

Role of turbulent kinetic energy modulation by particle–fluid interaction in sediment pick-up

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Abstract:

Reliable prediction of the erosion rate of sediment beds is important for many applications in coastal and river engineering. Theoretical understanding of empirically derived scaling relations is still lacking. This applies in particular for the scaling anomaly between low and high Shields number conditions. In this work, the erosion process is studied from the perspective of the phase-averaged turbulent kinetic energy (TKE) equations. The multi-phase TKE equations are written in a form that allows for a direct comparison with the TKE equation that appears for a stratified single-phase flow under the Boussinesq approximation. This reveals that next to buoyancy destruction, several other TKE modulation mechanisms become important at high Shields numbers and concentrations. Two scaling laws are derived for both moderate and high Shields numbers, and are tested against a wide range of experimental data.

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