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Creating a Road Map for Planetary Data Spatial Infrastructure

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Abstract

There currently exists a clear need for long-range planning in regard to planetary spatial data and the development of infrastructure to support its use. Planetary data are the hard-earned fruits of planetary exploration, and the Mapping and Planetary Spatial Infrastructure Team (MAPSIT) mission is to ensure their availability for any conceivable investigation, now or in the future.

1. Introduction

Planetary spatial data, which include any remote sensing, in-situ data or derived products with sufficient positional information such that they can be associated with a planetary body, continue to rapidly increase in volume and complexity. Maintaining these data using accessible formats and standards for all scientists is essential for the success of past, present, and future planetary missions. The MAPSIT is a group of planetary community members tasked by the Planetary Science Subcommittee of the NASA Advisory Council and NASA Headquarters to identify and prioritize the infrastructural spatial data needs for research and analysis using NASA's past, current, and future planetary science missions.

2. Planetary Spatial Data and MAPSIT

The extraction of scientific knowledge from planetary mission data relies on several steps of refinement of the raw data from instruments. Two of the most important are (1) the conversion of raw output into physically meaningful units and (2) placing the data into a recognized spatial framework. Creating scientifically useful information is often a major research and development effort in itself. To complete this process, goals need to be identified, missions need to be properly designed, and instruments need to be appropriately developed and calibrated. The software tools and content distribution platforms required for scientists to obtain, process, and analyze planetary mission data need continuing development and maintenance. For these reasons, community coordination and strategic planning, or "road mapping," for the use of planetary spatial data are essential for the success of planetary exploration.

To this end, NASA and the USGS have worked together to establish MAPSIT, which has steering committee membership (the authors of this abstract) drawing from many aspects of planetary spatial data expertise and Solar System bodies. MAPSIT's mission is to ensure that planetary spatial data are readily available for any scientific investigations, now or in the future. MAPSIT has several functions: (1) Provide community findings, in the form of a road map concerning the scientific rationale, objectives, technology, and long-range strategic priorities for planetary mapping [1] and spatial (including topographic) software development (e.g., [2]); (2) Encourage the development of standards for present and future planetary missions and research activities, coordinate systems, mapping, geologic mapping, cartographic methods and nomenclature; (3) Help define community needs for critical research and planetary mission infrastructure, particularly software tools and content delivery systems [e.g., 3], (4) Provide findings on the accuracy and precision required for spatial technologies and products; and (5) Coordinate and promote the registration of data sets from international missions with those from US missions to optimize their combined utility.

MAPSIT will help enable the broad spectrum of planetary spatial data and programmatic capabilities required to effectively achieve robotic precursor and human exploration of the Solar System. These include (but are not limited to) the science analysis of

planetary surfaces, the identification of safe landing sites, the down-selection of sample acquisition locations, hazard assessment, and the spatial characterization of in-situ resources [4, 5, 6].

3. Immediate Issues

There are numerous, high-priority issues that the MAPSIT-represented community is focused on addressing in the near future:

- How should the current, unprecedented influx of high-volume, planetary mission data (e.g., Mars Reconnaissance Orbiter, Lunar Reconnaissance Orbiter, MESSENGER) be geodetically controlled and integrated to enable science and operation of current and future missions?
- How should global, regional, and local topographic models be created from multiple data sets?
- What requirements should be developed for missions to follow during the formulation and definition stages to mitigate subsequent growth of costs?
- How can research and analysis programs support strategic development of mapping procedures for new and complex products?
- How should community input be obtained and used to prioritize product development on near-term time scales? What products should be considered foundational (meaning a base or data set that all other data should be registered too)? [7, 8]
- How can planetary spatial data products be used to enable and facilitate future human exploration and in-situ resource utilization? [9]
- When and how should geodetic analysis and mapping tools be developed and be tested for accuracy and usability?
- How can training in planetary spatial data be established or encouraged so that existing expertise is passed on to next-generation workers?

One example of in-depth assessment that MAPSIT can facilitate includes addressing the needs for software tools to process data from all missions, including the increasingly complex and vast data volumes of current and future missions. Such software needs include (1) faster and more robust matching between disparate data types, enabling new types of data fusion; (2) the ability to simultaneously adjust data from different platforms (e.g., orbital, descent, lander, and rover) and data types (e.g., images, radar, and altimetry); and (3) new tools to combine different methods for generating topographic information.

4. A New Strategic Plan

MAPSIT's first task is to synthesize a new cohesive road map or Planetary Geospatial Strategic Plan (PGSP). To build such a plan, MAPSIT will solicit broad stakeholder input through community surveys and town hall meetings, such as at the Lunar and Planetary Science Conference and at a MAPSIT community meeting in conjunction with the June 2017 Planetary Data Workshop. A partial goal is to recommend and prioritize the needed data products and infrastructural developments, following a process much like that of the Lunar Exploration Roadmap [10], the 2015 Small Bodies Assessment Group Goals Document [11] and in part the Outer Planets Assessment Group Roadmap for Ocean Worlds. The road map assumes that a Planetary Spatial Data Infrastructure (PSDI) [7] will be created, which – not a road map itself – will outline and define all aspects of planetary spatial data and lays out the needs, capabilities and tasks of the community. This builds on a similar document for Earth Sciences in the US, the National Spatial Data Infrastructure (NSDI) document [12]. It is envisioned that the roadmap will be a living document that evolves over time as milestones are met and the state of the art advances.

5. Conclusions

The planetary science community faces numerous issues relating to NASA strategic planetary spatial data infrastructure, particularly as the US and international partners aim to carry out ambitious planetary missions throughout the Solar System. By involving key stakeholders in the process and by inclusively building an active and productive community, MAPSIT will help NASA and international partners drive future discovery and innovation.

References

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