Abstract Submitted
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Coherent eddies in flows over three-dimensional dunes MOHAMMAD OMIDYEGANEH, UGO PIOMELLI, Queen's University — We performed large-eddy simulations of the flow over a series of 3D dunes at laboratory scale. The bedform three-dimensionality was imposed by shifting a standard 2D dune shape in the streamwise direction according to a sine wave. The flow structures are discussed for two cases, with the same crestline amplitudes and wavelengths but different crestline alignments: in-phase and staggered. Large-scale, mean streamwise vortices are the primary factor that alters the features of the instantaneous flow structures. Rollers generated in the separated shear layer appear regularly over the lobe, and are shed more frequently than in 2D geometries. Separated vortices in the lobe plane undergo a three-dimensional instability while advected downstream, and rise toward the free surface while developing into a horseshoe shape (similar to the 2D case). When the tip of such a horseshoe reaches the free surface, the ejection of flow at the surface causes boils (upwelling events on the surface). Strong boil events are observed on the surface of the lobe planes of 3D dunes more frequently than in the saddle planes and the corresponding 2D geometry. Boil events occur at higher frequency in the staggered alignment, but with less intensity than in the in-phase alignment.

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