A new wetting and drying algorithm using a combined pressure/free-surface finite element method

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A new wetting and drying method for numerical modelling of free-surface flows based on the Navier-Stokes equations is proposed. The method can be used in implicit schemes to allow large timesteps where several mesh elements are dried or wetted in a single timestep. A non-uniform unstructured mesh in the horizontal is employed. The mesh structure is fixed in time with layers moving in the vertical, although the long-term aim is to allow the use of fully unstructrered meshes in 3D and dynamic mesh adaptivity. The positivity of the water level is ensured by fixing the depth in dry regions such that a thin layer is maintained.

The key idea of the proposed method is the usage of a combined free-surface/pressure method in the wet areas and to apply a no-normal flow boundary condition on dry regions. The result is an accurate, stable and easy to implement scheme. These features are illustrated on idealised test-cases and on a more realistic wetting and drying process in a tidal estuary.

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