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Impact of turbulent flow structures on sediment transport dynamics around an aeolian barchan dune

C. Weaver, G. Wiggs

Oxford University Centre for the Environment, University of Oxford, U.K.
(corinne.weaver@ouce.ox.ac.uk)

It is widely acknowledged that flow events associated with high, short-term velocity and stress excursions are ubiquitous. They have been observed in natural environments as diverse as rivers, ocean currents and atmospheric boundary layers. Studies in both the aeolian and fluvial literature have recognised turbulence as a driving force in sediment transport and have highlighted the importance of coherent flow structures, particularly sweep and outward interactions, in these sediment transport systems. Furthermore, research in the fluvial environment has identified the significance of turbulence and coherent flow structures for bedform morphology and bedform spacing. However, equivalent research in the aeolian domain is absent. This paper reports the preliminary findings of research carried out to characterise turbulent energy and turbulent structures around an individual barchan dune form.

Measurements of wind velocity and sand transport at a sampling frequency of 10 Hz were made at numerous positions down the centreline of a 9 m high barchan dune located in the Skeleton Coast National Park, northwest Namibia. Sonic anemometers were positioned at heights of 0.22 m, 0.5 m, 0.9 m and 1.5 m. Safires (measuring high frequency sand grain impact) were positioned at 0.05 m above the ground surface. Measurement periods lasted between 20 minutes and one hour. The results presented demonstrate the development and modification of turbulence and turbulent structures occurring at the toe of the dune to those occurring at the dune crest. The implications of the findings for sediment transport and dune development, dynamics and stability are discussed.