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Space Administration

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

Big Data Visualization for Planetary Science

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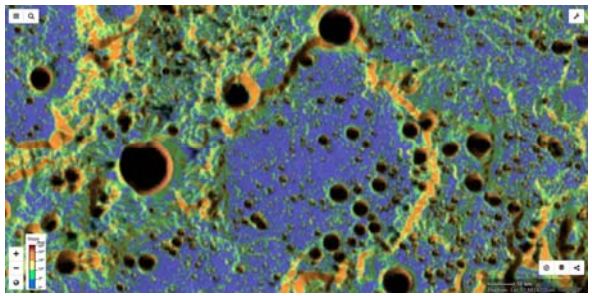
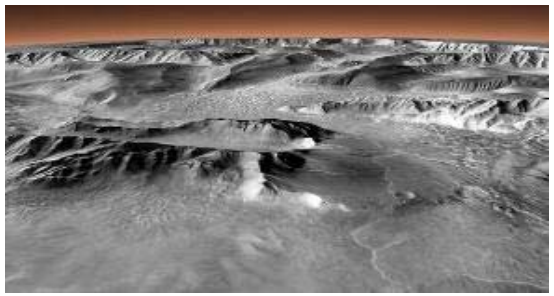
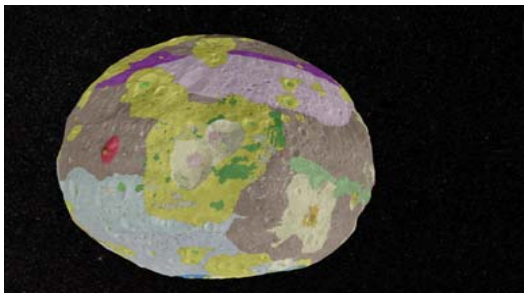

Takeaway

- Big data has many challenges
- Opportunity to leverage big data to improve user experiences and outcome
- Interactive Visualization and Analytics are critical
- Proven technologies and capabilities of those tools available today, yet data usability remains a challenge
- Path forward
  - Increase focus on data usability
  - Invest and research in these key areas
  - Work to improve and scale up data usability to meet increasing user expectations
  - Partner with industries

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Outline

- Solar System Treks Project Overview
- What Big Data Challenges Treks face
- How Treks Address Big Data Challenges
- Treks Features
- Demo / Discussion

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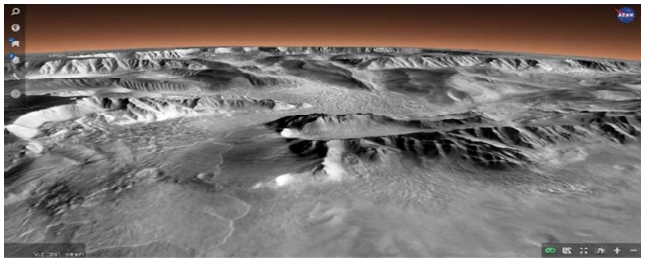
Solar System Treks Project Overview

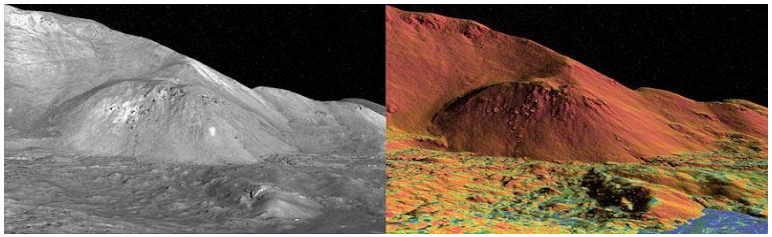
- Sponsored by SMD and HEOMD, Mission (e.g., Cassini)
- Development and operations at JPL
- An element of NASA's Solar System Exploration Research Virtual Institute (SSERVI)
- A family of web based interactive portals for mission planning, scientific research and public outreach
  - Visualization and Analysis tools
  - Data products from many past and current missions
- Data Access APIs
  - A variety of user interfaces (e.g., virtual reality goggles)
  - A variety of external platforms (e.g., Eyes on Solar System, planetariums)

Operational Treks

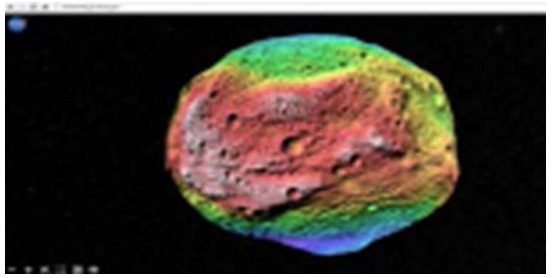
- Mars Trek
  https://marstrek.jpl.nasa.gov



- Moon Trek
  https://moontrek.jpl.nasa.gov



- Vesta Trek
  https://vestatrek.jpl.nasa.gov



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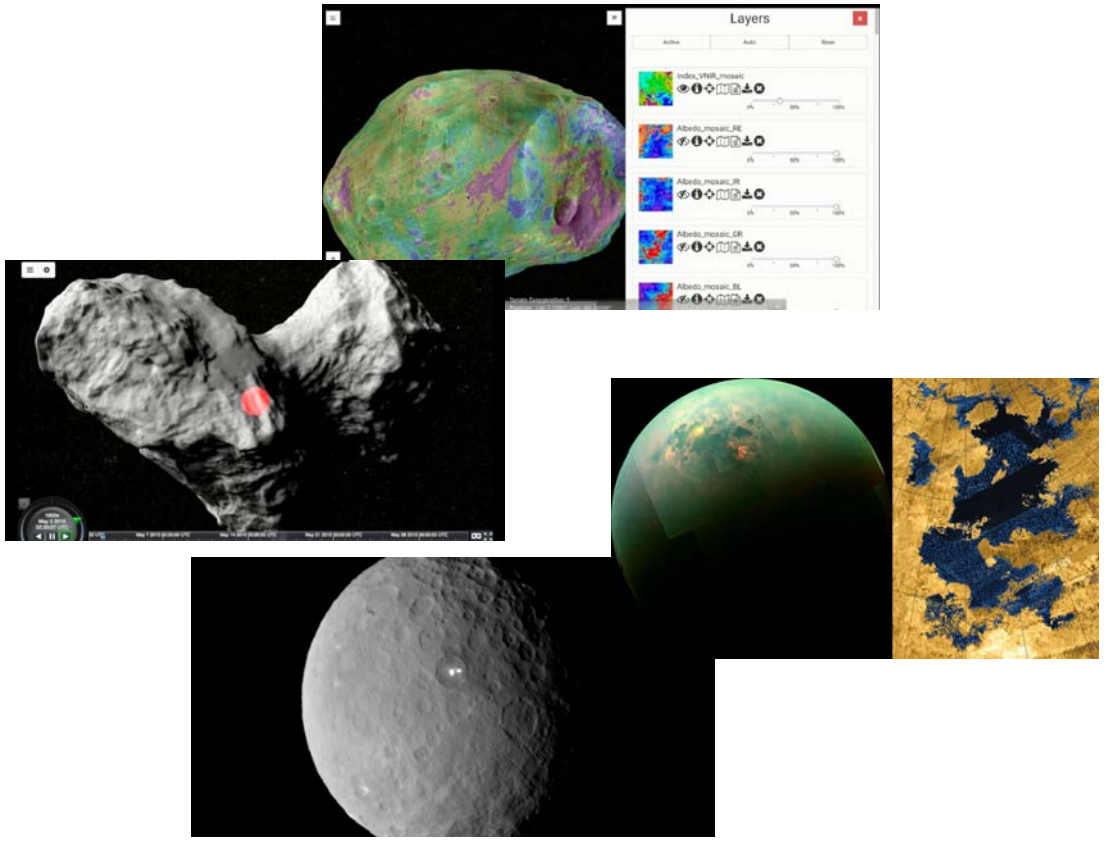
Treks In Work

- Titan Trek
- Icy Moons Trek
- Phobos Trek
- Ceres Trek
- Comet CG Trek



What Big Data Challenges Treks face

- Ever increasing (**Velocity**) Data **Volume**
  - Over 3000 data products and > 8 TB data
- Usability of large volume and **Variety** of data
  - Discovery (browse, search)
  - Provenance, Quality (**Veracity**)
  - Download
  - Sharing, Collaboration
  - **Value** Transformation of Archive Data for Visualization and Analysis

How Treks Address Big Data Challenges

- Architecture (Data and System)
  - Scalability
  - Extensibility
  - Reusability
  - Standardization / Interoperability
  - FAIR (Findable, Accessible, Interoperable, Reusable)
- Approach
  - Common Service Oriented Infrastructure
  - Data Science framework (Visualization and Analysis)
  - Open Source Big Data Technologies (e.g., Cloud computing, Hadoop, No SQL, Deep Learning)
- Applicable to other domains
  - E.g., Earth Science (Hydrology: Water Trek)

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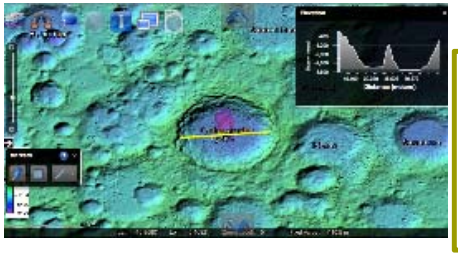
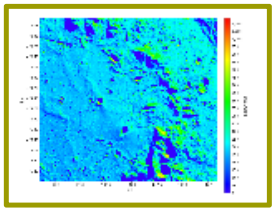
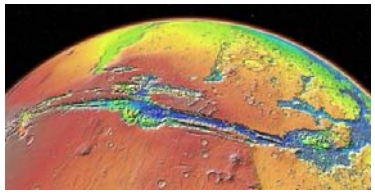
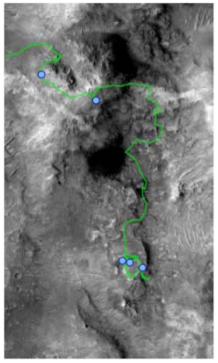
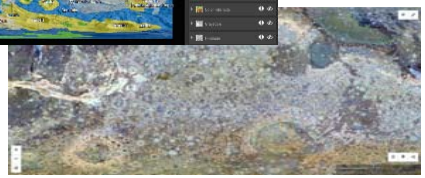
Treks Features

- Data products browse, search & download
  Analysis tools
  - Lighting, Measurement, Profile, Sun angle, Slope, Rock/Crater Detection, Hazard, Surface Potential, Subset, Path
- Visualization
  - Overlay
  - 3D Flyover
  - Landing Site features
- Collaboration (sharing)
- 3D print
- Data
  - Past/current missions and various instruments
  - Various types of data products
- Users
  - Missions, Lunar scientists, Teachers/Students, General Public



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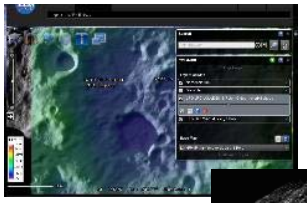
Variety of User Experiences

Virtual Reality Client



Web
REST API

HyperWall

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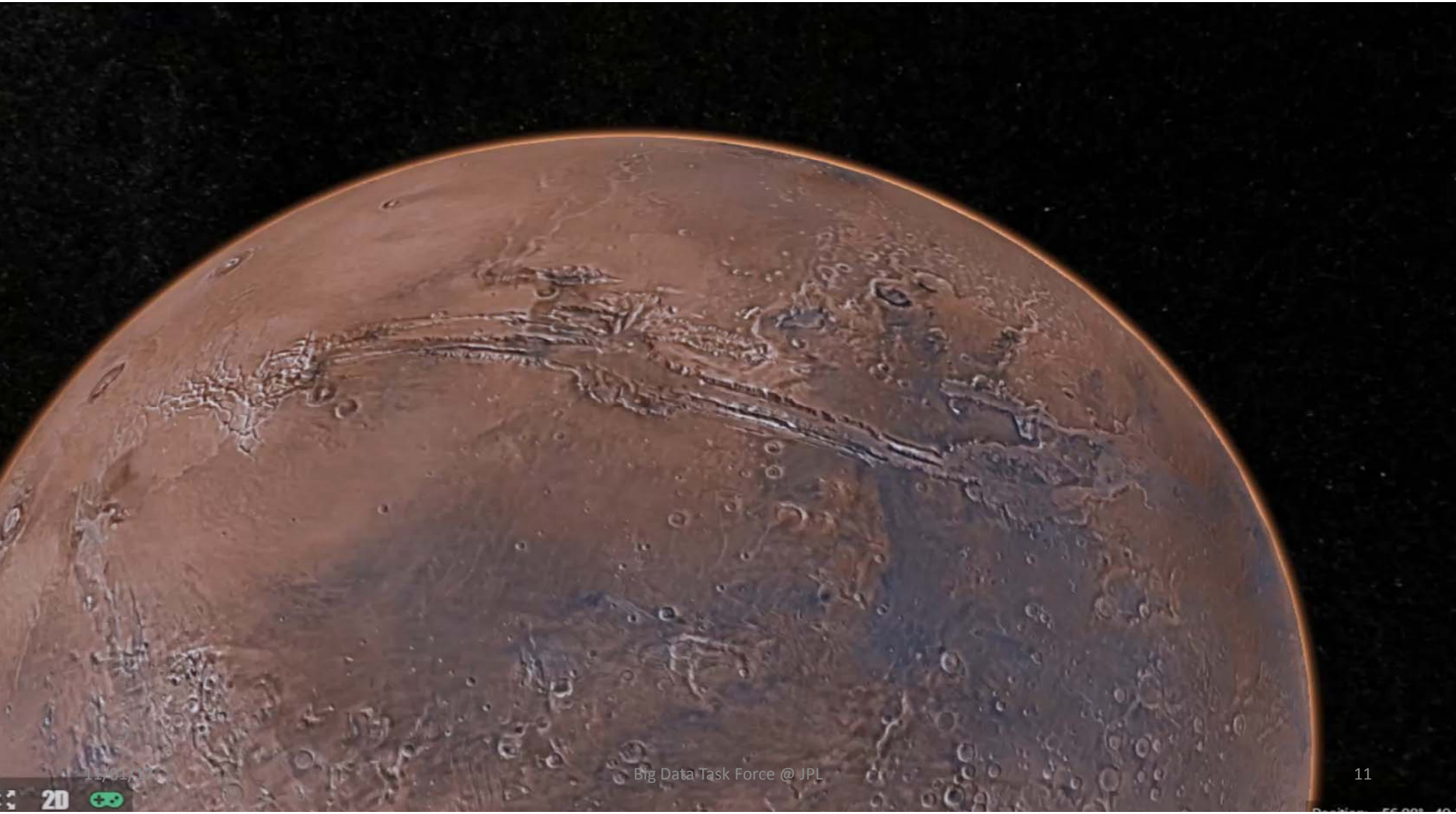
Serving data to
Morrison and
Hayden planetariums

Touch Table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Thank You!

Questions ?

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Backup

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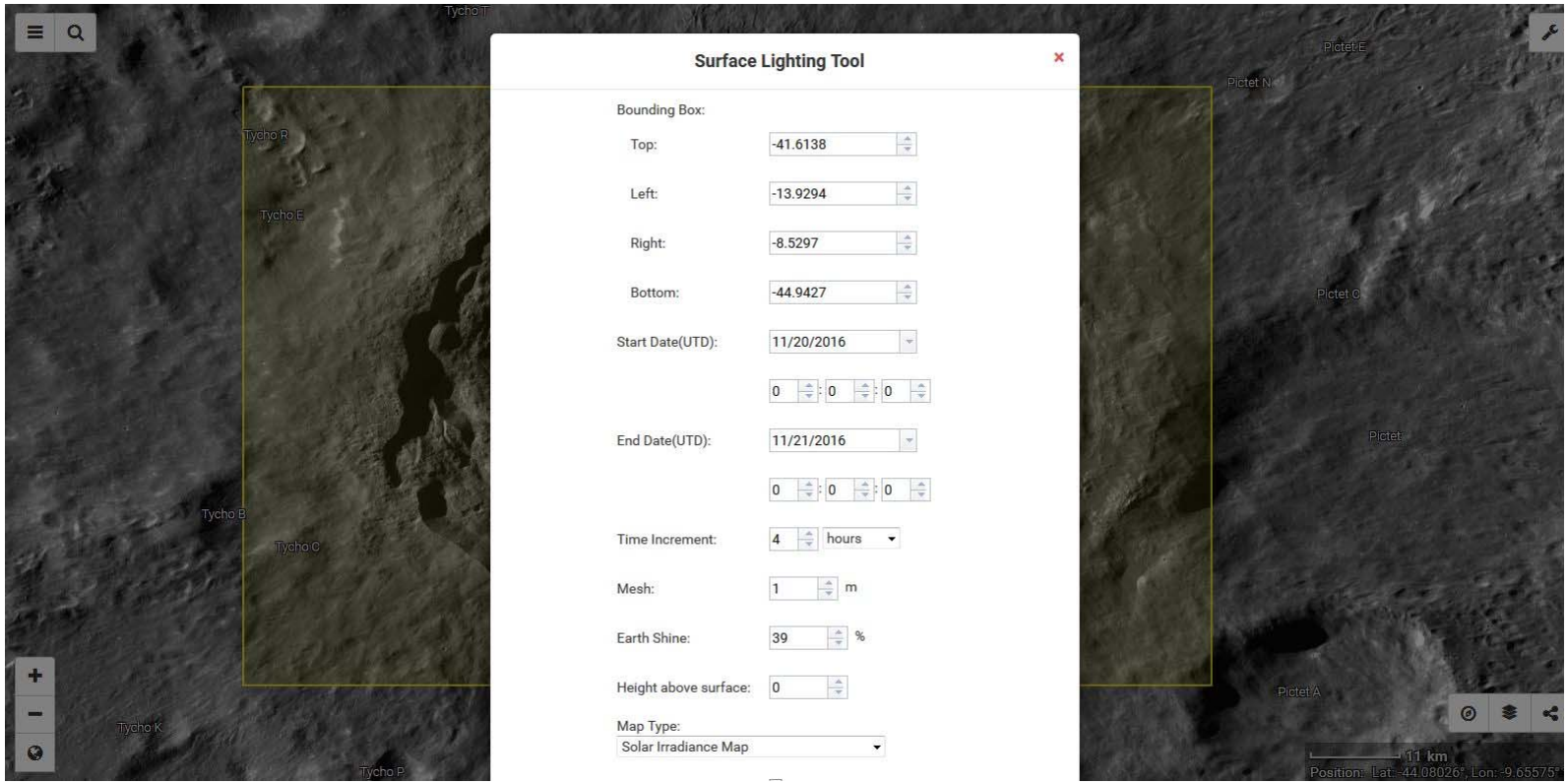
Lighting Analysis



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Lighting Analysis

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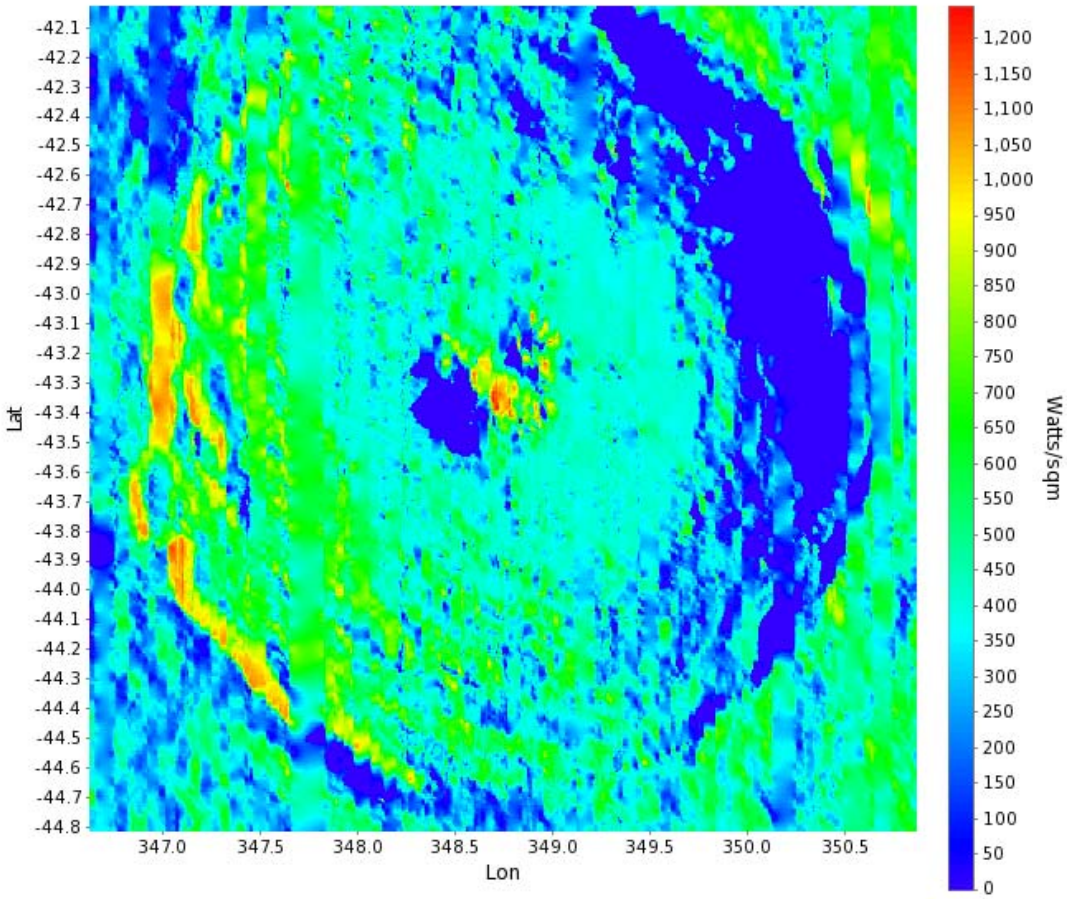

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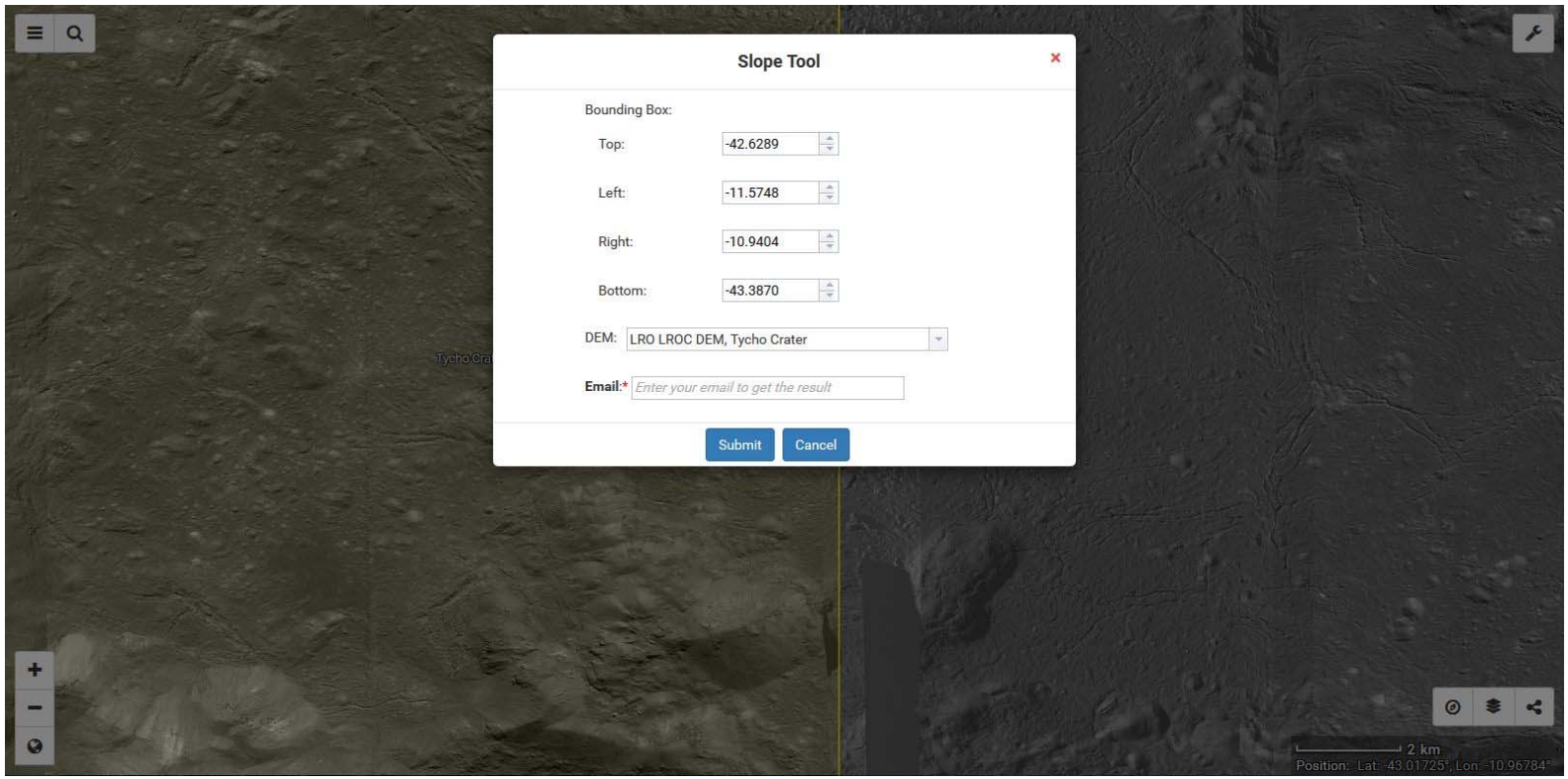
Slope Tool



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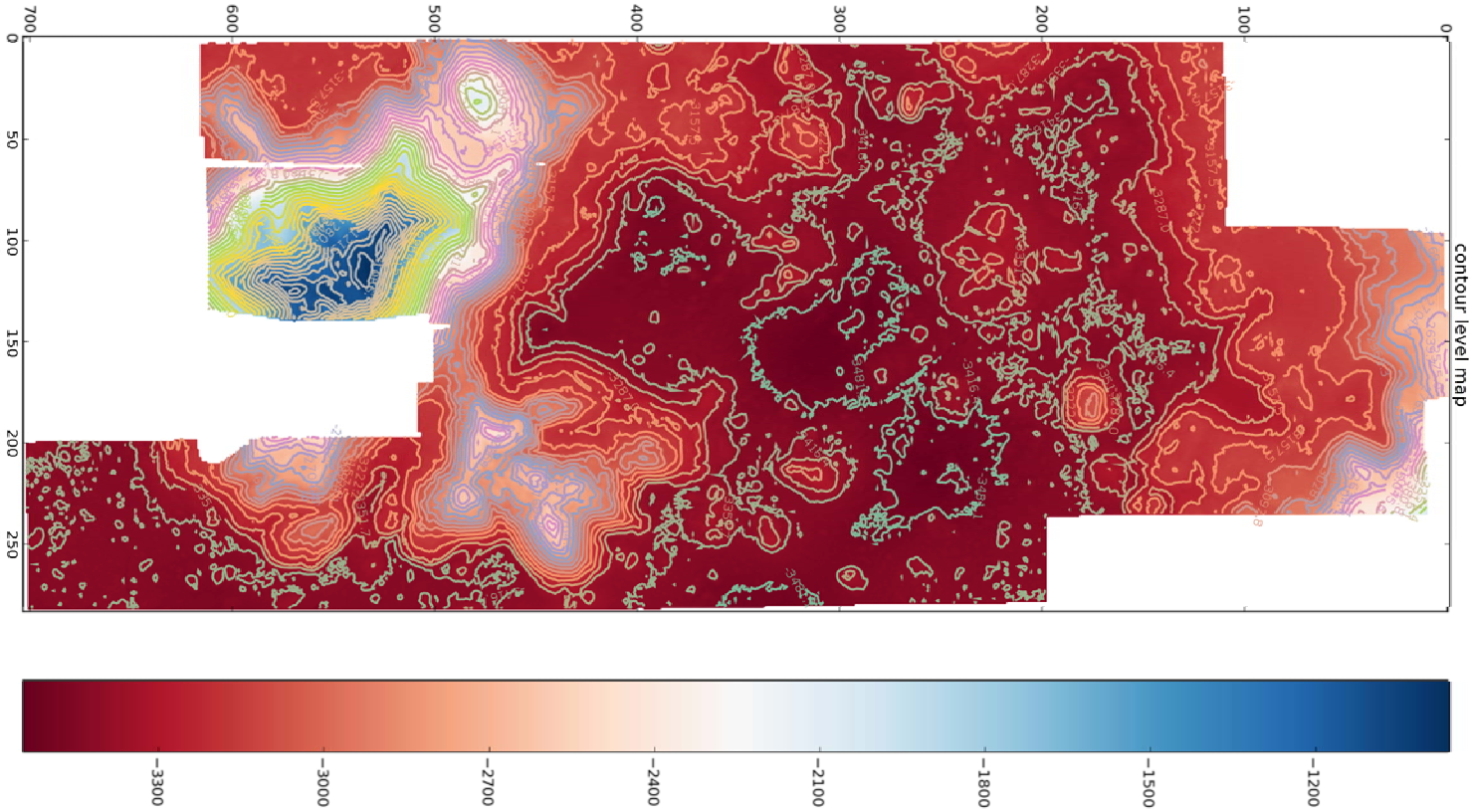

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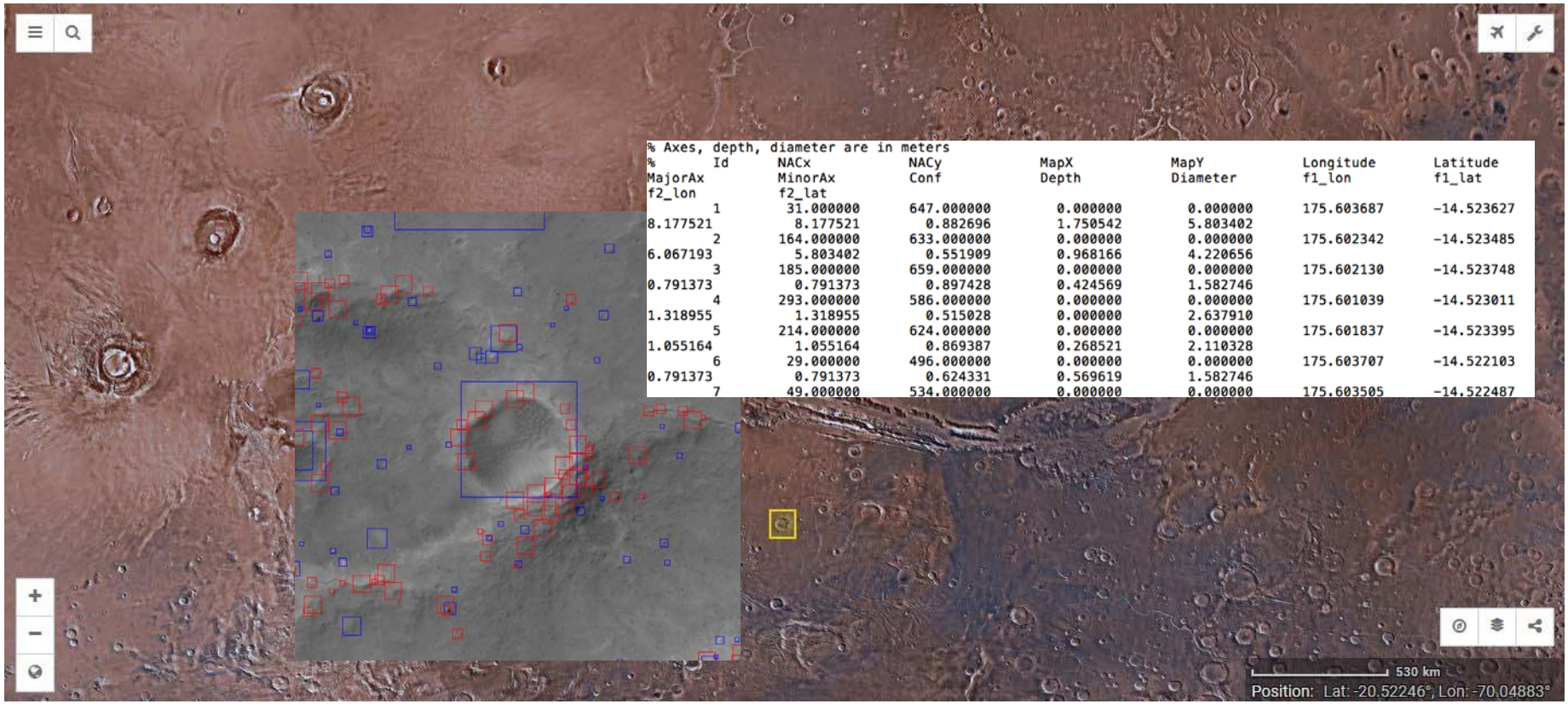
Crater Detection



% Axes, depth, diameter are in meters

% Id	NACx	NACy	MapX	MapY	Longitude	Latitude
MajorAx	MinorAx	Conf	Depth	Diameter	f1_lon	f1_lat
f2_lon	f2_lat					
1	31.000000	647.000000	0.000000	0.000000	175.603687	-14.523627
8.177521	8.177521	0.882696	1.750542	5.803402		
2	164.000000	633.000000	0.000000	0.000000	175.602342	-14.523485
6.067193	5.803402	0.551909	0.968166	4.220656		
3	185.000000	659.000000	0.000000	0.000000	175.602130	-14.523748
0.791373	0.791373	0.897428	0.424569	1.582746		
4	293.000000	586.000000	0.000000	0.000000	175.601039	-14.523011
1.318955	1.318955	0.515028	0.000000	2.637910		
5	214.000000	624.000000	0.000000	0.000000	175.601837	-14.523395
1.055164	1.055164	0.869387	0.268521	2.110328		
6	29.000000	496.000000	0.000000	0.000000	175.603707	-14.522103
0.791373	0.791373	0.624331	0.569619	1.582746		
7	49.000000	534.000000	0.000000	0.000000	175.603505	-14.522487