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Interactive comment on "A multirate mass transfer model to represent the interaction of multicomponent biogeochemical processes between surface water and hyporheic zones (SWAT-MRMT-R 1.0)" *by* Yilin Fang et al.

Anonymous Referee #1

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The discussion paper "A multirate mass transfer model to represent the interaction of multicomponent biogeochemical processes between surface water and hyporheic zones (SWAT-MRMT-R 1.0)" introduces a newly-developed model, named SWAT-MRMT-R, to simulate the hydrological and biogeochemical interaction between surface water and hyporheic zones. Hyporheic zone is usually ignored in large-scale watershed models because of its complex processes. Therefore, I think adding the simulation of hyporheic zone processes and connection hyporheic zones and surface water has a good intention and is appreciated. I have some major comments for this manuscript: 1.

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Discussion paper

The manuscript description about SWAT-MRMT-R, the connection between SWAT and MRMT, the connection of SWAT code and PFLOTRAN is not very clear. There is abundance of model concepts, software, and codes involving in this work (SWAT, MRMT, PFLOTRAN, NEXSS, NHD plus V2), and the connection between them was mentioned in different places in the manuscript. But I want to put in in a figure/schematization, to make the readers clear about the role of each of them in the model. I recommend modifying figure 1 or having a separate figure showing the connection between these. 2. It is not very clear to me about the connection in hydrology between SWAT and MRMT. Does SWAT provide inflow of upland catchment to hyporheic zones which is represented by MRMT, and how the transmission losses through streambed calculated by SWAT affect the hyporheic zones? I think hydrological exchange between surface water and hyporheic zones is very important for the constituent exchange, so please make it clear. 3. How many storage zones in your conceptualization of the hyporheic zones? Is the number of storage zones defined by the user in the setup? What is the maximum number of storage zones? 4. Why can NEXSS not use the reach system generated by SWAT to calculate residence time and exchange flux? 5. For matching the channel systems between NEXSS and SWAT, it seems that NEXSS reaches that do not overlap with those of SWAT are not considered. In the example in figure 2b, only reaches 386 and 380 contribute to SWAT reach 36. However, I think reach 374 also contributes to SWAT reach 36. If we change the threshold stream definition in SWAT, SWAT can generate a more detailed stream network and can overlap with all of the reaches from NEXSS. 6. The paper shows several modelling experiments. But I wonder if the authors did compare the model predictions with field measurements. I did not see calibration/validation in this paper. I do think the comparison with measurements is very necessary for a modelling paper. So please add a session on this if data is available. 7. Do you have a SWAT model application in this case study? Do you consider comparing SWAT-MRMT-R with SWAT to show the better prediction when hyporheic processes are included? 8. SWAT-MODFLOW coupling SWAT and MODFLOW models can represent hyporheic zones and its interaction with the stream. The

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author should add reference about SWAT-MODFLOW in the manuscript. What is the advantage of SWAT-MRMT-R compared to SWAT-MODFLOW? I suggest adding a section discussing about the strengths, weakness/limitations of the models, what cases the users should use SWAT-MRMT-R in the manuscript.

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