**ILLUMINATION CONDITIONS OF THE LUNAR POLES TO 65 DEGREES LATITUDE FROM LUNAR ORBITER LASER ALTIMETER DATA.**
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**Introduction:** Although diurnal temperature variations over most of the Moon's surface can be extreme, the lunar polar regions have the potential to trap volatiles in permanently shadowed regions (PSRs). Because the Moon's spin axis is nearly perpendicular to the ecliptic plane, the Sun is always low on the horizon in the polar regions, and topographic relief such as impact craters can be sufficient to provide permanent shadow. Although the Moon obliquity has been larger in the past, many PSR regions have likely been stable over tens to hundreds of millions of years. This was recognized before good topographic knowledge of the polar regions existed **[1]**, and was confirmed by more recent studies using ground-based radar **[2]** or spacecraft data **[3,4,5,6]**.

**Data:** We use data collected by the Lunar Orbiter Laser Altimeter (LOLA) instrument **[7]** onboard the Lunar Reconnaissance Orbiter (LRO) **[8]**. With more than 4.67 billion LOLA altimetric measurements (as of September 1, 2011), and the polar orbit of the LRO spacecraft, the data coverage of the poles is excellent. We construct topographic maps of the lunar polar regions, from ~55° to the pole, at a resolution of 480 meters per pixel.

**Method:** The horizon method was described in detail in **[6]**. Horizon (angular) elevation maps are constructed for the region of interest (~80°-90°) for 720 azimuthal directions (δθ=0.5°). The illumination conditions at any epoch can then be obtained by comparing the Sun elevation to that of the horizon (in the Sun direction).

**Results**: We conduct simulations with the LOLA topography to survey the extent of PSRs in both polar regions, down to 65° latitude. These regions are much larger than our previous work (down to 80°, **[6]**) and that of others. These calculations provide a nearly-complete survey of the lunar PSRs, with total areas of 21,866km$^2$ and 25,905km$^2$ in the North and South respectively. In addition to the average solar illumination, we also characterize the average and maximum incident flux. Those quantities are related to the illumination and energy budget of the lunar polar regions. We investigate how they relate to the LEND measurements **[9]**. Similarly to the LEND measured counts, the average, the average illumination decreases with increasing latitude, more steeply than what can be expected from a pure solar incidence effect.

**References:** [1] Watson K.B. et al. (1961) *JGR*, *66*, 3033. [2] Margot et al. (1999) *Science*, *284*, 1658. [3] Cook et al. (2000), *JGR*, *105*, 12023. [4] Noda et al. (2008), *GRL*, *35*, L24203. [5] Bussey et al. (2010), *Icarus*, *208*, 558. [6] Mazarico et al. (2011), *Icarus*, *211*, 1066. [7] Smith et al. (2010), *GRL*, *37*, L18204. [8] Chin et al. (2007), *Sp. Sci. Rev.*, *129*, 4. [9] Mitrofanov et al.(2010) Science, 330-6003, 483-486.

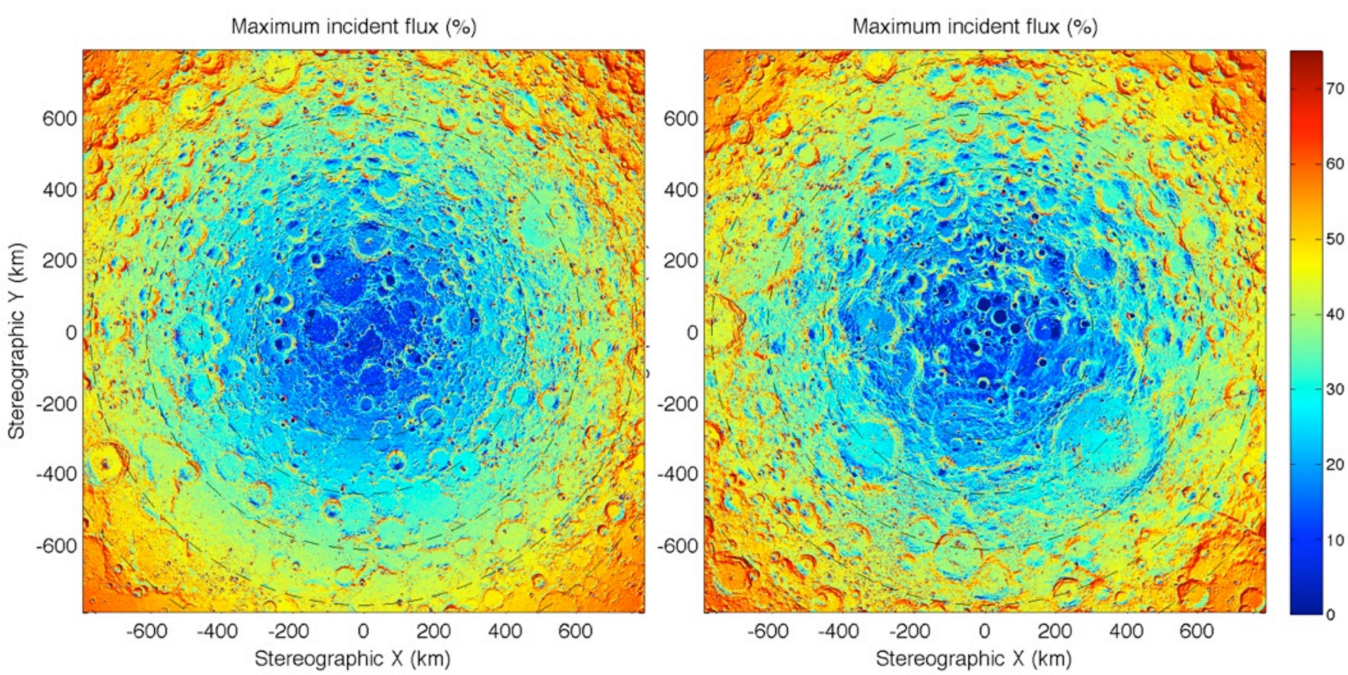


**Figure 1.** Maximum incident flux maps for the northern (left) and southern (right) polar regions. The simulation duration was one 18.6yr cycle, with a timestep of 6 hours. The latitude circles are every 5 degrees, down to 65° latitude.