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Hydrology and Earth System Sciences
Discussions

Interactive comment on "A Field Evidence Model: How to Predict Transport in a Heterogeneous Aquifers at Low Investigation Level?" *by* Alraune Zech et al.

Anonymous Referee #2

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The manuscript presents a hierarchical approach for modeling flow and transport in heterogeneous aquifer. The key idea is combining large-scale deterministic structures and simple stochastic approaches. While the inclusion of a hierarchical structure to deal with heterogeneous structure is not new (some modelers have used similar ideas, yet not as structured as in this case), the authors introduce a formalism to make it understandable and efficient, I think is the main value of the manuscript. A significant point in the manuscript is the n-th try to model the data from the MADE side (here n is a very, very large number).

So, maybe the main comment I have is the issue of dimensionality. First, the very

simple thing is that eq. (1) should be 3D, as this is a general idea, and no need to simplify the problem at this point (you can do that later). But, most importantly, your application is 1D. I have seen many models trying to fit the 1D data of MADE; but after all these years, I have not yet seen the spatial distribution of values. Everybody reports the correspondence with transects (your figures 6 and 7). Transects are ok, but do not reflect the real picture at all. From l.235, "Concentrations were observed within a spatially dense monitoring network at several times after injection". Is this data available? Why nobody uses it in their models? You start with Figure 1. Why such a simple concept, if we know that it is slightly more complicated.

But, in general I like the work, and I feel it is very well written. I loved in particular the section "Exemplary Model Aims". This is written in a very didactic way.

This is a tough one and I do not expect an answer. The model developed in Section 3.2 involves quite a number of decisions and parameters. Then you get a reasonable fit. Now, can you really calibrate this model with so many parameters at very different scales (variances, integral distances, p values, anisotropy ratios, directions of anisotropy,...)? I can see that being done manually for one-two parameters (e.g., your line 276), but more? You would need a supercomputer and plenty of staff or students working on it, but this would be a waste. So, is there any automatic calibration approach that you envision in the future?

Minor issues:

The problem inherent to hierarchy of scales is how do you assign variability to one scale or the other one. I mean, you can always claim that some general trends are nothing but randomness if we look at a larger scale. Some discussion about how to distinguish Modules (A), (B) and (C) in a general case could benefit the paper. I mean, should (B) always related to the transport features as suggested in l.166?

You could comment a bit on recharge, because probably recharge and transmissivity (in a 2D scenario) might be correlated. How does your hierarchy approach deal with this parameter? Similarly, you could also comment a bit on the impact of porosity, if you think it is relevant (maybe it is not); it appears in the transport equation.

L79. In my opinion the models of Fiori (2013, 2017) are completely non-predictive (actually, they are based on wrong assumptions, as you show in your paper); outperforming those methods should not even be cited.

L90. Again, the use of word "macro-dispersion"; maybe you refer to "enhanced dispersion". The concept of "macro" refers to a specific quantity (since the original derivation of Gelhar and Axness, to all those by Dagan and so) that are never, ever, attained in real field conditions.

L116. Is this reference really needed here? I mean, the relevance of pumping tests comes from the 1930's if not earlier. And we teach them in class...

L 254. "Arrival" is misspelled

L 312. This is equivalent only if a gaussian distribution of concentrations is invoked. You could add this warning.

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