Reviewer comments are in bold text while responses are in non-bold text. Line numbers refer to locations with the ***tracked changes version*** *of the document.*

Thank you for the opportunity to review the revised submission of "Organic matter composition and origin differ between restored and natural UK saltmarshes up to 100 years after the breach". Firstly, I would like to commend the authors again for making valuable comparisons and collating data across extremely heterogenous environments. Few papers investigating MR schemes encompass the level of site variability examined here, therefore providing an important contribution to the literature regarding the overall effectiveness of MR sites as C stores. Secondly, the authors efforts to amend the paper since last submission is evident and have significantly improved the quality of the manuscript.

My critiques of the revised submission will follow the same formatting as last time. I have. Provided my three most overarching critiques followed by line-by-line comments, referring to the tracked changes manuscript. I have not spent considerable time regarding grammar, spelling, or errors within the references.

1. My primary concern is the methodological consistency in which breach depth is identified. The results presented here have demonstrated that variability within and across sites requires additional proxies alongside foraminiferal data and that determination on a case-by-case basis may be necessary. However, the criteria for selecting a proxy to aid breach identification and in some cases explanation of how these proxies changed breach depth estimates are not clearly defined, which is essential for reproducibility. For example, OC/N ratios were used to widen breach depth identification, but no systematic application was described. Further within foraminiferal data, different criteria seem to be applied, with some breach depths identified based on the presence or absence of foraminifera and others based on changes in their abundance. It would be helpful to have a more developed and articulated framework used across all cores so that the approach can be more easily followed by the reader. The additional discussion regarding the benefits and downfalls of breach identification using foraminifera are a welcomed addition to the paper. However, I would encourage the authors to consider changing the use of the word success in certain parts of the paper, considering the method performs well in some cases but varies substantially among sites and cores.

First, thank you for a thoughtful and well-structured review. We believe that the smaller changes made as a result of your second round of suggestions have improved the manuscript further.

The breach depth of Fingringhoe Wick is now expanded based upon the foraminifera results so that the lower section of the OM peak is included in the range. Additionally, it is explicitly specified in the text that OC and N were *examined* for every site but that

expanding the breach depth range on the basis of this evidence was only deemed necessary for Brancaster West and Fingringhoe Wick (L415-L421). Furthermore, within the relevant figures (see Figures 4, 5. 7 and 8), red shaded areas are used to highlight the breach depth expansions that are based upon the OC and N results, while the blue shaded areas now represent the foraminifera-based breaches alone.

In the Abstract it is specified that foraminifera were successfully used to identify the breach depth within *individual* cores, as opposed to across sites as a whole (L31).

2. The discussion would benefit from a clearer overarching narrative, as it stands the individual sections currently read somewhat independently of one another. The discussion often shifts between broader implications, methodological considerations, and site-specific differences without a clear structure linking these themes together. As a result, the overall narrative can be difficult to follow.

Two paragraphs formerly in the Conclusions section have now been moved to different parts of the Discussion (L642-L654 and L661-L672). The former provides an introduction to the Discussion overall while the latter introduces the breach identification section. We believe that presenting a summary of the main conclusions before diving into the details makes the narrative of the Discussion easier to follow.

3. The implications of the study's findings within the conclusions should be discussed in more detail. Also, the novelty of this research should be further emphasized. Within the last round of reviews, we had described that reframing the novelty of using foraminiferal dating, of which the authors addressed in this resubmission. However, the broader significance and contributions of this paper are understated.

The Conclusions section has been expanded to ensure the significant and contributions of our findings are thoroughly discussed (L930-L962).

Abstract:

19-24: While C crediting establishes the context of this work, the paper only briefly discusses C crediting beyond the introduction and may place too much emphasis on C crediting within the abstract.

The emphasis upon C crediting specifically has been removed from the Abstract.

Furthermore, the wider implications of the study, including for carbon crediting, are now discussed in more detail in the Conclusions section.

Introduction:

107: Rather than having one small paragraph (121-127), it would flow better to make a new paragraph at this line.

This section has now been split into two roughly equally sized paragraphs. The paragraph on L92-L107 discusses bulk elemental and stable isotope analyses while the paragraph spanning L108-L127 discusses TGA.

112: Change "only" to largely. Recalcitrant and refractory OM can be lost at higher temperatures. Black C has been described to be lost within the thermal regions identified for labile OM (Helfrich et al., 2010).

"only" has been changed to "largely" (L113).

114-116: This sentence feels somewhat disconnected from the rest of the paragraph, as it introduces biological controls on OM/OC stabilization, whereas the subsequent discussion focuses primarily on physical and chemical stabilization mechanisms and their associated metrics. It may be helpful to either integrate the biological component more fully or clarify its relevance to the discussion that follows.

We believe that this sentence is important for explaining why OM protected and stable within a saltmarsh ecosystem would be burnt off quickly during TGA and thus appear highly labile. We have added an introductory section to the sentence to make this point clearer (L114).

126-127: It would strengthen the paragraph if this line was omitted or specific explanations were given to the limitations.

The following line has been removed from the end of the paragraph: "However, caution is needed when explaining any differences."

132: Is there any reason as to why visual interpretation using stratigraphy was not applied to determine breach depth? Would it be the same reasoning that applying radiometric dating cannot always be applied?

In our case, the cores appeared extremely homogenous along their entire lengths and so not much would have been gleamed from a visual interpretation of their stratigraphy.

Study sites:

179-193: Because this section is not site specific and is largely background information, I would suggest this section be incorporated into the introduction.

This paragraph was previously part of the Introduction but was thought to interpret the focus of that section upon the key aims of the study. Therefore, we would prefer to keep it in the Study Sites section. Given that it does not refer to a specific site, the paragraph has been moved from the "Restored marshes" subheading and is now part of a general introduction to the Study Sites section (L161-L274).

Figure 1b: The labels in panel b are still difficult to read because of the size. It might improve readability if larger text connected by arrows or lines to the pins. I will note however that changes since last submission have improved the figure substantially.

The size of all the text labels within Figure 1b have been increased.

197: I understand that "restored" indicates that Aldboro Point was not intentionally made to be a restoration project. However, I find it slightly confusing as it could be interpreted as the site may or may not be recovering. I have seen other papers use the word unmanaged realignment, which still differentiates it from the other intentionally managed sites.

"Restored" has now been removed and the phrase unmanaged realignment is used to describe the site instead (L192).

209, 227, 259, & 271: These sentences could be replaced with a single sentence saying the distance between coring location and the breach is recorded in Table S1 for each site.

These sentences have been removed and the suggested sentence added to L299.

Methodology:

292: Should this read that 3 replicate narrow-diameter cores were taken within the same area? If not, it is slightly confusing when considering the other three narrow cores on the map.

This sentence is about the wide cores. A sentence has been added to clarify what was done at each narrow core sampling location (L304-L306). A total of six narrow cores was taken from each site (as indicated by the six red markers in Figure 1) and within each sampling location, replicate cores were *not* taken because fewer analyses were planned for the narrow cores and so less material was required. Within each wide core sampling location (i.e., the two white markers in Figure 1), three replicate cores *were* taken within the same small area to ensure we had enough material for the analyses.

395-401: Please report the rate of temperature increase.

This information is now given on L403.

403: Why were the narrow and wide cores interpreted separately?

Narrow and wide correct were interpreted separately because they were subsampled at different resolutions and this justification is now given on L408-L409.

411: See main point number 1. Why was the additional OC and N data considered in this case to extend breach estimates but not for other cores? How was this systematically determined and how was it applied?

It is now specified in the Methodology that the necessity of expanding the foraminifera-based breach depth ranges based upon the OC and N data was *considered* for every site but was only actually necessary for Fingringhoe Wick and Brancaster West (L415-L421).

413: Please specify what the "totals" refers to.

This information has been added to L420.

Results:

Figure 3: The simplification of the figure since the first submission has improved clarity. It would substantially improve cohesion of the paper if the categories (red, blue, and grey boxes) were the same across all graphs, otherwise the categories appear subjective.

Categories have now been condensed into one key in the top left corner of Figure 3.

Figure 4: See main point number 1 and comments about line 411.

See our response to main point number 1.

Figure 6: The shortened axes have improved the figure. However, the figure is still incredibly complex. Reducing the reference data points to only a few key ones would reduce clutter and highlight the data. Also, the inset plots are too small to see clearly and obscure the graph. I would either make two separate figures, reincorporate the shading to indicate depth or put the depth profiles in the appendix.

The inset plots have been removed from Figure 6 and are now included as a separate, additional figure (Fig. 8).

Furthermore, the symbols used to represent the different possible OM sources in Figure 6 have been placed into two broad groups – "Marine OM" and "C_3 saltmarsh plants". Individual sources within the first group are green/blue coloured and are represented by simpler symbols while the second group are represented by more complex symbols coloured purple/red. These two groups are highlighted within the key to the figure. Additionally, the individual panels have been made wider to ensure datapoints have a clearer spread. Together, this makes the figure easier to read and understand. We have avoided removing reference data points because choosing which to get rid of would be relatively arbitrary. We do not know which specific marine OM sources are more likely than others to enter the sites. Also, nearly all of the C3 plant sources included in the figure were present within Aldboro Point and Brancaster West, meaning they should remain in the figure. While Brancaster West and Fingringhoe Wick were generally less diverse in terms of plant communities we believe it is better to keep the selection of possible sources consistent across the panels. Finally, the restored and natural marsh data points have been made large and slightly transparent in an effort to make them clearer to the reader.

669-672: It is not clear if the same breach depth identification methods calculated from the wide cores were applied to the narrow cores.

This section of the Results has been rewritten and added to so that the breach depth ranges applied to each set of cores is clearer (L620-L637). Furthermore, within the figures themselves (i.e., Figures 4, 6, 7 and 8), the key provides information about the depths used for breach depth assignment and stock calculations.

Table1 header: "using the evidence accumulated during the study" is not clear. This could be clarified to state stock calculations calculated using previously identified breach depths. Further, it was stated in line 667 that breach depth was changed with additional information which contradicts the header which states that calculations are based on foraminiferal results alone.

The Table 1 header has been amended and we believe the edits to the "Organic carbon stock estimates" section of the Methodology also add clarity to this matter.

Table1: The "Cores used for estimate" column is quite text heavy and could benefit from simplification. Also, using the sites full name in the "Site" column could make the table easier to read.

Full site names have been added to the "Site" column and the text within the "Cores used for estimate" column has been reduced and simplified.

Discussion:

715: It would benefit the discussion to provide a few sentences here restating the aims of the paper as well as stating the key findings and novelty of the paper.

A section has been moved from the Conclusions section that achieves this (L642-L654).

789: It may benefit the reader to have the key findings about the breach identification first followed by specific site descriptions and caveats

Another paragraph has been moved from the Conclusions section to provide a summary of the key findings at the beginning of the "Breach identification" section of the Discussion (L661-L672).

806-809: If I understand correctly, a 50 cm core with 20 cm of post-breach sediment accumulation should still contain the breach horizon. The discussion in the following lines about spatial variability in accretion rates across the MR site makes sense but this line is somewhat confusing in that context.

The core FS23/1 was only 20 cm long and so the breach depth horizon was likely missed. Although the other core, FS23/2, was longer, it was taken much closer to the breach and much higher rates of sediment accretion have been recorded by other studies in areas

close to the breach, again suggesting the possibility that we missed the deeper breach depth in this coring site.

We understand the confusion as the length of core FS23/1 was not specified in the paragraph and so we have now added this information to improve clarity (L694-L695).

817-821: When it is stated that absent foraminifera are interspersed with low abundances, I interpreted this as meaning that the breach horizon is present but cannot be identified with confidence. However, it is then suggested that deeper cores are needed to capture the pre-breach agricultural sediments. These seem like two different issues, and it is not clear how they are linked.

After a run of entirely empty samples from the lowermost depth to 19 cm, the core FW23/2 contained samples with low numbers of foraminifera interspersed with empty samples, from 12 cm the jump to high numbers of tests occurred. In the Brancaster West cores, we are missing the initial series of entirely empty samples and have only the section, presumed to immediately follow the breach, in which a mixture of empty and low (i.e., in terms of foraminifera numbers) samples are seen – suggesting that the pre-breach agricultural sediment is *not* present in the top ~50 cm of the site. Our thinking is that taking deeper cores would have allowed us to find the sediment layer entirely absent of foraminifera.

Reference to core FW23/2 has now been added to the relevant section (L705-L706).

1041-1045: This is more of a justification of the methods used and does not particularly add to the implications of the findings. I would suggest moving this sentence to the results or methods section.

This sentence about N losses has now been moved to the Results section (L587-590).

1077: Because this section is largely surrounding OM composition, renaming it could make the structure and progression of ideas easier for the reader to follow.

The title for this section has now been changed from “Elevation” to “Organic matter composition”.

1105-1119: Perhaps this belongs within the breach identification section.

We prefer not to move this section to “Breach identification” because a lot of the arguments made depend upon the information presented in the preceding paragraphs.

Conclusion:

1168-1179: This paragraph provides a succinct overview of the study. Moving it to the beginning of the Discussion, or adding a similar brief overview there, could help orient the reader.

This paragraph has now been removed to the beginning of the Discussion (L642-L654).

1180-1188: The implications of the findings are clearly articulated here. However, the implications are not discussed in as much detail throughout the rest of the Discussion. It would strengthen the paper to integrate more of the implications and broader meaning of the results throughout the Discussion or alternatively expand this section further. For example, while the Introduction provides a detailed discussion of C crediting, only a single sentence is devoted to this topic here, leaving an opportunity to more fully connect the findings to wider applications.

The Conclusions section has now been expanded to ensure the implications of our results are fully discussed (L930-L962).

1158-1202: providing a brief statement of the contributions or novelty of the paper would bolster this works contribution to the current literature.

See previous response.

Supplemental:

Figure S4: Please include what is defined as low number of tests in figure legend and/or the key.

This information has now been added to the Figure S4 key.

Overall, the edits made since last submission have significantly improved the paper. The results of this study demonstrate that the interpretation of results across different types of MR sites is imperative to consider due to the substantial variability within and across MR schemes. This study therefore offers an important contribution to the literature as it collates data across multiple sites, which is often a limiting factor in many other studies. The aforementioned comments detail that the paper would greatly benefit from for a clearer and consistent description of the approaches used to identify breach depth, as well as a clearer progression of ideas in the discussion with a greater emphasis on the implications of the findings. I enjoyed reading this paper and hope that the authors find these comments constructive.