~~community standards for geospatial data~~

(for the PDS)

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CIS/IMG – brief ongoing work

Ongoing PDS3/4 mission archives (learning PDS4)

PDS4: Imaging/Cartography/Display/Mission dictionaries

"Small" archive support (PDS3/PDS4). Note 10TB is not small.

PDS4: integration -- support in PROJ & GDAL (libraries)/ISIS3

Geospatial UPC database (API) and PILOT interface – refactor

Geospatial live mapping services (API)

Planetary Spatial Data Infrastructure (PSDI)

- 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

See Laura et al. (2017) ISPRS Int. J.G.I
doi:10.3390/ijgi6060181

What is Planetary Spatial Data Infrastructure?

- Most users want the data to *just work*

  a PSDI should enable this!
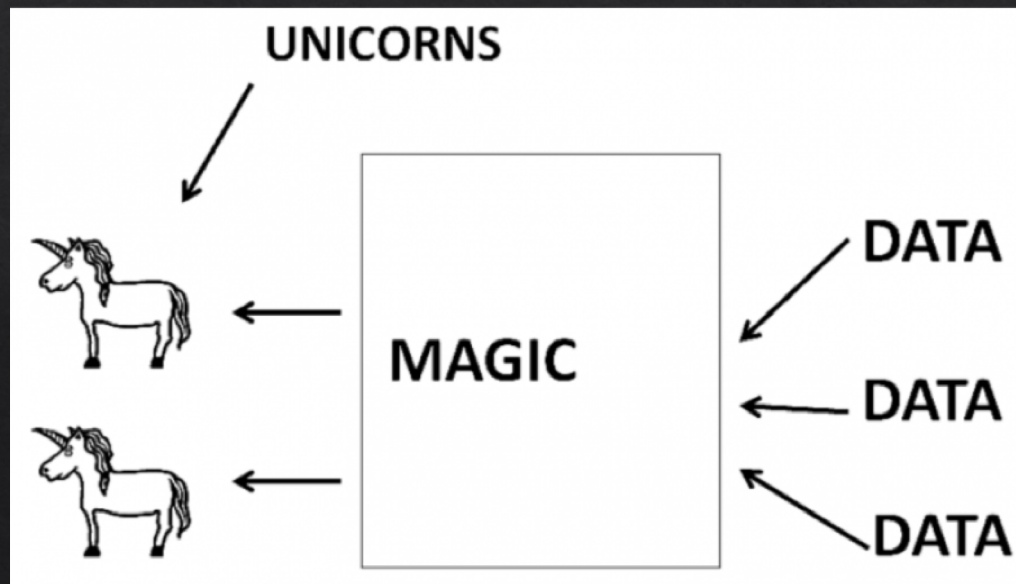
What is Planetary Spatial Data Infrastructure?

- Involves data and users, standards, policy, access

- Data should just work!

- Users can:
  - Develop critical skills
  - Engage stakeholders
  - Connect with new/non-expert users

Technology

DYNAMIC

CUMULATIVE

People

Data Access

Standards

Policy

Data

S/w to process low to high level data
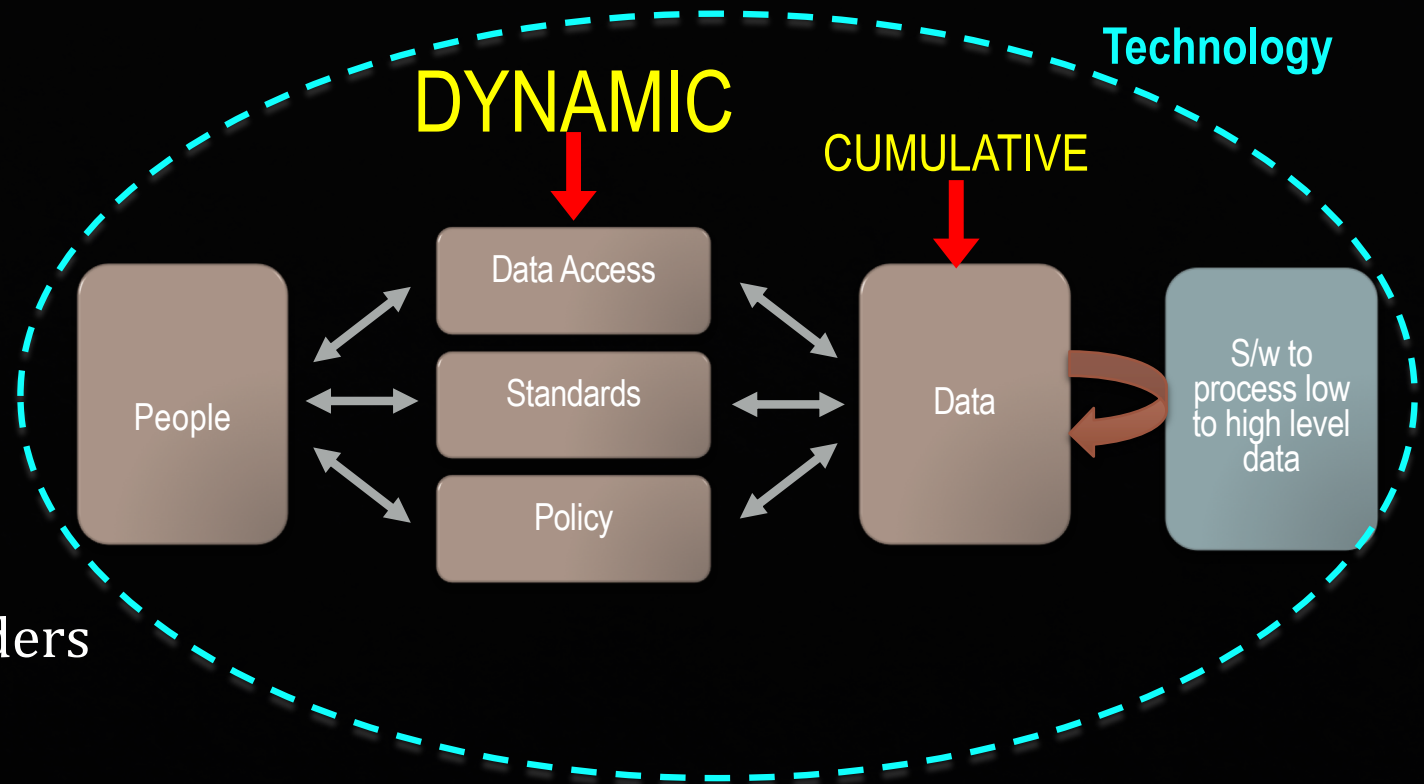
Doesn't NASA's PDS serve all data needs?

- PDS is tasked with long-term preservation of data
  - A required element of the PSDI initiative
- Often 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.
- PDS does not "create" data
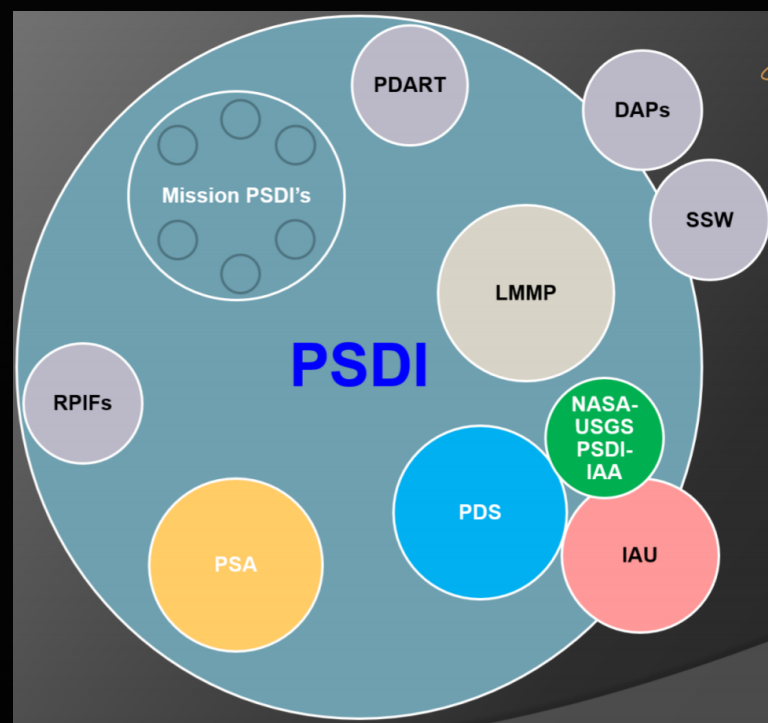
See Gaddis et al., 2017:
https://astropedia.astrogeology.usgs.gov/download/Docs/PlanetaryDataWorkshop/Presentations2017/Thursday/Humphreys/PDS_and_PSDI_Gaddis_6.15.17_v3.pdf

A PSDI Roadmap: Rationale

- MAPSIT, a NASA assessment group like LEAG or OPAG, 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/

MAPSIT:

Steering Committee

- Jani Radebaugh, Brigham Young University [Chair]
- Samuel Lawrence, Johnson Space Center [Chair Emeritus]
- Brad Thomson, University of Tennessee Knoxville [Vice Chair]
- Brent Archinal, United States Geological Survey
- Ross Beyer, SETI Institute
- Daniella DellaGiustina, University of Arizona
- Caleb Fassett, NASA Marshall Spaceflight Center
- Lisa Gaddis, United States Geological Survey
- Sander Goossens, Univ. Maryland, NASA Goddard Space Flight Center

- Trent Hare, United States Geological Survey
- Jay Laura, United States Geological Survey
- Erwan Mazarico, NASA Goddard Space Flight Center
- Pete Mouginis-Mark, University of Hawaii
- Andrea Naß, German Aerospace Center DLR
- Alex Patthoff, Planetary Science Institute
- Sarah Sutton, University of Arizona
- Julie Stopar, Lunar & Planetary Institute
- David Williams, Arizona State University

- Website: http://www.lpi.usra.edu/mapsit

Help connecting PDS4 services

The geospatial UPC database, OPUS database, the JPL Machine Learning database, GeoScience databases are all "value-add" services for PDS.

Can we use existing/building PDS4 APIs to connect these derived databases?

Connect PDS into PSDI Data Portals?

crossing PDS4 data "portal" APIs into more geospatial data portal capabilities (e.g. CKAN, Open Geoportal). This is mainly for geospatial data and would need conversions to and to/from PDS4 and FGDC/ISO metadata.

There are also good individual image data APIs coming into their own (called STAC). We plan on providing a planetary extension into STAC. This is not a supported PDS task at Astro, but it might be good for PDS too.

Data Streaming APIs

for our UPC spatial footprint database (PILOT interface) we are using community databases PostGRES/PostGIS and common geospatial interfaces. We are standardizing on providing an API standard called WFS (by OGC) to give folks programmatic access to the PDS records.

How can we use perhaps use these well-vetted APIs in PDS too? We also heavily use WMS and Tiled WMS (which many instrument teams and projects like the NASA Treks also use).

PROJ (Library, API) – map projections

We just supported adding the unique planetary map projections into the community-support and open library called [PROJ](). There are a couple archives that were (e.g. CASSINI) where their map projections were ONLY supported in the planetary community tools.

In the future, I would like to see if some of the specialize rover (in-situ) projection made available outside of VICAR.

GDAL (raster/vector Library, API)

Support for reading PDS4 data needs to be propagated into various applications. PDS4_View is great, but it does not enable PDS4 in existing science applications.

By supporting GDAL, we can help push PDS4 support into existing applications. QGIS already supports (some) PDS4 images already, because we have added initial support into GDAL. PDS4 support should show up in many other applications due to this.

 What other libraries, like GDAL, can the PDS support (for example perhaps in CIFTSIO)?
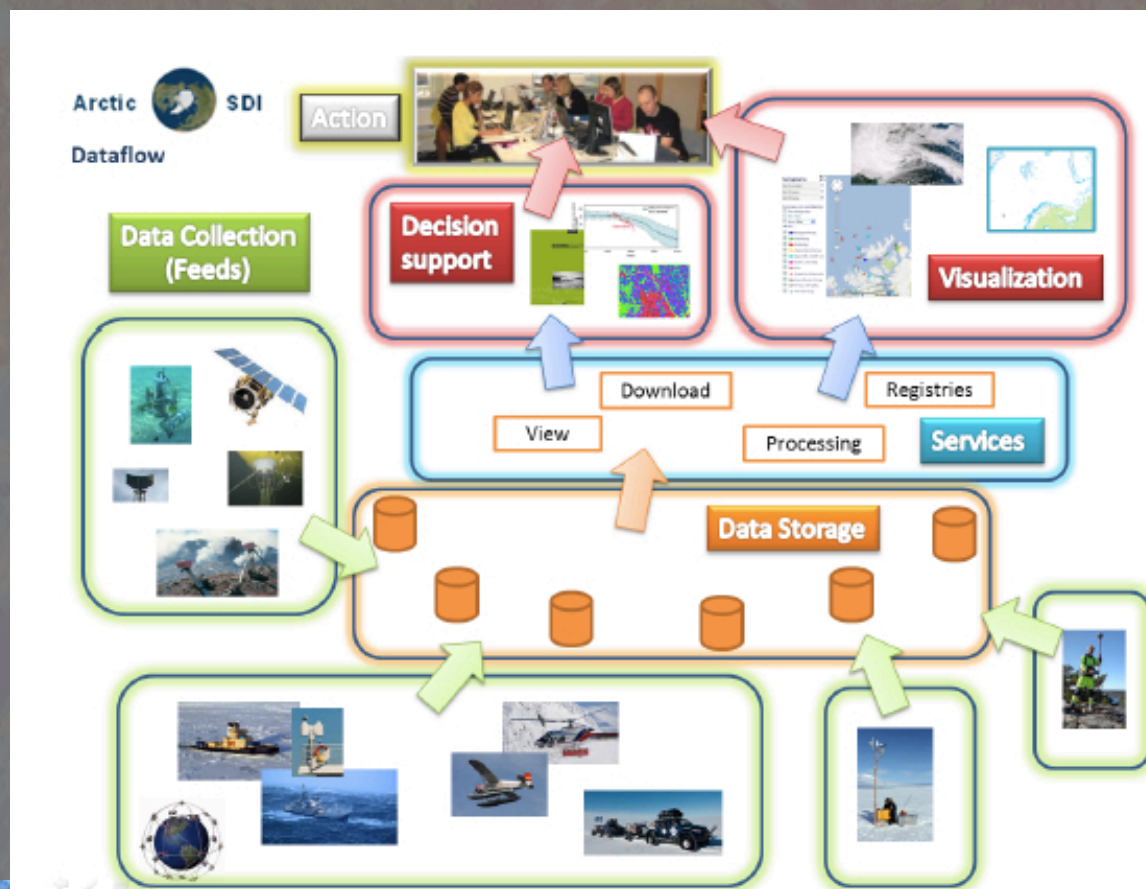
GeoTIFF

Allowing GeoTIFF into PDS4 will help our geospatial community

Simply a plug for my Tuesdays talk. ☺

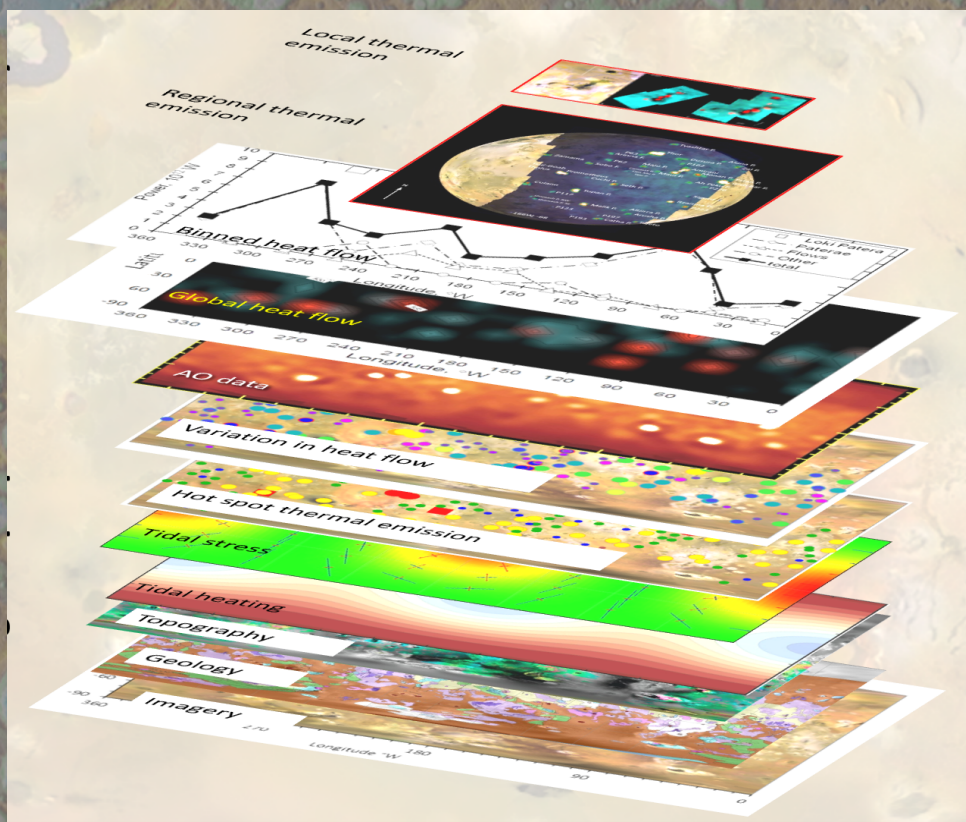backup

Earth SDI Example – Arctic SDI

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

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

See Williams et al., 2019: https://www.hou.usra.edu/meetings/lpsc2019/pdf/1053.pdf
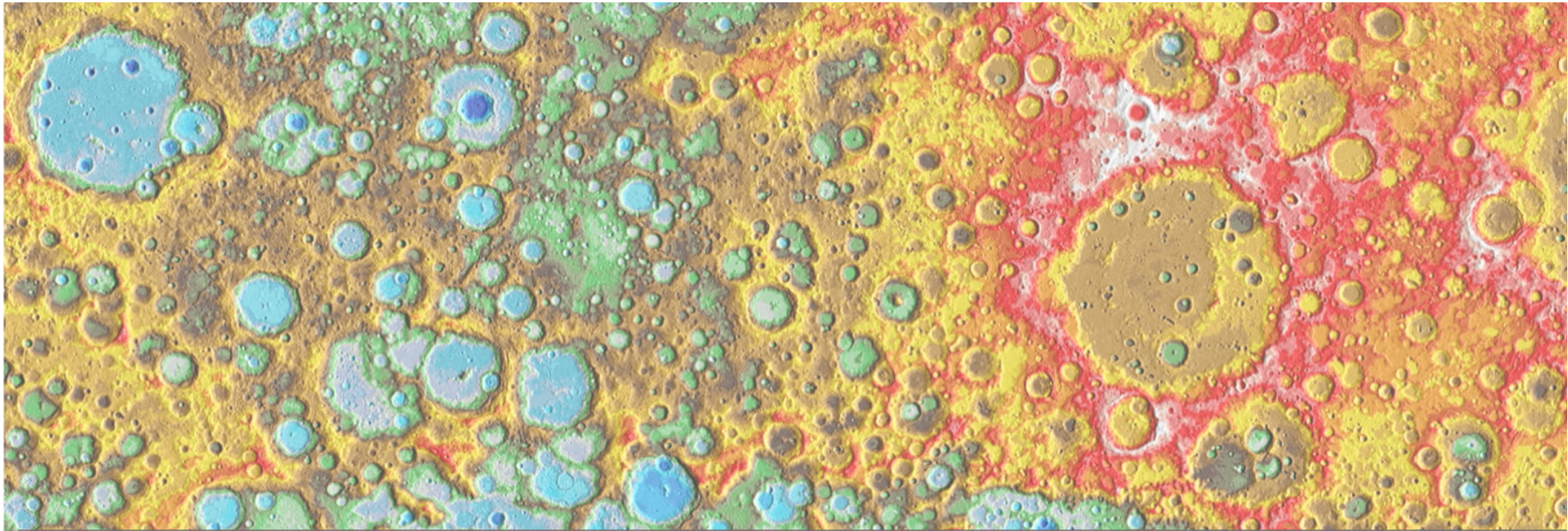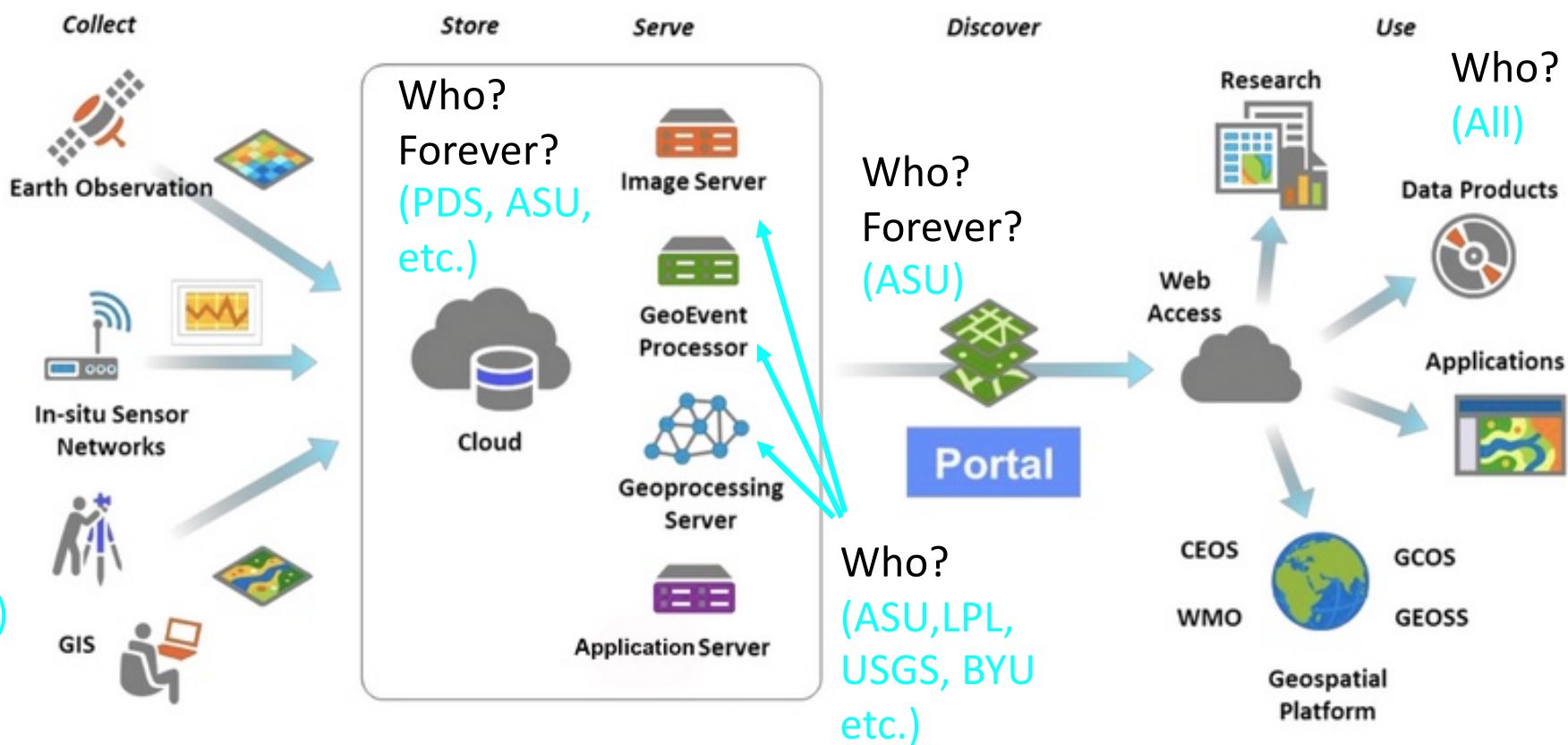
Example of a **FOUNDATIONAL DATA PRODUCT** – provides basic positional information on which all other data can be placed.

Lunar Reconnaissance Orbiter (LRO) WAC Color Shaded Relief Map of the Lunar far side showing the northern South Pole-Aitken basin, created from the Global Lunar Digital Terrain Model (100 m/pixel) and LOLA 30-m gridded DTM. (lroc.sese.asu.edu).

From data to a PSDI (Io)

Collect correct! (Galileo, Voyager, Cassini, NH, Juno, Ground based) and process (new axis basemap)

Collect
- Earth Observation
- In-situ Sensor Networks
- GIS

Store
Who? Forever? (PDS, ASU, etc.)
- Cloud

Serve
- Image Server
- GeoEvent Processor
- Geoprocessing Server
- Application Server

Who? (ASU, LPL, USGS, BYU etc.)

Discover
Who? Forever? (ASU)
- Portal

Use
Who? (All)
- Research
- Web Access
- Data Products
- Applications
- CEOS
- WMO
- GCOS
- GEOSS
- Geospatial Platform

http://www.opengeospatial.org/pub/ArcticSDP

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 (summary)

- **Finding I:** NASA missions should obtain high-quality data that can be incorporated into foundational data products and thus maximize the value of the NASA science return.

- **Finding II:** NASA-funded projects, including missions and R&A projects, that obtain or create spatial data should deliver data that are usable and conform to standards.

- **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 AGs, to ensure that foundational data products are produced and Planetary Spatial Data Infrastructures (PSDIs) are developed and maintained.

- **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 now and into the future.