Hydrol. Earth Syst. Sci. Discuss.,
https://doi.org/10.5194/hess-2018-439-RC1, 2018

Hydrology and Earth System Sciences
Discussions

Interactive comment on "Assessing the effect of flood restoration on surface–subsurface interactions in Rohrschollen Island (Upper Rhine River – France) using integrated hydrological modeling and thermal infrared imaging" *by* Benjamin Jeannot et al.

Anonymous Referee #1

Received and published: 17 October 2018

Thank you for giving me the opportunity to review the work by Jeannot and co-authors "Assessing the effect of flood restoration on surface-subsurface interactions in Rohrschollen Island (Upper Rhine River – France) using integrated hydrological modeling and thermal infrared imaging". The authors have set up a surface-subsurface physically-based model to investigate the effects of flood restoration on an island of the Rhine river. After manually calibrating the model on groundwater heads following a flood event (injection), the authors have validated model parameters and their hy-

Printer-friendly version

Discussion paper

potheses on groundwater heads of another flood event, and further checked that modeled exfiltration patterns matched observations from airborne thermal infrared imaging. This allowed them to study the mechanisms of groundwater exfiltration in restored conditions, and to compare those results to a simple case of pre-restoration conditions. They have showed that in this case restoration indeed enhanced groundwater exfiltration. They further compared two injection scenarii, high rate/small volume or small rate/high volume, and showed that injecting less water but with high rates over short periods maintained exfiltration over longer periods due to the modeled processes (time scale differences between surface water and groundwater response to floods).

This very well-written manuscript, shows in a short and concise way through this case study how a surface-subsurface hydrological model can be used to investigate complex interactions involving short wavelength and small amplitude topography, fast (overland flow) and slow (groundwater) compartments. The authors did a good job in describing clearly the processes at the origin of the surface-subsurface exchanges directions and amplitudes, backed-up by appropriate figures. Although I have some minor comments which I think should be adressed before publication, I think this work is of high quality and suitable for publication in HESS. I think this is a significan step toward improving tools for bridging the gap between hydrological research and water management stakeholders.

The two main points I want to raise are related to hypotheses which need to be mentioned or discussed: 1) Why setting-up a lower cost numerical model by simplifying the Richards equation if this does not result in using stochastic methods for calibration, or any other specific advantage? Please also give the runtime for those simulations. For instance, having a low cost model could allow sensitivity analysis to help showing which features of the restoration or paleo-geomorphology mostly impact the exchanges. I could also help to give an uncertainty estimates to the soil parameters and to the restoration effects, which could further help stakeholders. 2) I am probably biased, but I think a surface-subsurface hydrological model with no surface boundary condition or

Printer-friendly version

Discussion paper

source/sink term has to be justified. While the high rates, volume and resistance coefficients together with rather short periods involved in the present study probably moves evapotranspiration uptakes to a lower order, and one may assume that no rain happened during the studied periods, those points need to be written down and eventually discussed, for instance for future applications where such a model could be applied over longer periods. Also the calibration and validation periods concern different season, likely to be under different evapotranspiration regimes. Also was the vegetation – and ET uptakes- the same before and after restoration? Although I agree that it is likely that ET has minor effect in this study, those points need to be discussed or mentioned. Finally, I also find curious that no mention to the impacts of surface-subsurface exchanges on ecosystem services for the specific case of the Rohrschollen island are discussed in the introduction, which is rather general, while the case study aspect of the paper clearly appears in the manuscript title.

Specific points:

- Introduction: could you provide exemple of hyporheic processes that have specific ecological importance for the Rohrschollen? Because the study site is in the title, I would expect some mentions to it in the introduction, which is overall a little long and vague... maybe cutting off some repetitions and adding up a brief section on the specific targets of the restorations on the ecosystems of the Rohrschollen would encourage the reader? This is just a suggestion to improve the quality of the paper. - L162: "degraded the hydrological, geomorphological, and ecological functioning of the hydrosystem." This line and the following sentences would benefit from indicating a proper reference. Consider using 'impacted' instead of degraded if no detailed description (or reference) of those functioning can be given. - Fig. 3: What is the baseflow in this case ? How is it obtained ? It is not discussed in the main text. - Fig 2 and 4 are not really the same... how have you decided to change the spatial structures ? - Fig. 5. KGE: I understand that you show both RMSE and KGE, because KGE does not change much when the simulation clearly matches less to the observation. This is

probably due to compensations in the KGE terms and can be discussed in the main text by giving the three KGE terms (variance and bias ratio, and correlation coefficient). - Fig. 5 and 6.: What are the boundary conditions time series on West and East sides ? Would it be relevant to show it? How much of the water comes from the side and how much from the flood? It could help to add up West and East bank boundary conditions and injection time series in this figure, for instance by lowering the size of the scatter-plot. - L 297: “Results from particle size analysis also helped to predefine variation ranges of crucial parameters, such as the hydraulic conductivity and retention curve parameters of the sediments and the exchange coefficient between surface and sub-surface.”: This is key, have you any validation data of the calibrated values? Particularly over the different patches? Did you use pedotransfers functions? Which ones?

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2018-439, 2018.

Printer-friendly version

Discussion paper