EGUsphere, community comment CC1
https://doi.org/10.5194/egusphere-2022-889-CC1, 2022

Reply on RC1

Stefan Hergarten

Community comment on "Flow recession behavior of preferential subsurface flow patterns with minimum energy dissipation" by Jannick Strüven and Stefan Hergarten, EGUsphere, https://doi.org/10.5194/egusphere-2022-889-CC1, 2022

Dear Reviewer,

thank you very much for your review! Please allow some short responses before addressing all aspects in more detail in a revised manuscript.

Mathematics:
I guess that the spectral theory (Sect. 2.3) is the main issue. I learned the theory behind this stuff in a two-semester linear algebra course for mathematicians and later in functional analysis in the 1980s. Right, these fundamentals go much beyond what is taught in hydrology programs. On the other hand, I was afraid that people already developed this theory in the 1960s (like some other really fundamental theory) and we just did not find it in the literature. We can try to give some more support to the readers and also try to find a textbook with an appropriate starting level (digging into fundamental textbooks of linear algebra such as Halmos (1958) would not really be helpful).

Nondimensionalization:
The topic of nondimensionalization is treated indeed in a quite sloppy way in Sect. 2.5 since the transfer to nondimensional properties is often cumbersome if the equations are written completely. The reason why the problem can be nondimensionalized in such a way that Eqs. (39) and (40) are formally correct (although still an ad-hoc assumption) is that the hydraulic heads and horizonal lengths can be rescaled independently (although both are in meters). We will try to find a way to explain the nondimensionalization with a moderate amount of additional equations.

Passive nodes:
For the approximation by dendritic flow patterns, we assume that the flow directions are defined by those of a steady-state flow pattern. This would be something like directed conduits. Then the linear model is solved, which means that the fluxes are reverted if the head at the target is higher than at the considered node. For the considered recession scenarios, however, this situation is rare since nodes without donors have high head values initially.

Reference level for the hydraulic head:
Of course, zero is used as a reference level for the hydraulic head. In a linear concept for the instantaneous unit hydrograph, this would mean that the water level at the spring is always constant. Otherwise, an exponential decrease of the head values towards zero

would make no sense at all. You are right that this boundary condition is not stated explicitly, but this is just because it seemed to be so straightforward.

Best regards,
Stefan Hergarten