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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.

Alraune Zech et al.

a.zech@uu.nl

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We'd like to thank the referee for taking his time to review our manuscript and appreciate his positive evaluation and constructive criticism. We are going to revise the paper accordingly. The manuscript will improve based on the referee's comments. In this response, we plan to address the questions raised. Consequential text modifications in the manuscript will be outlined in the next step of the reviewing process (not intended in this review step) along with correction of typos etc:

- The the question of dimensionality (of the data):

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- Eq. 1 will be adapted to 3D.
- First we want to specify that the conceptual and numerical models are 2D. We postprocess the calculated mass distributions to allow a comparison with the 1D reference data of the MADE 1 experiment: As outline in the manuscript, averaged over the directions perpendicular to the flow and aggregated over intervals of 10m.
- Now, the critical point raised by the reviewer: "After all these years, I have not yet seen the spatial distribution of values." - We neither. Unfortunately, no other mass data than the 1D transects is available to us. In correspondence with many colleagues, we figured that the raw data is not public. We regret this situation, but are not in the position to change it. So, I can just agree to the referee.
- Addressing the point: "You start with Figure 1. Why such a simple concept, if we know that it is slightly more complicated." - That is actually one of the paper's targets: make use of the "simple concepts" and usually available data as piezometric surface maps to construct a reasonable heterogeneous hydraulic conductivity structure. In the application of the concept to MADE we wanted to show that by integrating and combining "basic" data, it is possible to reproduce apparently complex mass distribution patterns at least at the level of spatially integrated longitudinal mass distributions.

• The point of parameters to specify for the model:

  - In section 3.2, we tried to outline how to derive the required parameters from hydraulic observations. We aim to emphasize that the model is set up as a predictive model. There is no calibration involved. This is also the target for application: practitioners should be able to setup a transport model without relying on calibration. Th point of a predictive and calibration-free model will be stronger emphasized in the revised manuscript.

- The choice of several values of inclusion length (l. 276) is not a calibration but an integration of parametric uncertainty. We did not calibrate the model to one of the values, but included random realization with all of these values to the ensemble.
- We agree, that the general model contains many parameters at very different scales (variances, integral distances, p values, anisotropy ratios, directions of anisotropy,. . .). However, as outline later, they do not necessarily all be part of a conceptual model setup at a site. The model should be adapted to the available data and local conditions. As can be seen in the application to MADE: Module C (fine scale heterogeneity) does hardly impact the overall mass distribution. Thus, without this module, the number of required parameters is much smaller. However, there might be other application cases, where there is no indication of large contrasts warranting for Module A, thus a conceptual model only consisting of Module C might be apt for some sites, again resulting in a manageable amount of required parameters.

• hierarchy of scales: We fully agree with the referee that categorizing spatial variability observed at a specific site to scales is subject of discussion and uncertainty. We will integrate some discussion on how to distinguish Modules (A), (B) and (C) in a general case into section 2.2.

• We can add a notice on recharge and porosity. However, hydraulic conductivity will be the dominating parameter given the scale at which it varies (order of magnitude) compared to recharge and porosity (in a range of factor 2). Particularly here, where we advocate the use of heterogeneity aquifer structuring due to high conductivity contrasts. In this line, notice the uncertainty associated with hydraulic conductivity observations (differences in mean behavior between methods ranges up to 2 order of magnitude, see Figure 4). Thus, the range of uncertainty induced by hydraulic conductivity will outperform the impact of fluctuations in recharge and porosity.

- (L 79) We cannot agree to the referee's opinion on the work of Fiori et al. (2013, 2017). Being previous modeling work on MADE, we prefer to keep the reference.
- (L 90) In the context here, we agree that macrodispersion is not the proper choice of words. We are going to modify it to "enhanced dispersion". Generally, we use the word "macrodispersion" in the sense as defined by Gelhar and Axness [1983] and the work of Dagan [1986] and following.
- (L 116) We can remove the reference.
- (L 312) We will add the warning.

To all points raised and discussed above, we will integrate comments and text modifications in the manuscript to clarify. Typos are not listed above, but will of course be corrected.

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