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Discussions

Interactive comment on "A parsimonious analytical model for simulating multispecies plume migration" *by* J.-S. Chen et al.

Anonymous Referee #3

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This manuscript summarizes a new analytical model that simulates the reactive transport of multiple interacting species in a 2D groundwater flow system. The authors describe the model (with derivations in the appendices), and then provide several examples showing model output, comparison with a numerical model, and a short sensitivity analysis to identify influential transport parameters. Overall, the manuscript is organized well and covers an important topic. However, before recommending publication the following points must be addressed:

- One of the main concerns is the lack of connection with real-world systems. The authors compare their model with other models, but the actual behavior of the chemical species (particularly the sequential first-order decay reactions) in actual aquifer systems is not discussed, nor is it discussed in the Methods, Results, or Discussion

sections. Without this connection, it is difficult for the reader to have confidence that modeling results (and the model itself) can be useful if applied to real-world systems.

- In relation to the previous comment, the authors need to discuss limitations of their model. For example, I assume that the flow field used in the analytical model is steady state, and that sources and sinks within the groundwater system are ignored. When do these conditions actually occur? Under what field conditions can the model actually be applied? Again, without relating the model to reality, much of this is ignored by the authors.

- The use of the model requires a number of complicated numerical methods (correct?). So, at what point does the analytical solution actually become a numerical solution? Also, the authors never report the run-time of the model simulations in comparison with those of the numerical model (LTFD). Due to the complicated nature of the analytical model, I would assume that the run-times are substantial. Without this reported, it is hard to assess whether the newly developed analytical model is an improvement over numerical models. This must be reported and discussed.

- The derivations are very hard to sort through as a reader, particularly if the reader is not well versed in the intricacies of the numerous transformations, etc... that are being performed. Please narrate the derivations in clear, concise language, with clear definitions and explanations. As written, most readers will skip over the derivations.

- The first few sub-sections of the "Results and Discussion" section in fact seem like Methods. For example, 3.1 and 3.2 should be in the Methods section, since derivations are presented.

- Overall, there are too many tables and figures. The large amount of model output shown in the tables probably is not needed, and instead can be replaced by metrics in several tables. The large amount of results is very tedious for a reader to sort through, and in the end discourages the reader from analyzing the model data and results critically.

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