

Clim. Past Discuss., referee comment RC2  
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## Comment on cp-2021-120

Anonymous Referee #2

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Referee comment on "A 334-year coral record of surface temperature and salinity variability in the greater Agulhas Current region" by Jens Zinke et al., Clim. Past Discuss., <https://doi.org/10.5194/cp-2021-120-RC2>, 2022

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### Summary

Zinke et al present a new composite coral Sr/Ca record from the coast of Madagascar, which when combined with existing d18O records from the same corals, provides one of the longest paired annual temperature and hydrology reconstructions from the region. Using these records, the authors explore potential drivers of past hydrologic variability in the Agulhas current region, a critical component of the global thermohaline circulation. The paper is well written and contains interesting and potentially important contributions to the field, however, some sections of the text are a bit confusing. For example, it's unclear which samples are new versus which have been previously presented or whether d18Osw was calculated using composites, how annual growth was determined for sampling, or how the compositing of d18Osw was performed. The authors also employ a more statistically rigorous method for estimating uncertainty, which is great and well documented, but the reasoning behind it clearly explained. Lastly, ENSO and PDO are invoked to explain results (with some substantial lags), however, these processes are dynamically linked to the hydrologic variability in the region aren't clearly explained. I recommend the manuscript for publication following major revisions and provide more detailed comments below.

### Major comments:

The authors have an impressive body of work at this site that spans 10+ years. Unfortunately, this means there are a lot of cores across different manuscripts to keep track of and it's not immediately clear from the methodology which samples were drilled for previous studies and which ones were drilled for this study (lines 110-119). It's also not clear how the authors determine annual sampling intervals for Sr/Ca. The methodology implies sampling was based entirely on existing d18O chronology, while line 335 suggests growth banding was used. Some fine-tuning of the wording here could help make that clearer.

The Monte Carlo approach (lines 150-160) is interesting and may be an approach that others in the community may want to adopt, and so this section might benefit from some additional text explaining the advantages of this approach. The step-by-step explanation could be condensed into steps to make it easier to read. For example, items 3 & 4 could be better described as "d18Osw is calculated by randomly adding errors within a 1sigma range to Sr/Ca, d18O, and the proxy-SST slopes." Likewise, steps 5 and 6 could be combined in a single sentence. Is the Monte Carlo approach also used from for the section of the composite spanning 1881-1661?

I'm also curious as to why the average coral Sr/Ca-SST slope used in this manuscript instead of a site-specific one? A sentence or two explaining this choice would be helpful here. I'm also curious as to why HadISST was used to derive d18Osw, when (i) ERSST is used as a comparison point for Sr/Ca-SST and d18O-SST, and (ii) Sr/Ca-SST exists and can be used to derive d18Osw.

The discussion of model results and how they compare to the coral-based reconstruction is difficult to follow (lines 237-255). I've re-read this section several times and can't figure out what datasets are being compared to each other and the main take-away is here. Part of the issue is that there are a lot of different datasets being compared, a lot of statistics, and very little context. I would suggest expanding this section to more clearly explain what comparisons are being made and why and what the main takeaways are.

Minor Comments:

Line 17: Might be helpful to define the acronyms for sea-surface temperature and salinity as they're used later in the abstract.

Line 22: please indicate the full time period of comparison (1958-1995?)

Line 38: both "inter-ocean" and "interocean" appear in the manuscript. Use one or the other for consistency.

Line 42: possible formatting issue on one of the references?

Line 78: This is the first mention of d18O. It might be "spelling out" what the d18O notation stands for.

Line 170: One occurrence of "for SST" can be removed.

Line 160: The 0.22 per mil/°C relationship pre-dates Thompson et al., 2011. Please use the appropriate reference here.

Lines 202-205: Interestingly the d18O-SST variability appears to be more consistent with ERSST than Sr/Ca-SST (which has some very large spikes that aren't observed in temperature). Any thoughts on why this is the case?

Line 205: Are these trends? If so, please include the term "trend" in the sentence. Also, both numbers are consistent which is nice!

Figure 1: I'd recommend using a different light color to represent the errors in panels a-c (maybe gray) so that the median of each reconstruction is more visible. This is more of an issue with the panel A where the shades of red are very close to each other.

Line 240+: the use of both NST and SST is confusing. Using NST alone for this presentation is fine. Same goes for NSS/SSS.

Line 330: This sentence might be missing a few words?

Line 395: This sentence might be too strong and casts a lot of doubt the observations in the rest of the paragraph, especially given the evidence from the literature presented in the next paragraph that supports more ENSO activity in the 16th century.

Line 400: Cobb 2003 is a more appropriate reference

Line 402: Is this the same coral used in this study? If so, using it to support the results is somewhat circular. If it's a different core, it might be worth mentioning so others don't make the same assumption.