

Modelling the role of estuarine wetland development on salt-intrusion

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Introduction

Estuaries are at the transition from the river to the ocean. During storm surges or river droughts, salt water can intrude far inland into the estuary, limiting freshwater availability. Wetlands are proposed to reduce estuarine salt-intrusion by increasing horizontal mixing of fresh- and salt water. Namely, their presence in an estuary can affect (horizontal) flow circulation, tidal trapping and tidal pumping, key processes for mixing of fresh- and salt water. Effective design of wetlands requires in-depth understanding of the natural processes, which involves the interplay of physical (hydrodynamics, sediment dynamics, morphology) and ecological (vegetation dynamics), processes acting on extensive spatial and temporal scales. We will develop a modelling framework that is able to evaluate wetlands to counteract salt intrusion, under long-term estuarine development. Hereby, we will focus on the spatial scale of the entire estuary. In addition, climate change (CC) impacts will be taken into account, e.g. sea level rise (SLR), altered river discharges and SLR driven basin infilling.

Methods

We created an idealized estuarine model, within the Delft3D-FM model (Figure). Herein, various wetland scenarios will be implemented, e.g. changing its location, width or vegetation characteristics.

First, present day simulations are performed, whereby hydrodynamic forcings will represent contemporary conditions within the Rhine-Meuse Delta (RMD). Ecomorphological development (morphological and vegetation development, in 2DH) will be simulated for 1 year, to study the impact of a wetland scenario on development of the entire estuary and vice versa. A population dynamics approach is included to enable vegetation growth/expansion and decay. In succession, salt-intrusion (3D) is simulated during extreme events (3 days) with return periods of 1 year, representing storm surges, river droughts or a combination of both. Validation of hydrodynamics and morphology will be performed by quantitative comparison within the RMD for a 1 year simulation. Simulated wetland development (also 1 year) is compared with modelling studies on dynamic wetland vegetation.

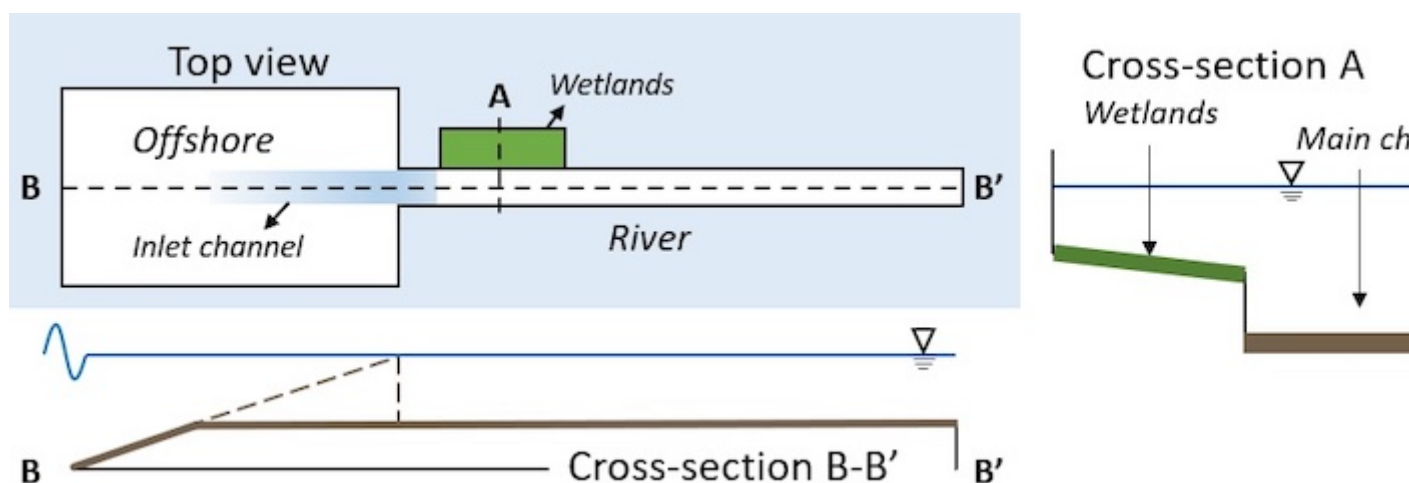


Figure: Schematic overview of the idealized estuarine model.

Next, CC impact on estuarine ecomorphology and salt-intrusion is assessed. The model is adjusted to represent future conditions by implementing CC projected hydrodynamic forcings and SLR modified bathymetry (Figure 2). Future simulations are performed of ecomorphology (1 year) and, in succession, salt intrusion during extreme events (3 days). These extreme events are also adjusted according to CC projections. The present day and future simulations are performed in parallel.

Expected results

- A modelling framework will be developed enabling us to predict the impact of a wide range of wetland scenarios on estuarine development and salt intrusion, under CC.
- Insights will be gained on estuarine wide development due to wetlands.
- Understanding on how this development affects salt intrusion will be improved.