



Wave modelling south of the Danube Delta in the Black Sea

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A multilevel wave modelling system, based on SWAN (Simulating Waves Nearshore) spectral model, was implemented in the Black Sea and focused on the western coast. Model simulations have been performed for a 10-year time interval (1999-2008). Validations have been carried out against both satellite data and in situ measurements. A high resolution SWAN computational domain (100m x100m), which is focused on the coastal environment south of the Danube Delta, was also implemented. This coastal area includes Sacalin, which is a newly formed island in the Black Sea, south of the Saint George branch of the Danube. Initially, this was an island system, which consisted of two smaller islands, Greater Sacalin and Lesser Sacalin. In time, due to the enhanced sedimentary processes, the two islands merged into a single continuous landmass. The island has become the habitat of a great variety of rare species and for this reason it was declared an ecological reserve.

In the high resolution computational domain, focused on the Sacalin Island, the effect of the currents induced by the Danube River outflow was also accounted in the model, together with some other processes specific to the coastal environment as diffraction, triad wave-wave interactions and wave induced set up. Considering the results of the ten-year SWAN model simulations with the modelling system covering the entire sea basin, the most relevant configurations of the environmental matrix, characteristic to this side of the sea, were defined.

On this basis, by performing SWAN simulations in the high resolution coastal domain, the wave propagation patterns in the nearshore, together with some parameters related to the shoreline conditions, were evaluated. A great number of possible situations were analyzed. The most relevant correspond to different directions of the incoming waves (N, NE, E and SE, respectively) and significant wave energy conditions. The results provided by the modelling system indicate two different processes. The first is dominant and it can be considered as a constructive process. This corresponds to the most common wave propagation pattern in the target area (waves coming from the northeast). In this case, the alluvial river input combines with the longshore sediment transport. This process determined the generation of the Sacalin Island and controls now its southern extension. The second is in fact a destructive process. This corresponds to the situations of very strong storms with waves coming from the southeast (and also in some cases from the east). Such cases of strong storm waves coming from the southeast are not very common in the target area. Nevertheless, such conditions may be encountered and moreover, they really occurred in the winter of 2013 leading to a strong penetration of the waves through the Sacalin Island that changed the coastal configuration and affected the local habitat. Various scenarios have been analyzed and the model results help in a better understanding of the coastal dynamics in this area.

Keywords: Black Sea, waves, SWAN, Sacalin island, coastal dynamics.

ACKNOWLEDGEMENT: This work was supported by a grant of the Romanian Ministry of National Education, CNCS – UEFISCDI, project number PN-II-ID-PCE-2012-4-0089 (project DAMWAVE).