25.04.2023

Author's response:

Dear editor, dear reviewers,

Thank you for the reviews. Please find in blue the answers to your reviews taking into account the new version of the manuscript.

Best regards,

The authors.

## RC1:

1) My main point is sec 2.1. I think this Sec. is not clear enough about the physical processes included or not in the model. In particular, in this version of the paper the authors claim that "coastal depth-induced breaking that occurs in shallow waters is parametrized using Battjes and Janssen, 1978" (L78-79). This choice is in line with current state-of-the-art large scale spectral wave models - e.g. UK Met Office wave configurations (Valiente et al. 2022). However, in the first version of the paper the authors stated: "MFWAM primarily aims at describing the open ocean sea states. As such, coastal (depth-induced) breaking is not included in MFWAM" (L92-93). So I don't really understand whether shallow water dissipative processes are included or not in the model. One think that makes me think is that I also checked Law-Chune et al, 2021 since the authors suggest checking this for the technical details. However, also in that paper there is no mention about shallow water physics included or not in the model. Could the authors please clarify this point, specifying all the processes that the model takes into account and which formulation/parameterization are used? I understand these are rather technical details but they can help a lot clarifying what the model should be able to reproduce.

In the first version of the paper, the coastal depth-induced wave breaking was not included and this process is also not included in Law-Chune et al., 2021 as you mentioned. For the second version of the paper, since we are interested in the coastal shallow waters processes, we additionally include (re-run the simulations) in the model the dissipation due to coastal depth-induced wave breaking with the parametrization of Battjes and Janssen, 1978. The paragraph has been revised to explain that this is a special addition for our paper.

2) Sec. 2.3 is not very clear in my opinion – I really like the idea behind this section, since explains the methodology and can help others to replicate the method, but as it is written is very confused. In particular, the authors should/could think to use better Fig. 2, perhaps describing it in the text. I suggest also if possible to use a consistent mathematical notation – e.g. I think it shouldn't be $k\_0$ or $k\_1$ but instead $k(t=0)$ and $k(t=1)$ (or just $k(0)$ and $k(1)$) … Anyway, with the current text I really didn't understand how the computations with the look-up tables are done.

The section has been revised. The details of the implementation of sea level changes in the wave model (e.g. look-up tables, Figure 2) have been revised and moved in a technical appendix to simplify the text for the readers. However, I didn't replace $k\_0$ by $k(t=0)$ or $k(0)$ as this is not the time but the vertical discretization in meters. I replaced $k\_0$ by $z\_0$ which is more meaningful for this variable.

3) Sec. 2.4 I think should summaries a bit the method used for the extreme value analysis.

done.

4) L166-167: I would rewrite this sentence, make it clearer that IBI-CCS-WAV_ssh is compared only against buoy and why.

done.

5) L323-326: please rephrase this sentence since I really don't understand what the authors are trying to say – e.g. 70% where does it come from?

The sentence has been revised: "In the southern North Sea, projected changes in both significant wave height and peak period are small (<10 cm, Figure 6a). The small impact of the non-linear interaction of sea level on waves (+3 cm, + 0.05 s) is therefore not negligible."

**Editor :**

- Abstract still refers to M-St-M tidal range of 10m (it is more than this). Please check.

"in average" has been added.

- Fig 1b colorbar would make more sense labelled as "depth difference" or "M2 tidal range"
- Similarly Fig 3 right hand colour bars should be labelled as difference in T, difference in H
- Same on Fig4.
- Fig 8/9 are superficially similar but very different in content. To help readers comparing parts of the paper I suggest titling them "Mean state" and "Extreme condition"
- Fig 10: To improve accessibility please add a key with line colours.
- I agree with Reviewer 2 that section 2.3 is a little confused from about line 133 and needs the wording tidying up. The bit about discretisation and the yellow arrows on the figure are simply "depth including tide is rounded to the nearest 15cm and truncated to a minimum depth of 3m" I think? Whilst depth in the tide-less model is truncated to 6m?

This is true at the surface. But, as the depth discretization follows a geometric series, the depth discretization is not constant (not always 15 cm). The deeper you get, the coarser the discretization (more than 15 cm). A sentence has been included for the deeper regions.

**References**

Battjes, J. A. and Janssen, J. P. F. M.: Energy loss and set-up due to breaking random waves, Proceedings of 16th Conference on Coastal Engineering, Hamburg, Germany, 1978, 1978.