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Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "Can an early warning system help minimize the impacts of coastal storms? A case study of the 2012 Halloween storm, Northern Italy" *by* M. D. Harley et al.

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Referee Comment: "The weak part of the forecast chain seems to be the offshore models (ROMS and SWAN) which fail to predict water level and significant wave height during the selected storm (water level is underestimated by almost 1 m). To my opinion such results could not be presented in a scientific publication, also considering that recently Mariani et al. (2015) reported a much accurate forecast of water levels in the North Adriatic Sea for the same storm event. Probably one of the reason of water level underestimation resides in the fact that water level set-up due to wind waves is not considered in the hydrodynamic model. For this reason I would not consider this model

chain as a state of-the-art coastal forecasting system."

Author Response: The peak offshore water-level was under-predicted for this particular event by 0.29 m. The study presents an open discussion about this under-prediction and cites it as a limitation for obtaining accurate forecasts of this particular event (as shown by the comparison between the three forecast modes). While the study of Mariani et al. (2015) was for a different region of the Adriatic Sea, we note they observe a forecast under-prediction of similar magnitude, particularly for the site closest to our study site (Chioggia). While the focus of Mariani et al. (2015) was on a detailed investigation of the forecast errors associated with the surge model of this event, the particular focus of this study is on the nearshore hydrodynamic/morphodynamic forecasts (i.e. XBeach), which are not included in the forecast model chain of Mariani et al. (2015). Indeed we consider the early warning system of this study as state-of-the-art as it is only one of several forecast systems worldwide (e.g. the COSMOS system in the USA) that specifically include the nearshore hydrodynamics/morphodynamics in the model chain. This forecast system also includes the use of storm impact indicators based on the XBeach output to support end users and assist in decision making.

Referee Comment: "The authors performed three set of simulations: (1) a default forecast (DF) mode based on three-day wave and water-level forecasts and default XBeach parameters, (2) a "perfect" offshore (PO) forecast mode using measured offshore values and default XBeach parameters; and (3) a calibrated XBeach (CX) mode using measured offshore values and an optimized parameter set obtained through an extensive calibration process. The models have been applied and tested for a unique storm event (31 October 2012). I think that they should instead follow the standard procedure of model calibration and validation in order to demonstrate the effective forecast capacity of the developed system. Therefore, I suggest to consider not only one but several storm events and to: (1) calibrate the XBeach model using measured offshore values; (2)validate the full Early Warning System for storm events different from the ones used inthe calibration process."

Author Response: As mentioned in the discussion section, validation from additional storm events will be undertaken in the future to further refine the early warning system once new data becomes available. It should be noted however that pre and post-storm coastal measurement datasets are quite rare worldwide and the results presented in this study provide a unique assessment of XBeach model performance during conditions where the dune impacts along the site vary between the collision and overwash regimes. With regards to the point about calibrating the XBeach model using measured offshore values, the model is calibrated using the Cesenatico wave buoy, which is the closest wave buoy to the study area and within the Emilia-Romagna region. This buoy is situated at 10 m water depth, which is precisely the same depth as the offshore boundary used for XBeach. The reviewer is right to suggest that the Ravenna tide gauge used in the calibration includes the additional effects of wind set-up at the nearshore boundary. Wave set-up inside Ravenna Harbour however is likely to have been very be limited for this storm event where Hsig < 2m. Since XBeach does not model wind set-up, we believe that it is appropriate to use the Ravenna tide gauge to include these additional effects.

Referee Comment: "The maximum waterline over-prediction of the PO forecast mode is probably due to the fact that the water level imposed as open sea boundary condition for XBeach (at about 3 km offshore) is measured inside the harbour of Ravenna and already includes local wind and wave set-up. For this reason I would not call this simulation set-up a “Perfect” Offshore forecast (PO) mode. Consequently, the XBeach parameters calibrated using the water level measured by the Ravenna tide gauge as a boundary condition could not be used in a forecast system. XBeach have instead to be calibrated using offshore observations (see comments above)."

Author Response: See above response with regards to the appropriateness of the Ravenna tide gauge. To avoid confusion with the use of the word “Perfect”, this mode has been renamed “Measured Offshore (MO)” mode

Referee Comment: "Please provide some results about the accuracy of the wind fore-

casts derived from the atmospheric model COSMO-I7."

Author Response: A study of the accuracy of COSMO-I7 based on wind intensity measurements during Autumn 2012 (September-November) at coastal stations along the Italian Northern Adriatic coast indicates a bias of about +1.0 m/s and an RMS error of about + 2m/s. This has now been cited in the text.

Referee Comment: "The simulated what-if scenarios based on alternative artificial dune designs represent a nice effort to analyse different management strategies along this coastline. These simulations should be carried out only once the model system has been properly calibrated and validated."

Author Response: We respectfully disagree with this point – the purpose of the what-if scenarios is to demonstrate the benefits of the early warning system from an end-user perspective in terms of possible emergency actions given a certain forecast. These simulations provide unique insights into the type of dune configurations that could potentially have been constructed prior to the Halloween storm to help minimize its impacts.

Referee Comment: "I suggest to include some Mediterranean storms in the list reported at the beginning of the Introduction section."

Author Response: The Mediterranean storm “Klaus” in 2009 has been added to the list, using Berlotti et al. (2011) as the citation

Referee Comment: "Cite also Bajo, M. and G. Umgiesser, 2010. Storm surge forecast through a combination of dynamic and neural network methods. Ocean Modelling, Vol.33 (1-2), 1-9, doi:10.1016/j.ocemod.2009.12.007."

Author Response: This reference has now been cited

Referee Comment: "Give a reference for the flooding of Venice."

Author Response: A reference has now been added to for this (ICPSM, 2015)

Referee Comment: "Please give more details about the calibration procedure. Did you use an automatic optimization algorithm? Did you carry out separate calibration for each profile?"

Author Response: Calibration was undertaken by manually adjusting parameters within the bounds of reasonable values in an iterative manner. The parameter set that resulted in the best brier skill score across all 11 profiles was selected as the optimized parameter set.

Interactive comment on Nat. Hazards Earth Syst. Sci. Discuss., 3, 3409, 2015.