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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 #2**

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Review of the manuscript hess-2018-439 "Assessing the effect of flood restoration on surface-subsurface interactions in Rohrschollen Island (Upper Rhine River – France) using integrated hydrological modelling and thermal infrared imaging" for Hydrology and Earth System Sciences

Jeannot et al. in the manuscript "Assessing the effect of flood restoration on surface-subsurface interactions in Rohrschollen Island (Upper Rhine River – France) using



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integrated hydrological modelling and thermal infrared imaging" evaluate the efficiency of restoration actions adopted in Rohrschollen Island, in the Upper Rhine River specifically in terms of surface-subsurface flow exchange in the hyporheic zone. The surface-subsurface interaction is quantified with a fully-distributed hydrological model, the Normally Integrated Model (NIM). The exfiltration areas are of great interest for this study, as they represent the opportunity for hyporheic exchange enhancement. Using an innovative approach, the output of the validated model in terms of exfiltration is compared with the information derived from thermal infrared imaging.

General comments

I appreciated reading this manuscript, I found it very instructive and I think it is a valuable contribution to HESS. Authors address a key issue for ecological restoration and suggest an innovative framework to evaluate the impact of anthropogenic activities. I have some suggestions I would like to see addressed in a revised manuscript. My first observation concerns the model setup. I might have misunderstood, but the surface-subsurface flow interaction model seems to be not considering some input/output terms related to the surface processes, e.g., the precipitation and evapotranspiration. If they are somehow included in the model parameters this should be pointed out in the manuscript and, if not, this hypothesis should be clearly stated and justified. Another point related to the model setup concerns the time step and the time horizon of the simulation. These aspects are not discussed at all in the presentation of the model setup. Being this a study of the effects of some management policies, the reader expects a long-term problem setup. Moreover, the time step and the time horizon might influence the results and this should be discussed in the manuscript. In other words, the short time horizon implies calibrating the model on one event only, opening a debate about the robustness of the calibration, although the performance in validation might be convincing.

My second observation concerns the sensitivity of the results of the hydrological model to the calibrated parameters, such as the hydraulic conductivity. The authors claim

that the exfiltration areas are the result of rapid infiltration which produces an important increase in groundwater level. However, the exfiltration areas do not always coincide with the temperature anomalies observed in the infrared imaging. The authors point out possible causes of the mismatch but do not talk about the sensitivity of the model to the calibrated parameters. One could claim that the observed results might be due to an overestimation of the hydraulic conductivity in certain specific areas of the catchment. The discussion of this issue is required in the revised version of the manuscript.

Specific comments

L84-93: It would be interesting to have some examples of how increasing exchanges in the hyporheic zone contributes to the restoration projects.

L109: Wrong citation: “Fattichi” change into Fatichi.

L115: change computer into computational.

L124-126: Refer citations to the specific effect which is taken into account (water table dynamics, flood frequency, ecosystem services..).

L138-142: Better to express research objectives, possibly related to the discussion paragraphs: (1) model performance, (2) comparison between model results and TIR images and (3) comparison of different management options in terms of input quantity (and frequency, to add).

L296-299: The results from field experiments helped predefining the ranges of variations of some parameters of the model, but still some uncertainty exist on their calibration. It is worth commenting on the uncertainty coming from the calibration of the parameters of the model here and/or in the discussion section. Moreover, some parameters that I assume were calibrated (e.g., the Manning coefficients) are not mentioned in Section 2.2.2. Maybe a table with the starting range of variation of all the calibrated parameters and the calibrated value could be useful.

L277-305: Here the simulation time step and time horizon should be discussed, be-

cause the reader does not know which is the reference time scale, also because restoration processes are usually associated with long time scales.

L315: “After a first simulation employing the initial parametrization (defined in Section 2.2.2)” see comments below concerning the explanation of the model parametrization. It should be more exhaustive.

L320-322: “Only the hydraulic conductivity and the exchange coefficient between surface and subsurface were slightly adjusted while trying to preserve the initial spatial zonation” Not clear statement. Which is the initial spatial zonation? How was it defined? Does it mean hydraulic conductivity and the exchange coefficient are the only manually-calibrated parameters? What about the other parameters of the model? How were they fixed?

L341-360: The discussion is consistent, but Figure 5 and Figure 6 are switched, so Figure 5 refers to the validation and Figure 6 to the calibration. This Section lacks of comments on the impact of the simulation horizon. The calibration on a single event does impact the results of calibration and validation. Please, comment on this.

L354 and L357: It would be interesting to see the values of the three components of the KGE and their variation from calibration to validation.

L371-377: Among this factors also the sensitivity to the model parameters should be pointed out. Somebody could claim that the observed dynamic might be due to an overestimation of the hydraulic conductivity implying higher infiltration and consequently exfiltration on a much larger area than the one where thermal anomalies are observed. Moreover, it is difficult to quantify the uncertainty related to the airborne TIR images, which were collected in a single survey. Maybe some comments on this uncertainty might help the reader to evaluate the results robustness.

L406-408: It could be helpful adding in Fig.10 also the injected flow reported in Fig.3.

L424: “..noting that the new channel was excavated in highly conductive sedimentary

formations" this information comes from field experiments or from the parameters of the calibrated model?

L464: "..but maintains increased areas of exfiltration over extensive periods" the definition "extensive periods" would have a more precise meaning if the problem in terms of time horizons was discussed while defining the boundaries of the problem. The observation is suitable also for "long periods" at L467. Section 3.4 is very interesting because it tests two different mitigation strategies in terms of input rate and volume, but under the title "Suggestions for management practices" some more information is expected, for example in terms of exchange frequency required over one year in order to observe ecological enhancement. Adding some information in this direction completes also the conclusions of Section 3.3, where the authors state "When forced injections enhance the development of wetlands and maintain high rates of exfiltration over long periods, from the mere hydrological stand point, restoration works are successful", but how often does it happen? How often should it happen in order to enhance the ecological status of the environment?

Figure 5: switch with Figure 6.

Figure 10: Add the pattern of the inflow. Right y-axes change m3/s into m3/s. If possible, it would be nice to have enhanced image quality of Figure 5, 6, 8, 9 and 11.

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