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Towards interoperable metadata description for imagery data of our Earth and other planets: Connection between ocean floor and planetary surfaces

Andrea Naß¹, Timm Schoening², Karl Heger², Autun Purser³, Mario D'Amore¹, Ernst Hauber¹, Tom Kwasnitschka², Robert Munteanu¹, and Thomas Roatsch¹

¹DLR / Institute of Planetary Research, Berlin, Germany

²GEOMAR / Helmholtz Centre for Ocean Research, Kiel, Germany

³AWI / Helmholtz Centre for Polar and Marine Research, Bremerhaven, Germany

Imaging the environment is an essential method in *spatial* science when studying the Earth or any other planet. Thus, this method is also a crucial component in the exploration of the ocean floor but also of planetary surfaces. In both domains, this is applied at various scales – from microscopy through ambient imaging to remote sensing – and provides rich information for science.

Due to recent the increasing number data acquisition technologies, advances in imaging capabilities, and number of platforms that provide imagery and related research data, data volume in nature science, and thus also for ocean and planetary research, is further increasing at an exponential rate. Although many datasets have already been collected and analyzed, the systematic, comparable, and transferable description of research data through metadata is still a big challenge in and for both fields. However, these descriptive elements are crucial, to enable efficient (re)use of valuable research data, prepare the scientific domains e.g. for data analytical tasks such as machine learning, big data analytics, but also to improve interdisciplinary science by other research groups not involved directly with the data collection.

In order to achieve more effectiveness and efficiency in managing, interpreting, reusing and publishing imaging data, we here present a project to develop interoperable metadata recommendations in the form of FAIR [1] digital objects (FDOs) [2] for 5D (i.e. x, y, z, time, spatial reference) imagery of Earth and other planet(s). An FDO is a human and machine-readable file format for an entire image set, although it does not contain the actual image data, only references to it through persistent identifiers (FAIR marine images [3]). Thus, the FDOs for spatial sciences are characterized at their core by 5D navigation data mentioned above which discriminates them from imagery of other domains (e.g., medical). In addition to these core metadata, further descriptive elements are required to describe and quantify the semantic content of imaging research data. Such semantic FDOs are similarly domain-specific but again synergies are expected between Earth and planetary research. Subsequent, by developing ontology concepts for these two imaging domains, scientific analogies and causal connections between the two research domains can be illuminated.

The main benefit expected by this project is to (1) improve the quality and reusability of future research data, (2) support a sustainable research data environment by closing the life cycle of the research data, (3) increase the inter- and transdisciplinary comparability of data sets, and (4) enable further scientific communities in transference of their own vocabularies, and in the use of the ontology concepts within other natural science applications.

We here present the current status of the project, with the specific tasks on joint metadata description of planetary and oceanic data outlined. In particular we show how we intend to implement metadata for valuable research data in both domains in the future, and demonstrate where these developments should be adopted.

[1] Wilkinson, M., Dumontier, M., Aalbersberg, I. *et al.* The FAIR Guiding Principles for scientific data management and stewardship. *Sci Data* **3**, 160018 (2016), doi:10.1038/sdata.2016.18.

[2] <https://fairdigitalobjectframework.org/>

[3] <https://marine-imaging.com/fair/ifdos/iFDO-overview/>