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Visualization pipeline for GIS-based planetary mapping - Cartographic approaches for geological and geomorphological interpretation results

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1. Introduction

A number of international research institutes and groups predominantly incorporate remote-sensing data for geological and geomorphological interpretations of planetary surfaces. By employing state-of-the-art Geographic Information Systems (GISs) and technologies with tools for data processing, management and visualization the results are represented in thematic maps with different topical foci. In order to combine different digital maps and to manage different interpretation results in one single database, a streamlined and homogenized method of GIS-based mapping is required.

2. Visualization Pipeline

The steps how scientific data in general and planetary interpretation results in particular are visualized proceeds in a fixed order (see Fig. 1). These steps are data (1) acquisition, (2) filtering, (3) mapping, (4) rendering as part of a visualization pipeline [e.g. 1,2]. Data acquisition describes the selection of an image data basis primarily through web-based catalogs and portals such as the Planetary Data System (PDS). Data filtering comprises geo-referencing of raw data (filtering in terms of location) and the effective geoscientific interpretation in form of cartographic generalization (filtering in terms of subjects). Here the subject-oriented information is abstracted from the individual comparison of image data. As result a vector-based object model is delivered, but without topically dedicated symbols. Within data mapping individual map objects resp. layers are represented by an individual cartographic symbol which is composed of the graphic variables (color, shape, brightness, size, pattern, and orientation). Data rendering deals with the final layout of the map during the actual map sheet is created.

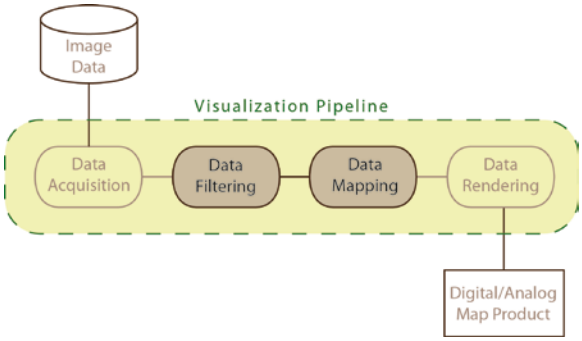

Fig. 1 Pipeline for visualize planetary interpretation results**.**

In order to extend and improve collaboration and workflow between different groups by streamlining and simplifying the GIS-based mapping process a number of approaches are currently in progress. As there are well known and established methods and techniques for data acquisition and rendering, the focus here is put on GIS-based mapping process. This process is concerned with the visualization steps *filtering* and *mapping* and it is specifically about the visual, textual and structural description of digital interpretation results. Due to their extent and novelty of process the developments will be edited in a modular way and are described, e.g. in [3-7]. Here the current status of development will be presented.

3. Approach

Within a detailed process analysis the user- and system-oriented requirements have been worked out. Such an analysis is paramount for the mapping process as the visualization pipeline has to be optimized with respect to user requirements and system-related technical conditions. All of these requirements are summarized in the following work

packages: (1) development of a symbol catalog for GIS-based planetary mapping following international standards (available through Europlanet web page at http://europlanet.dlr.de/node), (2) an informative and consistent description of digital mapping results, and (3) a well-structured data model linked by object attributes. (1) and (3) are assigned to the step *data mapping*. Whereas (2) is divided into (a) a description of basic data by using metadata information (assigned to *data filtering)* and (b) a description of mapping results, comparable with a digital map legend (assigned to *data mapping)*. These work items are already implemented as evaluation version in a commercial GIS environment and are used, e.g. by the research group "Geological Context of Life" of the Helmholtz Alliance "Planetary Evolution and Life" or for geological mapping in the context of the current Dawn mission [9][10].

4. Next steps

An ongoing task is the further development and adaption of work items so that a continuous and consistent visualization process becomes possible. Here, the previous developments must always be coordinated with the user- and system-oriented requirements. The next step is to join the different work items, in that way that all the different descriptions are interconnected. As the structure of digital objects is the fundament of (GIS-based) planetary mapping, the symbol catalog as well as the data descriptions will be linked to the data model. Additionally, a set of rules is developed that captures the main points that are necessary for a proper mapping and efficient management of digital data.

5. Summary and Conclusions

The consistent visualization process will provide the user/mapper with a comfortable and streamlined way to map planetary surfaces with a geological and/or geomorphological focus. It also provides means to separate highly technical aspects from the scientific mapping conduct so that the mapper does not have to deal with implementation issues. Furthermore, digital mapping data will be managed and archived within a well-described and structured data model which facilitates information exchange and interoperability. Finally, compiled data can be reused for future research as basis, and the previously obtained knowledge can always be extended.

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