

Review of '**Cyanobacteria net community production in the Baltic Sea as inferred from profiling pCO<sub>2</sub> measurements**' by Mueller et al.

The manuscript describes the application of the water budget method to constrain inorganic carbon drawdown, a proxy for Net Community Production (NCP), during the cyanobacteria bloom in the Baltic Sea. The work also examines the possibility of making use of the long-term ferry-box measurements of surface pCO<sub>2</sub> for the hindcasting of NCPs. The authors argue that the quantification of NCP is key to understanding the biogeochemical controls of cyanobacteria blooms in the Baltic Sea. The authors present compelling arguments substantiated by robust methodological approaches and error examinations. Overall, this is a well-written and well-structured work with scientific merit and is worthy of publication in *Biogeosciences*. Said that there are certain areas where the manuscript can be improved, and I would suggest minor revisions aiming at strengthening the message of this manuscript.

General major comments (no particular order):

- Traditionally NCP is constrained to the depth of the euphotic zone, compensation depth or MLD. Differences between these and their implications for the export of organic matter should be explained and discussed, even though you chose to use TPD in your approach.
- Discuss how NCP is related to export production and deoxygenation. Which processes and phenomena do alter/modulate organic matter supply to the deep?
- It is not clear how getting NCP for the previous years will aid in better understanding the bloom controls since there have been no simultaneous (to SOOP operation) studies of bloom phenology, POC profiles or nutrient concentrations.
- Which measurements, on which platforms and on which scales will help you 'disentangling the drivers of NCP' in the future.
- Please discuss the early-spring bloom and its contribution to the annual NCP.
- In the paper you mention that your approach to NCP (using surface pCO<sub>2</sub> and the modelled MLDs/TPDs) is limited to the time-periods of a stable or shoaling thermocline. Would you go as far as to estimate the % of time when the bloom falls outside this pattern based on your modelled MLD/TPD? This could give you some information/confidence about the applicability of the NCP approach using surface pCO<sub>2</sub> only in the lack of full profiles.
- The authors may want to include the calculations of heat flux and use it as a proxy for CT\* drawdown. These will likely correlate.

Specific comments:

L15: specify units of NCP (mol m<sup>-2</sup> (?))

L20: within 10% (if taking into account the period of a stable thermocline?) please specify

L30: see the general comments re conventional definition of NCP. Please add the missing info here.

L33: 1.2.Baltic Sea: please add more references citing studies of drivers and causes of hypoxia/anoxia in the Baltic Sea and sealed estuaries in general.

L47: how important is the spring bloom in the Baltic Sea relative to the summer bloom? Which species dominate during the spring bloom?

L58: 'The limited understanding of the factors...' This study does not explicitly address the factors controlling the bloom, instead examines the ways to quantify NCP. This paragraph needs rewording to include background information relevant to *this* study.

L73: cite the literature examining equilibration time of gases.

L75-L80: do these statements refer to the Baltic Sea? Need to make this clear to the reader. Global N-based NCP estimates are very popular)

L136: what are the accuracies and precision of the sensors after their calibrations?

L148: 'of 1% of reading'. Is this true for this particular study? Did you compare pCO<sub>2</sub> (sensor) to pCO<sub>2</sub> (DIC-TA)? If so, this comparison should be included instead.

L149: Please justify using A4.1 for tau determination and A4.2 for the correction? Why not to stick to one equation? Both work great, although A4.2 add more noise to the data.

L159: based on (the length) of the release line??

L160: HgCl<sub>2</sub>

2.4.1 should go before L 176

L177: in my opinion, the term 'estimate' already refers to an indirect, non-empirical way to assign value to a certain phenomenon. 'Best-guess' should, therefore, be dropped.

L276: 'Since July 6<sup>th</sup>....' what portion or % of the production you expect prior to July 6<sup>th</sup>?

L293: 'that NCP has ceased' ...do you mean there is no production (NPP), nutrient limitation or that NPP is balanced by respiration?

Fig. 5 f)-g) Fair-sea or Fatm for clariyy on Y-axis

h) flux = air-sea flux. 'Flux' is too ambiguous in this case.

flux mixing corrected ( - NCP ) – production has a positive sign, so negative to integrated CT\*

Fig.6. c) again, NCP must be positive by conventional definition. Either use NCP(CT) or some other way to clarify why Net Community Production in your case is negative.

L400: Please also explain how to overcome the caveats. This info can be useful for the reader. What other measurements are needed?

L420: Indeed, it is unlikely that production will continue during the periods of deepening thermocline. However, deepening-restratification events may have an impact on both entrainment of CT and detrainment of POC. The latter, especially, can moderate more efficient transport from the photic zone to the depth bypassing the respiration stage. Therefore, it appears crucial to monitor the frequency of occurrence of such events as they impact both the production and efficiency of carbon export.