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A wind tunnel simulation of the response of the coastal-aeolian transport system to the inclusion of mollusc seashells

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Beach surfaces upon which aeolian processes operate are complex deposits containing not only sand at various levels of water content, but also in some instances, roughness elements of varied origin. One particular form of roughness element that is unique to marine environments but has been little studied, apart from the early work of Carter (1976, 1978), concerns mollusc seashells. This study reports upon a series of wind tunnel simulations which attempt to quantify the effects of varied concentrations and sizes of shell materials upon the initiation and transport of beach sand by wind. While there is some degree of overlap with previous empirical and theoretical studies adressing non-erodible roughness elements, mollusc shells have a considerably more complex form (e.g. hollow, convexo-concave bivalves) than solid pebbles, for example. The wind tunnel experiments were carried out upon beds of medium sand which varied systematically in the concentration and diameter of the intact shell inclusions. In one series of experiments, the shells were reduced to fragments prior to inclusion in the test bed. Before starting the wind tunnel, sample plots along the test surface were scanned with a 3D laser scanner to provide a DEM at sub-millimeter resolution. The scans were repeated throughout the experiment to evaluate not only the physical roughness of the surface to compare with vertical profiles of wind velocity (specifically u* and zo), but also, to obtain information on the spatial and temporal distribution of volume losses and gains within the bed as related to the presence of the shell elements. A Laser Doppler Anemometer (LDA) was employed in measuring the heights and velocities (vertical and horizontal components) of sand particles moving in saltation over the rough surface, relative to a sand bed containing no shell elements. Finally, smoke was introduced into the airflow in order obtain turbulence statistics and Reynolds stress values from the LDA. As expected, the presence of the shells significantly increases shear stress and turbulence within the airflow, while sheltering portions of the surface from fluid drag. These two effects oppose one another, the first acting to increase the mass flux of sediment, and the second acting to reduce it. The balance between these is critically affected by the concentration of shells in the bed, their size, shape, and orientation, as well as, the velocity of the freestream and the presence of saltators in the airflow (introduced from an upwind feed).

Carter, R. W. G. (1976). Formation, maintenance and Geomorphical significance of an aeolian shell pavement. Journal of Sedimentary Petrology, 46(2): 418-429.

Carter, R. W. G. and C. L. Rihan (1978). Shell and pebble pavements on beaches; examples from the north coast of Ireland. Catena, 5(1-8): 365-374.