Respond to RC1: 'Comment on egusphere-2025-5352', Anonymous Referee #1, 16 Dec 2025

27 February 2026
Camiel Aggenbach

The respond on the comments in *cursive* text. and mostly refer to line numbers of the new manuscript.

General comments
The manuscript by Aggenbach et al. addresses a timely and important topic: the effects of drainage and rewetting on biomass production and decomposition, key processes underlying peat formation and carbon storage in temperate fens. The study is thorough, with a large number of sites and well-executed methods. The finding that nutrient availability and soil depth had a stronger influence on productivity than hydrological status, particularly during an unusually dry and warm season, is insightful and highly relevant given the increasing frequency of European heatwaves. This result has important implications for peatland restoration, suggesting that rewetting alone may not be sufficient to restore carbon sequestration potential and that nutrient regimes and peat depth should also be considered. A clearer introduction and a more concise, confident conclusion would strengthen the abstract and better communicate the significance of the study. The methods are generally sound, though a justification of the ingrowth core substrate for belowground production and clarification of how the small number of replicates per site were incorporated into statistical analyses would strengthen the manuscript.
Overall, the study provides valuable insights into the drivers of fen ecosystem functioning under changing climate conditions and will be of interest to the peatland and carbon cycling research community.
We thank the reviewer for the compliments. Our reaction to comments is covered in our reaction to specific comments below.

Specific comments
Abstract:
The abstract would benefit from a clearer introduction to the broader context and importance of the research topic. It currently opens with the study hypotheses but does not provide sufficient background on why the topic matters. I recommend beginning with a few sentences that highlight the role of peatlands as major carbon sinks, the existing gaps in our understanding of carbon cycling in these systems, and how this study aims to address those gaps. For instance, *in-situ* measurements of biomass production and decomposition, particularly belowground, are still underrepresented in fen peatland studies, even though they are crucial for understanding the effects of drainage and rewetting on biogeochemical cycling and carbon storage in these managed ecosystems.
*We thank the reviewer for pointing this out and agree that it is important to include the broader context. We have added a new introductory part to the abstract (**L30-36**).*

The results section of the abstract is detailed, but the emphasis on hypotheses could be reduced in favor of clearly presenting the most important findings and their implications.
We followed this recommendation and changed the text.

The final sentences currently sound overly cautious and may unintentionally undermine confidence in the results. Rather than framing the extremely dry and warm growing season as a limitation, I encourage the authors to consider discussing the relevance of these conditions, given that many peatlands have been experiencing similarly warm and dry summers over the past decade(s). These observations are not simply anomalies but reflect ongoing climate change, which makes your results particularly timely and valuable.
*We agree and thank the reviewer for this recommendation. We have now changed the part about influence of the hot-dry summer and added some reflection on effects of such events and climate change which were addressed in the discussion (**L51-54**).*

Introduction:
L59–60: Please clarify whether this statement refers to a global context.
*We have added "on a global scale" (**L59**).*

L72–73: Reference is missing for this statement.
*Reference Jaszczuk et al. (2024) has been added (**L72**).*

L72–73: The end of this sentence is unclear. I suggest rephrasing as: "In fens, peat accumulation is strongly influenced by belowground biomass from vascular plants, especially sedges (*Carex spp.*), which often provide the largest share of organic inputs."
*Done (**L71-72**)*

L76–77: End the sentence after "rare" and start a new sentence afterwards.
*Done (**L76**).*

L76–80: Some redundancy exists regarding the scarcity of belowground data. I suggest merging these lines into one sentence: "In situ observations of belowground biomass production and root responses in fens are generally rare…"
*Done (**L75-76**).*

L83: Reference is missing.
*We have added two references (**L80-81**).*

L88–89: Consider naming some of the abiotic factors you investigated, providing examples, or simply referring to Fig. 1.
*We have added main factor groups and referred to Fig. 1 (**L86-88**).*

L93–94: Rather than "displacement peat," you might say "less peat is formed by root ingrowth", which is more straightforward and emphasizes the relevance of your study.
*Done (**L93**).*

Methods:
The large number of sites and the broad geographic and climatic coverage are a major strength of the study. A map showing the spatial distribution of the 39 sites across Europe would greatly help readers visualize this gradient.
*We included a map with the research sites (**Fig. 1**).*

I suggest citing Table S1 of the supplements already in the opening sentence of the site description, so readers immediately know where to find detailed metadata on site

characteristics and history. This would facilitate understanding of the regional grouping and site categorization.

*We have added a reference to Table S1 at the start of the site description in order to indicate directly where meta-information for the single sites can be found. (**L103-104**).*

Further, the description of rewetted sites would benefit from more explicit information on management history, such as the approximate time since rewetting for individual sites or site groups. While the authors note that rewetting occurred "a few years to several decades"

*We agree and have added details on the rewetting date of all sites (**L115-119**).*

(**L116-117**) prior to sampling, a more constrained range or categorical grouping would improve transparency and allow readers to better assess potential legacy effects of drainage and rewetting.

*Done, also compare to response to the previous comment (**L115-119**).*

L144: I acknowledge the substantial logistical effort involved in implementing ingrowth cores across such a large number of sites. I also understand that using autochthonous peat material is often not feasible on this scale (three replicates per site across 39 sites makes n=117 cores in total?; please confirm).

*Yes, is right. an changed a sentence to: "After re-collection in 2018, each of the 113 (of 117) ingrowth cores retrieved intact" (**L162-163**).*

However, the sand–nylon substrate differs markedly from peat in key properties relevant for root growth, despite the authors' attempts to resemble the average peat bulk density of all sites. Variables such as water-holding capacity, nutrient availability, oxygen conditions and microbial activity must differ substantially between peat and sand substrates. Justifying this choice and discussing how these differences may influence root and rhizome ingrowth relative to the surrounding peat would help readers to better interpret the belowground production estimates.

*We did some validation of our measurements with respect to the substrate in the ingrowth cores, but did not add the result to the initial text in order to limit the length of the manuscript. Now, we have added it to respond to the clear demand for explanation (**L154-161**).*

L145: Since the dominant species are sedges (**L258-269**), please explain how vertically installed ingrowth cores capture realistic belowground production in species that have horizontal rhizome growth but also, to a great extent, vertical root growth. Could that have led to an underestimation of root compared to rhizome growth or even an underestimation of root production in deeper soil depth (**L450-452**). If yes, was this accounted for?

*We agree that vertical in-growth cores can potentially cause bias with regards to root orientation. To our knowledge, though, there are no direct comparisons published between vertical and angled or even horizontal cores which would allow for a quantification of this potential bias. We now have added a statement addressing this to the text (**L172-176**).*

L160-161: Please also indicate the mesh size of the Rooibos bags then.

*Added (**L182**).*

L200-206: Please add a formula to this description of calculating the peat formation potential. Is this method based on any reference?

*We have added formula and a reference (**L224-225**).*

L275-302: The authors state that replicate measurements were averaged per site and that these site means were used for subsequent statistical analyses. This approach is appropriate for avoiding pseudoreplication, however, it would be helpful to clarify consistently which explanations apply to which analyses. In particular, for the random forest analyses it remains unclear whether site-averaged values or individual replicate measurements were used, and how within-site dependence was handled in this context. Given the relatively small number of replicates per site and the high spatial heterogeneity typical of fens, a brief clarification of the unit of replication for each analysis would strengthen confidence in the robustness of the results.

With our analyses we focused on between-site variability, and with three or five replicates it makes not much sense to account for intra-site variability. We have added to section 2.8 (Analyses of the effect of hydrological status and soil depth) and section 2.9 (Impact of environmental factors on plant production and plant biomass decomposition) that we used site-averaged values of productivity and decomposition.
*We have added to section 2.3 (**L168-170**) and 2.4 (**L209-210**) the number of replicates per site for productivity and decomposition measurements and its derived variables.*

Just a site note, why was the ANOVA performed with a different R version (4.2.) than the random forest analysis (4.3.1)?
This had a practical reason: ANOVA was done by another person on another computer than the random forest analysis.

Results:
L325: "mass loss of local/root belowground biomass"
Figure 2 and 3: Several figures in the manuscript use color schemes that may be difficult to distinguish for readers with color vision deficiencies. Ensuring figures are colorblind-friendly is important because it improves accessibility, allows all readers to accurately interpret the data, and avoids misinterpretation of patterns or trends. I recommend using color palettes that are designed for colorblind accessibility (e.g., viridis, RColorBrewer, scico or colorspaces are some examples for R packages I can recommend) or adding distinct symbols/patterns in addition to color to convey information. Very helpful tool: https://www.color-blindness.com/coblis-color-blindness-simulator/
*Thanks for the useful tip. We have changed the colours to the Okabe–Ito palette which was specifically designed to be colour-blind friendly and remains distinguishable when printed in grayscale because the colours differ strongly in luminance (**Fig 3 and 4**).*

Discussion:
L539-556: I assume the conditions observed during the study year were extreme compared to long-term averages calculated over several decades. It would be helpful to put these conditions into context relative to the last decade as well. Were such warm and dry conditions still very unusual, or have similar events become more frequent? Providing this context would help readers interpret the observed patterns of productivity and decomposition in light of ongoing climate trends.
*Thank you for this suggestion. We agree and have added a dedicated section to the discussion (**L569-576**).*

L502: A reference is missing.
*We have added two references (**L531-532**).*

Technical corrections
in-situ in italics throughout the text
Has been done

Please use spp. instead of spec., as it is the correct and widely accepted abbreviation for multiple species within a genus.
Has been modified accordingly.

L106: Delete one "a" or move the first "a" in brackets.
Done

L271-272: Please introduce abbreviations of carbon and nitrogen and phosphorous, potassium, FAAS as well as CFA. Check the document for more of these unexplained abbreviations.
Done except for very obvious abbreviations like ANOVA, DW.