Orthophoto mosaic, elevation mosaic, and hazard analysis package for a potential Lacus Mortis landing site produced as part of Moon Trek

Abstract #2172

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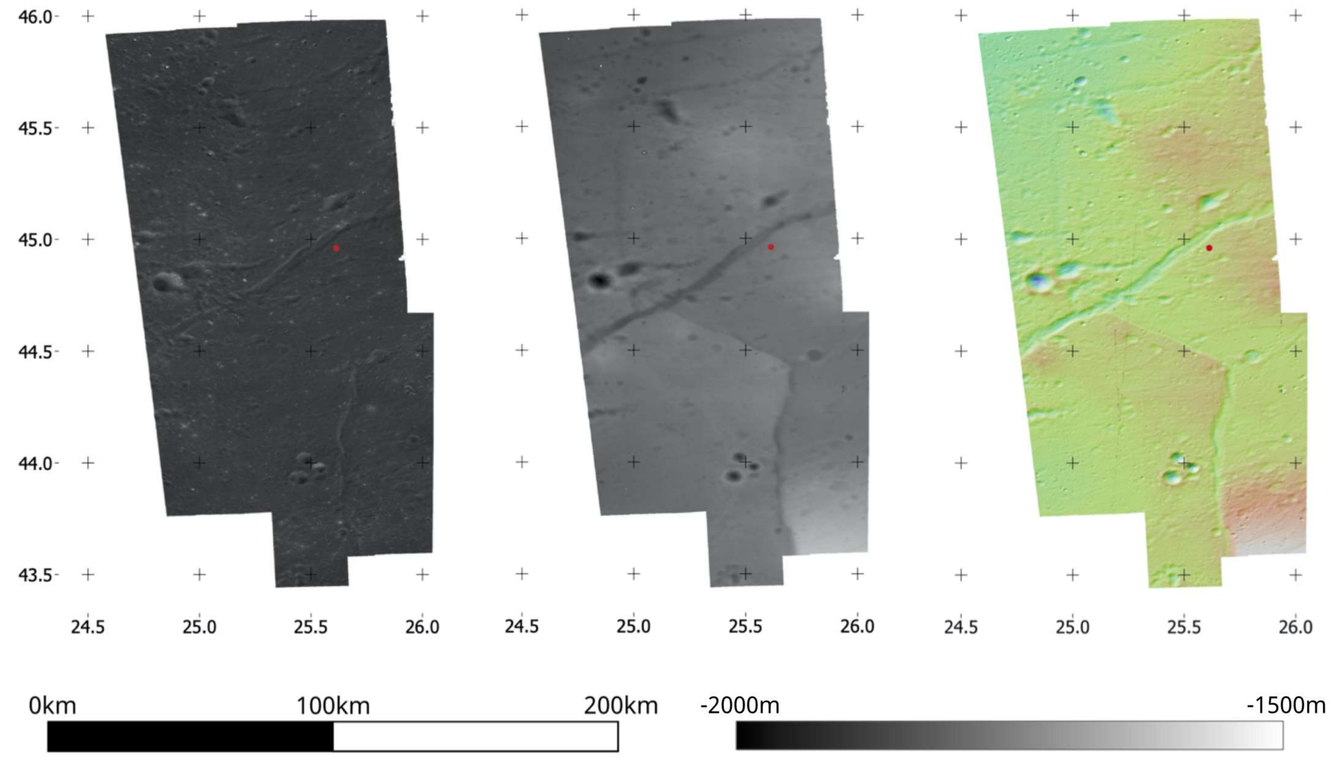
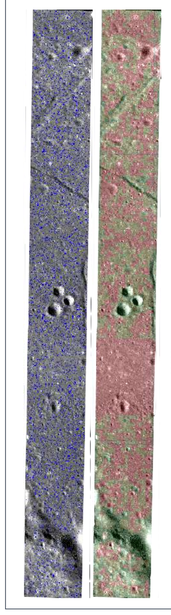
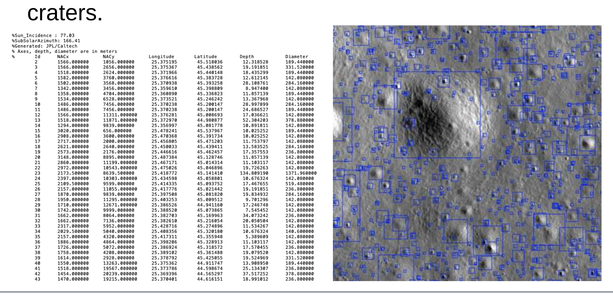
The Solar System Trek portals at https://trek.nasa.gov serve to provide a broad range of data from various missions to the planetary scientific community and the general public. Interest in various landing sites often prompt the creation of data packages generated from a suite of tools in the Moon Trek portal. The data package produced here focuses on the Lacus Mortis landing site. Using Lunar Reconnaissance Orbiter Narrow Angle Camera (LRO NAC) images, we produced an elevation mosaic with a North-South extent of 283 km, an East-West extent of 164 km, and a pixel resolution of better than 6m in the East-West direction and 8m in the North-South direction. The figures to the right show the orthophoto mosaic of the Lacus Mortis site, followed by the accompanying Digital Elevation Model (DEM) mosaic, and the corresponding Color Hillshade map. The package includes analysis results, most of which used the Lacus Mortis DEM produced to the right as input.



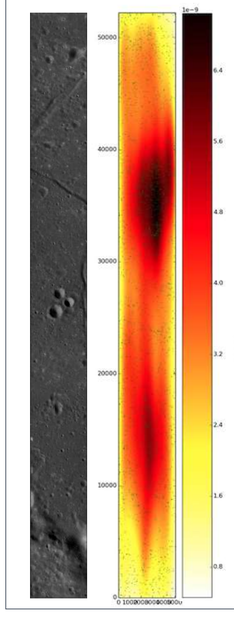
Crater Detection



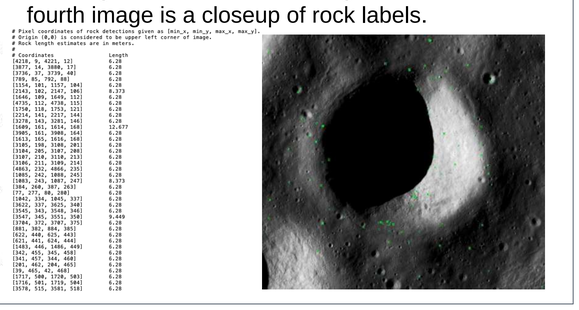
The crater detection tool accepts Narrow Angle Camera images from the Lunar Reconnaissance Orbiter as input and uses a combination of computer vision and deep learning to detect craters. The images detail sample results from the tool and described going from left to right. Results include map projected GeoTIFFs with craters labeled by blue bounding boxes, a heat map displaying crater densities per 500 square meter blocks, and a text file with crater locations and descriptions. The fourth image is a closeup of labeled craters.



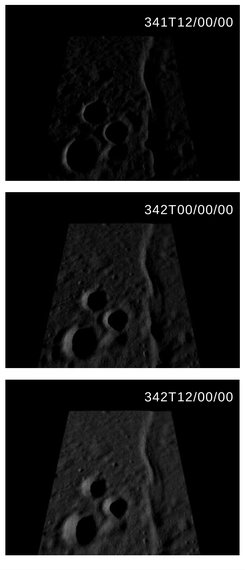
Rock Detection



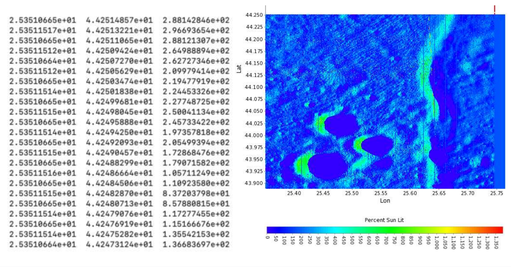
The rock detection tool accepts Narrow Angle Camera images from the Lunar Reconnaissance Orbiter as input and uses classic computer vision and image processing techniques for detection. The images detail results from the tool and are described left to right. The rock detector returns a JPEG image with rocks labeled by green bounding boxes, a density chart showing rock concentrations in deep red, and an ascii file showing rock locations and length estimates. The fourth image is a closeup of rock labels.



Lighting Tool

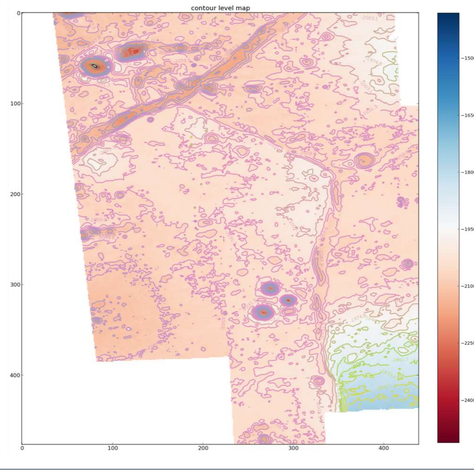


The lighting tool employs ray tracing and planetary geometry to estimate the amount of available light/wattage DEM as a function of time. Results on the left are timestamped PNGs that show lighting differences between 12 hour frames. The figures on the bottom show additional outputs in an ascii file listing x and y coordinates followed by irradiance of wattage per square meter at the center of each triangular plate (bottom right).



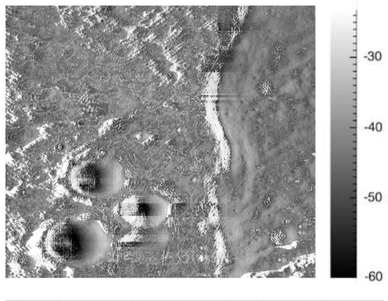
Slope Tool

The slope tool computes the gradient and slope for a given Digital Elevation Model (DEM). Slopes and gradients are computed by applying convolutional filters over the DEM.



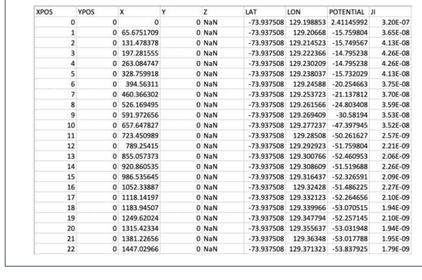
Three methods are supported for generating results: Horn, Sharpnack, and Zevenberger. Slope tool returns a GeoTIFF file with gradient values for each DEM supplied and a contour map (shown on the left). Optionally the user can add a color ramp text file to customize contour output.

Electrostatic Surface Potential



The Electrostatic Surface Potential tool calculates the ionization potential due to solar wind striking the lunar surface over time. As input this tool takes a DEM and computes electrostatic potential across different angles ranging from 0 to 360.

For each angle the following outputs are returned: A csv file containing potential static charge values for each pixel on the DEM and corresponding x, y, and z coordinates of the DEM, a GeoTIFF of static potential values (bottom), and a PNG representation of static potential for a given angle (top).



Ongoing Development

Feature Detector: Currently under development, the feature detector will offer analysis over a myriad of features in addition to rock and crater. This tool pulls in the latest deep learning technologies to potentially classify features such as rocks, craters, mounds, ridges, canyons, among others. Results will include images with labels, text files with detection locations, and density maps.

Line of Sight: Also under development, this tool will use high resolution terrain data coupled with planetary geometry to determine if a line of sight can be established between two entities (topographical points, planets, missions) at given time intervals. This tool will be invoked through a RESTful API.

For more information regarding the tools and data used for this package please visit https://trek.nasa.gov/moon. The data generated for Lacus Mortis analysis can be downloaded from: https://tinyurl.com/y8yefzbt .