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Overview

Planetary Mapping and Modeling - Solar System TREKS

• An integral project within NASA’s Solar System Exploration Research Virtual Institute (SSERVI), managed out of the SSERVI Central Office, and with software development and operations at JPL

• A set of data products, interactive tools and technology for exploration
  – Mission Planning
  – Scientific Research
  – Public Outreach

• Online, browser-based Web portal; nothing to install

• Visualization, Analysis, 3D Printing, Data Service
  – A variety of user interfaces (e.g., virtual reality goggles)
  – A variety of external platforms (e.g., Eyes on Solar System, planetariums)
  – Applicable to a wide range of target bodies
A New Look at the Moon:
• Moon Trek is a major new release that significantly upgrades and builds upon the capabilities of its predecessor, NASA’s Lunar Mapping and Modeling Portal (LMMP).
• Greatly improved navigation, 3D visualization, fly-overs, performance, and reliability.
• Compatibility with the other Trek portals developed by NASA’s Lunar and Planetary Mapping and Modeling Project.
• Designed for mission planning, lunar science, education and public outreach
• New 3D globe view uses standard keyboard game controls, for detailed fly-overs, and generating views from whatever angle and location the user desires.
Moon Trek

- Analysis tools
  - Lighting, Slope, Hazard, Profile, Sun angle
- Browse, search and download of data products
- Visualization (with overlays)
- Collaboration (bookmark)
- 3D print and terrain view
- Data
  - LRO, Apollo, LP, GRAIL, Clementine, Chandrayaan-1, Kaguya
  - Gravity models, Imagery, DEMs, Hazards, Resources
- Users
  - Missions, Lunar scientists, EPO
Insert MoonIntro movie here.
STL Generation
Insert Moon3D movie here.
Lighting Analysis
Lighting Analysis

Insert Lighting movie here.
Lighting Analysis
NAC Mosaic of Tycho Crater
Slope Tool
Slope Tool
Slope Maps (and More)
More Analysis Tools Coming Soon

- Crater Detection/Abundance
- Rock Detection/Abundance
- Electric Surface Potential Analysis (SSERVI PI Bill Farrell)
- Path Tool
Crater/Rock Detection
Crater/Rock Detection

Craters and Rocks

Distance (px) vs. Size (px)
Surface Potential Analysis
North Pole

LRO LOLA Laser Altimetry
North Pole

LRO DIVINER Average Temperature
North Pole

LRO DIVINER Maximum Temperature
North Pole

LRO LOLA Slope Map
North Pole

LOLA Permanently Shadowed Regions
North Pole

Hydrogen Abundance
The Marius Hills – one of the most spectacular concentrations of volcanoes on the Moon, as seen by LRO's Wide Angle Camera.
The Marius Hills

Initially, the Layers Search can be pretty imposing.
The Marius Hills

Narrowing the search based on the search term “LOLA”.

LOLA Roughness 16ppd, Colorized
LOLA Slope 16ppd, Colorized
LOLA and TC Stereo DEM Merge 512ppd, Shade
LRO LOLA DEM
LRO LOLA DEM, ColorHillshade
LRO LOLA DEM, ColorHillshade
LRO LOLA DEM, Coverage
LRO LOLA DEM, Grayscale
LRO LOLA DEM, Hillshade
The Marius Hills – one of the most spectacular concentrations of volcanoes on the Moon, as seen using a merge of LRO LOLA and Kaguya TC Stereo.
Measure a distance from the basic analysis tools available to any user.
The Marius Hills

Measure a distance from the basic analysis tools available to any user.
The Marius Hills

Measure a distance from the basic analysis tools available to any user.
The Marius Hills

Measure a distance from the basic analysis tools available to any user.
Calculate an elevation profile from the basic analysis tools available to any user.
Calculate an elevation profile from the basic analysis tools available to any user.
The Marius Hills

Functions associated with layers that have been loaded.
The Marius Hills

Toggle visibility
The Marius Hills

View general information about the layer.
The Marius Hills

View general information about the layer.
The Marius Hills

Fly to position.
The Marius Hills

View metadata.
The Marius Hills

Download data.
The Marius Hills

Remove the layer from your stack of loaded layers.
The Marius Hills

Search for “Kaguya” layers and load the Colorized Freeair Gravity Map.
The Marius Hills

Kaguya Colorized Freeair Gravity Map of the same area.
The Marius Hills

Show the legend for this layer
Adjust transparency of top gravity map layer to blend in the topography shown in the next layer down.
The Marius Hills

This allows us to visualize the surface topography of the volcanic field as well as the now-solidified, unerupted magma chamber beneath the complex.
The Marius Hills

Share your visualization by either generating a screen capture or a URL web link.
Mineralogy

• Where’s Moon Mineralogy Mapper?
  ▪ Star tracker problem resulted in georeferencing errors for the product.
  ▪ Efforts to correct the product are underway.
  ▪ We will integrate once a corrected product is available.
• Do have a variety of Clementine and Lunar Prospector products now.
• Working with Myriam Lemelin (SSERVI CLSE) to integrate strong signal and well-calibrated reflectance acquired by two different instruments, the Kaguya Spectra Profiler (SP) and the Lunar Orbiter Laser Altimeter (LOLA), in order to derive the first FeO and mineral maps of the polar regions at a spatial resolution of 1 km per pixel.
• Working to integrate Paul Lucey’s combined visible and near-IR multispectral data from the Kaguya Multiband Imager (MI) with thermal infrared multispectral data from the LRO Diviner Lunar Radiometer Experiment to produce global mineral abundance data at 60-m resolution.
• Planning to integrate Ice Stability depth maps by SSERVI researcher Matt Siegler (PSI).
A few more layer examples

WAC mosaic of Sinus Medii area.
A few more layer examples

Same area, LRO DIVINER CF Mosaic 128ppd, Colorized
A few more layer examples

Same area, LRO Diviner Rock Abundance Mosaic 128ppd, Colorized
WAC Mosaic

Same area, LRO Diviner Surface Temperature Mosaic 128ppd, Colorized
Time Series

We will be adding the ability to display time series data in a coming release.

This will enable us to display Jean-Pierre Williams’ temperature data featuring approximately a quarter trillion calibrated radiance measurements of the Moon, acquired over 5.5 years by Diviner, compiled into a $0.5^\circ$ resolution global dataset with a 0.25 hour time resolution.
DEM Evolution

Hortensius Domes – LOLA V4
DEM Evolution

Hortensius Domes – LOLA V6
DEM Evolution

Hortensius Domes – LOLA and Kaguya Terrain Camera Stereo Merge
North Pole - Peary

Elevation Map

NAC Imagery

Slope Map
Looking Ahead

Collaborate with NASA Astromaterials Acquisition and Curation Office at JSC to be able to access their database of Apollo lunar samples, and with SSERVI researcher Noah Petro (RIS4E and FINESSE) to integrate his digitized Apollo traverses so as to be able to enter an Apollo sample number into Moon Trek and have it take you to the location from which it was collected.
Enhance integration with lunar samples by linking to the Apollo samples in the Virtual Microscope from SSERVI’s Open University UK International partner.
Mars Trek
(https://marstrek.jpl.nasa.gov)

- Analysis tools
  - Distance, Profile, Sun Angle, Spacecraft Overhead
- Landing Site features
  - Viking, MER, MSL, Phoenix, Pathfinder
- Visualization (with overlays)
- 3D fly over and printing
- Data
  - Mars Reconnaissance Orbiter, Mars Odyssey, Mars Global Surveyor, Viking, Mars Express
- Users
  - EPO, Scientists
Science

NASA pops open a big can of red planet whup-ass with Mars Trek

Stand on Olympus Mons, tallest mountain in the Solar System
Mars Trek
(https://marstrek.jpl.nasa.gov)
Mars Trek
(https://marstrek.jpl.nasa.gov)

Mars Exploration Zones
Mars Trek
(https://marstrek.jpl.nasa.gov)

Mars Exploration Zones
Mars Trek

(https://marstrek.jpl.nasa.gov)

Mars Exploration Zones
Insert VM movie here.
Mars Trek
(https://marstrek.jpl.nasa.gov)

Valles Marineris – Eastern Melas Chasma
CTX Mosaic
Mars Trek

(https://marstrek.jpl.nasa.gov)

Valles Marineris – Eastern Melas Chasma
CTX Mosaic with overlay of CRISM Bound Water Polyhydrated Sulfates
Mars Trek

(https://marstrek.jpl.nasa.gov)

Valles Marineris – Eastern Melas Chasma
CTX Mosaic with overlay of CRISM Chloride Deposits
Mars Trek
(https://marstrek.jpl.nasa.gov)

Valles Marineris – Eastern Melas Chasma
CTX Mosaic with overlay of CTX Iron Minerals
Mars Trek
(https://marstrek.jpl.nasa.gov)

Hydrous Mineral Detections
Mars Trek
(https://marstrek.jpl.nasa.gov)

Global Geologic Map
Some Additional Layers

Hydrous Mineral Detections, Chloride Survey, Aqueous Mineral Distribution
TES: Albedo Mosaic, Thermal Inertia, High-CA Pyroxene, Plagioclase, Sheet Silicates/High-Si Glass, Surface Dust, TES Dust Cover Index
Mars Trek
(https://marstrek.jpl.nasa.gov)

RSLs, New Craters, and Active Gullies
Mars Trek


Mars Valley Networks (Hynek et al 2010)
Mars Trek
(https://marstrek.jpl.nasa.gov)

Kasei Valles: MOLA laser altimetry data from the Mars Global Surveyor spacecraft.
Mars Trek
(https://marstrek.jpl.nasa.gov)

Mars Exploration Zones
Mars Trek
(https://marstrek.jpl.nasa.gov)

Mars Dune Fields (Hayward et al, 2007)
The Bagnold Dunes in Gale Crater and the path of the Curiosity Rover
Insert Gale movie here.
Insert Gusev movie here.
Insert Jezero movie here.
Victoria Crater: Visualization using data from the HiRISE camera aboard the Mars Reconnaissance Orbiter. Opportunity’s path here in green.
Victoria Crater: Ground level view using data from the HiRISE camera aboard the Mars Reconnaissance Orbiter. Opportunity’s path here in green.
Insert McLaughlin movie here.
Mars Trek
(https://marstre.kp.jpl.nasa.gov)

Glacial landforms showing belts of mid-latitude glaciers
Mars Trek
(http://marstrek.jpl.nasa.gov)

Exploration Zones in the Deuteronilus Mensae region
Insert Deut movie here.
Mars Trek
(https://marstrek.jpl.nasa.gov)

CTX Mosaic: Rampart crater and lobate debris apron north of Reull Vallis
Mars Trek
(http://marstrek.jpl.nasa.gov)

Mars Express HRSC Mosaics

Working with the HRSC team and SSERVI German PI, Ralf Jaumann, as they produce global mosaics and DEMS. MC-11 quad was the first to be produced, and has been integrated into Mars Trek.
Climate/Weather

- Working with Laura Kerber at JPL on integration of her mapped data products focusing on Mars climate
- Working with Jeff Hollingsworth at NASA Ames to determine ways of representing his weather models
- As we integrate time series capabilities, looking at integration of MARCI daily global images documenting Martian weather
Vesta Trek
(https://vestatrek.jpl.nasa.gov)

- Analysis tools
  - Distance, Profile, Sun Angle, Sun and Earth Overhead
- Browse data products
- Visualization (with overlays)
- 3D fly over and printing
- Data
  - Iron, Hydrogen, Neutron, Geology, Hillshade, High-energy Gamma-Ray
- Users
  - EPO, Scientists
Vesta Trek
(https://vestatrek.jpl.nasa.gov)

Vesta 3D view with Hydrogen Abundance layer overlaid.
Vesta Trek

(https://vestatrek.jpl.nasa.gov)

Pitted terrain north of Marcia
Pitted terrain north of Marcia with the addition of the Vesta Trek Mineral Ratio layer using a mosaic of Dawn HAMO frames with band ratios emulating the Clementine Mineral Ratio Mosaic.
User Experience

Virtual Reality Client

Web
REST API

Touch Table
Outreach

Serving as an Infrastructure Project for SMD STEM Activation

Serving data to Morrison and Hayden planetariums

2nd year of student HLS2 meetings at Ames

Support NASA booth exhibits at AGU, NSTA, ALA, Comic Con

CSULA Senior Projects
Help us improve these portals!

Please let us know of any data products that you have and/or know about which would be of particular value to you to have included.
Thank You!

https://moontrek.jpl.nasa.gov
https://marstrek.jpl.nasa.gov
https://vestatrek.jpl.nasa.gov

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