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Numerical simulation of flow over three-dimensional dunes UGO PIOMELLI, MOHAMMAD OMIDYEGANEH, Queen's University, Kingston (ON), Canada — We performed large-eddy simulations of the flow over a series of three-dimensional dunes at laboratory scale (the Reynolds number based on the average channel height and mean-streamwise velocity is 18,900). The three-dimensionality is imposed by shifting in the streamwise direction a standard two-dimensional dune shape according to a sine wave with an amplitude A and a wavelength λ. The three-dimensional separation of flow at the crest-line alters the distribution of pressure gradient in the spanwise direction and may result in secondary flows across the stream. The secondary flow directs low-momentum fluid, near the bed, toward the "lobe" (the most downstream point on the crest-line) and high-momentum fluid, near the free surface, toward the "saddle" (the most upstream point on the crest-line). The behaviour of the reattachment length varies depending on the induced secondary flow. Three-dimensionality increases the drag in the channel and the turbulent-kinetic energy at constant flow discharge, but the normalized TKE by the wall stress is lower than the corresponding 2D dunes. The upward flow on the stoss side and higher deceleration of flow on the lee side, over the lobe plane, elevate and broaden the separated-shear layer, respectively, affecting the TKE.

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