The XXXVIII International School of Hydraulics, 21-24 May 2019, Łąck, Poland

Turbulent length scales and Reynolds stress anisotropy in wall-wake flow downstream of an isolated dunal bedform

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ABSTRACT

The study deals with the variations of third-order moments of velocity fluctuations, turbulent bursting and turbulent kinetic energy (TKE) budget downstream of an isolated dune mounted on a rough bed in an open channel, as shown in Fig. 1. The experimental data demonstrates that in the wall-wake flow, the third-order moments change their signs below the crest level of the dune, whereas their signs remain unchanged above the crest. The quadrant analysis reveals that the near-wake flow is characterized by sweep events and the far-wake flow is governed by the ejection. In the near-wake flow, the mean duration of bursting events is shorter than their mean interval of occurrence. Downstream of the dune, the TKE budget results show that the turbulent production and energy dissipation start with large positive values in the vicinity of the bed and decrease with an increase in vertical distance until the lower-half of the height of dune. Above the lower-half of the dune, their values increase with an increase in vertical distance and attain their peak values at the crest. In contrast, the turbulence and pressure energy diffusions start with negative values near the bed and change with an increase in vertical distance attaining their positive peak values at the crest. However, all the changes in the turbulence characteristics are significant at the near-wake zones that fade away after a certain distance in the downstream, confirming a recovery in the turbulence characteristics.

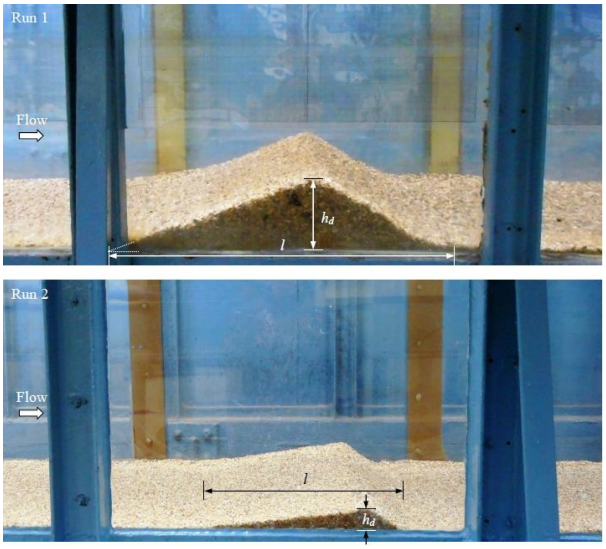

Fig. 1. Photographs of bed-mounted isolated dunal bedforms in the experimental flume.