

The impact of different NWP forecasting systems on *acqua alta* forecasts: Two IOP case studies over the NEI target site

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In the framework of the first HyMeX Special Observation Period (SOP1: 5 September–6 November 2012) devoted to study key processes leading to heavy precipitation and flash flood events, sixteen Intensive Operation Periods (IOPs) associated with different weather systems occurred over the three Italian target sites. Operational and specifically deployed measurement instruments provided detailed and valuable meteorological observations for each IOP. At the same time, numerical weather prediction (NWP) models implemented by the Italian HyMeX partners provided valuable support to the forecasting operations. Two of these IOPs (IOP16: 26–29 October and IOP18: 31 October–1 November) are of particular interest because the heavy precipitation observed was responsible not only of several damages in the North-East Italy (NEI) target site, but also of two exceptional storm surge events (*acqua alta* events) that took place in the Northern Adriatic Sea and, in particular, in the Venice Lagoon. The tide peak of 143 cm, registered on 1 November at the Venice tide gauge of “*Punta della Salute*”, represents one of the most intense events in the last twelve years (the 13th exceptional event for Venice since 1872).

Given the exceptionality of these kinds of events and their associated socio-economical impact, storm surge forecasting systems that model the sea surface elevation play a fundamental role in the operational monitoring activities of this area. Presently, ISPRA manage two systems for *acqua alta* over the Northern Adriatic Sea: *i*) a statistical model (ISPRA_STAT2008) to forecast the tide contributory factor of meteorological nature (the residual), which exploits the potential of the Italian real-time tide monitoring system represented by the Venice Lagoon and the Northern Adriatic Sea network (RMLV) and the National network (RMN), both managed by ISPRA; and *ii*) the Shallow water HYdrodynamic Finite Element Model (SHYFEM) developed at CNR-ISMAR. Both systems are forced with wind and mean sea level pressure forecasts generated either with the ECMWF global model or the meteorological 0.1° BOLAM model operational at ISPRA. This latter model, which is developed at CNR-ISAC, was one of the Italian NWP models available during SOP.

Even if both forecasting systems were able to forecast almost correctly the timing and magnitude of tide events occurred during IOP16 and IOP18, differences were observed in the predicted values of the peaks, due to the meteorological model forcing. Hence, the present study aims at investigating the quality and performance of these meteorological forecasting systems by evaluating them against the measurements collected during SOP1 and, in particular, those provided by the regional meteorological services of Veneto (ARPAV) and Friuli Venezia Giulia (ARPA FVG – OSMER). In addition, it is evaluated the performance of the two storm surge forecast systems when using other two versions of the BOLAM model provided during SOP, namely the ISPRA 0.07° BOLAM and the CNR-ISAC 0.1° BOLAM.

The data registered by the tide gauges of the Italian RMLV and RMN networks located alongside the Adriatic coastline are also considered for assessing the skill at forecasting those *acqua alta* events. Furthermore, it is also evaluated the contribution on forecast quality provided by the use of these data in the 4D-PSAS-based data assimilations module recently developed and implemented in the SHYFEM system.