Review of ***Combining probability distributions of sea level variations and wave run-up to evaluate coastal flooding risks***

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The manuscript presents a joint probability analysis of sea level – wave induced runup in the Finish coast to be used in coastal flooding assessment. In this sense, the topic is on the scope of NHESS and can be of interest for NHESS readers. In what follows, some comments are given.

[1] The first comment is purely formal. Authors state in lines 22-23 (pag 3) that they are going to call "run-up level" to the combined water elevation (mean water level and wave run-up contributions. This is misleading since it is not the unusual approach in the literature. It should be better to use something like "total water level" to avoid confusion with the standard wave-induced run-up.

[2] *Lines 13-14 (pag 3).* Coastal floods are also a consequence of storm-surges. Please rephrase the sentence.

[3] *Lines 6 (pag 4).* In general terms, the wave-induced component of the water level at the shoreline is the run-up and not the wave height (a different thing is that you approach the run-up with the wave height but this depends on how you calculate it).

[4] *Line 1 (pag 5).* Long-term mean sea level does not change from decade to decade. Mean sea level is continuously varying and "long-term" refers to the low-frequency component which, apparently, you consider to be associated to periods in the scale of decades (or longer).

[5] *Section 3.1. Long-term sea level.* You are using long-term estimations of sea level at selected horizons based on a paper that is under review. If this component is important for your calculations, it can be difficult for some readers to trust on it without having access to the scientific work supporting used values.

[6] *Section 3.2*. Please change the heading. Here you are not describing variability but just the existing data. They are simply water level measurements acquired by using tidal gauges. Use something similar to heading of section 3.3 (e.g. tidal data, water level data).

[7] *Lines 6-7 (Page 8).* Please remove the last sentence "The significant wave height is …". If you want to use a definition of Hs use a formal one (e.g. based on spectral moments).

[8] *Lines 23-25 (pag 8)*. See comment [1].

[9] *Lines 10-11 (pag 9).* When you explain which sea levels are used to obtain the probability distributions you mention that use sea levels with a given frequency (5 events/year or less in your case). This is equivalent to perform an extreme analysis in which you use a subset of your data composed by extreme events. Then, the usual way should be to select sea-level events by applying the POT method using a given threshold (which will result in a varying number of events per year that, in your case, is up to five events per year) and then fitting the obtained subset by a probability function (exponential in your case).

[10] *Section 4.3*. You determine an attenuation factor for both coastal locations to derive local wave time-series from 15-year long offshore measurements. This is equivalent to derive an empiric wave propagation model instead of using a numerical model. However, your coastal wave time series are just 31 days long in Jätkäsaari and 11 days long in Länsikari (section 3.3). Given the short-time duration of these records, it is necessary to have more details on this analysis to trust on reconstructed long-term wave time series at both coastal sites. For instance, it should be great to have $Hs_{coastal}$-$Hs_{offshore}$ plots at both locations under different conditions (T, θ) to see the expected uncertainty in the reconstruction.

[11] *Line 1 (pag 11).* This is a complicated ay to say that you use the maximum run-up, Ru_{max} instead of $Ru_{2\%}$.

[12.1] *Line 3 (pag 11).* It should be great to include a typical coastal profile of the study sites (maybe after Fig 2) to see how steep they are, especially since you are using this characteristic to approach Ru by H.

[12.2] The concept of *run-up height* needs to be defined to avoid misunderstandings. The run-up height is usually defined as the vertical distance between highest run-up level Ru and deepest run-down Rd. However, when we simply use wave run-up we refer to the vertical distance with respect to the mean water level. Please, clarify what you are using.

[13] *Line 5 (pag 11)*. The use of the relationship Hmax = 2 Hs need to be justified. The ratio Hs/Hmax can be quite variable depending on local conditions (see e.g. Oliveira et al. 2018, Ocean Engineering 153, 10-22). One possibility to select the value to be used is to obtain it from the wave data recorded at your offshore location.

[14] The use of "full" reflection needs to be justified (or simply says that it is arbitrarily selected to be conservative). The study of Björkqvist et al (2017c) used to justify this selection was done in front of a Caisson breakwater. Since we do not know how the coast is (see comment [12.1]), it is difficult to see if the application of this reflection coefficient is appropriated for the site.

[15] *Section 4.5.* Since you have 15 years of simultaneous data of water level and waves, why you did not convert these series into a single series of total water level (by simple summation) and then to obtain the probability distribution. This can give you a good estimation of the "real" joint probability distribution of water levels (for all components) under current conditions. This could be used to compare with the obtained one by combining individual probability functions.

[16] *Section 5.* It is not clear which is the contribution of this analysis to overall results. If you are just using theoretical distributions, you do not need any data (?). However, for a real case (as it is yours) you should fit a probability distribution (Weibull in your case) and retain the best fit (with the corresponding Weibull parameters). Of course, if you change your Weibull parameters your results will change.

You want to include here a sensitivity analysis but, there is no sensitivity analysis (nor uncertainty) associated to your previous selections (Ru formula (H), relationship between Hs and Hmax, refraction model, etc…). If you want to do a formal sensitivity analysis, probably you should account for the different contributions through the entire assessment.

[17] *Section 7.2. Lines 4-8 (pag 22).* See comment [15].

[18] *Lines 9-20 (pag 22).* This is true but this is also less and less common. As it is written, it seems that this is the most used approach. At present, flood assessments for combined water level-wave contributions, usually consider full time series instead of monthly maxima.

[19] *Lines 21 to 25 (pag 22).* More than the short-term variability in waves, probably, you must also consider the potential long-term variability in wave conditions for long time projections (see e.g. Méndez et al. 2006. Estimation of the long-term variability of extreme significant wave height using a time-dependent peak over threshold (pot) model." *JGR Oceans* 111,C7).