
Introduction: The LRO Spacecraft has been orbiting the Moon for over 6 years (~80 lunations), and in that time data from the seven instruments has contributed to a revolution in our understanding of the Moon. Since launch the mission goals and instruments science questions have evolved, from the initial characterization of the lunar surface and its environment to studying the variability of surface hydration and measuring the flux of new craters that have formed over the past 6 years. The growing LRO dataset in the PDS presents a unique archive that allows for an unprecedented opportunity to study how an airless body changes over time.

LRO launched on June 18, 2009, and began with the goal of seeking safe landing sites for future robotic missions or the return of humans to the Moon as part of NASA’s Exploration Systems Mission Directorate (ESMD). In addition, LRO’s objectives included the search for surface resources and the measurement of the lunar radiation environment. After spacecraft commissioning, the ESMD phase of the mission began on September 15, 2009 and was completed on September 15, 2010 (Figure 1) when operational responsibility for LRO was transferred to NASA’s Science Mission Directorate (SMD). The SMD mission was scheduled for 2 years and completed in September of 2012. Under SMD, the Science Mission focused on a new set of goals related to understanding the history of the Moon, its current state, and what it can tell us about the evolution of the Solar System. Since then LRO has participated in NASA Senior Reviews, receiving 2-year extensions.

Instrument and Spacecraft Status: The LRO instrument suite [1] is currently performing nominally, with no significant performance issues since the mission entered the current extended mission. The Mini RF instrument, which was not included in the current extended mission, is investigating new methods for collecting bistatic data in an upcoming extended mission [2] starting in September 2016, pending NASA approval.

The LRO spacecraft has been in an elliptical, polar orbit with a low perilune over the South Pole since December 2011 (Figure 1). This orbit minimizes annual fuel consumption, enabling LRO to use fuel to maximize opportunities for obtaining unique science (e.g., lunar eclipse measurements from Diviner, measuring spacecraft impacts by GRAIL and LADEE).

LRO Data: The LRO instrument teams deliver data to the PDS every three months, data that includes raw, calibrated, and gridded/map products [3]. As of January, over 681TB has been archived.

New higher-level data products are regularly added to the PDS archive; here we highlight just a few of those products and data tools.

LOLA Global Albedo: Using the energy of the reflected laser pulse from LOLA, a global albedo map at 1064 nm and 0° phase angle [4] has been produced (Figure 2). That these maps are generated using the active LOLA instrument, areas that are otherwise in permanent shadow are visible (note the relatively brighter interior of Shackleton Crater [5]). The maps are available via the PDS at a range of resolutions, globally at 10 pixels per degree (ppd) or at 1km per pixel for areas poleward of 50° N/S.

Figure 1. LRO orbit history from orbit insertion through mid-2015. The initial ~50x50km circular orbit included two low-passes over Apollo sites.

Figure 2. LOLA-derived 1064nm albedo of the South Pole. Map uses an orthographic projection centered on the South Pole, with the lunar nearside at the top.
**LROC NAC DTM:** Repeated imaging of selected targets enables the generation of localized, high-resolution digital terrain models (DTMs). Hundreds of these DTMs are available at scales of ~2 meters per pixel for a range of targets and areas of interest (e.g., Apollo and Luna landing sites, LADEE impact site, other areas of interest).

![Figure 3. Example of the web interface with the Apollo 17 DTM [6].](image)

**LROC WAC Mosaics:** There are a number of WAC products available [6] including empirically normalized reflectance maps, low and high sun angle mosaics, and a number of low-sun mosaics from several months-long imaging campaigns (Figure 4). These products are extremely useful for characterizing surface morphology.

![Figure 4. WAC Mosaic systematically acquired in June 2012. Orthographic projection centered on the farside.](image)

**CRaTER Data:** The CRaTER instrument provides data to the Prediccs website, an on-line system to predict and forecast the radiation environment at the Moon [7]. The on-line tool allows the user to view the radiation dose (at the Earth, Moon, or Mars) over the past 366 (Figure 5), 31, or 7 days.

![Figure 5. Plot of the radiation received at the Moon, with various modeled doses received behind thicknesses of Al.](image)

**Future Possibilities:** LRO has been invited to participate in the upcoming Planetary Science Division Senior Review to propose for two years of operations (FY17-18). As part of the senior review process the LRO instrument teams and project are defining exciting new science questions and instrument modes. We are also evaluating new orbits for the spacecraft in order to maximize the science return, as well as put us in a position to leverage possible future opportunities (e.g., observe future landings by commercial/private/international missions, upcoming eclipses).

**References:**