A CORRECTION TO THE THERMAL BANDS FOR THE DIIVINER LUNAR RADIOMETER EXPERIMENT. K. A. Shirley[1], T. D. Glotch[1], and the Diviner Science Team. [1]Department of Geosciences, Stony Brook University, Stony Brook, NY 11794-2100, katherine.shirley@stonybrook.edu.

Introduction: The Diviner Lunar Radiometer Experiment on board the Lunar Reconnaissance Orbiter is currently mapping multispectral thermal emission from the lunar surface [1]. This data provides key insight into the surface composition of the Moon, primarily from the three narrow bands centered near 8 µm. This is the location of the Christiansen Feature (CF), the position of which changes as a function of silicate composition [2,3]. Diviner also maps the lunar surface at longer thermal wavelengths (23-400 µm) which, to date, have not generally been used in mineralogical analyses. Here we examine the usefulness of the long wavelength thermal bands in compositional investigations.

As with the three 8 µm channels, we have found that emissivity of the long wavelength channels varies as a function of solar incidence angle (Fig. 1). In general, we find that the calculated emissivity of channels 6, 7, and 8 is lower at high incidence angles than at low incidence angles. The effect becomes especially pronounced above ~30° incidence. A correction has been developed for the 8 µm channels which normalizes all Diviner daytime data to 0°incidence angles at the equator [4]; To date, a correction for the long wavelength bands (bands 6-8) has not been formulated. We have developed a simple "bootstrap" approach to correct these bands, which is described here.

Methods: Our correction assumes that the data measured at an incidence angle of 0° is ideal. Thus, we begin by examining relatively homogenous locations on the Moon determined using a global map of CF values [e.g. 3], and averaging the emissivity measurements. We plot the average emissivity spectra and determine the slopes between bands. Because we assume that 0° incidence measurements are correct, the slopes between bands 5 and 6, 6 and 7, and 7 and 8 at this incidence angle are taken to be true as well. We have developed a set of calibration curves (e.g. Fig 2) based on the apparent band slopes at each set of incidence angles. Using these curves, we correct the band 6 emissivity using the band 5-6 curve. The corrected band 6 emissivity is then used to correct band 7, and so on.

We applied this simple correction globally using the slopes from emissivity data averaged over one location. Several locations were then selected from both mare and highlands areas (basaltic or felsic, respectively) and varying in longitude and latitude to test the correction.

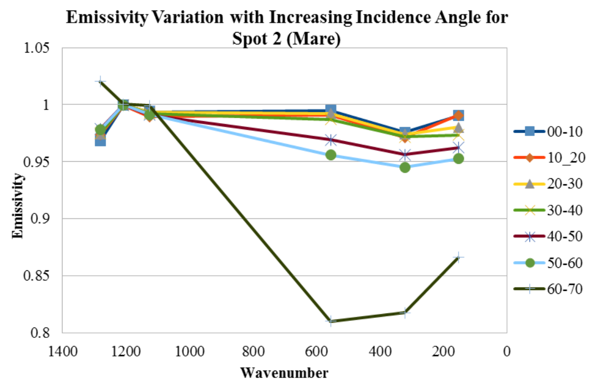

Fig 1. Emissivity measurements averaged over a mare location at increasing solar incidence angle increments.

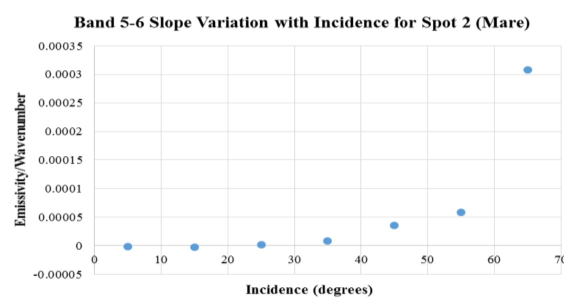

Fig 2. A plot of the slope between bands 5 and 6 shows that slope remains fairly consistent until 30° then deviates at high solar incidence.

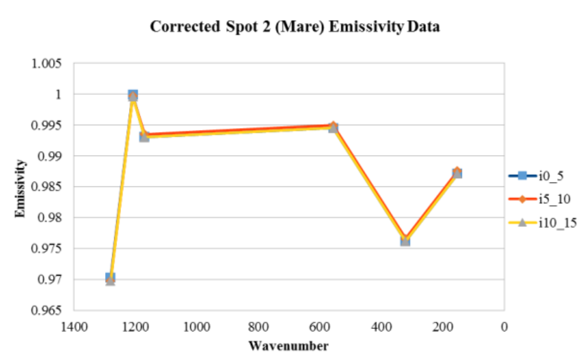

Fig 3. Emissivity measurements corrected using the bootstrap method of a mare correction applied to a mare location at increasing solar incidence angle increments. Bands 3, 4, & 5 were corrected using the method of [4].

Results: We found that this type of correction improves the data measured at higher incidence angle. It does, however, tend to overcorrect if applied to a location of different composition than the correction location used (i.e. a mare correction should be applied to only mare section of the lunar surface) (Fig. 3). Preliminary results indicate that under the right conditions, the correction appears to fully align the higher incidence angle increments with the 0° incidence measurements (Fig. 3).

Additionally, a map of each of the thermal bands 6, 7, and 8 shows that some compositional data can be gleaned at these wavelengths. We see that basaltic regions generally exhibit higher emissivity in band 6, while felsic regions have higher emissivity in band 8. Band 7 also seems to have higher emissivity values for basaltic regions, but the difference is less pronounced.

Fig. 4 shows a map of original and corrected band 6 emissivity data, which shows that higher emissivity at this wavelength reflects the locations of basaltic material on the lunar surface (shown as red). Fig. 4 also highlights the improvement in detail which our bootstrap correction provides.

Conclusions/Future Work: The current bootstrap correction is working well in normalizing higher solar incidence angles to emissivity data obtained at a 0° incidence angle, as seen in Fig. 3. We will continue applying this correction as more emissivity data is processed for higher incidence angle increments to fully assess its applicability. We will also combine the mare and highlands corrections based on silica content. A future global correction will apply a mare correction to regions with calculated CF values greater than 8.15 µm and a highlands correction to values less than 8.15 µm [3]. This should fix the overcorrections we see in mare regions when a highlands correction is applied. Another version of the correction will eventually take each pixel's information into account. This should be able to use the emissivity data per pixel at 0° incidence, and use it to correct the high incidence angle data.

In analyzing bands 6, 7, and 8 for use in compositional determination, we see the general trends in emissivity values for each band. A more accurate determination, however, may be obtained by taking all three bands into account in a similar method to that used in [3] to determine the CF location.

Overall, it is likely that these bands can be used to give insight into surface mineralogy in addition to thermal data, and increasing the amount of useful bands from 3 to 6 could allow us to create more mineral spectral indices and lead to spectral unmixing. Moreover, the data will be of better use with the developed correction applied to data measured at higher solar incidence and contribute to a better analysis of surface mineralogy.

Acknowledgements: We gratefully acknowledge NASA's support of the LRO mission and the great work of the Diviner Operations Team in collecting the data sets used for this research.

References:

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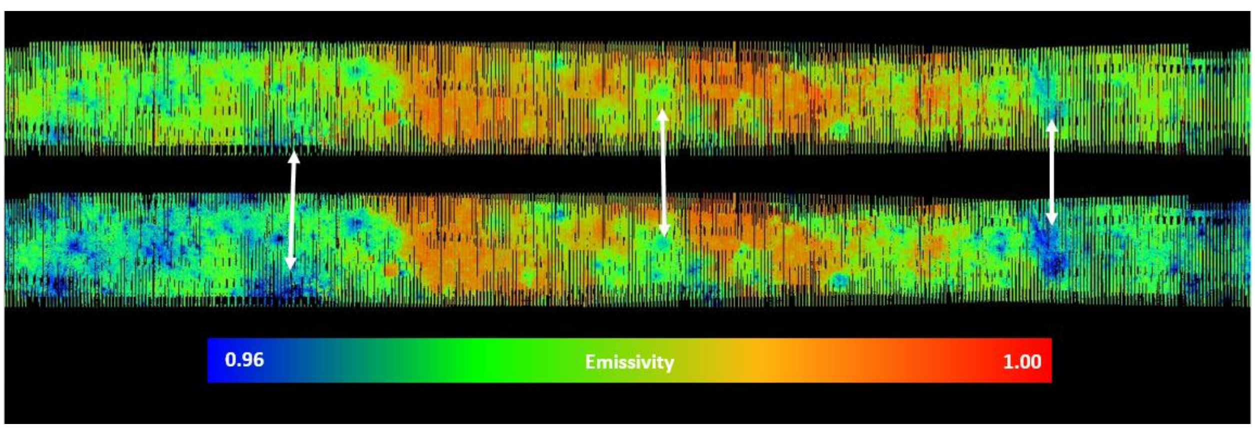

Fig 4. A global map of Band 6 (wavenumber 555.5) emissivity measured at solar incidence 10-15° for the original data (top) and the mare corrected data (bottom). Each map spans -180° to 180° E and ~20° N and S. The corrected data shows enhanced detail in the data (arrows point to examples) and highlights the more basaltic material (red) from the felsic (blue).