

Response

We want to thank the anonymous reviewer for the valuable comments. Below you can find our detailed responses (bold) to the comments:

Anonymous Referee #6

General Comments

In this paper, Kruger et al report the results of a study investigating the depth profile of various biogeochemical markers in peatlands. These markers are examined for their suitability in determining both qualitatively and quantitatively the level of peatland degradation. This paper is clearly appropriate for Biogeoscience, providing a useful assessment of the varying degrees to which stable isotopes, bulk density, C/N ratios, radiocarbon age, and ash content can be used to assess peatland health in the past and present. I believe the paper is suitable for publication, provided the authors address the issues brought up in the review process.

The authors may wish to consider rearranging the Results and Discussion section so that section 3.7 (radiocarbon age) appears before the other sections. This would allow them to make explicit linkages between peat age and the other biogeochemical markers. For example, in section 3.5, there is an inference of drainage activities owing to the enhanced ash content in the NW site between 10 and 60 cm. If the radiocarbon ages were presented earlier, this presumed drainage period could be linked to an actual date, and discussed in the context of the historical record.

Reply: The section 3.7 (radiocarbon age) will be presented earlier in the Results and Discussion part. We will discuss the enhanced ash content in the NW site between 10 and 60 cm in the context of the radiocarbon ages.

In some places, the units were a little different than elsewhere in the literature. For example, p2L24 (and others) use $t\ C\ ha^{-1}\ a^{-1}$. Consider using $kg\ C\ m^{-2}\ yr^{-1}$. This may be a convention for Biogeoscience, though.

Reply: We will change the units into $kg\ C\ m^{-2}\ yr^{-1}$.

When the authors reference GHG emissions, it is a little unclear whether this refers to just CO₂ emissions from the soil or to a fuller assemblage of GHGs including methane, N₂O, etc. For example, on P5 it discusses "Current GHG flux measurements", but then presents the actual fluxes in terms of NEP, which implies CO₂ fluxes only. Be clear about the types of emissions you are describing; if it's CO₂ flux measurements, say that so readers don't assume methane/N₂O were also being measured.

Reply: Fluxes will be presented in a clear defined way.

It might be helpful to have a concluding sentence in the abstract guiding readers as to which biogeochemical markers, based on this study, seem most useful for determining peatland degradation. Based on your results, it seems like ash content, in combination with radiocarbon age, presents a much clearer picture than either of the stable isotope profiles (especially nitrogen.)

Reply: An additional sentence with the most useful biogeochemical indicator(s) of peatland degradation will be added to the abstract.

In several places (P8L20, P10L12, P12L29) there is reference to the " upper centimeter" of the soil. Does that actually refer to the soil sample from 0-1 cm, or is it meant to convey soils in the upper horizon? Whichever it is, it needs to be made more explicit; i.e., " In the top 1 cm of the soil" or " From 0-10 cm). The paper could benefit from a close editing for English usage; there were some issues of clarity throughout the paper. I have noted some of them in the " Specific Comments" section.

Reply: In the whole manuscript depths will be presented in a clear manner. We will change "upper centimeter" in the whole manuscript to precise depths.

Specific Comments

P1L16 " lose carbon to the"

Reply: changed

P1L25 based on your results, the enhanced $\delta^{15} \text{N}$ is due to both decomposition and fertilizer application (in the GI case); the fertilizer application should be mentioned here as well.

Reply: we will add the fertilizer application in this sentence.

P1L27 . . . "This indicates that not only the managed. . . " It is a little unclear which marker is being described here. It could be read as just the ash marker (from previous sentence), or the whole panel of biogeochemical makers. If you are meaning to refer to the ash content only, saying " These ash profiles, not only in the managed grasslands but in the natural wetlands, indicate that all the sites were influenced by anthropogenic activities either currently in the past, most likely through drainage."

Reply: changed

P2L3-5 " . . . we calculated carbon loss from these sites in retrograde" reads a little awkwardly. Perhaps you could explicitly state the time frame for which you calculated C loss.

Reply: we calculated the total C loss form these soils since the peatland was influenced by anthropogenic activities. The calculated C loss by the combined method presents the total C loss since the peatland was affected by drainage.

P2L21 " GHGs from organic soils comprise 5.1% of Germany's national total emissions"

Reply: changed

P2L23-28 Keep units consistent! Either use C or CO₂ to trace emissions so readers don't have to scale on the fly.

Reply: We would like to do so, but the CO₂ emissions are presented as CO_{2eq} which includes the N₂O emissions from these sites and are only presented in this way in the literature.

P3L3 " almost constant with depth"

Reply: changed

P3L7 " show a slight decrease in $\delta^{13}\text{C}$ with depth"

Reply: changed

P3L21 I don't understand the " (wet) oxic soils" formulation. Is it different if the oxic soils are dry? Is this an important distinction to be made?

Reply: no, sorry to be unclear, we will delete (wet).

P3L29-30 Rather than " wider" C/N ratios, use " larger". Substitute " smaller" for " narrower". I think this is a more common way to express these ratios; check for other occurrences later in the text.

Reply: we will change in the whole text wider into larger and narrower into smaller. Please see also our reply to reviewer W. Bleuten.

P4L3 " aa" can be deleted

Reply: changed

P4L14 " weather"whether

Reply: changed

P4L28 remove comma: " The study area is located in Lower Saxony"

Reply: changed

P4L29 remove quotes around peatland name

Reply: changed

P5L7 " when conservation area" " when a conservation area"

Reply: changed

P5L13-25 Here you present a bunch of information on your 3 sites. It would be good if you could keep the sites in the same order throughout. Here you present GE before GI when talking about cut/fertilizer schedule, GI before GE when talking about drainage, and GI, GE, then NW when talking about carbon balances. It will be easier for readers to keep track of the differences between the sites if they are presented the same way each time.

Reply: We will keep the sites in the same order and revise the site description chapter.

P5L23-25 Either give the actual NEP values for all 3 or for none; here you give the exact values for GI but no numbers for GE or NWP.

Reply: We will add the information to the manuscript

P4L23 " The Net ecosystem" " The net ecosystem"

Reply: changed

P9L6-7 A more in depth explanation of how the different slopes point to different peat loss rates might be helpful. I understand how the overall pattern of $\delta^{13}\text{C}$ indicates relative levels of degradation, but it's harder to link the slopes to peat loss.

Reply: We will add a more detailed explanation to this part of our manuscript.

P9L7 " Below this point" - clarify. Below which depth?

Reply: changed in the revised version.

P9L14 " decrease in the upper" " decrease with depth in the upper"

Reply: changed

P9L20 delete " rather"

Reply: changed

P10L14 " Organic fertilizer may be" " Organic fertilizer may also be"

Reply: changed

P10L23 " C/N ratios are narrow" " C/N ratios are smaller"

Reply: changed

P10L26 you could add that these typical values indicate lower levels of microbial activity.

Reply: added

P10L30 " as well as the C/N ratio" " as well as decreasing the C/N ratio"

Reply: changed

P11L28 Include all sites in the first sentence: Carbon losses as induced by drainage are highest at GI and lowest at NW, as estimated by the combined bulk density and ash content method."

Reply: changed

P11L30 " higher current GHG emissions" " higher measured GHG emissions". Also, make sure that GHG emissions is correct; do you really mean CO₂ emissions?

Reply: changed

P12L7 " nowadays a C sink" " nowadays is a C sink"

Reply: changed

P12L22 check GHG vs CO₂ flux

Reply: the net ecosystem carbon balance of the NW site shows that this site is a C sink during the investigated years (Beetz et al. 2013).

Table 2: Is the $\delta^{15}\text{N}$ vs $\delta^{13}\text{C}$ column really necessary?

Reply: no, we will delete this column from Table 1 in the revised manuscript.