SEASONAL VARIATIONS IN SOUTH POLAR TEMPERTURES ON THE MOON. J.-P. Williams[1], B. T. Greenhagen[2], D. A. Paige[1], N. Schorghofer[3], K.-Michael Aye[4], P. O. Hayne[4], M. A. Siegler[5], and E. Sefton-Nash[6] [1]Earth, Planetary, and Space Sciences, University of California, Los Angeles, CA, [2]Johns Hopkins University Applied Physics Laboratory, Laurel, MD, [3]Institute for Astronomy, University of Hawaii, Honolulu, HI, [4]University of Colorado, Boulder, CO, [5]Planetary Science Institute, Tucson, AZ, [6]ESTEC, European Space Agency, Noordwijk, Netherlands.

Introduction: The Diviner Lunar Radiometer Experiment of the Lunar Reconnaissance Orbiter (LRO) has been acquiring solar reflectance and mid-infrared radiance measurements of the Moon since July of 2009 [1]. These observations provide information on how regoliths on airless bodies store and exchange thermal energy with the space environment [2][3][4][5]. In the polar regions where solar illumination is perpetually at grazing angles, seasonality can have a large influence on illumination conditions. The polar regions are of significant interest for *in situ* exploration for the possibility of permanently shadowed regions (PSRs) cold-trapping water [6][7][8]. The high density of coverage in the polar regions is providing the opportunity to characterize the seasonal variations in temperatures at the highest latitudes.

Mapping: We have begun generating seasonal maps of the poles. The initial mapping effort has focused on a 5° cap centered on the south pole. All data from the start of the mission through the end of 2017 has been split into summer and winter (defined by the subsolar latitude) and gridded at 240 m/pix in polar stereo projection and constant local time at 0.25 hour resolution.

Results: Our maps demonstrate the variation in seasonal temperatures in the south polar region. Figure 1 shows maximum bolometric temperatures for summer and winter seasons. The extent of shadowed areas varies considerably between seasons. The maximum temperatures below 110 K in the summer map, denoted by the black contour, corresponds to the PSRs with an area of 7,453 km^2 (~10% of the mapped area). In the winter, the shadowed areas extend to an area of 18,653 km^2 (~26% of the mapped area). Figure 2 shows the seasonal difference in the peak temperatures highlighting the influence of seasonally shadowing.

The illumination conditions are strongly influenced by topography [9][10]. Unlike temperatures observed at lower latitudes where peak temperatures occur around noon [3][4], diurnal temperatures can vary in complex ways that change with the seasons. Figure 3 shows the local time at which peak temperatures were observed during the southern summer. Peak temperatures in many locations occur during the nighttime hours. Figure 3b shows and example where summer illumination occurs near midnight when the subsolar

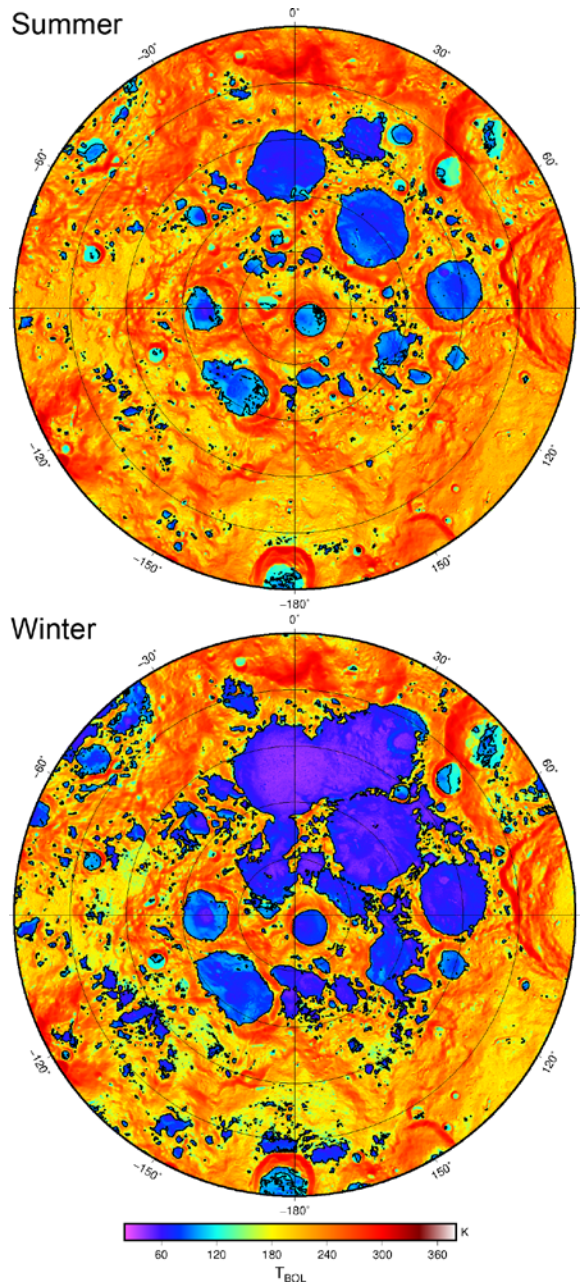

Fig. 1: Diviner maximum bolometric temperatures of the south pole 85°-90° S split into summer (top) and winter (bottom) seasons. The contours marks 110 K which approximates the boundary of regions shadowed throughout the season.

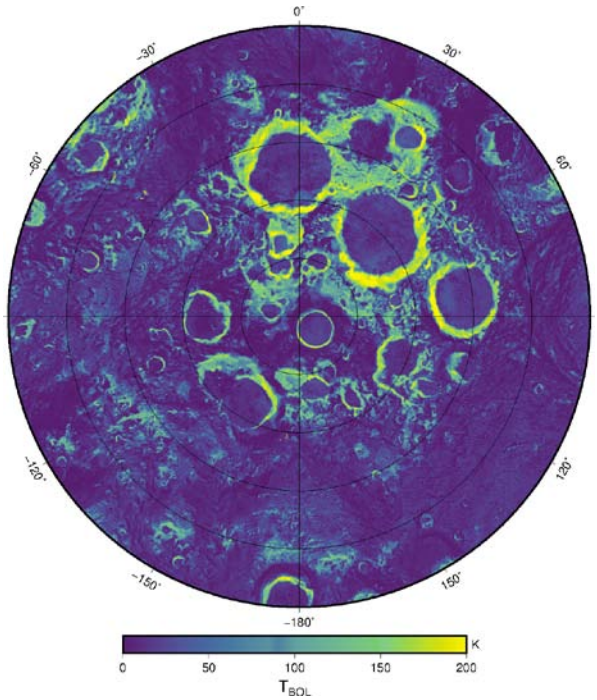

Fig. 2: The seasonal difference in peak temperatures of the south pole 85°-90° S.

longitude is on the opposite side of the pole.

Conclusions: We observe large regions around the PSRs that are shadowed seasonally for extended periods of time during the year with the amount of H_2O cold-trapping area more than doubling between summer and winter. Mission planning for landing and operating in these regions will need to contend with complex illumination conditions that will vary with the seasons (e.g. [10][11][12]).

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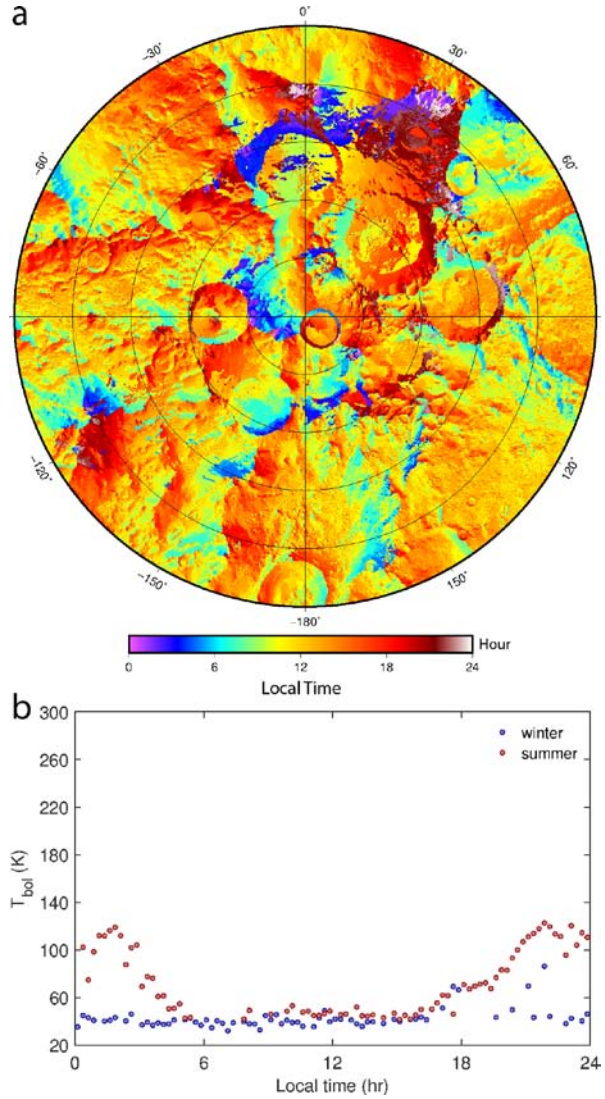

Fig. 3: (a) The local time at which peak temperatures occurred in the summer at the south pole 85°-90° S. (b) Diurnal temperatures for winter and summer seasons for longitude 30° E, latitude 86° S.