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GIS-based Conceptual Database Model for Planetary Geoscientific Mapping

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We here report on the conceptual design of a geodatabase model as part of a larger-scaled GIS-based system composed of several applications, templates and database backend which supports conducting combined geological as well as geomorphological mapping of planetary surfaces and which simplifies the process of maintaining data and map products.

Performing geological and/or geomorphological stand-alone or systematic mapping of planetary surfaces supported by modern GIS environments involves several tasks to be performed before the actual mapping process can be carried out. Such tasks deal with setting up a working environment by querying and defining raster data from a variety of planetary missions to be used and processed, importing auxiliary data, defining projection parameters for one or more map layer(s) and each raster/vector dataset, importing processed data, and defining a variety of vector shape geometries and attributes for mapping in terms of geometry type, representation symbology and attribute domains in a consistent way.

In order to allow consistent mapping approaches and subsequent homogenisation success, a mapper makes use of pre-defined model schemas (templates) and definitions allowing to import mapping representation and styles as well as a backbone geo-database to immediately start working and making use of the provided infrastructure.

The conceptual geo-database design developed far involves the design of the main object and data layers and consists of objects, object types, their relationships and additionally the formulation of integrity conditions on a level which is in principle independent of the exact implementation and its environment. Furthermore, the data layer containing attribute domains has been implemented. The conceptual design has been crafted using ESRI‘s ArcGIS File Geodatabase environment but it can be exported to any other GDBMS.

The overall layout consists of several main elements or entity groups composed of relations concerning, e.g., map products (product and cartograpic representation), sensor-data products, stratigraphy definitions for each planet (facies, formation, ...), and mapping units. Domains and subtypes as well as a set of two dozens relationships define their interaction and allow a high level of constraints that aid to limit errors by domain- and topologic boundary conditions without limiting the abilitiy of the mapper to perform his/her task.

The geodatabase model is part of a data model currently under development and design in the context of providing tools and definitions for mapping, cartographic representations and data exploitation. The database model as an integral part is designed for portability with respect to geoscientific mapping tasks in general and can be applied to every GIS project dealing with terrestrial planetary objects. It will be accompanied by definitions and representations on the cartographic level as well as tools and utilities for providing easy accessible workflows focussing on query, organization, maintainance, integration of planetary data and meta information. The data model‘s layout is modularized with individual components dealing with symbol representations (geology and geomorphology), metadata accessibility and modification, definition of stratigraphic entitites and their relationships as well as attribute domains, extensions for planetary mapping and analysis tasks as well as integration of data information on the level of vector representations for easy accessible querying, data processing in connection with ISIS/GDAL and data integration.