Exploring the Moon with the Lunar Reconnaissance Orbiter Camera

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The Lunar Reconnaissance Orbiter Camera (LROC) consists of two imaging systems that provide synoptic and high resolution imaging of the lunar surface. The Wide Angle Camera (WAC) is a seven band (315, 360, 415, 566, 604, 643, 689nm) push frame imager with a 90° field of view in monochrome mode, and 60° field of view in color mode. From the nominal 50 km polar orbit, the WAC acquires images with a pixel scale 100 meter for the visible filters (400 meter pixel scale for the UV filters). The Narrow Angle Camera (NAC) consists of two line scan cameras that provide high resolution images at a pixel scale of 0.5 to 2.0 meters and a combined field of view of 5.7°. Since going into orbit in 2009, LROC has acquired over 600,000 images. A subset of these archived images have been used to derive a set of digital map products and image mosaics. These reduced data record (RDR) products are publicly released through NASA's Planetary Data System.

The WAC images almost the entire Moon each month capturing the lunar surface under a variety of lighting conditions over time. These images are used to create global mosaics, a near-global digital terrain model, and polar illumination movie sequences. To create a global mosaic for morphologic interpretations, images from several months are combined into a single map product that reduces incidence angle variations at the equator. The resulting product is sampled at a pixel scale of 100 meters and is comprised of over 15,000 images acquired between November 2009 and February 2011.

In the 50 km polar orbit, WAC observations offer substantial (42% at the equator) across-track stereo with images acquired from adjacent orbits. A total of ~69,000 stereo models (providing about 100.2 billion points) acquired during the one-year nominal mission and the first months of the science mission phase are combined into a near-global (|latitudes| up to 79°, i.e. 98.2% of the entire lunar surface) digital elevation model (DEM) sampled at a pixel scale of 100 meters (GLD100).

The polar orbit also enables observation of each pole every two hours, which are reduced to illumination movie sequences. Over each pass of the north and south pole, the WAC images the terrain from 80° poleward to 90° and back to 80° on the opposite side. With the 90° field of view (in monochrome mode), the WAC provides images with repeat spatial coverage around both lunar poles, which enable the visualization of how the lighting conditions change as the Sun progresses across the horizon each lunar day and the sub-solar latitude migrates from 1.5˚ S to 1.5˚ N over a lunar year.

In addition to WAC derived RDR products, NAC images are also reduced into mosaics and digital terrain models. During the summer solstice at each lunar pole, when shadows are at a minimum, hundreds of images are acquired and later reduced into high resolution maps. These NAC polar mosaics extend from the pole out to 85.5° N/S and have a pixel scale of two meters. In addition to polar mosaics, high resolution (pixel scale between 0.5 and 2.0 meters) maps are also created for

other regions of interest all across the Moon.
Finally, NAC images are also being processed into high resolution DEMs. Although the NAC was not designed for stereo imaging, the spacecraft can roll off nadir and acquire stereo observations with nearly invariant lighting conditions. NAC stereo observations acquired over many months are processed using SOCET SET and then combined to create regional terrain models with a scale typically around two meters.
The reduced data products produced by the LROC team are used for a variety of studies including planning future lunar missions and answering key scientific questions.