Geophysical Research Abstracts
Vol. 16, EGU2014-6687, 2014
EGU General Assembly 2014

Geomorphometric multi-scale analysis for the recognition of Moon surface features using multi-resolution DTMs

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Moon surface features have great significance in understanding and reconstructing the lunar geological evolution. Linear structures like rilles and ridges are closely related to the internal forced tectonic movement. The craters widely distributed on the moon are also the key research targets for external forced geological evolution. The extremely rare availability of samples and the difficulty for field works make remote sensing the most important approach for planetary studies. New and advanced lunar probes launched by China, U.S., Japan and India provide nowadays a lot of high-quality data, especially in the form of high-resolution Digital Terrain Models (DTMs), bringing new opportunities and challenges for feature extraction on the moon. The aim of this study is to recognize and extract lunar features using geomorphometric analysis based on multi-scale parameters and multi-resolution DTMs. The considered digital datasets include CE1-LAM (Chang'E One, Laser AltiMeter) data with resolution of 500m/pix, LRO-WAC (Lunar Reconnaissance Orbiter, Wide Angle Camera) data with resolution of 100m/pix, LRO-LOLA (Lunar Reconnaissance Orbiter, Lunar Orbiter Laser Altimeter) data with resolution of 60m/pix, and LRO-NAC (Lunar Reconnaissance Orbiter, Narrow Angle Camera) data with resolution of 2-5m/pix. We considered surface derivatives to recognize the linear structures including Rilles and Ridges. Different window scales and thresholds for are considered for feature extraction. We also calculated the roughness index to identify the erosion/deposits area within craters. The results underline the suitability of the adopted methods for feature recognition on the moon surface. The roughness index is found to be a useful tool to distinguish new craters, with higher roughness, from the old craters, which present a smooth and less rough surface.