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Operational storm surge modelling in the Mediterranean Sea

M. Bajo, G. Umgiesser, and C. Ferrarin
CNR, ISMAR, Venezia, Italy (marco.bajo@ismar.cnr.it)

The storm surge forecast in coastal areas is of extreme importance. A good prediction is necessary to the population, since coastal flooding have strong economical repercussions. A storm surge forecast system, based on a finite element hydrodynamic model was set up at the Centre for sea level forecasting and flood warnings of the Venice Municipality (ICPSM) since the end of 2002. The system has been improved during these years in order to increase the accuracy and to spatially extend the prediction. The model now runs in two computational grids. A first simulation, forced with meteorological fields of the European Centre of Medium-Range Weather Forecasts (ECMWF), runs with a grid of the Mediterranean Sea with about 18,000 elements. The surge is post-processed with a routine based on an ANN that assimilates the observed residual level near Venice. Finally the astronomic tide, computed by means of the harmonic constants, is added to obtain the total sea level. This level is used as forcing at the three inlets of a second computational grid of the Venice lagoon. The fifth day forecast is now better than the accuracy of the first day forecast of the original prediction.

This method provides a very good estimation of local sea level, but it does not improve the global forecast on the whole grid. Moreover it provides only the storm surge forecast, and the sea level is computed only locally by means of the astronomic tide.

The interactions between tide, wave and surge in determining the total water level in the Mediterranean Sea, have been investigated by means of high resolution finite element tide-wave-surge model. The model system consists in a finite element hydrodynamic model, including a tidal model, and in a third generation finite element spectral wave model. The numerical computation has been carried out on a spatial domain that represents the Mediterranean Sea through an unstructured grid which consists of about 150,000 triangular elements with a resolution that varies from 15 km in the open sea to 5 km in the coastal area and to 1 km along the Italian coast. Model performance has been evaluated comparing the simulated water level and wave characteristics against 3 years long observation database. Tidal harmonic analysis has been performed on both modelled and observed water level in order to validate the model for both the tidal and the storm signals. The hindcast results of this new model framework show that the run with tide and with wave is more accurate than the conventional method (surge plus tide independently) in predicting the total water level along the Italian coast.