2019 Esri User Conference

Supporting the Life-Cycle of Planetary Geospatial Data

MARC HUNTER

USGS ASTROGEOLOGY SCIENCE CENTER

USGS Astrogeology Science Center

Interdisciplinary science, research and production group

- Partnered with NASA, universities, international space agencies, and primary research institutions since the Apollo era
- Focus on **foundational** data products (geodetic control networks, topography, and orthoimagery) and **framework** data products (compositional maps, nomenclature, and geologic maps)
- Development of planetary imagery processing software (ISIS3), and home to several facilities that represent the broader planetary science community

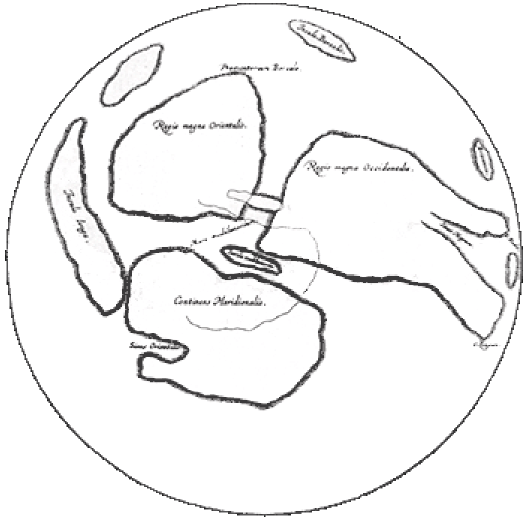
Lobby of the Astrogeology Science Center in Flagstaff, AZ

History of Spatial Data in Planetary Science

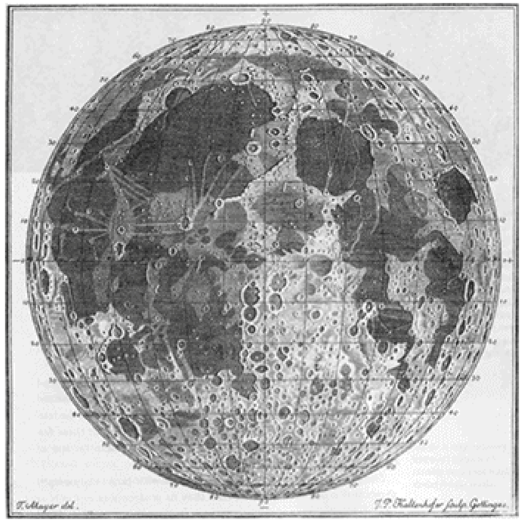
Rapid pace of technological advancement in 20th Century

- From near-side telescopic observations to *Apollo* and beyond (Greeley & Batson, 1990)

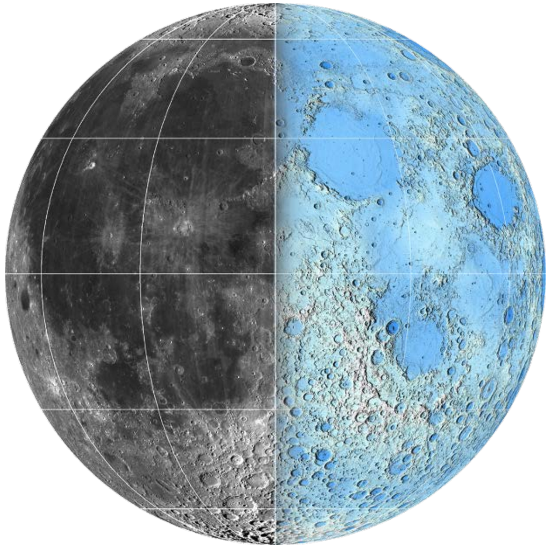
Converging with terrestrial geoscience visualization and analysis methods – desktop GIS, 3D visualization, web maps



William Gilbertin (1600)



Tobias Mayer (1775)



Hare et al. (2015)

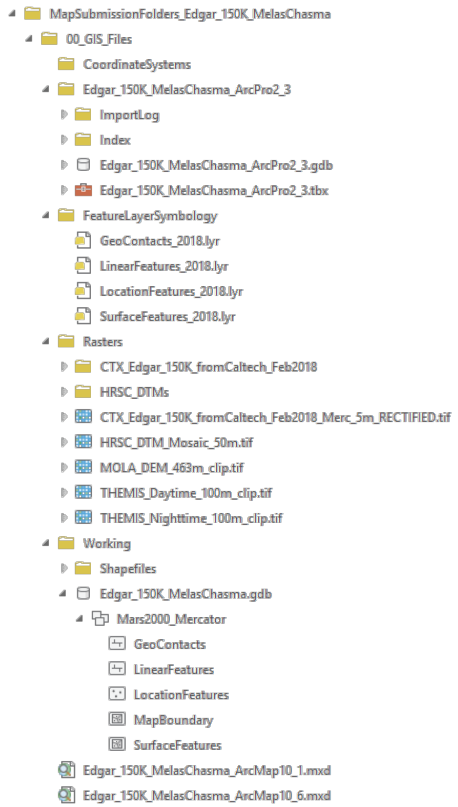
Planetary Geologic Mapping Program

Funded mappers are provided with prepared GIS projects

- Feature classes with ‘TYPE’ fields, supported by attribute domains
- Layer files created with FGDC standard geologic symbology correspond to attribute domains
- Includes basemaps identified in proposal

Reduce barriers to GIS mapping (properly)

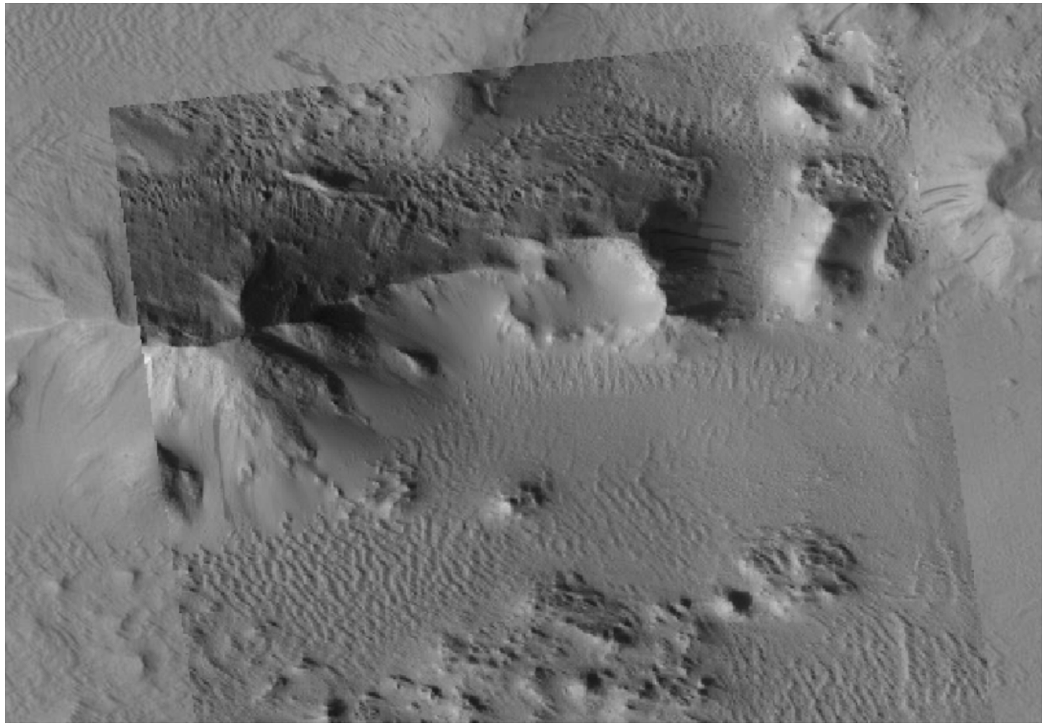
- Tools to ensure topological integrity
- Workflows that support final printed product



Project structure for NASA-funded USGS maps

MRCTR GIS Lab

Mapping, Remote-Sensing, Cartography, Technology, and Research



HiRISE image web service overlying CTX blended mosaic web service

GIS Tools

- Python Toolboxes and Esri Add-Ins
- Contracted tools
- Python scripts

Tutorials

- Videos published to YouTube
- Workflows and self-paced exercises

Technology Tests & Standards

- Tiled imagery web services for global mosaics via MRF with LERC compression
  - Special thanks to Esri's Lucian Plesea
- Representation at OGC and USGS standards WGs

Unique Challenges

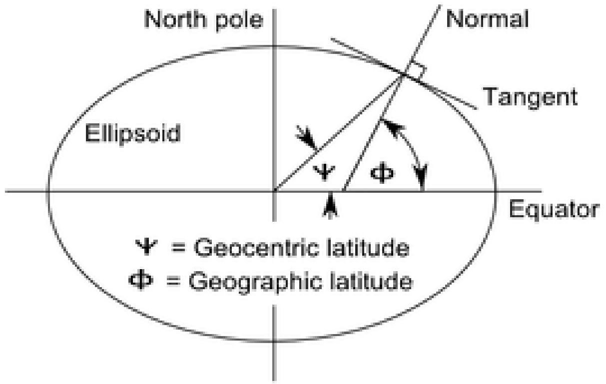
Representing all bodies being mapped in the Solar System

- Radii of bodies, evolving geodetic control systems
- Different coordinate systems for bodies
- Relatively young field with less mature ontologies

Missions capture bodies at increasingly higher resolutions; variety of data visualization platforms

De-centralized nature of the planetary science community

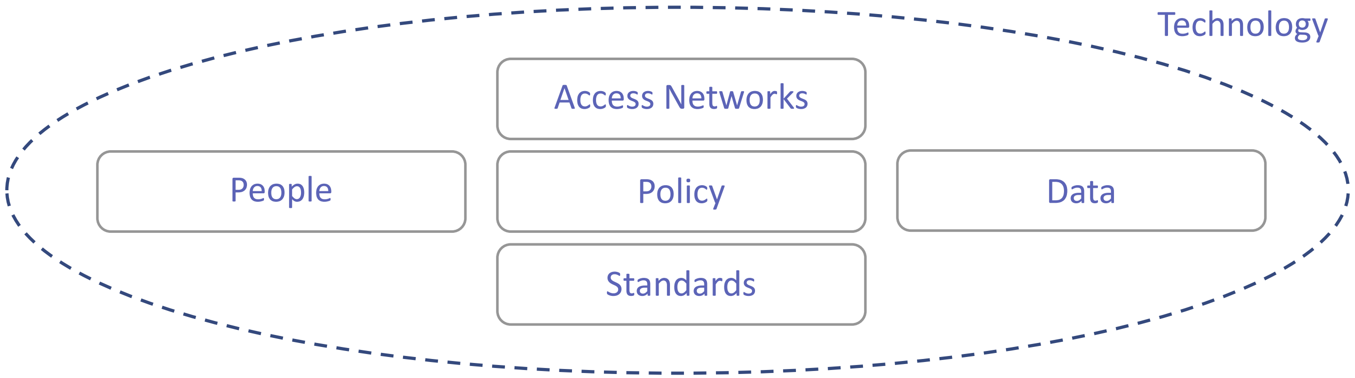
- Variety of data custodians with different organizational requirements and resources



Ocentric vs. ographic body definitions

Our Goals

Develop within a Planetary Spatial Data Infrastructure framework

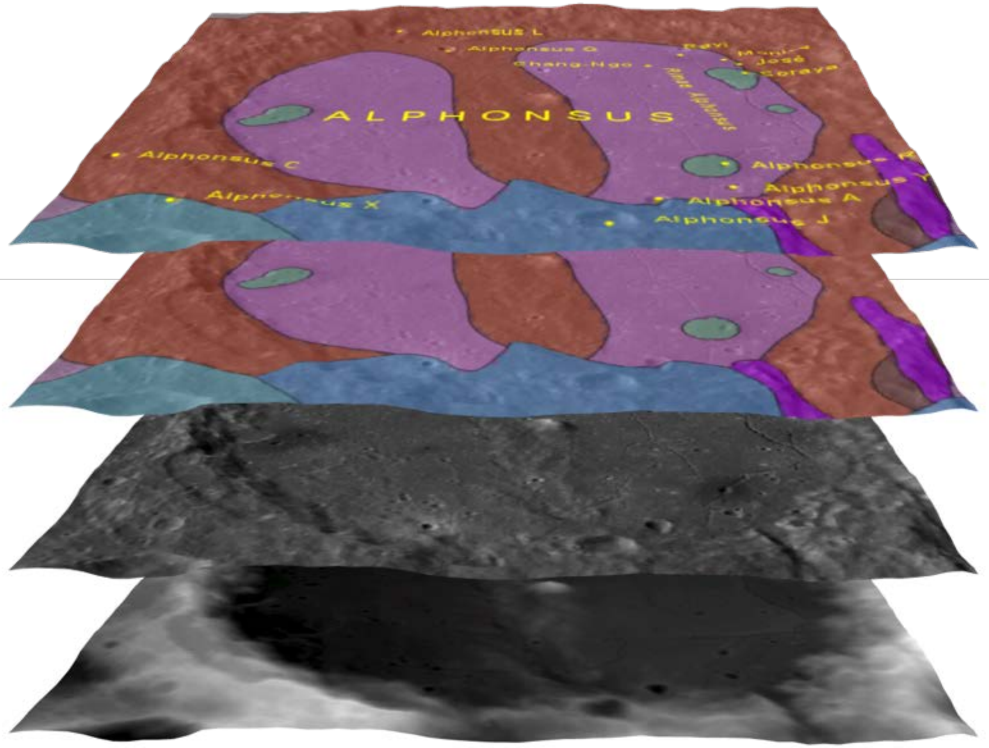


Product-base view of PSDI. Laura, et al. (2017).

Promote discoverability, accessibility and interoperability of spatial data (Naß et al., 2017)

Leverage best practices in terrestrial geoscience mapping (Hare et al., 2018)

Life-Cycle Approach to Geospatial Data



Well-controlled foundational data products served in GIS-ready formats

Tools that help to avoid common pitfalls of planetary GIS

Leverage current publication and visualization technologies

Long-term archive and open web services

Community-driven standards to enhance discovery and coordinate advancement

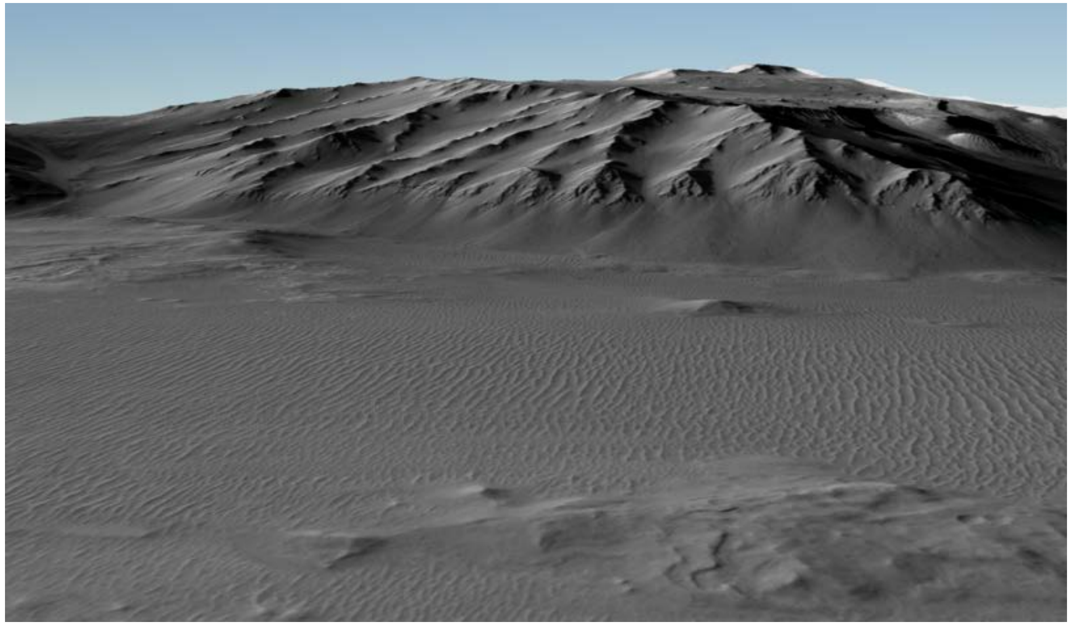
Current Efforts

Migration to ArcGIS Enterprise Server for basemaps

- Improved performance and functionality
- Served as OGC protocols (WMS, WFS, WCS)
- Testing service of all GIS data

Develop metadata and content standards for planetary data

Utilize 3D visualization with high resolution data



3D view of Mars using CTX orthoimagery and DTM

Conclusions

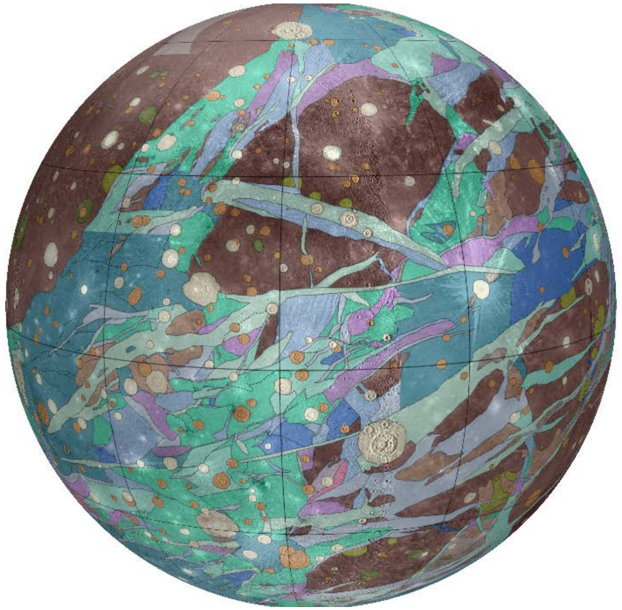
Aim to meet user expectations that spatial data should ‘just work’

- Develop policies, standards and access needed to connect people and data
- Create tools and training that help geologists think geographically
- Support appropriate use of data mapped at different scales

Build on existing spatial data standards

- Extend relevant data models for use in planetary domain
- Plug into modern visualization and analysis applications

Continued advocacy for support of planetary coordinate reference systems in web protocols and visualization tools



Global geologic map of Ganymede

References

Greeley, R., & Batson, R. M. (Eds.). (1990). *Planetary mapping* (Vol. 6). Cambridge University Press.

Hare, T. M., Rossi, A. P.,Frigeri, A., & Marmo, C. (2018). Interoperability in planetary research for geospatial data analysis. *Planetary and Space Science*, *150*, 36-42.

Laura, J. R., Hare, T. M., Gaddis, L. R., Fergason, R. L., Skinner, J. A., Hagerty, J. J., & Archinal, B. A. (2017). Towards a Planetary Spatial Data Infrastructure. *ISPRS International Journal of Geo-Information*, *6*(6), 181.

Naß, A., Di, K., van Gasselt, S., Hare, T., Hargitai, H., Karachevtseva, I., ... & Skinner, J. (2017). Planetary Cartography and Mapping: Where we are today, and where we are heading for?. *The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, *42*(W1), 105-112.

Questions

Marc Hunter

mahunter@usgs.gov

USGS Astrogeology Science Center

Flagstaff, AZ

https://astrogeology.usgs.gov/

MRCTR (Mapping, Remote-sensing, Cartography, Technology, and Research) GIS Lab

https://astrogeology.usgs.gov/facilities/mrctr-gis-lab