

Ocean Sci. Discuss., referee comment RC1  
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## Comment on os-2022-14

Philip Woodworth (Referee)

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Referee comment on "Technical note: Tail behaviour of the statistical distribution of extreme storm surges" by Tom Howard, Ocean Sci. Discuss.,  
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22 March 2022

Comments on "Technical Note: Tail behaviour of the statistical distribution of extreme storm surges" by Tom Howard (OSD)

This is a short technical note which attempts to make 3 points: (a) the shape parameter of extreme sea level curves at most UK sites is not zero (and usually negative) and so any parameterisation of the extreme level curve should accommodate its curvature, (b) in spite of that, an assumption of zero shape for a Gumbel distribution is reasonable for Hunter's allowance calculation, and (c) the shape parameters derived from short records are imprecise. These things were known already (or suspected anyway) but it does no harm to restate them in the same place.

I have no objections to the note's publication if the small things below can be attended to. The text is clearly written although the document itself is a little rough (hence some of the trivial comments below).

line 6 - mean sea level rise here and mean-sea-level rise at line 40 (I said these were trivial comments but they suggest some lack of attention)

15 - you don't present evidence that the shape parameter varies around the UK coast. You have a scatter plot in Figure 1 that shows there are clearly different values at different places but, unless you know where the UK place names refer to, you have no insight on how the shape varies around the actual coastline. A map is needed or at least a couple of sentences to say how it varies.

49 - not incompatible ==> compatible!

50-52 - these lines would be better following on at line 39

65 - I know this is a short technical note and there are many details in HW21, but it does no harm to give some essential minimum information. For example, presumably the surge extrema used for Figure 1 are from exactly the same years as the tide gauge extrema, or comparisons are not exact. So say so. Also say what the minimum record length of tide gauge record is employed.

After Figure 1 there should be a sentence to tell the reader that most of the UK shape parameters are negative. And that this observation is not new. For example, see Figure 9 of Marcos and Woodworth (JGR, 2017) which shows consistent negative shape parameters for both North Atlantic coasts. And Wahl et al. (2017) claim that 85% of records worldwide have negative shape parameters. As for the UK, I am sure the negative shapes will have been pointed out in older papers by Blackman, Horsburgh, Tawn etc. (although I have not checked which)

69 - give a reference. For example chapter 7 of Pugh and Woodworth (2014). As well as the physics of wind stress etc., there is a general point that there is only so much water in the ocean, so one would imagine any extreme level curve to turn down at some point.

73 .. in [shape parameter] (reference needed. HW21 again?)

I don't understand why in practice you know there is spatial correlation in the location parameters. That can only be in model runs where the datum at every point is MSL. But if you are using real tide gauge data the location parameters will depend on the datums used at each site. (I hope you see what I mean.)

79 - why 'vector'? It seems an odd word to use here.

82 - say 'For the model data at each tide gauge site'. To make it clear you are using just the short model data sets here and not the 484 year set mentioned later.

90 - from any other site. (?)

104 - the long run of 484 years. And this is for the 44 (?) tide gauge sites?

112 - .. not Gumbel-distributed as was known previously.

Figure 2 (a) and (b) should have (m) on each axis

line 4 of caption - .. the site of the 44 (?) tide gauges on ..

section 2.4 - I got the idea of this section although you have to read it a few times. It would help to fully explain things. For example, what does 'standard-uniform' (line 121) mean?

126 - ... from a given site conforms to a precise GEV distribution.

130 - .. depends on the three GEV parameters.

133-134 - standard-uniform (as above)

151 - an average (?) optimum .. They preferred

155 - simulation as represented in Figure 1 (presumably)

Figure 3 - I don't understand why there are 4 plots here. Shouldn't there be 8? You have tide gauge data (shown here) and line 155 says you use model data also, so you need another 4 for the model data?

title caption should be VdBK and not VdB&K to be consistent with the text But I would remove that anyway and just have QQ plot to be consistent with PP plot on the right. Presumably the dots are ordered so as to be monotonic. Define in the caption the delta symbol on y-axis for QQ (differences at the outliers). Finally I don't understand why you call them 'theory'.

caption line 1 - this should be reworded as you say above for both that QQ and PP derive from VdBK

caption line 2 - at the 44 (?) sites of UK ...

172 - in general zero, as known already (refs).

Figure 4 - I thought you were using 44 sites (see caption figure 5). This should be mentioned at the places in the text I pointed out above. However here in Figure 4 there are 46 locations given.

188 - why did CFB2018 take +0.0119 as its prior shape parameter when all the evidence from previous publications and your Figure 1 has it negative? And at line 192 why did you use a prior of +0.0119 ?

Could you explain Figure 5 a bit better? If the data really has a non-zero shape, and the choice of prior is reasonable, then wouldn't you expect the right-hand side to be tighter than the left for Gumbels?

198 - .. is negative in common with most UK sites (Figure 1) and worldwide (Marcos and Woodworth, 2017; Wahl et al., 2017).

Figure 6 left - the Hinkley plot is described in some detail in Batstone et al. (2013)

Acknowledgements - define BEIS and Defra

221 - Climate, 231 - Research Letters, 235 - Communications