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Armoring and vertical sorting in aeolian dune fields

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Unlike ripples, there are only few numerical studies on grain-size segregation at the scale of dunes in aeolian environments. Here we use a cellular automaton model to analyze vertical sorting in granular mixtures under steady unidirectional flow conditions. We investigate the feedbacks between dune growth and the segregation mechanisms by varying the size of coarse grains and their proportion within the bed. We systematically observe the development of a horizontal layer of coarse grains at the top of which sorted bed forms may grow by amalgamation. The formation of such an armor layer controls the overall sediment transport and availability. The emergence of dunes and the transition from barchan to transverse dune fields depend only on the grain size distribution of the initial sediment layer. As confirmed by observation, this result indicates that armor layers should be present in most arid deserts, where they are likely to control dune morphodynamics.