



ADVANCING EARTH
AND SPACE SCIENCE

Supporting Data as a World Heritage

Earth and space science data are a world heritage, and an essential part of the science ecosystem. All players in the science ecosystem—researchers, repositories, publishers, funders, institutions, etc.—should work to ensure that relevant scientific evidence is processed, shared, and used ethically, and is available, preserved, documented, and fairly credited. To achieve this legacy, all AGU members and stakeholders must have a clear understanding of the culture of responsible research, and take action to support, enable, and nurture that culture.

The Challenge

Preserving data as a world heritage requires a culture of data use, sharing, curation, and attribution that is equitable, accessible, and ethical, all of which are essential for scientific research to be transparent, trusted, and valued. Data and other research artefacts, such as physical samples, software, models, methods, and algorithms, are all part of the science ecosystem and essential for research. Data and other research artefacts must be discoverable, accessible, verifiable, trustworthy, and usable, and those responsible for their acquisition or creation should receive due credit for their contribution to scientific advancement. Trustworthy, robust, verifiable, reproducible, and open science is our responsibility and legacy for future generations. To achieve this legacy, policy makers, AGU members, and other stakeholders must recognize that the science ecosystem should be flexible enough to adapt to a changing landscape of research practices, technology innovation, and demonstrations of impact. They must also have a clear understanding of the culture of responsible research, and take action to support, enable, and nurture that culture. This statement, in alignment with other AGU position statements, helps form the foundation to support data as a world heritage.

The Solution

I. Championing Open and Transparent Data

Robust, verifiable, and reproducible science requires that evidence behind an assertion be accessible for evaluation. Researchers have a responsibility to collect, develop, and share this evidence in an ethical manner, that is as open and transparent as possible. Most Earth and space science data can and should be openly available except in cases where human subjects are involved, where other legal restrictions apply, or where data release could cause harm, (e.g. where data could lead to identification of specific people, or could publicly reveal locations of endangered species). Even where data are not publicly available, transparency of collection and processing methods, data quality, inherent assumptions, and known sources of bias is essential. Building transparency and ethical behavior into the entire science ecosystem, even as technology and scientific practice evolves, is a vital component of responsible research.

Data and other research artefacts are useful to the broader scientific community only insofar as they can be shared, examined, and reused. Working within discipline communities to develop, share, and adopt best practices, standards, clear documentation and appropriate licensing will facilitate sharing and interoperability.



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II. Enabling a Robust Science Ecosystem

Conducting research and collecting scientific observations are only a small part of a robust science ecosystem. Data and other research artefacts must be prepared for an existence rivaling civilization's most precious and enduring physical structures. Documentation must ensure that future users fully understand how to use these products or services as well as their full provenance (i.e. the history and lineage of the artefact). A key aspect of the documentation process is the data management plan. To maximize effectiveness, data management plans should be written before research even begins and consulted and adjusted throughout the course of the research. Trusted domain-specific data repositories must be available to curate, archive, and disseminate data and other research artefacts without restriction, ensuring accessibility well into the future. Ongoing maintenance is also required. Trained and skilled people must be available to pass critical knowledge and skills from one generation to the next. New facilities must be created, and older facilities repurposed to handle growing amounts of data, especially in underserved areas. All of this requires ongoing monetary, physical, and human resources—sustainability of data and other research artefacts through well-funded and well-operated data archives and repositories must be a key driver in future geoscience research funding.

Funding and research institutions of all types have a clear and critical responsibility not only to support the research, but also to develop skill pipelines, mentoring programs, training plans, and good practices that guard against critical loss of knowledge as the workforce changes over time.

III. Creating Effective Culture Change

Community-driven recognition and reward are a necessary part of genuine culture change. Effective culture change thrives in a framework of trust and support and is reinforced through proper recognition and demonstration of impact. Recognition can take many forms but is most often seen in the scientific community in the form of credit and attribution through citation. All elements of the science ecosystem are eligible for citation, including data processing, creating curated products, and code development, as well as the creation of the research artefacts themselves. Citing data sets and other research artefacts in a precise and persistent manner increases the use and sharing of data, publication, and other recognized impacts of scientific research.

Comprehensive community adoption through education and training (knowledge of available resources, community support, etc.) is part of any effective culture change. Consistent messaging from publishers, policy makers, funders, and institutions about the importance, and recognition, of data management best practices is needed to encourage the culture of robust, verifiable, and open science for which we strive. This enhanced, transparent, and elevated recognition of contributions creates the space where true culture change is supported.

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