IMPACTS LARGE AND SMALL: MODIFICATION OF THE LUNAR REGOLITH OBSERVED BY LRO DIVINER. J.-P. Williams[1], D. A. Paige[1], B. T. Greenhagen[2], and E. Sefton-Nash[3], [1]Earth, Planetary, and Space Sciences, University of California, Los Angeles, CA 90095 (jpierre@mars.ucla.edu), [2]Applied Physics Laboratory, Johns Hopkins Univeristy, Laurel, MD. [3]European Space Agency, ESTEC 2200 AG Noordwijk, The Netherlands..

Introduction: The Diviner Lunar Radiometer Experiment onboard LRO has been acquiring solar reflectance and infrared radiance measurements nearly continuously since July of 2009 [1]. Diviner is providing the most comprehensive view of how regoliths on airless bodies store and exchange thermal energy with the space environment. Approximately a quarter trillion calibrated radiance measurements of the Moon, acquired over 5.5 years by Diviner, have been compiled into a 0.5° resolution global dataset with a 0.25 hour local time resolution. Maps generated with this dataset provide a global perspective of the surface energy balance of the Moon and reveal the complex and extreme nature of the lunar surface thermal environment [2]. Impact craters from meter-scale to basin-scale are found to modify the thermophysical and radiative properties of the regolith over large distances as seen in reflectance and infrared observations demonstrating the dominating effect impacts, as a geologic process, have had on the global physical properties of the lunar surface.

Results: The hottest nighttime temperature anomalies are associated with young rayed Copernican-age craters. The thermal signature of Tycho is asymmetric, consistent with an oblique impact coming from the west and rays require material with a higher thermal inertial than nominal regolith. Rays are observable as thermal anomalies in nighttime temperatures indicating a contrast in thermophysical properties in addition to having a higher reflectance, however nighttime brightness temperatures do not display anisothermality indicating the thermal contrast of the ray must largely result from objects smaller than ~0.5 m. The coldest nighttime surfaces are associated with lunar cold spots [3], highly insulating regions around very young craters extending ~10–100 crater radii. The three largest cold spots have surfaces that remain >5 K colder than mean zonal temperatures and maintain this temperature difference throughout the night.The modification of the regolith by the formation of the Orientale basin is observable over a substantial portion of the western hemisphere despite its age (~3.8 Ga), and may have contributed to mixing of highland and mare material on the margin of Oceanus Procellarum where the gradient in radiative properties at the mare-highland contact is broad (~200 km). A lobe of the Montes Rook Formation extends beyond the Cordillera scarp in the southwest corner. The thermal signature is consistent with impact melt. A thermally distinct annulus of material ~300 – 600 km wide extending outward from the Cordillera ring corresponds to a region of low radar return [4] implying the unit is related to the radar-dark halos observed around other sizeable craters.

References: [1] Paige D. A. et al. (2010) *Space Sci. Rev., 150*, 125–160. [2] Williams J.-P. et al. (2016) *Icarus*, submitted. [3] Bandfield J. L. et al. (2014) *Icarus*, *231*, 221–231. [4] Ghent R. R. et al. (2008) *Geology*, *36*, 343–346.

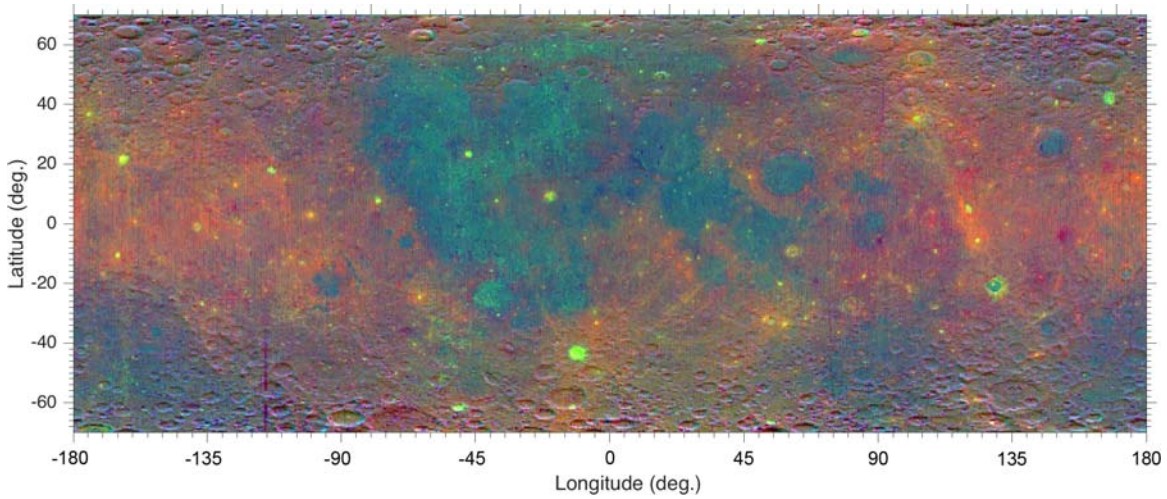

Figure 1: Maximum temperatures (T_{max}) are sensitive to the radiative properties of the surface and minimum temperatures (T_{min}) are sensitive to the thermophysical properties of the regolith. Anomalous T_{max} and T_{min} are highlighted by subtracting the zonal mean temperatures from maps. RGB channels are Diviner reflectance (red), T_{min} anomalies (green), and T_{max} anomalies (blue). Terrains can be characterized as low/high reflectance and low/high TI. Young craters and rays (yellow/orange) are bright and high TI. Cold spots and radar dark halos (magenta) are bright and low TI, mare (cyan/blue) are dark and high TI, pyroclastic deposits (blue) are dark and low TI.