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# A 3-month long operational implementation of an ensemble prediction system of storm surge for the city of Venice

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Advantages of an ensemble prediction forecast (EPF) technique that has been used for sea level (SL) prediction at the Northern Adriatic coast are investigated. The aims is to explore whether EPF is more precise than the traditional Deterministic Forecast (DF) and the value of the added information, mainly on forecast uncertainty. Improving the SL forecast for the city of Venice is of paramount importance for the management and maintenance of this historical city and for operating the movable barriers that are presently being built for its protection. The operational practice is simulated for three months from 1st October to 31st December 2010. The EPF is based on the HYPSE model, which is a standard single-layer nonlinear shallow water model, whose equations are derived from the depth averaged momentum equations and predicts the SL. A description of the model is available in the scientific literature. Forcing of HYPSE are provided by three different sets of 3-hourly ECMWF 10m-wind and MSLP fields: the high resolution meteorological forecast (which is used for the deterministic SL forecast, DF), the control run forecast (CRF, that differs from the DF forecast only for it lower meteorological fields resolution) and the 50 ensemble members of the ECMWF EPS (which are used for the SL-EPS. The resolution of DF fields is T1279 and resolution of both CRF and ECMWF EPS fields is T639 resolution. The 10m wind and MSLP fields have been downloaded at 0.125degs (DF) and 0.25degs(CRF and EPS) and linearly interpolated to the HYPSE grid (which is the same for all simulations). The version of HYPSE used in the SR EPS uses a rectangular mesh grid of variable size, which has the minimum grid step (0.03 degrees) in the northern part of the Adriatic Sea, from where grid step increases with a 1.01 factor in both latitude and longitude (In practice, resolution varies in the range from 3.3 to 7km). Results are analyzed considering the EPS spread, the rms of the simulations, the Brier Skill Score and are compared to observations at tide gauges distributed along the Croatian and Italian coast of the Adriatic Sea. It is shown that the ensemble spread is indeed a reliable indicator of the uncertainty of the storm surge prediction. Further, results show how uncertainty depends on the predicted value of sea level and how it increases with the forecast time range. The accuracy of the ensemble mean forecast is actually larger than that of the deterministic forecast, though the latter is produced by meteorological forcings at higher resolution