Hydrol. Earth Syst. Sci. Discuss.,
https://doi.org/10.5194/hess-2017-674-AC2, 2017

Hydrology and Earth System Sciences
Discussions

Interactive comment on "Minimum dissipation of potential energy by groundwater outflow results in a simple linear catchment reservoir" *by* Axel Kleidon and Hubert H J. Savenije

Axel Kleidon and Hubert H J. Savenije

axel.kleidon@bgc-jena.mpg.de

Received and published: 21 December 2017

We would like to thank the reviewer for his comments. While the first comments he made are relatively minor points that we will respond to in the final response, we want to respond to the last point as he considers this to be a major point. We think this last point is based on a misunderstanding which may be caused by our inadequate explanation in the text.

The last point is about the time scale of flow between the two reservoirs and of the optimization. We want to clarify first that we do **not** assume that the optimization holds all the time, but that it holds in the **mean**. This means, we do not enforce optimality at

each step of the streamflow recession curve, but rather apply the optimization to the mean discharge (we refer to this mean state in section 2, where we also refer to mean groundwater levels). The justification for doing the optimization on the mean is that the processes involved in the optimization likely involve the formation of dendritic flow networks in the groundwater, which takes place on much longer time scales than the time scale of a streamflow recession event. That we find the mean (relative) groundwater levels to be the same as the outcome of the optimization does not imply that the instantaneous groundwater levels are the same, and it also does not imply that the flow between the catchments is instantaneous.

On this aspect we would also like to point out that it actually requires very little flow between the catchments to accomplish the outcome of the optimization. One can use the equations from the manuscript to see that if recharge is about the same for both catchments, the flow between them is $Q_{ab}/Q = (\tau_a - \tau_b)/(2(\tau_a + \tau_b))$, which is likely to be much smaller than one. For the example of the Ourthe catchment, this amounts to about 3.5% of the discharge, which is a comparatively small flux. This small flux implies a much longer time scale than the one involved in the stream flow recession, which is consistent with the assumption that the optimization takes place on a longer time scale.

So we do not think that the interpretation by the reviewer is correct, but that this aspect would clearly need to be better described in the manuscript.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2017-674, 2017.