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Increasing Resilience of Global Earth and Environmental Science Data Supply Chains

Monday 13 October 2025 14:30 (1h 30m)

Significance of the issues to be tackled:
Earth and environmental (E&E) datasets have a critical role to play in the Sustainable Development of our Planet. They contribute to the prediction of natural hazards, effective development of our natural resources, long term monitoring of vegetation changes, etc., and underpin many UN Sustainable Development Goals. Since the 1990s there have been concerted efforts within some E&E domains to develop the standards, protocols and best practices to enable global sharing of digital data (e.g., OneGeology, Federated Digital Seismology Network (FDSN), Global Biodiversity Information Facility (GBIF), Earth System Grid Federation (ESGF)). These networks can federate multiple repositories internationally and as they mature and stabilise, they form global data supply chains that can be fundamental inputs into modelling and research ranging from faster-than-real-time emergency warning systems (e.g., tsunami, flood, volcanic ash, wildfire) to longitudinal monitoring over many decades (e.g., desertification, sea level rises, anthropogenic contamination).

As these global networks become accepted as critical inputs into E&E data supply chains, their vulnerability is becoming of concern. Loss of digital data and physical assets within a repository has long been assessed by repository managers and archivists, and there are many published mitigating strategies. However, recent events have highlighted firstly, the need to formally assess the resilience of physical infrastructures underpinning these networks (e.g., individual repositories, research infrastructures, data networks, etc.). Concrete examples show how they can be severely damaged, if not annihilated due to natural disasters, political decisions, wars, funding cuts, cyberattacks and the inability to obtain/retain skilled staff to ensure continuity.

Secondly, contemporary happenings are showing the power of collaborations, at both a national and international level, to help each other overcome barriers and create resilient data professionals - individuals equipped with the knowledge and tools, most importantly, to create human-networks to keep pushing through obstacles. More resilient data professionals form the backbone of more resilient data facilities.

Recently members of the Sustainable Data Management Cluster of the Earth Science Information Partners (ESIP) focused on understanding the many factors that contribute to increasing resilience of repositories. A repository scorecard was published (https://zenodo.org/records/15122046) to enable any repository to measure how resilient it might be both in its normal state and during certain crises. This includes a measure of how well a repository might weather an example crisis, how easy it might be to restore metadata, and how much societal impact a missing repository would have. The scorecard was based around four scenarios:

1. Incoming Natural Disaster in 48 Hours. A natural disaster (e.g., hurricane, wildfire, tsunami or earthquake), is forecasted to hit the primary facility of the repository. The focus of the scenario is on local destruction of the facility, including all physical devices and the deposits on them, with an uncertain timeline of facility restoration.
2. Loss of Organizational Funding: The repository is being shut down in one month, with that one month to implement any plans. The focus of the scenario is on eventual total loss of the repository including staff, hardware, and software, but there is time for mitigating actions to be taken.
3. Cyberattack/Organizational Infiltration: The facility has been infiltrated and hostile agents have control of cyberinfrastructure. The focus of the scenario is on sudden denial of access to any and all deposits, but not necessarily deletion of deposits and systems.
4. Loss of Technical Expertise: Technical expertise critical to running the repository (e.g., knowing how to operate, maintain, and extend the software systems), are no longer available. The focus of this scenario is on the loss of knowledge to keep critical repository systems and processes running.

The ESIP-led work resulted in three major Earth Science Research Infrastructures from Australia (AuScope), United States (EarthScope), and Europe (European Plate Observing System (EPOS) starting discussions on how combined, they could provide international support in times of crises affecting one national system and the potential impacts on the global supply chain of a particular dataset.

It is highly probable not all datasets can be protected. To help focus on the more critical and impactful, the American Geophysical Union (AGU) is coordinating a community effort to determine the most impactful E&E datasets, based on three perspectives:

1. People: education, training, disaster response and prediction;
2. Planet: geophysical phenomena, conservation, climate, environmental indicators;
3. Prosperity: economic good, social equity, humanitarian relief, community resilience.

Connecting these three themes, there are suggestions that we require internationally agreed policies, agreements and infrastructure for sustaining critical global data supply chains, and ensuring that essential data is always available. These acknowledge the inherent universal and multilateral nature of science requiring corresponding data arrangements. This applies all the more so in times of crisis where there is a critical need for evidence-based approaches to preparedness, response, and recovery.

Approach, structure, format, and suggested agenda:
The session will focus on increasing resilience of global E&E data supply chains. It will comprise Ignition/Lightning Talks and Structured Discussion

Agenda

1. 0-10 Minutes: Introduction and background to the drivers for the session
2. 0-50 minutes: Short papers to set the scene including a) Measuring Resilience of Individual Repositories (Joseph Gum, ESIP Sustainable Data Management Cluster); b) Global networking of Earth Science Research Infrastructures for supporting times of crisis (Tim Rawling, AuScope); c) Identifying Impactful E&E Science Datasets (Speaker TBC); d) Developing policies for sustaining critical E&E data supply chains during times of crisis (Adrian Burton,ARDC).
3. 50-85 Minutes: Structured Discussion
4. 85-90 Minutes: Closing circle and next steps.

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Track Classification: SciDataCon Persistent Themes: Policy and Practice of Data in Research