

Thank you very much for the thorough review and your valuable recommendations and suggestions, which surely help to improve the manuscript.

Jacobs et al. present 8-years of underway surface CO₂ and CH₄ measurements from the Baltic Sea. They assess the role of upwelling on surface gas concentrations and fluxes on seasonal time-scales, and describe typical annual cycles, as well as anomalies. The paper is very well written, and thoroughly describes regional and temporal differences in CO₂ and CH₄ concentrations, showing clearly the influence of upwelling and temperature. The methods used appear to be robust, and well-explained, with careful consideration of potential sources of error. The data set itself is of tremendous value, and the interpretation is well-done and could be applied to other regions with underway CO₂ and/or CH₄ systems.

Although it could be argued the paper lacks clear objectives or motivation, I propose the value of this paper is in the methodological development used to extrapolate discrete underway data, thus improving its already high-resolution. Additionally, the development of a robust technique for identifying upwelling and linking it with observations on these spatiotemporal scales is well done and could be of value to others interpreting similar data sets, which could facilitate more robust extrapolation of such measurements in regions sorely lacking data. This makes for a valuable contribution to understanding the importance of upwelling on temporal and spatial variability in CO₂ and CH₄ flux, and a delight to read.

Thank you for the encouraging words. The objectives you mentioned are indeed main foci of our study. As Reviewer #1 pointed out, however, we will point out our intended main goals of the study clearer in the introduction.

I have only minor suggestions to improve clarity of figures (especially regarding choice of colors), and text. I recommend publication of the manuscript.

Fig. 2-. The profile colors are hard to distinguish, and likely would be near impossible for anyone with color-blindness. I suggest using more easily discernable colors.

We have spent many thoughts on this topic and all colour scales in the manuscript have been chosen with the colour-blindness issue in mind. The colour scales we used (<https://cran.r-project.org/web/packages/viridis/vignettes/intro-to-viridis.html>) are perceptually uniform and robust to both colour-blindness and grey-scale printing. We would like to keep all those advantages. However, we do agree that the differences between colours are rather small in Fig. 2, which is partly because we left out yellow. You will find another version of the plot below, which includes yellow (thereby widens the colour gradient) and has bolder lines to make the colours more distinguishable. We hope that this improved version will find your approval.

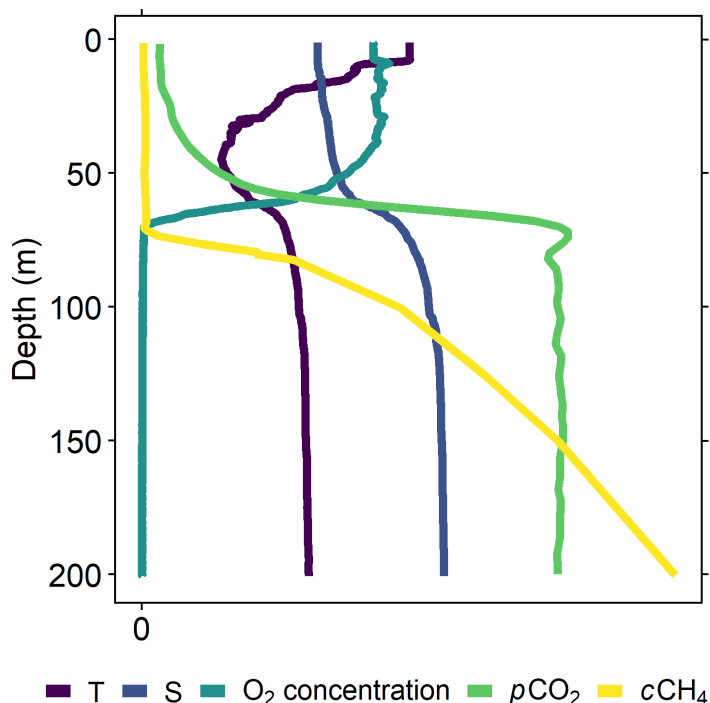


Fig. 2. Is oxygen available? I suspect it would be relevant especially for CH4.

Figure 2 already contains an oxygen profile. However, we do realize that we did not define “cO₂” because we do not need the term elsewhere and that it is rather easy to be confused with “CO₂”. Therefore, we replaced the legend label with “O₂ concentration” to make it clearer (see above).

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Line 41: ‘two minima’ are mentioned, but the subsequent text implies a minima during the spring bloom, and several subsequent minima throughout summer. Not clear when the second surface pCO₂ minima typically occurs, or if there are several more? Perhaps revise ‘two minima’ to ‘: : a minimum during spring and one or more subsequent minima throughout summer: :’

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Indeed, the two sentence parts do not really fit together and we revised the sentence according to your recommendation: “The typical seasonality of surface CO₂ partial pressure (pCO₂) in the Baltic Sea features a minimum during spring and one or more subsequent minima throughout summer: The spring bloom starts in March/April...”

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Lines-41-47 – could you clarify when the surface CO₂ is typically under-saturated vs. super-saturated when describing the spring/summer surface pCO₂?

We added “and undersaturation is usually observed from March/April to September/October, depending on region (Schneider and Müller, 2018).” to the end of the paragraph.

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Line 48-49 – ‘..vertical redox..’ would be helpful to add oxygen profile to fig 2.

Please see above comment addressing Figure 2.

Fig. 6 –colors are difficult to distinguish.

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As outlined above, the colour scales we used follow all criteria and many thoughts have been spent on them. We would like to keep it as is, since there are only three colours in this example. We will make the legend labels bolder, though, as these are indeed a little hard to distinguish.

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Line 332-335 You state that the estimated +0.4degK warming from atmospheric heat flux is insufficient to account for the observed warming. Can you remind the reader what the total surface warming was, and/or how much additional warming needs to be accounted for by mixing? (this could be included in this paragraph, or in the paragraph at the start of this section that describes temp relaxation after upwelling).

We will clarify this and replace “the observed warming of upwelled water masses” with “the observed warming of upwelled water masses in the order of 5–10 K”.