**Field testing and CFD LES simulation of offshore wind flows over coastal dune terrain in Northern Ireland**

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The role of offshore-directed winds in aeolian sand transport over and along coastal dune systems is studied under a project funded through the UK's Natural Environment Research Council (NERC) "Responsive Mode Program". A component of this research program is the measurement of the wind flows over and across the dune and beach terrain and comparison with Computational Fluid Dynamic simulation results.

The field study area is located at Magilligan Strand, Co. Londonderry, Northern Ireland, and forms part of a 6 km sandy beach system extending from Magilligan Point at its northwestern extremity to Benone Strand to the southeast. The coastline has a northeastern-facing orientation on the margin of the Atlantic Ocean and forms the seaward edge of a large vegetated Holocene (5-6000 yrs BP) cuspate foreland. Landward of the beach/foredune crest, a series of 15-20m high vegetated dune ridges are located parallel to the shore. These ridges have an undulating vegetated terrain with steep grass covered surfaces at the edge of the coast. The dunes offer wind sheltering to the beach during prevailing westerly and southwesterly winds. Detailed wind flow measurements were obtained during field testing in September 2009 using an extensive array of mast mounted three-dimensional ultrasonic anemometers. The measurements rake was installed along the prevailing westerly wind direction. Large Eddy Simulation (LES) was performed of the wind flow over the terrain. The simulations were performed using the open-source CFD tool openFOAM. The computational domain includes the terrain model obtained by high resolution LIDAR measurements. The computational grid includes localized mesh refinement near the complex terrain to capture finer details of the dune system that will affect the wind flows in the vicinity of the beach area, the area of focus for the aeolian sand transportation work carried out. The upwind atmospheric boundary conditions for the CFD model use typical wind profiles and turbulence kinetic energy and dissipation rate characteristics expected for the terrain type.

The paper illustrates the comparison between the measured and simulated wind flow characteristics and offers a discussion on the agreement and differences in predicted and measured flows. The discussion also includes commentary on how the CFD simulations offers new insights in the flow mechanics associated with the evolution of coastal dune geomorphology and how the predicted terrain steering of wind flow impact on the development and rehabilitation of the dune system. Commentary is also offered on the next phase of research which includes further field measurement of Aeolian transport and wind measurement on the beach, along with further comparative CFD simulation of both wind and Aeolian sand transport. The unique opportunity offered by this research program to numerically predict and validate wind flows over complex terrain such as dune systems, may present valuable new tools and insight for the computational wind engineering and geomorphology research community.