*Responses to Anonymous Referee #2*

<u>**NOTA: The initial reviewer comments are in italic, our answers are in bold, action taken in the revised version of the manuscript are underlined.**</u>

*The manuscript by Roche et al. summarises a noble and interesting attempt to improve our understanding of foram-based oxygen isotope data. The authors present a module ('FAME' – Foraminifers As Modeled Entities) they developed in order to predict changes in the oxygen isotope composition of the tests of different foraminifera species in response to changing climatic conditions. The model is forced by hydrographic data alone and incorporates a limited number of species-specific parameters, based on culture experiments, for each of five foraminifera species to describe their growth and habitat. Essentially, the model attempts to account for the effect of foraminifera depth habitat on their oxygen isotope composition, and to predict their oxygen isotope composition accordingly, as well as their presence/absence. To test their model they apply its methodology to reference datasets, namely the MARGO Late Holocene dataset. It is an interesting and concise presentation of their work and well-structured. I believe it will greatly contribute to research within the foraminifera and palaeoclimate community.*

**We are thankful for these positive and nice words on our work.**

*When such models are developed it's important to have some measure of their sensitivity. For that reason, I believe that error propagation in the model should be addressed given that several of the input parameters have errors associated with them.*

**We thank the reviewer for this remark. In response to this concern and to a similar concern expressed by the other reviewer, we have now included a discussion of the propagation of the errors in the Lombard growth equations into the maximum depth calculations and further in the distribution error of the previous figure 2, giving computed error arising from the propagation of the initial input parameter errors.**

<u>Action taken: In response to the reviewer and the other reviewer who had a similar request, we have tested a large range for the Lombard et al., 2009 growth rate curves and propagated the error in our results. The range tested are now presented in the new figure A1. Additions were made in the text where appropriate to describe these tests. The main message is that our results are very robust to such changes with an impact on the mean difference between computed and MARGO d18O below 0.1 per mil for all species.</u>

*Secondly, and this may sound pedantic but the authors may consider changing Globigineroides sacculifer to Trilobatus sacculifer as per its genus reassignment by Spezzaferri et al. (2015). I will leave this to the authors' discretion as there are arguments for retaining G. sacculifer given that this is still the most commonly used name for this species. However, over time this will obviously*

*change and the authors may want to introduce the new (and more taxonomically up-to-date) name.*

**We thank the reviewer for this comment that we have taken into account as suggested.**

<u>Action taken: The revised version makes reference to *Globigerinoides sacculifer* as the forma name (including *Globigerinoides trilobus*) in the first instance and uses *Trilobatus sacculifer* throughout.</u>

*In terms of convention, there are several instances where the author refers to oxygen isotopes incorrectly. For example, p1, line 16, the authors describe the 'oxygen-18 value', or in line 21, 'calcite oxygen-18', or elsewhere as 'species' oxygen-18' (e.g. p3, line 1). This is very pernickety but there are quite strict guidelines for isotopic notation. I suggest the authors double check their usage and perhaps refer to ratios rather than oxygen-18 content/signal as it's more in line with the literature.*

<u>Action taken : we have checked thoroughly the revised manuscript for mis-use of oxygen isotopes and have corrected them following the suggestion of the reviewer.</u>

*On page 7, line 16-17, you describe how you used a 0.1 per mil 'encrustation term'. Could you possibly elaborate as to where that value came from? It would make it easier for the reader as it seems a little arbitrary at present.*

**We have chosen a 0.1 ‰ value for the encrustation term in order to simulate maximum depths in agreement with the literature. The simulated depth of maximum growth shown in Fig. 4 and now summarized in the revised Table 1 do indeed match very well the available observations. For instance, Fig. 4e shows a deepening of *N. pachyderma* depth of maximum growt from 0-30 m in the Greenland Sea to 100-350 m in the Norwegian Sea, in agreement with the apparent calcification depths reconstructed by Simstich et al. (2003).**

<u>Action taken : we have added a few lines to summarize this to the text accompanying Table 1.</u>

*Also, the authors should mention wherever necessary that species with symbionts e.g. G. sacculifer (T. sacculifer) cannot live at depths greater than the photic zone, as is hinted at on page 7, line 20.*

**We agree with the reviewer that it is important to explicitly mention that T. sacculifer bears symbionts, like G. ruber. We would like nonetheless to emphasize a few aspects. Experimental determination by Spero suggests that the removal of symbionts drastically reduces the life-span of the host, therefore the reviewer is correct that symbiont bearing foraminifera should ideally inhabit the photic zone. However, the irridiance required for these**

symbionts is not known and hence we cannot infer maximum depth from that perspective. And finally the host is known, prior to gamete release, to be symbiont barren therefore there is a portion of growth that can be below the photic zone.

Action taken : we have modified the text p. 7 to explicitly mention that T. sacculifer bears symbionts.

*Some more specific comments:*

Action taken : specific comments have been corrected following the suggestions of the reviewer but for one instance.

*Page 1, line 17. Perhaps use 'reflected' rather than 'favoured'.*

*Line 20. Use 'throughout the year' rather than 'along the year' as this makes more grammatical sense.*
OK
*Page 2, line 7. I would consider adding a few more references here as several other studies have been done looking at carbonate ion and symbiotic effects. Pearson et al. (2012) gives a good summary of work up to that point.*
OK
*Line 26. Change 'being' to 'to be'*
OK
*Page 3, line 19. Italicise N. pachyderma.*
OK
*Page 5, line 21. Change 'weighs' to 'weight'?*
No, weighs is what we mean here.

*Page 8, line 2. Use a different word to 'ascertain' as this doesn't make sense in the context.*
We replaced it by « check »