Geophysical Research Abstracts
Vol. 21, EGU2019-13691, 2019
EGU General Assembly 2019
© Author(s) 2019. CC Attribution 4.0 license.

A coupled tide, storm surge and wave forecasting system at pan-European scale

Tomas Fernandez-Montblanc (1), Paolo Ciavola (2), and Michalis Vousdoukas (3)

(1) University of Ferrara, Ferrara, Italy (frntms@unife.it), (2) University of Ferrara, Ferrara, Italy (cvp@unife.it), (3) Joint Research Centre, Ispra, Italy (Michail.VOUSDOUKAS@ec.europa.eu)

In Europe, storm surges are considered a main coastal hazard, causing coastal flooding with high social, economic and environmental impacts. Additionally, the concomitance with extreme waves can increase the flood risk, by modifying the water level due to the contribution of wave set-up and changes in the sea surface roughness. Furthermore, the combination of high water level and extreme waves leads to higher coastal erosion rates, which in turn may increase coastal flooding and the final impact of a marine storm. Therefore, it is crucial to develop robust predicting tools including wave, storm surge and tide interactions. The tool should be able to provide information about where, when, and for how long the hazardous conditions may occur and to support real time coordination of emergency responders to flooding. Such tools are not yet available at European scale, even if they can contribute for disaster risk reduction and eventually may support the COPERNICUS initiative.

The present work outlines the development of a Pan-European Storm Surge and Wave Forecasting System (EU-SWF) in the context of the project EC-HORIZON2020-PR700099-ANYWHERE. The EU-SWF is based on a two-way coupled circulation (SCHISM) and wave (WWMIII) model. The circulation model SCHISM (Semi-implicit Cross-scale Hydroscience Integrated System Model) solves the full Navier-Stokes equations configured in 2D-barotropic mode. The WWM III (Wind Wave Model III,) is a wave spectral model that solves the wave action equation. The system account for the combined effect of wind, atmospheric pressure gradients, tides, nearshore wave process, increases in sea surface roughness and wave-current interaction. The EU-SWF provides as output water level and wave characteristic time series with a 1-hour time resolution and at a 10 km spatial resolution along the whole European coastline.
The EU-SWF validation was conducted comparing an eight-year hindcast (2010-2018). The tidal signal was evaluated by comparison with sea level measurement from 208 tidal stations covering the whole European coastline. Statistical index as absolute and relative error of phase and amplitude, as well as vectorial differences of the main tidal constituents were analyzed. The storm surge model performance was evaluated in terms of the root mean squared error (RMSE), relative root mean squared error (%RMSE) and correlation coefficient (r), by comparison with the tide gauge record as well as with altimetry satellite in the whole domain. The wave model was assessed in terms of normalized bias (NBI) and NRMSE (normalized root mean square error), comparing the model output with satellite altimeter data and a wave buoy database. Moreover, the influence of coupling the wave model in the storm surge and total water level performance was investigated.
The validation results showed a satisfactory model performance in terms of accuracy of water level, wave forecast and efficiency. The inclusion of the tide-surge interaction and the two way coupling of the wave model improves the performance of previous storm surge forecast efforts at pan-European scale.