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Beach-dune sediment exchange and airflow dynamics at a blowout throat during oblique onshore winds

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Blowouts are acknowledged as highly effective transport pathways. Their morphological form is indicative of aeolian transport and the propensity of their topography to modify airflow sufficiently to support transport has been extensively researched. As the evolution of sandy coastlines is governed by sediment exchanges between sub-units of the cross shore profile, blowouts located at the beach-dune interface may play a significant role in evolution through enhancing the landward transfer of sediment into the dune field. Although there is a growing number of studies detailing blowout transport, those which encompass synchronous measurement of flow and sediment exchange from the beach into the dune field remain extremely rare.

This study, conducted at Sefton dunes, northwest England, details airflow and sediment transport dynamics at the beach-dune interface of a trough blowout. A dense array of 3D sonic anemometers, co-located with transport sensors were deployed during an oblique onshore wind event. Instantaneous flow and transport dynamics were measured on the back beach, the adjacent upwind foredune and within the throat of the blowout. Additionally, the morphological response was captured via pre and post event TLS surveys.

The importance of alongshore deflected airflow in delivering sediment to the blowout throat area was highlighted by a linear trend of high magnitude transport intensity across the upwind foredune. Within the throat, levels of transport intensity displayed extremely high spatial and temporal variability across a relatively confined area. Multiple topographically forced flow modifications were observed. Although incident wind speed remained relatively constant, a sharp 15° onshore directional shift during the experiment resulted in a step change in transport intensity within the blowout, providing insight into how sediment is first delivered to the throat area and then driven landwards.