USING LUNAR ORBITER LASER ALTIMETER DATA TO INVESTIGATE THE LUNAR POLES.

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Introduction: The lunar poles have been the focus of recent scientific missions such as the Lunar Reconnaissance Orbiter, and several efforts are being planned to land and investigate in situ their unique properties. 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. As such, the lunar polar regions have the potential to trap volatiles in permanently shadowed regions (PSRs). This was recognized before good topographic knowledge of the polar regions existed **[1]**. We and others have modeled the location and distribution of such areas, in both lunar polar regions **[2,3,4,5,6]**.

Data: The data collected by the Lunar Orbiter Laser Altimeter (LOLA) instrument **[7]** onboard the Lunar Reconnaissance Orbiter (LRO) **[8]** since July 2009 have proven the most useful to conduct modeling simulations of the solar illumination on the Moon. We use more than 6 billion LOLA altimetric measurements to construct accurate high-resolution map of the surface elevation. The polar orbit of the LRO spacecraft, provides excellent coverage of the poles. We use a recent GRAIL gravity model **[9]** to improve the LRO orbit reconstruction and geodetic accuracy.

Method: We use the horizon method, as described in detail in **[6]**, with several computational improvements. In particular, we use a multi-resolution approach, where topographic grids of varying resolution and extent from the pole are used to model both near-field topographic effects and all possible far-field obstacles that affect the illumination on a more regional scale (e.g. large elevated regions). This enables us to conduct long-term (decade-long) simulations at high resolution (100m/pixel).

Results: We present the results of simulations with the LOLA topography, documenting the extent and distribution of permanently shadowed regions, as well as the illumination statistics on the proposed targets for future missions (ESA Lunar Lander, IKI LunaGlob). We also present maps of the sky visibility from the surface (Figure 1), which are important in calibrating and interpreting some instrument data. For instance, to calibrate the UV incident flux in the PSRs and yield UV surface albedo, maps such as shown in Figure 1 were used for the LAMP instrument. Visible sky angle is also important to predict or assess relative effects of the various proposed space weathering processes.

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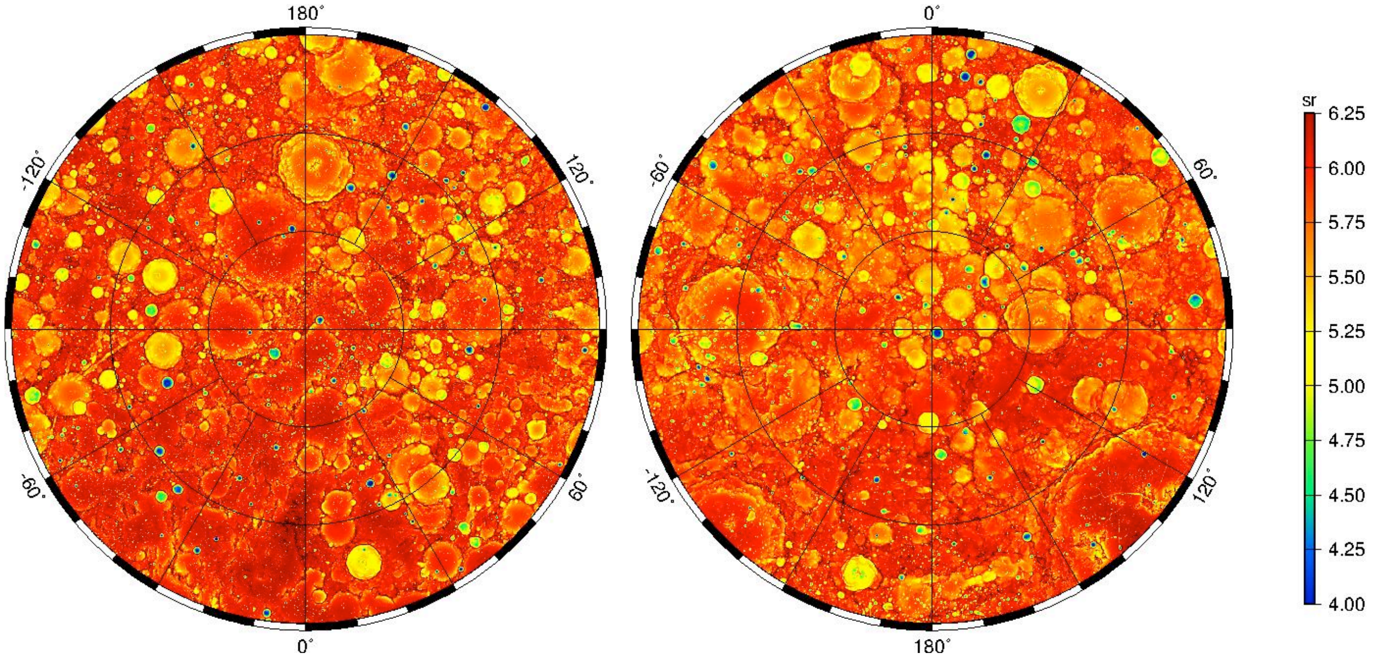

Figure 1. Maps of visible sky solid angle (in steradians) for the northern (left) and southern (right) polar regions. The latitude circles are every 5 degrees, down to 75° latitude. The floors of deep craters such as Shackleton see only a fraction of the sky compared to the typical 2π value of a flat surface.