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Cellular Automaton Simulation of Vegetated Dune Fields

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The development of aeolian dune fields in vegetated environments is a good example of an ecogeomorphic system where ecological and geomorphic processes interact dynamically on various scales to produce complex and varied landscapes. Our understanding of the interactions between vegetation and dune geomorphology has been limited, however, to largely descriptive observations and reasoning. This paper presents results from a second-generation cellular automaton model that simulates the development of such systems through self-organisation from a simple set of rules governing the interactions between vegetation and sediment transport on a modelling grid. Simulations of parabolic dune fields, blowouts, and coppice dunes are compared with current descriptive understanding of vegetated aeolian landscape development and the model is used to investigate exactly how and why various kinds of plant species and vegetation patterns influence the dynamics of dune development in aeolian environments. The paper further discusses a number of fundamental and conceptual insights from this research, both with regard to specific questions of aeolian landscape evolution and vegetation-geomorphology interactions, as well as general questions about the impact of vegetation (life) as a scale defining factor in otherwise inanimate geomorphic systems.