Future estuarine circulation patterns characterization based on a hydrodynamic models ensemble

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Estuarine regions are strategically important from an environmental, economic, and social point of view. To reduce vulnerability and increase resilience, it is crucial to know their dynamics that usually are poorly understood. Numerical models have proven to be an appropriate tool to improve this knowledge and simulate scenarios for future conditions. However, as the modelling results may be inaccurate, the application of the ensembles technique can be very useful in reducing possible uncertainties. In the EsCo-Ensembles project, this technique is proposed to improve hydrodynamic predictions for two Portuguese estuaries: Douro and Minho.

Two already validated numerical models (openTELEMAC-MASCARET and Delft3D), which have demonstrated their ability to accurately describe estuarine hydrodynamic patterns and water elevation for river flow in normal and extreme conditions, were applied. Several scenarios for climate change effects were defined including river flood peak flows for the 100 and 1000 year return periods and sea level extreme values for RCPs 4.5 and 8.5 in 2100.

The results demonstrated a clear difference between the hydrodynamic behaviour of the two estuaries. Model outcomes for the Minho estuary, which is dominated by the tide and therefore by oceanographic conditions, show a pronounced effect of rising sea levels on estuarine hydrodynamics. Whereas, for the Douro estuary, which is heavily dominated by the river flow, the effect of the sea level rise is hardly noticeable during flood events.

These and further results of this ongoing project are expected to (i) provide a complete hydrodynamic characterization of the two estuaries; (ii) evaluate future trends; (iii) estimate the flood risks associated with extreme events and (iv) demonstrate that the combined use of different models reduces their uncertainty and increases the confidence and consistency of the forecasts.

How to cite: Iglesias, I., Pinho, J. L., Bio, A., Avilez-Valente, P., Melo, W., Vieira, J., Bastos, L., and Veloso-Gomes, F.: Future estuarine circulation patterns characterization based on a hydrodynamic models ensemble, EGU General Assembly 2021, online, 19–30 Apr 2021, EGU21-6541, https://doi.org/10.5194/egusphere-egu21-6541, 2021.

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