IMPLICATIONS OF MOLA GLOBAL ROUGHNESS, STATISTICS, AND TOPOGRAPHY. O. Aharonson[1], M. T. Zuber[1,2], G. A. Neumann[1,2], [1]Dept. of Earth, Atm. & Planet. Sci., MIT 54-521, Cambridge, MA 02139; oded@mit.edu, [2]Lab. for Terr. Phys., NASA/Goddard Space Flight Center, Greenbelt, MD 20771.

Introduction: New insights are emerging as the ongoing high-quality measurements of the Martian surface topography by Mars Orbiter Laser Altimeter (MOLA) [1] on board the Mars Global Surveyor (MGS) spacecraft [2] increase in coverage, resolution, and diversity. For the first time, a global characterization of the statistical properties of topography is possible.

The data were collected during the aerobreaking hiatus, science phasing, and mapping orbits of MGS [10,11], and have a resolution of 300-400 m along track, a range resolution of 37.5 cm, a range precision of 1-10 m for surface slopes up to 30°, and an absolute accuracy of topography of 13 m [15]. The spacecraft's orbit inclination dictates that nadir observations have latitude coverage of ~87.1°S to 87.1°N; the addition of observations obtained during a period of off-nadir pointing over the north pole extended coverage to 90°N.

Analysis: Statistical estimators computed in a running window of width 100 km include the *Inter-Quartile Scale (IQS)* [3-6], *Correlation Length (l)* [7,8,9], *and RMS and Median Slope* (θ_r and θ_m) [5]. When applied to windowed MOLA elevation measurements, IQS corresponds to macro-scale surface roughness on a 100-km baseline. This estimator is robust because up to 25% on each end of the distribution can be outliers (due to small craters, tectonic structures and/or volcanic features, for example), which are ignored.

Results: Figure 1 shows the IQS surface roughness. Martian topography typically varies by 5-500 m over a 100-km baseline. However, the hemispherical crustal dichotomy clearly divides the surface into the smooth northern lowlands with IQS~5-40 m and the heavily cratered southern highlands with IQS~40-300 m. Power spectral analysis of the surface topography [17] has demonstrated that the southern hemisphere is rougher than the northern hemisphere at wavelengths less than about 250 km. The smoothest regions are west and north of Tharsis, including Amazonis Planitia whose unusual smoothness was noted previously [10, 4], remains the smoothest unit on Mars, with IQS<5 m. Away from the rough Tharsis Montes peaks and Olympus Mons aureole deposits, the Amazonian volcanic flows that cover a significant part of the Tharsis region display a characteristic smoothness that is indistinguishable from the lowlands. MOLA sampling and the baseline chosen are sensitive to the rough areas near the volcanoes. A smaller area in Chryse Planitia, where many outflow channels terminate, has a roughness comparable to Amazonis. The canyon walls of Valles Marineris exhibit a very high IQS using this baseline, as do the regions near the rims of the Argyre and Hellas basins. The rough rim and smooth floor of Argyre are readily apparent, however, most of Hellas is indistinguishable from the southern highlands. The exception is the southwest rim, which is smoother relative to the rest of the basin, indicating either a process related to the impact or subsequent modification (e.g.[18]) produced smoothing in a regional sense. In the longitude range 0°-180°E the dichotomy boundary appears rougher then the rest of the southern highlands, owing to the chaotic nature and short-baseline topographic variance in that region [19]. The Mars Polar Lander is slated to land at the margin of the southern layered deposit plateau [unit Apl of Tanaka and Scott map, 1987]. The landing site shows a regional roughness of 30-200 m on a 100-km spatial scale and thus appears rougher than all but the roughest areas of the north polar region. However, the area is also smoother than the surrounding southern hemisphere highlands.

An additional statistic that can discriminate between terrains of similar roughness is the correlation length *(l)*. The north polar dune fields, for example, show a distinctive value of $l < 0.5$ km. Other surfaces emerge as distinctive populations, when they are sorted in correlation length.

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Figure 1.: The north and south poles, and mid-latitude maps of roughness expressed as Inter-Quartile Scale. Projections are Stereographic and Mercator respectively. The proposed landing site for MPL is shown in dashes at the south pole.