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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Does consideration of water routing affect simulated water and carbon dynamics in terrestrial ecosystems?" *by* G. Tang et al.

Anonymous Referee #1

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The manuscript by Tang et al. compares two versions of the same hydrologic model (with and without water routing) to assess the role of hydrologic connectivity on ecosystem fluxes – in particular transpiration, primary productivity, autotrophic respiration, and heterotrophic respiration. This is a relevant topic, certainly of interest for readers of HESS, as it tackles the broader question about the role of hydrologic connectivity in shaping ecological and biogeochemical patterns at the landscape scale. The manuscript is well-written and generally clear. Figures are illustrative and results presented in a concise and clear way. I have some concerns, however, regarding the way the analyses are performed: as the results stand, they do not fully address the main

objectives posed in the introduction (see below). One other potential critique is that the model is not validated against biogeochemical fluxes, as the author very openly acknowledge on P12550, but I do not see this as a real problem, given the more theoretical goals of this analysis.

Main issue: Basically, the authors demonstrate that water routing has no or very minor effect on ecosystem functioning (and on the predicted river discharge). This conclusion seems too restricted to an ecosystem that appears to be energy rather than water-limited. My impression is that the proposed approach to assess the effect of routing is sound, but the analyses should span a wider range of hydrologic conditions to conclude in which conditions routing matters or not. I would suggest performing a systematic analysis of the same watershed, with same model parameterization and initial conditions, but using altered rainfall scenarios. For instance, the measured rainfall during the growing season could be decreased by different amounts to establish a set of drier scenarios. I would expect (and I could be very wrong!) that the watershed would become progressively more water limited as rainfall is decreased, therefore showing some stronger effects of water routing. Below some rainfall threshold, hot spots of biogeochemical activity would remain only where moisture is concentrated. In these conditions, routing would provide the mean to concentrate rainfall and allow these hot spots to exist. Without these additional analyses, I am not sure the conclusions can be much generalized in space and time. If these analyses still show that routing does not matter (except for the moisture fields), that would also be an important result and would stimulate discussion on this topic.

Minor issues:

- Abstract: the last sentence is long and a bit convoluted

- Introduction: little credit is given to the vast amount of work on spatial organization of plant-hydrologic systems in semiarid ecosystems – e.g., recent work by Caylor and coworkers (Princeton U.), or by Thompson, Katul and coworkers (Duke U.). In

more mesic systems such as the one studied here plant-water interactions are probably weaker, in the sense that strong spatial patterns may be less prominent. Nevertheless, similar ideas on the role of water concentration mechanisms still hold across climates.

- P12544: the values of the empirical sensitivity parameters seem a bit arbitrary: how were they chosen? Why in the case of no routing the sensitivity parameter is still >0? Is s_max equivalent to the soil porosity multiplied by the soil depth (i.e., the max storage capacity)? Also, on line 8, use small "s" for saturation deficit to be consistent with Eq 1.

- First line of Sections 2.3 and 2.5: in both instances I would re-phrase as "... time series OF daily..."

- Results section: I wonder about patterns in soil C, which partly drives soil heterotrophic respiration in the model. Do C distributions across the landscape change depending on routing?

- Discussion section: the implicit assumption throughout the discussion (and the rest of the paper) is that the mesic forest used to parameterize the model is the only ecosystem of interest. It might be worth reminding the reader that statements such as "75% of seasonal variations in soil respiration can be explained by variations in soil temperature" apply only to such a system, and not in general.

- Conclusions, point iii: lower productivity? This seems inconsistent with previous (L23, P12548) and subsequent statements that productivity was little affected by water routing.

- Conclusions, closing statement: while I fully agree on qualitative terms, this is not what your results show. Results clearly show that modeling routing does not matter when it comes to prediction of discharge and watershed-scale fluxes (even plot scale fluxes!). Therefore adding routing to models is not necessary, unless one wants to study moisture patterns that anyway don't matter. I am of course stretching the argu-

ment too far, but the point I would like to make (see also above) is that the chosen case study of an energy limited ecosystem is perhaps not the best one to show the role of routing and hydrologic connectivity.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 10, 12537, 2013.