

Clim. Past Discuss., referee comment RC1
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Comment on cp-2021-65

Joshua Ratcliffe (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-RC1>, 2021

In this manuscript Longman et al., present eight new carbon accumulation records for peatlands in the Carpathian mountains and combine this with the one existing published record. Not only is this a highly novel paper due to the location and type of peatland analysed it is also an excellent contribution to the question of the drivers of long-term carbon accumulation in peatlands. Longman et al., have done an admirable job of untangling the complex drivers of peatland carbon accumulation both in their own data and in the earlier literature. The difference in dominant drivers between the early and mid-to-late Holocene is highly convincing and matches similar trends seen elsewhere for which others have thus far failed to find such a satisfactory explanation.

I find the main message of this paper quite convincing, that message being that long term peatland C can be controlled by either climate or nutrient factors and that indeed a combination of these two drivers are important. Although I am myself convinced of the direct role dust and nutrients can have on CAR, if I am to be the 'devils advocate' the authors may wish to consider and rule out the linkage between dust and/or mineral input and climate itself which presents a conundrum as to which is the direct or dominant driver of CAR. Dust inputs into peatlands have in themselves been used to reconstruct climate, with the expectation that increasing aridity results in more dust (e.g. <https://doi.org/10.1016/j.epsl.2009.03.013>). This raises the question about how independent dust inputs and climate really are. In the case of my own work in New Zealand it was quite easy to discount climate warming or aridity as we would not expect this after a volcanic eruption, but for this work the separation is less clear. This dataset might offer a simple opportunity to test this given the detailed climate and dust records the authors present. It might warrant inclusion of a new regression or correlation table in the supplementary material or at the least a sentence or two considering how dust and climate may be interlinked and how the authors can separate these as dominant drivers.

In addition to this point above I have some minor comments and suggestions, see below.

Figure 2. My personal preference here would be to reverse the x axis so the time goes from modern to older, but this is just a personal preference and should be the authors decision.

Supplementary Figures:

The inclusion of C content and bulk density records for the individual cores would be nice to see in the supplementary figures. Particularly how often and to what degree mineral material is being washed in and also, thinking for the future, this information could be useful for future synthesis papers regarding peat properties.

Methodology:

It should be stated somewhere that the AMS radiocarbon dates are primarily on bulk peat. This has been controversial in the past, however recently I think people are less concerned about this <https://doi.org/10.1016/j.quageo.2015.10.003> , however the situation could still change so it would be good to be clear about this in the methodology, not just the SI.

L19: Suggest for clarity changing to "mountainous peatlands"

L28: This is really interesting!

L43: Suggest you say "stimulates plant growth more than organic matter decomposition"

L52: This question of early human influence is extremely interesting if a little tangential, I remember a recent paper revising the ancient human population upwards considerably. If you have not seen it I quite like the following paper about the 'lost' medieval peatlands in Flanders Belgium. <https://doi.org/10.1007/s12685-011-0037-4>

L62: I don't remember Kylander et al., 2018 talking about the inputs of mineral soil into peatlands due to deforestation and there is not any mention of trees or forests in that paper that I can find using ctrl+f. It might be worth checking that reference. It's a very interesting idea though!

L72: Might be worth mentioning here how important these mires may be regionally for Romania/Serbia's carbon inventory, especially as so little carbon work has been done on them

L194: Also maybe worth mentioning that these numbers are more comparable to those from Eddy Covariance. It's also really cool that we have these high numbers now for down-core and gas measurements of C accumulation

L194: You might also want to consider this paper <https://doi.org/10.1016/j.quascirev.2019.03.022> where there was also comparably high C accumulation despite a relatively harsh climate.

L195: The nutrients are presumably coming in in 'pulses' which seems to be quite important according to a new pre-print <https://doi.org/10.31223/X5FW3J>

L269: This could be a good place to mention the geology and soil fertility in the Carpathians. Is it exceptional in any way?

L271: Please define the migration period, I am not familiar with this

L293:297: Nice summary!

L308: This also contradicts the following highly cited paper: <https://doi.org/10.1038/s41558-018-0271-1> however I can really believe this is the case given the bias towards regions with cold and continental climate

L346: I agree it is not possible to read too much into the recent changes for the reasons you have mentioned. I also recommend you remove the last sentence of the conclusion for this reason (L408)