

Turbulent kinetic energy budget in a gravel-bed channel flow

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A b s t r a c t

The present experimental investigation focuses on the characteristics of near bed turbulence in a fully rough, uniform open-channel flow over a gravel-type bed. Due to bed topography small scale heterogeneity, the flow is not uniform locally in the near bed region and a double averaging methodology is applied over a length scale much larger than the gravel size. The double-averaged Turbulent Kinetic Energy (TKE) budget derived in the context of the present flow over a gravel bed differs from the TKE budget written for flow over a vegetation canopy. The non-constant shape of the roughness function measured in our gravel bed leads to an additional bed-induced production term which is null for vertical roughness elements, such as simplified vegetation elements.

The experimental estimation of the terms of the TKE budget reveals that the maximum turbulent activity takes place away from the reference plane, near the roughness crests. However, within the interface sublayer the work of the bed induced velocity fluctuations against the Reynolds stress is of the same magnitude as the main turbulence production term. Consequently, the characteristics of the TKE budget have similarities with uniform flows over canopies and strongly differ from uniform flows over smooth and transitionally rough flows over sediment-like beds.

Key words: turbulence, double averaging, kinetic energy, channel-flow, turbulent kinetic energy.