DIGITAL MAPPING TECHNIQUES 2018

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The contents of this document are provisional

See Presentations and Proceedings
from the DMT Meetings (1997-2018)

http://ngmdb.usgs.gov/info/dmt/

Exploring Interoperability Solutions for Interplanetary Data

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The USGS Astrogeology Science Center in Flagstaff, Arizona has supported planetary exploration and scientific research since the Apollo era. Mainstream GIS platform support for planetary body definitions and read/write capabilities in the GDAL library now allow the planetary GIS community to plug directly into terrestrial geoscience applications and file formats. This convergence provides a new opportunity to share best practices and tools between communities as we pursue common goals of spatial data standardization, GIS web services and 3D visualization. Astrogeology is developing within the spatial data infrastructure (SDI) framework that connects users to science-ready data with policies, standards and access networks meant to facilitate collaboration and is adaptable to advancements in technology. While challenges unique to planetary data remain, Astrogeology expects to increase commonality by adopting a widely-supported data model, and advocating for datum-agnostic tools and applications to promote the discoverability, accessibility and usability of GIS-ready data. The foundational ideal behind this approach is that spatial data should 'just work', and that research scientists and laypeople alike should have access to training and tools that enable their work, rather than impede it.

Those that are interested in learning more about planetary geology and GIS are encouraged to visit the websites listed below and contact Marc Hunter with any questions.

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

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.

2018 Digital Mapping Techniques Workshop

Exploring Interoperability Solutions for Interplanetary Data

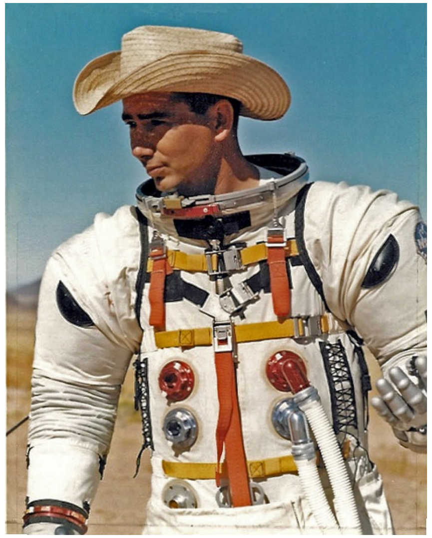
MARC HUNTER

USGS ASTROGEOLOGY SCIENCE CENTER

USGS Astrogeology Science Center

Interdisciplinary research and production group

- Partnered with NASA, universities, international space agencies, and standards-generating organizations since the Apollo era
- Focus on foundational data products (geodetic coordinate systems, elevation, and orthoimagery) and framework data products (compositional maps, nomenclature, and geologic units)



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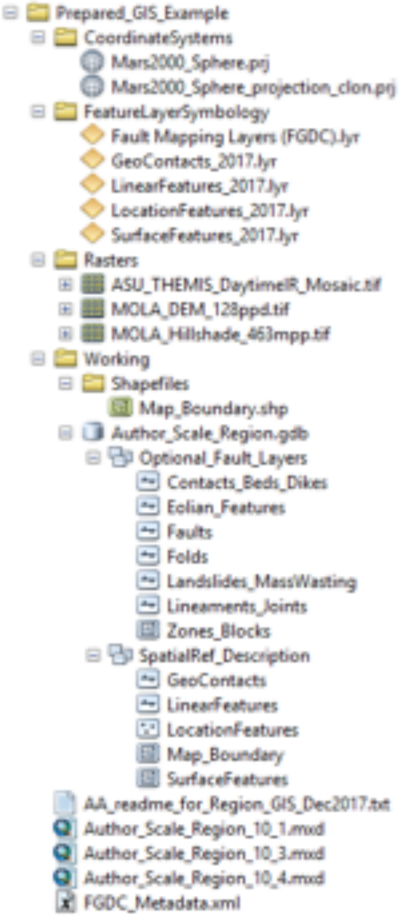
Planetary Geologic Mapping Program

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 base maps identified in proposal

Reduce barriers to GIS mapping (properly)

- Author generates new geologic units feature class and layer file
- Author and publications create FGDC compliant metadata



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MRCTR GIS Lab

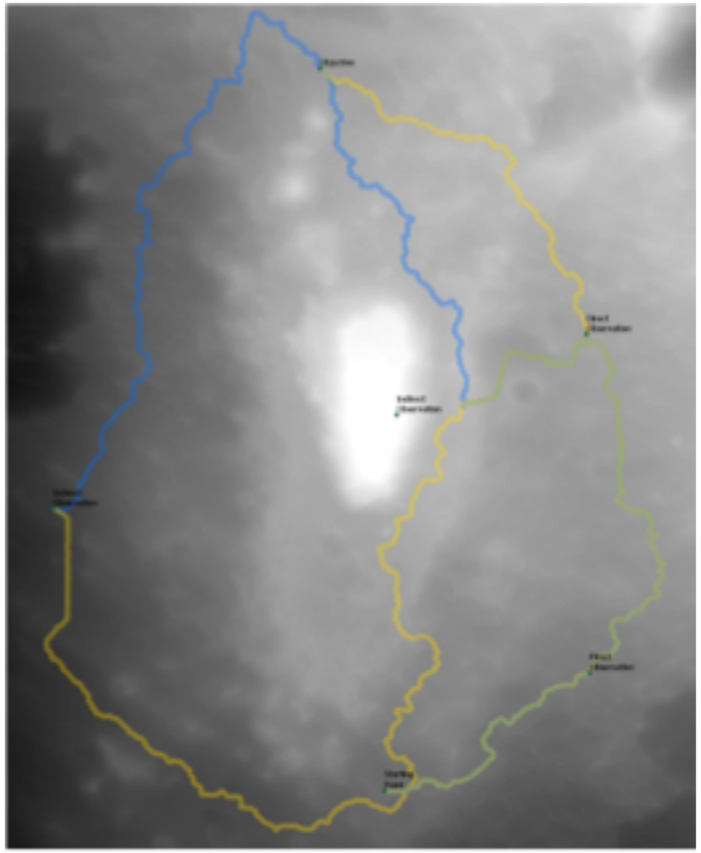
Mapping, Remote-Sensing, Cartography, Technology, and Research

Tutorials

- Videos published to YouTube (via USGS)
- Self-paced planetary GIS exercise
- Workflow SOP’s
- Workshop presentations

GIS tools

- PGM Python Toolbox
- Raster Riser
- Tools for Graphics and Shapes
- Geodesic Profiler
- Crater Helper Tools
- Tools in development to support exploration



Traverse Optimization tool in development

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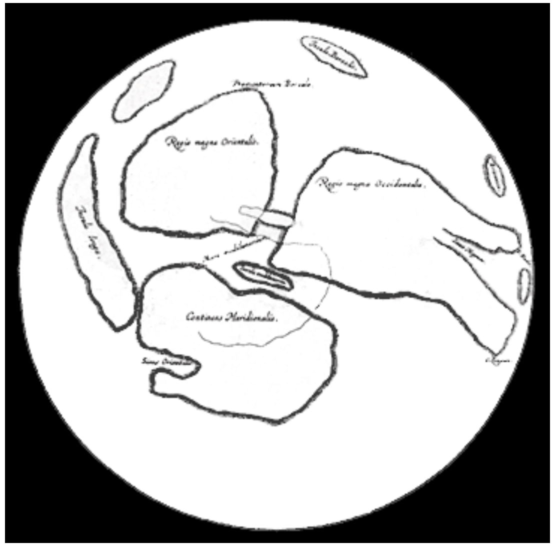
History of Spatial Data in Planetary Science

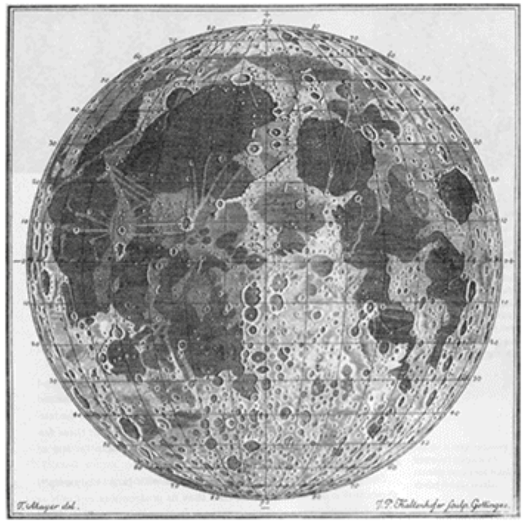
Rapid pace of technological advancement in 20th Century

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

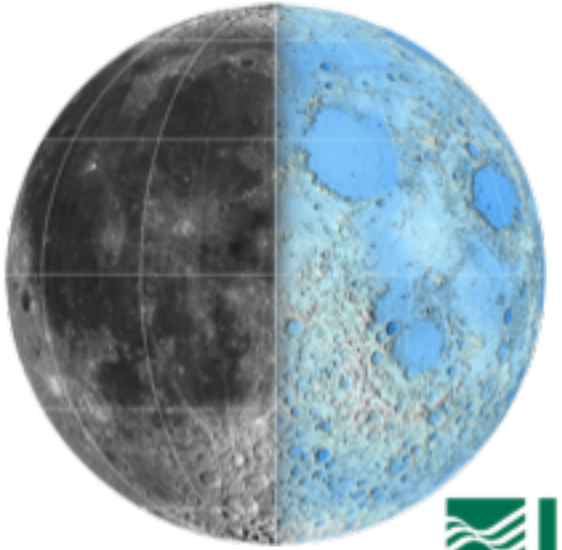
Converging with terrestrial geoscience visualization and analysis methods – desktop GIS, 3D visualization, web maps



William Gilbertin (1600)



Tobias Mayer (1775)



Hare et al. (2015)

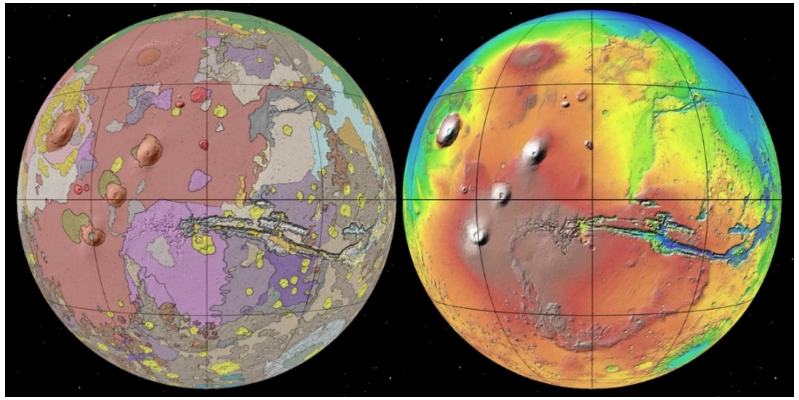
Common Data Types & Formats

Remotely sensed data

- Imagery (ortho-, mosaics), multi-spectral, altimetry (topography)
- GeoTIFF, GeoJPEG2000, ISIS3 cubes, etc.

GIS

- Evolving definition of 'cartography'
- Geologic, thematic maps
- Nomenclature
- GDAL-supported formats and tools
- OGC-compliant web services



Astrogeology.usgs.gov/facilities/mrctr-gis-lab (2018)

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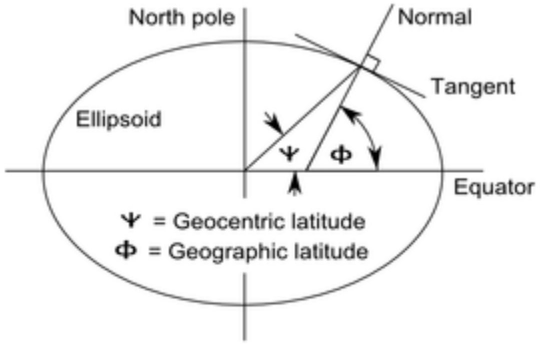
Unique Challenges

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

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Unique Opportunities

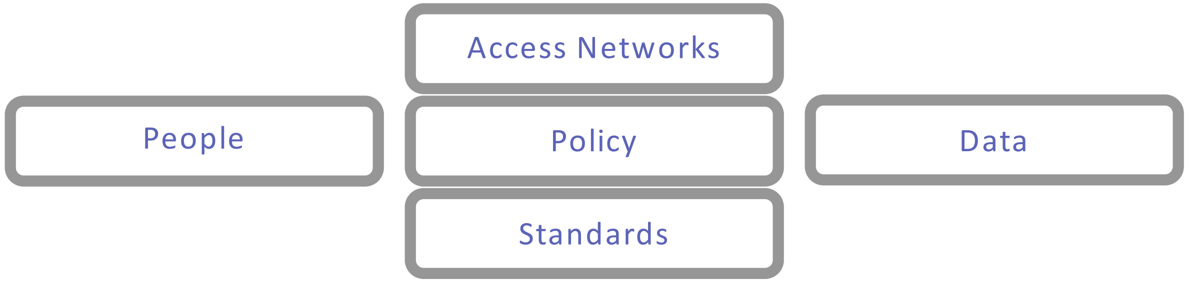
Build on terrestrial geoscience lessons learned in technical implementations and cooperative agreements (i.e., USGS National Geologic Map DB, OneGeology.org; Hare et al., 2018)

Multi-national collaborations facilitated by open data standards (Naß et al., 2017)

- Alignment of FGDC and ISO metadata standards

Our Goals

Develop within a Planetary Spatial Data Infrastructure framework



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

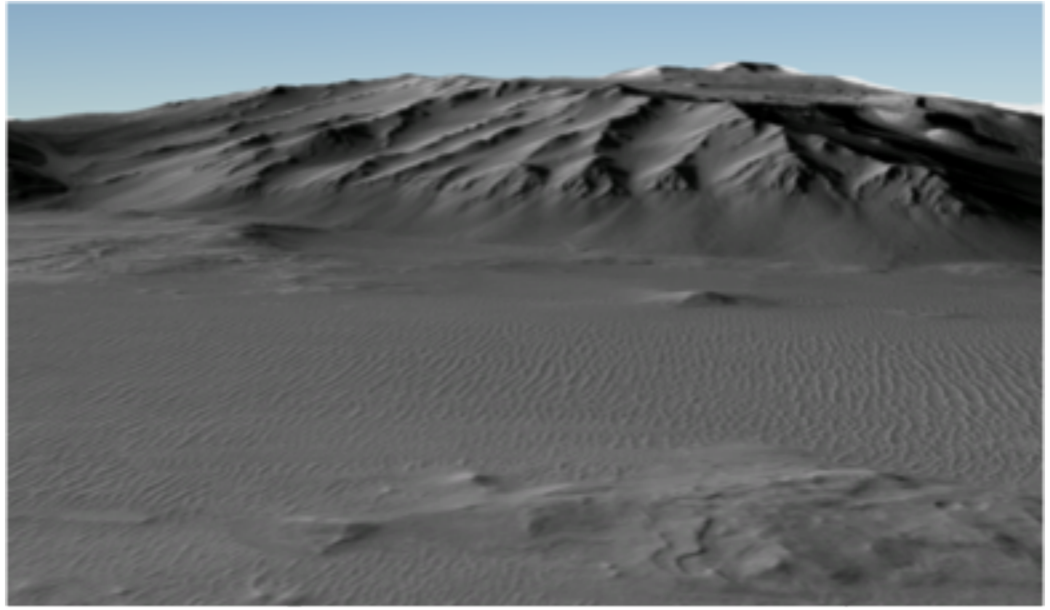
Promote discoverability, accessibility and interoperability of spatial data

Balance requirements of several data custodians and promote interests of the community

Current Efforts

Expanded web services built on open standards

- Currently serve global base maps as WMS, nomenclature as WFS
- Plans to serve geoscience data as WFS and integrate different geoscience databases via CSW
- Developing metadata and ontology standards to support semantic queries


3D view of Mars using CTX orthoimagery and DTM

Planetary implementation of existing data models

- GeMS, GeoSciML, GeoFITS

Utilize 3D visualization with high resolution data

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Conclusions

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

Highly recommend support of spatial domains beyond Earth in standards and software development

- Interoperability with body definitions and coordinate reference systems

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Referenes

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

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Questions

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

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