Dear Referee #1,

We thank you for your time to review our paper and for the well-considered comments, which have helped us improve and better scope the discussion and conclusions sections of the paper.

Below, we will repeat each comment (italic font) and reply directly below it (standard front). After each reply, we flag the associated changes applied in the revised paper to ease the re-review.

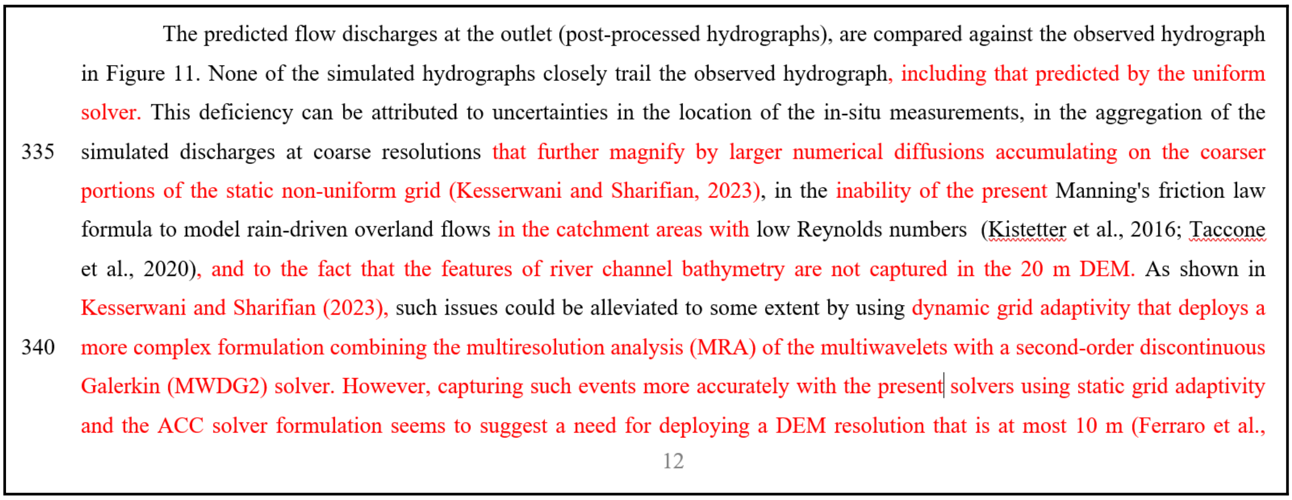
Best wishes,
Georges Kesserwani and Mohammad Kazem Sharifian

The manuscript titled "LISFLOOD-FP 8.1: New GPU accelerated solvers for faster fluvial/pluvial flood simulations" deals with the upgrade if the well-known LISFLOOD hydrodynamic simulator, using parallel programming and specifically the GPU capabilities in order to speed up the simulations. Except of the parallelization, the authors demonstrate the use of a smart grid coarsening way, which also speeds up the simulations but with an accuracy sacrify. The paper is well written and well structured and characterized by novelties. Referee #1, appreciatively, recognised the aim, scope and novelties of this contribution, suggesting well-considered technical corrections that have been addressed as described below.

I would suggest to be published after some minor technical corrections:

1) It is not consistent to compare all the numerical results (uniform, non-uniform 10^-3, non-uniform 10^-4) against the observed data. Since the non-uniform is an simplification of the uniform detailed grid, the latter should be the base of comparison and the observed values should be given as a supplementary material, not substantial for the core of the paper. We agree with Referee #1 about this comment. Already, in the original manuscript, the quantitative results used the uniform detailed grid as the base. For consistency, the qualitative results have been revised to refer to the uniform detailed grid as the base too. As for the observed values, we have kept them along with the results of the uniform grid as a useful indication of the validity of the base model.

The situation in which the non-uniform grid performs better than the uniform grid is rather a coincidence. I assume that the non-uniform grids introduce a kind of artificial diffusion, while similar results could be derived by the uniform grid with bigger values of Manning coefficients. We have also elaborately discussed that the fact the non-uniform grids introduce artificial diffusion and cited a paper that confirms the assumption of Referee #1. The associated revised text can be seen in the box below, in the discussions of the discharge hydrographs in Figure 11:



The predicted flow discharges at the outlet (post-processed hydrographs), are compared against the observed hydrograph in Figure 11. None of the simulated hydrographs closely trail the observed hydrograph, including that predicted by the uniform solver. This deficiency can be attributed to uncertainties in the location of the in-situ measurements, in the aggregation of the simulated discharges at coarse resolutions that further magnify by larger numerical diffusions accumulating on the coarser portions of the static non-uniform grid (Kesserwani and Sharifian, 2023), in the inability of the present Manning's friction law formula to model rain-driven overland flows in the catchment areas with low Reynolds numbers (Kistetter et al., 2016; Taccone et al., 2020), and to the fact that the features of river channel bathymetry are not captured in the 20 m DEM. As shown in Kesserwani and Sharifian (2023), such issues could be alleviated to some extent by using dynamic grid adaptivity that deploys a more complex formulation combining the multiresolution analysis (MRA) of the multiwavelets with a second-order discontinuous Galerkin (MWDG2) solver. However, capturing such events more accurately with the present solvers using static grid adaptivity and the ACC solver formulation seems to suggest a need for deploying a DEM resolution that is at most 10 m (Ferraro et al.,

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And also in the discussions of the water level time series in Figure 21, as shown in the box below:

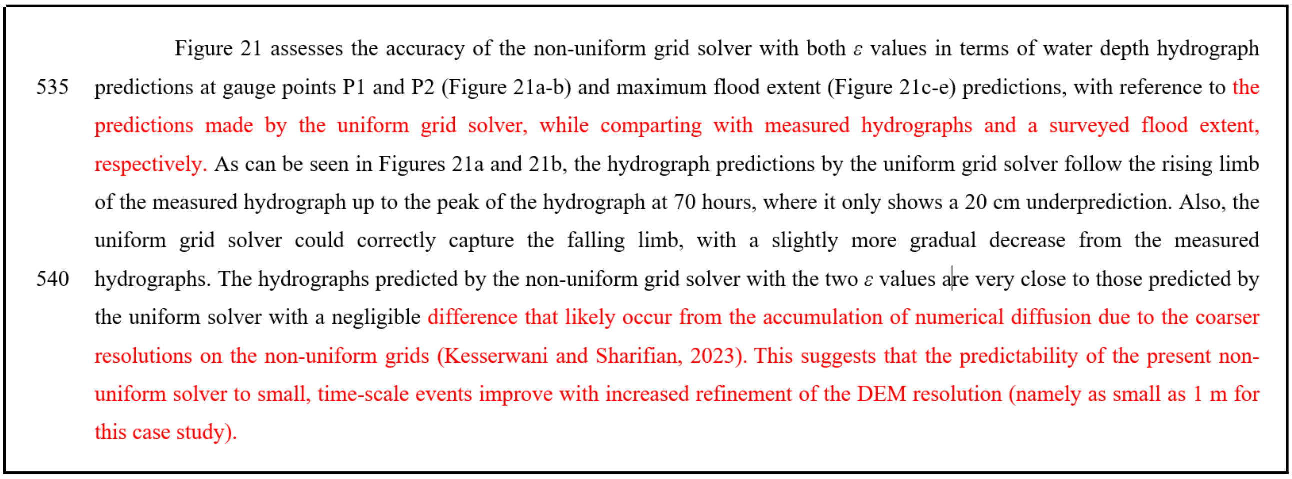
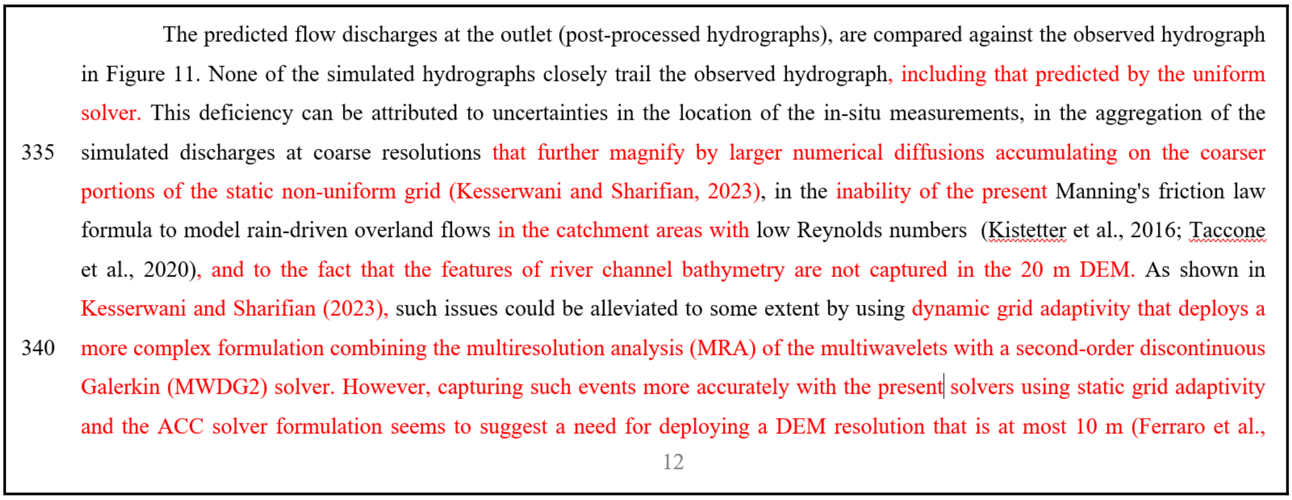


Figure 21 assesses the accuracy of the non-uniform grid solver with both ε values in terms of water depth hydrograph predictions at gauge points P1 and P2 (Figure 21a-b) and maximum flood extent (Figure 21c-e) predictions, with reference to the predictions made by the uniform grid solver, while comparting with measured hydrographs and a surveyed flood extent, respectively. As can be seen in Figures 21a and 21b, the hydrograph predictions by the uniform grid solver follow the rising limb of the measured hydrograph up to the peak of the hydrograph at 70 hours, where it only shows a 20 cm underprediction. Also, the uniform grid solver could correctly capture the falling limb, with a slightly more gradual decrease from the measured hydrographs. The hydrographs predicted by the non-uniform grid solver with the two ε values are very close to those predicted by the uniform solver with a negligible difference that likely occur from the accumulation of numerical diffusion due to the coarser resolutions on the non-uniform grids (Kesserwani and Sharifian, 2023). This suggests that the predictability of the present non-uniform solver to small, time-scale events improve with increased refinement of the DEM resolution (namely as small as 1 m for this case study).

2) In L335-340 the authors state that a possible cause of the discrepancy between the modelled and the observed hydrograph is the low Reynolds numbers of the flow. However flow ranges between 20 and 100 m^3/s. With these values is impossible to have low Reynolds numbers in the channel. The authors probably mean the rainfall-driven overland flow in the catchment and not in the hydrographic network. The Referee is right about this correction. The text has been revised, as shown in the box below:



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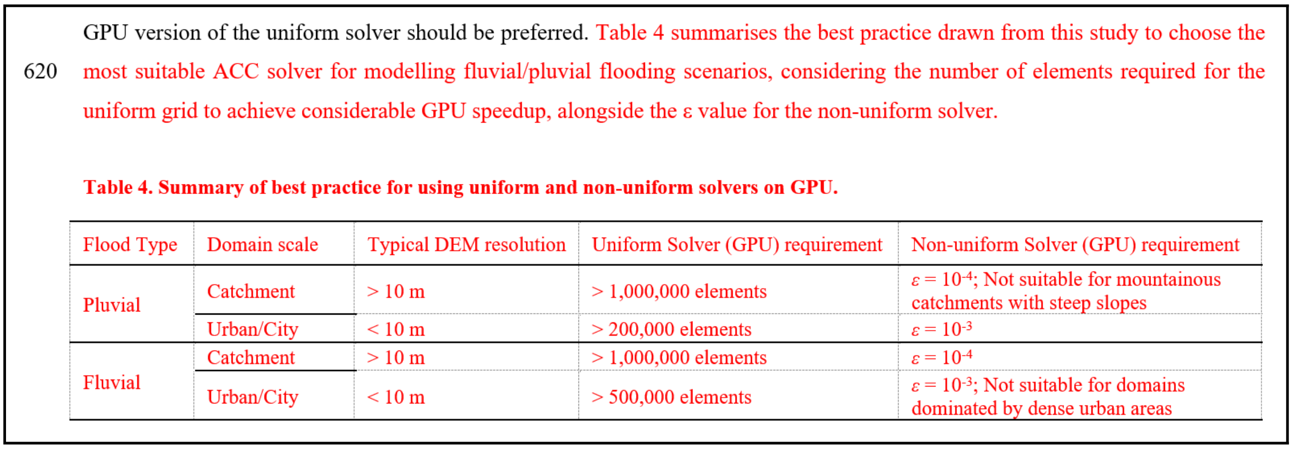
3) I really appreciate that the authors are not charatcerized by arrogancy and they give very rational conclusions avoiding global suggestions. However since the paper is mainly demonstrates new tools it might be better to give a more clear practice guidance for the modeller and how to handle every DTM resolution. A table with these suggestions might be good alternative which also highlights the main findings of the work. We have added a table dedicated to giving practical guidance for modellers recommending the best setting possible in relation to the DTM resolution and the property of the modelling project in question. The table and the associated revised text can be seen in the box below:



GPU version of the uniform solver should be preferred. Table 4 summarises the best practice drawn from this study to choose the most suitable ACC solver for modelling fluvial/pluvial flooding scenarios, considering the number of elements required for the uniform grid to achieve considerable GPU speedup, alongside the ε value for the non-uniform solver.

Table 4. Summary of best practice for using uniform and non-uniform solvers on GPU.

Flood Type	Domain scale	Typical DEM resolution	Uniform Solver (GPU) requirement	Non-uniform Solver (GPU) requirement
Pluvial	Catchment	> 10 m	> 1,000,000 elements	$\varepsilon = 10^{-4}$; Not suitable for mountainous catchments with steep slopes
	Urban/City	< 10 m	> 200,000 elements	$\varepsilon = 10^{-3}$
Fluvial	Catchment	> 10 m	> 1,000,000 elements	$\varepsilon = 10^{-4}$
	Urban/City	< 10 m	> 500,000 elements	$\varepsilon = 10^{-3}$; Not suitable for domains dominated by dense urban areas