Reviewer 2,

thank you very much for your detailed and constructive feedback provided within your major and smaller comments, which helped us to improve the manuscript.

The original manuscript and the study design focused on determining temporal variability and exploring biogeochemical interactions in summer, probably the most interesting season regarding GHG dynamics, and in a very complex and heterogeneous ecosystem. Many coastal peatlands (about 40,000 ha in MV) could be rewetted in this way, so there is a large potential and importance for rewetting coastal peatlands, partly with the option of rewetting with brackish waters. Due to the complex ecosystem and novel technology we used, we put strong emphasis on technical description, data analysis and interpretation of the underlying drivers and biogeochemical processes.

We also saw the issue that there is little literature on the rewetting of coastal peatlands by means of dyke removal. Furthermore, comparability to other studies is limited by very different environmental settings, so that the existing literature and data must be analyzed in a complex way, for example, by extracting only measurements from the summer months, to reach comparability to our measurements.

However, we understand that both reviewers saw the shortcoming of not putting our work in a broader perspective and suggested a better discussion of the findings in the framework of existing literature, and we are very thankful that the reviewers pointed this out.

We have taken many measures to reorganize and improve the text based on the major comments. We have analyzed the comments of both referees (RF1 and RF2) and identified major commonalities and strong similarities in the argumentation. We adressed these similarities between the referee comments by joint measures in the two responses to the referees (authors response (ACs)) which prompted us to formulate identical responses that address the following:

A) Restructuring of the abstract to better address the scientific question of greenhouse gas dynamics and the underlying biogeochemical drivers
B) Restructuring of the introduction to provide more context on the relevance of greenhouse gas reduction and to indicate that novel technology was used for this study
C) We tried to improve the clarity of the scientific question by emphasizing the biogeochemical interpretation before the technical description at appropriate points. For this reason, we also moved the discussion on the match between sensor data and results from discrete water sampling (former chapter 4.5) to the appendix.
D) We did our best to discuss our results on CO_2 and CH_4 fluxes in a broader scientific context by adding a new section 4.4.1. to the discussion.

In the following, we have reposted the comments by the reviewer (in bold) and placed our responses below them. Envisaged text changes/amendments are indicated by quotation marks.

1. **General comments**

The article presents interesting new data from an understudied ecosystem. It is well written and graphs are well presented and appropriate, while data and observed phenomena are well described. However, it is insufficiently placed within the context of the ecosystem measured and the potential wider implications of the ecosystem processes revealed. The emphasis of the article is overly weighted towards the measurement technique which is not claimed as novel. As I read it, the interest here is instead in presenting high resolution data from this particular ecosystem. Detail about "the landers" is placed ahead of the ecosystem in question throughout the article. The analysis of the data is there but it is not sufficiently presented in contrast with existing literature on ecosystem GHG production, fluxes and the processes that drive them.

The data and analysis presented here are certainly worthy of publishing, but I would say the article needs a substantial restructuring to change the focus, starting with a stronger emphasis on the research questions relating to the ecosystem.

Reply:

A) Abstract

Significant changes are proposed for the abstract to better reflect the clarifications and extensions envisaged for the revised manuscript.

- Shortening of a section which will be moved to the introduction (line 17-21)
- Inclusion of a sentence highlighting the novelty of the measurement technology (line 24)
- Inclusion of the Spearman correlation to better indicate the focus on the analysis of drivers and biogeochemical processes (line 26)

Taking account also minor changes requested by RF1 and RF2, we wil provide a new version of the abstract:

"**Abstract.** Rewetting peatlands is an important measure to reduce greenhouse gas (GHG) emissions from land use change. After rewetting, the areas can be highly heterogeneous in terms of GHG exchange and depend, for example, on water level, vegetation, temperature, previous use, and duration of rewetting. Here, we present a study of a coastal peatland that was rewetted by brackish water from the Baltic Sea and thus became part of the coastal shallow Baltic Sea water system through a permanent hydrological connection. Environmental heterogeneity and the brackish water column formation, require improved quantification techniques to assess local sinks and sources of atmospheric GHGs. We conducted nine weeks of autonomous and high-resolution, sensor-based bottom water measurements of marine physical and chemical variables at two locations in a permanently flooded peatland in summer 2021, the 2nd year after rewetting. For the study, we used newly developed multi-sensor platforms (landers) customized for this operation. Results show considerable temporal fluctuations of CO_2 and CH_4, expressed as multi-day, diurnal and event-based variability and spatial differences for variables dominantly influenced by biological processes. Episodic and diurnal drivers are identified and discussed based on Spearman correlation analysis. The multi-day variability resulted in a pronounced magnitude of measured GHG partial pressures during the deployment ranging between 295.0–8937.8 µatm (CO_2) and 22.8–2681.3 µatm (correspond to 42.7–3568.6 nmol L^{-1}; CH_4), respectively. In addition, the variability of the GHGs, temperature, and oxygen was characterized by pronounced diurnal cycles, resulting e.g., in a mean daily variability of 4066.9 µatm for CO_2 and 1769.6 µatm for CH_4. Depending on the location, the diurnal variability led to pronounced differences between the measurements during the day and night, so that the CO_2 and CH_4 fluxes varied by a factor of 2.1–2.3 and 2.3–3.0, respectively, with higher fluxes occurring over daytime. The rewetted peatland was further impacted by fast system changes (events) such as storm, precipitation and major water level changes, which impacted biogeochemical cycling and GHG partial pressures. The derived average GHG exchange amounted to 0.12 ± 0.16 g m^{-2} h^{-1} (CO_2) and 0.51 ± 0.56 mg m^{-2} h^{-1} (CH_4), respectively. These fluxes are high (CO_2) to low (CH_4) compared to studies from temperate peatlands rewetted with freshwater. Comparing these fluxes with the previous year (i.e., results from a reference study), the fluxes decreased by a factor of 1.9 and 2.6, respectively. This was potentially due to a progressive consumption of organic material, a suppression of CH_4 production, and aerobic and anaerobic oxidation of CH_4, indicating a positive evolution of the rewetted peatland into a site with moderate GHG emissions within the next years."

B) Introduction

Significant changes are proposed in the introduction.

To set the topic into a broader context, we want to give more information in the first paragraph (from line 43).

"Mitigating climate change requires a reduction in anthropogenic emissions of the greenhouse gases (GHGs) carbon dioxide (CO_2) and methane (CH_4) and the effective removal of CO_2 from the atmosphere (IPCC 2022). In all climate scenarios with a realistic probability to reach the Paris Agreement, aiming to keep anthropogenic temperature increase "well below 2 °C" (IPCCSR15, IPCC2023), land use, land use changes and forestry (LUCLUF) play an important role. Still, a large part of the hard to abate residual emissions projected in these scenarios for the 2nd half of this century come from the agricultural sector. Land use options with a large potential for climate mitigation include, for example, forestry, agriculture (pasture and cropland), wetlands, and bioenergy, (Roe et al, 2019, Shukla et al., 2019). In addition, in coastal areas, blue carbon options such as restoration and expansion of mangroves, salt marshes and seagrass meadows are suggested to have some potential for CO_2 removal (Macreadie et al., 2019, Duarte et al., 2013). The rewetting of formerly drained peatlands has beeen identified as one of the most promising approaches to lower CO_2 emission of used land, potentially even allowing turning (or re-establishing) some of these areas into CO_2 sinks (IPCC 2014, Wilson et al., 2016). Peatlands cover vast areas in partiuclar in Northern Europe, Northern Asia and western North America (Global Peatland Database / Greifswald Mire Centre (2024), and a large fraction of this area has been drained for agricultural use (UNEP (2022)).

Pristine peatlands and shallow coastal regions [...]"

Additional changes will be made from line 66 onwards.

"Rewetting of degraded peatlands reduces CO_2 emissions by preventing aerobic decomposition of OM. The low solubility of O_2 and the slower transport across the overlying water body limits the availability of oxygen in the waterlogged peat soils for soil decomposition, which reduces aerobic mineralization and favors anoxic conditions, enhancing organic carbon burial (Parish et al., 2008; Kaat and Joosten, 2009). In the long-term, a re-establishment [...]"

In the sentence that begins in line 72, an addition is made.

“However, the effects of brackish water on GHG emissions are still unclear, although beneficial effects such as lower CH_4 emissions compared to rewetting with freshwater are likely due to the availability of sulfate (SO_4^{2-}), a phenomenon better investigated for some coastal ecosystems, e.g. mangroves (Cotovicz et al., 2024), which could promote the activity of sulfate-reducing bacteria (SRB).”

In the paragraph beginning in line 92, some minor changes are made to emphasize the novelty of the instrumentation we used, resulting in the following text.

“In this work, two newly developed, mostly identical lander systems were deployed, which are designed as autonomous platforms hosting a wide range of marine sensors. The landers were placed as fixed platforms on the sediment surface, and were customized for this deployment with cabled power supply and uninterrupted high-resolution data acquisition. The systems can [...]”

We would like to add more information from line 96 onward.

“We performed sensor measurements of the partial pressures of CO_2 and CH_4 and a suite of physicochemical variables (i.e, water temperature, salinity, water level, O_2 saturation, turbidity, phosphate, nitrate, water velocity, and chlorophyll *a*) with high temporal resolution in the range of seconds and minutes in a recently flooded peatland over a period of around nine weeks in the summer of 2021. The high-resolution measurements were combined with discrete sample analysis, and GHG emissions of CO_2 and CH_4 were derived.

The rewetting of the coastal peatland [...]”

Due to reconstruction, the sentence in line 100„The high-resolution measurements were combined with discrete sample analysis, and GHG emissions of CO_2 and CH_4 were derived.“ is deleted/is moved to another position

The paragraph beginning in line 101 will be modified,resulting in the following text:

“The focus of this study is on exploring the time scales for the variability of GHG distribution and its drivers, as highly variable conditions are assumed. The nine week time-series is used to derive main cyclic as well as episodic variability in CO_2 and CH_4 concentrations and fluxes, and relate it physicochemical drivers. The impact of the temporal variability on the estimation of GHG emissions or with respect to discrete sampling strategies is assessed. By comparing GHG fluxes with a study conducted one year earlier (i.e., 2020, the first year after rewetting; Pönisch and Breznikar et al., 2023), the potential evolution towards further weakening of the CO_2 and CH_4 source strength is discussed.”

<u>C) Emphasizing the biogeochemical interpretation before the technical description/measurement technique</u>

With this points we implemented the following major changes:

a. We have changed the sequence of chapters 2.2 and 2.1 so that the study site and the study design are introduced first and then the technology.

   A new sentence must be included in line 147: “Two submersible landers equipped with sensors were used for autonomous multi-parameter investigations in the shallow water of the rewetted peatland through integrated high-resolution measurements.”

The first sentence in the line 109 must be shortened: "The two novel submersible landers are platforms for advanced autonomous multi-parameter investigations in shallow water. The entirety of the carrier frame [...]"

b. Moving section 4.5, which is indeed very technical and deals with the quality of the data and improvements for further missions, to the appendix. The new section will be "Appendix F: Assessment of the data quality and implications for future lander deployments" in line 863.

In addition, the heading in line 787 is renamed to avoid confusion into „C3 Quality assessment of sensor GHG measurements".

To assure the reader that we carried out a series of quality assessment measures, we would like to insert a short paragraph at the beginning of the discussion section starting in line 438 with a link to the corresponding appendix F. Subsequently, we start the discussion of the biogeochemical findings.

"With the deployment of two novel landers in a complex and heterogeneous environment of the rewetted peatland, it is important to integrate strategies to assess the quality of the sensor data. Therefore, we have conducted various measures and analyses to build confidence in the sensor data, which are discussed in detail in Appendix F together with the future implications for the deployment of the landers. Apart from the fact that quality assessment is complex, we can show that the sensor data are suitable for interpretation based on two main analyzes: First, the similarity of the main trends in the data series from both landers strongly suggests the appropriate sampling strategy for dynamic ecosystems. Second, with strong effort on discrete samplings and laboratory analysis, we observed both good agreements but also discrepancies compared to the sensor data. With all quality measures applied, we were able to achieve a robust post-processing which allows comprehensive biogeochemical interpretations."

D) Discussion of our results on CO2 and CH4 fluxes in a broader scientific/existing literature

a) We summarized GHG flux data from other environments at the terrestrial-marine interface, which will placed in the Appendix F2 "Selected greenhouse gas emissions of CO2 and CH4 along the land-sea-interface" in line 863:

"Table 1: Selected greenhouse gas emissions of CO2 and CH4 along the land-sea-interface in relation to the derived GHG fluxes from our study.

Carbon dioxide fluxes

from land	from streams	from restored peatland (s)	from this study	from open shallow water (brackish/salty)
0.07 g m^{-2} h^{-1} (drained unutilized land)[1]	−0.03–0.24 g m^{-2} h^{-1} (review with 34 study sites about streams in temperate Europe)[2]	0.02 g m^{-2} h^{-1} (open water) to 0.09 g m^{-2} h^{-1} (emergent vegetation stands, Germany)[3] −0.04 g CO_2 eq. m^{-2} h^{-1} (review of 38 restored peatlands)[4]	0.12 ± 0.16g m^{-2} h^{-1}	0.01 g m^{-2} h^{-1} (Bornholm sea)[5] 0.0007 g m^{-2} h^{-1} (Bothnian Bay)[6]
References of adapted numbers: 1 Tiemeyer et al., (2020); 2 Mwangada et al., (2023); 3 Franz et al., (2016); 4 Bianchi et al., (2020); 5 Thomas and Schneider, (1999); 6 Löffler et al., (2012)				

Methane fluxes

from land	from streams	from restored peatland (s)	from this study	from open shallow water (brackish/salty)
0.6 mg m^{-2} h^{-1} (drained unutilized land)[1]	1.3–12.8 mg m^{-2} h^{-1} (Donau river, Germany)[2]	1.48 mg m^{-2} h^{-1} (emergent vegetation stands) to 6.05 mg m^{-2} h^{-1} (open water, Germany)[3] 29.68 mg m^{-2} h^{-1} (occasional brackish impact)[4] 3.2 mg m^{-2} h^{-1} (rewetted organic soils)[1]	0.51 ± 0.56 mg m^{-2} h^{-1}	39.9–104.2 mg m^{-2} h^{-1} (June/July, shallow water of the Baltic Sea)[5] 0.015–0.024 mg m^{-2} h^{-1} (continental shelves)[6]
References of adapted numbers: 1 Tiemeyer et al., (2020); 2 Lorke and Burgis, (xxxx); 3 Franz et al., (2016); 4 Hahn et al., (2015), 5 Heyer and Berger, (2000), 6 Bange et al., (1994)				

"

b) We plan to insert a new section "4.4.1 Assessment of the GHG fluxes with fluxes at the land-sea-interface", in which the fluxes from our peatland are placed in a broader context, based on the almost complete Table 1.

Section 4.4 must be altered and shortened so that 4.4.1 can be added. The old text was changed from line 572.

"Greenhouse gas fluxes for CO_2 and CH_4 could be derived from the high-resolution sensor data as measurements were made narrowly below the water surface (< 1.25 m) and a direct coupling of water at the lander with the surface water was assumed. Although the peatland showed a slight CO_2 uptake in early June (**Fehler! Verweisquelle konnte nicht gefunden werden.**a), accompanied by stable but slightly decreasing chlorophyll *a* concentrations, the ASE was clearly dominated by a flux of CO_2 to the atmosphere. This amounted to 0.12 ± 0.16 g m^{-2} h^{-1} derived from both landers. Increasing fluxes through early July stabilized with a simultaneous strong increase in chlorophyll *a* concentration. Overall, CO_2 emissions in the peatland were controlled by the simultaneous occurrence of primary production and mineralization, with the latter predominating for an overall net CO_2 outgassing. The derived CH_4 fluxes of 0.51 ± 0.56 mg m^{-2} h^{-1} showed a stable development during the measurement period with a slight trend to lower fluxes in August (**Fehler! Verweisquelle konnte nicht gefunden werden.**b), also strongly controlled by mineralization prozesses of OM."

The planned section 4.4.1 "Assessment of the GHG fluxes with fluxes at the land-sea-interface" will be structured by following the bullet points. The main focus will be on the assessment of our fluxes in relation to the magnitude of the fluxes at the sea-land-interface, in relation to the variability (e.g., diurnal cyclicity) and in relation to the magnitude of CH4 release compared to freshwater systems

CO2

- Peatland fluxes in the study area are around one order of magnitude higher than emissions reported in other peatland studies.
- In a shallow lake formed on a formerly drained fen, CO2 emissions 9 years after flooding ranged from 0.02 g m^{-2} h^{-1} (open water) to 0.09 g m^{-2} h^{-1} (emergent vegetation stands) (Franz et al., 2016).
- Compared to land-based emissions (e.g., drained unused land, cropland, forestry), emissions in the study area are significantly higher (Tiemeyer et al., 2020).

- Greenhouse gas fluxes from rivers and streams in temperate European latitudes, often influenced by human activities, are of a similar magnitude to the study area (−0.03 to 0.24 g m^{-2} h^{-1}; Mwangada et al., 2023).
- Emissions from shallow waters of the Baltic Sea or the North Sea are much smaller than those from the rewetted brackish peatland (Thomas and Schneider, 1994; Löffler et al., 2012).

CH4

- Derived CH_4 fluxes are significantly lower than those from peatlands which were rewetted with brackish water (Couwenberg et al., 2011; Hahn et al., 2015; Franz et al., 2016).
- CH_4 emissions from a shallow lake rewetted with freshwater ranged from 1.48 mg m^{-2} h^{-1} (emergent vegetation stands) to 6.05 mg m^{-2} h^{-1} (open water), even 9 years post-rewetting (Franz et al., 2016).
- In a dry fen converted to a shallow lake with occasional brackish water, CH_4 fluxes reached 29.68 mg m^{-2} h^{-1} in the first year post-rewetting (Hahn et al., 2015).
- Derived CH_4 fluxes are comparable to CH_4 emissions from drained, unused land-based systems (Tiemeyer et al., 2020).
- Derived CH_4 fluxes are much lower than those reported for the German river Donau (1.3–12.8 mg m^{-2} h^{-1}; Lorke and Burgis). Also variability is much lower.
- Shallow coastal waters show high CH_4 flux variability, e.g., Baltic Sea summer fluxes: 39.9–104.2 mg m^{-2} h^{-1}
- Continental shelf fluxes are lower compared to our fluxes and amounted to 0.015–0.024 mg m^{-2} h^{-1} (Heyer and Berger, 2020; Bange et al., 1994).

2. Technical comments

Line 19 – "to" is not an appropriate connector in "unlike to rewetting" and to make a subtler point there is a logical inconsistency in saying "unlike x, y is less studied", either of these alternatives would be more natural: "compared with x, y is less studied" or "unlike x, y remains understudied".

Reply: Thank you for this comment. We want to change the sentence in line 19 to:

"Compared with rewetting with freshwater, the effects of rewetting with brackish, sulfate-containing water are less studied, although positive effects are expected as sulfate-reducing bacteria may become established and might out-compete methane-producing archaea (methanogens) for substrates, resulting in lower CH4 emissions."

Line 67 – grammar errors in "considered as one of the potent measure". "Considered to be" is the appropriate construction here and "measure" should be plural. But it would be more appropriate to use an indefinite article eg. "considered to be a potent measure".

Reply: Thank you, we want to correct the error by changing the sentences in line 67 to:

"Rewetting of degraded peatlands reduces CO_2 emissions by preventing aerobic decomposition of OM and is considered to be a potent measure to mitigate global warming through land-use change."

Line 105 – I have not seen this double author et al. style before. It seems you want to give equal credit to the first two authors? In any case, this is a question for the editors.

Reply: This publication is a "shared first authorship" with both first authors contributing equally to the work. The citation style of "Pönisch and Breznikar et al. (2023)" will be adjusted to match the journal's guidelines in the final typeset manuscript.

Line 108 - Perhaps a different term to 'lander' could be used since this term is not likely familiar to more terrestrial peatland ecologists.

Reply: You may be right. Reviewer 1 also made a similar comment. We have therefore already inserted a sentence in line 93 ("The landers were placed as fixed platforms on the sediment surface with cabled power supply."). In addition, we would like to make the following changes to the sentence from line 109 onwards.

"Two submersible platforms were used for autonomous multi-parameter investigations in the shallow water (~ 0.5 m) of the rewetted peatland through integrated high-resolution sensor measurements. The entirety of the carrier frame, the power supply, the technical units for sensor control and the sensors are referred to as landers and were deployed as stationary measuring units at the sediment-water surface. Each lander system was equipped with […]"

Line 113 – "customized deployments"? What information is meant to be conveyed here?

Reply: The landers are highly modular in their equipment and programming. They can therefore be applied to various scopes, such as extreme events (storms), which require a particularly high measurement resolution. To convey this, we want to add the following to line 113:

"Sensor scheduling, time stamping, and data recording were centralized in the Data Processing Unit (DPU) and allow customized deployments, for example long-term deployments or shorter-term deployments during extreme events such as storms."

Line 119 – is the indent necessary?

Reply: We think that the list is helpful to quickly recognize important adjustments on the one hand and to signal important features of the deployment very quickly on the other hand. The final layout and level of indentation will be determined by the journal's guidelines in the typeset manuscript.

Line 125 – annual cycle of what?

Reply: The term can be confusing. Therefore, we want to change the sentences in line 125 to:

"The time of deployment was chosen based on the study of the annual cycle of GHG dynamics from the first year after rewetting and based on weekly to bi-weekly sampling (Pönisch and Breznikar et al., 2023), which indicated that the summer season is the most important and dynamic with respect to GHG-fluxes."

Line 204 – "bottle data" is not the most appropriate term to refer to the manually collected dissolved gas concentration data, perhaps another phrase could be found.

Reply: To clearly distinguish measurements based on manually collected water samples and sensor-based measurements, we want to clearly indicate their origin from the Niskin bottle sampling. Therefore, we want to keep the term "bottle data", which is also commonly used for manually sampled validation data in other hydrographic studies. However, we suggest to rearrange the paragraph from line 202 to introduce the bottle data sampling device first.

"To validate the sensor-based measurements, discrete field measurements were taken during the lander deployment at lander 1 (in the central peatland area) and at lander 2 (in the connecting channel). Undisturbed water was taken manually using a 5-L Niskin bottle. The bottle was deployed horizontally from a small working boat and its closure noted with an exact time stamp. Altogether 9-sampling sessions were carried out in the direct proximity to the landers (Table C 1; bottle data for all discrete sampled variables can be found at https://doi.org/10.1594/PANGAEA.964758; (Pönisch et al., 2024)). Water from Niskin bottle sampling was analyzed using established laboratory methods as described below."

Line 206-207 – these 2 sentences are unnecessary.

Reply: We think that in the context of the very strong spatial variability in the peatland water column (discussed e.g. in section 4.5) together with a shallow water column (~1 m) the information of a horizontally deployed Niskin bottle (itself being 0.4 m long) is very important. Furthermore, in a water column in which scientists can move around with waders, it cannot be readily assumed that a boat was used for sampling. To encourage good practice in follow-up studies, we want to stick to give those details in the methods section.

Line 234 – GHGs should be CO_2 and CH_4

Reply: We will change the term "GHGs" into CO2 and CH4 in line 234:

"All involved variables (i.e., CO_2, CH_4, wind speed, temperature, salinity, atmospheric-equilibrium conditions) were averaged hourly to obtain more robust values and matching timestamps."

Line 240 – perhaps more could be said about the Schmidt number and the linear interpolation.

Reply: We suggest to change the text as follows, which gives both more detail on the interpolation and reference to the source used with detailed background on the Schmidt number itself:

"The Schmidt number was approximated by a linear interpolation in salinity between the freshwater and seawater values (Wanninkhof, 2014). The Schmidt number depends on the gas, the temperature and to a minor degree, the salinity of the water."

Line 242 - Is Utö the most appropriate data source for atmospheric GHG concentrations? I presume the authors chose it because it is also situated in a Baltic coastal setting, however it is 800 km away. If this is the most appropriate measurement site for atmospheric concentrations, some justification for its choice could be included

Reply: The ICOS Station Üto is the nearest high quality atmospheric measurement station reflecting marine air. Inland stations, of which there are only very few in higher proximity, are more prone to local land-derived sources. An analysis of the "offset" between the marine station Mace Head (Altlantic Air masses) and Utö is given in Appendix Figure 2 of Jacobs et al, 2021 (https://doi.org/10.5194/bg-18-2679-2021). We therefore believe that Utö is the best choice for our study site.

Line 245 - awkward reference to the previous work here, consider rephrasing

Reply: We would like to repharse the sentence in line 245:

"Moreover, the same parameterization was used in Pönisch and Breznikar et al. (2023). The use of the same parameterization facilitated comparison of the results of our work with this previsou study."

Line 248 – no need to mention the results table in methods.

Reply: We will delete the link.

Line 251 - could there be a clearer way to explain this?

Reply: Sure. We would like change the sentences from line 251 into:

"ASE derived from our high-resolution time series to represent the day-night bias. Daily averages for 00:00 UTC ± 1 hour and 12:00 UTC ± 1 hour were isolated (resulting in ~ 200 data points for each calculation)."

Line 258 – since this data is presented before the fluxes should this section on the methods go before ASE

Reply: Of course and thank you for the comment, we will change section 2.6 with 2.5 to put "Data processing and analysis" before "Air-sea exchange (ASE) calculation".

Line 260 – presumably "descried" is a typo here.

Reply: Correct, it should read "described" and will be changed accordingly.

Line 261 – for what scientific purpose were the correlations conducted?

Reply: To make the purpose more clear, we want to add the following sentence in line 262:

"Spearman correlation coefficients (rs) were calculated [...]. To identify potential drivers, processes and mechanisms of CO2 and CH4 variability, the presence or absence of (strong) correlations helps to identify and discuss potential causal relationships."

Line 262 – save figure references for results.

Reply: Agreed. The Figure 3 reference was removed from the methods section.

Line 277 – no unit for salinity?

Reply: We have followed the work of Millero, F.J. 1993, (What is PSU? Oceanography 6(3):67) and Millero, F.J. 2015 (History of the Equation of State of Seawater, https://doi.org/10.5670/oceanog.2010.21), and a summary exists here (http://www.coastalwiki.org/wiki/Salinity). It was stated: "The practical salinity scale was defined as conductivity ratio with no units" and "This definition is adopted by all national and international oceanographic organizations". On this basis we suggest to keep salinity without units.

Line 295 – unnecessary clause

Reply: We will change to:

"Although occasionally low O_2 values were detected, measurements indicate a predominantly oxygenated water column, with slightly lower mean O_2 values at lander 2 (Figure 2f, Table 1)."

Line 299 – "short-term"; not sure what is meant by "d; Sect. 3.2, Table 1"; how low are "lower values".

Reply: We will change the term "short-scale" into "short-term" in line 299.

The "d" in the term "d; Sect. 3.2, Table 1" is the abbreviation for day. As the definition is not necessary because it is generally valid, we will delete the abbreviation.

In June, the pCO2 value was generally lower compared to the rest of the deployment, as can be seen from the smoothing line in the graph in Figure 2a "lower values". We would like insert "average" to make this more clear in line 299:

"Sustained lower average values occurred at the beginning of the deployment (early June), but then changed to on average higher values (> 1000 µatm) during most of the deployment at both locations.**"**

Line 303 – "strong negative correlation"

Reply: As we have introduced various effect sizes with the Spearman correlation, we refer to this information for the strength of a correlation and must be linked there: The strength of a correlation must therefore be "with a strong effect size". If I also changed to "strong negative correlation", I would have "strong" twice in the sentence. We would therefore like to stick with the original sentence.

Line 304 – the results might start with this comparison and also the part on the same comparison for CH_4

Reply: With this comparison, we show how the sensor data behaves compared to the discrete data. As the results and biogeochemical features of the sensor-measurements should be the main focus, and both reviewers suggested to put a stronger focus on the biogeochemical results rather on technical considerations, we have decided to leave the statements on sensor comparison with the discrete data at the end of the respective paragraphs.

Line 313 – rather than always referring to the landers, the locations could be used, since the location is what is of interest. This point applies throughout.

Reply: Though the positions of the two landers is clearly described in the site description, we will introduce the site information ("central part" ; "channel); at some places in the text to make it easier for the reader to follow. Thank you for the suggestion.

Line 352 – Short-term variability of what?

Reply: Thank you. We would like to change the headline into:

"Short-term variability and diurnal cycles of the measured variables"

Line 355-357 - This sentence belongs in methods.

Reply: Agree. Please find the answer under the next comment.

Line 364-366 – These 2 sentences also to methods

Reply: We agree that both lines 355-357 and 364-367 should transfer into the methods. We have inserted a new paragraph after the line 267 in the section "2.6 Data handling and analysis"

"In order to show the diurnal cyclicity and the relationships between the variables affected by the diurnal cycles, the high-resolution measurement time series (lander 1 and lander 2) were divided into one-hour-bins and a mean value was calculated for each hour of the day, resulting in a diurnal distribution pattern. Furthermore, to show the magnitude of diarunal variability of the variables, the mean diurnal variability was calculated. For this purpose, we divided the high-resolution data into 24-hour intervals, each starting at midnight. Then, for each interval, the difference between the minimum and maximum was determined. Subsequent determination of the mean, minimum, and maximum yields an approximation of the magnitude of diurnal variability."

The sentences in section 3.2 will be changed accordingly from line 384:

"The variables pCO_2, pCH_4, temperature, and oxygen showed pronounced short-term variability and diurnal cyclicity, [...]. The diurnal cyclicity and the relationships between the variables affected by the diurnal cycles was made visible by calculating the distribution of hourly mean values (see section 2.5). The distribution indicated that pCO_2 and pCH_4 showed an inverse character compared to temperature, O_2, and the wind speed (**Fehler! Verweisquelle konnte nicht gefunden werden.**). [...]"

The sentences in section 3.2 will be changed accordingly from line 395:

"To show the magnitude of daily variability, the mean, minimum, and maximum of 24-hour intervals were calculated (see section 2.5) and summarized in Table 1. The mean daily range for pCO_2 of ~ 4000 µatm is substantial. [...]"

Line 378 - why not just say hourly?

Reply: Yes, we would like to change "one-hour-parts" into "hourly sections" in line 378 and also in line 853.

"The distribution of the mean values of pCO2, pCH4, temperature, O2 and wind speed of hourly sections over 24-hours."

Line 379 – why switch between quantile and percentile?

Reply: Agreed. We change the text to use percentile throughout. .

Line 385 – "shared observation" is not really the right phrase here

Reply: Yes, we will simplyfy as follows:

"All three events, although different in nature, […]"

Line 408 – What caused this outflow? Some explanation would be interesting if there is one; the phrasing about the water level relative to the sensor is a little clumsy.

Reply: The outflow occurs because the peatland is directly connected to the Kubitzer Bodden and this is connected to the Baltic Sea. If the water levels drop there, the peatland follows. In addition, local wind regimes can lead to an outflow or inflow. This has already been described in line 135. Nevertheless, we want make a change and rephrase the sentence to make it less clumsy in line in line 408.

"In late July, we observed an outflow of water from the peatland towards the *Kubitzer Bodden.* The outflow caused a strong lowering in the water column, which drained large areas of the rewetted peatland and caused the pressure measurements of the CTD-O2 sensor to reach ~ 0 dbar."

Line 416-419 – Is this not already in methods, if not it should be moved there.

Reply: Yes, we streamlined the first paragraph of this section as follows

"GHG fluxes for CO_2 and CH_4 were derived from the entire high-resolution sensor data and from the different scenarios: from bottle data only, during daytime, during nighttime, and using data of a previous study to isolate GHG fluxes for a direct year-to-year comparison (Table 2)."

Line 429-436 – this table heading seems more like a section of the methods.

Reply: You are right. With the figures and tables, we follow the idea that the objects should be understandable as independent/stand-alone objects. That is why we have added more information in the caption so that the figures can be understood without searching in the manuscript. As the calculation is not so comprehensible, we would like to stick to the rather methodical description.

Line 439 – tell the variables

Reply: We will change the sentence in line 439 to:

"The deployment of two landers equipped with sensors for the high-resolution determination of the marine variables pCO2, pCH4, temperature, salinity, hydrostatic pressure, O_2, turbidity, water velocity, c(PO_4^{3-}) and chlorophyll *a* in a coastal peatland revealed large temporal and spatial variations of the measured variables."

Line 442 – A claim including the phrase "covering a comparable study area" is problematic when the study only includes measurements from 2 points, consider rephrasing.

Reply: We understand the point. Therefore, we would like rephrase into:

"To our knowledge, there is no study that covers a comparable environmental setting with a similar temporal data resolution."

Line 518 - remove sentence starting "The effect of this…"

Reply: We will remove the sentence.

Line 583-586 – this section is a little clunky

Reply: Yes, we want to make some changes:

"The studies mentioned above report annual GHG fluxes. Since our study only covers the summer months, comparability with these studies is limited, as annual CO2 and CH4 emissions are normally highest in the late summer months. To allow a more direct comparison of the development of greenhouse gas emissions at our study site, we used the published data from Pönisch and Breznikar et al. 2023."

Line 596 – Grammar

Reply: Thank you. We would like to change the both sentences in line 596 into:

„In addition to a high degree of comparability due to comparable boundary conditions, this approach also has limitations. The most important of these are slightly different sampling height […]"

Addtional changes: We would like to make an additional change to Figure A2 by pixelating the faces.