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Towards understanding orbital scale climate dynamics in the early Pliocene warm world

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Benthic d18O records are an essential tool for understanding orbital-scale dynamics of the Earth's climate. The early Pliocene (∼5.3-3.7Ma) is of particular interest as it can elucidate important climate feedbacks operating during periods of reduced ice and sustained warmth, such as what is expected in near future conditions. Consequently, the development of a high-resolution early Pliocene d18O stratigraphy is fundamental to advancing our understanding of how the Earth's climate operates in a greenhouse world. Currently, however, the number of early Pliocene benthic d18O records is low, spatial coverage is poor and sample resolution is variable, as compared with the late Pleistocene. Here, we present a newly established ∼5.3-0Ma benthic d18O record from ODP Site 1264 (2505m) on Walvis Ridge. Our early Pliocene section has the highest sample resolution of any published record (∼1.3-kyrs). We explore two alternative, orbitally tuned, age models in order to assess the optimal chronology for our early Pliocene section. We find that early Pliocne Marine Isotope Stages, as established by Lisiecki & Raymo (2005), are not well expressed at our site, leading to significant uncertainty in correlation to the LR04 stack. Comparison with other available early Pliocene records shows that this issue is not unique to our site. Furthermore, spectral analysis shows that the benthic d18O response to orbital forcing is considerably diminished when records are aligned to the LR04 stack, compared to independently tuned age models. The low amplitude of variability in early Pliocene benthic d18O records, and differences between them, necessitates that local temperature and salinity conditions have a strong influence on the d18O signal, potentially dominating over the ice volume effect. Hence, we suggest that stacking globally distributed d18O records, during periods of low ice volume variability, directly limits our ability to understand the climatic response to orbital forcing and create reliable stratigraphies.