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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Long-term river trajectories to enhance restoration efficiency and sustainability on the Upper Rhine: an interdisciplinary study (Rohrschollen Island, France)" *by* David Eschbach et al.

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Interactive comment on "Long-term river trajectories to enhance restoration efficiency and sustainability on the Upper Rhine: an interdisciplinary study (Rohrschollen Island, France)" by David Eschbach et al. -> Please note that the title will be modified by "Long-term river trajectories to enhance restoration efficiency and sustainability: an interdisciplinary study (Upper Rhine, France)"

GENERAL COMMENTS

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Discussion paper

The study deals with the long-term evolution of a reach of the Rhine River which underwent some restoration activities. Overall, I think it is a very good work: the novelty is combining reconstruction of morphological evolution with other aspects, specifically with geochemical characteristics of sediments. Some revisions are needed to make some parts more effective, especially the last section (see “specific comments”), and to put the work in a wider context (it could be useful to summarize one or two key points that comes out from this study and this restoration project). -> For this last part outlined in bracket, we will summarize the main findings of the study in a short conclusion.

SPECIFIC COMMENTS

“Study area” section (pages 4 and 5). The part dealing with the restoration project could be improved. I think it could be useful to describe a little bit more in detail the restoration project and, in particular, the aims of the project. This would be very helpful for improving the last section of the manuscript (4.4) (see one of the following comments). -> This will be done accordingly.

Page 8, L. 2. A brief explanation of the CM diagram method would be useful. -> This will be done accordingly.

IRSL dating. I have some concerns about using this dating method within this study: is this method appropriate to the temporal scale considered in this study? -> Indeed, the presented IRSL ages are close to the upper dating range of the method, but it has been shown in previous papers that ages of a few years can reliably be determined using luminescence methods (e.g. Ballarini et al. 2003, Quat. Geochron.; Madsen et al. 2005, Marine Geol.).

How much reliable are the results? -> This question applies in general to geochronological data, actually to any kind of data collected. For the present samples, we refer to the detailed discussion in Preusser et al. (2016, Geochronometria).

I am specifically referring to Figure 7, which shows that dates have significant errors

and reverse ages can be obtained (see pit 2, where there is a reverse relation between sediment depth and age). -> We cannot follow the reviewer here. What are 'significant errors'? The ages are associated with uncertainties of ca. 10 %, i.e. lower than those related to radiocarbon dating in this time range due to calibration uncertainties. As a matter of fact, there are no reverse ages in the study, see figure 7. The ages are all in excellent agreement within uncertainties.

Overall the contribution of IRSL may be considered useful for this study, since it constrains the age of fine sediment deposition, but it would be useful if authors would add some comments on such data. For instance, could alternative dating method be used in a similar context? -> Again, we refer to the paper by Preusser et al. (2016), providing a full overview of the topic and discussing the issues raised by the reviewer. Since such a discussion is well beyond the scope of the present study, we consider inappropriate to repeat it here. In summary, there is no alternative dating approach.

Section 4.4. This is part could be improved: considering the amount and quality of data, I think that the authors could make some efforts to make this part more effective. I think that they should try to go more in detail about the effects of the restoration project. For instance: were the project aims appropriate for this river reach? -> The effects of the restoration project cannot be developed here. The aim of this section is to highlight how long-term trajectory of the hydrosystem allows identifying the driving factors, amplitude and response-time of past disturbances. We show that this study is unavoidable and contributes to the construction of a restoration project. The effects of the restoration linked with the inherited morphological characteristics are developed in another paper submitted in Geomorphology. However, we will improve the text to highlight the legitimacy (efficiency and sustainability) of the restoration project, which is strengthened by considering the historical context.

To what extent are (or will be) those aims achieved? -> Again, this is developed in the paper submitted in Geomorphology. A retrospective analysis is carried out to determine the efficiency of the restoration project in the basis of a fine monitoring which is leading

in short term (3 years).

Which are the main limitations of a restoration project carried out at reach scale, such as the one described in this study? -> Main limitations are developed in section 4.4.2. For instance, we showed that fine sediments could be remobilized as well as pollutants bound in such sediments.

Other examples to improve this section: “in part, this functioning has been targeted by recent restoration efforts” (Page 21, L. 11-12), this could be illustrated more in detail; -> Of course, by “functioning” we mean “the functioning before major engineering works”, and by “restoration efforts”, we mean the creation of hydromorphological dynamics. Aims of the restoration are twofold: reinstalling lateral and vertical dynamics into the channel and stimulating bedload dynamics and groundwater - surface water exchanges. We propose to add the following sentence: Âń Indeed, this functioning and processes have been targeted by recent restoration efforts”: “More specifically, the restoration aims have been to recover bedload transport, lateral and vertical dynamics, as well as groundwater - surface water exchanges”.

“this highlight the impact: “works are irreversible” (Page 21, L. 20-21), this statement requires further explanations. -> We propose to give more information by adding the following text after “irreversible”: "... because the removal of very large amounts of fine sediments seems unthinkable. Furthermore, the strong hydrological alteration by the canalization works makes the functional alteration of the hydrosystem irreversible as well. In this context, the main challenge...". Following this idea, we will add the following text p. 22, L.23, after “...fine sediments”: “... and/or natural fine sediment removal by the recovery of active bank erosion in lateral channels”.

I am wondering if it could be useful to add a final section (e.g. “Conclusions” or “Final remarks”) where major outcomes of this study (both specific and general) could be summarized. -> This will be done.

Page 22, L. 30. This sentence is not clear: I think it would be useful to explain bet-

ter what could be likely the future evolution of this reach, and I would avoid a direct reference to Lane balance (it is a concept well known among geomorphologists but, probably, not for readers with different backgrounds). -> This will be done. We will add the following text: "...years/decades, in order to consider a likely future sediment deficit in the upstream extremity of the channel".

Figure 9. I have some concerns about this figure. Is it really meaningful to calculate sinuosity if channel configuration was multi-thread from 1743 to 1838? -> In braiding systems, sinuosity can be calculated by using the thalweg of the main channel.

Sinuosity is a key characteristic in single-thread channel, while less relevant in multi-thread channel. I think that it is not correct to assume that sinuosity in 1872 was 1 (it does not look like a straight channel!). I am wondering if this figure could be removed. -> The average axis of the active band (which corresponds roughly here to the 1872 channel) can be used as a reference to calculate the sinuosity, as this was also shown by Malavoi and Bravard (2010). Moreover, this figure cannot be removed because it summarizes the morphological planimetric evolutions driven by the engineering works, including the sinuosity.

Some suggests concerning terminology: "channelization" or "channelization work" instead of "correction"; -> "Correction" or "correction works" are the specific terminology used in engineering reports, books or articles to consider the first engineering works in the Upper Rhine River (project of Tulla). That explains why we preferred this terminology as "channelization". Moreover, this is previously specified in the introduction.

Page 14, L. 7. "Central bar" instead of "median bar". -> This will be done.

TECHNICAL CORRECTIONS

Page 1 – L. 21. "IRSL" instead of "IRLS" -> This will be done.

Page 2 – L. 1. It could be better to use a chronological order where several works are cited. Please consider this comment throughout the manuscript. -> This will be done.

Page 4 – L. 15. Figure 3 (as well as Figure 4, page 5 L. 7) is cited within the main text before Figure 2. -> We will remove the references to these figures.

Page 20, L. 2. What is the meaning of “NN”? Above sea level? -> NormalNull is a specific altimetric system reference used in the Upper Rhine. This means that the sea level reference is located in Germany (North Sea) and not in France (Mediterranean Sea).

Page 21, L. 5. “Different spatio-temporal scales”? -> We propose to keep this expression because it is commonly used to describe an interlocking of spatial scales and temporal scales

Page 21, L. 32. Eschbach et al., submitted is missing in the reference list. -> This will be done.

Page 22, L. 33. “Short” instead of “medium”? -> This will be done.

Figure 4c. A legend should be add to explain the two symbols of this figure (i.e. anchor points and RMSE errors). -> In the figure 4c, the legend of the bold and dotted lines refer to the line style used for the vertical axis.

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