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Biogeosciences
Discussions

# *Interactive comment on* "Climate-related changes in peatland carbon accumulation during the last millennium" *by* D. J. Charman et al.

**D. J. Charman et al.**

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The ms presents an interesting dataset of changes in carbon accumulation rate in peatbogs over the last millennium. The present research fits the topic of BG. However in the text and the figures I have noted some points that need to be clarified before publication in BG.

Figure 1 – I don't understand the caption for panel b. Could you explain it better?

RESPONSE: We have added more detail to the caption to explain the way in which climate space is defined (a combination of moisture balance and temperature expressed as growing degree days) and the use of the different colours to relate each grid cell



plotted in climate space to the carbon density map in panel a.

Figure 2 – The example is from the Misten Bog in Belgium. As several cores have been retrieved in this site (De Vleeschouwer et al., 2012; Allan et al., STOTEN, in press), you should precise the core number. Moreover the age model here is different than the published age model (see Figure 2, De Vleeschouwer et al., 2012). The difference is especially marked at $\sim$40 cm with different curvatures in the two age-models. As the selected age-model has an impact on the estimated PAR, this point must be clarified.

RESPONSE: The core is the same one used by de Vleeschouwer et al. (2012). The aim here was to treat all the cores in the most consistent way possible so we re-analysed all the published data and constructed new chronologies for all cores. Because we were interested in capturing potential accumulation rate changes we chose to set the memory to lower values than the default in the age-depth modelling program, Bacon. De Vleeschouwer et al. (2012) used settings closer to the defaults and these resulted in some differences in the age-depth model. There is of course no single known best age-model, so we do not know which of the two papers gets closer to the true accumulation history of Misten Bog. However, our analysis builds in uncertainty by using the resampling of different age-depth models (the one in Figure 2 is only one of 10,000 used for this core) and we are interested in large scale patterns of change so one site will not have a major influence on the overall conclusions

Section 2.4 – You should better explain why you define 1850 AD as the limit to exclude the carbon accumulation rate in the uppermost peat.

RESPONSE: On the basis of our collective field experience, we believe that pre-1850 AD peat is consistently below the aerobic decay zone at the various sites included in the analysis. The apparent increase in carbon accumulation in the uppermost peats is mostly or completely a result of incomplete decay in this zone and cannot be directly compared to earlier phases of peat accumulation. We have added a sentence has s to explain the rationale for using AD 1850. The choice is felicitous because it corresponds

to the widely accepted end point of the LIA, and the conventional definition of the pre-industrial.

Section 3.1 – In the text you precise that the strongest relationship between the carbon accumulation rate and climate is observed for the parameter PAR, with a R2 of 0.33 (Figure 5a). R2 is higher than for GDDO (0.19) but is this really significant? In the text you describe a weaker overall relationship between C accumulation rate and GDD. Indeed in the figure 5b the data may be clustered in two groups, the first one with rapid increase of C accumulation rate for GDD below 2 and the second one with limited increase of C accumulation rate but variable GDD between 1 and 4. Why do you not discuss those two trends that seem to be characterised by higher R2 than the whole dataset?

RESPONSE: There are various more subtle patterns in the plots suggested in Figure 5. The R2 for GDD0 is 0.13 (not 0.19). Both relationships are statistically significant ($p<0.01$). Therefore the strength of the linear relationship between carbon accumulation and GDD0 is weaker than that for PAR0. However, it is correct that there may be other non-linear relationships between the different variable such as that suggested by the reviewer here. However, the data are noisy and we have preferred to be cautious in our interpretations of the patterns in the scatter plots.. However, one of the intriguing patterns that formed part of our analyses is the difference in response between different peatland types. We have focused mainly on the overall response of the whole peatland data set, but separating the ombrotrophic principally Sphagnum dominated bogs from the minerotrophic sedge and higher plant-dominated fens suggests a link between plant community and peat accumulation rates with a stronger relationship between GDD0 and fen accumulation rates than for bogs.

Section 3.2 – In the text you observe “an overall downward trend in the composite C accumulation rates from AD1000 to 1850”. This trend is not obvious at figure 6a. The values remain quite stable between AD1000 and 1650 and then start to decrease in the younger section (AD1650-1850). You could plot the C accumulate rate versus the



modelled T° to better evidence the data-climate relationship.

RESPONSE: Yes, it is not a monotonic linear decline, although we quote the statistical significance and gradient. We have now added a comment on this to note that the change in the latter LIA is the greatest change. As suggested, we plotted the C accumulation against temperature (see figure). The IPCC data were smoothed to decadal means and the median value from both sets of data was plotted. With the exception of a few outliers, there is a good positive relationship with quite a lot of scatter. The correlation is not high ($r = 0.39$), but significant ($p < 0.001$).

Section 3.4 – The estimated decline of C sink during LIA is very low (1 ppm) in regard with the error (2.41 ppm). You should insist on this in your conclusion.

RESPONSE: We agree this is a small change (noted on p14345, line 9-10) and have now referred back to this again in the conclusion of the revised ms. References – All references listed are cited in the paper.

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Interactive comment on Biogeosciences Discuss., 9, 14327, 2012.

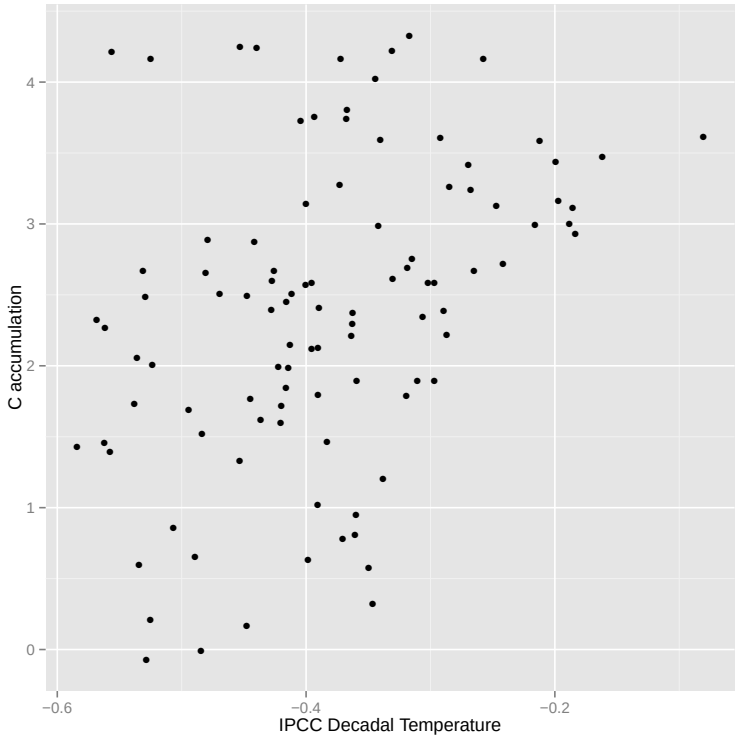


**Fig. 1.** Scatterplot of peat carbon accumulation rates against Northern hemisphere temperature from 1000-1850 cal AD, from data shown in Figure 6 of paper.