Numerical Simulation of Turbidity Currents in Sinuous Channel

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A 3D numerical model based on the Reynolds-averaged Navier-Stokes (RANS) equations for a bulk fluid containing particulate species of various sizes is developed. A multiphase flow approach that treats water as the liquid phase and sediment as particulate phase is utilized to express the mass and momentum conservation equations for the bulk fluid. The Exner equation for multiple size classes of sediment is solved for the evolution of the bottom boundary. Turbulence closure is obtained with a buoyancy-modified k-\&epsilon model for the bulk fluid. The mass conservation equation for each sediment size class is solved to obtain the concentration of the individual size fraction. A finite volume method for non-orthogonal grid with collocated arrangement is used for solving the governing equations. The model is applied to simulate a series of recent 3D experiments on turbidity currents in an unconfined sinuous channel. The model has successfully reproduced the thickening and spilling of currents due to water entrainment, significant stripping at channel bend due to super-elevation and the resulting deposits with increased thickness on the outsides of channel bends. The model results revealed also the temporal evolution of the flow and bed, the vertical velocity and density structures, and distribution of different size classes.