

Nat. Hazards Earth Syst. Sci. Discuss., referee comment RC2  
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## Comment on nhess-2021-236

Anonymous Referee #2

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Referee comment on "Extreme-coastal-water-level estimation and projection: a comparison of statistical methods" by Maria Francesca Caruso and Marco Marani, Nat. Hazards Earth Syst. Sci. Discuss., <https://doi.org/10.5194/nhess-2021-236-RC2>, 2021

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The paper "Extreme Storm Surge estimation and projection through the Metastatistical Extreme Value Distribution" by Caruso and Marani compare different approaches to perform extreme value analysis of storm surge data at four sites along the European coasts.

The goal of the paper is relevant for the journal and the analysis seem to be correct. Results are well presented and exhaustively explained, I particularly appreciated the quality of the figures.

However, in my opinion there are some aspects the Authors should clarify before the manuscript is deemed suitable for publication. A list of comments is reported below.

- Three approaches are compared in this research, i.e., GEV distribution on annual peak maxima (GEV-BM), the Metastatistical Extreme Value Distribution (MEVD), and GEV distribution on peaks over a higher threshold (GEV-POT). With respect to the latter approach, wouldn't it be better to rely on a Generalized Pareto Distribution (GPD) when threshold exceedances are considered? As far as I remember, GPD is a derivation of GEV for POT data; as such, is it conceptually correct to test a GEV distribution rather than a GPD on POT data? Please comment on this in the Methods section and/or extend the explanation in the Introduction (e.g. lines 37-39).
  
- Lines 15-19 in the Introduction. As you speak of "active field" as for the modeling of

extreme value probability of occurrence, you could reference more recent works.

- Line 29 in the Introduction. The list of reference is rather long; perhaps it would be enough to cite a few works and the "references therein".

- Line 48 in the Introduction. You can also cite Solari et al. (2017).

Solari, S., Egüen, M., Polo, M. J., & Losada, M. A. (2017). Peaks Over Threshold (POT): A methodology for automatic threshold estimation using goodness of fit p-value. *Water Resources Research*, 53(4), 2833-2849.

- Page 4, Fig. 1. Please reduce the y-axis range for Marseille plot.

- Page 5, line 107. If I understood correctly, "year" in the following line should be replaced with "block".

- I would swap Section 2.2.1 and Section 2.2.2. First explain how you pre-processed the data, then the distribution used to model them.

- Section 2.2.1. I think you should explain what are the cumulative distributions F you tested for the ordinary values, and which one did you choose.
  
- Section 2.2.2, line 134. The fact that you neglect the interactions between tides and surges means that gauges are placed in deep waters. Is that true? Please add the respective water depths in Table 1 if such info are available.
  
- Section 2.2.2. Please number the equations.
  
- Section 2.2.3, lines 171-173. This paragraph is unclear. Indeed, looking at the correlograms (Fig. S1) it seems that independent events are achieved for no lags. This aspect is crucial so it should be better explained. Correlograms also reveal that tides are relevant (negligible) in Venice and Newly (Marseille and Hornbaek). Perhaps you could comment on this in the paper.
- Section 2.2.3, line 177. Please use consistent tenses throughout the paper when referencing other works. For instance, here you say "Bernardara et al. (2011) adopted", while previously you use the present tense (e.g. page 6, line 117 or later in the paper at page 8, line 212).
  
- Page 9, line 239. I do not understand why the return period is expressed for annual maxima (AM). Apologies but I am not familiar with the MEVD, however it is clear that it allows to select multiple events per year. Then, why Eq. (3) is defined with respect to AM data?

- It is not clear the purpose of Section 3.1, given that no non-stationary distributions are subsequently employed. However, if you want to keep it, I suggest adding the confidence intervals of the slopes fitted to the data (and perhaps comment them with respect to the p-values of the Mann-Kendall test).
  
- Section 3.2, lines 277-279. What does it mean that thresholds are selected “based on local tidal ranges”? This is a pivotal step of the study, please extend the explanation (you could also add it to the Methods section).
  
- Figures S2-S6. Please use a 1:1 axis ratio. This would help to assess the quality of the fit.
  
- Figure 5. Levels in the return period plots refer to  $z$  or  $h$ ? I find the terminology rather confusing throughout the whole manuscript, e.g. sometimes you talk about storm surge, some other time about extreme sea levels. Please be consistent.
  
- Conclusions, line 349. Please specify that MEVD outperforms the other distributions for long enough calibration periods.

