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Ocean Science
Discussions

Interactive comment on "Indian Ocean subtropical mode water: its water characteristics and spatial distribution" *by* T. Tsubouchi et al.

Anonymous Referee #2

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This paper presents a description of Indian Ocean Subtropical Mode Water (IOSTMW) based on an analysis of a 3-D isopycnally averaged hydrographic data set. The author's analysis shows that the IOSTMW exists as a robust structure in the summer months in the western part of the Indian Ocean. The paper describes the average properties and distribution, using analysis techniques that have been successfully applied for North Pacific STMWs. Some of the analysis techniques work, others don't, and the paper presents a light overview of why this is so.

The paper presents an interesting description of this poorly defined water mass, and warrants publication after some revision.

Detailed points

1) The introduction could be improved with a better description and definition of Indian Ocean mode waters in general, based on previous studies, and then what is known particularly about IOSTMW. For example, the paragraph on page 728 starting on line 22 should be in the introduction. In particular, mode waters are formed across the Indian subtropical gyre around the STF, and not just in the western basin. How are these defined if they are not "IOSTMW" ? For example, p 728 lines 25-26 describes mode waters of 10-12°C, formed north of the STF, in the Indian Ocean – which do not fall into your definition of IOSTMW. So what are they called? If your IOSTMW are formed in the western part of the basin, north of the Agulhas Front, they should be defined differently!

2) Since some of the analysis (and figures) compare the Indian and North Pacific mode waters, their different characteristics should be introduced earlier. The fact that a lot of the analysis techniques were derived for the North Pacific, and will be applied in this paper, should also be presented in the introduction.

3) P 726. Data and Methods. If T and S data are both available in the isopycnally averaged data base, why only use a temperature definition, and not a density or PV definition from the beginning? This choice should be explained.

4) P 726. line 18. Data were interpolated to 10-m vertical intervals before vertical gradients are calculated. This is quite coarse for a gradient calculation, and may make it even harder to determine weak gradients below the upper mode waters. If the vertical data are too noisy, perhaps you could smooth vertically, but maintain a 2 m vertical interval to improve the depth and thickness estimates of the mode waters.

5) P 726. Data and Methods. Does your method distinguish between the minimum temperature (or PV) gradient in the surface mixed layer and the deeper LMVTG? Is the surface mixed layer ALWAYS less than 50 m in summer?

6) You have not included any analysis of the other seasons. Does the IOSTMW only exist in summer, and re-emerges every winter? The “lifetime” of the IOSTMW, as observed by your data set, should also be discussed.

7) P727 lines 17-20. I don’t understand your description of this LMVTG detection technique. Nowhere on your plots can I see gradients > 2.0 C/100 m BELOW the warmer LMVTG. So I don’t see how your single threshold technique works. This needs a clearer explanation.

8) P728 lines 11-14. This description of one core of MW in most of the basin, and two cores of MW in the western part should be discussed further. Is the one core mode of 8-14°C water SAMW or a mix of STMW and SAMW, depending on the geographical region? This "other mode water" is not the key part of your analysis, but is should be discussed, in particular relative to your definition of “IOSTMW” as > 15.5°C in the western part of the basin.

9) P729, line 14. It would be interesting to see a plot of your IOSTMW core temperature in the box as a function of time, to verify the data distribution, the temporal variations, and the extent of the peaks in the 1970s and 1990s.

10) P729, lines 15-26. For the comparison with the Olsen study. What data set did Olsen et al use (what is ARC?), and how is it different from yours? Same time period of data, geographical distribution, analysis techniques, etc?

11) Section 4, pages 730 and 731 lines 25 onwards. I don’t understand the analysis in this section and the use of equation 1. Why have you not used the observed vertical salinity gradients in your data base, rather than a set value of 0.07 / 100 m ? Equation 1 gives the relative contribution of the thermal and haline gradients in the calculation of PV, and in this region of strong T and S gradients, they should vary together. However, because you have put a set value for dS/dz, then you force the PV to vary with dT/dz. You need to show that this choice is realistic. I would expect that the salinity plays an important role here.

12) Page 731, equation 1. Second point, equation 1 does not give information on the thickness of the layer. How was this derived “according to equation 1” ?

Some typos : P 725, line 15 remove “does”. P 727, line 24. remove “for” P 732, line 12. Change “area was easily described” to “area can also be described”

Interactive comment on Ocean Sci. Discuss., 6, 723, 2009.