Authors' responses to comments of Reviewer #1:

We appreciate your review and comments on our manuscript, "*Accumulation-based Runoff and Pluvial Flood Estimation Tool*". Your feedback is valuable to us, and we will make the recommended revisions accordingly. We provide detailed responses to each of your comments below.

In the manuscript titled "*Accumulation-based Runoff and Pluvial Flood Estimation Tool*", the authors present a novel and improved raster-based model to represent key hydrodynamic variables such as maximum inundation depth, maximum flow velocity and maximum specific discharge. The model results are compared against those from two 2D models. The raster-based model achieves a level of accuracy comparable to both 2D models while significantly reducing computational cost. The topic is relevant and timely, and the manuscript is generally clear and well-structured. Overall, I consider this work an interesting and useful contribution to flood modeling and a potential tool for real-time forecasting. For these reasons, I recommend the manuscript for publication in GMD after minor revision.

General comments:

Lines 39-47: Several 2D models implemented on GPUs can achieve faster-than-real-time performance even for large computational domains, with efficiency sufficient for real-time forecasting. However, this performance strongly depends on the characteristics of the simulated case. The main limitation arises when large domains include localized features (e.g., gullies, small rills) that require fine spatial resolution, leading to small time steps and many operations. I suggest clarifying these situations in the manuscript, as the proposed raster-based model could represent a valuable alternative under such conditions.

Thank you for pointing this out. We will add a brief section on this highlighting the fact that this can have a substantial impact on the performance of 2D hydrodynamic models.

Lines 56-60: I suggest emphasizing the novelty of the work in this paragraph. Highlighting how this approach differs from existing methods would help readers better understand the main contribution of the study.

Thank you for pointing this out. We will elaborate a bit more on the novelty of AccRo already here.

Section "*Introduction*": I recommend adding a short paragraph at the end of the *Introduction* to briefly outline the structure of the manuscript, summarizing the content of each section.

We will add a short paragraph like: 'The Paper is structured as follows. In section 2 we describe the methodological details of the AccRo as well as the validation framework we used to verify AccRo output in comparison to 2d-hydraulic models. In section 3 the results of the validation are presented. Discussion of the findings and suggestions for possible further improvements are provided in section 4. The paper ends with a conclusion section.'

Figure 6: The figure illustrates the details of the test cases. However, I recommend including a more detailed representation of cases (a) and (b), indicating relevant dimensions such as length and width. This would improve the clarity of the test case setup and facilitate reproducibility.

We will add more details regarding dimensions etc. in Figure 6.

Table 2: The table presents results from both 2D models and the raster-based model. However, two of the three simulations using RIM2D are unstable, and the remaining simulation produces results that differ substantially from the others. It is unclear how the model can be unstable for an analytical case. The authors should consider either using alternative software, modifying the simulated case, or removing the RIM2D column entirely, as the results are not informative when the model is unstable, and in the stable configuration, one of the reference 2D models provides results significantly different from the other models.

Actually we think that already the information that RIM2D and HydroAs are in some cases not stable, whereas AccRo is, might already be a result. However, we will emphasize this in more detail in the text. In addition, we will get in touch with the developers of RIM2D in order to find a configuration which might be a bit more stable. Since we include both models for comparison in the real world case as well we wanted to have the same setup in the design case to be consistent o our analysis pathway.

Section "*Discussion*": The authors compare model results using the Figures 7, 8, 9, 11, etc., but the analysis is entirely qualitative. I recommend including at least one quantitative performance metric (e.g., Mean Absolute Error (MAE) or Root-Mean-Square Error (RMSE)) to provide a clearer comparison between models. It is not necessary to compute these metrics for all variables, but, for example, MAE, Peak Percentage Difference, or Peak Time Difference could be reported for the discharges in Figure 11. These metrics would strengthen the discussion.

Thank you for pointing this out. We will add some more quantitative performance metrics for our results presented, as suggested.

Section "*Discussion*": I suggest adding a table summarizing the computational cost for each model and test case. This would make the discussion of computational efficiency clearer and more concise.

Very good suggestion. We will add a table with computation times and computation systems

The abstract states that "*… AccRo is a valuable tool for assessing pluvial flood hazards*." but the conclusions note limitations regarding temporal development and assumptions of constant velocity. I suggest revising the last sentence of the abstract to better reflect these limitations.

Thank you for pointing this out. We will revise the sentence.

Specific comments:

Lines 10-16: I recommend homogenizing verb tenses for consistency. For example, the authors alternate between "*we developed…*" and "*we find…*" within the same paragraph.

We will homogenize verb tenses

Figure 1: The variable *L* is included but not defined. If it represents cell length, a uniform notation should be used, as the same variable is defined as *l* in the text.

L is the dimension length and l is the cell size. The definition of both parameters is provided in Table A1: list of variables. We will make sure that this becomes clearer and once more check the text for uniform notation of variables.

Equation 3: Values “0.02*m*” and “0.15*m*” should include a space between the number and the unit, and the unit should not be italicized, consistent with the formatting used elsewhere in the manuscript: “0.02 m” and “0.15 m”.

We will include spaces and change the format.

Figure 3: Values for ∑s are included but units are not specified. The same applies to s_{max}.

We will specify the units

Line 446: The authors state “*… (also for other events and test cases not included in this study).*” I recommend either including these additional results in an Appendix, together with the corresponding references (if any), or removing this sentence.

We wanted to show that on top of the analysis framework presented, we meanwhile got a lot of data and test case where we compare AccRo with 2d-Models. However, since we do not always have the setup with the 3 models we did not want to include the detailed results in the manuscript in order to keep the consistency of the evaluation framework presented here. Hence, we will remove this sentence.

Technical corrections:

Line 7: Replace “*with two-dimensional hydrodynamic models, …*” with “*with 2-dimensional hydrodynamic models, …*”.

Will be changed accordingly.

Line 13: Replace “*state-of-the-art two-dimensional*” with “*state-of-the-art 2-dimensional*”.

Will be changed accordingly.

Line 47: Replace “*Reinecke et al., 2024*” with “*Reinecke et al, 2024*”.

Will be changed accordingly.

Line 164: Include a space between ∑s and “*change*”.

Will be changed accordingly.

Figure 8: Add a period at the end of the figure caption.

Will be changed accordingly.