Investigating diurnal changes in the normal albedo of the laser surface at 1064 nm: A new analysis with the Lunar Orbiter Laser Altimeter

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Abstract. We are interested in how extreme thermal variations[1] may affect the reflectance of the lunar surface given that lab studies demonstrate that pyroxene shows temperature-related spectral changes in NIR wavelengths[2]. We analyze the surface albedo of the Moon using the highest quality calibrated LOLA data, acquired by Detector 3 on Laser 1[3]. The LOLA data are analyzed for differences in mean normal albedo during the cycle of the lunar day by sorting the data into two groups based on the local time at which the data were acquired: mid-day (11:00–13:00) and morning/evening (06:00–07:00 and 16:00–17:00). These two groups are chosen to represent times at which surface temperatures are at a maximum and minimum, respectively, and times for which LOLA data exist. We target regions of interest (ROIs) within the mare and highlands between 65°S and 65°N, latitudes between which temperature fluctuations are greatest. Each ROI is only 1° x 1° in spatial extent, representing surface areas that are ~30 km x 30 km depending on the specific location.

Here we provide the preliminary results of a new analysis investigating diurnal changes in the normal albedo of the lunar surface. Our statistical analysis, incorporating over 200,000 individual LOLA shots, suggests that temperature variations do have a measurable effect on the normal albedo of the surface at 1064 nm wavelength in the maria, and this may be due to temperature-induced spectral changes. However, the diurnal differences discussed here are only on the order of a few % change in normal albedo, indicating that temperature changes do not have a large effect on measurements of the lunar surface at the sensitivity of the LOLA instrument. An ability to understand how the lunar surface varies with temperature will provide important constraints for future remote sensing observations[4]. Such observations can help constrain the relative abundance of particular minerals (here, pyroxene) that exhibit a change in spectral reflectance with temperature independent of spectroscopic methods.

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[3] Lemelin et al. (2016) *Icarus 273,* 315–328.
[4] Lucey et al. (2017) *LEAG,* #5048.