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Hydrology and Earth System Sciences Discussions

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Interactive Comment

Interactive comment on “A variable streamflow velocity method for global river routing model: model description and preliminary results” *by* T. Ngo-Duc et al.

Anonymous Referee #2

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1. General comment

This paper addresses the improvement of TRIP, a very simple routing model designed for the global scale. The goal is interesting and in the scope of HESS, and the paper is overall well written.

The new version of TRIP, TRIP2.0, includes two innovations:

- a representation of the delay related to the transfer of a fraction of runoff (as predicted by an input land surface model) through a groundwater reservoir. This

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innovation is described but it is not implemented and tested, and should thus be excluded from the ms.

- a way to describe the variations of river flow velocity with discharge. This work follows several applications of Manning's equation in global river routing models, but it uses the empirical relation proposed by Dingman and Sharma (1997) to characterize the roughness coefficient. This approach is interesting, as this parameter needs otherwise to be either set a priori or calibrated. Previous attempts in this direction should be mentioned, however, such as the one by Vorosmarty et al. (1989) in South America, based on an empirical formula by Leopold et al. (1964).

If the idea is appealing, especially in the framework of modeling the global water cycle, the discussion is rather weak, leading to conclusions (in the conclusion section and the abstract) that are not totally supported by the shown results, and that might be too optimistic regarding the real interest of the method. The paper would also deserve a better assessment of the skills of TRIP2.0, and I thus recommend for a major revision of this paper in this regard. In particular, the inclusion of the sensitivity study mentioned at the end of the Discussion section would really increase the value of paper, and it is possible without making the paper too long, as its present version is short, and the description of the groundwater parameterization could be removed.

2. Specific comments

The conclusion that the variable velocity developed in TRIP2.0 improves the hydrographs simulated for rivers that have clear short-term fluctuations of river discharge is not evident, with the noticeable exception of the Mekong (used twice, in sections 4.1 and 4.2). In particular, the improvement is arguable regarding the Danube, as the variability is overestimated with TRIP2. On the other hand, it seems to me that the general shape of the hydrograph is markedly improved for the Lena, even if the phase is incorrect, but this might be related to the dynamics of the snow pack. Generally, the

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discussion of the results is limited, and the Columbia for instance raises many questions.

More importantly, the criteria to assess the quality of the simulations are few, and the study does not use the most important ones in hydrology, namely the Nash-Sutcliffe efficiency and the bias. The bias is extremely important in the framework of the variable velocity parameterization, which relates velocity to discharge. As a consequence, a bias on discharge deteriorates the simulated velocity. It might help to explain the overestimation of short-term frequencies in the Danube and the African rivers. Besides, the authors write that the simulated and observed discharge are “practically un-correlated” in these African river and in the Columbia, but it seems very exaggerated in view of the hydrographs in Figure 6. Yes, the peak flows do not coincide, yes the short-term fluctuations are poorly reproduced (either overestimated or underestimated), but the seasonality is not completely missed. In any case, one cannot write that two signals are uncorrelated with the reported values of R^2 (Table 2). But the authors should firstly check the R^2 values in Table 2, as some of them exceed 1.

The discussion is also weak on the limits of the approach, whereas many simplifying assumptions are performed: rectangular shape of the river sections, formula by Arora and Boer (1999) to estimate the related mean river width, choice of the meandering ratio, flow direction map with small and negative slopes brought back to a minimum slope of 1 mm / km. Logically, the grid points where such a correction is performed often coincide with major floodplains, as in the Nile, Amazon, Parana, or in the lowlands of the Arctic rivers (Figure 7). There, the assumption of a rectangular river channel is not consistent with the flooding that is known to occur, and that is likely the first-order control on flow velocity.

Thus the last line of the abstract “suggesting that TRIP2.0 can be used to model flood events” is contestable.

3. Technical comments

The authors use “standard deviation” for what seems to be the “standard error” (including in Figure 4, Taylor diagram).

Table 2: as mentioned above, the figures need to be checked, as the table give R^2 greater than 1, which is not possible.

Figure 1 and section 3.2: I understand that the width of the riverbed is deduced from Eq 14, proposed by Arora and Boer, using mean discharge simulated in 1986. If I am correct, I question this choice, because mean discharge exhibits a significant interannual variability, and 1986 is not likely to be representative of the “climotological” behaviour.

Figure 2: give the meaning of the color table.

Figure 3 and 6: I recommend to change the linestyles to better differentiate the simulated hydrograph by the two versions of TRIP in black and white; some hydrographs are cut for the high values, and velocity is not introduced in the captions; the simulated year is not given the caption of Figure 3.

The paper is rather well written, but it should be checked for typos and some questionable expressions. Examples include:

P 4396, title of section 4.1: Capital initial for Mekong.

P 4397, L3: traverses ?

P 4397, L7: assess instead of “access”

P 4397, L23: check the expression between brackets

P 4398, in several instances: originating instead of “originate”, and originates instead of “origins”

P 4401, L10: simulated BY

4. Additional References

Leopold, Wollman and Miller (1964), Fluvial Processes in Geomorphology, W. H. Free-

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Nash, J. E. and J. V. Sutcliffe (1970), River flow forecasting through conceptual models part I – A discussion of principles, Journal of Hydrology, 10 (3), 282–290.

Vorosmarty et al. (1989), in Global Biogeochemical Cycles, 3: 241-265.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 4, 4389, 2007.

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