Biogeosciences Discussions

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Comment on bg-2021-132

Paul J. Morris (Referee)

Referee comment on "Modelling long-term alluvial-peatland dynamics in temperate river floodplains" by Ward Swinnen et al., Biogeosciences Discuss., https://doi.org/10.5194/bg-2021-132-RC1, 2021

OVERVIEW

This is an interesting and largely well-written paper that describes the development and analysis of a new coupled model of channel dynamics and Holocene peat development in lowland riverine peatlands. The coupled model consists of the existing STREAM catchment model and the DigiBog model of peat development, which have been joined in thoughtful way to simulate what are arguably under-studied landscapes. The authors conclude that, unlike more commonly modelled ecosystems such as raised bogs, the Holocene development of riverine peatlands is likely to be more heavily influenced by channel dynamics than by internal feedbacks. The main contribution of the article is to provide the community with a new tool with which to study these ecosystems, which will surely be of interest to the journal's readership. The methods are detailed, and for the most part clear. I don't have any major concerns about the technical accuracy of the paper, but I do have some suggestions for improved presentation in some places.

SUBSTANTIVE COMMENTS

The methods are rather long, especially when one considers the extensive methodological detail in the supplementary material as well as the main article. This isn't a problem in itself; rather, I commend the authors for providing full and reproducible methodological details. However, the methods comprise multiple sequential steps of model development, which are introduced in a piecemeal fashion. There are the field data, their incorporation into the two models, algorithmic alterations to then two models, their coupling, the sensitivity analysis, and experimentation with an aggrading channel. Some of the alterations to DigiBog are quite extensive (productivity, water balance), but are rather hidden in the appendix – a short mention here would be appropriate. I for one would have

benefitted from a short, crisp overview at the very beginning of the methods (perhaps just a few sentences, in plain language), that primes the reader for all the various methodological steps and how they fit together. Some, but not all, of this information is conveyed in the final paragraph of the otherwise well-written introduction. This paragraph starts off with a statement of aim, but then rather drifts. I recommend having a short statement of purpose at the end of the introduction, and a methodological summary at the start of the methods.

On line 151, we are told that the simulated peatland is infinitely long in the along-stream axis. This is probably a reasonable starting point for these kinds of simulations. However, the diagram in Figure 3a seems to show the peat deposits as quite short, fat ellipses in plan, far from infinitely long. Figure 3a is probably closer to the reality of the situation, but isn't a good representation of the idealised simulations. I recommend adjusting Fig 3a to show peatlands then are (infinitely-) long, thin rectangles in plan, not ellipses. Figure 3b is fine.

On lines 184-5, we read that the simulated peatlands are not eroded by a laterally-meandering stream. I can't help but wonder if this is a realistic assumption for lowland riverine peatlands. Again, simulations with such a novel modelling framework have to start somewhere, and it makes sense to add complexity incrementally rather than all in one go. So I am not suggesting altering the model specification. Nonetheless, some consideration here of the limitations of this assumption would be appropriate. Basal radiocarbon dates can tell us about how old the peat can get before it is eroded away.

Figure 6 has an unusual presentation given that both temperature and precipitation are time series. I'm all for innovative graphics as long as they convey the intended meaning clearly, and I think it's useful to show these scenarios on climate space like this. However, I think it would also help to have two extra panels in the figure to display the two variables as time series for each of the two catchments, and to have numbered shaded bars to indicate the climate space of the six scenarios.

MINOR AND PRESENTATIONAL COMMENTS

Line 43: Here and throughout, the term "peat bogs" is somewhat ambiguous, and would be more clearly presented as "raised bogs".

Line 89: Here and throughout, I think "allows to" should be "allows us to".

Lines 210-214: Good idea to experiment with these parameters. From what we know about previous versions of DigiBog, anything that affects the water budget that is retained by/lost from the model is likely to be highly influential upon peat accumulation and development.

Lines 216-221: I agree with this interpretation that very low oxic decay rates and well-preserved peat are unlikely to be able to retain much water, thereby stunting peat growth. Again, this is exactly what we see in previous versions of DigiBog.

Line 247: The calendric unit BCE is somewhat awkward. I take this to mean before current era, in other words equivalent to the Christian calendar. In which case, 10,005 BCE equates to 11,955 BP (where 0 BP is 1950 AD). Converting from unusual date formats quickly gets tangled. I recommend presenting these dates in a more familiar format. What's wrong with BP, which is very widely used in Quaternary/Holocene studies? Either way, please define the baseline (zero) year unambiguously.

Lines 251-2: I think "selecting randomly daily times series" should be "randomly selecting daily time series".

Line 271: Now BP is being used for dates. Suggest using a consistent calendar throughout.

Figure 8b: Suggests that the river would erode the peat. See earlier comment about acknowledging the assumption that it does not.

With best wishes,

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University of Leeds, 6th July 2021.