Treatment of artificial ponding in numerical simulation of salt marsh hydrodynamics

Mithun Deb\textsuperscript{1}, James T. Kirby\textsuperscript{1}, Ali Abdolali\textsuperscript{2}, and Fengyan Shi\textsuperscript{1}

\textsuperscript{1}Center for Applied Coastal Research, University of Delaware, Newark, DE, USA
\textsuperscript{2}National Oceanic and Atmospheric Administration, College Park, MD, USA

September 14, 2018

Abstract

Modeling hydrodynamic processes in a salt marsh system is a challenging task, because of the complex topographic features such as rills and cuts through channel berms, small creeks on marsh platform and the variation in the scale of such features. They are often missing in the model grid due to both incomplete resolution in data sources such as LiDAR, spatial vegetation bias as well as loss of resolution in the development of DEMs and model grids. Technically, identifying them is a challenging task, as many of these small scale topographic features may be hidden under dense vegetation canopies and are thus not easily recognized using even higher resolution techniques such as Structure from Motion (SfM). Loss of resolution and representation of these features can lead to modeling defects such as artificial ponding, resulting inaccuracies in important processes such as flow hydrodynamics and the draining and filling of the platform. Recently, we have introduced a porosity parameter in the FVCOM model following Kennedy \textit{et al.} (2000) in order to improve the wetting and drying phenomena in artificially isolated depressions. The modification is carried out primarily to eliminate artificial ponding effects observed in the original model simulations in Bombay Hook National Wildlife Refuge, DE. This model improvement is essential for accurate estimates of the depth and duration of inundation, which is crucial in the selection process of vegetation species, and of the volume and speed of flooding and draining processes, which ultimately contributes to estimation of sedimentation rates and marsh platform geomorphological evolution. Finally, we have verified the model performance using data from pressure gauges deployed in a modeled marsh platform region which is subject to artificial ponding, after which we develop an estimate of the volumetric effect of ponding and the impact on marsh inundation and channel circulation for the study area as a whole.