EPSC Abstracts
Vol. 6, EPSC-DPS2011-1865, 2011
EPSC-DPS Joint Meeting 2011

Lunar optical remote sensing measurements: Quantitative comparisons of M^3 and SIR-2 on Chandrayaan-1 and SP and MI on Kaguya

S. Besse (1), J. Boardman (2), R. Green (3), J. Hayaruma (4), U. Mall (5), T. Matsunaga (6), M. Ohtake (4), C. Pieters (7), M. Staid (8), J. Sunshine (1), S. Yamamoto (6), Y. Yokota (6) and the M^3, Kaguya, and the SIR2 teams.
(1) University of Maryland, College Park, MD, USA (sbesse@astro.umd.edu)
(2) Analytical Imaging and Geophysics, LLC, Boulder, CO, USA
(3) Jet Propulsion Laboratory, Pasadena, CA, USA
(4) Japan Aerospace Exploration Agency, Sagamihara, Japan
(5) Max Planck Institute, Lindau, Germany
(6) National Institute for Environmental Studies, Tsukuba, Japan
(7) Brown University, Providence, RI, USA
(8) Planetary Science Institute, AZ, USA

Abstract

Recently, the Moon has been orbited by a several spacecrafts and instruments from different space agencies that have all looked at the same object. Ultimately, measurements from comparable optical instruments should be the same because the surface of the Moon evolves very slowly. We use observations of 5 different instruments to evaluate the degree to which all measurements made onboard different missions agree and to understand their differences.

1. Introduction

Observations of the lunar surface through remote sensing instruments should present exactly the same characteristics if measurements are taken at the same illumination conditions (i.e. incidence, emission and phase angle). Although these conditions are not always possible, intrinsic residuals, differences in the instrument signal and calibration can also affect the measurements. In order to assess the absolute brightness of the Moon for future missions and improve the calibrations of each instruments used in this comparison, we study some areas on the Moon surface observed by different instruments with relatively close viewing geometry. All the measurements that we compare have different spectral and spatial characteristics. A combination of all the datasets increases dramatically the understanding of lunar composition with the best spectral and spatial resolution.

2. Kaguya's instruments

The Kaguya mission has orbited the Moon several times from 2007 to 2009 and has returned an important quantity of qualitative data from visible to near-infrared wavelengths. In this work, we use three instruments that have observed the Moon in the visible (TC, MI, SP) and the near infrared (MI, SP) (Haruyama et al., 2008).

2.1 Spectral Profiler (SP)

The SP is a line spectral profiler with a 400-m-wide footprint and 300 spectral bands with 6–8 nm spectral resolution in the visible to near-infrared ranges (0.5 to 2.6 μm).

2.2 Multiband Imager (MI)

The MI is a multi-spectral imager with four and five color bands with 20 m and 60 m spatial resolution in visible and near-infrared ranges.

2.3 Terrain Camera (TC)

The TC is a high-resolution stereo camera with 10-m spatial resolution from a Kaguya nominal altitude of 100 km and a stereo angle of 30.

3. Moon Mineralogy Mapper (M^3)

M^3, a guest instrument aboard India's Chandrayaan-1 mission to the Moon, is an imaging spectrometer that operates over the spectral range 0.43 to 2.97 μm and is designed to characterize and map surface mineralogy (Pieters et al., 2009). During the Chandrayaan-1 mission, M^3 mapped more than 95% of the Moon (Boardman et al., 2011) with resolutions of 140 and 280 m/pix with 85 spectral channels in the lower resolution global mode.

4. SIR-2

The SIR-2 instrument (Mall et al., 2009) is a grating-based, compact, high-resolution point spectrometer operating in the 0.9–2.4 µm spectral range sampled by a 256 channels (giving a 6 nm spectral resolution). The SIR-2 field of view from 100 km altitude translates into a ground sampling resolution of approximately 220 m.

5. Comparison

Comparisons are made between instruments, namely MI to SP, SP to M^3 and M^3 to SIR2.

MI and SP measurements have numerous observations with the same viewing conditions that allow a good selection of comparison sites. The match between the two instruments is very good, although short wavelengths present some discrepancy.

SP to M^3 measurements are more difficult to compare because the instruments are on two separate missions. In order to be independent from the photometric measurements developed for each set of data [Besse et al., 2011, Yokota et al., 2010], the tests site are selected with the same viewing condition (±1°). Fig. 1. This limits the range of candidates on the lunar surface. However, the comparison of spectra from the two instruments shows a relative good agreement between the data. Differences are seen in the UV, this is most likely due to scattered light problem in M^3.

M^3 to SIR-2 comparison show relatively good agreement. The range of comparison does not include the problematic UV for M^3 but the remaining part of the spectral range shows good agreement over absorption features. An offset problem between the two instruments is still present and corrections are on going to assess the differences between the two instruments.

6. Conclusion

Comparisons of the spectra from all the instruments are still on-going as the calibration of the instruments is improved. At this point the, instruments have data that are in good agreement. Preliminary comparisons with ROLO measurements (Staid et al., 2007) confirm that the absolute reflectance of all instruments is close to ground-based earth observations.

References

[1] Hayurama et al., EP&S, 2008
[2] Pieters et al., Current Science, 2009
[3] Boardman et al., JGR, 2011
[4] Mall et al., Current Science, 2009
[5] Besse et al., LPSC 42nd, 2011
[6] Yokota et al., LPSC 41st, 2010
[7] Staid et al., LPSC 38th, 2007

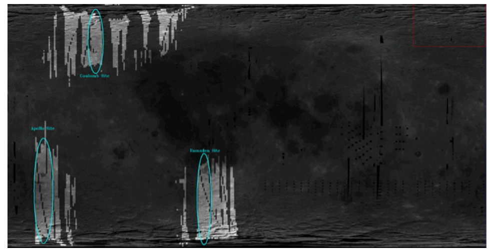

Fig 1: Example of matched observations between SP and M3 on a Mercator projection of the Moon.