A robust finite volume method for 2D turbulence in shallow water flows

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Abstract

We present a robust finite volume method for large-eddy simulation of shallow water flows. The governing equations are derived from the Navier-Stokes equations with assumptions of shallow water flows including bed frictions, eddy viscosity and wind shear stresses. The turbulence effects are incorporated in the system by considering the Smagorinsky model. The numerical fluxes are reconstructed using a modified Roes scheme that incorporates, in its reconstruction, the sign of the Jacobian matrix of the convective part of the large-eddy shallow water equations. The diffusion terms are discretized using a Green-Gauss diamond reconstruction. The method is well-balanced, non-oscillatory and suitable for both structured and unstructured triangular meshes. The proposed method is verified for the benchmark problem of shallow mixing layers. We also apply the method for simulation of a compound channel flow which can be considered as a prototype for many estuarine environments. In both test problems, the proposed method demonstrates its ability to provide accurate simulations for large-eddy simulation of shallow water flows.

Keywords. Finite volume method, Shallow water equations, Large-eddy Simulation, Unstructured grids, Mixing layers.

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