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Interactive comment on "*tran*-SAS v1.0: a numerical model to compute catchment-scale hydrologic *tran*sport using StorAge Selection functions" *by* Paolo Benettin and Enrico Bertuzzo

Anonymous Referee #3

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The authors present a very useful Matlab implementation of the StorAge Selection modeling framework.

The implementation is essentially a solute transport model, because the solute concentrations are one of the state variables. With the SAS framework it is possible to calculate solute concentrations "offline", by storing the travel time distribution of stream flow for select (sampled) times, and multiplying these with the tracer input history. This is efficient for a small number of samples and a large number of tracers. Perhaps not a common case.

From the manuscript, it is not clear if the model supports simultaneous calculation of

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Discussion paper

multiple solutes. Perhaps I missed that. It would be useful.

I would like to see a stronger encouragement by the authors to test the parameter space for each new case. The example parameters are very hypothetical.

The model description is accurate and easy to understand (for someone who has worked with a different implementation of a SAS model). I hope one of the other reviewers is a "SAS dummy" who can ask the questions that seem obvious to me.

I have a few comments specific to the text:

P5 L19, Eq 6: This implementation is equivalent to the fractional StorAge Selection (fSAS) implementation, right?

Section 3.3: I would like the authors to elaborate on the discussion of the "old pool". Transient tracers like tritium and chlorine-36 demand that the age distribution of the old pool is accurately represented. Or at least in the concentration in the "old pool" needs to be represented.

P9 L6: "long term" = 4 years? P9 L13: S0=1000? mm? P9 L11: I understand the parameterization of the example is not intended to represent the hydrogeological conditions of the particular data set. Nevertheless, I find the random sample (kET=1) surprising, as I would expect the vegetation to have even the slightest preference for younger water. Perhaps the authors can warn the reader that these parameters should not be considered "valid" for any catchment and encourage the user of the tranSAS to vary all parameters of the example case drastically if applied to a specific setting to test the sensitivity.

Figure 3d, please clarify that this is the stream flow TTD.

P10 L1: "solutes with a yearly period".... like stable isotopes of water? (These aren't really solutes.)

P10 L8: The range in median ages can vary much more. It all depends on the fictional parameters you enter into your model. It might be more relevant to compare the non-random-sampling cases with the random-sampling case. Or reiterate that any power with a k < 1 prefers younger water and will therefore have a younger TTDs (right? or is this not alwyas the case?)

P10 L10: This dilution example is interesting. Is it true that the stream solute concentration is the inverse of the TTD in the random sampling case (k=1)? It might be worth mentioning. The inverse problem, a step increase of a contaminant input relates more directly to the TTD. I do like this example because it is more optimistic about the potential to reduce environmental contamination. And it illustrates an important aspect of transient contaminant flow, that even with zero input, stream concentrations can increase due to the variable hydrology.

P15 L6: "less than a second" for a 4 year time series? How much longer does the ode113 solution take?

P15 L28: "chronology of the inputs is irrelevant" Not quite sure how to interpret this. The chronology of a constant input decaying tracer (e.g. tritium for the last 30 years) is irrelevant, in the sense that it doesn't matter "when" the precipitation entered the catchment, but it does matter "how long ago". I know what is menat, but it reads like this model is only relevant for tracers with input fluctuations, which isn't the case (as long as the tracer decays on relevant time scales).

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