Numerical simulation of Dune morphodynamic changes for unsteady flows

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ABSTRACT

The morphological evolution of river dunes exposed to unsteady flow conditions presents challenges to engineers trying to predict water levels for navigation, flood and water management. Our long term objective is to develop a coupled hydrodynamic-sediment transport model to predict the evolution of dunes under unsteady flows. This paper presents our preliminary investigation into the hydrodynamics of flows of varying flow depths over rigid dunes. Detailed velocity measurements are collected using LDV over a train of 130cm long and 7.43cm high dunes under various flow depths at our laboratory flume located at the Coastal Lab at Queen's University in Kingston Ontario. A RANS numerical model is developed using the OpenFOAM CFD package and compared to the laboratory measurements. We conduct a detailed investigation into the meshing requirements in the near-wall region order to develop a computationally robust and efficient mesh. We also compare the results of a rigid-lid and a free-surface model using based on the Volume-of-Fluid approach. Finally we present the preliminary results of our sediment transport model.