

## ***Interactive comment on “A sea surface temperature reconstruction for the southern Indian Ocean trade wind belt from corals in Rodrigues Island (19° S, 63° E)” by J. Zinke et al.***

### **Anonymous Referee #1**

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#### General comments:

The authors have made new high-resolution measurements of the Sr/Ca ratios in two coral cores from Rodrigues Island in southwestern Indian Ocean. They have undertaken screening for diagenesis and detailed mapping of the corallite orientation which they apply to assess the fidelity of the coral-derived sea surface temperature (SST) reconstructions through the length of the two coral time series. They also ‘calibrate’ the coral Sr/Ca series with a range of available ‘observational’ SST and air temperature products for the region. I appreciate that available SST/air temperature products for calibration with Sr/Ca may produce different results (Section 5.3) but it is extremely confusing for the reader to distinguish what is important in the detailed dissection of the

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different calibrations (e.g. Figure 6). It might be more understandable to the reader to present a summary table of the different calibrations and characteristics of the resulting SST reconstruction time series. Can we clearly identify the best ‘calibration’ data set for this region? At present there is a plethora of detailed descriptions but no overall synthesis or tests of whether the differences using different calibration data sets are statistically significant. Overall, I found this paper extremely hard to follow. It would greatly help if the authors clearly articulated the questions they address and then follow this framework to present the Results, Discussion and Conclusions. There is also a lack to statistical analyses whereby the fidelity/reliability of the two coral records and associated reconstructions can be objectively presented. As a consequence it is hard to determine what the main conclusions are and how well supported they are by the data and analyses presented. A shortened and more straightforward presentation of the findings could be a useful addition to the literature. I strongly recommend that the authors reconsider how they present their findings and also focus on summarising findings rather than give a detailed account of every wiggle in the time series that appears either anomalous and/or does not match the other coral or temperature data sets.

Specific comments:

Line 27: ‘over recent decades’ rather than ‘past decades’.

Lines 29-30: ‘sea surface temperature’.

Line 30: ‘tropical coral reef ecosystems’.

Line 38: replace ‘of paramount importance’ with ‘essential’.

Line 50: give the time period over which this increase was observed rather than ‘the recent 15 years’.

Line 52: Do you mean the past century or the past 60 years?

Line 54: ‘major role in the decrease’.

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Line 59: 'event causing widespread coral bleaching...'. Also provide reference for this statement.

Line 61: 'sustainability of tropical coral reef ecosystems'.

Line 71: 'for centuries at a rate of 0.5 and 2 cm.yr<sup>-1</sup>'.

Lines 71-72: 'down-core geochemical sampling of massive corals can yield reconstructed SST time series at approximately monthly resolution.'

Line 74: 'relative to Ca, in proportion to ambient SSTs'.

Line 75: 'have been shown'.

Line 83: what is meant by 'need to be excluded by specific analysis'?

Lines 96-97: 'past variation in salinity associated with'.

Line 99: 'sea-level pressure (SLP)'.

Line 103: 'significant' rather than 'strong'.

Line 104: Does the Indian air temperature record go back to 1847?

Line 106: add (ENSO).

Line 112: Replace 'El Nino-Southern Oscillation' with 'ENSO'.

Lines 121-122: 'continuous fringing reef approximately 90 km in length'.

Lines 133-135: Confusing.

Line 136: 'in the annual mean'.

Line 141: what category of tropical cyclone is 'extreme'?

Line 142: is this referring to waves or a storm surge?

Lines 142-143: is this after they have crossed land and dissipated?

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Line 144: spell out 'CTD'.

Lines 144-145: what was the sampling resolution of the CTD measurements?

Line 148: Provide the name and WMO number for the meteorological station.

Line 156: 'coral cores'.

Line 170: 'Annual density bands' rather than 'growth laminae'.

Line 172: Reorder Figures in appendix as this refers to Figs 7 and 8

Line 181: 'alteration in the Totor and Cabri cores'.

Lines 181-185: So were several slabs taken from each core? How many? Is it likely that there would be diagenesis in one slab and not another from the same core?

Line 188: What is 'RWTH'? spell out.

Line 204: 'analogous'.

Lines 212-214: Unclear how the assignment of the Sr/Ca maxima relates to the SST data.

Line 230: 'SST from sparse data'.

Line 237: 'We also used the United Kingdom Meteorological Office's monthly SST...'. Presumably the sea ice data was not relevant to this study.

Line 246: Is it relevant that this data is used by NOAA's coral reef watch program?

Lines 224-259: Suggest shortening this section and focus on the SST series actually used in the analysis. Also if average statistics of the different data sets are provided in

Appendix Table 1, there is no need to repeat in the text, just provide some general commentary about the differences/or not between the different SST products.

Line 264: values here given in mm.yr whereas in Table 1 in cm.yr.

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Lines 270-285: Shorten and simplify. Is there a reason to expect long-term trends in the different growth variables.

Line 278: 'the fit is less optimal' – the fit between what and what?

Lines 290-292: is the difference in seasonality between the 2 cores significant?

Line 293: 'between average Sr/Ca ratios in the two cores.....'.

Lines 297-299: Before combining the two records to form a composite series, it would be useful to know whether the two series are correlated. Also, do the SST reconstructions presented here show similar temporal variations to other coral-based climate reconstructions for the western Indian Ocean – do these new reconstructions tell us anything new or just confirm previous findings (which is a useful statement in its own right).

Lines 300-322: In the previous paragraph it was indicated that the Sr/Ca ratios were converted to SST – why not present the SST reconstructions in Figure 3 and use these in the text rather than having to explain that more negative = warming etc? Also suggest simplifying this section as it is hard to determine what the authors are trying to convey apart from identifying wiggles in the time series. How about including some statistics, e.g. are there significant linear trends etc? Also suggest including a weighted filter in the time series graphs to illustrate the decadal variability referred to.

Lines 324-394: I found this section very long and confusing. Why not present the SST:calibrations first in the Results section and then go on to discuss what the SST reconstructions tell us about SST variability in the region? It would be worth considering moving some of the details of the calibration methods to Supplementary Material – as a reader I am getting lost as to what was done and why.

Line 388: What is meant by 'slab 7'? Is this a different slice from the coral or is it the section number downcore?

Line 395: I have stopped commenting at this point on writing style and clarification.

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Lines 396-424: Should this section on diagenetic alterations not come earlier in the Results section?

Lines 426-453: Again, this is long-winded and confusing for the reader. What questions are being addressed by the authors in this section? How as 'Indian Ocean wide SST' calculated and with what data set of the many used in this study?

Lines 456-536: Again this section is long-winded and confusing for the reader. It is very hard to determine what the main discussion points are.

Lines 538-617: Comments as for the previous sections – confused and confusing and hard to determine what is being done and why.

Lines 619-635: The main conclusion seems to me to be the need for careful screening of coral samples (for diagenesis and corallite orientation) before measuring and developing climate reconstructions. Do the reconstructions actually tell us anything new about SST variability in the Indian Ocean given the main period is 1945-2006?

Line 864 (Table 1): clarify that depth is of the colony; also provide time periods for the calculations of average growth characteristics.

Line 882: 'Rodrigues Island'

Lines 887-889: provide the sampling resolution for these graphs.

Lines 892-894: Indicate in Figure caption that y-scale for Sr/Ca is inverted.

Lines 936-939: There are 3 panels to Fig A1 – explain each in caption; also indicate temporal resolution of time series.

Supplementary Tables 1-26: This is a lot of information that I feel needs to be better synthesised for the reader. Also, in carrying out so many correlations on the same set of time series, has any allowance been made for loss of degrees of freedom? i.e. the number of correlations undertaken increases the probability of obtaining a significant correlation by chance.

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