

# How ecological restoration may contribute to mitigate hydrodynamic changes in estuaries

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The hydrodynamic characteristics of estuaries, such as the tidal range, tidal asymmetry, residence times, waves, storm surge events, and long-term sea level rise, are to a large extent determinant for many estuarine processes and functions, including natural processes such as the fluxes of sediments, nutrients and biota, but also socio-economic functions such as protection against flood risks and water depth for shipping. In many estuaries, especially those where human impacts have modified the estuarine morphology, these hydrodynamic characteristics have changed over various time scales, leading in certain situations to undesired developments such as growing tidal range, increasing tidal asymmetry, further inland propagation of sea level rise and storm surges. In this presentation, we intend to give an overview of how the ecological conservation and restoration of estuarine habitats may contribute to mitigate such undesired hydrodynamic changes, with special reference to examples on intertidal habitat effects on hydrodynamics in the Scheldt estuary (Belgium and The Netherlands).

Our overview is based both on field observations on tidal (and storm surge) propagation within a large intertidal marsh (Saeftinghe), as well as on model simulations of within-marsh hydrodynamics and upscaling to hydrodynamic effects on the whole estuary scale. As such we demonstrate that the potential to mitigate undesired hydrodynamic changes, such as the mitigation of tidal range, tidal asymmetry and storm surge levels, largely depends on the geomorphological properties of intertidal habitats, such as their size, elevation and location along the estuary, and on ecological properties, such as vegetation-induced friction. Our overview also shows that effects of intertidal habitat restoration on estuarine hydrodynamics are often complex and not straightforward, highlighting that further research is needed in support of effective restoration plans.