

Response to Referee 1

We are thankful for Referee 1's constructive and valuable feedback. We have assessed the Referee's concerns in the manuscript and detail our individual responses in the following. The Referee's comments are in a yellow background, and our responses are beneath.

The authors present an interesting article on a topic which is well-known to most flood modelers, but what is under-researched so far. In that sense, this article is very welcome and the analyses are very systematic, well structured and well explained. I only have several minor points where the authors should comment on:

We thank the referee for his feedback and for acknowledging the importance of the study.

- Mitigation strategies are in the title, but only investigated a bit in chap. 3.5; the authors should check whether that should remain in the title; should they want to leave it in the title, a bit more investigations should be done

We thank the referee for this observation. We agree that the major focus is not about designing mitigation strategies. Still we argue that one of the main outcomes of this study is that individual culverts have a larger impact on flood dynamics than others, which allows for mitigation strategies. We have changed the title to:

Culvert Blockages in 2D-Hydrodynamic Flash Flood Modeling: Quantifying the Impact on Flood Dynamics and Mitigation Strategies

- L. 31f: I suggest here to add that the 2 methods are for the computation of the losses or are runoff generation approaches

We have rephrased the sentence to clarify that the two stated methods are for the runoff calculation only.

- Fig 1: please show both creeks in Fig 1, also Würzburg; I suggest to use the English terms, eg Bavaria; please check whether the Reichenberger and Guttenberger Bach can be shown more clearly

Fig. 1 indeed lacked some necessary information. We have added the two creeks, changed the labels of the states into English and added the location of Würzburg. We thank the referee for these suggestions.

- L. 118: comparatively dry for Bavaria, eg in Berlin / Brandenburg the precipitation is ~500 mm; 800 mm is average for Germany -> rephrase

We thank the referee for pointing out this imprecision. The area is indeed only comparatively dry for bavaria, and not for Germany. We have rephrased that the region is frequently affected by droughts, but still the catchment experienced several minor flash floods in recent years.

- Chap 2.2: please comment on even larger events eg for the Starkregen Gefahrenkarten which are currently produced in the federal states 90 or 100 mm in 1 hour is investigated; this can be done here or in the discussion later, limitation part; how would more extreme events impact your results ?

We have included more information on this issue in the limitation section. Since the effects of the blocked culverts already decreases in the HN50 and the HN100 events, they are expected to further diminish for even more extreme rainfall scenarios.

- L. 150: would you expect better results with a finer mesh ? grid convergence, please comment on this

A finer mesh resolution only marginally changed the results, but resulted in significantly higher computation costs. This information is added to the manuscript in the section "Mesh Generation and Parameters".

- L. 151: mention the resolution of the DEM

The DEM has a resolution of 1m. This information is added to the manuscript.

- Headline 2.4: wouldn't it be better to call this Plausibilisation of the Model or similar ? see also line 491

We thank the referee for this suggestion. We agree that calling it a model plausibilisation is more suitable in this context and have adapted the manuscript accordingly.

- Chap. 2.5: comment here or in the discussion; you could also link Telemac2D with a drainage model; would that have advantages, possibly produce more realistic results ?

There are currently some developments in linking Telemac2D to drainage models. However, this so far only accounts for vertical drains and overflows, and not for horizontal ones, as we have in culverts. Therefore, this would first require further development to be applied here. Once implemented, this would possibly enhance results, as it could represent the time lag between inlet and outlet, as well as allows for modeling of bifurcations or changes in geometry. However, the results in this study are not expected to change much when taking these into account. Most culverts in the study are straight, rectangular or circular pipes and the time lags would most likely only inflict changes in the timing of the inundation and less in the extent.

We have added this reasoning to the limitation section.

- Chap. 3.3: I suggest to include 1, 2 or 3 cross sections and the related figures from the appendix here in the paper; the cross sections not shown and the related text then should occur in the appendix

We thank the referee for this suggestion. We have moved the descriptions of the other cross-sections to the Appendix and only present the critical cross-section 3 (now cross-section 2, since the former

cross-section 2 was removed from the study) in this section. This should improve the clarity of this section.

- Could one think about some statistical approaches to determine when which culvert is blocked to what extent? include that also in the manuscript

In our opinion, these statistical approaches would need to be based on laboratory experiments and would be strongly dependent on different factors such as topography, flow characteristics at the culvert, and debris availability. Especially debris availability is a parameter that can also vary temporally within a catchment based on the season, agricultural period, or logging activities. We have added some considerations about this in the Limitations section and in the Conclusion and Outlook.

- Can't one overall say the impact of the blockage is not that big except some local effects? Should you agree, formulate that more clearly, especially in the conclusions and abstract; this would not mean that the paper is not good or not novel, but would provide a valuable information to readers and flood modelers

We agree that we should have more clearly formulated that the blockage causes more local effects. We have added to both the abstract and the conclusion that the effects are more local, but rather small at the catchment scale.

There are further minor points in a pdf attached; no need to comment on them

We thank the referee to also point out further points in the pdf and have made the necessary changes.