MULTI-SCALE LUNAR IMPACT CRATER TOPOGRAPHY FROM LROC WAC/NAC STEREO DATA.

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Introduction: From the mean LRO orbit altitude of 50 km the Lunar Reconnaissance Orbiter Camera (LROC) [1,2] provides image data with cross-track and along-track stereo data from which we derive digital terrain models (DTM) of the lunar surface. We adapted the DLR photogrammetric processing system, which has been used operationally for DTM generation from Mars Express HRSC [3,4] and other stereo imagery, to LROC data processing. While LROC WAC images are used for the derivation of global topography [5], LROC NAC data (~0.5 m/pxl) allow for local topographic mapping [6]. DTMs from stereo typically support the topographic analysis of contiguous areas and surface features (e.g. craters), at least as long as DTMs derived from laser altimetry suffer from significant gaps between adjacent tracks.

WAC Stereo DTM Generation: From a polar orbit, the Wide Angle Camera (WAC) of the Lunar Reconnaissance Orbiter Camera system (LROC) provides image data with substantial cross-track stereo coverage (50% overlap and 30° stereo angle at the equator). The LROC WAC consists of a 1k x 1k CCD frame which is split up into sub-frames for seven different spectral bands, two ultraviolet bands and five bands in the visible spectrum. Each band consists of 14 lines/subframe, while subframes form an image strip using the pushbroom principle ("push-frame"). WAC's IFOV is about 5.1 arcmin, its ground scale from 50 km orbit altitude is about 75 m/pxl. For the stereo processing we used WAC data of the visible bands, which comprise 704 pxl/line. Within the overlap of WAC images from adjacent orbits we carry out area-based image matching. Ground points are derived by 3D forward ray intersection and finally a 200 m DTM grid with a vertical accuracy of a few tens of meters is interpolated..

NAC Stereo DTM Generation: LROC NAC consists of 2 pushbroom scanners, NAC-L and NAC-R, both with an IFOV of 2 arcsec (0.5 m ground scale from 50 km orbit altitude) and 5,000 pxl/line. We use NAC data from 2 subsequent orbits for stereo. DTMs are derived as described for WAC. The typical DTM grid is 2 m with a vertical accuracy of a few decimeters.

Crater Topography: We will present a multi-scale series of DTMs and profiles from NAC stereo data, describing the horizontal and vertical structures of small craters (few tens of meters in diameter, e.g. Fig. 1), as well as WAC DTMs of larger craters up to tens of kilometers in width, impact basins like the South Pole-Aitken basin, and finally topography of entire hemispheres (e.g. Fig. 2).

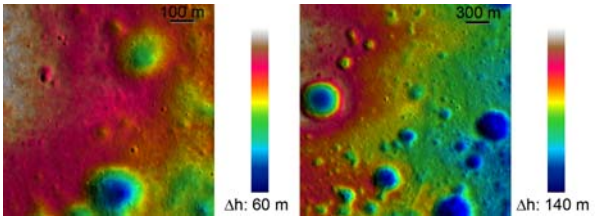

Fig. 1: Subsets of local LROC NAC DTMs (near the Apollo 17 landing site).

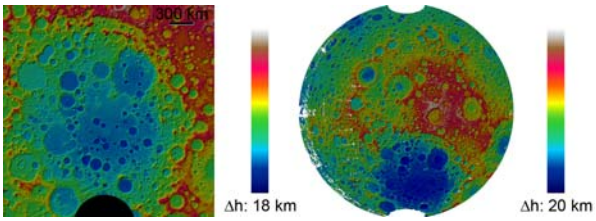

Fig. 2: Regional and global LROC WAC topography of the South Pole-Aitken basin (left) and the lunar far side (right)

References: [1] Robinson M. S. et al. (2005) *LPS XXXVI*, Abstract #1576. [2] Chin G. et al (2007) *Space Sci. Rev., 129*, :391–419, doi 10.1007/s11214-007-9153-y. [3] Gwinner K. et al. (2009) *PE&RS, 75(9)*, 1127-1142. [4] Gwinner k. et al. (2009) *Earth Planet. Sci. Lett.*, doi:10.1016/j.epsl.2009.11.007 (in press). [5] Scholten F. et al. (2010) *LPS XLI* , Abstract #2111. [6] Oberst J. et al. (2010) *LPS XLI* , Abstract #2051.