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A finite element wetting-drying method, with application to the Scheldt estuary

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During the last decade, the has been a growing interest in the finite element methods for coastal modelling applications. Indeed, coastal modelling involves the simulation of large scale processes in the open sea, but also of smaller processes occuring in the coastal area. Classical finite difference methods on structured grids require a nesting strategy to model processes of such different length scales. This is not the case when having recourse to the more modern finite element methods, as these allow the use of variable-resolution unstructured grids.

In shallow areas (such as coasts, embayments or estuaries), wetting and drying processes may occur due to the tide. This processes raise numerical issues (such as negative thickness) that have to be addressed. A variety of methods are found in the literature to simulate them accurately with finite difference models - see e.g. Balzano (1998, *Coastal Engineering*, 34, 83-107). On the other hand, for finite element models the situation is more obscure. Several finite element models do use a wetting-drying method, but a rigourous description of the method is often lacking.

Here we present the wetting-drying method as it is implemented in the Second-generation Louvain-la-Neuve Ice-ocean Model (SLIM, http://www.climate.be/SLIM) and validate it with the test cases proposed by Balzano and Thacker (1981, *Journal of Fluid Mechanics*, 107, 499-508). Within the framework of the interdisciplinary project TIMOTHY (http://www.climate.be/TIMOTHY), our first real wetting and drying application consists of the simulation of the tidal cycle in the Scheldt estuary where sand banks are periodically submerged.