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The persistence of large-scale blowouts in largely vegetated coastal dune fields

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Coastal dunes move through natural phases of stability and instability during their evolution, displaying various temporal and spatial patterns across the dune field. Recent observations, however, have shown exceptionally rapid rates of stability through increased vegetative growth. This progressive vegetation colonisation and consequent loss of bare sand on coastal dune systems has been noted worldwide. Percentage reductions in bare sand of as much as 80% within just a few decades can been seen in examples from South Africa, Canada and Brazil as well as coastal dune sites across NW Europe. Despite these dramatic trends towards dune stabilisation, it is not uncommon to find particular examples of large-scale active blowouts and parabolic dunes within largely vegetated coastal dunes. While turbulence and airflow dynamics within features such as blowouts and other dune forms has been studied in detail within recent years, there is a lack of knowledge about what maintains dune mobility at these specific points in otherwise largely stabilized dune fields.

This work explores the particular example of the 'Devil's Hole' blowout, Sefton Dunes, NW England. Approximately 300 m long by 100 m wide, its basin is below the water-table which leads to frequent flooding. Sefton Dunes in general have seen a dramatic loss of bare sand since the 1940s. However, and coinciding with this period of dune stabilisation, the 'Devil's Hole' has not only remained active but also grown in size at a rate of 4.5 m year-1 along its main axis. An exploration of factors controlling the maintenance of open bare sand areas at this particular location is examined using a variety of techniques including Computational Fluid Dynamics (CFD) airflow modelling and in situ empirical measurements of (short-term experiments) of wind turbulence and sand transport. Field measurements of wind parameters and transport processes were collected over a 2 week period during October 2015. Twenty three 3D ultrasonic anemometers were deployed at 0.5 m elevations over a grid covering sections of the blowout walls, deflation basin and depositional lobe. A number of high resolution sand traps and wenglor sensors were co-located with anemometers in the walls and basin, and a terrestrial laser scanner was used to collect high-resolution topographic data both before and after the strongest transport event recorded during the study period. Preliminary results indicate significant transport differences in operation at each of the two blow out walls as well as complex interactions between turbulence, superficial moisture content and up-wind sediment sources.

This study represents a comprehensive examination of both wind and sediment flux patterns at high spatial and temporal resolution inside a large trough blowout feature; and reveals insights into why such systems are maintained as erosional features for long time periods.