

Clim. Past Discuss., referee comment RC2
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Comment on cp-2021-65

Nicole Sanderson (Referee)

Referee comment on "Carbon accumulation rates of Holocene peatlands in central–eastern Europe document the driving role of human impact over the past 4000 years" by Jack Longman et al., Clim. Past Discuss., <https://doi.org/10.5194/cp-2021-65-RC2>, 2021

This study by Longman et al. present a thorough synthesis of long-term Holocene carbon accumulation rates for the Carpathian Mountains, presenting data from eight new peat cores. This is an excellent addition to global peat datasets as records from mountain peatlands and peatlands from Eastern Europe and poorly studied. The Holocene dating resolution for the study sites is very impressive, as is the evaluation of the potential drivers for changes in CAR. The methods and discussion of a complex mix of drivers including anthropogenic impacts and dust inputs are well thought out and clearly presented, both from data-driven hypotheses and explanations from other studies in the region.

In general, for clarity, I would recommend that the site information, results, supplementary etc. are presented in the same site order every time, either from North to South or the reverse.

In addition, after reading such a well-presented and convincing "carbon story", I would have preferred the conclusion to end with larger-scale impacts for the future of the regions and further study. Perhaps adding that high-resolution studies of the last millennium or last couple centuries would be useful future studies to evaluate these drivers as well as recent anthropogenic impacts and future trajectories. Finally, the importance of the sites should be highlighted. Yes, it is a small carbon sink on a global scale, but what about the relative % for Romania or the Carpathian Mountain region?

In addition to the above general comments, I have the following minor points to clarify the methods and enhance the discussion, in particular relating to the age-depth models.

Line 19: suggest rephrasing to "in mountainous peatlands"

Line 49: suggest rephrasing to "on individual scales" to "for individual peatlands" or "on a local scale"

Line 72: suggest rephrasing to "important carbon sink for the regional carbon budget"

METHODOLOGY

Section 2.1 Refer to Figure 1 and Table 1 here in the text

Section 2.2: where were the samples for the other cores dated? What sample thickness was dated?

Section 2.3: There is a step missing here. To clarify, as with LOI calculations, was the C density calculated as 50% of the organic matter density (as in Turunen et al. 2002 and others by convention)?

It might be useful to present figures for the bulk density, C%, ash content for each core in the supplementary material, particularly in light of the focus in the discussion on dust.

Section 2.4: The time series with changepoint analysis aspect is really interesting!

I suggest that the LORCA and C stock sections be moved to section 2.3 (on Carbon accumulation calculations). There should also be a mention that these rates (CAR, LORCA) are all "apparent" rates, not accounting for decomposition, and not calculated from a net carbon balance.

Line 104: Clarify the simple LORCA definition before explaining the calculation. As in the Clymo and Turunen articles cited, LORCA is the cumulative carbon for the core divided by the basal age.

Line 117: The justification for limiting discussion of RERCA is very relevant here – focus on longer term rates! I would suggest adding a methodological justification that the dating resolution for the last ~100 years is limited for the cores presented.

Line 135: “averaging multiple records provides” (add “s” to provide)

RESULTS

I suggest, for clarity, that the results in the figures, models and tables be presented in the same order as in the methods.

Line 170: Suggest using consistent decimals for LORCA and CAR.

Line 186: peat bogs (separate the words)

DISCUSSION

In addition to mineral inputs from local erosion and deposition, could wind direction and/or exposure be factors to consider? For instance, in peatlands along the Gulf of St Lawrence in Canada had higher LORCA if they were sheltered from cold winter winds (<https://doi.org/10.1177/0959683614540727>), and other peatlands in NE China had increased productivity from mineral inputs from wind-borne dust from the Loess Plateau (<https://doi.org/10.1177/0959683619892661>). Note that, while I do find the anthropogenic driver argument provided by the authors very convincing, these could be additional climatic factors to consider.

Line 210: yes, this is a small global sink and the rapid nature of accumulation is great

But perhaps to further value the importance of this sink, could you put it in context in Romania? For ex. Is this more C than in forests? Is it 50% of annual emissions?

Line 345-346: Rephrase this passage for clarity. The decomposition is ongoing and recent peat has undergone less decomposition resulting in more “apparent” carbon. It’s not clear that it is being preserved or sequestered.

TABLES

Table 1. I suggest (for clarity) that the authors present the peatlands in Table 1 in the same order as in the map or figures throughout the paper.

It may also be useful to add the coring date and a very general description of peatland type (raised bog, blanket bog, fen) – perhaps split into 2 tables (for example, Table 1: site information; Table 2: peat data), or in the supplementary material if the authors feel this is too much for one in-text table.

Table 2. Add the units for RERCA

Table 3. Precipitation seasonality p-value for whole period should be <0.01

SUPPLEMENTARY MATERIAL

First paragraph: Rephrase - Sphagnum stems not stalks

Last paragraph: The dates were calibrated using IntCal20 (Calib 8.2?) not IntCal13, as stated in the main text. Indicate here also that the models were generated using the rbacon package (v.?) in R.

Age-depth models: As stated previously, the modelling resolution is very impressive! Below are some small points of clarification, or curiosity on my part.

- Supplementary Figures 1, 4 and 3: indicate in the legends that the bottom of these models is interpolated (e.g. BVU, the bottom-most 14C date is 144 cm yet the model extends to almost 200 cm and the basal peat). The rates calculated for these interpolated sections could bias the results.
- Supplementary Figures 6, 7 and 8: there is no surface input into these models. Were the dates interpolated from the top-most 14C date to the coring date? A brief sentence explaining this could be added to the legend.
- Supplementary Figure 2 (SUR): what is the green calendar date at ~35-40 cm?
- Supplementary Figure 6 (ZNG): Do the authors have any thoughts on why the accumulation rate is so low between 1000-8000 cal BP? Perhaps a hiatus in the model would allow for all the dates to be included, if there were a known disturbance such as erosion or a fire.

Supplementary Table 1:

- It would be useful to add columns for calibrated dates and modelled dates (and ranges) in addition to the 14C ages presented in the table. If not here in the supplementary material then definitely on Pangaea
- There is an error with the depth for the Mlhua core – basal depth is 6730 cm!

Supplementary Figure 9: Romanian peat bogs (add n to Romanian)