

## ***Interactive comment on “Modelling hyporheic processes for regulated rivers under transient hydrological and hydrogeological conditions” by D. Siergieiev et al.***

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The manuscript presents an analysis of the effects of hydrological controls (bank slope, river bed Ksat, and river discharge wave characteristics) on bank storage and hyporheic exchange in the Lule River, Sweden. The paper is well written, concise and clear. It provides a new insights into understanding what kind of river discharge wave provides optimal hyporheic exchange and therefore stream ecological benefit. It is specific to the site, but should be universally applicable to rivers worldwide.

My general comments are: It is complicated to have both site specific and generally

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applicable information together in a paper and both maintain relevancy to the study site and not limit general modelling observations by the site conditions. While the balance of the paper feels good, there are some places that could be either more specific in outlining the site specific results (p 9340). It would be good to have a little more separation of general and site specific work – particularly in the scientifically interesting section 5.1 discussing hyporheic exchange (see below).

It would be good to have 3 or so clear points stating why the paper is different from some of the other literature you have included – specifically Doble et al. 2012 a and b. This study seems to combine the results from these two papers and discuss how it impacts hyporheic exchange, particularly for the Lule River. I suspect there are more distinguishing features and it would be good to specify these up front.

I would also like to see a conceptual figure of what type of discharge wave (duration, amplitude etc) would provide the optimal ecological conditions, for the Lule River (and other if possible) hydrogeological conditions.

Specific comments include: Abstract – line 24 – spawning potential of riverbeds. Might be clearer as ‘potential of river beds as fish spawning locations’, if that is what is meant. P 9329 – Lines 9 to 12. This is a bit unclear. Could you simplify these sentences and explain what type of severe modification of neighbouring ecosystems this refers to? P 9334 - Line 24 – how does having multiple waves impact the output, especially for short duration waves? This would vary initial soil saturation conditions. P 9335 – Line 9 – how long did it take for steady state to be reached for the initial conditions run? P 9336 – Lines 8 to 10 – did you recalibrate the model to the different recharge values, or just run the model using the original calibration? P 9337 – line 1 – the increase in exchange flux was not ‘linearly’ proportional to ..... Was it logarithmically related, or somehow non-linearly related? P 9337 – line 11 – and duration on bank storage: add ‘volume’ if this is what you mean. P 9338 – line 1 – how do you define residence time? Is it for 50% of bank storage water to return to the river, or 90% or 100%? It may be 100% since you have diffuse recharge in the model, but I have seen it defined

differently where there is no diffuse recharge, therefore no baseline flow toward the river – hence not all bank storage water returns to the river. It might be good to specify this. Section 5.1 – this is really the crux of the paper I think. P 9339 – line 18, 20 and throughout – more steeply sloping banks. I assume steep banks to be close to vertical, but I think you are referring to flatter banks here (slope angle close to 0 degrees). I'm not sure if there is an international convention for the description of slope, but it may be better to refer to high and low bank slope angles. You have defined these in a figure at least. P 9340 – line 12 onward (to line 5 on next page). Is it possible to include a figure of the Lule River hydrograph, or a representative section of it? I would almost make this a new section from line 12 onwards, as you have started to discuss the Lule River specifically. It is also a very interesting discussion. I would love to see some kind of conceptual figure showing what the key parts of ecologically important flows – perhaps two conceptual hydrographs with one supporting ecologically important flows and the other not with notation why this is so. P 9341 – line 12 –Can you say what this optimal wave configuration is for the site that you have studied?

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