CATEGORIZATION OF LUNAR TERRAIN USING HIGH RESOLUTION WAC DTM DATA. A. Boyd[1], T. Tran[1], M.S. Robinon[1], F. Scholten[2] , J. Oberst[2,3] and the LROC Team, [1]School of Earth and Space Exploration, Arizona State University, Tempe, AZ, 85281, aboyd@ser.asu.edu, [2]German Aerospace Center (DLR), Institute of Planetary Research, Berlin, Germany, [3]Technical University Berlin, Institute for Geodesy and Geoinformation Sciences, Berlin, Germany.

Introduction: The Lunar Reconnaissance Orbiter Camera (LROC) Wide Angle Camera (WAC) images the entire Moon in stereo each month [1]. Stereogrammetric reduction of the WAC stereo provides the means to construct a 100-m scale near-global (80°S to 80°N) digital terrain model (DTM), known as the GLD100 WAC DTM [2, 3]. From GLD100 (**Figure 1**), terrain can be characterized by elevation, slope, and roughness, which are dominantly the result of asteroidal and cometary bombardment and resurfacing events (volcanism and ejecta). The new LROC WAC DTM allows accurate characterization of slopes at the ≥300-meter scale. Such information is useful for unraveling the origin and evolution of units defined by other datasets (e.g. albedos, color, composition).

Slope and roughness information were extracted from major terrains (**Figure 2**) for comparison (**Table 1**), guided by a 100-meter per pixel WAC global mosaic [4]. Slopes were computed on a 300×300 m baseline and stored as 100 m/post at the central pixel. Roughness is reported as the standard deviation of the local slope (100 m/post) within an n × n meter box, where n is 500 and 1100. Roughness at the 500-m scale is more susceptible to noise in the DTM.

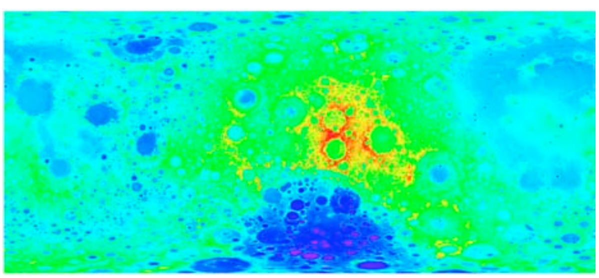

Figure 1. WAC DTM 80S° to 80°N latitude, simple cylindrical coordinates centered at 180°E [2,3].

Results: The average global 300-m slope is 6.6° and the median is 4.7°. Global average and median 500-m roughness are 0.8° and 0.6°, and the 1100-m roughness average and median are 1.4° and 1.1°. The average of all mare median slopes is 1.2°, 500-m roughness is 0.4°, and 1100-m roughness is 0.5°. Amongst mare units, the median slope ranges from 1.0° (Serenitatis) to 1.4° (Fecunditatis) and 1100-m roughness 0.45° (Serenitatis) to 0.6° (Fecunditatis, Procellarum). In the highlands, the standard deviation of the slope sampled at 500 and 1100 meters is 1.71°, which is 2.1 times larger than the average of the sampled mare regions.

Large-scale smooth plains have been of interest to the lunar science community for many decades. Most are formed by basaltic flood volcanism and (fluidized) basin impact ejecta. The most studied of the basin ejecta is the Cayley formation explored by Apollo 16 astronauts [5]. Smaller smooth plains exist as impact melt deposits around and in younger impact craters. We searched for smooth plains within the DTM derived products by thresholding slopes <2° and 1100-m roughness <0.7°. The remaining points were filtered so that polygons in the mask that contained less than 100 points were deleted (to minimize noise). This technique identified the major and minor mare deposits and numerous smaller units within the highlands (**Figure 3**). Globally (80°S to 80°N) smooth plains cover ~17.4% (mare and highlands smooth plains).

Unit	Slope	500m Roughness	1100m Roughness	Altitude
Mare Crisium	1.14	0.35	0.51	-3580
Mare Fecunditatis	1.40	0.39	0.60	-2040
Mare Humorum	1.25	0.38	0.57	-2340
Mare Imbrium	1.02	0.34	0.49	-2240
Mare Nectaris	1.10	0.31	0.47	-2740
Mare Nubium	1.23	0.35	0.53	-2180
Oceanus Procellarum	1.28	0.40	0.60	-1870
Mare Orientale	1.20	0.31	0.48	-2720
Mare Serenitatis	0.98	0.31	0.45	-2650
Mare Tranquilitatis	1.27	0.36	0.55	-1300
Highlands1	5.02	0.59	1.11	-470
Global	4.70	0.60	1.12	-638

Table 1. Unit median statistics of the 100 meter WAC DTM, slopemap, and roughness (standard deviation of the slopemap) at 500x500 m and 1100x1100 m box sizes.

Future Work: We intend to map the highlands smooth plains identified in the statistical analysis and investigate their mode of origin. Understanding the percentage of lunar highlands resurfaced with basin ejecta is relevant not only to lunar studies but new results concerning mercurian plains units currently under investigation with MESSENGER data. In addition, we are investigating the possibility that a roughness parameter may serve as a proxy for relative and absolute ages within mare terrains.

Additionally, applying the techniques described here to higher resolution DTMs such as those made with the LROC Narrow Angle Camera (NAC) [6] may have the potential of identifying fresh craters by the higher roughness and higher angle of the crater wall, as well as possible melt pond material in craters (low slope and roughness values).

References: [1] Robinson M.S. et al. (2010) *Space Sci. Rev.*, 150, 81-124. [2] Scholten F. et al. (2011a) LPSC XLII (this conf.). [3] Scholten F. et al. (2011b) LPSC XLII (this conf.). [4] Speyerer et al. (2011) LPSC XLII (this volume). [5] Ulrich G. E. et al (1981) *USGS Prof. Paper 1048*, 539 pp. [6] Tran et al. (2010) LPSC XLII (this volume).

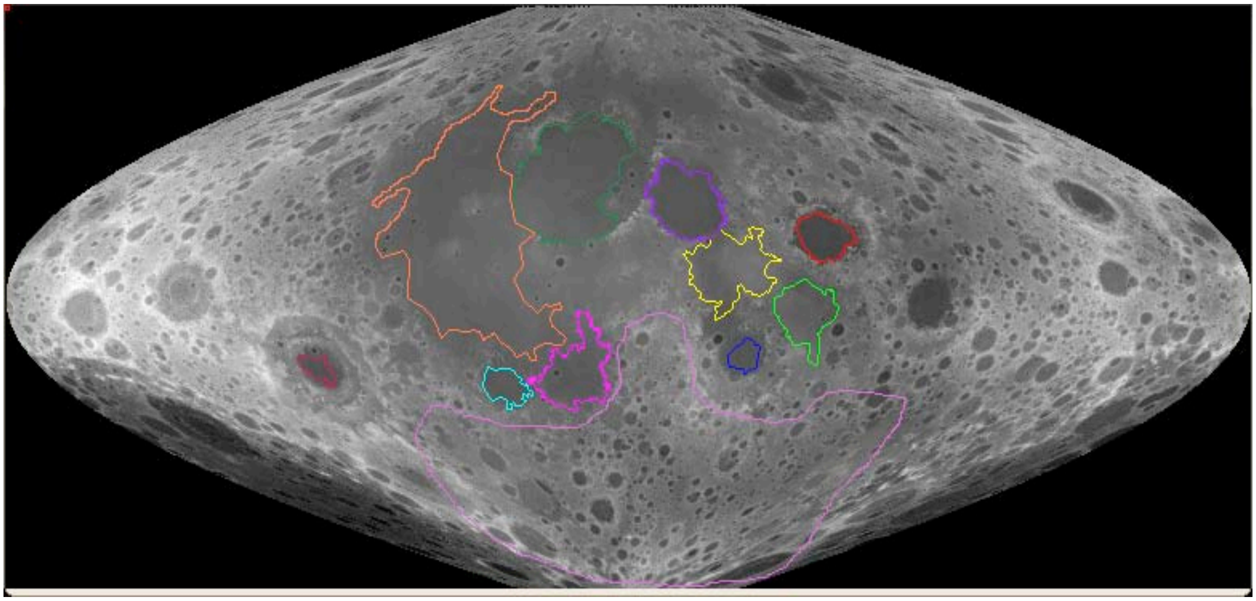

Figure 2. WAC 100 meter DEM with the statistical units highlighted (sinusoidal projection centered on the near side, latitude range 80°S to 80°N, longitude range 180°W to 180°E).

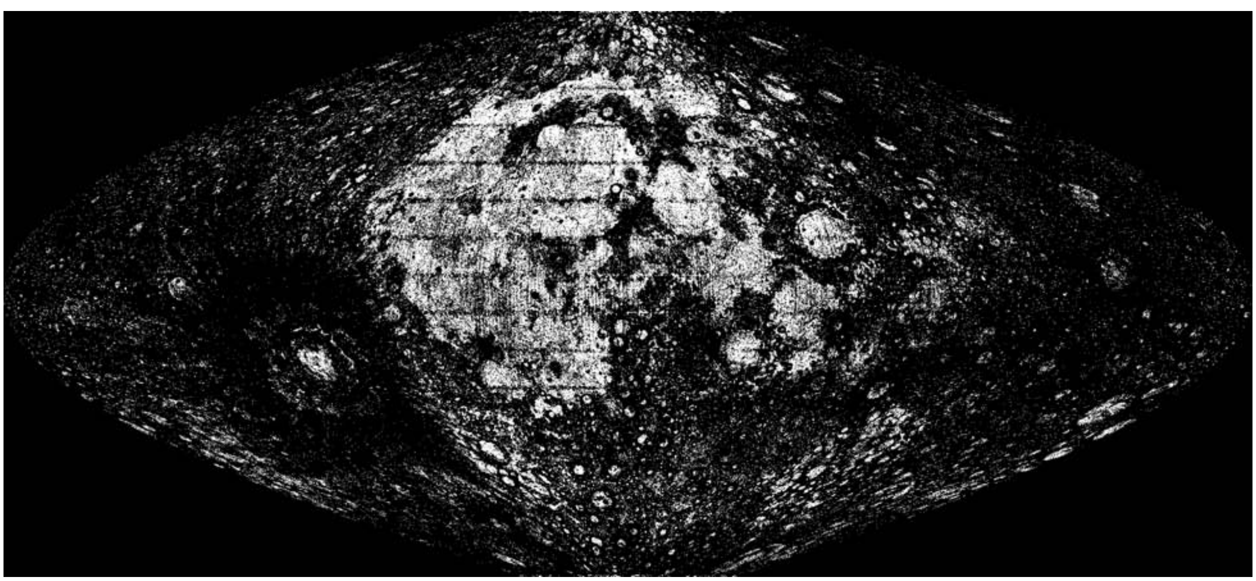

Figure 3. WAC 100 meter smooth plains image (sinusoidal projection centered on the near side, latitude range 80°S to 80°N, longitude range 180°W to 180°E).