We thank Referee #1 for the very constructive review of our manuscript. We worked extensively to address his/her comments and suggestions. Below, we provide a point-by-point response together with a description of all relevant changes performed to the manuscript. To facilitate the discussion, we copied Referee #1 comments and suggestions in black and inserted our responses in blue. All line numbers mentioned in our responses below refer to the revised version of our manuscript with track changes on.

Anonymous Referee #1

The manuscript represents an important contribution for the paleoceanographic and paleoclimatic reconstruction of the Southwest South Atlantic, addressing relevant scientific questions within the scope of CP. It analyzes the relative abundance of some species of planktonic foraminifera and 100m-temperature reconstructions from the uppermost 350 cm of a sediment core extracted from the southern Brazilian margin. Despite it does not contribute with new concepts or substantial data, it intends to elucidate the mechanisms behind the high glacial productivity recorded in the region, and consequently, interesting conclusions are reached. In general terms the manuscript is well written and it is easy to follow the reasoning proposed by the authors. The title clearly reflects the contents, the abstract is concise and complete, the overall presentation is clear and correctly structured, and the references are correct. The language is fluent and precise; I did only some minor comments in the PDF about it.

Response #1 – We thank Referee #1 for the suggestions made directly in the PDF file. We incorporated all of them in the revised version of our manuscript.

The scientific approach is correct. However, there are methodology aspects that could be improved. Some of the applied methods lack of robustness:
the authors state that the “basic assumption is that temperature of ambient seawater is the primary control of foraminiferal assemblages” (line 139). In a particular region like this, why not considering that the planktonic foraminiferal assemblages could mainly respond to productivity instead of temperature? Did the authors test this option? I suggest them to consider this possibility and evaluate it.

Response #2 – We agree that under specific circumstances, productivity may be the first order stressor controlling planktonic foraminifera assemblage (PFA). Indeed, PFA are controlled by different environmental parameters (e.g. temperature, productivity, mixed layer depth), and productivity has been reported as the first order stressor in eastern boundary upwelling zones (e.g. Salgueiro et al., 2014). In general, however, when MAT is used to reconstruct past temperatures out of eastern boundary upwelling zones, the basic assumption is to consider temperature as the first order stressor (Telford et al., 2013), as performed in our study. This assumption has been extensively tested and is routinely applied in paleoceanographic studies not investigating eastern boundary upwelling zones (e.g. Kucera et al., 2005; Lessa et al., 2017; Niebler & Gersonde, 1998; Portilho-Ramos et al., 2015). Additionally, the Canonical Correspondence Analysis of core-top sediments and water column properties from the Atlantic and Pacific Oceans indicates that PFA is highly correlated (30.4% of faunal variance) to temperature, while only 7.9% of the faunal variance is related to productivity (Morey et al., 2005). The western boundary upwelling zones like those along the Brazilian margin are not as strong and geographically extensive as their eastern boundary counterparts (e.g. off Iberian margin and off NW Africa). In contrast, the Brazilian margin is generally an oligotrophic area bathed by nutrient-poor, warm and salty tropical waters of the Brazil Current (e.g. Peterson and Stramma, 1991; Brandini et al., 2000; Locarnini et al., 2013; Zweng et al., 2013; Garcia et al., 2014) dominated (i.e. ca. 80% of the PFA) by warm tropical water foraminifera species (i.e. *Globigerinoides ruber*, *Globigerinoides trilobus* and *Globigerinella siphonifera*) (e.g. (Boltovskoy et al., 1996, 2000; Kucera et al., 2005; Venancio et al., 2016). In the investigated marine sediment core JPC-17, tropical species are responsible for ca. 70% of PFA. Thus, warm-oligotrophic species largely dominate PFA variance and supports the application of a temperature-based MAT, as performed in our study.

Instead, the authors use 100m-temperature reconstructions derived from MAT following Portillo-Ramos et al. (2015). In that contribution, the authors follow the criteria of Telford et al. (2013). Telford et al. emphasize that the highest performance of a transfer function is the one that should be used and, in 2015, Portillo-Ramos et al. obtained the best performance at 10 m, not 100 m depth. As in this contribution the aim of the authors is to reconstruct the subsurface temperature, I strongly recommend (following Telford et al., 2013) to constrain the training set to a regional scale and try to obtain a better performance at 100 m depth. In fact, they could apply the same criteria of Lessa et al. (2017), who added 161 core tops from upwelling areas such as the Iberian Peninsula and NW Africa to the training set. I see this item important to be addressed.

Response #3 – Indeed, the criteria of Lessa et al. (2017), using the entire Atlantic Ocean dataset from MARGO (Kucera et al., 2005) and including 161 samples from North Atlantic eastern boundary upwelling zones (Salgueiro et al., 2014), improved the MAT performance at 100 m water depth in comparison to Portilho-Ramos et al. (2015). This approach also provides analogs between 5° and 15°C that are otherwise not available when the South Atlantic database is used alone. We now use a similar approach applying the entire Atlantic Ocean dataset from MARGO (Kucera et al., 2005) as well as and including 161 samples from the North Atlantic eastern boundary upwelling zones (Salgueiro et al., 2014) and obtained a R^2 of 0.98 and RMSEP of 0.95 (in the previous version of manuscript we had a R2 of 0.90 and a RMSEP of 1.5 for 100 m water depth). It is worthy of note that the new training set shows the same R2 for 10 and 100 m water depth, thus showing an equally good performance for these two specific water depths. The revised version of our manuscript was changed accordingly (lines 134 – 145 and Figure 3F).

Finally, I suggest the authors to use the WOA data previous to 2005 in order to avoid the “global warming” signal.

Response #4 – We agree that using earlier versions of the World Ocean Atlas has the advantage of minimizing a possible bias related to “global warming”. However, these earlier versions have the disadvantage of showing a smaller spatial coverage, introducing local biases due to the interpolation of sparse data (Locarnini et al., 2013). Thus, using the 2009 version of the World Ocean Atlas (as performed in this study) represents a compromise between the deleterious effects of “global warming” and sparse data. Indeed, the impact of “global warming” over the temperature output of the World Ocean Atlas 2009 is rather small compared to the impact of “global warming” inherent to the first version of the World Ocean Atlas (Levitus and Boyer, 1994). In the 2009 version of the World Ocean Atlas, temperature is calculated as the average of instrumental data back to 1955 (Locarnini et al., 2009).

The age model is another point of argue. The first meter (which corresponds to the first 23 ka) was already published by Tessin and Lund (2013) and it contains 5 reversals (if we also consider the one obtained by Portillo-Ramos et al. -2014-). The last 2.5 meters have one AMS point from Portillo-Ramos et al. (2014) and two _18O points of control performed in this study. The _18O curve fits correctly with the Stack LS16 and the one obtained for sediment core GL-1090. However, as there are so many reversal points, why not trying a Bayesian model like Santos et al. (2017)? In fact, it would be better for the comparison with core GL-1090. I consider this a major point in the MS and I encourage the authors to check the age model. These issues can be easily improved.

Response #5 – Agree. We improved the age model by applying the R script BACON version 2.2, which uses Bayesian statistics to reconstruct Bayesian accumulation histories for sedimentary deposits (Blaauw and Christeny, 2011). All AMS ^{14}C ages were calibrated using the IntCal13 calibration curve (Reimer et al., 2013) with a reservoir correction age of 400 ±100 yr (1σ error). We estimated the error of the δ^{18}O tie-points similarly to Santos et al. (2017), considering the mean resolution of the JPC-17 benthic δ^{18}O record around the tie-point depth, the mean resolution of the reference curve around the tie-point age, a matching error visually estimated when defining tie-points, and the absolute age error of the time-scale used for the reference record. The chronology of core JPC-17 was additionally verified and supported by regional planktonic foraminifera biostratigraphy (Ericson & Wollin, 1968; Portilho-Ramos et al., 2014).

The new age model does not differ significantly from the previous one (i.e. maximum difference is 3.7 kyr around 56 – 60 cal ka BP), but BACON smoothed the interval with reversed ages (i.e. between16 and 21 cal ka BP). Importantly, the new age model does not change our interpretation or conclusions. Still, Figures 2-4 were updated. The revised version of our manuscript was changed accordingly (lines 148 - 177).

I carefully read the referenced publications from the SBM and revise the results obtained for G. bulloides' relative abundances. When compared the different core's results, glacial abundances of G. bulloides in JPC-17 seem to be a bit higher than in the other cores (<10%). Nowadays, this species is considerably abundant along the Malvinas Current (Boltovskoy et al., 1996) and apparently the modern configuration of the Brazil-Malvinas Confluence would have been established _9 ka ago in response to changes in the strength of the SW-winds (Voigt et al., 2015). If the authors suggest that during the last glacial period there were "prolonged winter-like conditions of prevalent alongshore SW-winds and frequent cold front passages", I think they should consider the Malvinas Current also as a G. bulloides input.

Response #6 – Core JPC-17 (27°S) is located ca. 10° to the north of the mean position of the Brazil-Malvinas Confluence (BMC) (Combes and Matano, 2014). We argue that a 10° meridional shift of the BMC during the last glacial period seems unrealistic. First, if this would have happened, the stable oxygen isotopic composition of glacial *Globorotalia inflata* (a particularly suited isotopic tracer of the Malvinas Current; Chiessi et al., 2007) from core GeoB6211-1 collected at ca. 32°S should have registered the presence of the Malvinas Current, which is not the case (Chiessi et al., 2008). Second, one would expect a similar pattern between the abundance of planktonic foraminifera *Globigerina bulloides* and the abundance of dinoflagellate cyst *Brigantedinium* spp. (a particularly suited species to track the Malvinas Current; Zonneveld et al., 2013) from nearby core GeoB2107-3, which is not the case (Gu et al., 2017).

We argue that the slightly different *G. bulloides* abundance between core JPC-17 and nearby cores collected to the north of it (Portilho-Ramos et al., 2015) is rather related to the regional distribution of the species along the Brazilian margin. The high abundance of tropical species (ca. 80% of the PFA at 30º–36ºS) decreases towards higher latitudes along the Brazilian margin (Boltovskoy et al., 1996; Niebler et al., 1998; Boltovskoy et al., 2000; Kucera et al., 2005a; Venancio et al., 2016). For example, in surface sediments from the MARGO database (Kucera et al., 2005a), the abundance of *G. ruber* around the site of core GL-75 (21ºS) ranges between 50 and 60 % but decreases to 30–50% at the site of core JPC-17 (27ºS). The glacial abundance of *G. ruber* (and total tropical species) was 52.4% (84%) in northern core GL-75 and 38% (53%) in JPC-17, while its Holocene abundance was 55% (95%) in GL-75 and 45% (72%). Today, *G. bulloides* is virtually absent from the Brazilian margin, being restricted to surface sediments from the Cabo Frio Upwelling system (10–20 %; Lessa et al., 2014). Thus, we interpret glacial abundances of *G. bulloides* of 8–18 % (JPC-17) and 3–12 % (GL-75) as associated to enhanced upwelling.

References:

Brandini, F. P., Boltovskoy, D., Piola, A., Kocmur, S., Röttgers, R.,Cesar Abreu, P., and Mendes Lopes, R.: Multiannual trends in fronts and distribution of nutrients and chlorophyll in the south-western Atlantic (30–62◦ S), Deep-Sea Res. Pt. I, 47, 1015–1033, doi:10.1016/S0967-0637(99)00075-8, 2000.

Blaauw, M., & Christeny, J. A. (2011). Flexible paleoclimate age-depth models using an autoregressive gamma process. *Bayesian Analysis*, *6*, 457–474. https://doi.org/10.1214/11-BA618

Boltovskoy, E., Boltovskoy, D., & Brandini, F. (2000). Planktonic Foraminifera from southwestern Atlantic epipelagic waters: abundance, distribution and year-to-year variations. *Journal of the Marine Biological Association of the UK*, *80*(2), S0025315499001794. https://doi.org/10.1017/S0025315499001794

Boltovskoy, E., Boltovskoy, D., Correa, N., & Brandini, F. (1996). Planktic foraminifera from the southwestern Atlantic (30 °–60 °S): species-specific patterns in the upper 50 m. *Marine Micropaleontology*, *28*, 53–72. https://doi.org/10.1016/0377-8398(95)00076-3

Chiessi, C. M., Ulrich, S., Mulitza, S., Pätzold, J., & Wefer, G. (2007). Signature of the Brazil-Malvinas Confluence (Argentine Basin) in the isotopic composition of planktonic foraminifera from surface sediments. *Marine Micropaleontology*, *64*(1–2), 52–66. https://doi.org/10.1016/j.marmicro.2007.02.002

Chiessi, C. M., Mulitza, S., Paul, A., Pätzold, J., Groeneveld, J., & Wefer, G. (2008). South

Atlantic interocean exchange as the trigger for the Bølling warm event. *Geology*, *36*(12), 919. https://doi.org/10.1130/G24979A.1

Combes, V., & Matano, R. P. (2014). A two-way nested simulation of the oceanic circulation in the Southwestern Atlantic. *Journal of Geophysical Research: Oceans*, *119*(2), 731–756. https://doi.org/10.1002/2013JC009498

Ericson, D. B., & Wollin, G. (1968). Pleistocene Climates and Chronology in Deep-Sea Sediments. *Science*, *162*(3859), 1227–1234. https://doi.org/10.1126/science.162.3859.1227

Gu, F., Zonneveld, K. A. F., Chiessi, C. M., Arz, H. W., Pätzold, J., & Behling, H. (2017). Long-term vegetation, climate and ocean dynamics inferred from a 73,500 years old marine sediment core (GeoB2107-3) off southern Brazil. *Quaternary Science Reviews*, *172*, 55–71. https://doi.org/10.1016/j.quascirev.2017.06.028

Kucera, M., Rosell-Melé, A., Schneider, R., Waelbroeck, C., & Weinelt, M. (2005). Multiproxy approach for the reconstruction of the glacial ocean surface (MARGO). *Quaternary Science Reviews*, *24*(7–9), 813–819. https://doi.org/10.1016/j.quascirev.2004.07.017

Lessa, D. V. O., Santos, T. P., Venancio, I. M., & Albuquerque, A. L. S. (2017). Offshore expansion of the Brazilian coastal upwelling zones during Marine Isotope Stage 5. *Global and Planetary Change*, *158*(September), 13–20. https://doi.org/10.1016/j.gloplacha.2017.09.006

Morey, A. E., Mix, A. C., & Pisias, N. G. (2005). Planktonic foraminiferal assemblages preserved in surface sediments correspond to multiple environment variables. *Quaternary Science Reviews*, *24*(7–9), 925–950. https://doi.org/10.1016/j.quascirev.2003.09.011

Niebler, H.-S., & Gersonde, R. (1998). A planktic foraminiferal transfer function for the southern South Atlantic Ocean. *Marine Micropaleontology*, *34*(3–4), 213–234. https://doi.org/10.1016/S0377-8398(98)00009-7

Portilho-Ramos, R. C., Ferreira, F., Lago, L. C., Da Silva, A. G. V., Jaworski, K. S., & Toledo, M. B. (2014). Globorotalia crassaformis optimum event: a new late Quaternary biostratigraphic marker for the southeastern Brazilian margin. *PALAIOS*, *29*(11), 578–593. https://doi.org/10.2110/palo.2013.097

Portilho-Ramos, R. da C., Ferreira, F., Calado, L., Frontalini, F., & de Toledo, M. B. (2015). Variability of the upwelling system in the southeastern Brazilian margin for the last 110,000years. *Global and Planetary Change*, *135*, 179–189. https://doi.org/10.1016/j.gloplacha.2015.11.003

Reimer, P. J., Bard, E., Bayliss, A., Beck, J. W., Blackwell, P. G., Ramsey, C. B., … van der Plicht, J. (2013). IntCal13 and Marine13 Radiocarbon Age Calibration Curves 0–50,000

Years cal BP. *Radiocarbon*, *55*(04), 1869–1887. https://doi.org/10.2458/azu_js_rc.55.16947

Salgueiro, E., Naughton, F., Voelker, A. H. L., Abreu, L. De, & Alberto, A. (2014). Past circulation along the western Iberian margin : a time slice vision from the Last Glacial to the Holocene. *Quaternary Science Reviews*, *106*. https://doi.org/10.1016/j.quascirev.2014.09.001

Santos, T. P., Lessa, D. O., Venancio, I. M., Chiessi, C. M., Mulitza, S., Kuhnert, H., … Albuquerque, A. L. S. (2017). Prolonged warming of the Brazil Current precedes deglaciations. *Earth and Planetary Science Letters*, *463*, 1–12. https://doi.org/10.1016/j.epsl.2017.01.014

Telford, R. J., Li, C., & Kucera, M. (2013). Mismatch between the depth habitat of planktonic foraminifera and the calibration depth of SST transfer functions may bias reconstructions. *Climate of the Past*, *9*(2), 859–870. https://doi.org/10.5194/cp-9-859-2013

Venancio, I. M., Franco, D., Belem, A. L., Mulitza, S., Siccha, M., Luiza, A., … Kucera, M. (2016). Marine Micropaleontology Planktonic foraminifera shell fl uxes from a weekly resolved sediment trap record in the southwestern Atlantic : Evidence for synchronized reproduction. *Marine Micropaleontology*, *125*(April), 25–35. https://doi.org/10.1016/j.marmicro.2016.03.003

Zonneveld, K.A.F., Marret, F., Versteegh, G.J.M., Bogus, K., Bonnet, S., Bouimetarhan, I., Crouch, E., de Vernal, A., Elshanawany, R., Edwards, L., Esper, O., Forke, S., Grøsfjeld, K., Henry, M., Holzwarth, U., Kielt, J.-F., Kim, S.-Y., Ladouceur, S., Ledu, D., Liang, C., Limoges, A., Londeix, L., Lu, S.-H., Mahmoud, M.S., Marino, G., Matsuoka, K., Matthiessen, J., Mildenhal, D.C., Mudie, P., Neil, L.H., Pospelova, V., Qi, Y., Radi, T., Richerol, T., Rochon, A., Sangiorgi, F., Solignac, S., Turon, J.-L., Verleye, T.,Wang, Y.,Wang, Z., Young, M., 2013. Atlas of modern dinoflagellate cyst distribution based on 2405 data points. Rev. Palaeobot. Palynology 191, 1e197.

Zweng, M.M, J.R. Reagan, J.I. Antonov, R.A. Locarnini, A.V. Mishonov, T.P. Boyer, H.E. Garcia, O.K. Baranova, D.R. Johnson, D.Seidov, M.M. Biddle, 2013. World Ocean Atlas 2013, Volume 2: Salinity. S. Levitus, Ed., A. Mishonov Technical Ed.; NOAA Atlas NESDIS 74, 39 pp.