datasets for broad impact across all scientific, educational, environmental, and societal fields, datasets encompassing climate and global environmental changes, biogeoscience, society and geohealth, form the core of the initial set of nominations. For example, “Climate” appears in over 70% of the entries—the single dominant cross-cutting theme of the whole nomination pool—though additional submissions are welcome for all groups in the list.

The nominated datasets are included in *Impactful Datasets in the Earth, Space, and Environmental Sciences* (Sedora & Stall, 2026). For each nominated dataset the database includes the name or names of the nominators, the name or names of the dataset creators and/or curators (if different from the nominators), and the disciplinary grouping. A brief narration of the reasons for nominations, that is, how the dataset is impactful, is summarized in the long form of the spreadsheet. The spreadsheet will be regularly updated to reflect new entries. The link should be checked regularly to follow any revisions and upgrades to the list and to the information contained therein.

5. Significance and Impact

Impactful datasets support the work of geoscientists in identifying the dynamic interconnections underpinning the transfer of energy and matter across the lithosphere, the atmosphere, the hydrosphere, the cryosphere and the biosphere. This inherent complexity cannot be studied without a systems-thinking approach that relies on solid and verifiable evidence. In linking together datasets with the dimensions of People, Planet, Prosperity, we hope the submissions provide examples of how scientific data personally affects researchers and non-researchers on a daily basis, even if the linkages may not be clear at first glance. This AGU initiative is timely, and we believe its value goes well beyond the information stored in the datasets: it is a small but effective contribution to affirming the collaborative and selfless nature of scientific work done in pursuit of human health and of the welfare of our entire planet.

6. Conclusions

At time of this writing there are 133 datasets from 164 nominators in the linked database. We hope and expect that this number will grow progressively in all groupings, and in contributions to the special collection, as a testament to the work of researchers, technicians, scholars, decision makers, and end-users, for the benefit of all and to address humanity's “big issues” in the broadest possible sense. Our aim is for this living collection to become a reliable compilation of reference for scientists, and the place where concerned citizens, leaders and policy makers, are sure to find critical and unbiased information. The work of AGU and ESIP staff and volunteers will continue to fulfill this aim, and we hope that this initiative will prompt similar efforts in other domains, to generate a veritable intersection of useful and impactful information created, curated and preserved for the benefit of present and future generations.

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the conduct of the study. Christine Shields reports financial compensation as an editor for a Springer journal outside the submitted work. James Swift reports grants from US National Science Foundation and grants from US National Oceanic and Atmospheric Administration during the conduct of the study. Nina Welti reports grants from Australian Research Data Commons during the conduct of the study. Thomas Westerhold reports grants from Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) during the conduct of the study. John Williams reports grants from National Science Foundation and grants from Belmont Foundation during the conduct of the study. Debra Wunch reports grants from NSERC, grants from Canadian Space Agency, grants from Canada Foundation for Innovation, and grants from Ontario Research Fund outside the submitted work. Benjamin Zaitchik reports grants from US Department of Energy, grants from NIH, grants from NASA, grants from NOAA, and grants from NSF outside the submitted work. Steven Bergman reports that the bulk of the core and data acquisition was funded by the Mudrock Research Program at Shell, Houston, TX in 2010–2013.

Conflict of Interest

The authors declare no conflicts of interest relevant to this study.

Availability Statement

The *Impactful datasets in the Earth, space, and environmental sciences* (Sedora & Stall, 2026) is openly available in Zenodo.

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