DIVINER MONITORING OF COLDEST LUNAR POLAR REGIONS  K.-M. Aye¹, D. A. Paige¹, M. A. Siegler², E. Sefton-Nash¹, B. T. Greenhagen², ¹Department of Earth, Planetary and Space Sciences, UCLA, Los Angeles, CA, USA (michael.aye@ucla.edu), ²Jet Propulsion Laboratory, Pasadena, CA, USA.

Introduction: The Diviner Lunar Radiometer Experiment is orbiting the Moon since July 2009 on the Lunar Reconnaissance Orbiter [1]. It has been mapping the infrared emission from the Moon using seven spectral channels that span a wavelength range from 7.55 to 400 µm at a spatial resolution of ~200 m, including the first radiometric measurements of surface temperatures at the lunar poles. Diviner’s surface-temperature maps have revealed the existence of widespread surface and near-surface regions that extend beyond the boundaries of persistent shadow [2]. Large areas of the lunar polar regions are currently cold enough to cold-trap water ice as well as a range of both more volatile and less volatile species. Due to their low obliquity and rough topography these high latitude regions have been shown to never receive direct sunlight.

In absence of other sources, the only effect that balances the surface thermal emission is then the heat flow rate from the warmer lunar interior [3]. To constrain models for the prevalence of volatile species and lunar heat flow, the lowest temperatures as measured by Diviner can be used. Channel 9, with its range from 100 to 400 micron provides these lowest temperature measurements. For this channel a minimum observed temperature of less than 20 K in winter season night-time brightness temperatures, observed in the north polar Hermite Crater, was reported in [4]. Ongoing efforts to produce a Diviner foundation data set with an improved calibration of the Diviner data and easier accessible moon temperature map products currently show more realistic minimum temperatures for the coldest areas on the moon as shown in Fig. 1.

Methodology: Several double-shadowed regions (shadowed from first-order scattering) have been defined at the lunar south pole for further study (Fig. 3). Regions 1, 3 and 5 have been considered for this work. First, newly calibrated radiances for these areas were calculated, then binned in 1-day bins and finally converted to brightness temperatures. The statistics of the binning is indicated in Fig. 2, where the kernel density estimation plots of the samples per 1-day bin indicate the amount of data that went into the binning for the different regions.

Results: Formerly reported low temperatures below 20 K can not be confirmed by these data, the minimum spike for region 3 in Fig.1 is believed to be a statistical outlier. The similarity of all three region’s brightness temperatures over time supports this state-
ment. A new minimum temperature between 25 and 30 K can be deduced, which is a level that can be attained by thermal models. Short-scale oscillation effects can be seen that are reproducible in thermal models as well, though with a lower amplitude currently.

We intend to report on comparisons with thermal models during the conference, including polar maps with newly calibrated data.


Fig. 3 Channel 8 map of all summer solstice data over several years at local midnight. Regions 1, 3 and 5 have been considered for this work.