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On an assessment of surface roughness estimates from lunar laser altimetry pulse-widths for the Moon from LOLA using LROC narrow-angle stereo DTMs.

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Neumann et al. [1] proposed that laser altimetry pulse-widths could be employed to derive "within-footprint" surface roughness as opposed to surface roughness estimated from between laser altimetry pierce-points such as the example for Mars [2] and more recently from the 4-pointed star-shaped LOLA (Lunar reconnaissance Orbiter Laser Altimeter) onboard the NASA-LRO [3]. Since 2009, the LOLA has been collecting extensive global laser altimetry data with a 5m footprint and ≈25m between the 5 points in a star-shape. In order to assess how accurately surface roughness (defined as simple RMS after slope correction) derived from LROC matches with surface roughness derived from LOLA footprints, publicly released LROC-NA (LRO Camera Narrow Angle) 1m Digital Terrain Models (DTMs) were employed to measure the surface roughness directly within each 5m footprint. A set of 20 LROC-NA DTMs were examined. Initially the match-up between the LOLA and LROC-NA orthorectified images (ORIs) is assessed visually to ensure that the co-registration is better than the LOLA footprint resolution. For each LOLA footprint, the pulse-width geolocation is then retrieved and this is used to "cookie-cut" the surface roughness and slopes derived from the LROC-NA DTMs. The investigation which includes data from a variety of different landforms shows little, if any correlation between surface roughness estimated from DTMs with LOLA pulse-widths at sub-footprint scale. In fact there is only any perceptible correlation between LOLA and LROC-DTMs at baselines of 40-60m for surface roughness and 20m for slopes.

[1] Neumann et al. Mars Orbiter Laser Altimeter pulse width measurements and footprint-scale roughness. Geophysical Research Letters (2003) vol. 30 (11), paper 1561. DOI: 10.1029/2003GL017048 [2] Kreslavsky and Head. Kilometer-scale roughness of Mars: results from MOLA data analysis. J Geophys Res (2000) vol. 105 (E11) pp. 26695-26711. [3] Rosenburg et al. Global surface slopes and roughness of the Moon from the Lunar Orbiter Laser Altimeter. Journal of Geophysical Research (2011) vol. 116, paper E02001. DOI: 10.1029/2010JE003716 [4] Chin et al. Lunar Reconnaissance Orbiter Overview: The Instrument Suite and Mission. Space Science Reviews (2007) vol. 129 (4) pp. 391-419