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Hydrodynamic models ensemble to forecast future estuarine circulation and morphological patterns

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Abstract

Numerical models are essential tools to simulate the hydro-morphodynamics of estuarine systems, allowing a better understanding of these systems and the anticipation and prediction of the effects of anthropogenic interventions, extreme events and climatic change impacts, and providing the basis for efficient management tools. However, as model results present uncertainties, mainly related to inaccuracies or assumptions in the initial and forcing conditions, we need to increase the forecasts accuracy by developing and implementing new solutions that avoid or mitigate such errors. The EsCo-Ensembles project proposes the application of the ensembles technique to improve the hydro-morphodynamic patterns forecasts in estuaries. Two numerical models, openTELEMAC-MASCARET and Delft3D, are considered to simulate current and future states of two of the most important estuaries on the Northern Portuguese coast: the Douro and Minho estuaries.

Preliminary simulations considering extreme sea level conditions, under different climate change scenarios, demonstrate an aggravation of the associated flood level in the Douro estuary also due to the recent evolution of the sand spit located at the estuary mouth. Given that this estuary is strongly dominated by the freshwater flow, the effect of the rising sea is hardly noticeable during flood events. On the contrary, the Minho estuary, dominated by the tide and therefore by oceanographic conditions, shows a more pronounced effect of sea level rise.

The final results of this project are expected to demonstrate that the combined use of different models reduces their uncertainty increasing the confidence and consistency of the forecasts. These results will contribute to: (i) provide a complete hydro-morphodynamic characterization of the two estuaries; (ii) evaluate future trends; (iii) understand the distribution of the biota and the functioning of ecosystems; and (iv) estimate the flood risks associated with extreme events.

Keywords

Estuaries, Morpho-hydrodynamics, Numerical models, Extreme events and climatic change