

# MAPSIT: Roadmap for Planetary Data Infrastructure



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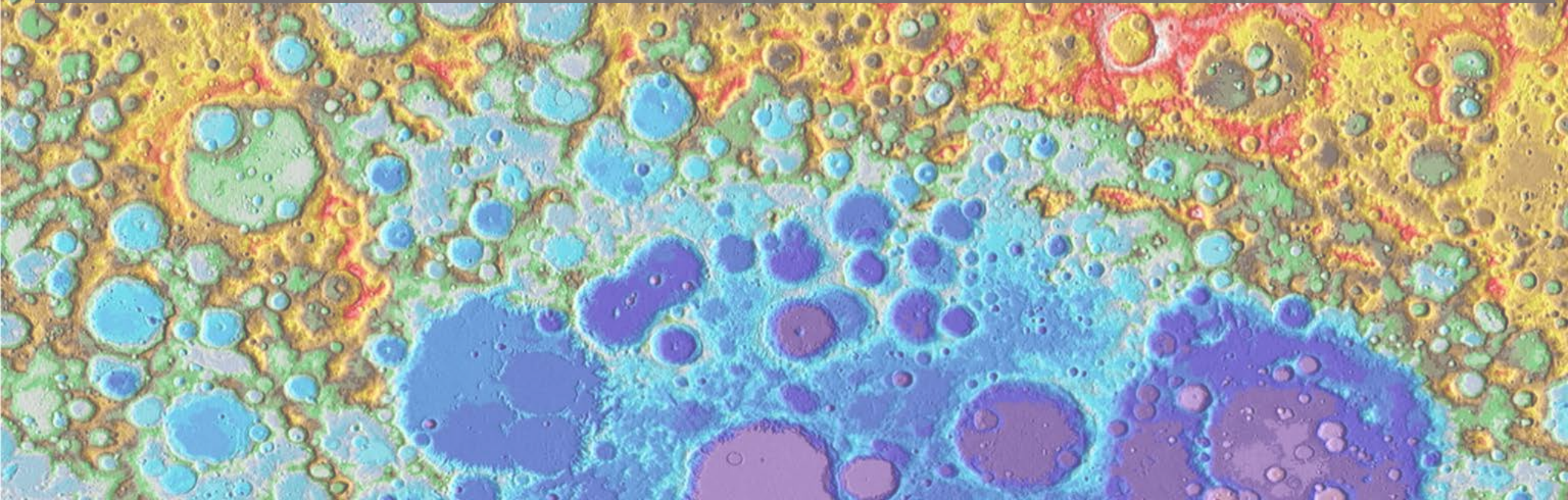
# A PSDI Roadmap: Rationale

- Spatial data contribute significantly to the success of NASA endeavors *if they are correctly acquired, accessible, and usable.*

Galileo Io

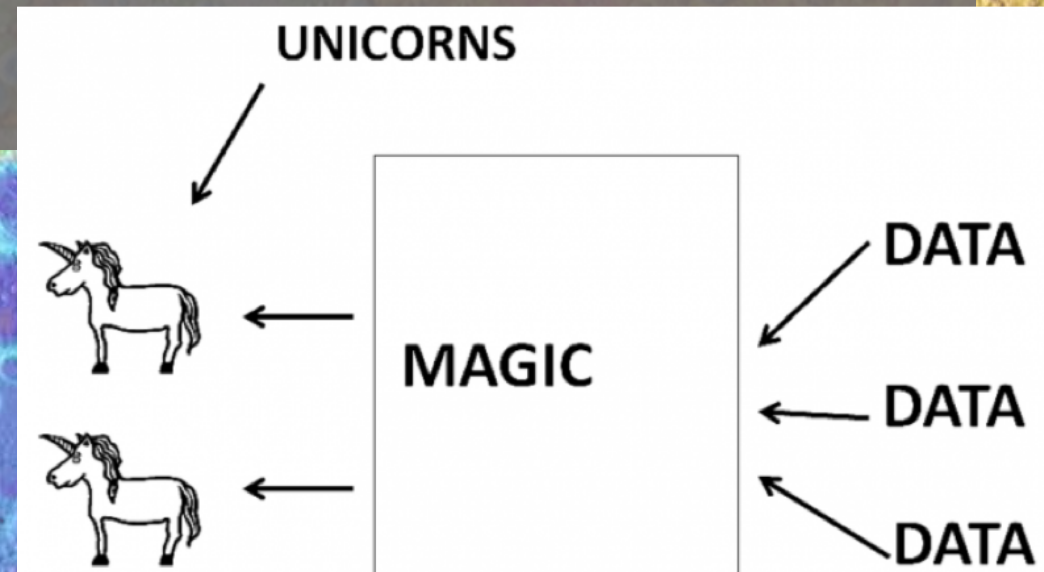
# A PSDI Roadmap: Rationale

- Spatial data contribute significantly to the success of NASA endeavors *if they are correctly acquired, accessible, and usable*.
- Often, spatial data are *not readily interpretable* to users outside mission science teams or they are processed in ways that are *non-standard*.



# What is Planetary Spatial Data Infrastructure?

- A plan for obtaining and organizing data in a standardized way to make them **discoverable, accessible and usable**.
  - NOT an application, like ArcGIS, a Trek, etc.
  - A structure around which data are **obtained** and **served**
- Most users want the data to **just work** – a PSDI should enable this!



# What is Planetary Spatial Data Infrastructure?

- A theoretical concept developed in the terrestrial community
- For planning, not a canned solution
- **Goals are to improve data**
  - Discoverability
  - Accessibility
  - Usability
- Broader than just data
  - Data sets and products
  - Technologies (access, processing, use, preservation)
  - Human resources (training and continuity of knowledge, outreach)
  - Standards

## Towards a Planetary Spatial Data Infrastructure

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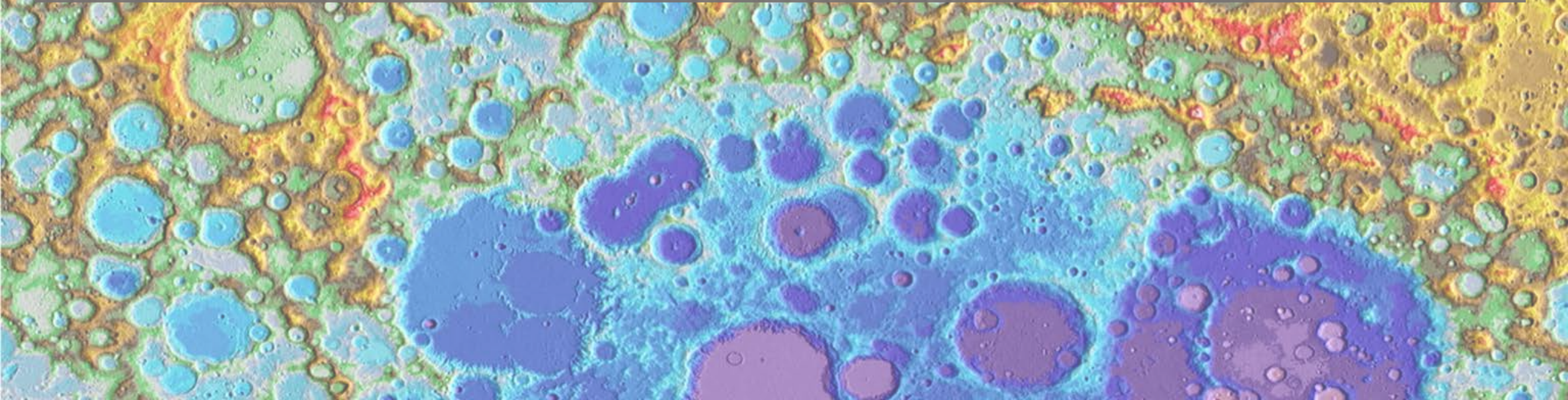
*See Laura et al. (2017) ISPRS  
Int. J. Geo-Inf., 6, 181,  
doi:10.3390/ijgi6060181 for a  
theoretical framework for a  
Solar System-wide PSDI*



- PSDIs require **FOUNDATIONAL DATA PRODUCTS** – provide basic positional information on which all other data can be placed. These are **controlled** and **registered** to the body.
- Not all bodies have these products made automatically by missions.
- This one: Lunar Reconnaissance Orbiter (LRO) WAC Color Shaded Relief Map of the Lunar far side, created from the Global Lunar Digital Terrain Model (100 m/pixel) and LOLA 30-m gridded DTM. ([lroc.sese.asu.edu](http://lroc.sese.asu.edu)).

# The Mapping and Planetary Spatial Data Infrastructure Roadmap

- Encourages the creation of initiatives to ensure that planetary spatial data are **correctly obtained and processed** and are **discoverable and usable** for a wide range of research and exploration purposes.



# The Mapping and Planetary Spatial Data Infrastructure Roadmap 2019-2023 (SHORT summary)

- **Finding I:** High-quality data should be obtained and foundational data made – these are key to registering all data for a specific body.
- **Finding II:** Data that are ready-to-use and that conform to standards should be made – these broaden the reach of information.
- **Finding III:** Future efforts should ensure that data are easily discoverable, accessible, usable, and conform to evolving standards.
- **Finding IV:** PSDI(s) should be developed – this helps data reach beyond a single application or community.
- **Finding V:** Additional data tools, technologies and expertise should be developed following community priorities.

# The Roadmap is driving action

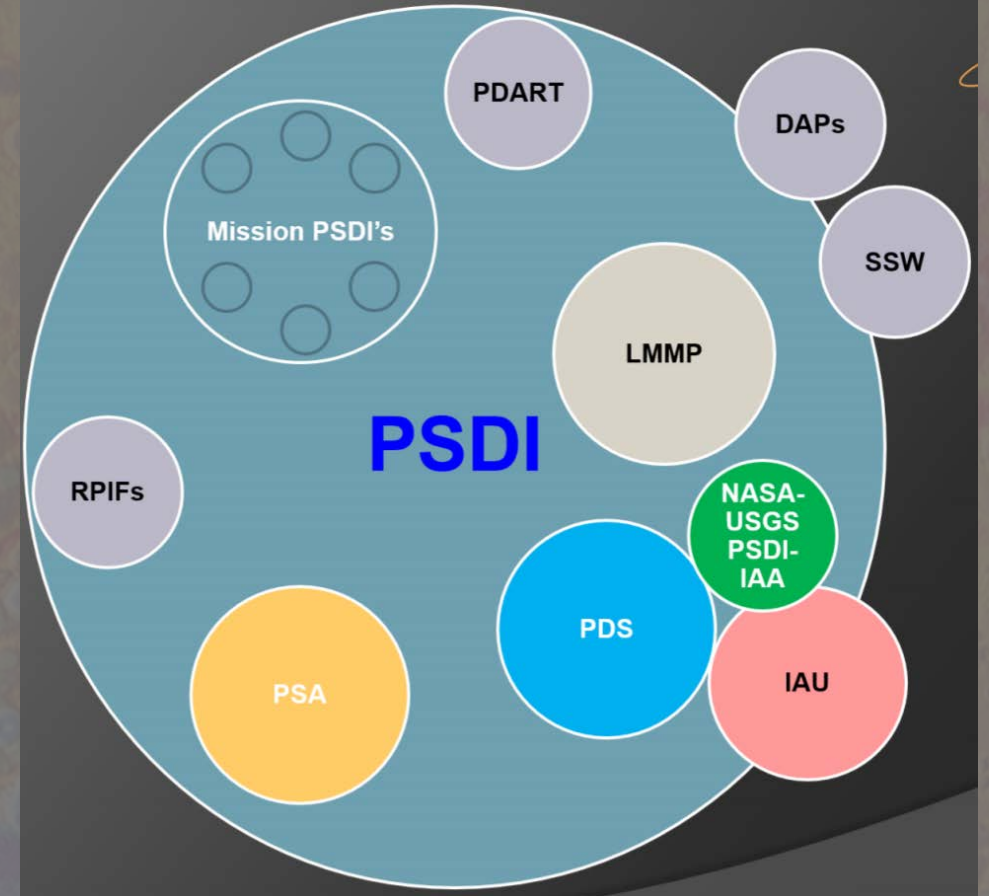
- DISCUSS with AGs and community their spatial data priorities, **provide a basis to help get funding** to support this effort
  - Trial run at SBAG in spring 2019 – we heard a lot about Bennu, Psyche, and being responsive to NEO hazards
- STRATEGIZE **for how to start building an overarching PSDI** and location-based PSDIs
  - “No PSDIs exist” – Jay Laura , USGS
- WRITE **White Paper/s** for the Decadal Survey on Planetary Spatial Data needs



extras

# Doesn't NASA's PDS serve all data needs?

- The Planetary Data System (**PDS**) is tasked with long-term preservation of data
  - An element of the PSDI initiative
- Typically data stored within the **PDS archive** are **not spatially enabled** for immediate use by non-expert research scientists.
- Instead, adequate metadata are provided with the image data that **enable the user to create** spatially enabled products.
- **Significant expertise is required** to perform these operations and interpret the spatial correctness of the products.



See Gaddis et al., 2017:

[https://astropedia.astrogeology.usgs.gov/download/Docs/PlanetaryDataWorkshop/Presentations2017/Thursday/Humphreys/PDS\\_and\\_PSDI\\_Gaddis\\_6.15.17\\_v3.pdf](https://astropedia.astrogeology.usgs.gov/download/Docs/PlanetaryDataWorkshop/Presentations2017/Thursday/Humphreys/PDS_and_PSDI_Gaddis_6.15.17_v3.pdf)

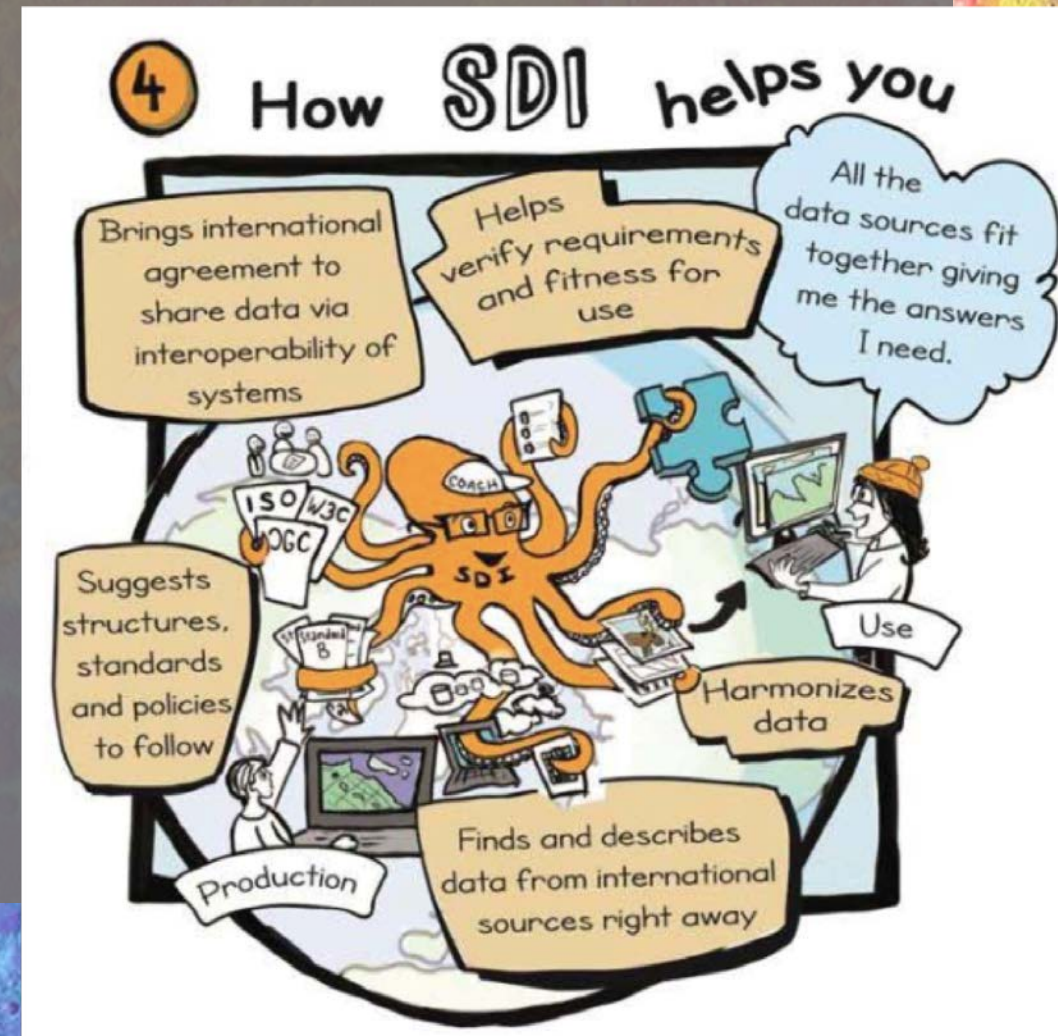
# A PSDI Roadmap: Rationale

- MAPSIT is tasked with strategizing within the planetary science community on ways to obtain spatial data appropriately and make them **accessible and usable** to the community.
- This effort has been recently completed as the Mapping and Planetary Spatial Data Infrastructure Roadmap 2019-2023.
  - <https://www.lpi.usra.edu/mapsit/roadmap/>

# Don't we already have online applications?

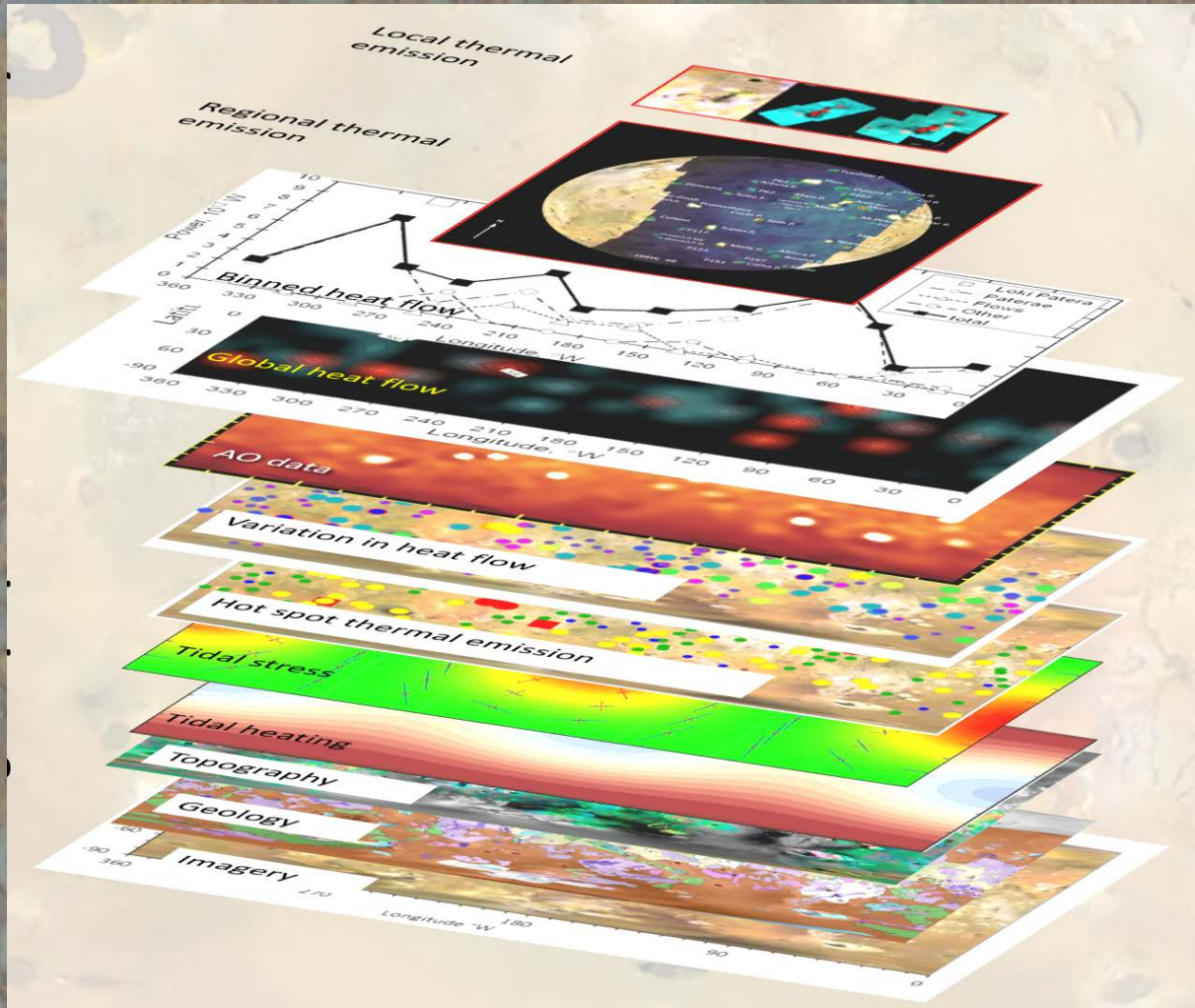
- PSDIs are **more dynamic** than most data servers and tools
- Often the controlled, foundational data need to be created and registered to the body, so that the popular web-based tools or GIS-based applications can work
  - *Anyone can contribute to this effort!*

Lots of Earth-based SDIs



# Types of Integrated Data: Io example

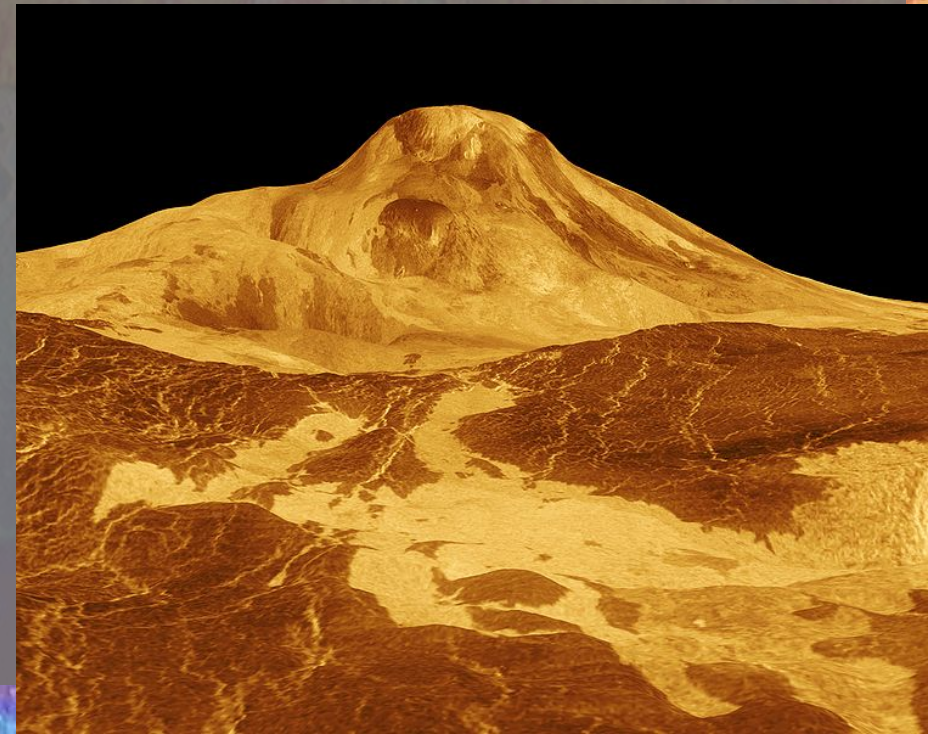
Existing and proposed ASU Io database layers



- Foundational (base) data
  - Geodetic Coordinate Reference Frames - subject to refinement as knowledge improves
  - Elevation (Topographic) data
- Overlain data
  - Orthorectified orthomosaics
  - Spectral compositional maps
  - Geologic maps at various scales

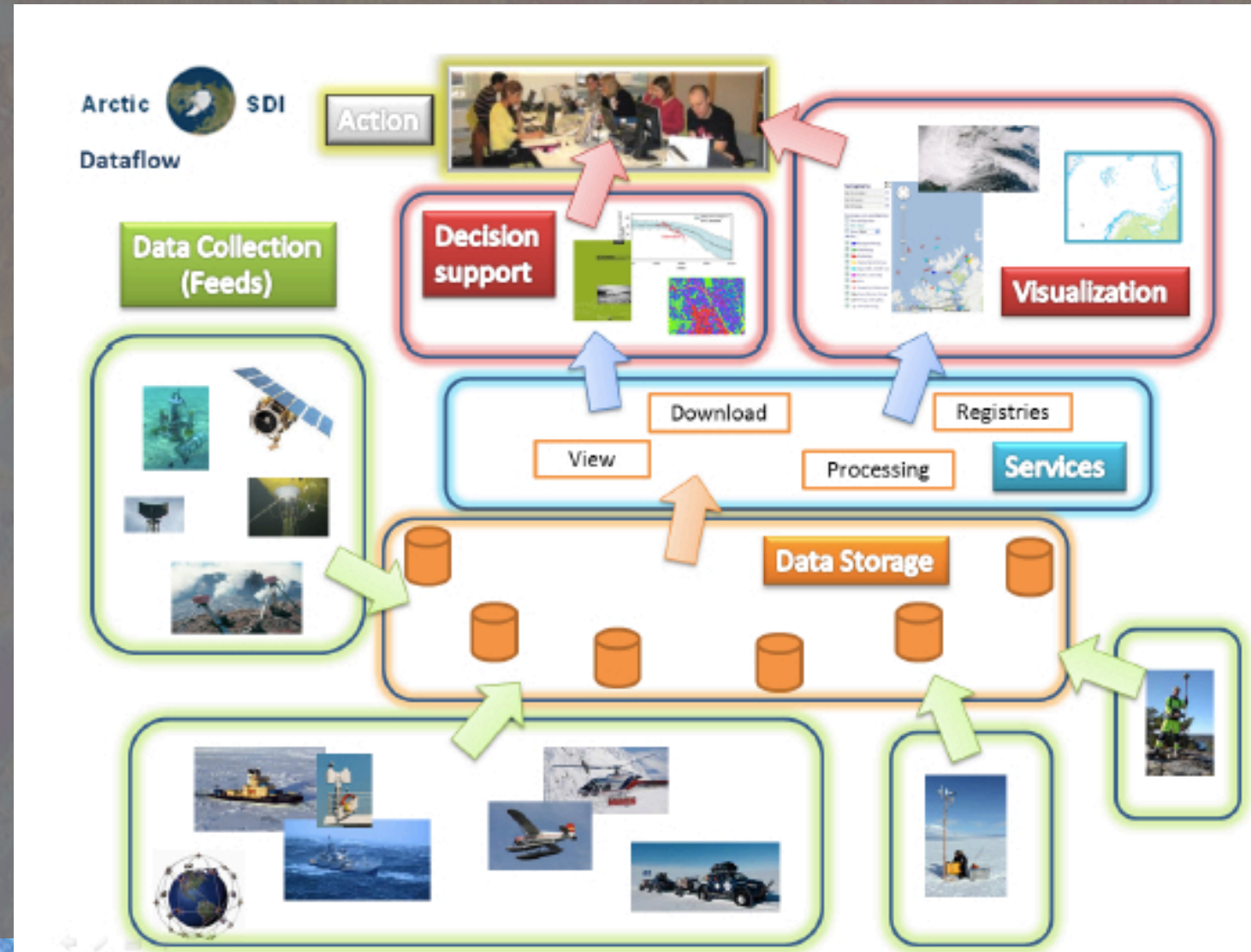
# Planetary Foundational Data Examples

- Geodetic Coordinate Reference Frames
  - IAU defined lat/lon and ephemeris
  - Planetary is special: geodetic coordinate reference frames are iteratively defined as data improves. Laser altimetry (e.g., LOLA) for the Moon)
- Elevation Data
  - Mars DTM from MOLA, Magellan DEM, MLA from MESSENGER for Mercury
- Compositional maps from spectra
  - Clementine iron and titanium maps for the Moon
- Orthorectified Orthomosaics
  - Global Io Voyager/Galileo basemap
- Geologic maps at various scales (Mars 1:24K to 1:25M)
- As a non-spatial expert - **these data sets should all just work and be readily accessible**



# SDI Example – Arctic SDI

- Data from 12 different organizations – required heavy **standardization and foundational data**
- Available in **widely used** geospatial formats
- **Search enabled** by tight data/information coupling
- Data **available** to all kinds of users



# HQ Decadal Challenge – Top 6 Questions

We think of ourselves as “special”, so we started with our own concerns:

- **1)** Can we invest in, and improve, the spatial data infrastructure presently used for planetary surfaces to accelerate the rate of scientific discoveries and maximize the return from past and future missions? What improvements in data, formats, standards, access and agency policy would lead the planetary science community to make the most progress going forward?
- **2)** What steps can be taken so that future missions prioritize high-quality foundational data—obtained with accurate spacecraft tracking, ephemerides, and high geodetic fidelity—enabling future science and exploration? What can be done to improve the delivery of high-quality calibrated data, documentation, and higher-order data products to the broad scientific community by missions and instruments?
- **3)** In an era with petabytes of data, how will individual scientists and institutions be able to address the community’s most important science questions with the full scope of information that current and future missions will gather?
- **4)** How can we ensure future programs, missions, and projects obtain datasets that are not only archived appropriately, but also discoverable, usable, and accessible to future science users?
- **5)** What investments in tools, technologies, and scientific expertise will lead to the highest science return from future missions?