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Comment on nhess-2021-136

Francesco Dottori (Referee)

Referee 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-RC2>, 2021

This work provides a detailed comparison between freely available global datasets for mapping flood-prone areas and population exposure. The manuscript is generally well written and structured, and builds on previous efforts in comparing global models. The outcomes of the study might be of interest for researchers and practitioners working on flood risk assessment and management, so I think it should be considered for publication after addressing some issues that I'm listing below.

General comments

- 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.

- 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?)

- 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 Authors 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?

Specific comments

- 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.

- 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?

- L230: typo (Vietnam)

- Figure 1 caption: perhaps "Flood exposure in the 26 countries...." is more appropriate here

- 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?

- 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?

- 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)

- Figure 3: please add in the legend the meaning of gray areas

- Figure 3 caption: I would delete lines 314-315, these are comments to results that are already in the main text

- 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".

- 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.

- 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.

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

- 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

- 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)

- 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)

- 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)

- 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