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# Reply on RC1

Heiko Apel et al.

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Author comment on "Brief communication: Impact forecasting could substantially improve the emergency management of deadly floods: case study July 2021 floods in Germany" by Heiko Apel et al., Nat. Hazards Earth Syst. Sci. Discuss., https://doi.org/10.5194/nhess-2022-33-AC1, 2022

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Author response to the comment of the anonymous referee #1 on "Brief communication – Impact Forecasting Could Substantially Improve the Emergency Management of Deadly Floods: Case Study July 2021 floods in Germany" by Heiko Apel et al., Nat. Hazards Earth Syst. Sci. Discuss., https://doi.org/10.5194/nhess-2022-33-RC1, 2022

We thank the referee to take the time to review our manuscript, and the general judgement that it is a valuable contribution. However, we cannot follow the critical comments, which are mainly based on the wrong assumption that the model is not validated.

As we describe on page 5 in lines 122-132 and shown in figure 2 the model is validated against the actual flood event of 2021. We compared the model results to the latest and most valid mapping of the flood extent and calculated the binary flood pattern metric $F^{(2)}$, which is a standard for the quantification of hydraulic model performance. This evaluated to a high value of 0.845. Moreover, we validated the simulated inundation depths against 75 surveyed high flood water marks, which resulted in a minimum bias of 0.09m, and a RMSE of 0.30m. Thus, the model setup for this river reach, including the assumption taken for the river bed, is well validated. In fact, it is much better validated than many other hydraulic simulations, for which the validation data as presented here is missing.

We also regard the suggested sensitivity analysis of river bed elevations and roughness as an exercise, that does not create additional knowledge. The mathematical and numeric foundation of the RIM2D model has been shown in many applications and papers using LISFLOOD-FP, to which RIM2D is identical in terms of numerics and hydraulic equations. To cite just a few papers, we refer to (Bates, 2022;Wing et al., 2021;Shaw et al., 2021;Bates et al., 2021;de Almeida et al., 2018;Savage et al., 2016;Stephens and Bates, 2015;de Almeida and Bates, 2013;Almeida et al., 2012;Bates et al., 2010). Thus we see no need and particularly gain in performing sensitivity analysis.

Regarding the flood impact impacts: we chose the approach of Jonkman and Penning-Rowsell (2008) to illustrate the potential gain that is created using the hydraulic model for flood forecasting. Of course, other approaches can be used, which might result in slightly

different maps. But the main message is here that with the proposed approach, these kind of maps can be provided rapidly to flood emergency managers. This is the decisive message here and much more important than potential differences in the estimation of human instabilities caused by different methods. And of course, other impact indicators like the mentioned car instability, or potential structural damage to houses can additionally be provided. We have actually done this for cars using the approach of Bocanegra and Francés (2021), but it is not shown because of the limitation to 3 figures in the brief communications format. But again, the main message is here, that these impact forecasts are only possible using the hydraulic model for flood forecasting. Without this approach no spatial explicit impact forecasting would be possible at all. The shown impact on human instability is used to illustrate this, and is not meant as the only possible impact to be forecasted. We will stress this point in more detail in a revised version of the manuscript.

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