BUILDING A CARTOGRAPHIC PLANETARY FEATURE DATABASE: THE SIGNIFICANCE OF FEATURE MAPS. H. I. Hargitai, [1]ELTE Eotvos Lorand University Budapest, Hungary hargitaih@caesar.elte.hu

Introduction. We have previously created a metacatalog [1] of some of the surface feature databases of Mars. For this work, we, together with the original authors, have converted previously published databases into GIS-ready data files and made them accessible online. Our goal is to produce a solid GIS-ready cartographic dataset that can be used from landing site selection to any general cartographic representation of Mars, such as in the OpenPlanetaryMap [2] or outreach projects. The GIS databases can be directly imported to ArcGIS or other GIS platforms making it easy not only the integration of a wide variety of spatial datasets for a multicriteria characterization of the surface, but also the creation of a detailed cartographic representation of Mars for the general public, similar to those found in terrestrial World Atlases, that is yet to be created.

Why Feature Maps are unique? Feature maps contain critical information on the climate, lithology and surface processes and yet most of these data are missing from geological maps. Each feature map is typically a result of an individual study published as a research paper. The database itself was typically built to answer a science question and not as the ultimate goal of a study, and may be published as a table, a figure or, for only the last few years, as digital supporting data files, not necessarily in GIS ready format. In some other cases they are built to provide a solid basis for further analysis (such as crater databases that support age determination). Many of these datasets may remain beyond the horizon of landing site selection studies and only few of them are included in WebGIS services [1]. When multiple mapping studies produced catalogs of the same type of feature, they are difficult to compare, or correlate. We call our database “integrated” because we also correlate existing databases.

Geologic maps and feature databases. Geologic maps are now published at USGS as GIS databases, but non-USGS geologic maps are typically uploaded as static jpg image files. However, it is true for any geologic map that they frequently exclude relevant geologic information, merely because many of these landforms do not constitute geologic units (are not individual rock bodies); are too small in size for a typical (>1:500,000 scale) geologic mapping project; are ephemeral features; or simply because those features are visible only on a dataset that was not used for the geologic mapping.

The evaluation of surface geology may be based on e.g., topography, spectral analysis, or the types and arrangements of geologic units. For the delineation of regions or global latitudinal zones with unique characteristics it is critical to also include features that do not appear on geologic maps but reflect local present or past climate, lithology for example small scale processes such as mass movements. Therefore it is critical to integrate geological, topographic and feature data maps in mission planning and geologic investigations.

Why these feature maps are needed in GIS format? Most feature databases are only available in print, scanned, pdf or jpg maps or tables. Most of these data are relevant today. USGS has started digitally retracing (“renovating”) geologic maps produced during the hardcopy era, supporting their GIS integration. It is more problematic to “renovate” feature databases, which have been published by individual authors in various platforms, journals and formats and many have been updated but only as manuscripts. GIS-ready geologic maps already contain several major spatial feature databases as layers, as parts of the geologic map, such as structural features. *Feature databases complement geological maps but most are not available in a format where both the map and the feature databases could be displayed together.*

Project developments. We have produced a preliminary version of such a digital map bundle we called Integrated Database of Planetary Features [1] whose layers have been integrated into ASU’s JMARS and NASA’s MarsTrek webGIS systems. In this database we included 34 feature types, all from Mars *(Fig. 1).*

Now we report on the continuation of this project in which we have identified a total of 150 landform and feature types from the major solid surface planets and moons in the Solar System for which feature databases or maps have already been published but are not available in GIS-ready formats. We have also defined a pipeline for database creation and a set of criteria for the metadata of each database and each item in a database. Our plan is to archive this database in the PDS Cartography and Imaging Sciences Node Annex to make it compatible with any GIS systems present or future. Each database would also show the mapped area visually that is also helpful to evaluate unmapped areas that may not be evident from the distribution of the actual data points.

Potential uses of the feature database. The feature database products will provide GIS-ready input datasets for analysis in a number of study types that include geology, astrobiology, engineering, and will support a range of new scientific studies that includes the followings.

Geology: These catalogs are essential in the reconstruction of surface evolution and interpretation of planetary surface geology and are fundamental and frequently used parts of global to local scale geologic mapping and analysis efforts.

Landing site selection: Global feature datasets are especially useful in multicriteria analysis that is critical to the evaluation of landing sites, including robotic and human landing sites on the Moon and Mars, for finding optimal sites for local resources, science experiments and, potentially, habitats.

Habitability analysis: Many surface features indicate the past or present subsurface presence of H_2O ice and are therefore useful for the identification of potentially habitable regions (for either terrestrial or local organisms), including Special Regions, or regions where water can potentially be derived from in situ resource utilization (ISRU).

Training dataset for AI: Future AI-driven machine-learning-based automated feature recognition applications will need human-supervised ground truth data for training the database. These datasets link feature types to surface coordinates, either as point data or a feature outline, and can provide reliable training datasets for such machine learning systems for global, full coverage identification of these features, or their identification on other planetary bodies, in a "big data type", massive image database.

Location-based review: This database would help the researcher in locating the studied examples of particular features linked by metadata to the paper that originally discussed the feature. In this sense the database would be a location-based research history literature review. Correlation of this data, i.e., collection of the same type of data from different studies, would help in producing a "unified" dataset that is as complete as possible and reflects the state of the art knowledge on the distribution of the specific features.

"Renovation": Feature location data resulting from decades of mapping studies. We would collect this valuable part of planetary mapping efforts and made it available in a format that is used today (and will be used in the future) for planetary studies.

Education and Public Outreach: The proposed work will make a large number of research results visually accessible to not only researchers, but also students and the general public. This collection also will facilitate crowdsourcing-based feature identification studies.

References: [1] Henrik Hargitai 2016 Metacatalog of Planetary Surface Features for Multicriteria Evaluation of Surface Evolution: the Integrated Planetary Feature Database. DPS 48/ EPSC 11 Meeting #426.23, Pasadena, CA. [2] http://openplanetary.co/opm/#3/11.80/-45.04

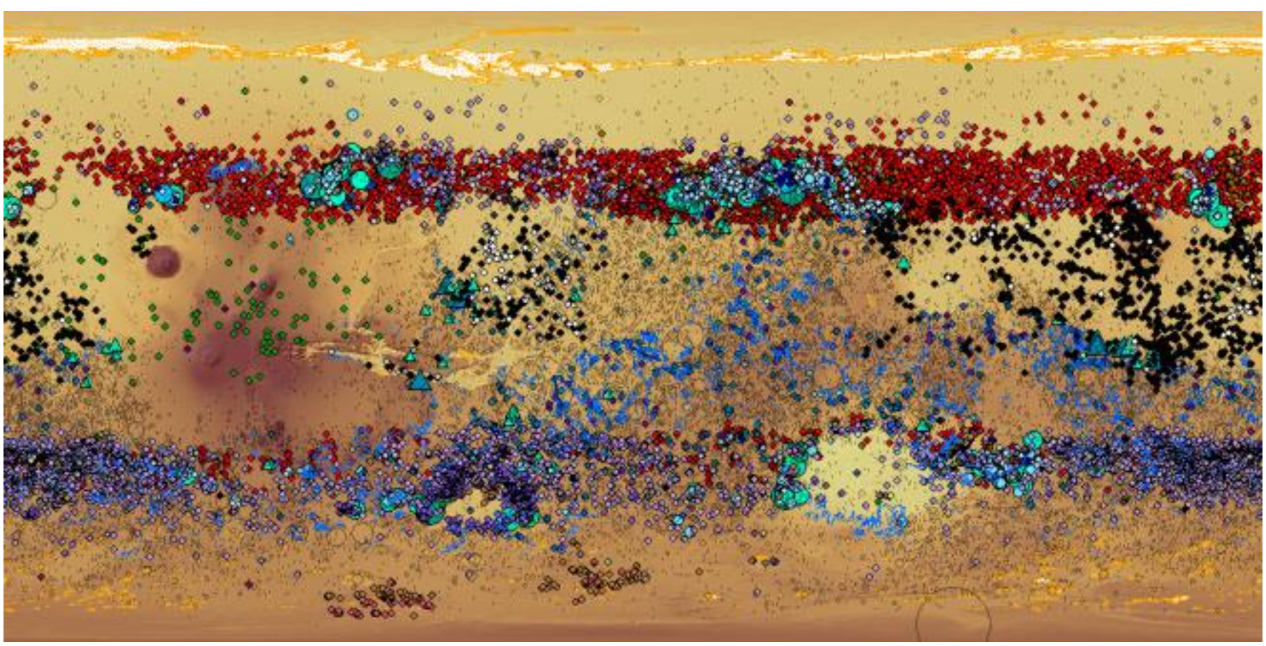

Fig. 1. Data overlayed from 34 datasets (Mars).