A MULTIPLICATIVE APPROACH TO CORRECTING THE THERMAL CHANNELS FOR THE DIIVINER LUNAR RADIOMETER EXPERIMENT. K. A. Shirley[1], T. D. Glotch[1], B. T. Greenhagen[2], M. White[3] and the Diviner Science Team. [1]Department of Geosciences, Stony Brook University, Stony Brook, NY 11794-2100, katherine.shirley@stonybrook.edu, [2]Johns Hopkins University, Applied Physics Laboratory, Laurel, MD 20723, [3]University of Vermont, Burlington, VT 05405.

Introduction: The Diviner Lunar Radiometer Experiment on board the Lunar Reconnaissance Orbiter is currently mapping multispectral thermal emission from the lunar surface [1]. These data provide key insights into the surface composition of the Moon, primarily from the three narrow channels 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 have not generally been used in mineralogical analyses.

In previous work we found that emissivity of the long wavelength channels varies as a function of solar incidence angle [4,5]. A correction has been developed for the 8 µm channels that normalizes all Diviner daytime data to 0° incidence angles at the equator [6]. Here we describe our current correction for the thermal wavelengths that adopts a similar normalization method.

Methods: Our correction assumes that the data measured at an incidence angle of 0° are ideal and emissivity values measured under these conditions are close to true. Thus, we examined several relatively homogenous locations within the equatorial region of the Moon to determine the variation of emissivity with incidence angle (the equatorial zone has the most variation in incidence angle, Fig. 1). We plotted the spectra for each location, and compared the emissivity change with incidence angle for each channel. Because we assume that 0° incidence measurements are ideal, all emissivities

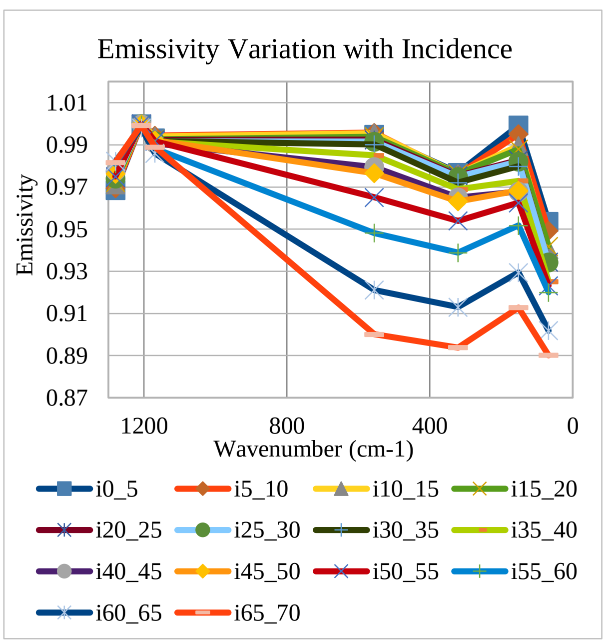

Figure 1. The emissivity spectra measured at varying incidence angles from a spot within Mare Tranquilitatis. Note the decrease in spectral signal with increasing incidence angle.

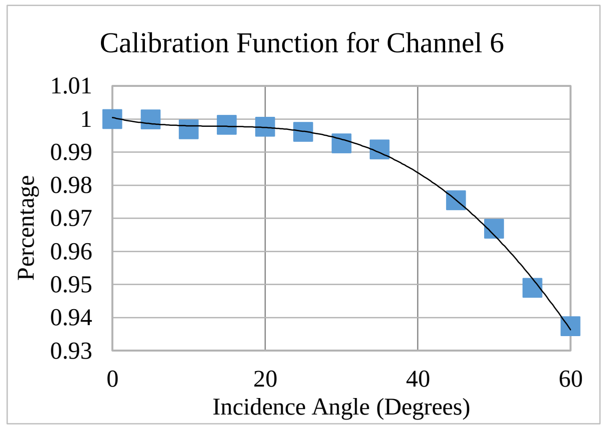

Figure 2. The calibration function for our correction is derived by dividing each emissivity value by the 0° incidence angle emissivity for each channel.

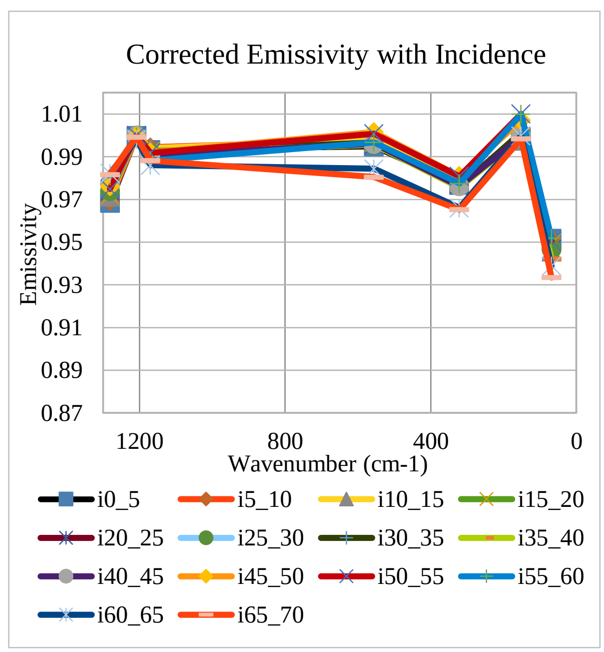

Figure 3. The emissivity spectra corrected with the calibration function. While there is still variability in the spectra with incidence, the signal is increased and there is more consistency to the data.

were divided by the emissivity at 0° to develop a calibration curve for each channel (Fig. 2). We then applied the calibrations to their respective channel across the global data set to correct the emissivity values for higher incidence angle measurements.

Results: The applied correction normalized the data and consistently increased the emissivity for the higher incidence angle measurements (Fig. 3), bringing them closer to the emissivity values measured at 0° incidence. The spectra are still not exactly the same for the same location, but are more consistent than the uncorrected data. In some areas, we saw a bit of overcorrection, and the emissivity for channel 8 was always above 1.0.

Additionally, a global map of each of the thermal channels shows that the correction improves the consistency of the data set at different incidence angles. Fig. 4 compares the global data set for several incidence angle bins with and without the correction for channel 6.

Conclusions/Future Work: The current correction normalizes the data as a function of incidence angle, which increases the spectral signal, and allows for reliable interpretation of the emissivity data measured at varying incidence angles. This improves our ability to use data collected in the thermal wavelengths and allows us to use this data to augment our interpretation of the lunar surface composition.

The correction currently relies on analyzing several locations around the Moon's equator, but we are developing a method to apply it to smaller regions that are outside the equatorial zone. This regional correction will work by searching for pixels within the region that have multiple incidence angle measurements, and running through a similar method of calibration. Additionally, we will continue to incorporate more parameters into our calibration such as terrain type, phase angle, and emission angle.

Summary: We originally saw ~10% difference in the spectra measured from 0° to 65° incidence angle. These differences result in drastic changes to the spectra measured at high incidence angles. With this correction applied to the data, we lower the variation to < 2 % which allows for a more consistent interpretation of the same location regardless of the incidence angle at which the data are measured.

The ultimate goal is to be able to use the thermal infrared data to better classify the composition of the surface of the Moon.

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. Support for this work was provided by the LRO Extended Mission science program and the RIS^{4}E SSERVI team.

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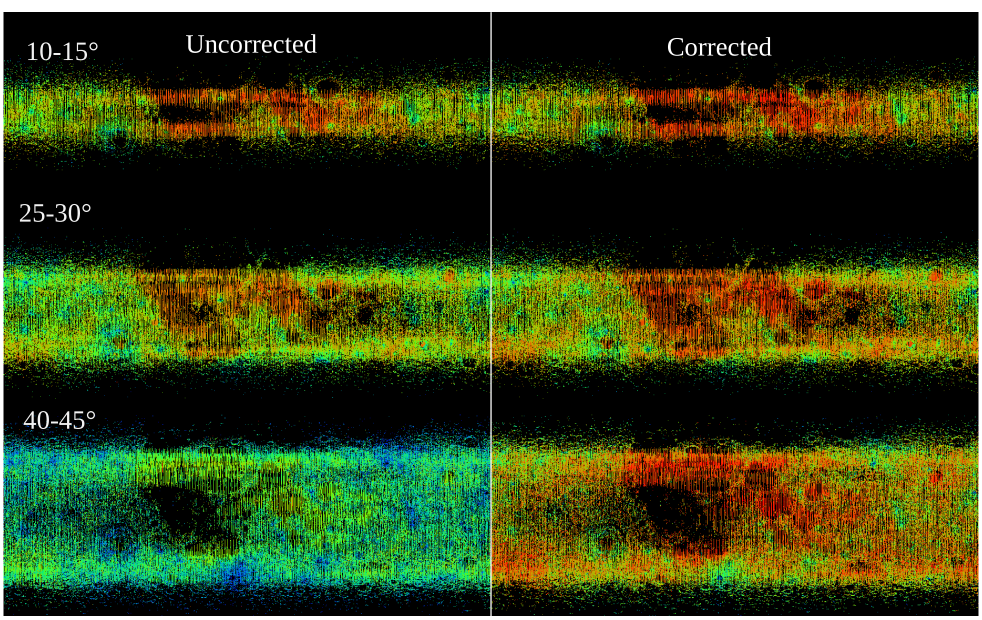

Figure 4. A comparison of the uncorrected and corrected global data set for channel 6 measured at 10-15, 25-30, and 40-45 incidence angles. The corrected data shows more consistency despite incidence angle.