MULTI-MISSION INFORMATION SYSTEM IN PLANETARY SCIENCES: A PROTOTYPE FOR PLANETARY RESEARCH DATA AND PUBLICATIONS. A. Naß[1], M. Mühlbauer[2], M. d'Amore[1], T. Heinen[2], M. Böck[2], R. Munteanu[1], T. Riedlinger[2], J. Helbert[1], T. Roatsch[1] and G. Strunz[2]
[1]DLR, Planetary Research, Rutherfordstr. 2, 12489 Berlin, Germany (andrea.nass@dlr.de); [2]DLR, German Remote Sensing Data Center (DFD), Oberpfaffenhofen 82234 Weßling, Germany

Introduction and Motivation: Research data acquisition and maintenance plays an important role in any scientific discipline. In the recent years, further discussions and demands came up to also push the sustainability and reusability and, last but not least, the interoperability of research data within different disciplines. In order to provide platforms to facilitate use and reuse of data in a transparent and sustainable way and to comply with recommendations and guidelines research initiatives such as the *Research Data Alliance* (RDA) (www.rda-alliance.org), *GoFAIR* (www.go-fair.org) or *CODATA* (www.codata.org) have been established. Besides this, the field of *Research Data Management* (RDM) has become an integral part of the research and publication process, not least to fulfill the upcoming requirement of such management tasks within proposals submitted to research foundations and publishers. Pushed by these requirements repositories like *figshare* (www.figshare.com/), *zenodo* (www.zenodo.org) or *PANGAEA* (www.pangaea.de) were founded in order to provide the scientific community with platforms to archive citable, sharable, discoverable and citable research data. Beside this, further federal initiatives like *Nationale Forschungsdateninfrastruktur* (NFDI) on national and the European Open Science Cloud (EOSC) (https://ec.europa.eu) on European level were established in order to provide a trusted and virtual environment that cuts across borders and scientific disciplines to store, share, process and re-use research digital objects. All these initiatives are now based on the FAIR principles in order to create **f**indable, **a**ccessible, **i**nteroperable and **r**eusable data [1].

Looking into the field of Planetary Exploration one can say that along with recent and upcoming planetary missions the amount of different data (remote sensing data, in-situ, astronomical data and measurements and derived products) increases constantly and serves as basis for scientific research resulting in derived scientific data and information. Within missions to e.g. to Mercury (BepiColombo), the Outer Solar System moons (JUICE), and asteroids (NASA`s Dawn mission) one way of scientific analysis is the systematic surface analyses which is based on the numeric and visual comparison and combination of different remote sensing data sets, such as optical image data, spectral-/hyperspectral sensor data, radar images, and/or derived products like digital terrain models (here: primary research data). Conditioned by the spatial component, the analyses mainly result in derived research data like map(-like) figures, profiles/diagrams as well as models (here: secondary research data), and finally serve for describing research investigations within scientific publications. Hence, cross-links between different missions, surfaces, bodies and topics are possible and thematical analogues could be extracted by the spatial context. This includes a great potential to create a sustainable reuse of historical, current and future information.

In the last years web-based Geographic Information Systems (GIS) became a common mean to impart spatial knowledge to all kinds of possible users. Those systems are often built upon a well-established stack of open source software such as PostgreSQL (database) [2], GeoServer (server for sharing geospatial data) [3] and a graphical user interface based on JavaScript [4]. Standards developed by the Open Geospatial Consortium (OGC), such as the Web Map Service (WMS) [5] and the Web Feature Service (WFS) [6], serve as interface between the user interface and the server. While those technologies were developed with geographic data in mind, our present study applies them in the context of planetary data.

Aim: Having in mind the developments of reusability of research data in general and the huge amount of heterogeneous planetary research data, we here present a project that aims at a prototypical system for the structured storage, accessibility and visualization of planetary data compiled and developed within or with the contribution of Institute for Planetary Research (PF) at German Aerospace Center (DLR). The goal is to enable different user groups to store and spatially explore research data centrally, sustainably across multiple missions and scientific disciplines in planetary science for future investigations.

Technically, the prototype is based on two main components developed at the German Remote Sensing Data Center (DFD) (see also Figure 1): (1) data storage and management capabilities as well as OGC-compliant interfaces for collaborative and web-based data access services (EOC Geoservice) [7]. (2) UKIS (Environmental and Crisis Information Systems), a framework developed at DFD or the implementation of geoscientific web applications [8].

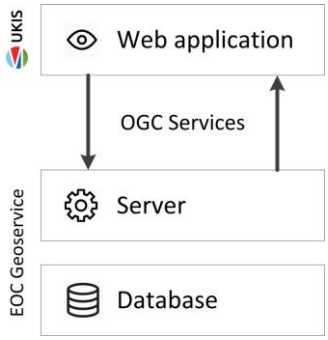

Figure 1 Combined structure between PostgreSQL, GeoServer and web application.

Method and Implementation: Starting the development of the prototype, as *first* step (1) a user analysis and inventory of the available data and information diversity in PF is needed (cf. requirement analysis). Here, the complementary character and delimitation of this prototype to existing projects is stated. Within the analysis, question should be answered like: Which data should be provided in a combinable way? How do existing data structures have to be processed in order to be integrated into an information system? Who is the addressed user group and what kind of information system do they require? Furthermore, an analysis of integration possibilities for DLR BepiColombo data (MERTIS and BELA) will be conducted.

The *second* step will be (2) the data storage and management within EOC Geoservice which combines a PostgreSQL database and a data management via GeoServer. Therefore, a representative and exemplarily data collection is used which is based on a recent approach developed within PF [9]. Here, an existing database established at Planetary Spectroscopy Laboratory (PSL), handling different kind of spatial data, meets a vector-based data collection of thematic, mainly geologic and geomorphologic mapping results [e.g. 10-13], as well as raster-based global mosaics in different resolutions [13, 14] as background. This data merging enables a multi-parameterized querying across different data types, multiple missions and scientific disciplines in planetary science.

The *third* step will be (3) the implementation of a geospatial information system using UKIS. Within this, the visualization and utilization of the exemplarily data package will be realized in an interactive, web-based system that displays all different datasets within the individual spatial reference system. For the already existing framework of UKIS this means an adaptation for planetary usage, implementation of numerous additional functionalities, e.g. a dashboard, more automation, and spatio-temporal filtering. This addresses both, internal DLR users' needs for visualization and sharing of structured geospatial information from different sources as well as external scientists interested in DLR data and collaboration. With the integration of a flexible user management system, the prototype could also easily integrate rules for data restriction, needed for ongoing missions.

The *fourth* and currently final step is (4) to configure generic interfaces. These will enable the connection to other DLR systems and databases like the electronic library (ELIB) on the one hand. On the other hand, to other archives and repositories outside the DLR, which are substantially related to the internal stored data, but were conducted without DLR involvement.

Conclusion: The topic of this contribution is to introduce a current work at DLR to implement a (for the time being institutional) platform for PF, which can retrievably provide and visualize various scientific data and information of individual planetary bodies. After prototyping and testing this structure internally, it is planned to make the system also available to the scientific community outside DLR as well as the open public. UKIS, as DFD-developed software framework for web-based geographic information systems, together with an infrastructure providing geospatial data access and data management services, such as the DFD-hosted EOC Geoservice, are the ideal basis for such a spatial platform due to their stable architecture. Both can adapt to other spatial reference systems, as well as provide and visualize the planetary data after individual system configuration. A research data information system of this kind is essential to ensure the efficient and sustainable utilization of the information already obtained and published by previous research. This is considered a prerequisite for guaranteeing a continuous and long-term use of scientific information and knowledge within the departments, the institute and potentially also outside of DLR. Finally, the utilization of scientific data and results is increasingly demanded by third-party funding agencies (e.g. DFG, EU).

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