**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.

Xiao Ma et al.

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Thank you very much for the comments. They are thought-provoking and helpful to improve our manuscript.

Quantifying the concentrations and dynamics of dissolved N2O in seawater is important for understanding the climate change, but conducting measurements of sufficient duration to determine trends over seasonal, interannual, and decadal time frames for any marine ecosystem remains a challenging task. A long-term Time-Series Station like Boknis Eck in the Eckernförde Bay can provide invaluable information for documenting the role of oceans in relation to N2O, hence this type of study is significant.
for our scientific understanding. The paper is well-written and clear. I only have few comments/suggestions below:

Lines 95-96: more information is needed on seawater sample collection.

Reply: The sampling procedure is described in detail in lines 95-100 on page 3. Thus we do not see a need to revise the text.

Lines 108-109: The N2O concentration of standard gases should be provided.

Reply: We have added this information in the method section.

Line 154-155: dry mole fractions of atmospheric N2O at the time of the sampling. This description is not the fact since atmospheric N2O at the time of the sampling has not been measured and the monthly average of N2O data measured at Mace Head was used to N2Oeq.

Reply: Thank you for pointing this out. We modified the sentence. It reads now: “Since the atmospheric N2O mole fractions were not measured at the BE Time-Series Station, atmospheric dry mole fractions of N2O were derived from the monthly average of N2O data at Mace Head, Ireland (AGAGE, http://agage.mit.edu/), instead.”

Lines 185-193: NH4+ concentrations should be provided in the text as well as Figure 2.

Reply: Both reviewers requested to show additional temperature, salinity, chlorophyll a and ammonium data. These data were not explicitly shown in our ms because they have been published already in Lennartz et al.: Long-term trends at the Boknis Eck time series station (Baltic Sea), 1957–2013: does climate change counteract the decline in eutrophication? Biogeosciences, 11, 6323–6339, https://doi.org/10.5194/bg-11-6323-2014.). However, in order to provide this obvious lacking information, we decided to include the seasonal and annual variations of temperature, salinity, chlorophyll a and ammonium in a new supplement to our manuscript.
Lines 221-222: The expression caused misunderstanding.
Reply: We would like to change it to “The seasonal variations of NO2- and NO3- were significantly correlated with each other \([\text{NO}_3^-]=11.59[\text{NO}_2^-]-0.51, R^2=0.80, n=72, p<0.0001\) and high concentrations were observed for both in winter.”

Lines 239-243: Does N2O correlate with NH4+?
Reply: There is no straightforward relationship between N2O and NH4+. By the way, we realized that there were some problems with the calibration of pH data and, therefore, this part will be deleted.

Line 462: The year of 2015 should be 2005?
Reply: Thank you for pointing out the mistake. It should be 2005, which is the beginning of the N2O measurement.

Line 476: There is no temperature data provided at all in this study but with a conclusion ‘Temperature plays a modulating role for the N2O emission at the BE Time-Series Station’. I suggest to provide t data in Figure 2 and more t data provided in related discussion in the text.
Reply: We would like to show temperature data in the supplement. Also will rewrite the relevant text in section 3.5 to explain how temperature modulates N2O emissions in. See our reply to reviewer #1 as well.

Figure 2: It would be better for the authors to provide the vertical profiles of t, s, density, NH4+ and Chl a.
Reply: The data is now shown in the supplement.

Figure 6: The vertical profiles of hydrological parameters, such as t, s and density are needed to help understand the possible influence of physical processes on N2O distribution as discussed between lines 301 and 309.
Reply: Vertical profiles of temperature, salinity, NH4+ and Chl a are shown in supplement. Mixed layer variations can be seen in Fig. 4.

Figure 8: title is needed for x- and y-axis at figure b and d Figure 9: title is needed for x- and y-axis

Reply: We have added new titles in the figures.

Please also note the supplement to this comment: