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Interactive comment on "Understanding the mechanisms behind high glacial productivity in the southern Brazilian margin" *by* Rodrigo da C. Portilho-Ramos et al.

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We thank Referee #2 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 #2 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 #2 This paper presents a new record of foraminiferal species abundances, which are used to reconstruct temperature and productivity changes off

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Discussion paper

the Brazilian Margin over the last 70 kyr. In general, I enjoyed reading this paper, which is clearly written and with apparently sound methods (note that the use of MAT isn't my area of expertise) and mostly good interpretations. I have a suggestion for a moderate revision to the manuscript before publication in Climates of the Past, and some minor corrections/ suggestions for the correct use of English. My main comment surrounds the interpretation of the silicic acid leakage hypothesis (SALH). The authors use as evidence for silicon leakage the opal records from sediment core RC13-254 and 259. Whilst these do show a change in opal burial from the glacial into the Holocene, this change in burial is most likely a result in the shift of location of opal production (due to movement of frontal zones), rather than an overall net change in opal accumulation in the Atlantic Sector and leakage of DSi (see papers by Kumar et al., 1995 and Frank et al., 2000). [In contrast to the Atlantic, the Pacific Sector may have experienced not only a shift in opal burial location, but also a net decline across the glacial termination (Chase et al., 2003)]. Although there is some evidence that there was a net decrease in opal burial in the Equatorial Atlantic over this time period (Bradtmiller et al., 2007), opal records from the Atlantic Ocean north of the APF are variable and paint an inconsistent story. There are also AAIW DSi reconstructions available for the Western Atlantic available for comparison, including from GeoB2107- 3 (Hendry et al,. 2012; Griffiths et al., 2013). In summary, I think the authors should make a more nuanced discussion of the evidence for Atlantic ïĄĎSi leakage changes on glacial-interglacial timescales taking all of the evidence into account.

Response #1 – We agree that a more nuanced discussion about the Atlantic silicic acid leakage hypothesis (SALH) would be beneficial to the manuscript. We now discuss the evidences for the SALH in the South Atlantic. This includes the Antarctic Intermediate Water silicic acid content from nearby core GeoB2107- 3 (Hendry et al., 2012) and from equatorial Atlantic cores RC24-01, RC24-07 and MD99-2198 (Bradtmiller et al., 2007; Griffiths et al., 2013). Importantly, South Atlantic Central Water is highlighted as the major conduit for sub-Antarctic thermocline waters involved in the SALH (Sarmiento et al., 2004) that has great potential to boost primary production in the southern Brazilian margin (Campos et al., 2000). We also improved Figure 4 by adding biogenic opal records from cores RC24-01 and RC24-07 from the equatorial upwelling off NW Africa (Bradtmiller et al., 2007). The revised version of our manuscript was changed accordingly (lines 310 – 322, 326 – 330 and 355 – 356, and Figure 4).

Minor suggestions/corrections: Line 18: The first sentence of the abstract would read better if merged with the second sentence: “This study explores the mechanisms behind the high glacial productivity in the southern Brazilian margin during the last 70 kyr, using planktonic foraminifera: Line 49: Avoid phrases such as “On the other hand” e.g. use “Opposing this drawdown, the upwelling: Line 79: Change “mechanisms” to “mechanism” Line 94: What is meant by “besides other oceanographic processes”? Perhaps just remove this phrase as I don’t think it adds anything Line 101: Change “vicinities” to “vicinity” Line 110: Change “vicinities” to “vicinity” Line 120: Change “limestone” to “sediments” Line 153: Change “where” to “were” Line 157: Change “decide” to “decided” Line 180: Change “by” to “of” Line 204: Change “has” to “have” Line 214: Change “like” to “such as” Line 237: I find the references to G. bulloides vs. dinocyst deposition showing different seasonal changes rather repetitive as it appears a number of times throughout the text. As a suggestion, perhaps remove reference to it at this point, leaving the explanation of the interpretation to the next section. Line 248: Remove “On the other hand” Line 256: Change “to” to “with” Line 259 (and elsewhere): I find the use of the phrase “eutrophic environmental dinocysts” a little unclear. As a suggestion, perhaps replace with “dinocysts characteristic of eutrophic conditions”, and then subsequently just refer to “dinocysts”? Line 286: Change “do” to “does” Line 288: This sentence could do with restructuring. Perhaps “dinocyst record from core GeoB2107-3 matches austral winter (June) insolation at 65oS very well over the past: : :” Line 301: This sentence could do with restructuring. Perhaps “We suggest that, rather than being driven by changes in upwelling intensity: : :, the increased productivity may have been a result of increased silicic acid content: : :” (this sentence appears in a similar form in the conclusions, and so should also be rephrased) Line 324: Change “benefited the” to “benefited from the” Line 337: Change “decrease” to “decreased” Line 338: Change “Oligotrophic conditions is” to (e.g.) “The presence of oligotrophic conditions is”

Response #2 – We thank Referee #2 for the corrections. We incorporated all of them in the revised version of our manuscript.

References

Bradtmiller, L. I., Anderson, R. F., Fleisher, M. Q., & Burckle, L. H. (2007). Opal burial in the equatorial Atlantic Ocean over the last 30 ka: Implications for glacial-interglacial changes in the ocean silicon cycle. Paleoceanography, 22(4), PA4216. https://doi.org/10.1029/2007PA001443 Campos, E. J. D., Velhote, D., & da Silveira, I. C. A. (2000). Shelf break upwelling driven by Brazil Current Cyclonic Meanders. Geophysical Research Letters, 27(6), 751–754. https://doi.org/10.1029/1999GL010502 Griffiths, J. D., Barker, S., Hendry, K. R., Thornalley, D. J. R., van de Flierdt, T., Hall, I. R., & Anderson, R. F. (2013). Evidence of silicic acid leakage to the tropical Atlantic via Antarctic Intermediate Water during Marine Isotope Stage 4. Paleoceanography, 28(2), 307–318. https://doi.org/10.1002/palo.20030 Hendry, K. R., Robinson, L. F., Meredith, M. P., Mulitza, S., Chiessi, C. M., & Arz, H. (2012). Abrupt changes in high-latitude nutrient supply to the Atlantic during the last glacial cycle. Geology, 40(2), 123–126. https://doi.org/10.1130/G32779.1 Sarmiento, J. L., Gruber, N., Brzezinski, M. A., & Dunne, J. P. (2004). High-latitude controls of thermocline nutrients and low latitude biological productivity. Nature, 427(6969), 56–60. https://doi.org/10.1038/nature10605

Please also note the supplement to this comment:
https://www.clim-past-discuss.net/cp-2018-98/cp-2018-98-AC2-supplement.pdf

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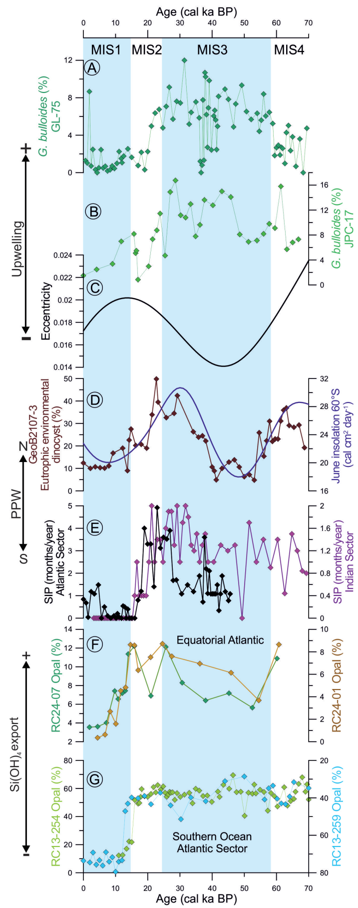
Age (cal ka BP)
MIS1
MIS2
MIS3
MIS4
A
B
C
D
E
F
G
G. bulloides (%) GL-75
G. bulloides (%) JPC-17
Upwelling
Eccentricity
GeoB2107-3 Eutrophic environmental dinocyst (%)
June insolation 60°S (cal cm² day⁻¹)
PPW
N
S
SIP (months/year) Atlantic Sector
SIP (months/year) Indian Sector
Equatorial Atlantic
RC24-07 Opal (%)
RC24-01 Opal (%)
Si(OH)4 export
RC13-254 Opal (%)
RC13-259 Opal (%)
Southern Ocean Atlantic Sector

Fig. 1.