Supplement

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

1) No clear IOSTMW definition is given which makes the first part of the study confusing. I would recommend clarifying that in the first part of the paper.

- p.728 lines 10-20: the authors show that two cores of layer of minimum vertical temperature gradient (LMVTG) are observed in the in the South Indian Ocean. They observe that the lighter core (T_15.5 17.5_C) is robust and shows a maximum of occurrence in the western basin. Then they conclude that IOSTMW has a robust structure in the western basin. So is the definition of IOSTMW a layer of LMVTG between 15_C and 18_C?

We will clarify IOSTMW definition in this study in the revised manuscript.

- p.728 lines 20-25: the second core is associated with a mode formed north of the STF and another mode formed north of the SAF. SAMW is said to be the mode formed North of SAF. So what is the mode water formed north of the STF? Why wouldn't it be IOSTMW?

- P.729 lines 1-5: the authors prefer not answer this question in this study. Although I understand that a detailed answer to this question would be another paper, I feel like there is a need to better define what is the IOSTMW in a paper specifically on this subject.

- Why not plotting a longitudinal (or even better, an along Agulhas Retroflection) section of dT/dz or PV (distance from Africa, versus density)? Then we could clearly see if there is any link between the LMVTG on 26.1 and the LMVTG on 26.6. The low frequency of occurrence of LMVTG in the density class 26.2-26.5 could be due to the fact that the surface circulation is not inline with surface isopycnals in the central Indian Ocean. The Agulhas crosses very quickly surface isopycnals of 26.2 to 26.6, because, in the central Indian, surface isopycnals have a strong SW-NE direction, while streamlines have a strong NW-SE direction. So STMW could be continuously formed north of the Agulhas with density ranging from 26.1 to 26.6, but with a core in the 26-26.1 and a core in the 26.6-26.7.

- It wouldn't change the nice results of this study if the 26.1 and 26.6 LMVTG were in fact connected. It is just a matter of definition of these water masses. But I think having this piece of information could greatly improve the definition and help in understanding author's choices.

Figure I shows the longitudinal section of dT/dz along 35.5S latitude. Along this section, three dT/dz minima are observed on 25.8-26.2 σ_θ in 28-45E, on 26.4-26.7 σ_θ in 45-70E and on 26.6-26.9 σ_θ in 70-100E. Similar feature is observed in other sections between 33.5S-38.5S. Therefore, we argue that dT/dz minimum on 26.4-26.7 σ_θ is disconnected from IOSTMW (25.8-26.2 σ_θ) and SAMW (26.6-26.9 σ_θ).

Although it has been almost presented that the 26.1-26.6 LMVTG are disconnected, we did some analysis to investigate their formation regions and to confirm reviewer's suggestion. The combined dataset based on Argo database and World Ocean Circulation Experiment Southern Ocean database was analyzed. Mixed layer and dynamic height reference to 1500dbar were calculated from individual profile. Mixed layer depth (MLD) was defined with density difference criteria, difference of 0.03 σ_θ from the near surface density. Then calculated MLD and dynamic height were interpolated using Ridgeway et al. (2002) technique. Please see Sallee et al. (2008) for the detail data procedure. The positions of subtropical front (STF) and subantarctic front (SAF) were defined by Orsi et al. (1995). Figure II shows that three MLD maxima are observed north of STF: A maximum around 120m with 25.8-26.2 σ_θ in 35-38S, 35-50E, a maximum around 200m with 26.25-26.4 σ_θ in 35-42S, 48-58E and a maxima greater than 200m with 26.4-26.65 σ_θ in 35-42S, east of 55E. It is not clearly visible that "isopycnals have a strong SW-NE direction, while streamlines have a strong NW-SE direction in the central Indian Ocean" within the isopyncals of 26.2 to 26.6. On the other hand, it is clearly visible that the area between 26.2 and 26.6 σ_θ becomes wider east of 45E, which is favorable condition for mode water formation. It is also worth to mention that the area between 25.8 and 26.2 σ_θ becomes wider in 35-45E where the southern area of IOSTMW distribution area. Finally, this figure also shows that formation area of mode water on 26.4-26.6 σ_θ is disconnected from the formation area of IOSTMW (25.9-26.1 σ_θ). Based on the result of fig. I and fig. II, we conclude that a mode water with core temperature 12-14C should be recognized as another mode water from view points of water characteristics, distribution area and formation region.

2) P. 729 line 3: the authors state that it would be difficult to separate the two mode waters using the IOHB climatology. Why? Is it not accurate enough?

We tried to assess the existence of mode water by confirming whether its water characteristic forms modal class of temperature and salinity for the regional area census. In this sense, two maxima are not observed in the maximum between 8-14C and 35.0-35.4 psu. However, the distribution of dT/dz along 35.5S section (Fig. I) shows that dT/dz minimum on 26.4-26.7 σ_θ is disconnected from SAMW (26.6-26.9 σ_θ).

3) P. 731 line 2: It is said that the salinity stratification is 0.07 psu/100m without explanation. Is it an assumed vertical stratification or is it calculated? If it is calculated, it could be great to add a standard deviation. If it is assumed, it could be great to mention whether this assumption is sensitive on the PV calculation.

This salinity stratification was calculated by averaging dS/dz at the core of LMVTG higher than 15.5C; same calculation for the averaged IOSTMW water characteristics (p729 l5-7). The salinity stratification at the core in LMVTG is 0.066 +- 0.031psu/100 m. This value corresponds to the15.5-17.5C layer thickness of 100.4 +- 4.8 m.

4) Fig 5 displays close PV contours with a minimum in the center. The minimum PV is really inside closed streamlines contours. Is it any related to a Rhines and Young (1982) homogenization of PV? Where do the 26.1 layer outcrop? It's maybe not really the issue of the present paper, but would have important implications for thermocline ventilation. Why not providing IOSTMW Oxygen content? Is it a layer as ventilated as SAMW?

Although it is difficult to answer this question completely, we are examining the distribution of potential vorticity (PV) on several isopycnal surfaces and their outcrop positions. We would like to discuss this issue in the revised manuscript. We would like to leave the oxygen contents analysis for future studies.

5) The author conclude that the IOSTMW is about 1_C lower than in previous studies. Why is there such a difference? Previous studies were based on synoptic surveys, which I believe are included in the IOHB. Was the water at 32_S during the survey, colder? Or is it due to a different definition of IOSTMW?
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 locations.

6) I am wondering why the author chose not to use Argo data. The Argo array provides an unprecedented amount of data, especially in the poorly sampled Southern Ocean and could be of great support for describing IOSTMW characteristics and distribution area.
We did it for examining the formation region of mode waters in the south Indian Ocean.

7) Figures are very small, especially Fig. 4.
We will modify in the revised manuscript.

Acknowledgement
Mixed layer and dynamic height calculated from the combined dataset were provided by Jean-Baptiste Sallee.

References

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Sallee, J. B., K. Speer, and R. Morrow, 2008: Response of the Antarctic Circumpolar Current to atmospheric variability. *J. Climate*, **21,** 3020-3039.

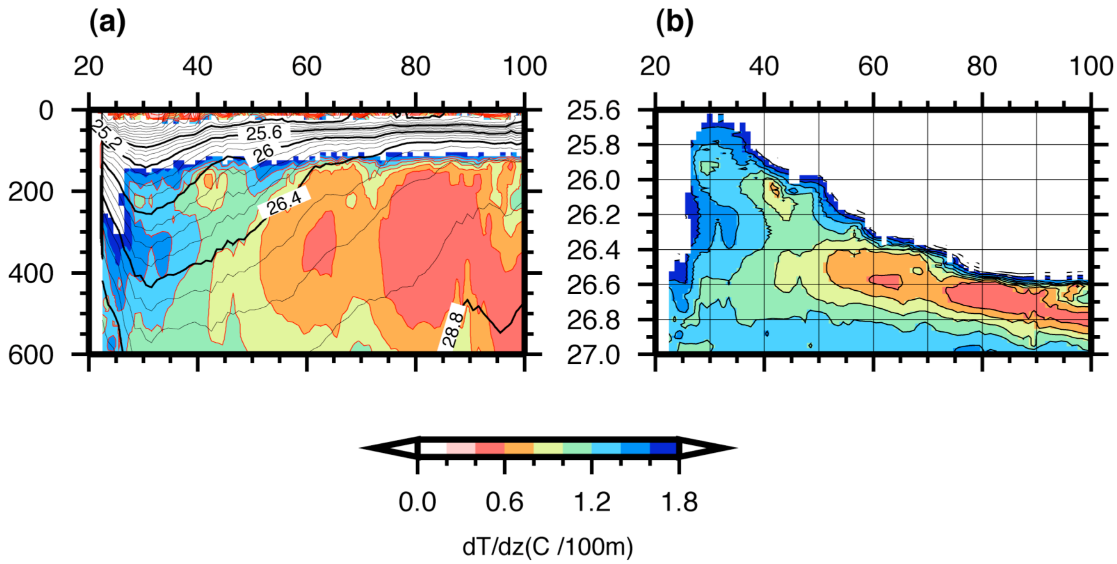

Figure I: longitudinal section of dT/dz versus (a) depth axis and (b) density axis along 35.5S. Color shading shows dT/dz (C/100 m).

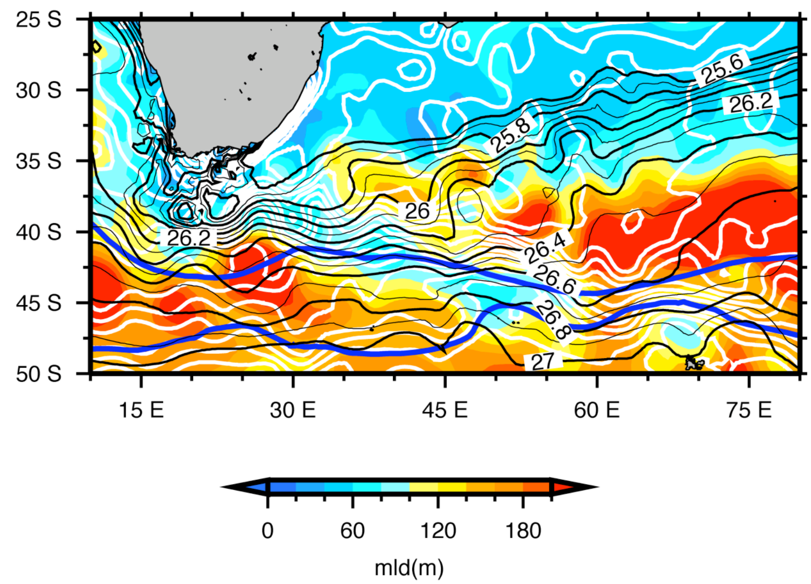

Figure II: Distribution of MLD (m; color shade), mixed layer density (kg/m^3; black contour) and dynamic height (m^2/s^2; white contour) relative to 1500dbar in September. Contour interval of dynamic height is 1.0 m^2/s^2. STF and SAF are shown in blue contours.