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Wave modelling to assess the storm conditions in the Black Sea

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The work proposed herewith presents the results of a ten-year wave hindcast performed in the Black Sea and focused on the storm conditions. A wave modelling system, SWAN based, was implemented in the basin of the Black Sea. Validations have been performed both against in situ and remotely sensed data for the entire ten-year period considered (1999-2008). The wind field provided by NCEP-CFSR (United States National Centers for Environmental Prediction, Climate Forecast System Reanalysis) with a spatial resolution of 0.312ºx0.312º and a temporal resolution of 3 hours was considered for forcing the wave model. In statistical terms, the results are in general in line with those provided by similar wave prediction systems implemented in enclosed or semi-enclosed seas, the most important factors in increasing the general system reliability being the accuracy and resolution of the wind fields considered. As regards the physical processes, the calibration tests performed show that whitecapping still represents the weak link in deep water wave modelling. The most relevant storm conditions encountered in this ten-year period considered were further analysed. This analysis was performed from the point of view of the intensity, location of occurrence, duration and propagation in the geographical space of the storms. Following the results of the work, the western side of the sea is more energetic and almost each year storms with significant wave heights of about eight meters are encountered in this part of the Black Sea, while in the case of the extreme storms significant wave heights even greater than eleven meters may occur. From this perspective, it can be concluded that the present work provides valuable information about the characteristics of the storm conditions and on their dynamics in the Black Sea. Moreover, this marine environment is currently subjected to high navigation traffic and to offshore operations and the strong storms that systematically occur may produce accidents with very serious economic and environmental consequences. The work is still ongoing and an important direction considered is to use the wave modelling system for performing long term projections concerning the dynamics of the wave climate in the Black Sea. This is motivated also by the fact that, according to various evaluations, the variability of the environmental parameters in the Black Sea is expected to be in medium to long term higher than in the neighboring sea environments. Finally, as a further step, some data assimilation methods are also being considered for improving the wave predictions in the basin of the Black Sea, especially those related to the storm conditions when sometimes the model predictions may become inaccurate.

Keywords: Black Sea, hindcast, storm conditions, SWAN, wave climate.

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