Herewith we submit a revised version of the manuscript entitled "Mg/Ca, Sr/Ca and stable isotope from planktonic foraminifera *T. sacculifer*: testing a multi-proxy approach for inferring paleo-temperature and paleo-salinity". We appreciate the effort the reviewers put into our manuscript, which greatly benefitted from their comments. Each of their comments was addressed separately.

Answer to anonymous referee 2:

Overall, I find this paper to be confusing, not overly novel, and missing key related studies: As the authors point out, their Mg/Ca-SST calibration results in a similar regression to studies published by Nurnberg et al. 1996.

Answer:
As pointed out in our manuscript line 401, our Mg/Ca-SST calibration results, are indeed, very similar to the regression by Nurnberg et al. (1996). However, we strongly disagree with the reviewer that our study is not overly novel, in the sense that the Mg/Ca-T°C calibration was previously published. On the contrary, being able to reproduce the same temperature-element regression based on foraminiferal geochemical signatures of very different samples: Regression based on experimentally cultured foraminifera maintained under laboratory conditions (Nurnberg et al., 1996) *versus* surface water foraminifera collected using underway pumping from ca. 10m depth (this study). As both studies use different analytical techniques (electron microprobe for Nurnberg et al., 1996, *versus* LA-ICPMS for our study), we encourage and confirm the strong reliability of foraminifera Mg/Ca as a temperature proxy.

What makes this present study novel is their attempt to combine Mg/Ca and Sr/Ca measurements to further improve the SST calibration by accounting for the minor influence of salinity.
However, it is not until section 4.2 that the basis for including Sr/Ca is explained. This should be put in the introduction of the paper, and more emphasis should be placed on this.
Answer:
To accommodate this comment, the introduction from line 80 to 85 was modified as follow: "The primary objectives of this study are (1) to test and improve the calibration of both the Mg/Ca and oxygen isotope paleothermometer for the paleoceanographic relevant species *T. sacculifer;* (2) to test whether the incorporation of Sr into the Mg-T reconstruction equation improves temperature reconstruction by accounting for the impact of salinity; (3) to evaluate the agreement between observed and predicted $\delta^{18}O_w$ and (4) test potential for SSS reconstructions of the Atlantic Ocean."

I am concerned though because in lines 224-240, when Mg/Ca and Sr/Ca are combined, it is unclear how this is done. I do not understand how the combined regression was created, and how an R-squared of 0.92 is obtained.
Answer:
We understand the confusion, and even though our combined regression is correct, we modified the manuscript for better clarification as follows:
"The relationship between both Mg/Ca and Sr/Ca ratios and measured temperatures were calculated using least square differences. Both show a good correlation with surface water

temperature (Fig. 2, Tab. 3). The Mg/Ca ratio increases exponentially by 8.3%/°C (best fit) (Mg/Ca and Sr/Ca ratios given in mmol/mol):

$Mg/Ca=(0.42\pm0.13)\ exp((0.083\pm0.001)*T),\ R^2=0.86$ pvalue=2,9e-06 (equation 1)

whereas Sr/Ca ratio increases linearly by 0.6%/°C (Fig. 2a and b), best fit:

$Sr/Ca=(0.009\pm0.002)*T+(1.24\pm0.05),\ R^2=0.67$ pvalue=5.e-04 (equation 2)

Concerning the temperature reconstruction, by inversing the approach, univariate regressions yields to:

$T= (12.3\pm1.5)+(\ (10.5\pm1.2)*log(Mg/Ca),\ R^2=0.86$ pvalue=2,9e-06 (equation 1')

And

$T= +\ (-84.1\pm22.9)+(\ (71.7\pm15)*Sr/Ca,\ R^2=0.67$ pvalue=5e-04 (equation 2')

Combining Mg and Sr data for a non-linear multivariate regression allows improvement of the correlation with temperature, best fit:

$T=-(27\pm15)+(8\pm1)*ln(Mg/Ca)+(28\pm11)*Sr/Ca$, pvalue Mg/Ca: 2.10^-4 (equation 3)

$R^2=0.92$ pvalue= 2.e-04

For comparison, with regression found in the literature, Mg/Ca is estimated below as a function of temperature and Sr/Ca.

$Mg/Ca = exp\ ((0.98\pm1.89)+(0.09\pm0.02)*T+\ (-1.43\pm1.45)*\ Sr/Ca)$

$R^2=0.86$ pvalue= 2.05e-05 (equation 3')"

The paper does not mention the Bayesian calibration for *T. sacculifer* from Tierney et al. (2019, Paleoceanography and Paleoclimatology). For completeness, I think an examination of this calibration should be included in the paper.
Also, the study of Gray and Evans 2019 is discussed on lines 260-266, but then not used in the comparisons later in the paper. Both of the calibrations for *T. sacculifer* from these two studies should be used later on in the paper when the different available calibrations are compared for "reconstructions".

Answer:

For completeness, both equation are now included and extensively discussed from line 263-286. Interestingly, both calibrations, when applied to our data, yield correlation coefficients of 0.9 for Gray and Evans (2019), and 0.82 for Tierney et al., (2019), only slightly below the correlation established in our study (R2 of 0.86, for T°-Mg/Ca only, 0.91 for T°C-Mg/Ca-S, and 0.93 for T°C-

Mg/Ca-Sr/Ca). This is now described in line 283-285: “Here we can conclude, that despite the difference in sampling strategy and samples geographical distribution, our regression models are in line with the previous work of Gray and Evans (2019) and Tierney et al. (2019).”

There is no mention of the study by Thirumalai et al. 2016 (Paleoceanography and Paleoclimatology) that developed a program called PSUSolver that uses a similar Monte Carlo approach to propagate the error of Mg/Ca and δ18Oc measurements for δ18Osw convolution.

Answer: The similar technique (Monte Carlo approach) developed in the paper of Thirumalai et al. 2016 is now cited line 575 : “*Here, error propagation related to $\hat{S}$ was computed by a Monte Carlo simulation, which is simple to implement (Anderson, 1976), and in line with the method applied by Thirumalai et al., (2019) on sediment samples. Ruber (W) specimen.”*

I find the section 5 on “reconstructions” to be confusing. The authors go through an exercise of trying to determine the best Mg/Ca calibration to use, and then use Nurnberg et al. for their “reconstruction”. I do not understand why they do not use the Mg/Ca calibration they created in the current paper?

Answer:

The idea here is to test previously established calibrations, using our data, and compare the results with the measured environmental parameters (temperature) these fits reconstruct. Using our own calibration (established with our data), to test the fit to our data would be senseless.

I also find their use of “reconstruction” to be confusing. Paleoceanographers tend to use the term reconstruction for the creation of a long-term record. I think a term like “calibration testing” would make more sense for what the authors are trying to do.
The term “successive reconstructions” is also found throughout the paper, but I don’t think this is the correct term.

Answer:

We disagree with the reviewer, in our study we use the same tools available to Paleoceanographers, to reconstruct the same environmental parameters. We therefore prefer to leave the terms originally chosen in the paper.

On lines 241 the authors discuss the relationship between Mg/Ca and Sr/Ca and salinity, but these relationships are not shown in any figures. I think these would be useful figures to include.

Answer:

All the raw data are given in the table 1 and 2 of the manuscript, the correlation of Mg/Ca and temperature, and Sr/Ca and temperature, respectively are both shown on table 2, for conciseness no additional figure has been added to the manuscript.

The equation shown on line 250 should be solved for Mg/Ca and put into the same form as the equation on line 259 to enable comparison of the two equations.

Answer:

For completeness and to better enable comparison of equations, we now present both forms (equation 3 and 3’) from line 243 to 249:

$T=-(27\pm15)+(8\pm1)*\ln(Mg/Ca)+(28\pm11)*Sr/Ca$, p value Mg/Ca: 2.10^-4 (equation 3)

R^2=0.92 pvalue= 2.e-04

For comparison, with regressions found in the literature, Mg/Ca is estimated below as a function of temperature and Sr/Ca.

$$Mg/Ca = \exp((0.98\pm1.89)+(0.09\pm0.02)*T+(-1.43\pm1.45)*Sr/Ca)$$

R^2=0.86 p value= 2.05e-05 (equation 3')

Lines 580-587 are a duplicated of lines 569-576.

Answer: We disagree with the reviewer, from line 569 to 576, we explain why we decide to use a Monte Carlo Simulation, and from line 580-587 we explain the two different applications of the simulation, first considering only the error associated with the successive fits (assuming that variables, i.e. the data, are perfectly known without any uncertainties), and then line 590 adding successively the uncertainties related to estimating the variables using proxy data.
Both these sections are necessary to understand how we proceed with the Monte Carlo simulation.

Table 2: it says 5 to 9 specimens per station but on line 165 it says 5 to 8 were used.

Answer:

Both statements were corrected. 5-13 specimens were measured per sampling station (see answer to reviewer 1 where a table with Mg/Ca row data is given).

Throughout the whole paper, the 18 is δ18O needs to be superscript.

Answer:

It was corrected in whole manuscript.

In table 1, it says World Ocean Atlas 2005 was used, but this is a quite old version of WOA.

Answer:

The column showing annual surface temperature was removed from table 1, as it was of no use in this version of the manuscript.

In table 3 and 4, decimals should be used instead of commas.

Answer:

Commas were replaced by decimals within both tables 3 and 4.

Figure 1 – I think it would make more sense of a map of temperature was used rather than the gridded δ^{18}Osw product.

Answer:

The map was modified, and as suggested by the reviewer we changed the gridded δ^{18}Osw by surface temperature as a background to show the distribution of the sampling stations.

Also, the color bar needs to be labeled with units. I would also try to avoid using a "rainbow" colorbar.

Answer: The color bar is now labeled with units.

Figure 4 and 5: the d needs to be replaced with the delta symbol on the axis labels.

Answer:
The delta symbol is already present on the axis labels

The title of the paper does not seem to be grammatically correct. It needs the word "the" between "from" and "planktonic". I would also say $\delta^{18}O$ instead of "stable isotope" to make it more specific.
Answer:
We agree with reviewer and have changed to "….THE PLANKTONIC FORAMINIFER…". However, we maintain "ISOTOPS" (now in plural) as Carbon isotopes were also measured, and will be made available in the raw data: "Mg/Ca, Sr/Ca AND STABLE ISOTOPES FROM THE PLANKTONIC FORAMINIFER *T. SACCULIFER*: TESTING A MULTI-PROXY APPROACH FOR INFERRING PALEO-TEMPERATURE AND PALEO-SALINITY"