LRO DIVINER RE-CALIBRATION AND ITS EFFECT ON VOLATILE RESEARCH K.-Michael Aye, Laboratory of Atmospheric and Space Physics, University of Colorado at Boulder, CO, 80303 (Michael.Aye@colorado.edu)

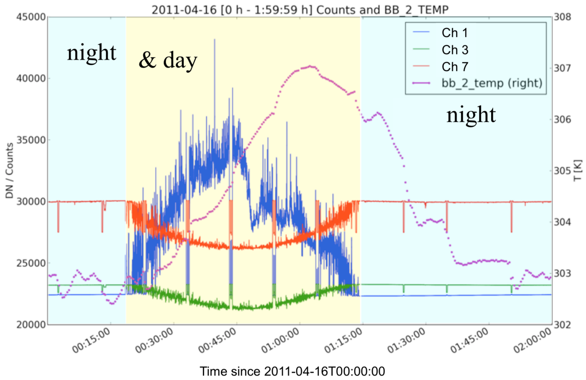

Figure 1: Raw data from 3 different channels of Diviner. Ch1 is observing the visual wavelengths, ch3 is used for mineralogy studies and ch7 focuses on thermal observations. (More description in the text)

Introduction: After a hiatus, the re-calibration efforts of LRO's Diviner Lunar Radiometer instrument [1] have been restarted. We describe the main mechanisms of the Diviner calibration, the anticipated improvements and their effect on the detected extreme temperatures.

Raw Data Figure 1 shows raw Diviner data from 3 different channels. Channel (Ch) 1 is observing the visual wavelengths, Ch 3 is used for mineralogy studies and Ch 7 focuses on thermal observations. The different areas of activity are caused by observing either the night or the day side of the Moon. Also shown is the temperature data for an internal calibration black-body. Because it is allowed to free-float without thermal control other then the environmental temperatures of the spacecraft, it is heating up from the day-side operations. Regular blips in the data indicate the locations of spaceviews, where the instrument is pointed away from the moon.

Spaceviews During spaceviews, the instrument is pointed first (usually) into space to determine the offset, then onto instrument-internal blackbodies at a known temperature, and back to space for a second offset measurement (see Fig. 2). These calibration events are scheduled on average every 10 minutes of operation. Additionally, Diviner regularly observes a so called "solar target" mounted on the LRO spacecraft for a calibration of its visual channels.

General Calibration Procedure The general calibration sequence is as follows:

1. Determine the digital number (DN) for zero radiance by averaging the spaceview readings, providing "space[c]" ([c]= 'in counts').
2. Measure the average DN of a black-body view at a known temperature, providing "bb[c]".
3. Convert the house-keeping temperature of the blackbody to a radiance value, using conversion curves determined on ground before launch, providing "rad(bb)".
4. Calculate the gain as

$$gain = \frac{-rad(bb)}{space[c] - bb[c]}$$

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5. Calculate the final radiance by applying both offset and gain in a linear fashion:

$$Rad = (counts - offset) * gain$$

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Options in the calibration procedure Above described procedure glosses over several decisions on how to apply the reality of non-continuous measurements. For example, the black-body temperatures house-keeping data is taken at different intervals for the different telescopes of Diviner, with the data points of telescope 2 being approx 25 seconds apart on average. The current implementation just reuses the last measured value without taking into considering potentially large drifts when the spacecraft is entering the lit side of the moon.

The new implementation will smoothly interpolate between these points as shown in Figure3.

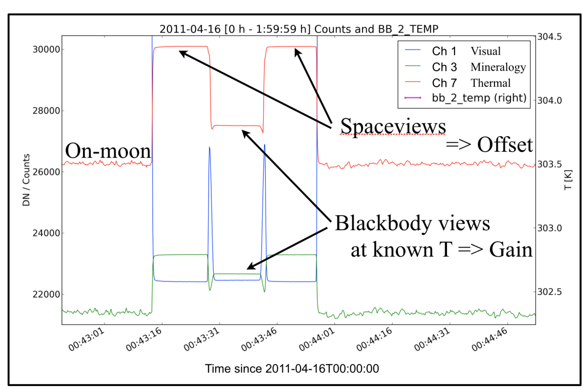

Figure 2: Zoom into a spaceview calibration sequence of the Diviner instrument.

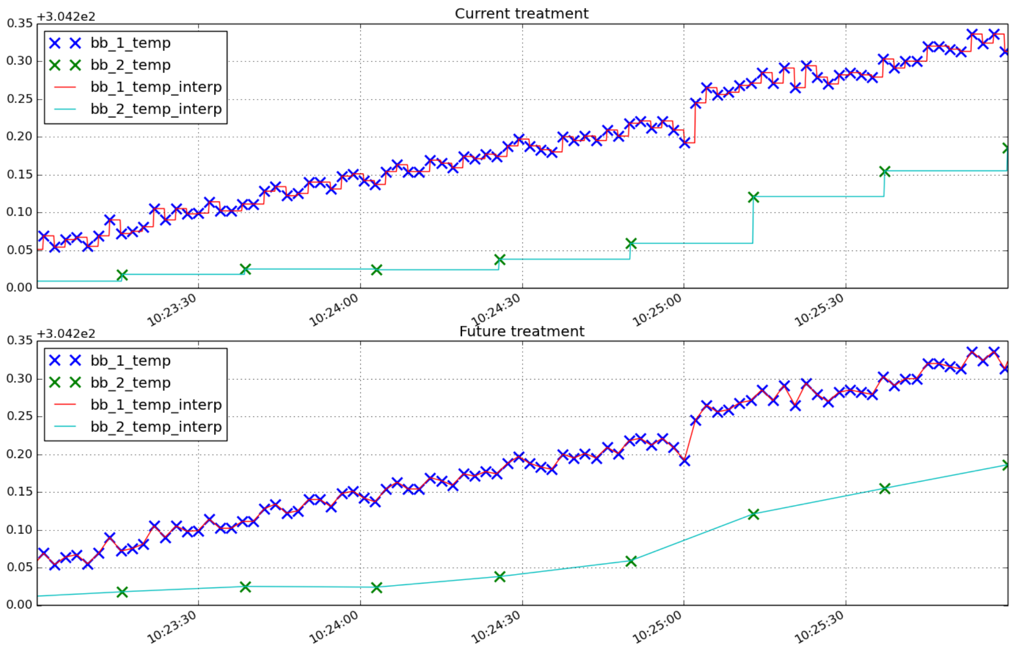

Figure 3: Differences in the treatment of the blackbody temperatures during the calibration of Diviner data. The current implementation is shown at the top, where the blackbody data is padded with the same value until another measurement is taken. Below is the new implementation where the values are smoothly interpolated between adjacent measurement stations.

Discussion Because these implementation details have an effect on the measured maximum and minimum temperatures measured on the lunar surface, this will have an affect on the areas where volatile storage is deemed possible. We will discuss these effects in greater detail at the conference.

References: [1] Paige, DA, Foote, MC, Greenhagen, BT, et al. *Space Sci. Rev.*, 150:125–160 (2010). doi:10.1007/s11214-009-9529-2.