MODELING WETTING AND DRYING OF SHALLOW WATER IN ESTUARIES WITH TIDAL FLATS

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ABSTRACT

It is well known that wetlands play a very important role in the ecosystem and their productivity is maintained mainly by the periodic drying and wetting process [1]. The hydrodynamic processes occurring over wetlands and floodplains are shallow water flows governed by the depth-integrated two-dimensional Reynolds equations. In recent years, significant progress has been made in the numerical solution of the governing shallow water equations (SWE). However, in problems involving moving boundaries caused by wetting and drying, some problems remain regarding modeling of real estuarine regions [2]. The difficulty is mainly associated with the fact that mass and momentum conservation may be affected by the fictitious flow between wet and dry elements, causing computational instabilities due to an inadequate treatment of small depth hydraulics. In this work, we investigate a wetting and drying numerical treatment that adopts fixed meshes for SWE solutions based on the thin water layer (TWL) and porosity methods. The TWL method keeps a thin layer of water in nominally dry elements that are conceptually modeled by reducing flow without eliminating elements or nodes [3]. On the other hand, in the porosity method, all of the dry and wet elements of mesh are included in the computation by introducing porous flow in dried elements, so that the local water level falls below the bed level, eliminating the need to check whether an element is wet or dry at each time step. Numerical experiments are presented in order to demonstrate the robustness and capability of the investigated methods in the proposed wetting and drying treatment. Those are achieved through canonical flows investigation, in addition to a real case study of an estuary in Brazil.

References

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