UK Centre for Ecology & Hydrology (UKCEH)

Maclean Building,

Wallingford,

U.K.

16th February 2022

Dear Prof. Gentine,

**Re:** Marthews *et al.*

***Inundation prediction in tropical wetlands from JULES-CaMa-Flood global land surface simulations***

HESS submitted paper https://editor.copernicus.org/HESS/ms_records/hess-2021-109

Very many apologies for the delay in responding to the two reviews received for the paper above. We were only able to see the final reviewer response on 1st February.

Firstly, we would like to thank you very much for sourcing the two Reviewers for this paper: their comments have been extremely insightful and identified several shortcomings to the paper. We are very grateful to have had the opportunity to address and correct these during the discussion period.

We have revisited all parts of the manuscript in the light of these comments and we truly believe that the paper is now very much stronger than our original submission. We have had two rounds of reviewer comments to date, and extensive improvements have been made to the paper both last July and this month. These include the insertion of new analyses and figures (e.g. Fig. 1 which was not in our original submission) and the complete revision of three sections in the Methods and Conclusions that we hope clarify the overall presentation of the paper and argue important points in full that were only briefly mentioned in our original submission.

We hope that the revised version of the paper attached and the comments below answer all remaining reviewer concerns.

Very many thanks again for the time that you have spent considering our paper for publication.

Best regards,

Toby Marthews *et al.*

*Response to specific reviewer comments received*:

Reviewer #2, although he/she submitted the most comments during the first round of review last July, is now very happy with the paper (labelling it "Excellent" for scientific quality in the MS records). He/she has requested a few extra changes in their latest report, which have all been implemented without any modification (reordering figures and rephrasing a few sentences).

For reference, a point-by-point response is included at the end of this letter below (Report #2).

Reviewer #1 has raised several important points that were not fully covered by our responses back in July 2021. He/she is essentially concerned that we have not considered the various model biases inherent in our analysis in sufficient detail, both at the JULES stage and the CaMa-Flood stage of our modelling workflow. As a result of this, my coauthors and I have been through the draft paper in detail again. We did indeed consider model bias and uncertainty throughout our analysis, but on reflection we do agree that this was not made sufficiently clear in our original submission and we have therefore made substantial changes to the new manuscript to address the reviewer's concerns. Essentially, Reviewer #1 made two requests:

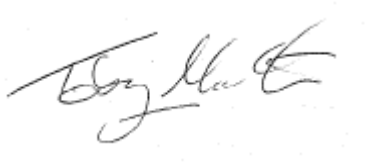
- Reviewer #1 requested "In the methodology section, it is clear that JULES provided runoff outputs. However, it is not clear how accurate JULES runoff was. Although JULES runoff evaluation was published before, as the major driving variable of CaMa-Flood model, it's still worthwhile to e.g., add a full paragraph to summarize JULES' runoff at a global and regional scale (particularly the major inundated regions used in this study)."
    - In addition to the substantial improvements made last July, Section 2.2 in *Methods* has now been expanded to include two entirely new sections: 2.2.1 ("**Validation of land surface runoff**") and 2.2.2 ("**Validation of land surface inundation**") and in these sections we have given extensive details exactly along the lines requested by Reviewer #1. These new sections give summaries of the validation of both runoff and inundation data procured from our models.

- Reviewer #1 also requested: "Also, it will be great to have a full paragraph in the discussion section to discuss the contribution of runoff bias to the CaMa-Flood simulated inundation area bias." and again in a later comment "Discussion section, the bias in the inundation area needs to be mechanistically attributed to multiple relevant factors (e.g., precipitation, runoff) first before the bias-corrections so that one could learn why CaMa-Flood was biased and provide insights into how to bias correct the model through improving model structure, input data, parameterization scheme and so on in the future."
    - We have considered these requests and do agree that we needed to provide more detail on these important issues. We have expanded the Discussion to include a new section "4.1.2 **Quantifying bias in JULES-CaMa-Flood inundation predictions**" where we present the major

factors that we believe contribute to the bias we found in our analyses both in the model and observations of inundation extent. Our belief is that the key factor is whether a wetland may be considered to be groundwater-maintained or derives the majority of its flow from fluvial inundation. The values we have obtained for the statistics *beta-opt* for each wetland are the most indicative here and show clearly, we believe, in which wetlands we might expect the bias to be positive and in which we should expect the opposite (and we have illustrated this in Fig. 7). We have now included a thorough argument of the significance of this and its implications for the assessment (and future development) of models like *JULES* and *CaMa-Flood*.

We hope very much that these new sections form a sufficient response to the remaining concerns of Reviewer #1. As we have argued in the paper, we believe that this research makes a valuable and timely contribution to the current state-of-the-art in the model prediction of global wetlands: we are not aware of any comparable validation of observations *vs* predictions in this field and we believe that our results will, if published, effectively set the standard for future similar studies to follow.

Best regards,



Toby Marthews

UKCEH

*Report #2:*

Minor comments

- In abstract: timely information on inherent biases in inundation data -> inherent biases in inundation prediction and observation

Done

- The new figure 1 makes it clear there are different categories of the wetlands/wetland zones based on their scale. I suggest reorganizing the order of wetlands/zones in table 1 and figures 3-5 according to these categories. Additionally, please add latlong grid/ticks and labels, scale, legend. Revise caption - why "Example"?

Fig. 1 and legend updated (many apologies: I should have put in the scale and tick marks before). I have also reordered the rows in all the tables so that the wetlands are in progression of scale, as requested here (from regional to subcontinental to continental; from west to east).

- By convention, acronyms should be in brackets and full name spelled outside, rather than the opposite. Also, acronyms are still undefined in the abstract.

The text has been searched and the use of acronyms regularized.

- Add "and references therein" to Hoch & Trigg (2019) and Zhao et al. (2017).

Done

- Suggest to rephrase "perhaps the inundation is actually real but for some reason unobserved" to "perhaps inundation actually occurred but was unobserved"

Done - thank you for this!

- Please double check that all italicized terms representing model variables have been defined at first use.

Text has been searched to ensure this.

- Line 65, remove "="

Done