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Impact of grain size distribution and wind velocity on the armoring layer of aeolian megaripples

lior saban[1], Itzhak Katra[1], and Hezi Yizhaq[2]
[1]Ben-Gurion University of the Negev, Geography and Environmental Development, Beer-Sheva, Israel (sabal@post.bgu.ac.il)
[2]Swiss Institutes for Dryland Environmental and Energy Research, BIDR, Ben-Gurion University of the Negev, Midreshet Ben-Gurion, Israel

Aeolian megaripples are a landscape formation widespread on Earth and Mars that develop in sand surfaces with a bimodal grain size distribution of coarse and fine grains. Megaripples are relatively high with a greater wavelength compared with normal sand ripples. Previous works provided quantitative information on the morphological characteristics, development, flattening mechanisms, longevity, and transverse instability of megaripples. It has been hypothesized that the sorting process of the initial bimodal size distribution is a key factor in megaripple formation. In this study, we experimentally explored the impact of the grain size distribution on the crest characteristics under different wind velocities in a boundary-layer wind tunnel. The controlled experiments allowed measurements of sand fluxes, particle size distributions, and ripple morphology by a laser module. The results reveal links between the rate of growth of the incipient megaripples, ripple height, and the armoring layer thickness and composition to wind velocity. The ripples grow higher as the wind velocity increases, and the armoring layer is thicker up to a certain wind velocity when erosion of the crest starts. In addition, the correlation between the armoring layer's nonlinear thickening rate and the ripples growth rate seems to indicate a fundamental connection between ripples height and the formation of the armoring layer, which is crucial for megaripples formation.