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# A field study of flow turbulence and sediment transport dynamics on a beach surface in the lee of a coastal foredune under offshore winds

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The past decade has seen a growing body of research on the relation between turbulence in the wind and the resultant transport of sediment over active sand surfaces. Widespread use of sonic anemometry and high-frequency sand transport sensors and traps have facilitated recent field studies over dunes and beach surfaces, to move beyond monitoring of mean wind speed and bulk transport to more detailed measurements at much higher spatio-temporal resolutions.

In this paper we present results of a field study conducted in the recirculation flow and re-attachment zone on a beach behind a foredune at Magilligan Strand, Northern Ireland. The offshore winds over the foredune at this site are associated with flow separation and reversal located over the beach surface in the lee of the dune row, often strong enough to induce sand transport toward the toe of the foredune ('against' the overall offshore flow). The re-attachment and recirculation zone are associated with strongly turbulent fluid flow and complex streamlines that do not follow the underlying topography.

High frequency (25 Hz) wind and sand transport data were collected at a grid of point locations distributed over the beach surface between 35 m to 55 m distance from the 10 m high dune crest, using ultrasonic anemometers at 0.5 m height and co-located load cell traps and Safires at the bed surface. The wind data are used to investigate the role of Reynolds shear stresses and quadrant analysis techniques for identifying burst-sweep events in relation to sand transport events. This includes an assessment of the issues involved with data rotations for yaw, pitch, and roll corrections relative to complex flow streamlines, and the subsequently derived turbulence parameters based on fluctuating vector components (u', v', w').

Results illustrate how transport may exist under threshold mean velocities because of the role played by coherent flow structures, and the findings corroborate previous findings that shear velocity obtained using traditional wind profile approaches does not correlate with transport as additional stresses are generated due to turbulent structures.