A ROADMAP FOR PLANETARY SPATIAL DATA INFRASTRUCTURE. Jani Radebaugh[1], B. J. Thomson[2], B. Archinal[3], R. Beyer[4], D. DellaGiustina[5], C. Fassett[6], L. Gaddis[3], J. Hagerty[3], T. Hare[3], J. Laura[3], S. Lawrence[7], E. Mazarico[8], A. Naß[9], A. Patthoff[10], J. Skinner[3], S. Sutton[5], D. Williams[11]. [1]Brigham Young Univ., Provo, UT, USA 84602 (janirad@byu.edu), [2]Univ. of Tennessee, Knoxville, TN, USA, [3]USGS, Astrogeology Science Center, Flagstaff, AZ, USA, [4]SETI/NASA/Ames, Mountain View, CA, USA, [5]Univ. of Arizona, Tucson, AZ, USA, [6]NASA/MSFC, Huntsville, AL, USA, [7]Astromaterials Research and Exploration Science, NASA Lyndon B. Johnson Space Center, Houston, TX, USA, [8]NASA/GSFC, Greenbelt, MD, USA, [9]DLR, Berlin, Germany, [10]PSI, Tucson, AZ, USA, [11]Arizona State Univ., Tempe, AZ, USA.

Introduction: A major component of many planetary missions is to return planetary spatial data, which are any data with a spatial component. Such data include orbital, remotely sensed data; rover-collected, navigation imagery; and collected samples with a spatial component [1]. These data are used to make higher-order products used by planetary scientists and engineers for analysis and exploration, including image mosaics, basemaps, Digital Elevation Models (DEMs; Fig. 1), thermal maps, and other products.

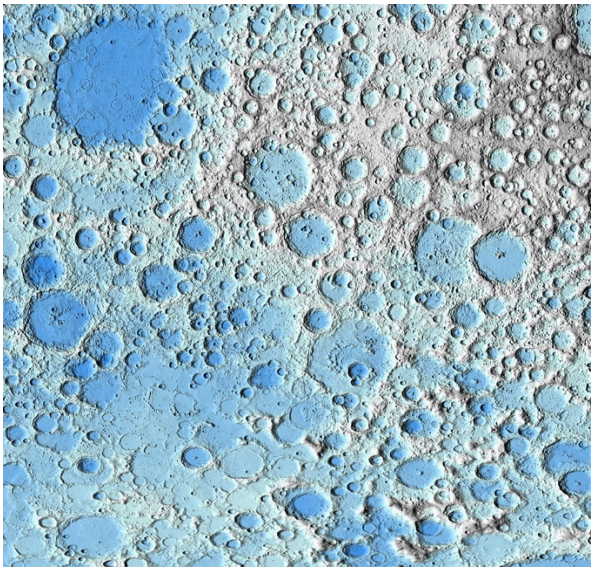

Fig. 1. Lunar Reconnaissance Orbiter (LRO) Digital Terrain Model from the High Resolution Orbiting Camera (HiROC) Wide Angle Camera (WAC) data [2].

Often these spatial data are not processed in ways that are standard or interpretable to users outside the mission science teams, nor are the higher-order products available to the general scientific user, especially over the long term. Earth science data users have addressed this issue and made easily accessible clearinghouses of ready-to-use spatial data, for example for Landsat Enhanced Thematic Mapper images [1, 3].

NASA and the planetary community have recognized the need for a strategy for making planetary spatial data accessible and useable to the planetary community and have assembled the Mapping and Planetary Spatial Infrastructure Team (MAPSIT), similar to other Assessment Groups (AGs). This community group (with the author list as the steering committee) is tasked with preparing a Roadmap for Planetary Spatial Data Infrastructure (PSDI). Here we detail the rationale, outline, and plans for this roadmap.

Rationale and Definitions: The intent of the MAPSIT PSDI Roadmap is to offer guidance on how to make planetary spatial data accessible and useable and to encourage best practices in acquiring new data and development of products and tools. Planetary Spatial Data Infrastructures (PSDIs) are frameworks to support Solar System spatio-temporal data discovery, access, and use. Foundational data products support PSDIs and include global topographic mosaics and other spatial products that are based on the best-available data and that are accurately scaled and registered to a given planetary surface. These products, along with their quantitative assessment of spatial efficacy, serve as a base to which additional products can be photogrammetrically controlled [4]. They can be used in any planetary delivery service to support accurate and effective decision-making for science, engineering, and management to achieve NASA goals.

A coherent plan for obtaining and using planetary spatial data is necessary to fully realize the potential of the data and to fulfill NASA's future science and exploration goals. MAPSIT is developing findings that are aimed at enabling seamless discovery, access, and use of spatial data for all users, developing interfaces that exploit current technologies, and evolving capabilities in pursuit of these goals.

Current Availability of Spatial Data: MAPSIT recognizes that there are numerous efforts within the NASA planetary science community that focus on planetary spatial data and delivery services. The PDS (Planetary Data System; https://pds.nasa.gov/) has a specific NASA charter to archive and deliver mission data, but their services focus on medium-to-long-term preservation (an engineering focus) and are not necessarily focused on delivery of the most usable, often highly derived, products (a user focus) [5]. The typical planetary data user, who often is not an expert in spatial data manipulation, may not able to easily access or use archived planetary data. Furthermore, there is no requirement placed on NASA missions to accurately register their

spatial data onto the target planetary body's surface, an often laborious and complex process that leads to the necessary quantified, accurate knowledge of the location and scale of objects within spatial data, and that allows for the proper use and comparison with other data. Such highly usable data products often do not exist for many planetary bodies, or were created with now outdated standards, coordinate frames, and techniques.

Roadmap Findings: The following major findings are the main points of emphasis in the current draft of the MAPSIT PSDI Roadmap, each with supporting details not included in the abstract for space reasons.

Finding I: NASA missions should be encouraged to obtain high-quality data that can be incorporated into existing spatial foundational data products, or create new ones for unseen territory, and thus maximize the value of the NASA science return.

Finding II: NASA-funded projects, including missions and Research and Analysis (R&A) projects, that obtain or create spatial data should be encouraged to deliver data in formats that are easily usable and that conform to standards agreed upon by the community.

Finding III: Existing and new planetary spatial data should be easily discoverable and accessible, and data access tools must evolve with the technology.

Finding IV: MAPSIT should coordinate with community representatives and groups, such as NASA Assessment Groups (AGs), to ensure that foundational data products are produced and that Planetary Spatial Data Infrastructures (PSDIs) are developed and maintained for each planetary body in the Solar System to best enable NASA exploration and mission goals.

Finding V: NASA and the planetary community should support the development of tools, technologies and expertise to ensure planetary spatial data are properly acquired, processed and available for effective use to the fullest extent, now and into the future.

Plans for Roadmap Feedback and Rollout: The current version of the MAPSIT PSDI Roadmap will be available to the planetary community at the time of the meeting, via the MAPSIT website (https://www.lpi.usra.edu/mapsit/). The steering committee welcomes feedback and suggestions from the entire planetary community. By summer or fall of 2019, the MAPSIT PSDI Roadmap, with findings through 2023, with the option to update as the community sees fit, will be delivered to NASA Headquarters.

Conclusions: The ultimate goal of the MAPSIT PSDI Roadmap is to enable seamless discovery, access, and use of spatially-enabled data for all users, to help develop interfaces that exploit current technologies and evolving capabilities in pursuit of this goal, and to support NASA in its science and exploration goals. These tasks collectively support a broad community effort to develop tools, data products, and services that support a range of community members to use current technologies for data storage, processing, and visualization, and to deliver products that "just work" for users.

References: [1] Laura J. M. et al. (2018) *Earth & Space Sci.,* accepted. [2] Scholten F. et al. (2012) *JGR, 117,* E00H17. [3] Beyer R. A. et al. (2018) *Planetary Sci. Informatics & Data Analytics Conf.,* Abstract #6067. .[4] Archinal B. A. et al. (2018) *Celestial Mech. and Dynam. Astro., 130*(22). [5] Laura J. et al. (2018) *Planetary Sci. Informatics & Data Analytics Conf.,* Abstract #6005.