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GIS-based Cartographic Approaches for Geological and Geomorphological Mapping: Current Status

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1. Introduction

Our knowledge about the origin and the evolution of planetary bodies in the solar system is based upon research making use of predominantly remote-sensing data obtained at different wavelengths. With the help of such data a variety of scientific research activities and analyses are conducted by different international scientific institutes and research groups. An essential component in this context is the geological and geomorphological interpretation of planetary surfaces. Today, such tasks are performed by employing state-of-the-art Geographic Information Systems (GISs) and technology. Such integrated systems provide tools for data incorporation, data processing, preparation, management, and (cartographic) visualization. Results are usually represented through thematic maps which focus on the geology and geomorphology of target areas.

2. Approaches for Solutions

Currently, a number of different approaches are in progress in to extend and improve collaboration and workflows between different groups by streamlining and simplifying a GIS-based mapping process [1]. Some of these approaches include theoretical and practical aspects of implementation of standardized cartographic symbols [2] and data description by creating auxiliary metadata contents [3]. These aspects are being linked to an underlying database backend which manages spatial data for GIS by making use of standard object-relational concepts. [4][5].

2.1 Cartographic Symbols

Cartographic symbols are implemented within the ArcGIS environment and are based upon the "Digital Cartographic Standard for Geologic Map Symbolization" [6]. The most recent version of this symbol set is made available through the Europlanet web page at http://europlanet.dlr.de/node. This symbol catalogue is being reviewed and updated frequently by the research group "Geological Context of Life" of the Helmholtz Alliance "Planetary Evolution and Life". For a software-independent use of such a symbol catalogue a number of different scenarios were generated which link symbology into an underlying database model. Such an approach guides the user to the appropriate symbol through a detailed object description.

2.2 Metadata Description

Metadata describe mapping results and link a traditional map legend to digital mapping data. Descriptions are divided on two different levels: (1) metadata for the image-data basis which focuses on the description of raster-based sensor data that serves as map basis, as well as (2) metadata on the map level which represents the scientific result of analyses and interpretations of primarily vector-based datasets.

The first task of this work is the definition of topical components that have to be addressed by metadata entries. The second task is the assignment of appropriate keywords under consideration of existing standard documents developed by the Planetary Data System (PDS) or the Federal Geographic Data Committee (FGDC). The third task is the establishment of a proposal for standardized metadata values. This proposal should help to avoid erroneous and incomplete metadata definitions as far as possible and will be reviewed by the research group "Geological Context of Life" and the scientist of the Institute for Planetary Research, Planetary Geology at the German Aerospace Center (DLR). The goal is a metadata description and template incorporated into a GIS platform by making use of a Graphical User Interface (GUI) which has to be filled in by mapping geologist after completion of mapping.

The resulting structured file (XML-based) is related to mapping data (in Portable Document Format), and thus allows searching and integrating map-data results for further investigations. Finally this metadata information is linked to the database either as an external XML-file or decomposed and integrated into the database model.

3. Summary and Conclusions

Future work will include (1) conversion of cartographic symbols for a non-proprietary use outside of the ArcGIS environment, (2) implementation of a metadata catalogue and (3) combination and linking of information to the database model. These tasks 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 all the technical issues. Furthermore, digital mapping data will be managed and archived within a well described and structured data model and improves information exchange and interoperability.

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