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Comment on hess-2021-470

Anonymous Referee #1

Referee comment on "A Time-Varying Distributed Unit Hydrograph considering soil moisture content" by Bin Yi et al., Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2021-470-RC1, 2021

The manuscript proposes a Unit Hydrograph estimating travel times including also the time-varying rainfall intensity and soil moisture content information.

The topic is surely interesting although is well crystallized in literature and in practical hydrology.

Unfortunately, the manuscript has some drawbacks that do not allow me to suggest its publication. I see practical, technical, and theoretical issues to be addressed.

Firstly, the text (language, structure, figure captions, typos) should be significantly improved since presently, it does not allow a full understanding of described methods.

It is not clear (although the title is clear) if the manuscript proposes a IUH model, that is a rainfall-runoff method, or a simplified routing approach. Reading the title and the introduction it seems the first option, looking the case study the second one.

As recalled by the authors in the Introduction the IUH approach assumes some hypotheses (i.e. linear system, time invariant, rainfall spatially homogeneous) that of course are far from the watersheds real behavior, however this is an accepted compromise in challenging hydrological studies (i.e. ungauged basins). In my opinion there is a contradiction in trying to make non-linear a linear approach, maybe it is better to use a non linear approach or an other approach. If a time-varying rainfall and spatial distribution information are introduced, the nature of IUH is lost and we do not know any more what we are implementing. In my experience I also tried to force the IUH concept,

however I limited it to the estimation of the hillslope velocity cell by cell indeed further adaptation (i.e. empirical estimation of channel velocity) would have been in contrast to the IUH theoretical definition (Grimaldi et al. 2010; 2012).

Most importantly, it should be clarified the practical context on which we are referring. Personally, I consider the WFIUH approach particularly brilliant in small and ungauged basin application since it optimizes the topographic information and since the IUH approximations are coherent with by the basin dimension. In other contexts, maybe, other approaches should be preferred (semi-distributed or fully distributed models).

The present manuscript does not clarify these aspects. It provides a case study with a large basin, eliminating the hillslopes (including an area threshold of 1 km2), assuming calibration, increasing the number of parameters: without a clear context it disorients the reader. I would expect to see nine case studies (each sub-basin) in order to evaluate the expected improvements of IUH given by the soil moisture content, in ungauged contest. If the practical aim is different (large gauged basins) the comparison should be performed with other models underlying the added value of the proposed approach.

Grimaldi, S., Petroselli, A., Alonso, G., Nardi, F. Flow time estimation with spatially variable hillslope velocity in ungauged basins (2010) Advances in Water Resources, 33 (10), pp. 1216-1223.
Grimaldi, S., Petroselli, A., Nardi, F. A parsimonious geomorphological unit hydrograph for rainfall-runoff modelling in small ungauged basins (2012) Hydrological Sciences Journal, 57 (1), pp. 73-83.