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CBS METHODOLOGY FOR ENVIRONMENTAL HYDRAULICS. A CONTINUOUS FEM COMPETITIVE CHOICE

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ABSTRACT

Realistic numerical simulation of tidal and fresh water currents in estuaries and rivers and corresponding transported quantities has some concurrent requirements. These requirements are, broadly, long term computation of low Froude number flows, stiff viscous terms (coming e.g. from longitudinal dispersion), and computational domains partially confined by artificial and evolutionary boundaries.

The extension of the Characteristic based split model (CBS) presented in [1] is a nearly implicit version that satisfies efficiently first and second requisites, while a global conservative first order radiation condition is presented and implemented for the artificial exterior boundary. We specialize and show this implementation for tidal wave propagation over intricate domains, obtaining substantial reductions of the typical spurious reflections present in non conservative options.

Otherwise, the coastline is an archetype of moving boundary (ubiquitous in shallow water problems) commonly prescribed by either slip or nonslip wall boundary conditions. When considerable portions of the domain become activated/deactivated, null total height of water determines the position of the boundary and wall assumptions are not sufficient. In these cases, positive preservation is a desired property for the numerical model in the computation of water heights, avoiding spurious residual trailings once motion of the interface takes place.

Flux correction transport methodology, originally proposed in [3] and applied for the first time for FEM in [4], is positive preserving, showing consistently that simulation of interfaces depending on positive variables are defined over compact support, e.g. in the modelling of landform propagation over non-erodible beds [2].

We explore enhanced stages of the CBS model incorporating some of the flux correction tools based on the flux correction transport idea, emphasizing on the stringent modelling of flows over domains where evolutionary boundaries or interfaces prevail. Numerical tests are carried out focusing on positivity and non oscillatory behaviour of the transported properties near zeros.

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