Response to Referee 3 / Reviewer 1

We are thankful to Referee 3 for taking the time to once again assess our submission and provide constructive and valuable feedback. We have addressed 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 paper has been significantly improved. However, there are still a couple of minor points that should be addressed before the paper can be accepted.

- Section 2.4: "plausibilisation". I could not find this word in any English dictionary. Perhaps the authors can replace it by "plausibility assessment" or "plausibility check" or something similar, both in the section title and throughout the text. Besides, I don't think it is necessary to use the expression "the plausibilisation event" every time, just call it "the event".

The referee is correct in pointing out that "plausibilisation" can not be found in any dictionary. We thank the referee for suggesting "plausibility assessment", which we have adopted in the manuscript. We also no longer use the term "plausibilisation event".

- In Section 3.3, I reiterate that the presentation of results can be slightly summarized. For example, I don't think that each of the plots H20-H100 deserves a bullet point with a separate description. The authors can just write an overall comment, since the trends are quite similar.

The referee is correct that the HN20-HN100 events can be better described by simply explaining the overall trend. We have therefore summarized those events in one single bullet point.

- In Section 3.4, the authors should add a general comment about how the relative differences are influenced by the denominator (i.e. the flooded area, which increases with the return period). For example, for the case BR=0.8 and TR=0.8 and focusing on the "resind" land use, for H20 and H30 the relative differences are 16.4% and 13.2%, respectively, while the absolute differences 388 m^2 and 458 m^2, respectively. My point is that the scenario with the largest difference in the inundated area may not necessarily be the same in relative and absolute terms, and this should perhaps be mentioned in the text for the sake of completeness, as it may be relevant for flood mapping applications.

We thank the referee for adding this important observation. We have added a statement regarding this issue to put our results into a better context.

Response to Referee 2 / Reviewer 2

We are thankful to Referee 2 for taking the time to once again assess our submission and provide constructive and valuable feedback. We have addressed 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.

I appreciate the effort the authors have made to address my (numerous) requests for clarification, as well as those raised by the other three reviewers. Many of the issues I previously raised have been clarified or further elaborated in the revised version of the manuscript, which in my opinion represents an improvement compared to the earlier version. Nevertheless, the authors will hopefully excuse me if a few points still require clarification. Some of these arise from the revisions themselves, while others remained partially unresolved from the previous version.
For clarity, I list them below.

1. Figure 1
In Figure 1 the cross-sections (drawn in green) are somewhat difficult to distinguish. It would be helpful to highlight them more clearly in the figure. When they are described in the text, it might be helpful to emphasize more clearly that the cross-section no. 2 (previously no. 3) is not located along the ICC2 culvert but rather along a street in the centre of Reichenberg. Consequently, when water flow is present at this section, flooding conditions have already started. Clarifying this point would help the reader understand the large difference in discharge observed at this section for HN = 5 (see Figure 6).

We acknowledge that Figure 1 contains a lot of information, and therefore, some information is easier to distinguish than others. We have tried different colors for the cross-sections, but have concluded that changing the color would clash with the other colors shown for culverts or streams, or the general colors from the OSM basemap.
We also agree that it is crucial to stress that cross-section 2 is located at a street in Reichenberg, and we have added this information in section 3.3 to further clarify this point.

2. Figures 3 and 7a
These figures show the maximum water depths for the plausibilisation event (Figure 3) and for the HN5 event without blockage (Figure 7a). Since these represent maximum water depths, one might expect the flooded areas to remain connected to the stream network (or to roads that effectively become flow paths after the blockage of some culverts). However, particularly in Figure 7a, some flooded areas appear to be completely disconnected from the others. It would be helpful if the authors could clarify how water reaches these locations.

This is explained by two reasons. First, we set a lower limit of 3 cm to show the maximum inundation. This is done because, for very low thresholds, the displayed inundation area would appear significantly larger and distract from the more crucial inundation. However, this can lead to disconnected areas if they were connected by water depths below the threshold. Second, due to the rain on grid method, water can accumulate in minor topographical sinks. Since the mesh must be coarser outside the main flow paths to save computational resources, some small areas may be topographically disconnected from the main flow paths at low water depths. Even

though this is a slight model imprecision that prevents water from draining into the main flow paths, the volumes of these small pondings are negligibly small.

3. Table 3
Table 3 indicates that in some cases (for example HN5 TR = 1.0 or 1.2) the peak discharge is slightly higher than the value obtained for TR = ∞. It would be useful to better understand the reason for this behaviour. In other cases the peak discharge slightly decreases as TR increases (for example HN30 TR = 1.0 gives Qc = 14.7 m^3/s, whereas TR = 1.2 gives Qc = 14.5 m^3/s). I realize that these differences are small; however, if they fall within the numerical or modelling uncertainty (e.g. implying that the first decimal place may not be significant), it might be worth clarifying this explicitly, as similar differences of the order of 1–2% are discussed in Table 3.

Our results show that the timing of the blockage of some culverts can have a minor impact on hydrographs, as the blockage first creates a retention effect but can then also cause an increased water release if the tunneled object is overtopped. Therefore, this changes the propagation and, therefore, superposition of different flood waves from sub-catchments. This can also result in an increased discharge peak. However, we agree that these changes are small and that simple model uncertainties can also not be ruled out as a cause. Therefore, we have added both reasons to the manuscript.

4. Line 426
"One of the additionally blocked culverts in the TR = 1.2 scenario is located just downstream of cross-section 3." In Figure 1, however, the culvert indicated as particularly critical (shown in black) appears to be located upstream of cross-section 3 rather than downstream. A similar statement is made in line 433, referring to a "critical culvert downstream of cross-section 3". It would therefore be helpful to check the consistency between the text and Figure 1 and clarify this point.

The referee is correct that the critical culvert is located just upstream of cross-section 3. We thank the referee for this precise observation and have changed the manuscript accordingly.

5. Lines 450–451
"For HN50, the hydrographs remain nearly indistinguishable across all blockage scenarios. Only the initially blocked scenario shows a slightly attenuated discharge peak." This behaviour is not entirely clear to me. Figure 6 shows the discharge hydrographs passing through cross-section 2, which is located along a street in the centre of Reichenberg. It is therefore not clear how an earlier blockage of a culvert could lead to a even slightly reduced discharge at cross-section 2. I would kindly ask the authors to attempt to provide an explanation for this behaviour. If these small differences are instead within the range of modelling approximations or numerical artefacts, it might be useful to state this explicitly and possibly avoid over-interpreting them.

The reasons for the attenuated discharge peak for the initially blocked scenario align with our reply to comment 4. Different timing results in different water retention and release, leading to differences in the propagation and superposition of flood waves from subcatchments. However, we agree that these hydrographs in Figure 6 might have been over-interpreted, and therefore, we have summarized the important trends for the hydrographs of the HN20-HN100 events in one bullet point here.

6. Lines 453–454
A similar comment applies here, where the manuscript states: "In the HN100 event, the

discharge peak in the initially blocked scenario is even more flattened compared to the HN50 case." It would be helpful if the authors could clarify the mechanism leading to this behaviour.

See our reply to comment 5.

7. Line 689
Please remove the word "later".

We have removed the word.

8. Figure C6
The hydrographs shown for HN = 10 and especially HN = 5 appear to be very delayed. In the latter case the peak has not yet been reached after more than 9 hours, although the figure refers to cross-section 6, which is located relatively far upstream in the basin ("Cross-section 6 lies upstream of Reichenberg along the Guttenberger Bach. Only one upstream culvert, identified during the field campaign, is present... It is not blocked in any of the triggered scenarios."). It would be useful if the authors could provide an explanation for this behaviour, as it appears somewhat unusual and may raise questions regarding the interpretation of the simulations.

The upstream catchment of cross-section 6 is mainly forested land, with a higher infiltration capacity and therefore reduced surface runoff. This then leads to a delayed hydrologic response from the upstream subcatchment. We have added this to the manuscript.

Final remark
Overall, the revised manuscript represents an improvement compared to the previous version. Addressing the points listed above would further improve the clarity of the manuscript and help the reader better interpret the results.

We would like to thank the referee again for their insight and for helping us improve the quality of the manuscript.