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Discussions

Interactive comment on "Evaluation of coastal vulnerability to flooding: comparison of two different methodologies adopted by the Emilia-Romagna Region (Italy)" *by* L. Perini et al.

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The answers to the reviewer's comments are presented below, after each comment posted by the reviewer, numbered from 1 to 3.

1. SGSS has defined three scenarios excluding wave run-up. The major requirement of these is to have a simplified method to estimate flooding risk. However, authors have found, extension of flooding is over estimated in the central and under estimated at some part of the south. Do you think that excluding of wave run-up is partly responsible for these discrepancies? Also, according to the analyses, I believe, SGSS approach provides rough estimation of flooding risk while the method prior to EU Di-

rective provides relatively high accuracy of predictions.

Answer to comment 1: The over-under estimation of the extension of flooding is due to several components. Run-up exclusion is surely one of these components as stated on page 2333, lines 24-27 ("Finally, the over/under estimation of flood's extension could be due to the exclusion of run-up values and to the difference between the scenarios used for the evaluation and the observed storms, in addition to local variability of storm surge levels between different locations"). We agree with the reviewer comment that the VaPL method provides a relative high accuracy of predictions. However, for the implementation of the Flood Directive at regional level 2D maps were to be produced. Therefore, to implement the least-path analysis it was decided to create a new methodology. Hence, the paper presents both methods and how/if they are able to identify hot-spots because at the regional level both approaches are used to identify vulnerable areas. In the online web-GIS of the region that shows the main data collected along the coast the VaPL method outcomes are also presented (https://applicazioni.regione.emilia-romagna.it/cartografia_sgss/user/viewer.jsp?service=costa).

2. Pg 4336, ln 14 'The SGSS will improve the methodology developed so far by updating the analysed return periods with more recent datasets and evaluating the combined probability of occurrence of storms and surge levels. However, this was not feasible within the time-scale set by the EU directive.' Why EU time-scale is not feasible, better to specify the time-scale.

Answer to comment 2: The EU Directive was issued in 2007, while the implementation of the Directive into the Italian legislation was in 2010. The initial discussions at national level on how to analyse the data and produce the maps started in May 2011. The first documentation/guidelines from the Ministry of the Environment were issued in 2012. The maps were to be produced by December 2013, thus leaving less than two years to set-up the method, analyse the data and produce the maps. It is important to underline that there were not allocated funds to fulfil the Directive requirements. Therefore it was not possible to collect new data or to contract external personnel to carry out a more detailed analysis. The regional authorities, thus, decided to use already available datasets and information. The following sentence was added on page 4336, line 18: "(i.e. slightly more than one year, considering the first guidelines issued in 2012 by the Ministry of the Environment on the application of the Directive in Italy)"

3. Beach evolution during storms (e.g. lowering of dune crest levels) which is important in developing passages of inland flows was not considered in your analysis though you have mentioned in the discussion some studies have shown the importance. What impacts for you findings are expected if you considered the beach evolution, specially the area of sandy beach/dune system without coastal protection structures? I believe, this is even more aggravated if there is a series of storms (even with low return levels) compared to that of a strong single event (high return level) (see for example Dissanayake et al., 2015a,b).

Answer to comment 3: We agree with this comment. We have added on page 4333 the following statement, in order to better clarify the importance of the beach/dune system evolution during storms. "Furthermore, a more detailed numerical approach should consider also the effect of storm clusters on the beach/dune system that can lead to the formation of passages of inland flows (e.g. dune breaching), aggravating the inundation extent (Ferreira, 2005; Vousdoukas et al., 2012; Karunarathna et al., 2014; Dissanayake et al., 2015)." The cited papers have been added to the reference list, specifically:

Dissanayake, P., Brown, J., Wisse, P., and Karunarathna, H.: Comparison of storm cluster vs isolated event impacts on beach/dune morphodynamics, Estuar. Coast. Shelf S., 164, 301-312, doi:10.1016/j.ecss.2015.07.040, 2015.

Ferreira, O.: Storm groups versus extreme single storms: predicted erosion and management consequences, J. Coastal Res., SI 42, 221–227, 2005.

Karunarathna, H., Douglas Pender, D., Ranasinghe, R., Short, A.D., and Reeve, D.E.: The effect of storm clustering on beach profile variability, Mar. Geol., 348, 103-112, http://dx.doi.org/10.1016/j.margeo.2013.12.007, 2014.

Vousdoukas, M.I., Almeida, L.P., and Ferreira, O.: Beach erosion and recovery during consecutive storms at a steep-sloping, meso-tidal beach, Earth Surf. Proc. Land., 37, 583–593, 2012.

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