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Towards a concept for a Planetary Science Data Library based on a Spatial Data Infrastructure Model

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1. Introduction

After a planetary mission's lifetime, digital data such as raster images, data cubes, terrain model data and photomosaics, as well as the respective pieces of meta information are stored in digital archives or repositories. For the planetary sciences, the main archives are ESA's *Planetary Science Archive (PSA)* and the *Planetary Data System (PSA)* Nodes in the USA [1, 2]. In addition, a number of national space science institutes and agencies across the globe provide access to archived mission data for a period of time as long-term archiving and making data accessible to the public requires dedicated long-term resources. These data are potentially compiled into higher-level data products and maps to form a basis for continued research and for new scientific and engineering studies.

The concept of mapping generally encompasses the process of information abstraction and compilation in order to generate higher-level data products and maps. However, in the planetary sciences '*mapping'* has a number of different meanings attached to it. One aim of planetary mapping is related to research topics and is scientifically motivated, another one might be related to engineering topics (landing sites or surface activities). Mapping can also refer to systematically observing a surface from orbital platforms and thus it combines techniques of systematic retrieval of physical information. Finally, mapping might also refer to the technical and artistic creation of map products.

Interpreted planetary maps differ considerably from Earth maps due to generally missing ground truth except for few local investigations. With an expected increase of robotic and human activity on planetary surfaces in the future, more detailed information and advanced cartographic products might become popular and develop towards an indispensable tool for future exploration.

2. Derived scientific information and maps in Planetary and Earth sciences

Modern geographic and geological planetary maps are commonly developed from processed raster and terrain-model data and photomosaics. Here, thematic maps in general and geologic maps in particular, represent a highly complex form of data derivation and abstraction due to an added level of interpretation by individuals. Their interpretation and integration into new research work are essential approaches for creating new information.

Along with the availability of specific information, maps will become more targeted and cover a wider range of topics. In order to achieve a higher degree of specialization and variation, cartographic products require a consistent and extensive data basis accessible through a larger data infrastructure. To develop such an infrastructure, formal coordination of organizational processes is required.

In the Earth sciences these topics have been growing organically within individual state mapping campaigns (e.g., in the federal states of Germany and the US), national approaches (such as the former German 1:200,000 federal geology or the British 1:50,000 geology mapping project) and national infrastructures (such as the Australian Geoscience Information network (AUSGIN) or the US National Geospatial Program) that were later reshaped by using improved technical concepts.

These mapping approaches might differ in detail from developments in the planetary sciences. However, similar programs have been created during the beginning of modern space exploration and planetary mapping can look back on decades of experience in mapping and data collection (USGS *Planetary Geologic Mapping Program* funded by NASA, e.g. [3]). With new data and new research products accumulating over the decades the planetary community has already initiated discussions and activities to organize data and to handle data complexity.

3. Basis and Inspiration for a Planetary Science Data Library

In order to create a basis for data re-usability, and organize reliable and lasting data access, a consistent and extensive data basis accessible through a common infrastructure in a research environment is required. In the planetary sciences first efforts are being made to establish a spatial data infrastructure (SDI) and make data easily accessible, ready for interpretation and operation, and usable by non-spatial data experts [4]. Furthermore, a formal coordination of organizational processes will be required.

There are currently efforts and initiatives in the planetary sciences to make higher-level spatial information, such as conventional maps and cartographic products, available to the community. Platforms are – among others – the USGS for standardized geological maps [5], or the *Astropedia Annex* which is a data portal integrated into the PDS for registering and hosting derived geospatial products [6]. We introduce and discuss existing standards, as well as first initiatives, such as MAPSIT (NASA) [7], PlanMap (Horizon2020), or VESPA (Europlanet).

For building a library for scientific data in general and maps in particular we are looking into and learning from the current European infrastructure framework. Since 2007 this framework has been aiming at a spatial data infrastructure for European administrative data (INSPIRE [8]). This infrastructure is built on established standards from the OGC and ISO for metadata and services. It contains and serves data models and requirements, and is divided into 34 spatial data themes. INSPIRE looks like an ideal infrastructure to adopt and adapt existing elements like the predefined data models (e.g. for geology), and levels of coordination nodes.

Our first step is to create a user and system analysis, where data, information, processes, user groups, systems and responsibilities are visualized within one scheme. The current situation will be presented and serves as basis for upcoming discussions on establishing a *Planetary Science Data Library*. Built on this we will present three options: 1) two decentralized interfaces embedded into every existing affiliation and coordination, and 2) centrally survey-coordinated, and 3) an externally-coordinated approach.

Beside this user and system analysis, further basic questions have to be answered within ongoing discussions. These are, e.g.:

- funding sources
- responsibilities
- design
- enabling Re-Use
- definition of user groups
- data models and their modular and flexible design

Such discussions already started in the planetary science community and need to be continued. Beside these, further discussions with the Earth Science, more SDI expertise is very welcome!

References

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