

UPSCALING THE SHORELINE TO MODEL EROSION-ENHANCED FLOODING DUE TO CLIMATE CHANGE

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INTRODUCTION

Coastal erosion and flooding are the most relevant hazards in coastal areas and they are closely interconnected. While waves and water levels are the main drivers of coastal change, coastal morphodynamics also play an important role on wave hydrodynamics, coastal water levels and sediment transport. With the increasing threats imposed by climate change at the world's coasts, robust projections of coastal flood risk are essential, and to this end, the morphodynamic feedback needs to be considered. However, most studies at the climate change scale continue to analyse coastal flooding and erosion separately, as their coupling is not easy. This may lead to potential spurious risk estimates (Toimil et al., 2023).

OBJECTIVES

In this work, we will present a novel nearshore evolution model that bridges the gap between current process-based and reduced-complexity coastal models by efficiently solving the nearshore evolution over decades. As we will show with examples at different spatial scales, model outputs can be directly used to include the dynamism of the coast to better predict coastal flood risk.

METHODOLOGY

The methodology consists of coupling a spectral wave propagation model, a profile translation model (McCarroll et al., 2021) and a reduced-complexity shoreline model (Álvarez-Cuesta et al., 2021) to update the profile geometry considering the different coastal processes (longshore, cross-shore and SLR), as detailed in Álvarez-Cuesta et al. (2023).

We will present the capabilities of the novel nearshore evolution model to handle complex environments with structures and natural ecosystems. In Figure 1, the decadal nearshore evolution is solved at an embayment with and without coastal features like structures, a coral reef and a vegetation patch. Additionally, we will show two real case applications of the method. First, we will present a topo-bathymetric reanalysis database of more than 10 years at a cross-shore dominated beach in northern Spain, which is obtained by running the nearshore model and assimilating satellite-derived shoreline observations. This provides an accurate boundary condition for subsequent forensic flood analyses. Second, we will show how the methodology is applied to project future topo-bathymetries for flood modelling considering different climate-related uncertainty sources at a 40km highly anthropized coastal stretch. We will show the implications of neglecting coastal erosion on flood modelling.

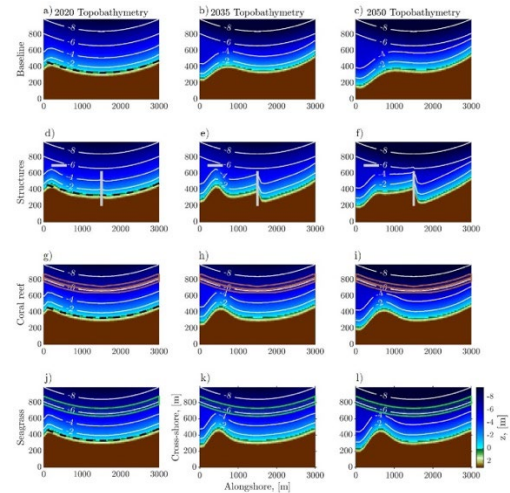


Figure 1. Nearshore evolution of a coastal embayment with no features (1st row), with structures (2nd row), with a coral reef (3rd row) and with vegetation patches (4th row).

CONCLUSIONS

We conclude that the proposed reduced-complexity nearshore model offers great potential to model erosion-enhanced flooding projection at the climate change scale.

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