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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Climate-vegetation-soil interactions and long-term hydrologic partitioning: signatures of catchment co-evolution" *by* P. A. Troch et al.

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In the following, Dr. Ding's comments are in between "", our reply in plain text.

"The review by Savenije, in his larger/major comment 1 (one), helps spotlight on the most significant role played by the so-called "perched aquifer advective time scale [day]" in the Discussion Paper (see Figure 6 and, later on, Figure 9). This being the case, the subject of baseflow recession from groundwater storage release may bear or merit another brief mention by this writer.

A grand synthesis of an ecosystem at a catchment scale is a laudable aim, and I

applaud the authors for their ambitious, intellectual pursuit. For a synthesis to be successful, it must be rooted in the first principles of whichever fields or disciplines involved, such as and including hydrology, but having only a few parameters to capture the essence of the system (e.g., Dooge, 2005), one being their aquifer advective time scale".

We thank this reviewer for his nice words and the time taken to write this comment.

"As defined by their Equation (4), obviously this is linearly related to the length of the hillslope in m (metre), implying that the larger the size of an aquifer, the longer its time scale. But the authors need to provide or clarify the context: what does a tau of, say, 10 days mean, in terms of the moisture storage available for plant growth and survival, etc.?"

The time scale mentioned results from an analytical solution to the linearized hillslope-storage Boussinesq equation (see Berne et al., 2005 for more details). There are two time scales that control hillslope subsurface flow described by Boussinesq's equation: a diffusive and an advective time scale. The ratio of these two time scales define the so-called hillslope Peclet number and expresses the competition between pressure gradient v. gravity driven subsurface flow. For instance, a horizontal aquifer would only have a diffusive time scale. Our equation (4) is the advective time scale as derived in Berne et al. (2005). It basically measures the time required to drain the hillslope by gravity, and thus steeper and shorter slopes would drain much faster than more gently sloping and longer hillslopes. To interpret the time scale [days] is best done with respect to other time scales of interest, such as the time required to empty root zone storage by evaporation. We refer to Carrillo et al., 2012 for an in-depth discussion of dimensionless numbers that result from ratios of different time scales. It is beyond the scope of this paper to add more details.

"I suggest the authors cast this, if they haven't done so elsewhere, in the context of a lumped storage system. What is frequently and prominently reported in current literature is the famous Brutsaert-Nieber (BN) recession plot (e.g., Stoelzle et al., 2013). The BN equation, ôĂĂĂdq=dt = aqb, is, in my view, based on the law of momentum conservation or balancing. As part of a discussion of Stoelzle et al. paper, the writer (Ding, 2012a) establishes the equivalence of the BN model and, again in my view, an energy-balancing, nonlinear storage-discharge model, q = cNsN, and further more that b = 2 ôĂĂĂ 1=N and a = Nc. Their scale parameter _ is expected to relate to other one, a or c, maybe in as simple as those between the BN model and that of mine".

Since the advective time scale of (4) is derived from the Boussinesq equation, it is totally related to the B-N model (see Brutsaert, 2005, for how different solutions of the Boussinesq equation can be cast in terms of the power law model of B-N).

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 10, 2927, 2013.