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Source-to-sink sediment transport in a cellular automaton simulation of aeolian dune field evolution

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The interpretation of aeolian dune fields as self-organized systems represents a non-traditional approach to dune-field formation. Within a self-organizing system, order and pattern formation are a result of internal dynamics and feedback. The capabilities now exist to research modern dune fields by making comparisons between real-world dune fields and model simulations. We present results from a cellular automaton model that simulates aeolian dune field development through self-organization. The two-dimensional morphology of a bare sand system is governed by three simple, physically-based rules: 1) probabilities of erosion and deposition control sediment transport; 2) a shadow zone prevents transport in the lee of a dune; and 3) the angle of repose is enforced through avalanching. The algorithm has been modified from Werner's model to allow source-to-sink sediment transport, resulting in more realistic dune field simulations. Simulations are performed using different combinations of input parameters to best replicate a modern dune field and elucidate past conditions that may have contributed to its initial formation. The ability to model open sediment systems also provides an opportunity to investigate the role of sediment input in the creation of the overall landscape. Landscapes generated using different methods of sediment input are compared: a line source vs. a point source, and periodic supply vs. constant supply. The ability to model source-to-sink sediment transport and therefore replicate modern dune fields allows us to address the fundamental question of aeolian landscape evolution.