LUNAR POLAR ILLUMINATION MODELING TO SUPPORT DATA ANALYSIS. Erwan Mazarico[1], Joseph B. Nicholas[2], Timothy P. McClanahan[1], Gregory A. Neumann[1]. [1] Planetary Geodynamics Laboratory, NASA Goddard Space Flight Center, Greenbelt, MD 20771, USA (erwan.m.mazarico@nasa.gov); [2] Emergent Space Technologies, Greenbelt, MD 20770, USA.

Introduction: Regions of extreme insolation environments exist in the polar regions of the Moon because of its low obliquity and lack of an atmosphere. Altimetric data from the Lunar Orbiter Laser Altimeter (LOLA) [1] yield precise high-resolution topographic maps of the poles, which enable the computational modeling of the solar illumination and thermal environment [2,3]. In addition to the determination of the permanently shadowed regions (PSRs) and their relationship to remote sensing data such as neutron flux observations [4] and surface albedo [5], we show that the modeling of the illumination conditions can be helpful for data calibration and data analysis of scientific datasets, such as the LEND data [4].

Method: As outlined in [2], our approach is to precompute the angular elevation of the horizon from each point in the region of interest. This expensive but one-time computation has been parallelized to achieve larger study areas and higher resolution. The resulting horizon data allow rapid direct comparison to the elevation of a source at any time. While we previously computed solar illumination for large polar regions at every time step to obtain average illumination maps, we can readily perform calculations on small patches of the surfaces. This can prove useful to reproduce the geometry of specific spacecraft observations, as the illumination modeling only needs to be done over a given field of view at any given time. Therefore, for data calibration and analysis, the increased number of temporal steps (e.g., one measurement per second, instead of the more typical hourly timesteps, e.g. [2]) can be compensated by the limited spatial extent to be modeled. Figure 1 illustrates the application to LEND.

Analysis: Algorithm improvements have allowed us to update our past results [2] over both poles (65-90°) with improved resolution. The information in each field-of-view can be condensed statistically, to create time series of average illumination (Figure 2), illumination texture, etc., to be compared with the measurements. The study of insolation-driven variability of the LEND-measured neutron counts [6] can potentially benefit from the modeling of actual illumination conditions over the instrument footprint, as the local solar time is not necessarily an accurate proxy for actual insolation in the polar regions.

References: [1] Smith D. E. et al. (2010) *GRL*, 37, L18204. [2] Mazarico E. et al. (2011), *Icarus*, 211, 1066. [3] Paige D. et al. (2010), *Science*, 330, p479-482. [4] Mitrofanov I. G. et al. (2010) *Science*, 330, 483-486. [5] Gladstone G. R. et al. (2011), JGR, 117, E00H04. [6] Livengood T. A. et al., AGU 2013, P51B-1733.

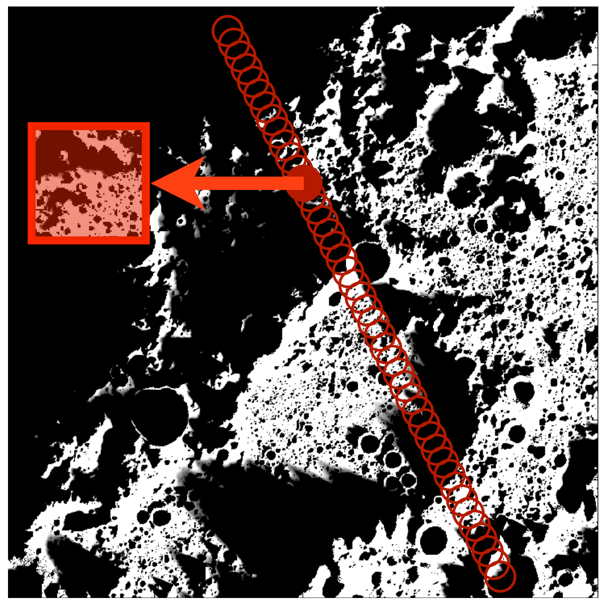

Figure 1. The illumination conditions of all the pixels within each LEND footprint (red circles) are calculated with the exact solar, lunar and spacecraft positions. The red insert shows the obtained sun visibility for each pixel in one LEND footprint.

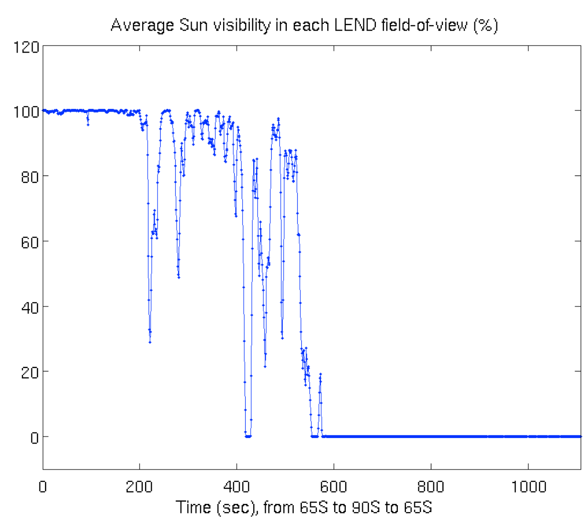

Figure 2. Average sun visibility in the LEND field-of-view over the north polar region during one LRO orbit.