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Cartographic Symbolization and Managment for GIS-based Geological and Geomorphological Mapping

A. Nass (1,2), S. van Gasselt (3), R. Jaumann (1,3) and H. Asche (2)
(1) German Aerospace Center (DLR), Institute for Planetary Research, Department of Planetary Geology, Rutherfordstr. 2, 12489 Berlin, Germany (andrea.nass@dlr.de, Fax:+49-30-67055-402) (2) University Potsdam, Faculty of Mathematics and Natural Sciences, Institute for Geography, Division Geoinformatic, Karl-Liebknecht-Strae 24-25, 14476 Potsdam, Germany (3) Free University of Berlin, Department of Earth Sciences, Institute of Geological Sciences, Division of Planetary Sciences and Remote Sensing, Berlin, Germany

1. Introduction

The steadily growing international interest in exploration of planets in our solar system, rapid technical development, and the need of fundamental research led to launching several missions to, e.g., Mars, the Moon, Venus, and Outer-Solar System objects, such as Jovian and Saturnian satellites. The instruments carried along on these missions image a variety of data in different wavelengths and allow the derivation of additional data (e.g. high resolution digital terrain models). With the help of these data it is possible to explore the evolution and development of planetary bodies by analyzing and geoscientifically interpreting the surface structure. The results are represented in thematic, mostly geological and geomorphological maps. By using modern GIS techniques comparative work and generalisation work during mapping processes have resulted in new information, which is crucial for subsequent investigations.

2. Approaches for Solutions

To allow for an effcient collaboration among different scientists and groups within the research community, all mapping results have to be uniformly prepared, described, managed and archived. In order to simplify this mapping process, GIS-based approaches are currently underway. Two important aspects are presented here and deal with (A) the GIS-based implementation of cartographic standardized symbols [1] and (B) adding detailed data descriptions by metadata information to the mapping results. Furthermore, issues like data integration, management, processing aspects and analysis, which include the use of relationship classes and topology constraints, are addressed in a single database schema and are organized in a GIS database model [2].

(A) Cartographic Symbols

For the technical implementation of the cartographic symbols we used the "Digital Cartographic Standard for Geologic Map Symbolization" [3] as basis. The described symbols are scale-independent, which means that symbols are appropriate for use at any scale. This allows the user to produce small-scaled outline maps (e.g. 1:500,000) as well as large-scaled detailed maps (e.g. 1:20,000). In particular we implemented the appendix chapter "25 - Planetary Geology Features" of the standard, which describes the most common geological and geomorphological structures that are detectable on planetary surfaces. We enlarged the symbol catalogue with further symbols, which are required within the research group "Geological Context of Life" of the Helmholtz Alliance "Planetary Evolution and Life". Furthermore, we generated different scenarios for the implementation of the symbology into an underlying database model [1].

(B) Metadata Description

We are currently creating a concept for a metadata template for individual needs in planetary sciences. This template is based on existing metadata standards [4], is structured by XML and forms an obligatory component to be filled in by the user after mapping conduct. Such information is based upon traditional map legends and is essential for the understanding of individual thematical interpretations and digital spatial data. The description contains information about the overall mapping result such as map projection and body reference or overall extent on the one hand, and on the other hand it incorporates metadata information for each individual mapping element comprising information such as minimum mapping scale of particular spatial objects, interpretation hints [5]. Finally these information are linked to the database.

3. Conclusions and Outlook

By using the implemented symbology catalogue and proper application of these symbols, digital maps follow cartographic guidelines as close as possible and therefore allow a better communication and common understanding across study groups. The mapping process in the GI system is significantly improved for the planetary mapper because the mapper does not have to deal with technical and cartographic issues, and can focuses on the interpretation and analysis work. The usage of the predefined standard cartographic symbology in combination with the assignment of dedicated metadata description, which can be used either in stand-alone GIS projects and can also be integrated into a more sophisticated database model, also facilitates the efficient and traceable storage of spatial data and mapping results on a network level.
In the future the availiable signature catalogue will constantly be evaluated, modified and extended to specific requirements of planetary mapping. Furthermore, as the symbology can be theoretically used independently of the specific software architecture, an embedding of description of vector-based graphics in the underlying database model can be done for which a conversion of symbols in the open and standardized format for Scalable Vector Graphics (SVG) is envisaged.

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