Dear Reviewers and Associate Editors,

Thank you for your thoughtful reviews and for allowing us the time to address the comments on our manuscript, "Characterisation and quantification of organic carbon burial using a multiproxy approach in saltmarshes from Aotearoa New Zealand." We appreciate the care taken by the reviewers to strengthen this work.

In response, we have substantially improved the clarity and presentation of the manuscript. Briefly:

- *Structure and readability:* redundant text removed and sections reorganised for clearer flow.
- *Methods clarified and streamlined:* methods streamlined and shortened where appropriate, sampling/processing order, terminology, and statistical approach are now clearly described and consolidated in Methods.
- *Figures corrected and enhanced:* map location fixed; accumulation rates replotted by depth with minor corrections; visuals reorganised for easier comparison and captions clarified.
- *Analyses focused and made more interpretable:* PCA configuration now stated and simplified; unnecessary explanations removed; detrending moved to Supplementary; cluster analysis results tabulated.
- *Results/Discussion tightened:* redundant text removed; uncertainty reporting standardised (mean ± SE); interpretation of $\delta^{13}C$ sources clarified, including limits distinguishing autochthonous vs allochthonous inputs.
- *Practical relevance strengthened:* final section now outlines implications for blue-carbon assessments.

We believe these revisions make the manuscript clearer, more robust, and more useful to the community. Thank you again for your time and constructive guidance. We hope the revised version meets your expectations.

RC2

Albot et al., provide a new dataset and exploration of saltmarshes from across New Zealand exploring the quantity and composition of carbon in these system. Saltmarsh carbon data from New Zealand is rare and has been absent from global studies, making this study especially important.

The quantity and quality of the data presented in the manuscript is highly commendable as it could be easily split into several high quality papers. The density of data in the manuscript results in it being hard to follow in places, the is a decision for the authors but splitting this in to two papers would be possible and would not reduce the impact of the research.

Overall the manuscript is written well, but reads more as a thesis chapter opposed to a research article, I would suggest taken time to remove some of the unnecessary information presented.

Author response:

We thank the reviewer for this thoughtful comment and appreciate the recognition of the dataset's value. We have streamlined the manuscript by removing unnecessary detail and improving clarity. While the data could be presented in two papers, we want to present a coherent and comprehensive package of data in 'one place'. This integrated format allows us to present a comprehensive picture of the methods that are available to assess carbon stocks, accumulation rates, and organic matter composition across a range of wetland sites. Our combined approach also allows us to compare and discuss variability in carbon source/provenance and accumulation between sites that have different histories and span several degrees of latitude.

Introduction

The introduction needs to restructured, though all the information is present in the text, the text is overloaded with unnecessary information that the manuscript does not tackle.

Author response:

We have removed lines 53-72 to make the introduction shorter and have made the writing more concise and to the point.

Methods

Line 141 - Remove grinder

Author response:

Thank you, this is addressed.

Line 141 - elaborate on how - Large roots and aboveground biomass were removed
Line 142 - The samples were not size fractioned as this research focuses on bulk soil OC - in the previous sentence it was stated that large roots were removed.
Line 141/142 - Are the sentences ordered correctly did you mill the sample then remove the roots, this seem back to front.

Author response:

Thank you for the comments. We have clarified the sample preparation steps and rationale in the methods section. The revised text now reads:

"First, large roots and aboveground biomass were manually removed from surface samples to avoid biasing average soil OM properties. We note that samples were not size fractioned as this study focuses on bulk soil OC, which includes belowground living plant biomass (e.g., small rootlets and rhizomes; Macreadie et al., 2017). All samples were then weighed, freeze-dried and weighed again, and homogenised using a ball mill."

This revision addresses the order of steps and explains why size fractionation was not performed.

Line 144 - change irMS to IRMS

Author response:

We have changed irMS to IRMS.

Line 160 - Lead isotope data - state which isotopes

Author response:

We have clarified which isotopes were analysed.

"For gamma spectrometry, sediment samples were packed into petri dishes and left to equilibrate for three weeks and then analysed to detect radionuclide activity to include ^{210}Pb, ^{137}Cs, ^{228}Ra and ^{226}Ra (Arias-Ortiz et al., 2018; Goldstein & Stirling, 2003). For alpha spectrometry, the samples were first processed to prepare the granddaughter ^{210}Po source, and the activity of ^{210}Po was then measured to calculate excess ^{210}Pb activities."

Line 160 - 177 - Does slicing the cores at 2cm intervals impact the quality of the radionuclide data, would doing it at 1cm resolution be more useful.

Author response:

We thank the reviewer for their comment. We state that the cores for ^{210}Pb dating were sampled in 1-cm increments.

Remove section 3.4

Author response:

We have removed Section 3.4 and integrated some of these methods into Section 3.2.

Lines 223 - 227 - remove these line they are not required.

Author response:

We have removed these lines.

Should section 3.6.2 and 3.6.3 be switched as the RPO analysis uses the Py-GCMS data (line 253)

Author response:

We thank the reviewer for this helpful comment. The current order of sections reflects the analytical workflow and the rationale behind it. RPO analysis is performed first to separate CO_2 fractions at specific temperature intervals, which are then radiocarbon dated to provide age estimates for different thermal fractions. Py-GC-MS is subsequently applied to separate sample splits to characterise the compound classes within those fractions. While Py-GC-MS can be conducted independently, performing RPO first informs the optimal temperature ranges for the Py-GC-MS ramped heating procedure. This approach ensures that the thermal decomposition steps in Py-GC-MS align with the preservation characteristics identified through RPO, providing deeper insight into the composition and stability of carbon pools. For these reasons, we have retained the sequence where RPO results are presented first, followed by Py-GC-MS analysis.

Section 299 - you do not need to explain what a PCR is, taken a more direct approach will shorten and improve the manuscript.

Author response:

We have streamlined this section and removed unnecessary text.

Figure 2 - in the methods you state the troel smith classification scheme is used, can you outline how this aligns with the soil descriptions.

Author response:

We have included an explanation in the Fig. 2 caption that the Troels-Smith classification was simplified to reflect peaty and minerogenic soils. Full descriptions following the Troels-Smith classification system are provided in appendices Fig. S1-S5.

Section 4.2 - the presentation of the data in the text is not required as it present in table 1.

Author response:

We have removed this section.

Figure 3 - could the plot be placed side by side.

Author response:

We have placed the plots side by side. During our revisions, we carefully reviewed and replotted all datasets. We identified and corrected minor discrepancies in bulk density calculations for several cores. These corrections have been applied consistently across all datasets and analyses, and the updated values are presented in the revised manuscript. While these adjustments had a minor impact on the results, they do not affect our interpretations or conclusions.

Figure 4 - the outputs from the Rplum model are not the easiest to understand can you make clear which one was produced by gamma vs alpha spectrometry.

Author response:

We thank the reviewer for this comment. The outputs shown in Figure 4 are generated by the *rplum* model using both gamma and alpha spectrometry data. Specifically, *rplum* integrates measurements from gamma (^{210}Pb, ^{226}Ra, ^{137}Cs) and alpha (^{210}Po) in a single run, so the resulting age-depth models represent a combination of these inputs rather than separate outputs. We have clarified this in the figure caption to make it clear that both gamma and alpha results contribute to the same model.

Section 4.5 - the use of detrending is interesting but the utility of the method to the manuscript has whole is questionable, I would move this to the sup mat.

Author response:

We agree that detrending was exploratory and have moved this section to the supplementary materials (Fig. S11). To further strengthen the analysis, we re-evaluated the restoration effect using the Okatakata core instead of Awanui. This wetland has a sediment accumulation rate that is closer to the national mean, and reduces the potential bias introduced by the high sedimentation observed at Awanui. We submit that this approach provides a more representative, preliminary assessment of restoration impact.

Figure 7 - As d15N data has been produced, did improve source estimation.

Section 4.7 - this section does not provide any results, could you remove or provide detail on what was measured.

Author response:

We have revised Section 4.7 to clarify what was measured and how these measurements were used in subsequent analyses. The updated text now explicitly states the elements quantified by XRF. Ratio calculations and proxy interpretations have been moved to the methods.

Section 4.8.1 - move the equation and ratio discussed to the methodology.

Author response:

We have moved all equations to the methodology.

Section 4.9 - could the thermograms be displayed.

Author response:

We thank the reviewer for their comment. The thermographs are provided in Figure S9 (Supplementary Materials).

Discussion

The discussion in generally written well, but as with other section there is a significant amount of unnecessary text, if this could be cut down the manuscript would be much more readable. The above comments concerning the results should inform the discussion.

Again I would like to state that the data in this manuscript is of high quality and the interpolation is well done. However the current structure and dense text struggle to communicate the importance of the study. There is unnecessary text and data that can be removed. I would also ask the authors to consider splitting this into two papers - 1) stocks and accumulation, 2) source

Author response:

Thank you for this valuable feedback and for recognising the quality of the data and interpretation. We agree that clarity and readability are critical for communicating the importance of this study. In response, we have streamlined the manuscript significantly by removing redundant text, condensing overly detailed descriptions, and improving transitions between sections. These changes reduce density and make the narrative easier to follow while retaining all essential information.

We considered the suggestion to split the manuscript into two papers; however, we believe that presenting stocks, accumulation, and sources/preservation together provides a more integrated understanding of carbon dynamics at the sites presented in this study.