**LUNAR POLAR ILLUMINATION CONDITIONS DERIVED USING KAGUYA LASER DATA.** D. B. J. Bussey[1] , J. A. McGovern[1], P. D. Spudis[2], C. D. Neish[1], and S-A. Sörensen[3], [1]The Johns Hopkins Applied Physics Laboratory, Laurel MD, USA (ben.bussey@jhuapl.edu), [2]Lunar and Planetary Institute, Houston TX, USA, [3]University College London, United Kingdom.

**Introduction:** The lunar Polar Regions experience unusual illumination conditions that make them attractive candidates for future exploration and possible use. The small angle between the Moon's spin axis and the ecliptic plane result in locations that are permanently shadowed as well as some that are nearly continuously illuminated. We have used the Kaguya laser-altimeter derived topography to comprehensively characterize the illumination conditions at both poles of the Moon.

**The Data:** This detailed illumination study became possible with the partial release of the Kaguya laser-derived topography data set. Kaguya was a JAXA lunar orbiter, launched in 2007, which mapped the Moon from a 100 km polar orbit for 2 years. Kaguya (known as SELENE before launch) carried an extensive suite of instruments that conducted a comprehensive study of the lunar surface [1]. The primary data set used in this study is the polar Digital Elevation Model (DEM) derived from the laser altimeter experiment. The laser altimeter on Kaguya used a 1064 nm laser firing at 1 Hz (with a corresponding along track spacing of ~1.6 km). Spot size on the lunar surface was 40 m and the vertical accuracy was 5 m. These data were used to produce a 500 m/pixel spatial resolution DEM covering from 85° S to 90° [2].

**Technique:** We are able to simulate where is illuminated on the lunar surface for a chosen value for Sun position. We have used a Kaguya-derived DEM to generate simulations of a diverse range of lunar polar illumination conditions.

**Results:** Specifically we have addressed four topics: 1. Clementine Comparison, 2. Permanent-shadow, 3. Seasonal variations, & 4. Illumination profiles for key sites.

*Clementine Comparison:* We ran multiple simulations using solar positions that correspond to a Clementine UVIS image. An example is shown in Figure 1. We find that the Kaguya DEM can be used to predict illumination conditions with a high degree of confidence. In fact we think that this is the first data set of sufficient quality to be used for conditions where this is not an image to provide ground truth.

*Permanent Shadow:* We used the Kaguya DEM to calculate areas of permanent shadow and also those areas, which are also Earth shadowed.

*Seasonal Variations:* We have used the data to investigate seasonal variations in the illumination conditions. Even though the Sun only varies a total of 3° in elevation during a year there are significant variations between summer and winter. Initially we produced a quantitative illumination map over the course of an entire year. Next quantitative illumination maps were made for seven lunar days. Day 1 had mid-summer for the southern hemisphere at the middle of the day, whilst day 7 has mid-winter at the middle of the day. The maps for days 1 & 7 for the South Polar Region are shown in Figure 2.

*Illumination Profiles:* We used the seasonal-variation maps to identify regions that receive the most illumination near both poles. For several of these regions we then determined the detailed illumination profiles. These show the amount and duration of the eclipse periods. Additionally they show the maximum single amount of time that they receive continuous illumination. We have found places near the south pole that are illuminated continuously for more than four months around mid-summer.

**Conclusions:** The Kaguya DEM has proved to be a major asset in trying to understand the illumination conditions at the lunar poles. We have used this topography product to comprehensively characterize the lunar polar illumination conditions. New data now being obtained by LRO will increase our understanding of polar lighting conditions.

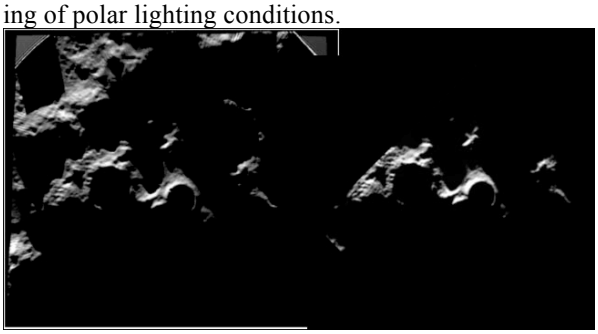

Figure 1. Comparison between a Kaguya-derived simulation and an actual Clementine image.

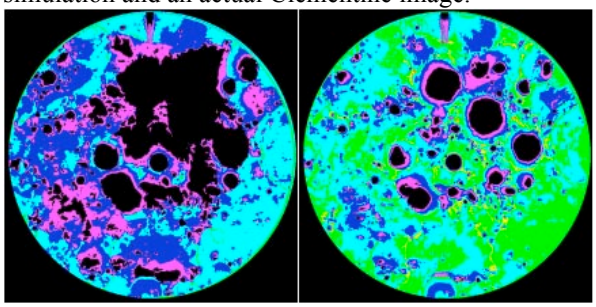

Figure 2. Quantitative south-pole illumination maps for winter (left) and summer (right).

**References:** [1] Kato M. et al., (2008) *Adv. Space Res, 42,* 294-300. [2] Noda H. et al., (2008) *GRL*, 35, L24203.