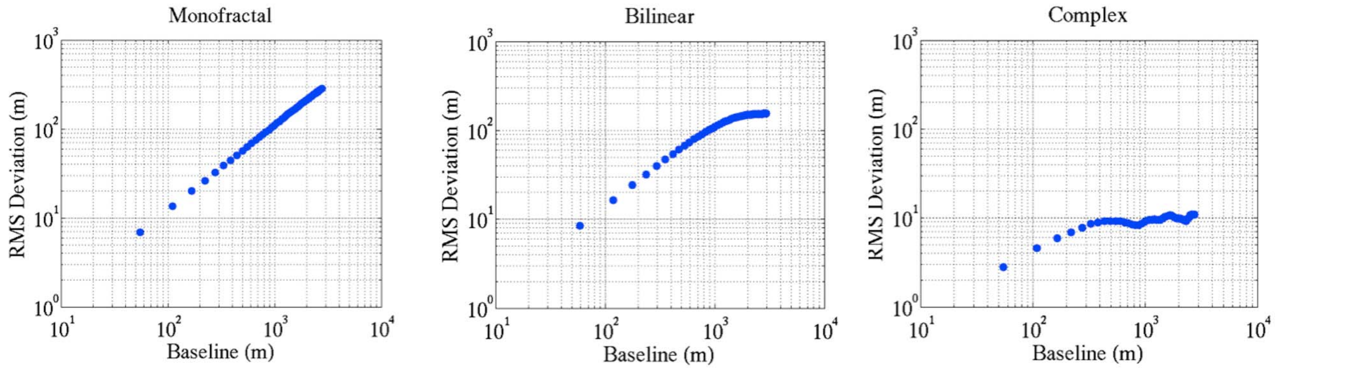

Figure 9. Observed deviogram shapes. Though many deviograms are monofractal over the baseline range explored (from 1 to 50 shot spacings, or ~57 m to ~2.7 km), most are bilinear, breaking over to a shallower slope at a certain breakover baseline. Many others exhibit complex behavior that is not well characterized by a line over a given portion of the baseline range.

Therefore, we use 1° (30 km) windows for this calculation, spaced 0.5° (15 km) apart. We use only shot-to-shot profiles of laser spot 3, selected for its consistency.

[18] To remove roughness features on the order of our window size, we detrend each deviogram at the 30 km scale. This process deemphasizes large-scale roughness features in favor of small-scale features of more interest to this study, and it avoids biases due to long-wavelength trends that are undersampled within each window [*Shepard et al.*, 2001]. Figure 7 shows how the detrending is accomplished. Slopes measured at the 30 km baseline are subtracted from small-scale slopes, leaving a slope profile with a mean near zero within the window. Slopes at scales less than 3 km are only slightly affected by the detrending process, except where long-wavelength slopes are high, for example, those near mountain ranges.

[19] In some cases, the deviograms are well characterized by a single log-log slope (exponent), but many others transition to a different slope at a certain length scale. This behavior is well documented in the literature for other planetary surfaces [e.g., *Shepard et al.*, 2001; *Morris et al.*, 2008] and is often attributed to surface processes acting at small and large scales. For the Hurst exponent fit within each window along the track, we use baselines ranging from one shot spacing (~57 m) to the breakover scale (the point where the deviogram diverges from a straight line, Δx_0) for that location. Figure 8 is a map of the Hurst exponent calculated in this way. Although the baseline range used in this map varies over the surface, this method avoids including fits to nonlinear sections of each deviogram and thus presents a more accurate estimate of the Hurst exponent at the smallest available scales.

[20] The highest Hurst exponents on the Moon are found in the highlands within crater walls and the rims and ejecta of large basins, and in these regions values above 0.95 are not uncommon. This result is surprising, given that typical Hurst exponents for topographic surfaces on the Earth and Mars are lower, between 0.7 and 0.9 [*Kreslavsky and Head*, 2000; *Orosei et al.*, 2003; *Morris et al.*, 2008]. A Hurst exponent of 1 implies self-similar topography, meaning the roughness at small scales is exactly replicated at large scales. The high values observed for the lunar highlands may be related to the density of impact craters in these regions and the absence of competing morphologic processes to transport fine material downhill. Hurst exponents within the lunar maria are lower than those within the highlands, with a median value of 0.76, indicating smoother topography at large scales relative to small scales.

[21] To classify deviogram shapes, we use a method similar to that of *Main et al.* [1999] that establishes whether a given deviogram is best fit by one line or by two, or whether

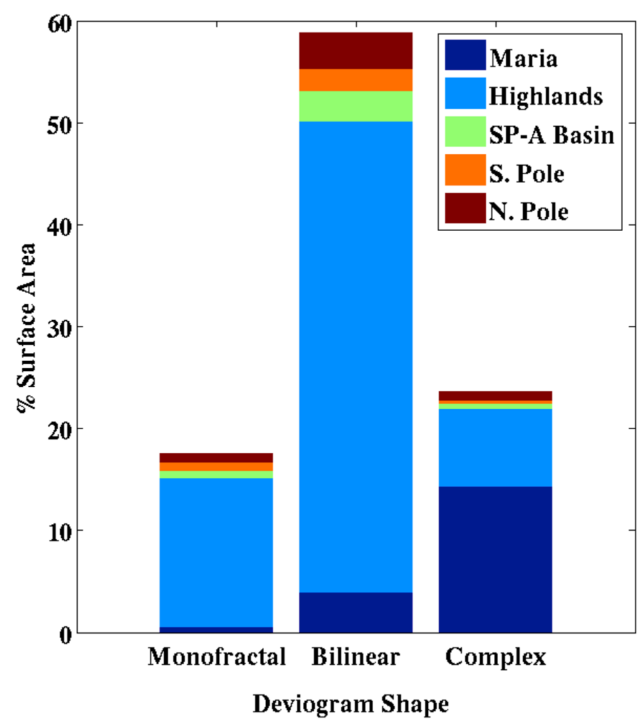

Figure 10. Abundance of deviogram shapes by surface area, sorted by region. The most common deviogram shape is bilinear (~59%), with monofractal (~17%) and complex (~24%) making up the remaining area. The highlands are almost entirely bilinear and monofractal, while the maria contain primarily complex deviograms.