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Morphological response of a large-scale coastal blowout to a strong magnitude transport event

Irene Delgado-Fernandez (1), Derek Jackson (2), Alexander Smith (2), and Thomas Smyth (3)

(1) Geography, Edge Hill University, Ormskirk, United Kingdom (delgadoi@edgehill.ac.uk), (2) Centre for Coastal and Marine Research, School of Environmental Sciences, Ulster University, Cromore Road, Coleraine BT52 1SA, Northern Ireland, UK, (3) Geography and Environmental Science, Liverpool Hope University, Hope Park, Liverpool, L16 9JD

Large-scale blowouts are fundamental features of many coastal dune fields in temperate areas around the world. These distinctive erosional (mostly unvegetated) landform features are often characterised by a significant depression area and a connected depositional lobe at their downwind edges. These areas also provide important transport corridors to inland parts of the dune system and can provide ideal habitats for specialist flora and fauna as well as helping to enhance landscape diversity. The actual morphology and shape/size of blowouts can significantly modify the overlying atmospheric boundary layer of the wind, influencing wind flow steering and intensity within the blowout, and ultimately aeolian sediment transport. While investigations of morphological changes within blowouts have largely focused on the medium (months) to long (annual/decadal) temporal scale, studies of aeolian transport dynamics within blowouts have predominantly focused on the short-term (event) scale. Work on wind-transport processes in blowouts is still relatively rare, with ad-hoc studies providing only limited information on airflow and aeolian transport. Large-scale blowouts are characterised by elongated basins that can reach hundreds of meters, potentially resulting in airflow and transport dynamics that are very different from their smaller scale counterparts.

This research focuses on a short-term, strong wind event measured at the Devil's Hole blowout (Sefton dunes, NW England), a large-scale blowout feature approximately 300 m in length and 100 m in width. In situ measurements of airflow and aeolian transport were collected during a short-term experiment on the 22nd October 2015. A total of twenty three, 3D ultrasonic anemometers, sand traps, and wenglor sensors were deployed in a spatial grid covering the distal end of the basin, walls, and depositional lobe. Terrestrial laser scanning (TLS) was used to quantify morphological changes within the blowout before and after the strong magnitude transport event. This allowed, for the first time, examination of the morphological response as a direct result of a high energy wind event as it passes through a large-scale blowout. Results indicate strong steering and acceleration of the wind along the blowout basin and up the south wall opposite to the incident regional winds. These accelerated flows generated very strong transport rates of up to 3 g/s along the basin, and moderate strong transport rates of up to 1.5 g/s up the steep north wall. The coupling of high-frequency wind events and transport response together with topographic changes defined by TLS data allows, for the first time, the ability to co-connect the morphological evolution of a coastal blowout landform with the localised driving processes.