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Discussions

Interactive comment on "A comprehensive one-dimensional numerical model for solute transport in rivers" *by* M. Barati Moghaddam et al.

Anonymous Referee #2

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General comments:

During the last few years, an increasing number of studies have focused on contaminant transport in surface water system with transient storage models. As a result, the topic of this paper is timely and appropriate. The authors present an interesting study of a numerical model for contaminant transport along an 1D channel with transient storage zones and performed various model verifications.

First of all, it is important to acknowledge how difficult and time consuming the development of a complex numerical algorithm is. At the same time, it can be difficult to publish work in the field of environmental modeling that focuses on increased abilities to handle complex problems. The authors tend to overrate the novelty of their work and miss to cite relevant previous works which are quite similar or more advanced than the

model suggested in the paper. Considering that the authors suggest a "comprehensive" model, the question "what is scientifically new?" arises. The authors may want to take the opportunity to further highlight advances made by this development (e.g., the flexibility, applicability and robustness of their model). Therefore, the paper is on the borderline in my view from Major Revision to Rejection. I believe the author should be allowed to respond to the reviews and strongly improve the clarity of the scientific contributions.

1) English-editing is required to improve the quality of this paper. 2) The manuscript needs in general more discussion on the novelty of the work. 3) How could the method presented in the paper solve real-world problems (i.e., complex river networks)? 4) The authors should provide more in-depth discussion on the efficiency, applicability and robustness of this method.

Specific comments:

Slide 2, Line 21: Please provide the dimensions or units for each of the parameters in all the equations used in the paper.

Slide 3, Lines 26∼28: Please provide references related to the real-world applications of the TSM.

Slide 4, Line 5: "comprehensive" needs to be reworded since the 1D model has limitations on solving complex problems.

Slide 4, Line 19: Since TSM suggested in this paper is somewhat similar to previous works (see additional references), I believe that Table 1 is highly misleading. Therefore, the model comparison part should be thoroughly reworked.

Slide 5, Line 7: What is the "QUICK" scheme?

Slide 10, Line 1: I believe that Equation (18), 1D discretization matrix, does not provide valuable information because it is a trivial matrix form for the 1D discretization.

Section 3.1: The verification results (Tables 5, 6, 7 and 8) should be discussed further. Did authors mean the grid size of the simulation domain is 1 m and the time step size is 30 seconds? If so, are they optimized conditions for your model verifications? Since the grid and time step sizes affect simulation results, further discussion is necessary on this point.

Section 3.2: What is the definition of the “flow sub-model”? Did authors mean that 1D surface flow simulations were performed to obtain the initial conditions? If so, what kind of the flow model was applied? It should be detailed in the manuscript.

Section 4: Please provide information about “CTQS, CTCS and BTCS.” Again, further discussion is necessary on the simulation settings (i.e., grid and time step sizes). Generally, the oscillations of concentrations in the concentration profiles can be removed if the grid and time step sizes are very small.

Slide 15, Lines 8∼11: It is hard to see that the suggested model performs better than the other models. Further discussion is also necessary on this statement. Section 4.2: Again, the results of the model comparison should be discussed further.

Slide 16 Lines 4∼6: Authors should explain about the statement that “MIKE 11 model has a little flaws.” It is hard to believe that MIKE 11 has defects based on the simulation results.

Section 4.3: Since reactive solute transport was performed in Section 4.4, Section 4.3 (conservative solute transport) is not necessary.

Slide 24 Lines 6∼8: There are several papers that worked on the issues. Please refer to additional references attached in the review comments.

Additional references recommended to be taken into account:

Gooseff, M. N., S. M. Wondzell, R. Haggerty, J. Anderson (2003) Comparing transient storage modeling and residence time distribution (RTD) analysis in geomorphically varied reaches in the Lookout Creek basin, Oregon, USA, Advances in Water Resources,

26 (9), 925-937.

Gooseff, M. N., K. E. Bencala, D. T. Scott, R. L. Runkel, D. M. McKnight (2005) Sensitivity analysis of conservative and reactive stream transient storage models applied to field data from multiple-reach experiments, Advances in Water Resources, 28 (5), 479-492.

Phanikumar, M. S., I. Aslam, C. Shen, D. T. Long, T. C. Voice (2007) Separating surface storage from hyporheic retention in natural streams using wavelet decomposition of acoustic Doppler current profiles, Water Resources Research, 43 (5), n/a-n/a.

Zarnetske, J. P., M. N. Gooseff, T. R. Brosten, J. H. Bradford, J. P. McNamara, W. B. Bowden (2007) Transient storage as a function of geomorphology, discharge, and permafrost active layer conditions in Arctic tundra streams, Water Resources Research, 43 (7), n/a-n/a.

Haggerty, R., E. Martí, A. Argerich, D. von Schiller, N. B. Grimm (2009) Resazurin as a “smart” tracer for quantifying metabolically active transient storage in stream ecosystems, Journal of Geophysical Research: Biogeosciences, 114 (G3), n/a-n/a.

Bottacin Busolin, Andrea (2010) Transport of solutes in streams with transient storage and hyporheic exchange. [Ph.D. thesis]

Neilson, B. T., D. K. Stevens, S. C. Chapra, C. Bandaragoda (2010) Two-zone transient storage modeling using temperature and solute data with multiobjective calibration: 2. Temperature and solute, Water Resources Research, 46 (12)

O’Connor, B. L., M. Hondzo, J. Harvey (2010) Predictive modeling of transient storage and nutrient uptake: Implications for stream restoration, Journal of Hydraulic Engineering, 136 (12), 1018-1032. Bencala, K. E., M. N. Gooseff, B. A. Kimball (2011) Rethinking hyporheic flow and transient storage to advance understanding of stream-catchment connections, Water Resources Research, 47 (3)

Jackson, T. R., R. Haggerty, S. V. Apte (2013) A fluid-mechanics based classification scheme for surface transient storage in riverine environments: quantitatively separating surface from hyporheic transient storage, Hydrol Earth Syst Sci, 17 (7), 2747-2779.

Haggerty, R., M. Ribot, G. A. Singer, E. Martí, A. Argerich, G. Agell, T. J. Battin (2014) Ecosystem respiration increases with biofilm growth and bed forms: Flume measurements with resazurin, Journal of Geophysical Research: Biogeosciences, 119 (12), 2220-2230.

Zhou, Y., G. V. Wilson, G. A. Fox, J. R. Rigby, S. M. Dabney (2015) Soil pipe flow tracer experiments: 2. Application of a streamflow transient storage zone model, Hydrological Processes, n/a-n/a.

Trévisan, D., R. Periáñez (2016) Coupling catchment hydrology and transient storage to model the fate of solutes during low-flow conditions of an upland river, Journal of Hydrology, 534, 317-325.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 12, 11959, 2015.