Non-oscillatory Forward in Time Model for Wetting-Drying Areas

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ABSTRACT

An unstructured/hybrid mesh Nonoscillatory Forward in Time integrator [3,4] is employed for modelling water flows in a two-dimensional shallow water and three dimensional hydrostatic models. A rigorous positivity preservation of water depth, required for an effective treatment of wetting/drying areas, is ensured by the Multidimensional Positive Definite Advection Transport Algorithm (MPDATA) [1] with the drying areas treatment arising naturally from the governing equations.

The models employ an edge based finite volume spatial discretization implemented on unstructured meshes that admit arbitrarily shaped cells and ensures that the rest of the lake condition is satisfied.

Theoretical considerations are supported with examples illustrating the efficacy and flexibility of the model. The water surface evolution in a parabolic basin benchmarks used for comparisons with an analytical solution and in a second order asymptotic mesh convergence study. A second order filtering for unstructured meshes is developed and implemented in a numerical treatment of propagating discontinuity in an irrigation channel. Results of a hydrodynamic simulation of the flow over idealised bathymetry illustrate the performance and multidimensionality of the hydrostatic model.

REFERENCES

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