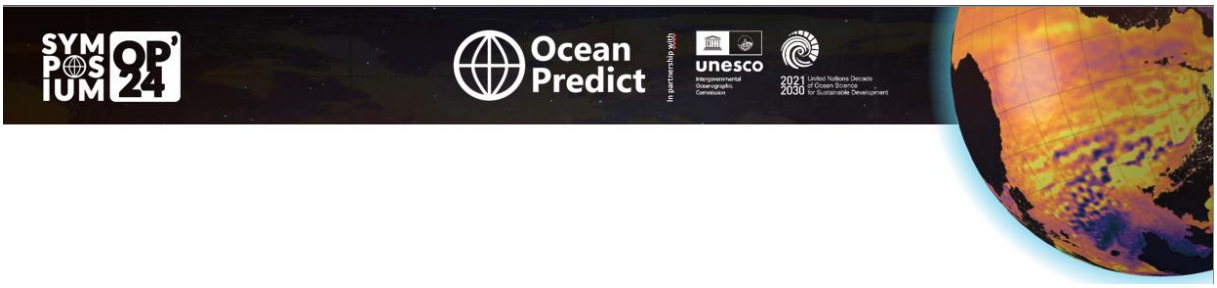

From the Danube delta to the Black Sea: A multiscale modelling approach to understand land-sea continuum

The Danube River, second-longest river in Europe, significantly influences the hydrodynamics and nutrient dynamics of the Black Sea. Notably, it contributes to approximately 60\% of the total freshwater inflow to the sea, and bring more than 30 times more Nitrogen than the combined contribution of the two other main rivers in the region (Dniester and Dnieper). This substantial nutrient influx has profound implications for the Black Sea's ecosystem, biogeochemical processes, and overall environmental health. Eutrophication in the coastal zone due to the amount of nutrients coming from the river has caused important biological and financial losses since the 1970s. Despite the extensive modeling efforts and studies focused on the Black Sea, the Danube Delta, which serves as the critical buffer between the Danube River and the Black Sea, remains relatively understudied. Data is scarce inside the delta and at its mouths, making studies on the delta's influence on the Black Sea challenging. Existing Black Sea models mainly rely on climatic averages to represent the inputs from the Danube to the sea, leading to potential errors in coastal areas' dynamics. We aim to bridge this knowledge gap by developing a comprehensive model of the land-sea continuum encompassing the Danube Delta and the Black Sea. Using the Second-generation Louvain-la-Neuve Ice-ocean Model (SLIM), an unstructured hydrodynamic model, we aim to provide a high resolution representation of the complex deltaic and coastal processes. The model set-up reaches a resolution of 30 meters in the Danube branches, 200 meters near the coast bordering the delta, and around 1 kilometers offshore on the North-Western Shelf of the Black Sea. Data scarcity lead us to reconstruct the bathymetry of the branches of the Danube River inside the delta, using different sources of information. Preliminary results show a good agreement between the model and the available observations, and underscore the importance of the Danube Delta's flood plains in regulating the hydrodynamics in the region. The accurate representation of the bathymetry in the three branches of the Danube River is also crucial for capturing the complex flow patterns. As outputs of this study, we provide a complete bathymetric dataset for the three main Danube branches, as well as discharges at the outlet of said branches.

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