Invited abstract for EP004: Aeolian Research at the Interface of Biophysical, Sedimentary, and Atmospheric Processes (Jon Perkins, Kenzie Day, Gianluca Blois, Kenneth Christensen).

Origin of the two scales of wind ripples on Mars

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Earth's sandy deserts host two main types of bedforms – decimeter-scale ripples and larger dunes. Years of orbital observations on Mars also confirmed the existence of two modes of active eolian bedforms – meter-scale ripples, and dunes. By analogy to terrestrial ripples, which are thought to form from a grain mechanism, it was hypothesized that large martian ripples also formed from grain impacts, but spaced further apart due to elongated saltation trajectories from the lower martian gravity and different atmospheric properties. However, the Curiosity rover recently documented the coexistence of three scales of bedforms in Gale crater. Because a grain impact mechanism cannot readily explain two distinct and coeval ripple modes in similar sand sizes, a new mechanism seems to be required to explain one of the scales of ripples. Small ripples are most similar to Earth's impact ripples, with straight crests and subdued profiles. In contrast, large martian ripples are sinuous and asymmetric, with lee slopes dominated by grain flows and grainfall deposits. Thus, large martian ripples resemble current ripples formed underwater on Earth, suggesting that they may form from a fluid-drag mechanism. To test this hypothesis, we develop a scaling relation to predict the spacing of fluid-drag ripples from an extensive flume data compilation. The size of large martian ripples is predicted by our scaling relation when adjusted for martian atmospheric properties. Specifically, we propose that the wavelength of martian wind-drag ripples arises from the high kinematic viscosity of the low-density atmosphere. Because fluid density controls drag-ripple size, our scaling relation can help constrain paleoatmospheric density from wind-drag ripple stratification.