DIURNAL SURFACE TEMPERATURE VARIATIONS OF LATITUDINALLY AND GEOLOGICALLY DISTINCT SITES ON THE MOON. G. Ambily and K. Durga Prasad, Physical Research Laboratory, Ahmedabad, India (durgaprasad@prl.res.in)

Introduction: Lunar surface temperatures show significant variations as a function of its latitude, local relief and thermophysical properties [1]. Average temperature at equator is around 260K, which oscillates between ~400K at noon and ~100K at midnight. However, these variations are dependent on several parameters. While the daytime temperatures are determined by the incoming solar flux, the nighttime temperatures are dictated by mainly the local relief and the thermophysical properties of the surface [2]. Even though there is abundant data on global regolith temperatures, local and regional scale variations are still less explored, unless for some certain landing sites [3]. Hence, the question of whether the local scale variations are analogous to the global temperature variations is still unanswered. To address this problem, we have processed LOLA & Diviner datasets onboard LRO, of four latitudinally and geologically distinct sites and diurnal temperature variations of the lunar surface were studied. Some of these results are presented here.

Site selection & DLRE Analysis: The selected sites for the present study are the Apollo-17 Landing Site (LS), Ryder Crater, Compton-Belkovich Thorium Anomaly hotspot (CB-Th Anomaly) and Demonax B Crater. They are distributed across latitudes ranging from 20^0-85^0 and are either geologically, morphologically or thermophysically distinct. The sites selected for the present study are shown in figure 1 and their characteristics are detailed in Table 1.

The sites are constrained to a maximum 20 x 20 km area. The topography is obtained from DEM files of LRO LOLA observations and the brightness temperatures are obtained from DLRE observations. We used RDR products from NASA-PDS, obtained for an interval of 3.00 hours local time at the selected sites over the period from July 2009 to December 2020 [4]. Data from channels 6,7,8 & 9 are evaluated separately and the temperature observed during each period is derived. The maximum and minimum temperatures at each local time are identified and are plotted. While data for all the selected sites were analysed, results for Apollo 17 landing site landing site are only presented here.

Apollo-17 Landing Site: The Apollo-17 landing site is selected due to its geology and complex morphology. A strip of 8 x 21 km of Taurus-Littrow valley is selected

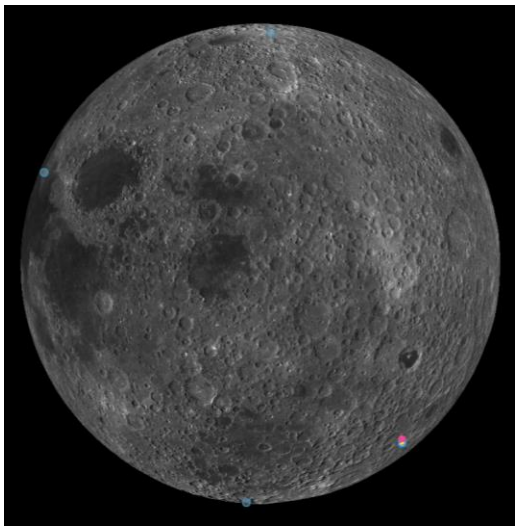

Figure 1. *Selected sites from LROC-Quickmap with resolution of 300km.*

Site Name	Co-ordinates	Importance
Apollo-17 LS	20.1911N, 30.7723E	Landing site, diverse geology
Ryder Crater	43.8747S, 143.2994E	High Albedo, 15 km diameter
CB-Th Anomaly	61.1N, 99.5E	High Thorium abundance, LP-GRS hotspot
Demorax B	72.0459E, 81.4876S	Permanently Shaded Region

Table 1. Selected sites and their specifications.

and corresponding temperature data from Diviner observations from January 2014 - December 2015 are used. The data obtained are separated for each orbit and five orbits having maximum number of datapoints within these years have been selected. The temperature maps at different local times are generated and then overlaid over the topography to decipher the variations with respect to local relief.

Results: The actual temperatures observed on each point are obtained from the output image of the region. A significant diurnal variation in temperatures on a local scale is clearly evident. Since this is an equatorial region, the brightness temperatures are found to show

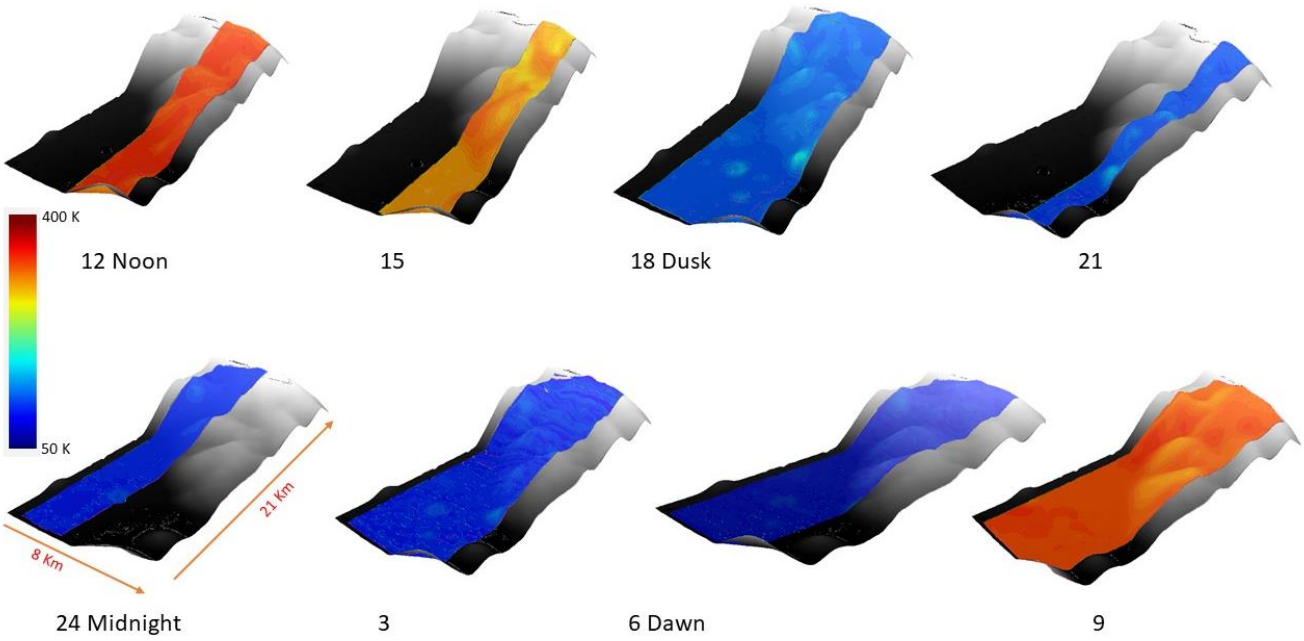

Figure 2. *Maps of surface temperature overlaid on topography for different local times for the selected area of Apollo 17 landing site. The number shown below each map represents the local time of observation in hrs.*

significant variations thus exhibiting a huge difference between maximum and minimum temperature values. The temperature maps overlaid on topography for different local times for the selected area of Apollo-17 landing site are shown in figure 2.

It is also interesting to note that the temperature variation happens not only over a temporal scale, but also on a spatial scale. For example, we can find that at 15 hrs. at noon, there is a large temperature variation of around ~50K, even within a 15 km distance. This shows that the surface temperatures undergo a huge fluctuations during a lunar day. The diurnal variation of maximum and minimum temperatures are also obtained and shown in figure 3 which decipher substantial variability. The studies at other sites also showed distinct variations in diurnal temperatures that can be attributed to several site-specific parameters. A detailed study of these sites supported by numerical modeling is underway to have a better insight on the driving parameters that are possibly causing the observed temperature variability.

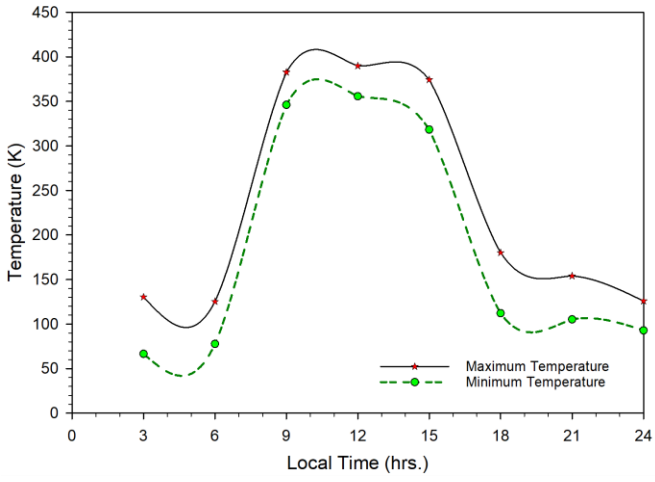

Figure 3. *Diurnal variation of minimum and maximum surface temperatures at Apollo 17 landing site*

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References: [1] Vasavada, Ashwin R., et al. *Journal of Geophysical Research: Planets* 117.E12 (2012). [2] K. Durga Prasad, Vinai K. Rai, and S. V. S. Murty. *Earth and Space Science* (2022): 9, e2021EA001968. [3] Williams, Jean-Pierre, et al. *Earth and Space Science* 9(2) (2022). [4] https://pds-geosciences.wustl.edu/missions/lro/