

Interactive comment on “Macropore flow of old water revisited: where does the mixing occur at the hillslope scale?” by J. Klaus et al.

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Received and published: 5 June 2012

We would like to thank the reviewer for his constructive and detailed review. Since the timeframe for the open discussion is about to end we want give a quick answer to the concerns of the reviewer and will rework the manuscript in a next step. Rereading our manuscript we also recognized that we have to give a more explicit answer to the question/objectives in our introduction. We are convinced that the experimental results and the model analysis provide an answer to the question, yet theses answers seem not to be clear enough in the current version and are hidden. We will improve the discussion/conclusion section an present these answers more clearly.

The reviewer asked to what extent the used modeling approach add value compared

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to a simple mixing approach. Solving the mixing with both tracer and two end-member will lead to different results, the use of the linear programming approach combines the use of both tracers in one mixing calculation and minimizes the error to fulfill the best mass balance for both isotopes and the water mixing. We will add an extra line in the manuscript to explain why we chose the method.

The use of spiked Deuterium can clearly add additional value to the results and we think in general that it can be a good idea to perform a fourth “closing” experiment with Deuterium spike water. As a drawback an artificial high deuterium signal can superimpose the knowledge we can gain from the soil water isotope data that we used to determine the contributing depth of the soil water.

The compartmental model constrained our understanding of the mixing processes within the soil profile and gave us a hint on the non-existence of pressure wave displacement or translatory flow, together with the non-existence of downward propagation of the pre-event soil water isotope profiles. To summarize, the compartmental modeling showed a clear macropore-matrix interaction and mostly no vertical flow in the soil matrix (perceptual model in Figure 1). This information combined with the tracer analysis of the tile drain was important for the overall understanding of the processes. We will clarify this in the reworked manuscript as we will clarify section 3.4. In this comment we slightly disagree with the opinion of the reviewer, who stated that isotopic signal of the applied water was so close to the soil water and that hydrograph separation was not performed. At first, we performed a hydrograph separation based on bromide (event and pre-event water) because the isotopic variability of the soil profile (Figure 3) made it impossible to describe the soil water end-member with a unique isotope value. That was the reason we used the knowledge of the bromide based hydrograph separation to calculate the isotopic composition of the soil water end-member (in the isotope based hydrograph separation). Also we think that the difference between the isotope signal of the applied water ($^{18}\text{O} = -8.3\text{‰}$ and $\text{D} = -56\text{‰}$) is clearly different from the soil water signal (Profile 1: $^{18}\text{O} -6.7\text{‰}$ to -5.5‰ Deuterium -49‰ to -42‰).

Profile 2: 18O -7.1‰ to -5.9‰ Deuterium -52.5‰ to -49.5‰ and Profile 3: 18O -5.5‰ to -7.8‰ Deuterium -42.5‰ to -57.5‰), except the lower part of the deuterium signal in the third soil profile.

Considering hydrograph separation we think that our data clearly showed that soil water is activated during the precipitation/irrigation event, a classical threshold process that is often observed for hillslopes. This mobilized hillslope water is usually not similar to the pre-event streamflow water that is used to describe the pre-event isotopic signal or alluvial groundwater. Further the isotopic signal of the soil shows stratification. This can cause severe problems in two component isotope hydrograph separation since soil water is frequently observed in three component hydrograph separations. Thus we think that separation methods should be adjusted as suggested by various authors (e.g. Harris et al., 1995).

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 9, 4333, 2012.

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