

Interactive comment on “Sensitivity of the air–sea CO₂ exchange in the Baltic Sea and Danish inner waters to atmospheric short term variability” by A. S. Lansø et al.

Anonymous Referee #2

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Title: Sensitivity of the air-sea CO₂ exchange in the Baltic Sea and Danish waters to atmospheric short term variability Author(s): A. S. Lansø et al.

General

The manuscript is an interesting study on the sensitivity of the air-sea CO₂ flux to the atmospheric short term variability. The role of the Baltic Sea in the global carbon budget is small, but the research in the area is important, not only locally, but also in understanding the shelf seas in general. The results from the Baltic Sea area have been contradictory, and although the present manuscript does not solve the issue, it is a step forward in understanding the complex system of carbon cycle. The manuscript

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is well written and the subject is handled in a concise manner.

Specific comments

Study area

16998, line 15. How typical the ice conditions were in the simulated years 2005-2010?

16999, line 18. How many years of measurements were there? 13? What was the depth of the measurements, both in ships and stations?

Figures 3 and 8 (and S1) show also Lake Lagoda but there is no mention of the data from there in the text.

Maybe the weakest point in this and previously published results from the Baltic Sea is the amount of the pCO₂ data available. Only one station in the Bay of Bothnia is not enough to describe the whole area, and it is questionable if the Gulf of Finland can be treated as one area: the conditions can be quite different in the eastern section than in the western section. Although the Baltic Sea can be regarded as "coastal" waters, there can be quite large spatial variations of pCO₂ in the surface water due e.g. upwelling or different biological activity at the coast and open sea areas. It is understandable that the fluxes over the whole Baltic Sea are interesting, but care should be taken in interpreting the whole Baltic Sea as a sink or source, especially when the scarce measurements have to be extended over a large area. The authors have discussed the subject in the Discussion section, which is good, although a more profound discussion would have been in place. I would still stress that the differences between the two simulations are the most important results in the manuscript. The absolute values are quite uncertain.

Results

3.1 Model evaluation What is the reason for that the weekly means agree better in Fig. 5 than in Fig. 4? Please, state clearly what stations represent conditions over land and what over sea.

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3.2.1 Variable atmospheric CO₂ concentration

17010 (and 17017). The model underestimates the diurnal variation of the atmospheric CO₂: is there a way to estimate the error caused by this underestimation?

3.2.2 Constant atmospheric CO₂ concentration

17011-17012 (and 17016) What is the reason for the difference in pCO₂ between the CAT and VAT, especially during winter? This is not clearly explained. Due to the different signs, Figure 8 is quite difficult to interpret.

A line explaining the mixing length would be good. Why this parameter was chosen as explanatory parameter?

4.2 Air-Sea CO₂ fluxes

17015. The annual changes have been discussed in earlier studies as well. What about the annual variation in pCO₂ in the surface water? Could it be so large that it would be meaningful?

4.3 Impact of atmospheric short term variability

17016. The coastal site south of Sweden, why this specific place was chosen? Were the wind directions such that the place represent marine conditions?

4.4 Uncertainties

17017, last paragraph. How coastal are the central parts of the Baltic Sea after all? Any proof for this?

17019. Due to the uncertainties in the distribution of pCO₂ in the surface waters, I am not convinced that the transfer velocity is the largest source of uncertainty. Of course it does not mean that it would not be an important, and still open, factor.

Figures

Figure 1. The yellow lines in the Gulf of Bothnia and the eastern Gulf of Finland are C7672

hard to see. It might be good to add the places given as coordinates in the text to the figure.

Figure 2, panel e. The red dots are not visible. Could the panels be arranged so that a and b, c and d are side by side? Now the panels are quite small.

Figure 4. Please use same y-scale in both panels.

Figure 5. Please use same y-scale in all panels. "2005-2011" should be "2005-2010" in the caption.

Figure 7. This is the VAT simulation?

Supplement

Figure S1. The year should be 2005, I believe. The figure is not referred to in the text, though.

Typos

Loffler et al. 2012 in the text and reference list: use the Scandinavian letters in the authors' names.

Bothnian Bay should be the Bay of Bothnia.

16999, line 15: the Bothnain Sea -> the Bothnian Sea 17010, line 16: the Bothnain Sea -> the Bothnian Sea

17017, line27: arears -> areas

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