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Interactive comment on "Variability of distributions of wave set-up heights along a shoreline with complicated geometry" *by* Tarmo Soomere and Katri Pindsoo

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We very much appreciate the efforts of Referee #2 identifying weak points of the manuscript and for recommendations to improve its quality.

We agree that our formulation of the core question (or hypothesis) of the study and the main conclusion are not perfect. The basic aim is to find out which type of theoretical distribution describes the probability of occurrence of different wave set-up heights. As set-up may contribute up to 1/3 of the nearshore water level rise during strong storms, this question is of clear interest not only from the theoretical viewpoint but also for practical coastal management.

There has been extensive research into the statistical properties of other drivers of high local water levels and the reach of large water waves. The relevant distributions are very different: Gaussian for the water volume of the Baltic Sea, exponential for storm surges, quasi-Gaussian for water levels on the shores of the Baltic Sea, Weibull for different significant wave heights, and Weibull or Rayleigh for wave run-up. The knowledge of the shape and parameters of such a distribution is often crucial in various forecasts and management decisions. The process of wave set-up should be, to our understanding, no exception. Thus, it is necessary to determine the shape of its typical probability density function. This is, in essence, the precondition for building an adequate climatology of set-up heights.

When we started the analysis of set-up heights, the expectation was that the result would be one of the listed distributions. Surprisingly, a Wald distribution popped up in a non-negligible manner. This 'surprise' is apparently not properly represented in the introduction, and we will adjust the introduction, discussion and conclusions accordingly.

The problem of the translation of our results to other locations was also highlighted by Referee #1. We think that part of our results (namely, that set-up heights on the majority of occasions follow an exponential distribution) has universal relevance and would have justified an international publication on its own. The other major conjecture is that the (empirical) probability distribution function of wave set-up heights may have an unusual shape in some coastal sections. This feature might be specific to coastlines with complicated shape and strongly anisotropic wind and wave regimes. However, we think that additional efforts are necessary to find out why, when and where this type of probability distribution emerges. These questions are definitely important as a proper answer to them may lead to more adequate estimates of marine-induced risks in affected coastal segments but, to our understanding, are out of the scope of the current study.

We apologize for the missing bibliographic information in the reference list. It will definitely be added into the revised version.

As for specific comments, we agree that the use of one-point wind information and a simplified method of reconstruction of the wave properties in the study area is a fragile aspect of this manuscript. Even though we fully agree that an adequate reproduction of wave time series would add much confidence in our results, a detailed simulation of wave time series over several decades with a resolution suitable for the study area is an enormous task. However, there are numerous indications that even extremely simple parametric models forced by one-point winds lead to very reasonable reconstruction of time series of wave properties for several locations of the Estonian nearshore (Suursaar, 2010, 2013, 2015; Suursaar and Kullas, 2009). Our study basically relies on statistical properties of wave fields (the probability of occurrence of seas with different wave height, period, and direction) and, strictly speaking, does not require a reconstruction of time series. It is thus very likely that our approach, in particular the use of highly reliable wind information and relatively high-resolution wave model, properly represents statistical properties of wave fields. Thus, we will add a relevant comparison.

The mathematics of wave set-up is a complicated matter for waves that approach the shore under large incident angles and we probably compressed this material too much. In fact we use a sequence of equations. We start from Eq. (9) on page 8 to evaluate the changes to the wave properties owing to refraction and shoaling as waves propagate from the model grid point to the breaker line. This equation gives us properties of the wave field at the breaker line. Thereafter we employ Eq. (7) to find the set-up height. The derivation of this equation is provided because of intense discussion of the physics of breaking of obliquely approaching waves by Hsu et al. (2006) and Shi and Kirby (2008). We apologise for the presence of two equations (9). The second one on page 11 is not really used and is only presented to illustrate the functional form of the probability density function of a Wald distribution, and will be renumbered.

We are also thankful to the Referee for highlighting quality issues with Fig. 2 (which we shall redraw). The left panel of Fig. 5 shows the time when the all-time highest waves

occurred in the study area in 1981–2016 whereas the right panel of this figure shows the timing of the all-time highest set-up events. This figure is meant to explain that high waves in the nearshore of an area with complicated geometry do not necessarily lead to high wave set-up.

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