

Interactive comment on “Tracer test modeling for local scale residence time distribution characterization in an artificial recharge site” by C. Valhondo et al.

Anonymous Referee #3

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The authors investigated a MAR system near Barcelona, Spain using tracer methods combined with numerical analyses. Here they highlighted the importance of heterogeneous structures on the estimation of travel times of waters below an infiltration basin which is of importance when it comes to assessment of removal rates of unwanted substances. The manuscript is clearly written and introduction fits to the content. The methods used and the results obtained are of high scientific relevance. Beside this, the methods and analyses used seem appropriate regarding the objectives focused on. Therefore, I suggest to accept the manuscript after some minor revisions by authors. Please see the following comments:

The main drawback of the manuscript in its current state is the simplified explanation

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of the model set-up used here. Although the methods seem scientifically correct, additional information should be provided to the reader to support a better understanding of the content and to ensure reproducibility of the numerical results. This holds true for both the input parameters used here and the numerical procedure. Regarding the first, for example, dispersivities in horizontal and transverse directions cannot be found in the manuscript. However, often dispersivities are used to include the effect of mixing and spreading if spatial variability of the hydraulic parameters is not included directly in the model. This may lead to larger dispersivity values used in homogenous models as compared to heterogeneous models for the same conditions. Are dispersivities for both models the same?

Regarding the numerical procedure some additional information would be helpful, e.g. the software used and how the inner region was selected in its extents (why basin so close to local domain boundary). Beside this, for me it is not clear if and in case of any which retention model was used for the unsaturated zone modeling?

Next to the mentioned issues, the link between lithology data from the site and the layering used in the models should be better explained (maybe using some lithology profiles as shown in Fig. 1). In page 6, Line 12 and page 8 line 9-10 preferential flow paths were mentioned which indicate non-continuous layering. Are there additional bore profiles, than shown in Fig. 1 supporting the assumption that layers are consistent at the site? Is there any change of thickness in the layers with space in the model? Please explain this further as the fact that every layer is exact 2 m in thickness everywhere sounds a little bit subjective.

Specific comments: Page 1, Line 5: "broad" seems rather undefined. Please better define.

Page 1, Lines 7-9: Please check the order of these two sentences. The heterogeneous model is mentioned after the 9 layers which are part of this model.

Page 2, Line 8: "the wells" – At this point nobody knows about the observation wells of

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this study.

Page 2 Line 9-10: What is the difference between point (1) and (2): In both cases the concentration of substances are observed and conclusions are made.

Page 2, Line 14: Flux distribution may also be influenced by temporal flow field changes and different sources and sinks of water balance within a region.

Page 2, Line 17-19: Vertical distribution of hydraulic properties can be gained among others using Direct-Push techniques (e.g. Dietrich et al. 2008, Butler et al. 2002).

Figure 1: The gamma-ray profile and the lithology should be shown in Fig 1B.

Page 5, Line 22: Is the large domain the regional model sometimes mentioned? Please clarify procedure here.

Page 5, Line 30: Which kind of local tests do you mean?

Page 6, Line 10: How this function look like? Is there an areal distribution of the input concentration?

Page 6, Line 14: Why both layers, layer 7 and 9 were used distributing the time-dependent inflow data?

Fig. 3: Different scales make the concentrations hard to compare with each other. Maybe these could be transformed into equal scales (maybe using logarithmic scales?)?

Page 11, Line 7: typo "iwas"

Page 11, Line 25 Is TCA possibly subject to reaction (conservative modeling used here)?

Page 11, Line 33-34: Maybe velocity field without artificial recharge is not very sensitive to local hydraulic conductivities, but maybe other processes were missed in the model as it was built and calibrated to reproduce the vertical infiltration processes.

Fig. 5 and 6 and statements on page 11 line 32ff: What is the screened portion of the Px named observation wells? Does the screened interval match with the lithologic layering used in the model (for all observation points, also P8.x wells) and the respective concentrations simulated in the layers?

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