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Modelling the coastal processes at the mouths of the Danube River in the Black Sea

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The mouths of the Danube River in the Black Sea represent the main southern entrance in the seventh Pan European transportation corridor that links the Black and the Northern seas and is the most important inland navigable waterway in Europe. For this reason the coastal area close to the Danube Delta is subjected to high navigation traffic, which is crucially affected by the strong processes mainly induced by the interactions between the waves and the currents generated by the Danube River outflow. From this perspective, the objective of the present work is to develop a computational framework based on numerical models able to evaluate properly the effects of these interactions and to provide reliable predictions concerning the wave and current conditions corresponding to various environmental patterns. Following this target, a wave modelling system, SWAN based, was implemented in the entire basin of the Black Sea and focused on the coastal sector at the entrance of the Danube Delta. As a next step of the modelling process, SWAN simulations were performed at two different computational levels, considering in parallel the situations without and with the current fields for the main environmental conditions characteristic to the target area. The first level covers the entire coastal area at the mouths of the Danube River and has a resolution in the geographical space of 500m. The second is a computational domain with the resolution of 50m that is focused on the Sulina channel, which is the main navigation gate at the mouths of the Danube River. The results show that the presence of the currents induces relevant enhancements in terms of significant wave heights. Additionally, the Benjamin Feir index (BFI) was also evaluated. This is a spectral shape parameter that is related to the kurtosis of the distribution and indicates the risk of the freak wave occurrence. The enhanced values for BFI in the case when the current fields are considered in the modelling process indicate also an elevated risk from this point of view. In situ measurements have been also performed in the target area and they confirm in general the results of the numerical simulations. The work is still ongoing and, as a further step, data assimilation techniques are considered for improving the wave predictions at the mouths of the Danube.

Keywords: Black Sea, waves, currents, Danube Delta, SWAN, coastal processes.

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