



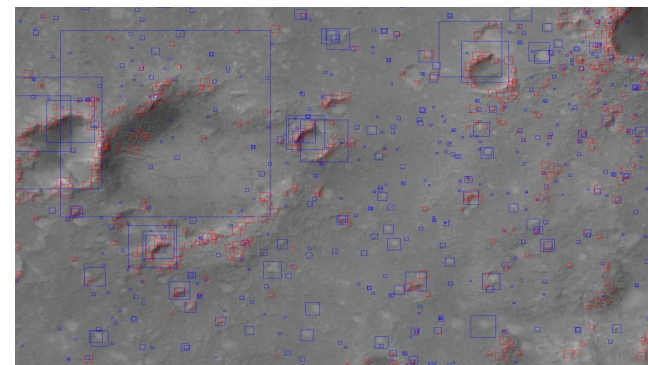
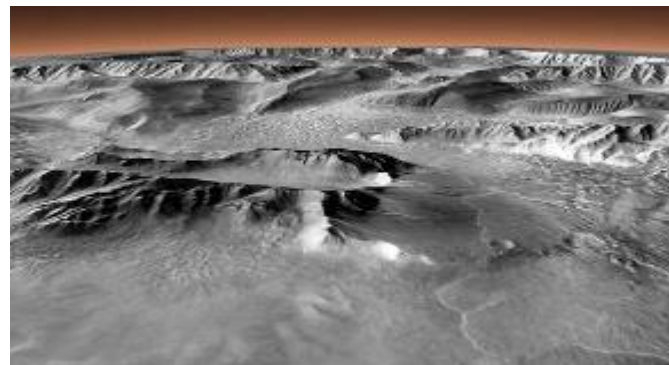
National Aeronautics and
Space Administration

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

Planetary Surface Visualization & Analytics

Planetary Science Informatics and Data Analytics

Emily Law



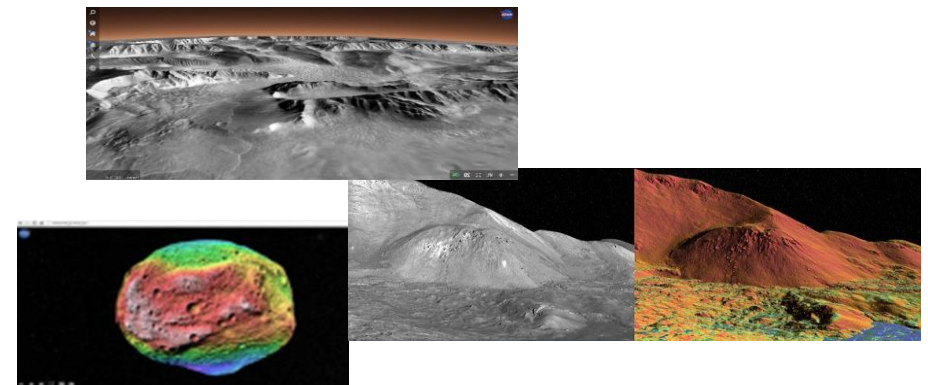
These activities were carried out at the Jet Propulsion Laboratory, California Institute of Technology,
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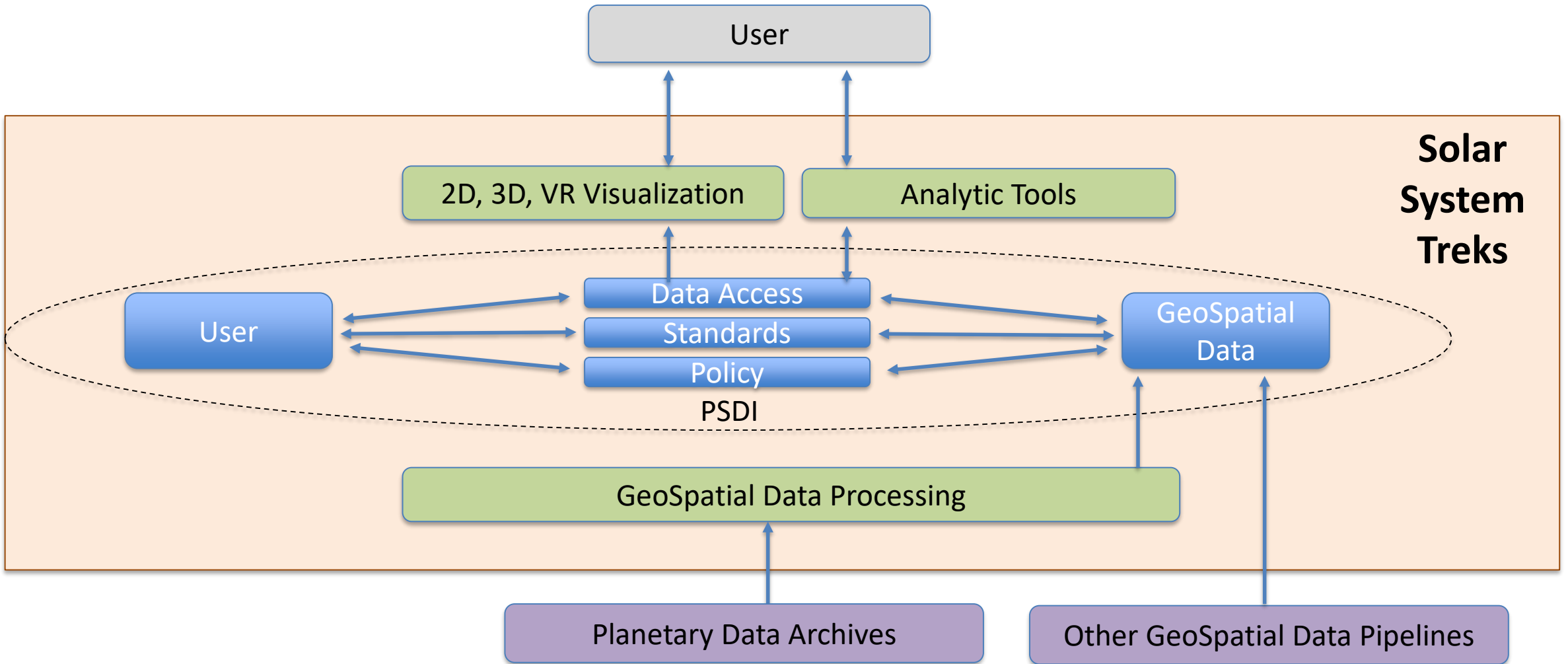
Solar System Treks (SST)

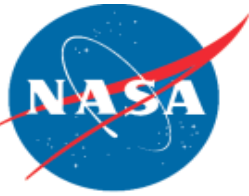
- Web based interactive portals for mission planning, research and EPO
 - Planetary surface Visualization and Analysis tools
 - GeoSpatial Data processing pipeline
 - GeoSpatial Data products based on PDS data from past and current missions
- Standard Data Access and Web Service APIs
 - A variety of user interfaces (e.g., virtual reality)
 - A variety of external platforms (e.g., planetariums)
- Publicly available portals
 - Mars (<https://marstrek.jpl.nasa.gov>)
 - Moon (<https://moontrek.jpl.nasa.gov>)
 - Vesta (<https://vestatrek.jpl.nasa.gov>)
 - More to come (e.g., Phobos, Titan)



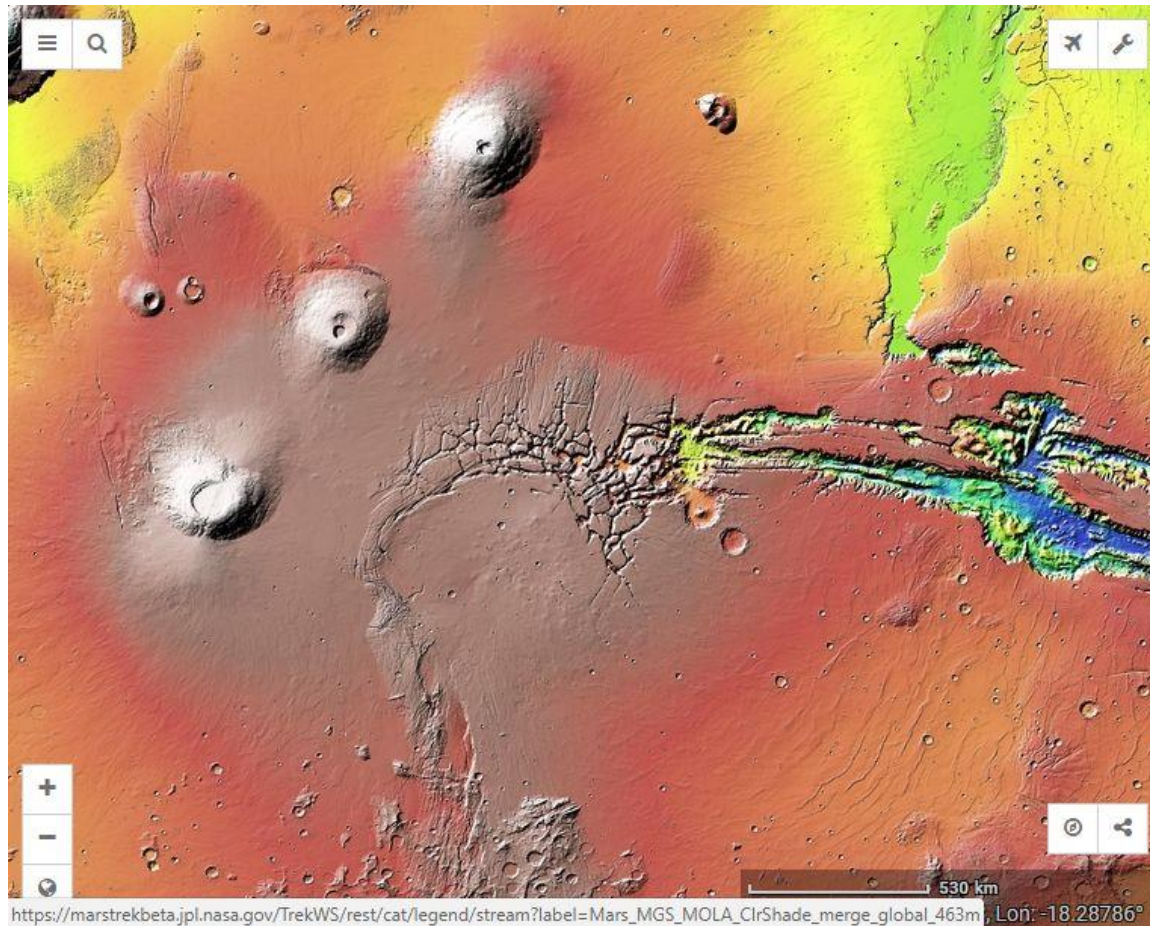


Architecture





Visualization



Layers

Added Static

MGS MOLA, Global Color Hillshade

0% 50% 100%

-8200 Minimum Elevations above 9000 meters found only on the larger volcanos 21229 Maximum

MRO CTX, Mosaic InSight

Metadata also available as

Metadata:

- [Identification Information](#)
- [Spatial Data Organization Information](#)
- [Spatial Reference Information](#)
- [Metadata Reference Information](#)

Identification Information:

Citation:

Citation Information:

Originator: NASA-JPL
 Originator: USGS
 Originator: Advanced Laboratory for Landing Site Terrain Analysis and Reconnaissance
 Publication Date: 20171129
 Title: MRO CTX, Mosaic InSight
 Geospatial Data Presentation Form: raster digital data
 Other Citation Details:
 Golombek, M., Kipp, D., Warner, N. et al. Space Sci Rev (2017) 211: 5.
 Online Linkage: <https://doi.org/10.1007/s11214-016-0321-9>

Description:

Abstract:

This is a 5m/px CTX orthophoto mosaic of the InSight Landing Site. After being transformed using a spline transformation, each image had the exterior 100m of pixels removed and was detrended by fitting a third order polynomial and subtracting it from each image. All of the detrended images were then mosaiced into a single image and color balanced using Distributed Gradient-Domain processing.

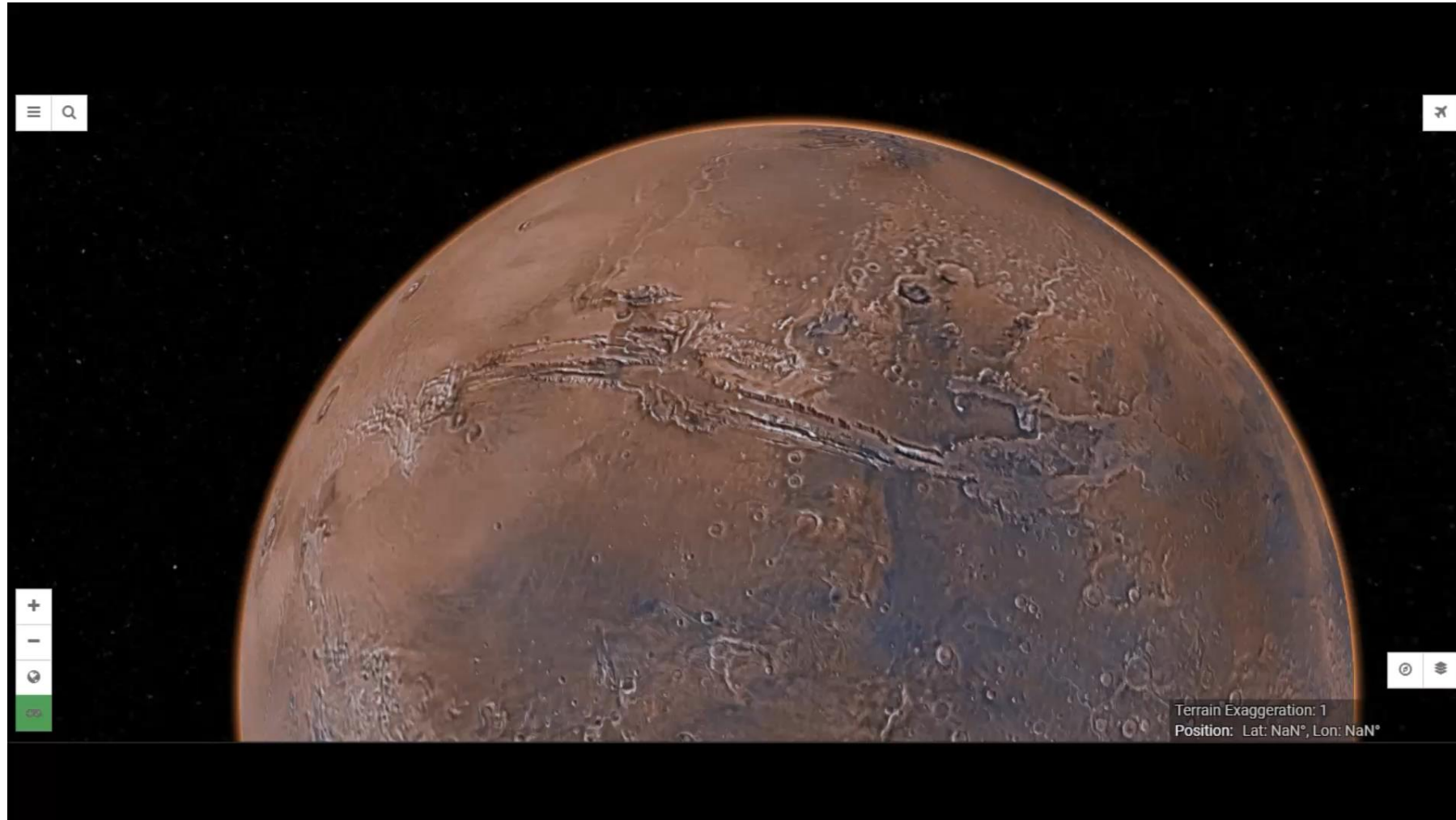
+ Add Layer

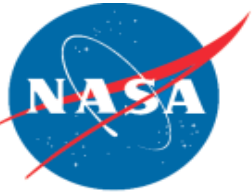


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3D Visualization





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Other User Interfaces



Mobile Apps



Virtual Reality Goggles



HyperWall

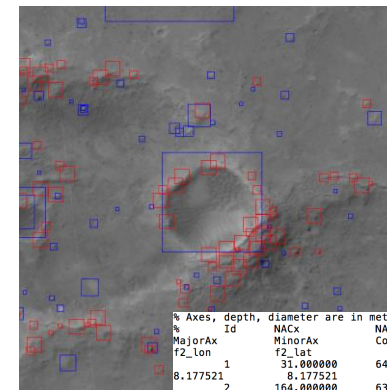
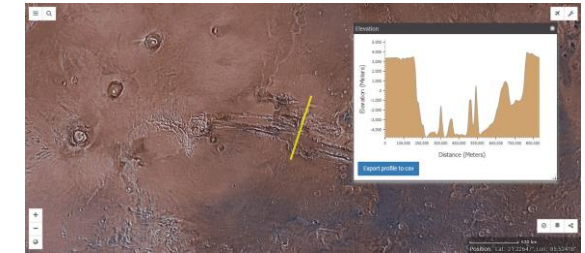
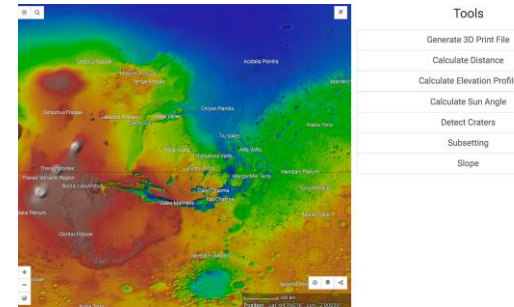


Touch Table

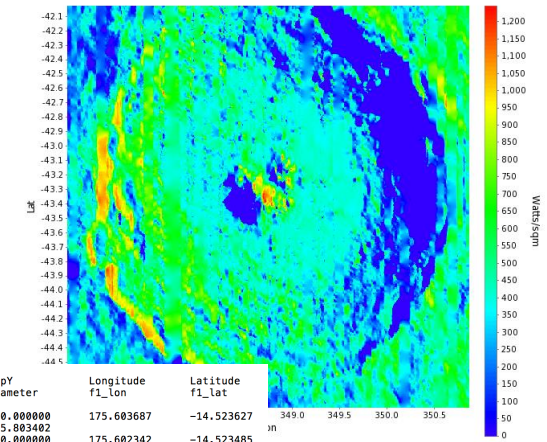


Analytics

- Basic tools
 - Distance, Elevation, Sun Angle, 3D prints generation
- Advanced tools for exploration and research
 - Lighting, Crater Detection, Rock Detection, Slope, Path, Surface Potential



%	MajorAx	MinorAx	NACx	NACy	MapX	MapY	Longitude	Latitude
f2_lon	f2_lat	f2_lat	Conf	Depth	Diameter	f1_lon	f1_lat	
1	31.000000	647.000000	0.000000	0.000000	0.000000	175.603687	-14.523627	
2	164.000000	633.000000	0.000000	0.000000	0.000000	175.602342	-14.523485	
3	5.803402	0.551909	0.968166	4.220656	0.000000	175.602130	-14.523748	
4	185.000000	659.000000	0.424569	1.552746	0.000000	175.601039	-14.523011	
5	1.318955	0.515028	0.000000	2.637910	0.000000	175.601837	-14.523395	
6	214.000000	624.000000	0.000000	0.000000	0.000000	175.603707	-14.522103	
7	1.055164	0.869387	0.260521	0.000000	0.000000	175.603707	-14.522103	
	29.000000	496.000000	0.000000	1.582746	0.000000	175.603505	-14.522487	
	0.791373	0.624331	0.569619	0.000000	0.000000			
	49.000000	534.000000	0.000000					

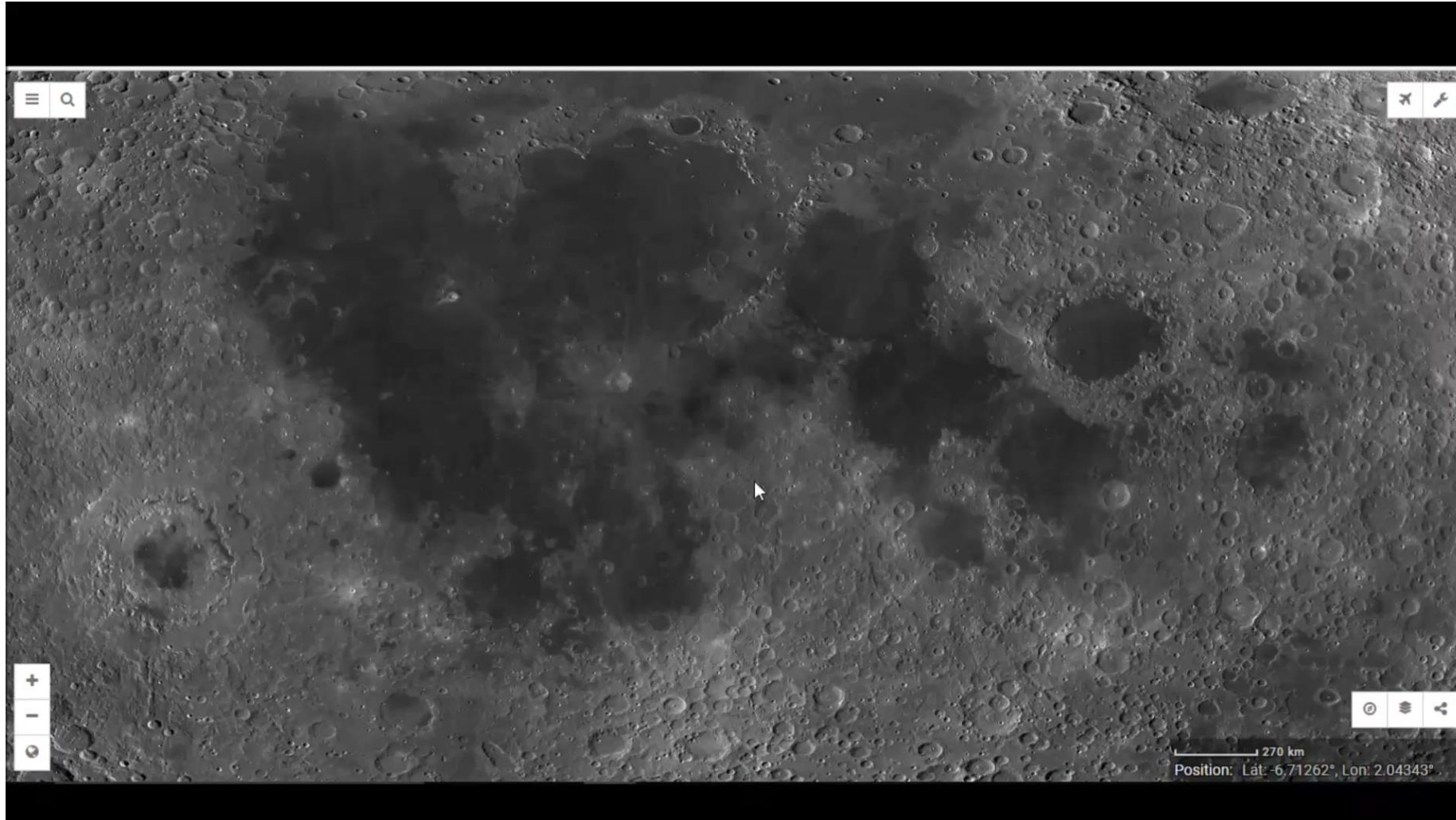




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Visualization & Analytics



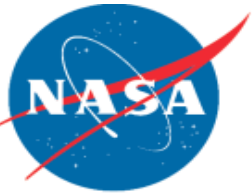


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3D Model





Lighting Analysis

Surface Lighting Tool

Bounding Box:

Top: -41.6138

Left: -13.9294

Right: -8.5297

Bottom: -44.9427

Start Date(UTD): 11/20/2016

0 : 0 : 0

End Date(UTD): 11/21/2016

0 : 0 : 0

Time Increment: 4 hours

Mesh: 1 m

Earth Shine: 39 %

Height above surface: 0

Map Type: Solar Irradiance Map

Position: Lat: -44.08026°, Lon: -9.65575°



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Lighting Analysis Result



2016-312T00:00:00.000



Slope Analysis

Slope Tool

Bounding Box:

Top:

Left:

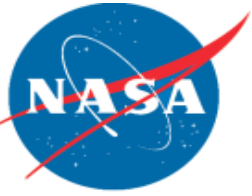
Right:

Bottom:

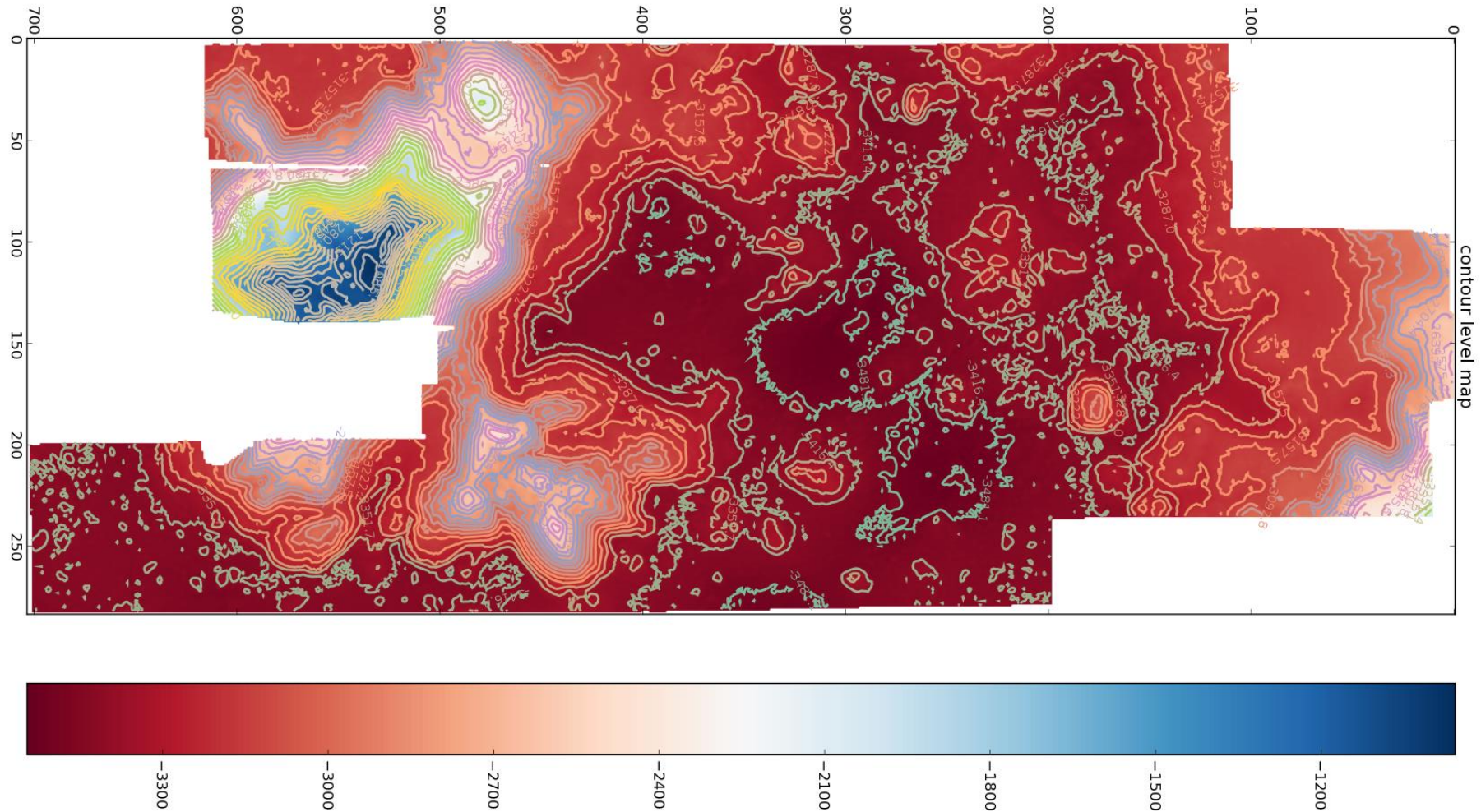
DEM:

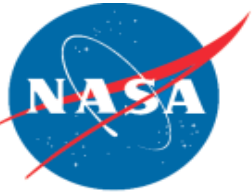
Email*

2 km
Position: Lat: -43.01725°, Lon: -10.96784°



Slope Analysis Result





Crater Detection

https://moontrek.jpl.nasa.gov/#v=0.1&x=-79.76623386363772&y=-5.564575091513323&z=7&p=urn%3Aogc%3Adef%3Acrs%3AEPSSG...

Detect Crater ✕

Bounding Box:

Top:

Left:

Right:

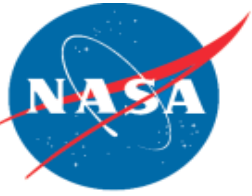
Bottom:

downsample rate(X): ?

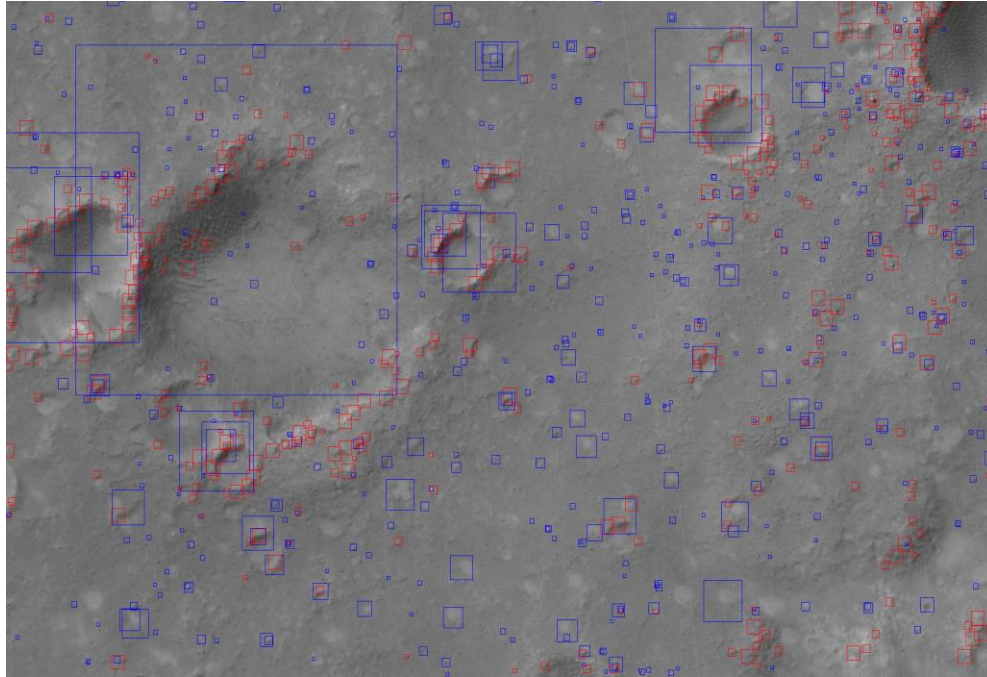
Selected Image: ?

Image Name	Incidence	Upper Left	Upper Right	Lower Left	Lower Right
M107379635LE	20.62	-4.81, 283.25	-4.81, 283.43	-6.78, 283.26	-6.78, 283.43
M133336589RE	80.71	-3.71, 282.94	-3.71, 283.02	-5.44, 282.96	-5.44, 283.04
M133336589LE	80.64	-3.71, 282.87	-3.71, 282.94	-5.44, 282.88	-5.44, 282.96
M165167375RE	107.37	-8.71, 283.26	-8.71, 283.19	-3.57, 283.38	-3.57, 283.31
M179314626LE	88.27	-6.05, 282.77	-6.06, 282.94	-2.79, 282.85	-2.8, 283.03
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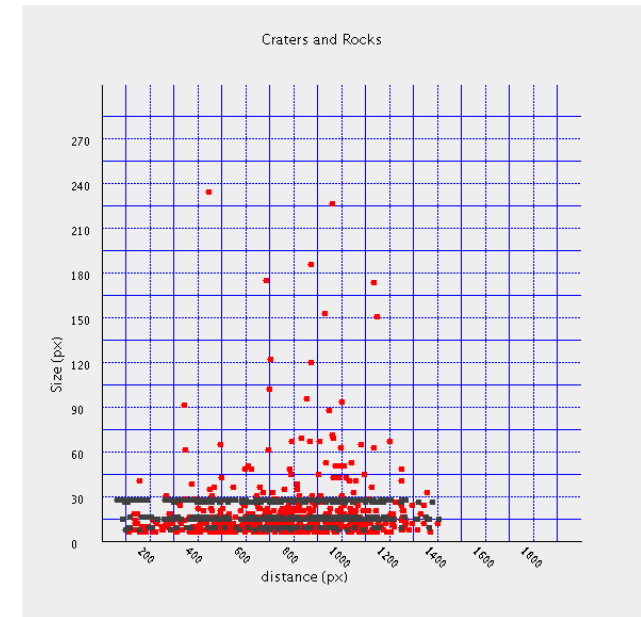
Email:



Crater/Rock Detection Result



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





Summary

- Planetary exploration and science are complex
 - Data is difficult to interpret and use
- Interactive Visualization and Analytics have major impact
 - Lower barrier of usability, advance science & science communication, inspire public
- Technologies and capabilities exist but lacking, more investments needed
 - Visualization and analytics
 - Value added geospatial product generation
- Solar System Treks project continues to advance these fields
 - New portals coming soon: Phobos, Titan, IcyMoons, Ceres



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Thank You

<https://moontrek.jpl.nasa.gov>

<https://marstrek.jpl.nasa.gov>

<https://vestatrek.jpl.nasa.gov>

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