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Conference Abstract

Advancing Scientific Research through Well-Defined and Standardized Data Products in eLTER

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Abstract

The scientific community increasingly relies on high-quality data products to drive research, enable cross-disciplinary studies and inform decision-making. The eLTER RI, as a European scale research infrastructure, aims to monitor the key characteristics of ecosystems and biodiversity and their response to global change and provide data streams as one of its services. In this context, the Whole System Approach (WAILS) and the derived eLTER Standard Observations (SOs) provide the scientific framework and protocols not only for data collection but also for integrating legacy data from long-term observation available at eLTER sites and from partner research infrastructures and researchers.

Data products can be broadly defined as “tools that facilitate an end goal through the use of data”. More specifically, applying product thinking to datasets ensures they possess essential characteristics such as discoverability, security, explorability, understandability,

and trustworthiness. To maximize usability and uptake, high-level scientific data products must be designed in such a way that they:

1. maximize utility while balancing available resources,
2. ensure alignment with observational capabilities, and
3. navigate the trade-offs between scientific needs and technical constraints. Data products can be provided on multiple levels, ranging from observational data, harmonised and aggregated data to elaborated and derived datasets produced, e.g. by modelling upscaling to larger areas or through reanalysis.

Data products are not static because requirements evolve over time as scientific needs and technological capabilities change. In this respect, effective governance, well-defined responsibilities, sustained efforts and a clear data policy are essential to the successful establishment and extension of data products. They must adhere to scientific data requirements, ensuring compliance with FAIR principles (Findability, Accessibility, Interoperability, and Reusability). Establishing such processes and adoption of existing standards promotes long-term usability, cross-disciplinary integration, interoperability across community and infrastructure, and findability through semantic enrichment.

Within the eLTER PLUS project, we work on the definition of pilot data products for the research challenges:

1. bio-geochemical cycles,
2. water-climate-food-nexus,
3. biodiversity loss, and
4. socio-ecological systems interactions.

The piloted data products, which currently rely on legacy and third-party data, are proxies for eLTER Standard Observations and allow the integration of data from multiple sites and data sources. This also involves considerations of standardization in terms of variables, formats, and processing methodologies. With its whole system approach, eLTER aims to integrate multiple scientific domains, all having their own well-established standards and vocabularies. Thus, the challenge undertaken within eLTER to harmonize data products and enabling a holistic approach while aligning with these standards and vocabularies, is essential to provide data products supporting cross-disciplinary studies and informed decision-making considering all aspects of an ecosystem, guaranteeing at the same time the uptake of eLTER data products by the different scientific communities.

Engaging both data users and providers is critical to the success of scientific data products. Collaboration frameworks, stakeholder consultations, and feedback mechanisms help align data products with user needs while maintaining scientific integrity. Encouraging active participation ensures that data products remain relevant, well-maintained and widely adopted. In this dynamic and iterative process, we discussed requirements for data products resulting in the above mentioned pilots. In particular, the science use cases developed within the eLTER PLUS project served as proxies for the wider scientific community in this process, defining the needs for scientific data products

and contributing to a proof of concept. They aided in the refinement of workflows and the definition of technical requirements, thereby contributing an essential milestone to the implementation of the data management services that will be provided by the eLTER RI.

Keywords

eLTER, data product, standard observation

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Conflicts of interest

The authors have declared that no competing interests exist.