Discussion of "Tracer test modeling for local scale residence time distribution characterization in an artificial recharge site" by Valhondo et al. (doi:10.5194/hess-2016-197)

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Commentary

Valhondo et al. (2016) is an important paper that exams near-field flow under managed aquifer recharge (MAR) spreading ponds. It combines both geochemical tracer techniques and numerical modeling of flow and transport. The combination of these separate approaches reveals the complexity of flow beneath spreading ponds. I suspect that this is largely due to the local hydrogeology. Spreading ponds are often located in alluvial settings such as the one examined near Barcelona, Spain by the authors.

A unique contribution of this paper is the careful consideration given to the vertical structure of the aquifer below the spreading pond. The authors created a finer scale grid with nine layers that was imbedded into a regional numerical model of flow by Abarca et al. (2006). Three different fine scale models were tested: "Hom"—containing homogeneous K_h and K_z; "Het-1" —containing different K_h for each of the nine layers while maintaining the same K_z for each layer; and "Het-2"—containing different K_h and K_z for each of the nine layers (see Table 1 of the paper). Field measurements of head and geochemistry were used to validate the fine grid model. I particularly appreciated the use of TCA (1,1,2-trichloroethane) as way to quantify the advection of regional groundwater into the study area.

The most significant contribution of Valhondo et al. (2016) is their characterization of preferential flow in the heterogeneous aquifer found in their study area. Unfortunately, they did not discuss the work of Thompson et al. (1999) who produced one of the original tracer data numerical flow models to interpret the complexity of flow and transport near MAR sites. They used a different approach but reached a similar conclusion. As mentioned above, MAR sites are more often than not located above heterogeneous aquifers, so the authors' findings should be applicable to other settings. As Fox et al. (2007) demonstrated many years ago at the 6th International Symposium on Managed Aquifer Recharge (ISMAR6), the placement of monitoring wells for management purposes must account for preferential flow. Without using complex numeral model such as those employed by Thompson et al. (1999), Fox et al. (2007) and Valhondo et al. (2016) or detailed deliberate (added) tracer experiments (e.g., Clark et al., 2014; Becker et al. 2014), it is hard to demonstrate the residence time distribution and hydraulic connection between the recharge area and monitoring well. Therefore documentation of water quality changes is uncertain and must be recognized.

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