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## Reply on RC2

Julia Rulent et al.

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Author comment on "Distribution of coastal high water level during extreme events around the UK and Irish coasts" by Julia Rulent et al., Nat. Hazards Earth Syst. Sci. Discuss., <https://doi.org/10.5194/nhess-2021-118-AC2>, 2021

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P1L7 - Does the 7.7% refer to 90th %ile waves or surges or both?

**It refers to both. This is now specified in the text.**

***'High (>90<sup>th</sup> percentile) waves and high surges occurred simultaneously at any tidal stage, including high tide (7.7% of cases) [...]'***

Don't see any key words, but 'Ireland' might be a good one since its included here

**We will include this if keywords are asked by the journal. There do not seem to be a keyword space in the paper's template at the moment.**

Intro:

P1L18 - Worth mentioning that 2013/14 storms were particularly large and that the £592.1 million of damage is presumably a maximum rather than typical? I know this is made clear later on, but adding something like "during the exceptionally stormy winter of 2013/4..." would work here.

**This was added in the text.**

Also, were there flooding and damage reported then on the western Irish coast?  
Seems as though there should have been with 14m waves!  
Be good to add these cases in as well since Ireland is being resolved.

**We have added information and references with regards to Ireland and how it was affected by winter 2013/4. Extreme wave during this period did lead to flooding over the west coast and great geomorphological changes.**

**P1L19-21. *'In Ireland, the extreme conditions of that winter lead to high coastal erosion rates with extreme environmental impact (Sanchez-Arcilla et al. (2016), Cox et al. (2018), Janjic et al (2018)) and flooding, especially over the south, west, and north-west coasts (Met Eireann (2014), Thorne (2014)); insurance claims and repairs resulting from the extreme weather damages amounted to more than €210 millions (Kandrot et al. (2016)).'***

P2L27 - "increase in the future"

**Done.**

P2L27 - Since mentioning other factors related to coastal flooding here, I think it would be good to mention the risk of compound flooding in estuaries from TWL and high river flows.

**Added, see P2L31.**

P2L32 - Please clarify what you mean by "residuals"

**Done.**

Methods:

P3L65 - Were rivers included in the model runs? Please clarify

**P3L72-73 This has now been clarified. The model uses climatological river inputs. A version of the UKC4 model coupled to the JULES river model does now exist, but this was still being implemented when we ran the simulation used in the study.**

P3L70 - I'd expect that the min 10m model coast would mean that your results are on the conservative side?

**We are not sure we understand this comment; if this refers to the fact that the model cannot resolve the shallow water processes, then yes, the results could be defined as conservative considering we cannot resolve near coast amplification. The assumption that the water is no shallower than 10 m means that waves do not experience bottom dissipation and are therefore bigger than they would be in reality, while for tide/surge the amplification is not large enough, so this component is underpredicted.**

Also in terms of timings relative to the tide, the timing of HW can shift through the intertidal, e.g in long estuaries, meaning that, for instance, an extreme Hs occurring an hour before HW at the coast of the UKC4 model might occur at HW further inshore. These points could be added.

**These points were added (P3L89-P4L90) '*Shallow water dynamics as well as the tidal asymmetry and modulation of high waters in intertidal estuaries (Nidziako2010) could lead to changes in the timing of waves, surges and tide inshore which cannot be represented here.*'**

Results:

A lot of the text here is written in present tense, whereas past tense seems more appropriate to me.

**This was discussed but we decided to keep the present tense in the result section, as the tense refers to our present results.**

Fig2 - Nice figure.

**Thank you.**

Should the overlapped shading ending at 35 hrs actually end at 34 hrs, to reflect the end

of the surge >90th %ile?

**Yes, this was an error in the plot. It was corrected.**

Also might be clearer if the wave panel shades only waves >90%, the surge panel only surges >90%, and the overlap between waves>90% and surges>90% is shown only in the tide panel below?

**Done.**

P13L115 - A note that Hs in Fig3 is reduced in a few spots in east/north.

**This was added to the figure 3 caption.**

Fig5 - could a more distinctive colour scale be used, and the outer black line removed? This would make the figure clearer I think.

**This was discussed within the author team but, after making different versions of the figure, we feel that the changes do not improve the image. The colour scales chosen are equivalent to the cmocan deep and cmocan amp colourmaps, which are usually friendlier to colour blind readers.**

Also noticed that the 2013/14 surges on SE coast were 'normal' (Fig-4b), but the %ages in Fig5b in SE were high?

A brief discussion on this would be good.

**The 90<sup>th</sup> percentile of surges in Fig-4b from the CS3x model is normal, however the maximum surges are high. This shows both in the maximum surges from CS3x (not shown in the paper) as well as the UKC4 fig-5b. This region of the east coast was hit by one of the highest surges of the past 60 years during storm Xaver (5 December), which could explain the extreme increase in the maximum not reflected in the percentile.**

Discussion:  
Generally excellent.

P15L212 - In the future...

**Done.**

Conclusion:

P16L232 - When 90th-%ile waves, surges and tides co-occurred, what/where was the flooding impact?

**As the paper deals with the high-water levels reached before inland propagation, we cannot draw direct conclusion on flooding. To answer your question, we have decided to upgrade part of the discussion, including adding reference to literature that deals with flooding during the period that we studied.**

**P14L189-L193 *'During winter 2013/4, a sequence of extreme storms induced by an unusually strong North Atlantic jet stream (RMS2014) followed a more southerly path than usual (Thorne2014), causing extended flooding over the north of Scotland, west of Wales, west, south-west and south-east of England (Haigh2016, RMS2014, Thorne2014). The extent of storms over that season lead to question if the ongoing changes in the climate and typical storms conditions may also lead to changes in the spatial distribution and duration of floods (Thorne2014).'***

**We have also added what/where the TWL was high at times in which 90<sup>th</sup>oile wave, surges and high tide co-occurred P13L163-165 '*During the period of coincidence between extreme waves, extreme surges, and high tides the regions showing the highest TWLs are over the west of Ireland, Scotland and in the Bristol Channel, followed by the north-west and south-east of England.*'.**

**However, we have left the line in the conclusion unchanged as we cannot directly quantify the flooding impact in our own results.**