Solution of shallow water equations using fully adaptive multiscale schemes

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SUMMARY

The concept of fully adaptive multiscale finite volume methods has been developed to increase spatial resolution and to reduce computational costs of numerical simulations. Here grid adaptation is performed by means of a multiscale analysis based on biorthogonal wavelets. In order to update the solution in time we use a local time stepping strategy that has been recently developed for hyperbolic conservation laws.

The adaptive multiresolution scheme is now applied to two-dimensional shallow water equations with source terms. The efficiency of the scheme is demonstrated on several problems with a general geometry, including circular damp breaks, oblique hydraulic jump, supercritical channel flows encountering sudden change in cross-section, and, finally, the bore wave and its interactions.

KEY WORDS: Shallow water equations; multiscale techniques; local grid refinement; finite volume methods.

1. INTRODUCTION

Shallow water equations (SWEs) are used to describe many physical problems of interest often encountered in environmental and hydraulic engineering: free surface flows caused by damp breaking, hydraulic jumps, open channel flows, bore wave propagation, tidal flows in estuary and costal zones are just a few examples. The SWEs are obtained through integration of the Navier-Stokes system over the depth of the fluid body by assuming hydrostatic pressure distribution.

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Contract/grant sponsor: This work has been performed with funding by the Deutsche Forschungsgemeinschaft in the Collaborative Research Center SFB 401 "Flow Modulation and Fluid-Structure Interaction at Airplane Wings" of the RWTH Aachen, University of Technology, Aachen, Germany.