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Numerical and experimental study of flow over stages of an offset merger dune interaction.[1] CHAO WANG, UT Dallas, ZHANQI TANG, Hebei University of Technology, NATHANIEL BRISTOW, GIANLUCA BLOIS, KEN CHRISTENSEN, University of Notre Dame, WILLIAM ANDERSON, UT Dallas
— Results of unidirectional turbulent flows over barchan dunes at high Reynolds number are presented. In order to capture the inertial-dominated dynamics typical of these environmental flows, complementary large-eddy simulations (LES) and experimental measurements have been used. A series of dune field topographies have been considered wherein a small dune is positioned at different positions upflow of a large dune, from a spanwise-offset position. The smaller dune is geometrically similar, but one-eighth the volume of the larger dune, thus replicating instantaneous realizations during actual dune interactions in laboratory or natural settings. Experimental measurement and LES are both used to study these configurations, with strong agreement reported between resultant datasets. We report that flow channeling in the interdune space induces a mean flow heterogeneity – termed "wake veering" – in which the location of maximum momentum deficit in the dune wake is spanwise-displaced. Elevated turbulent stresses are observed in the shear layers flanking the channeling flow. Finally, spatial distributions of surface stress from LES have been used to identify locations of elevated erosion, predicting bedform migration patterns. Results show that locations of minimal erosion – whether associated with upflow sheltering or with vanishing spatial gradients of dune height – constitute spatial "junctions" of coalescing, proximal dunes.

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William Anderson
UT Dallas

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