Referee's comment was cited in red and our response was written in black.

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 nor th 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 par t of the basin, north of the Agulhas Front, they should be defined differently!

Please see our reply for referee #1 about this issue. We will revise the introduction focusing on poor understanding of the mode waters north of subtropical front (STF).

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.

We will revise the manuscript including this issue.

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.

We should focus on dT/dz structure to find out the signal of IOSTMW. Although logitudinal dT/dz structure and potential vorticity (PV) structure along 35.5S looks similar, there are some differences between them probably because of salinity stratification (Fig. III). While dT/dz minimum appears on 25.9-26.1 σ_θ in 30-45E, PV minimum does not appear on 25.9-26.1 σ_θ in 30-45E. This difference may come from salinity unstable stratification (greater than 0.1 psu/100m) on 26.1-26.40 σ_θ in 30-40E and 26.3-26.40 σ_θ in 40-50E. As we mentioned (p727 l15-20), this does not signify the vulnerability of the IOSTMW; rather, salinity unstable stratification below the IOSTMW makes the PV minimum 25.9-26.1 σ_θ in 30-45E invisible.

Two interesting points should be mentioned on Fig. III. First, as a broad picture, distribution of low salinity stratification (less than 0.1psu/100m) corresponds to the distribution of low temperature stratification (less than 0.8C/100 in east of 50E, less than 1.0C/100m in 40-50E and less than 1.4C/100m in 25-40E) better than low PV distribution. Higher salinity stratification (greater than 0.1psu/100m) appears lower PV region (less than $60*10^{-12}$ $m^{-1}s^{-1}$ in 55-80E). This suggest that focusing on dT/dz structure is better than focusing on PV structure in order to find out the mixed water in the Indian Ocean subtropical gyre. Second, dT/dz minimum appears on 26.4-26.6 σ_θ in 50-70E while PV minimum appears on 26.5-26.7 σ_θ in 50-70E. Again, this difference may come from salinity unstable stratification (greater than 0.1 psu/100m) denser than 26.6 σ_θ in 50-70E. Focusing on dT/dz structure is a good way to find out the remnant of mixed layer and focusing on PV is a good way to trace the advected water in the interior ocean under the assumption of PV conservation.

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.

We think 10-m vertical interval is enough resolution for this study purpose because Hydrobase is prepared as standard depth and we used Akima's shape-preserving local spline method (Akima, 1970) to interpolate the data. Considering the original dataset vertical resolution, we can not examine the spatial structure less than 10 m. Akima's shape-preserving local spline method has an advantage for vertical gradient calculation than other interpolation methods because this method never create vertical gradient minimum artificially as other interpolation methods sometimes do.

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 50m in summer?

Our method can distinguish between low dT/dz in the surface mixed layer and deeper LMVTG. LMVTG is only detected when both upper boundary of LMVTG and lower boundary of LMVTG exceed the threshold of dT/dz and thickness of LMVTG is greater than 50m. A low dT/dz in the surface layer is not detected as LMVTG because there is no temperature stratification above it. We will add this explanation in the revised manuscript.

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

Seasonal variability of IOSTMW is an interesting topic. However, we would like to focus on the basic description of IOSTMW by introducing new analytical method in this study. Argo data should be useful for this topic.

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.

We tried to talk about assumption even though it does not occur. We would like to replace this part by "If sufficient temperature stratification (greater than 2.0°C/100 m) had existed below the warmer LMVTG, we could have detected the warmer LMVTG in both sub-regions A and B reasonably by applying any single threshold of vertical temperature gradient from 1.4 to 2.0°C/100 m.".

We will explain our LMVTG detection technique more carefully.

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 par t 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 par t of your analysis, but is should be discussed, in particular relative to your definition of "IOSTMW" as > 15.5◦ C in the western par t of the basin.

Please see our reply for referee #1 for this issue. We will describe this more clearly in the revised manuscript.

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.
We would like to leave the temporal variability of IOSTMW for future studies. Figure IV shows the spatial and temporal data distribution around IOSTMW distribution area in the Hydrobase during January-March.

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?
ARC is Agulhas Retroflection Cruise (p.724 l22). As we mentioned (p.729 l20-26), it may come from difference of analyzed area. ARC was conducted in the southern offshore of African continent during November to December 1983. Please see Olson et al. (1992) fig. 1 for the observation location.

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.
As we discussed the effect of salinity unstable stratification on IOSTMW density range for your (3) comment, this assumption is not so good for detail examination. However, this estimation may still work for rough estimation. We estimated the thickness of 15.5-17.5C layer which is equivalent to PV=300 ($m^{-1}s^{-1}*10^{-12}$) under a fixed salinity stratification with some uncertainties. As shown in Fig. III, salinity stratification within IOSTMW density range is around 0.07+-0.03 psu/100m. This value corresponds to the15.5-17.5C layer thickness of 98.9 +- 6.8 m. We will revise the manuscript keeping this issue in our mind.

References

Akima, H., 1970: A New Method of Interpolation and Smooth Curve Fitting Based on Local Procedures. *J. Assoc. Comput. Math.*, **17,** 589-602.
Olson, D. B., R. A. Fine, and A. L. Gordon, 1992: Convective Modifications of Water Masses in the Agulhas. *Deep-Sea Res.* , **39,** S163-S181.

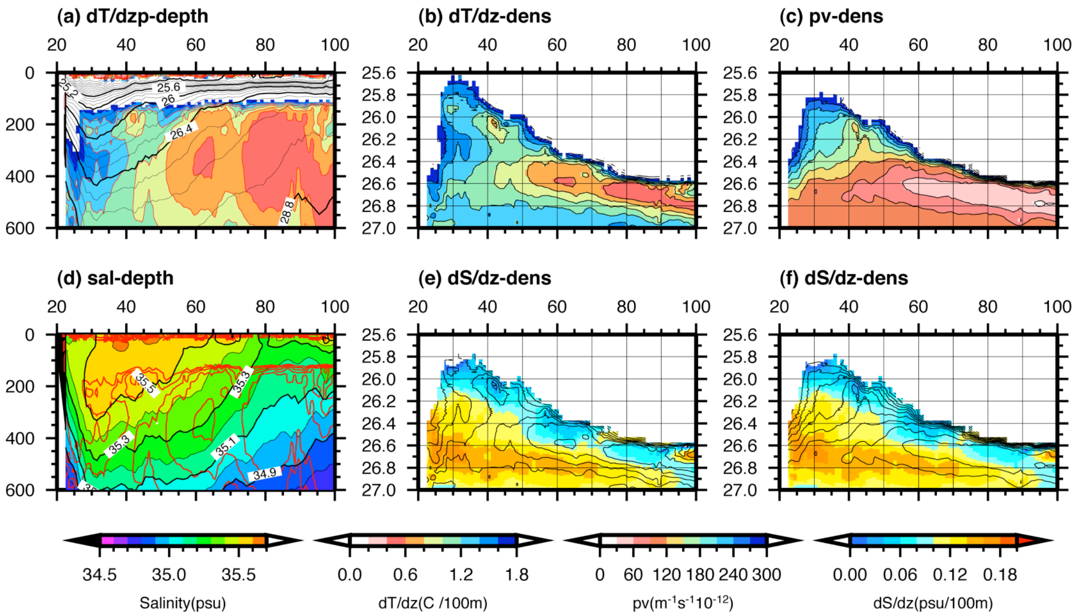

Figure III: longitudinal section of (a) dT/dz (C/100m) versus depth (m), (b) dT/dz (C/100m) versus potential density (kg/m^3), (c) PV ($m^{-1}s^{-1}*10^{-12}$) versus potential density (kg/m^3), (d) salinity (psu) versus depth (m), (e) dS/dz (psu/100m) versus potential density (kg/m^3) and (f) dS/dz (psu/100m) versus potential density (kg/m^3) axis along 35.5S shown by colored shading. Contour shows (a) potential density (kg/m^3), (d) dT/dz (C/100m), (e) dT/dz (C/100 m) and (f) PV ($m^{-1}s^{-1}*10^{-12}$).

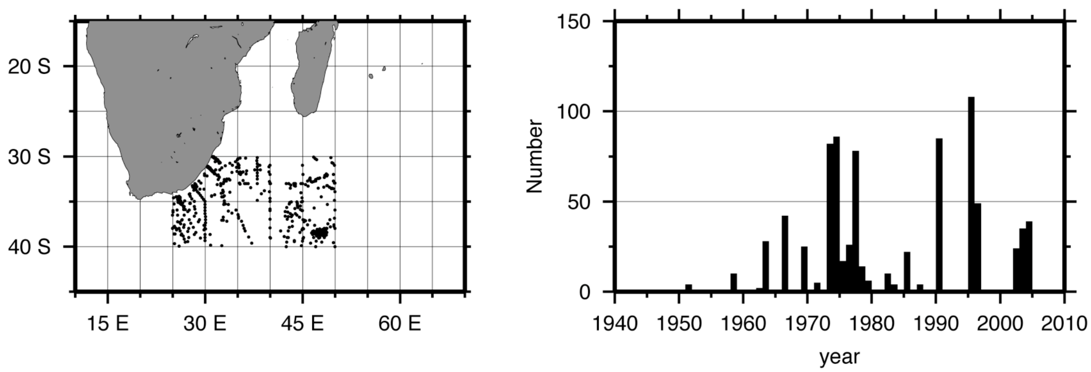

Figure IV: spatial and temporal data distribution around IOSTMW distribution area in the Hydrobase during January – March.