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Earth Surface Dynamics Discussions

Interactive comment on "Reconstructing lateral migration rates in meandering systems; a novel Bayesian approach combining OSL dating and historical maps" *by* Cindy Quik and Jakob Wallinga

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Dear Editor and Reviewers,

Thank you very much for your kind words and appreciation of our manuscript. We will take your constructive comments into account, which form a valuable addition. Thank you for your detailed suggestions regarding text and style, we agree and all related points will be included in the revised version. Please find our continued reply below.

Interactive comment on "Reconstructing lateral migration rates in meandering systems; a novel Bayesian approach combining OSL dating and historical maps" by Cindy Quik and Jakob Wallinga
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1. Line 42 I suggest you add "and river management" after "land use". I am thinking of things such as weirs, mills, cut-off channels, bank modification etc.
We agree; this is what we meant with direct interference with the river; we have clarified the text to make this clear.

2. Line 53 There are some other papers that do this, e.g. including Kemp and Rhodes (2010) QSR, though I am not suggesting you include the citation.
We will include the citation, as well as a paper by Rowland et al., 2005.

3. Line 70 I very firmly agree that this is underexplored.
Thank you.

4. Line 138 This is an excellent selection of maps.
Thank you.

5. Line 140 Is "normalization" a recognised term here? I would possibly suggest "regularization" (not great) or perhaps simply "channel management works" (better).
We have changed it to "channelization", in line with the suggestion by Janet Hooke (see comment 24).

6. Line 145 It is not clear to me what "otherwise used" includes.
We have changed the sentence to improve clarity.

7. Line 175 It would be informative to know the values of what the range of spatial errors was here.
The spatial errors (RMSEs) are available in Table 1, we have added a reference to this

table at the end of the sentence.

8. Line 203 "The moment: : :" is not 100% accurate, as some electrons are emitted and recombine shortly after the light source is turned on. I would simply say "When" which has a lesser degree of suggestion of an instantaneous effect.
We agree and have changed the sentence.

9. Line 204 As partial and incomplete bleaching are a feature of some samples, I would try and be more precise here. I suggest you say something like "the OSL signal is reduced (bleached) to a low level, often close to zero".
We agree and have included your suggestion.

10. Line 244 It is useful to include the concentration and time of treatment for the HF here.
We have included details on the HF treatment.

11. Line 260. We need a reference to the measurement conditions, which are presented in Table 2. It is useful to describe the equipment used and the filters used (probably U340 on a Riso set, but let's be sure). Note, in Table 2, "10s cutheat to 180 deg. C" doesn't make full sense. A cutheat by definition is for held for no time. I appreciate that the heat treatment in the second part of the SAR cycle is often referred to as a cutheat to distinguish it from the preheat before the main OSL measurement, so perhaps you could either just use "10s preheat at 180" here, or if you want to preserve cutheat, say "10s "cutheat" at 180"?
We agree; indeed we used a heating of 10s for the testdose, but like to preserve "cutheat" to make a distinction with the preheat prior to measurement of the natural and regenerative signal. We therefore added the quotation marks as you suggested.

12. Line 322 The use of +/- to mean "approximately" is a little misleading, and not recognised scientific usage. Either use the "$\sim$" symbol, say "approximately". I was misled when I read this, as I assumed this was an uncertainty value on the width, rather than the width value used. In fact, as you used this width value, there is not really

any uncertainty on the value, only on whether it is appropriate (which I think it is!), so I would just say 30m here.
We agree and have changed all occasions where +/- was used to indicate "approximately" to the symbol $\sim$.

13. Line 335 It would be useful to know how much uncertainty in position there was here. Give us some typical or max/min values possibly.
We have added the maximum RMSE value and referred to Table 1, which lists the RMSE values for all maps used.

14. Lines 399-401. Some of this information is repeated from a few line above, so you can contract this first sentence a little.
We agree and have reduced the text here.

15. Lines 440-450 Is it possible that the channel widths varied significantly, for example during the progression downstream of a gavel slug?
There are indications that channel width varied through time (Candel et al., 2018), however this will have only have a minor effect on our analysis as the model has low sensitivity to reasonable changes in the z-values (as demonstrated by our sensitivity analysis). We included an additional paragraph in the discussion to address effects of spatial uncertainties.

16. Table 3 and elsewhere. Did you consider using CE (Common Era) rather than AD?
We agree that using CE is better and thank the reviewer for this valuable suggestion. We have changed all writing of BC/AD to BCE/CE notation.

Interactive comment on "Reconstructing lateral migration rates in meandering systems; a novel Bayesian approach combining OSL dating and historical maps" by Cindy Quik and Jakob Wallinga
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17. It would be useful to have a summary Figure at the end plotting migration rates themselves over time (with error bars) since much of the discussion is about these, though it can be inferred from Fig. 7.
Indeed it would be interesting to present such a plot, and we considered it at an earlier stage, and again following the reviewer's suggestion. Nevertheless, we decided not to include such a graph as it can already be deduced from the slope of the graph in Fig. 7. We feel that plotting this information separately (including uncertainty) would be of limited added value, as the precision and resolution of our chronological data does not allow inferences on fluctuations in migration rate. We deduce the average migration rate from Fig. 7 but recommend caution in interpreting rate fluctuations.

18. 40 not entirely true that historical maps only cover "cultivated" areas.
We agree and have modified the sentence.

19. 53 and elsewhere on p 2 - other literature should be acknowledged, e.g. Rowland et al. (2005). Need to be very careful in naming only one exception that literature search is absolutely comprehensive.
We have changed the sentence and included the citation.

20. 87 give width of channel so we understand its size - very important for subsequent evidence and analysis.
We added channel width.

21. Fig.1 and 120 - cannot refer to a paper that is only submitted and not available.
This paper is currently available in interactive discussion on ESurfD (https://www.earth-surf-dynam-discuss.net/esurf-2018-31/), we have changed the reference to the paper.

22. Section 3.2 Need a fuller review of use of historical maps. Hooke and Kain (1982) wrote a book on use of historical evidence, including guidelines on checks to be made. Other subsequent papers give more detail on accuracy in relation to meander changes.

Not all older maps necessarily less accurate. Certainly those pre 1840 in Britain were less accurate and not usable for river planform position but late 19thC / early 20thC OS maps at large scale were of high accuracy.
We have added references to general background information on using historical sources (including the book by Hooke and Kain, 1982). We added more references on the maps we used, as the historical background on their production and information on cartographers, survey techniques and depiction methods were addressed in previous publications. For checking map quality we rely on these publications and on our analysis with the MapAnalyst software, which is one of the most recent (2011) techniques for checking map accuracy and can be used in combination with modern GIS techniques.

23. 3.2.1 Discuss scale of maps.
We have changed the sentence that mentions differences between the maps to include scale.

24. 140 - "normalization" is a term to be avoided since straightening is far from normal and is completely artificial (although it is common translation). Use channelization.
We have changed the wording to "channelization".

25. 150 Finding GCPs is a frequent problem in analysing rivers because of lack of fixed features in floodplains. Is not simply due to nature of maps nut nature of floodplain landscapes.
We agree and have changed the text for clarification.

26. 3.3.1 Explain position of samples in relation to scroll bars and ridges and swales.
We have added two sentences to the manuscript text to explain the choice of sampling location and distribution of samples over the scroll bar deposits.

27. Precision of 3m seems unnecessarily low, Discuss effects on errors.
The GPS equipment we used had a precision of up to 3 m. We averaged the precision as recorded with our coordinates, which is 5 m. As sample spacing was 200 m, the

effects of these uncertainties on final rate estimates and trends are negligible compared to other uncertainties. As demonstrated by our sensitivity analysis, the model has low sensitivity for minor changes in the z-value (GPS position, channel width). We have added a paragraph in the discussion to address effects of spatial uncertainties.

28. 3.4 Indicate the width of scroll bars. It is possible to plot the trajectory of maximum meander movement if the scroll bars are highly visible on air photo or satellite images. This would be an added check and corroboration. Also indicates direction of meander movement in relation to the assumed profiles taken.
The width of the scroll bars is indicated in section 3.4 and used to calculate the k0-value for the model (77 and 42 m, for Junner Koeland and Prathoek respectively). The profile of Candel et al. (2018) was taken along a line perpendicular to the point bars. We have added this information to the section on the lithological survey, and refer to the Candel et al. (2018) paper for further details.

29. 299 Explain in more detail why or what is meant by assumption of randomness in deposition.
Randomness relates to the Poisson process; we mean that lateral migration rates can vary. We have added "varying in rate" between the brackets that were already in the sentence.

30. 312 but position only accurate to 3m
We have changed the wording and added the precision of the GPS (see also reply to comment 27).

31. 318 Channel width is very likely to have varied significantly over the period of the last few centuries. Numerous papers document such changes on European rivers. Thus assumptions about width introduce another uncertainty, which is assessed but the variations could be real. Again, could supplement with measurements of meander scroll widths if visible on images.
See reply to comment 15.

32. 323 Danger of circular argument. Need to be very careful about assumptions on migration rates since it has been shown that rates tend to accelerate with curvature and during bend development (Hickin, Hickin and Nanson, Hooke, numerous papers).
We are well aware of this challenge and prevented circular reasoning through the iterative approach, which we believe provides an eloquent solution to circumvent the problem.

33. 4.1 I found that maps earlier than 1840 tend to be much less accurate, including the 1st Ordnance Survey maps In England. May help to show presence and absence of features but not exact position. Agree with strategy to exclude the older maps (L439).
Thank you.

34. 417 & 464 state that river moves outside valley but river must be in the valley . Do you mean outside floodplain and moving into terraces and/ or valley wall? If extends into such materials they tend to be more resistant than alluvium so tend to impede channel movement, whereas development shown on Fig. 5 is relatively rapid. Need to explain what the channels move into and what was restricting them prior to that.
The investigated meanders have moved outside the former valley and through the former valley side, thereby expanding the floodplain and moving into Pleistocene fluvial deposits and cover sands, locally with Holocene drift-sands on top (all unconsolidated sediments). For clarification we added some lines on this in the section Study Area and emphasised the nature of the sediments reworked by the laterally migrating channel in line 417. The reason of prior restriction within the former valley side is partly addressed by Candel et al. (2018) and is the topic of our next manuscript, so please stay tuned!