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Climate of the Past Discussions

Interactive comment on "Climate, cryosphere and carbon cycle controls on Southeast Atlantic orbital-scale carbonate deposition since the Oligocene (30–0 Ma)" *by* Anna Joy Drury et al.

Anonymous Referee #1

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Drury et al., present a new XRF (Ca/Fe) record that extends the previously published study of Liebrand et al., 2016 from early Miocene into Pleistocene. CaCO3 content estimated from this new dataset provides the first composite record in the South Atlantic with a continuous astronomical chronology for the last 30 Ma. Through wavelet analysis, Drury et al., find that the variability and dominant cyclicity in %CaCO3 content have evolved over time. Overall, 3 distinct stages are recognized: from 30 to 8 Ma, eccentricity paced cyclicity dominates %carbonate variability. After 8 Ma, obliquity and precession become more prevalent while eccentricity imprint is reduced. In the last 3 Ma, both precession and obliquity become hard to observe and the age model relies on previously published benthic d18O (Bell et al., 2014). The manuscript is well written,

and the dataset has the potential to make a great contribution to the community and serve as a framework for future palaeoclimatic and palaeoceanographic studies. I thus suggest acceptance of the manuscript with some minor revision.

My primary concern about the studied site is the potential complications of winnowing. Sites of Leg 208 were drilled to provide a depth transect in the South Atlantic to monitor changes in ocean chemistry as a function of time and depth. However, a submarine edifice such as the Walvis Ridge also forms a major obstacle to the flow of deep and intermediate waters. Sediments deposited on such a topographic high can be highly winnowed due to intensified flow of waters around and over the ridge. Shackleton et al. (1984) have also studied the accumulation rate of fine fraction along the depth transect of Leg 74 and concluded that winnowing has removed fine-grained material from topographic highs and deposited them on the flanks and in the basins.

I also take a look at the biostratigraphy of Site 1264 in the initial report. I find that 1) the highest occurrence of D. tamalis is ∼18 mcd and 30 mcd at Site 1264 and 1266, respectively; 2) the highest occurrence of D. pentaradiatus is ∼16 mcd and 26 mcd at Site 1264 and 1266, respectively; 3) the highest occurrence of D. brouweri is ∼11 mcd and ∼20 mcd at Site 1264 and 1266, respectively; the list can go on. The point here is that the deeper Site 1266 (3800 meters) has much higher carbonate accumulation rates (∼ doubled) than the shallower Site 1264. This difference cannot be due to productivity and is unlikely due to dissolution. The most possible interpretation therefore is that strong winnowing has significantly affected the carbonation accumulation of Site 1264.

I do not rule out the possibility that changes in carbonate accumulation and %CF can be partially explained by changes in primary productivity at Site 1264. However, can authors provide some other evidence to support their interpretation of a change in primary productivity? Alternatively, if winnowing is important at Site 1264, could it compromise the %CaCO3 records and how it might affect the spectrum properties? For instance, could winnowing explain obscure cyclicity in the last 3 Ma at Site 1264? I think

these are open questions but the authors should be aware of the potential complication at this location.

ref: Shackleton, N. J. (1984). Accumulation rates in Leg 74 sediments. Initial Reports of the Deep Sea Drilling Project, 621-644.

Other comments: Figure 2 caption suggests that the black and green records are magnetic susceptibility. The label of y axis, however, is XRF (Ca/Fe).

Page 7, Line 10: a typo?

P14, the authors relate the recovery of %CaCO3 $\sim$14.5 Ma to changes in dissolution. The study of Kender et al., 2014 (benthic foram B/Ca) can be helpful.

ref. Kender, S., Yu, J., & Peck, V. L. (2014). Deep ocean carbonate ion increase during mid Miocene CO 2 decline. Scientific reports, 4, 4187.

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