



Interpreting ecogeomorphic interactions and disturbance response in vegetated aeolian dune systems

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Vegetated aeolian dune fields are sensitive to disturbances such as fire or drought, which can influence the observed dune morphology and mobility. We utilise a Discrete Ecogeomorphic Aeolian Landscape (DECAL) cellular automaton model, that replicates the self-organisation of vegetated dune systems and simulates realistic long-walled (hairpin) parabolic dunes, to examine the impact of different disturbance types and durations on dune field behaviour, tracing changes in mobility and highlighting system resilience and elasticity. We derive threshold sensitivities, determining quantitative relationships between disturbance type and simulated landscape response. These can give an indication of real-world dune pattern behavioural change under environmental stress due to changes in climatic conditions. Simulations suggest characteristic pattern formation controlled by the response of the ecological component and mutual feedback between this and the geomorphic forcing. Phase space realisations depict this, where like landscapes cluster and a change in conditions may encourage a trajectory from one pattern class to another. These phase space realisations are constructed using cluster and principle component analysis to group statically derived state variables that describe vegetation and geomorphic attributes. The encompassing of simple rules and ecogeomorphic feedback in a cellular automaton model allows us to examine complex landscape development and response to anthropogenic impacts and climate change.