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Reply on RC2

Sara Lindersson et al.

Author comment on "Global riverine flood risk – how do hydrogeomorphic floodplain maps compare to flood hazard maps?" by Sara Lindersson et al., Nat. Hazards Earth Syst. Sci. Discuss., <https://doi.org/10.5194/nhess-2021-136-AC2>, 2021

The author team is grateful to referee Francesco Dottori for providing a thorough, constructive and helpful review, including several comments that indeed will improve the final manuscript, both in terms of general and specific issues. We are very pleased to read that the overall opinion is in support of publication. We have commented on each point below:

General comments

- **RC2:** *"In the conclusions, the Authors state that "Inter-model comparisons like this study do not answer the question of how well the individual flood layers agree with actual flood events". I believe that the paper should provide some provide a better description of what we presently know about the skill of global flood maps. So far, global flood models have been validated and compared only in few regions (Bernhofer et al 2018; Sampson et al., 2015) and model skill has shown to be unsatisfactory in some areas due to limitations of global models and data (e.g. Dottori et al. 2016). On top of that, the present study confirmed the limited agreement of global flood maps, meaning that the overall uncertainty is still quite large. I invite the Authors to elaborate further on this topic, in order to put the intercomparison study in perspective."*
Authors: This is a great idea and we agree that elaborating more on this topic will enrich the manuscript. We will deepen this discussion in the final manuscript, both in section 1 and 5.
- **RC2:** *"In light of these considerations, maybe the Authors could also provide suggestions on how the outcomes of their study can be useful for real-world applications (for instance, should we use ensemble of flood maps as usually done for climate projections?)"*
Authors: Thanks for providing this good suggestion. We agree and will elaborate more on this in section 5.
- **RC2:** *"the authors mention that GFPLAIN approach can be swiftly applied to update floodplain maps whenever new elevation data are available. Perhaps, GFPLAIN could also be applied to map the minor river network (i.e. river basins with area <1000km²), thus providing information on potential flood-prone areas that are generally not included in global flood maps. Perhaps the Autors could elaborate on this point. Do you think that GFPLAIN has the potential to do that, or perhaps there are limitations that could hinder such application?"*
Authors: We agree that this is a very relevant aspect and will highlight this in the final

manuscript. GFPLAIN does cover river basins with smaller areas compared to JRC and GAR. And we also think that this is a relevant potential for hydrogeomorphic maps in general, especially as more fine resolution terrain maps become available.

Specific comments

- **RC2:** *"Section 2.1: according to Table A1, GAR flood maps include (at least partially) the effect of dams and reservoirs, this is something I would mention here."*
Authors: Indeed, this is an important point. This difference is described on L103-L108, but we will rewrite this for clarity.
- **RC2:** *"L159-160: "MAI values, Eq. (1), were then calculated for all the basins in the world that are covered by all three models, resulting in 2776 river basins". My understanding is that larger river basins (e.g. Amazon, Mississippi etc) have been split into sub-basins for this analysis, correct? Can you please provide some information about the average-min-max areas of the river basins analyzed?"*
Authors: Yes, this understanding is correct. We will provide this information as suggested and briefly discuss this aspect.
- **RC2:** *"L230: typo (Vietnam)"*
Authors: We have used the spelling "Viet Nam" throughout the manuscript and figures, as it is still used by the United Nations and by the Vietnamese government. But indeed, the spelling "Vietnam" is more common. If the editors wish, we will change it.
- **RC2:** *"Figure 1 caption: perhaps "Flood exposure in the 26 countries...." is more appropriate here"*
Authors: We agree and will change this in the final manuscript.
- **RC2:** *"L305-307: my understanding here is that spatial distribution of MAI-500 is calculated irrespective of basin area (e.g. small basins count as large basins). Could you please add some justification for this approach?"*
Authors: Yes, you are right. The spatial distribution is based on a local spatial autocorrelation analysis identifying clusters of basins having higher-than-average or lower-than-average model agreement (as described in section 3.2.1, L190-L196). The method treats all basins equally, but larger basins might also have a larger number of neighbouring basins compared to smaller basins (increasing the potential for clusters). We will investigate if this and make sure to elaborate more on this in the final manuscript, in section 3.2.1 and 4.1.2.
- **RC2:** *"L305-307: "Figure 3 provides the spatial distribution of MAI-500 across all 2776 river basins, and local clusters of high and low model agreement basins as identified from the spatial autocorrelation analysis". Could you please specify how "high" and "low" model agreement are defined here?"*
Authors: This is described in section 3.2.1 L190-L196, but we will briefly repeat this in section 4.1.2 for clarity.
- **RC2:** *"Figures 2 and 4: please describe in the caption the meaning of all graphical elements (e.g. do boxes represent standard deviation or quantiles? meaning of crosses and yellow lines, etc)"*
Authors: Thanks for noting this, we will add this to both figure captions.
- **RC2:** *"Figure 3: please add in the legend the meaning of gray areas"*
Authors: Thanks for noting this, we will add this to the legend.
- **RC2:** *"Figure 3 caption: I would delete lines 314-315, these are comments to results that are already in the main text"*
Authors: We agree and will amend the caption accordingly.
- **RC2:** *"L320: "The snow and ice regions in North America" is not a great definition, perhaps "The regions in North America where river flow is influenced by snow accumulation and snow melt", or just "The regions in North America with cold climate"."*
Authors: Thanks for pointing this out, we will change this according to one of your suggestions.
- **RC2:** *"L324; "This can, at least partly, be explained by the same regions being dry in*

the sense that they are snow-covered". Cold or mountain regions can have a dry climate irrespective of snow cover (it is indeed the case of western sector of southern Andes), please rephrase."

Authors: Thanks for pointing this out, you are right. We will rephrase this.

- **RC2:** *"L330-332: "A possible explanation for the low agreement in coastal river basins might be that the individual riverine flood maps differ in how they mask coastal areas. For instance, GFPLAIN tends to mask areas near the coast, while JRC does not." This is not much clear to me. Could you please briefly explain why and how coastal areas are masked out (or not detected) in GFPLAIN flood maps? JRC maps also could miss or underestimate smaller coastal basins due to their high threshold on upstream area."*

Authors: Thanks for noting this. We will explain this more thoroughly in the final manuscript for clarity.

- **RC2:** *"Figure 4a: Why is Siberia included here while Oceania is not? Is it an oversight or done on purpose?"*

Authors: Thanks for pointing this out, this is an oversight. We used the geographical regions as categorised by the HydroBasins dataset, which originally had the name "Australia and Oceania". We will fix this for the final manuscript, perhaps using the continents instead.

- **RC2:** *"Figure 4b: Which definition of stream order are you using? How are coastal basins defined exactly? I looked at the related references but could not find an explanation on these points, so please provide some details"*

Authors: Good point. Some information about this can be found in the Technical Documentation of HydroBasins. We will ensure to clarify these two questions in the final manuscript.

- **RC2:** *"Figure 5: I don't see the reason for including pair-wise correlation between all variables, I suggest leaving only MAI against the other variables (this would also improve the readability of correlation values between -0.25 and 0.25)"*

Authors: This is a good suggestion, and we agree that this would improve the focus and readability of the figure. We will change the figure.

- **RC2:** *"Section 4.1.3: my impression is that the the discussion of correlation values is not fully consistent with what shown in Figure 5 (perhaps because the color scale makes values not easy to distinguish, see my comment above). For instance, it seems that correlations between model agreement and some anthropogenic influence factors (e.g. population count) are stronger than for some climatic factors (e.g. annual precipitation)"*

Authors: Thanks for raising this point, we will change Figure 5 so that the correlation values are more clearly communicated. We will also revise the discussion in section 4.1.3 to ensure consistency.

- **RC2:** *"figure 7: please clarify in the legend (or in the caption) how exposed population bars should be read (e.g. GFPLAIN values on the left, GAR value as shaded bars on the right etc)"*

Authors: We agree that this needs to be clarified, we will do this for the final version.

- **RC2:** *"caption figure 8: I would delete the part: " GFPLAIN and GAR cover ... for the Niger Delta (b)", these are comments to results that fit better in the main text"*

Authors: Yes, you are right. We will delete it in the caption.