

Hydrol. Earth Syst. Sci. Discuss., referee comment RC1
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Comment on hess-2021-148

Anonymous Referee #1

Referee comment on "The influence of hyporheic fluxes on regional groundwater discharge zones" by Brian Babak Mojarrad et al., Hydrol. Earth Syst. Sci. Discuss.,
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General comments

This paper investigates how hyporheic flow redistributes regional discharge at the scale of riverbeds in a case study and discusses the implications for the fate and transport of radionuclides from deep nuclear waste depositories. The study involves a multiscale flow and transport modelling framework and a rather sophisticated analysis of model outputs.

The main result (fragmentation of the regional discharge by hyporheic flow) is rather intuitive and could already be anticipated by looking at Tóth (1963) flow fields. This takes nothing away from the merit of the study, which achieved a proper demonstration and quantification of this phenomenon in a realistic example. Therefore, I recommend publication without any doubt.

The main issue I found is that the paper lacks a number of explanations (see below), but I am sure the authors can improve on this aspect.

Detailed comments

L51-56: I am not sure that velocity is the most relevant indicator for what you are trying to convey here. In fact, all the flow paths end up having similar velocities when approaching discharge (Cardenas and Jiang, 2010; Zijl, 1999; Zlotnik et al., 2011). Instead, I would think that the ratio of hyporheic flow (i.e., its total flow rate) to that of regional flow is more relevant in this discussion.

L59: I guess you mean "principal effects" and not "principle effects".

L62-64: The sentence is grammatically incorrect.

L110: This section should be better put before the description of the models.

L111-114: A situation map would be useful (I would suggest including Figure S1 here).

L129: This sentence is unclear. I guess you mean: the mean annual runoff estimated from the stream discharge measurements was set as the infiltration (please correct if needed).

L129: Is it reasonable to neglect overland flow in your study area (you may be overestimating infiltration)?

L129: Can you indicate the calculated infiltration rate?

L161-162: I suggest referring to Haitjema and Mitchell-Bruker (2005) in support of this sentence.

L162-164: I suggest referring to Bresciani et al. (2016a, 2016b) in support of this sentence.

L166-173: This only makes sense if hydraulic head is specified and equal to the topography along the top boundary, but you just said above that you are using a recharge condition, so I am lost here.

L134-185: What are the horizontal limits of the domain?

L194: I do not understand the meaning of " $C_{damp}(\lambda_i)$ ". Is C_{damp} a function of λ_i (I would think not since C_{damp} seems to be treated as a constant)? And if it is, shouldn't it be λ_{ij} ...

L206-216: How does this relate to the previous paragraph?

L187-216: What are the extent and boundary conditions of the hyporheic flow model? I guess the boundary conditions must be head = 0 everywhere but the top boundary so as to keep a continuous solution when doing the superposition...?

L219: The term "models" is confusing here. I guess you refer to the other parameters of the hyporheic flow model and all the parameters of the catchment-scale model.

L239: "Carlo", not "Carla".

L247: What are "the" cubes? You have not talked about cubes before.

L252: What does "the 1552" refer to?

L253-256: How did you distinguish between intermediate and deep groundwater flow paths from these particles (did you track them backward as well)? Furthermore, how can you be sure that some of these particles are not hyporheic flow?

L264-272: This part could be clearer. Did you focus on the same 1552 areas as above (I guess so)? How did you determine the coherent catchment-scale discharge areas (I guess this would involve particle tracking and a certain grouping method)?

L308-310: I think the differences between the three layers are mostly independent of the hierarchical structure of flow cells (which was not evaluated in this study, by the way).

L331: Define the Froude number.

L418-420: So is it a good news (less exposure time of aquatic sediments)?

L421: Why would it lead to higher exposure if the exposure time is shorter?

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