Operational storm surge forecast in Venice

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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). The model runs on a computational grid of the Mediterranean Sea and uses a 2-dimensional formulation of the shallow water equations. Open boundary conditions are set at the Gibraltar Strait and only the surge due to meteorological forcing is computed. It is forced with surface wind and pressure synoptic fields of the European Centre of Medium-Range Weather Forecasts (ECMWF). The local storm surge forecast near Venice is extracted and improved through a routine based on artificial neural networks that assimilates sea level observations of one day before each operational run. These data are used to create the inputs for the neural network, together with the forecast of the model, and a new forecast, more accurate, is created. Finally the astronomic tide, computed through the harmonic constants, is added to the surge and this total sea level is used as boundary condition at the three inlets for a second simulation inside the Venice lagoon. This final simulation provides a forecast of the total sea level and currents in each location inside the lagoon.
The routine based on neural networks gives a strong improvement to the forecast. The accuracy at the fifth day forecast is now better than the accuracy of the first day forecast of the original prediction.
Future improvements consist in adding new inputs to the neural network and in a new training, using the latest data available. An assimilation system based on the 4D-Var technique is also under development.