Review: Karst aquifer discharge response to rainfall interpreted as anomalous transport

The authors simulate flow dynamics in a karst system via a CTRW particle tracking approach. The approach is based on the idea of representing a flow in (partially) saturated domain analogous to transport dynamics involving accumulation and release of tracer substances. The authors demonstrate that the model is able to recover the combined effects of both the slow and rapid flow components by using suitable parameterizations for the probability density functions governing particle movement in space and time of each domain. Furthermore the authors demonstrate limitations of the approach which is attributed to piston-type flow processes that could potentially be modeled via a third component.

The paper is concise (partially it could be slightly extended) and I could follow the main points of the authors. The graphics are mostly of high quality. In my manuscript figures showing discharge (e.g. 4, 6...) are partially blurry, though this may be a problem of my pdf viewer or the manuscript draft quality.

In the following I have a few content related remarks. I have not found typographic errors.

Content:

1. (line 209) Flow paths are assumed to be linear elements connecting each point in the catchment with the spring. With a tortuosity factor unknown features of the flow geometry are taken into account. While this approach is efficient it potentially neglects various aspects of the internal system geometry. Here or in the discussion it would be helpful to add some further information about the catchment (if available). What is the thickness of the vadose zone and roughly what volume of the system is considered phreatic? While the chosen flow paths approach may be more realistic for systems which negligible vadose zone and/or thin phreatic zone in other cases a more realistic flow paths distribution may be chosen. Małoszewski and Zuber (1996, 2001) in their works have for example

often assume various flow distribution patterns (though mostly assuming phreatic settings).

2. (line 248) Recharge is estimated with a rather simple approach neglecting more complex processes in the soil water balance or runoff dynamics. How is baseflow computed? The authors should briefly discuss how the simplification might influence the results. Certain effects of this process spectrum might for example affect the peak recharge and hence discharge dynamics (e.g. more runoff might decrease the input during strong precipitation events). As the peak discharge components are difficult to fit without a third component according to the authors this may already be one potential issue here.

3. (line 266) My understanding is that particles are able to transition from the fast into the slow domain. While this is conceptually often the case, in the bulk aquifer system the opposite case can occur in both the phreatic and especially vadose zone. Karst conduits connected via rapid infiltration features to the surface (dolines, sinks) may transmit water during recharge events into the matrix when a gradient inversion occurs. In addition within the vadose zone typically the matrix receives water from adjacent rapid flow elements (e.g. fractures) due to the differences in capillary pressure, (though this effect may not be present under non-equilibrium conditions as preferential flowpaths may partially overcome the effect of capillary suction). This limitation in the approach should be briefly mentioned in the discussion section.

4. (line 374) "without the prominent peaks" What is exactly meant by this? Are you removing exactly one datapoint (15min intervals)?

5. (line 386) Why would this need a third component? Is it impossible to fit this with the available parameters or possibly a different form instead of the TPL? Many karst springs have been successfully modeled with dual-domain approaches (spatially distributed, lumped parameter approaches). I wonder wether this is a limitation of the approach or caused by the distribution of heterogeneities (fractures, conduits) specific to this spring system.

6. Conclusion chapter: Here I feel it would be good to slightly extend the scope and relate the results to other modeling approaches. Why should one employ the demonstrated approach? What are the benefits in terms of process representation and computationally efficiency?