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Biogeosciences Discussions

Interactive comment on "A multi-year observation of nitrous oxide at the Boknis Eck Time-Series Station in the Eckernförde Bay (southwestern Baltic Sea)" *by* Xiao Ma et al.

Anonymous Referee #1

Received and published: 4 July 2019

General comments:

The present paper examined the seasonal and annual variations of dissolved N2O in a time-series station located in the southwestern Baltic Sea. The results show the coupled variations between the N2O anomalies, the oxygen concentrations, and nutrients.

The paper presents a valuable new dataset of N2O and related biogeochemical parameters in a marine region subject to extensive human activities and so nutrients inputs, responsible of the deoxygenation in the Baltic sea. After the revision, I consider that the manuscript is highly interesting and provide relevant information about processes occurring to the N2O in the Boknis Eck. The paper is well written and structured, with

an appropriate description of the state of the art, objectives are clearly outlined and discussion precisely referenced. The main strength of the paper is the monthly sampling undertaken during twelve years.

However, there are several weaknesses in the paper. First, the authors make the discussion of the results based on data that are included in this study. There are references to data that exist but are not shown. But, in other to discuss about upwelling and hydrographic changes, about algal blooms and ammonium changes, the salinity, temperature, chlorophyll and ammonium data should be included and shown in this paper. Secondly, the paper lack of a proper description of the water masses presents at BE and their temporal variability.

Specific comments:

-Lines 129-130: How did you shifted the data to the 15th? Include procedure and assumptions in the text. Line 170: Could you explicitly explain in the text how did you computed Sc, instead just give the reference? what is the equation for computing Sc?

Lines 176-184: The comparison of the range of concentrations found between Boknis and other time-series would be better move later in the text, since the reader at this point does not have enough information about the causes that differentiate it from other time-series. The authors should better discuss not only the different magnitudes of the N2O concentrations, but also the site-specific processes responsible of such differences.

Lines 207. . .: In case there is additional information in the BTS, such as chlorophyll, during the study period, show the data in figures instead to refer to previous studies.

Lines 235: are there NH4 data available at the study site during the study period? In that case, it would be better to show them for the discussion instead to appeal to a reference

Lines 238-239: "Denitrification is inhibited by the presence of O2 and thus nitrification

is presumably responsible for the high N2O concentrations in winter/early spring." This statemen is not correct at all. The production of N2O by denitrification can occur at suboxic and hypoxic environments. Please, modify this sentence.

Line 239-240: The authors should normalized the N2O and pH to a constant temperature. Otherwise, temperature changes can be the responsible of this relationship because of thermodynamics changes and not necessarily due to nitrification. In fact, it is not as clear the positive correlation between the N2O and pH in figure 5, since for pH higher than 7.6, there is no apparent trend between N2O and pH. The relationship between pH and N2O obtained during incubations experiments described by Rees et al (2016) cannot be directly compare to this study, since the experimental conditions and approaches are completely different. The authors should rewrite the entire paragraph.

Lines 263-269: Again, the temperature salinity and Chla information at Boknis are mentioned in the text, but data are missed. If data for these parameters exist, the authors should include in the manuscript. It would reinforce some of the statement that now could look only speculative.

Lines 287-288: "Although the observed temperatures and salinities during October 2016–April 2017 were comparable to other years,..". Please, show temperature and salinity. Lines 295-296: "Considering the classical view of N2O consumption via denitrification under hypoxic and anoxic conditions". This is contrary to the statement done at lines 238-239. Consider to rewrite the first one. Lines 304-306; 308-309: The authors should make use of temperature, salinity or density to show changes in water masses. Lines 313: Instead of "presence" it would be more correct "concentration/level" Lines 320: "We did not observe an exceptional spring algae bloom in 2017". Please, consider to include Chla or POM to support this statement. Lines 319: Why can not be shown the Chla data?

Lines 331-335: The author should also discuss the potential dependence of rates on temperature and its impact on the seasonal variations of N2O production/consumption

trough the text.

Lines 356-357: Please, consider to support this statement with the salinity data 371-373. Please, show the density (or temperature and salinity) record to track the upwelling event in autumn 2017. Lines 377-378: Please, show the chlorophyll data. Lines 385_386: Please, show the ammonium data. Lines 394-399: This is a very speculative paragraph as it is written. Could you give any evidence for these potential explanations of the homogeneous distribution of N2O?

-Section 3.5: The author should evaluate in the results the impact of the dissolved gas analysis uncertainty in the air-sea flux computation and the uncertainty introduced in the net seasonal and annual air-sea NO fluxes.

Lines 416-424: The authors show that N2O concentration change seasonally, but the saturation stay almost constant. So, how can the author affirm that emissions are controlled by temperature?

Lines 476-484: Unless the author do not include salinity and temperature, they should not used them to conclude the hydrographic conditions at Boknis Eck. Further studies about the hydrography at the BE would complete the picture together with the biogeochemical data at the BE time-series station.

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