Response to Katrine Husum

We would like to take this opportunity to thank Katrine Husum for her helpful comments on our manuscript. Below we provide a detailed response to her comments (in italics), indicating the changes that have been made. Line numbers refer to those of the revised manuscript that includes all tracked changes.

With kind regards,

Mattia Greco (on the behalf of all co-authors)

General comments

The manuscript BG_2019_79 by Greco et al. study which factors that influence the depth habitat of the planktic foraminifera Neogloboquadrina pachyderma using both published and new data together with a suite of statistical methods. The scope of the study is very timely as the regions where this species dominates are subject to climate-ocean changes, hence in order to evaluate current changes and establish robust natural baseline values a better understanding of this species' depth habitat is necessary. The manuscript is well-written and in an advanced state.

Specific comments

1. Figure 10: Introduce this information and figure early on?

We understand the comment from the reviewer. However, the structure of the paper builds on previously proposed drivers of DH of N. pachyderma and we started with investigating these variables first. The fact N. pachyderma does not appear to track specific temperature, salinity or density (Fig. 10), shows that its habitat is not controlled directly by these environmental variables, lending support to our proposed model. We therefore prefer to keep the original order in which the information is presented.

2. It would be beneficial to define what is a good correlation/a correlation/a weak correlation, e.g. what is the difference between the r- values of -0.28; -0.38 and -0.60. I am not an expert on statistics but +/- 0.28 seems like a weak correlation? It would also be good to point out that it seems that the correlation improves with a smaller number of observations (e.g. 21 samples without sea-ice)?

We agree with the reviewer that our model does not explain all observed variability in DH and have discussed the potential reasons for why this is the case on page 8 lines 7-10.

To avoid ambiguity, we will reword cases where we used subjective adjectives to describe the correlation (page 7, lines 27-30).

'Contrary to observations, the modelled DH shows the highest correlation with the depth of the mixed layer (r = 0.57, p <0.01). Moreover, the observed relationship between the modelled DH and the modelled sea-ice and chlorophyll concentration is lower and of opposite sign compared to the observations (Figs.8a-b).'

With regard to the second point raised, we would like to point out that, contrary to the impression of the reviewer, the correlations actually improve both in strength and in significance when more samples are included in the analyses for the subsets of profiles with and without sea ice. (page 7 lines 27-29, Figs 5c and 5d).

3. The PLAFOM2.0 model is introduced somewhat superficially; more information would be useful.

A more detailed description of PLAFOM2.0 was also suggested by Robert Spielhagen, so we integrated the following text in the introduction section:

'This model is driven by temperature, food concentration, and light availability (which matters only for species with symbionts). The species-specific food concentrations are simulated by the Community Earth System Model, version 1.2.2 (CESM1.2, Hurrell et al., 2013) at every time step and are subsequently used by PLAFOM2.0 to calculate the monthly carbon concentration of N. pachyderma and four other species of planktonic foraminifera.'

Technical comments

1. Overall: The use of "planktonic" vs "planktic". Please refer to Emiliani 1991: https://doi.org/10.1016/0377-8398(91)90003-O

We agree with the reviewer that the correct expression would be "planktic" as explained in the referred paper. However, the expression "planktonic foraminifera" is more common in the literature than "planktic foraminifera" (up to about 5 times more- as a quick search in Scopus revealed). For practical reasons we therefore prefer to keep using the term "planktonic".

2. Overall: There are many acronyms in the paper. Except for SST, SSS, DVM and DH they do not help reading the paper.

We will check the use of the acronyms and make sure that each is properly introduced and used consistently in the text.

3. Page 5, lines 6-15 and lines 20-32 ("Materials and methods"): This seem more like a description of results, which it may benefit to move to the start of "Results".

Caterina Bergami also suggested this change in her review. However, we consider that part of the methods section more as an evaluation of the methods employed in the analyses and not results. We therefore prefer to keep it in the methods section.