Response to Comments from Referee #2

We thank the referee for careful reviews and constructive comments in improving the original manuscript. Below is our point-to-point reply to these comments (the reviewer's comments are in blue, and out responses are in black).

In this study, the authors incorporated three mixing schemes into the ocean general circulation model, namely non-breaking surface-wave-generated turbulent mixing(NBSW), the mixing induced by the wave transport flux residue(WTFR), and the internal tide-generated turbulent mixing(IT) along with Mellor-Yamada 2.5 mixing scheme. This study of quantifying the role of wave and tide-induced mixing in an ocean model is a timely and valuable contribution. However, the authors are unable to represent it in terms of value addition to its scientific contributions. There are many gaps in this study starting with ocean model configurations and their different experiments.

Many thanks for the comments about the contribution of this study. More detailed description about the model configurations and experimental design has been added in the revised manuscript. The MASNUM ocean and wave models should become more practicality and repeatability. The codes have been uploaded on the Zenodo: https://doi.org/10.5281/zenodo.6717314 and https://doi.org/10.5281/zenodo.6719479, the required data, including the topography, the surface forcing, the open boundary, etc., are also uploaded on the Zenodo: https://doi.org/10.5281/zenodo.6749788. All configuration scripts, preprocessing and post processing subroutines are included in these repositories. The three mixing schemes were incorporated into the ocean model as independent subroutines, which will be applied into other ocean models conveniently.

Furthermore, addition to the scientific value, the results in this study are helpful to improve the accuracy and timeliness of the global ocean numerical prediction for the national or regional forecasting agencies, because the MASNUM ocean model is able to depict more complete physical processes. In our opinion, it is important to study the

NBSW- and IT-induced mixing for promoting the development of the ocean and coupling models.

All of the explanation and statement have been added into the revised manuscript, please refer to the revised manuscript for details.

The introduction lacks the present status of the state of the art model's mixing schemes with details and its drawbacks in the Indian Ocean. The authors are unable to give the scientific objectives to be achieved in this study as compared to the previous works. The representation of the internal tide-generated turbulent mixing is not new, in fact, it's been introduced by Simmons et al. (2004) in a global Ocean General Circulation model. The author did not mention this work and its related works (Nagai and Hibiya, 2015).

Many thanks for the reviewer's constructive suggestions about the introduction of the IT-generated turbulent mixing. Previous studies, such as Simmons et al. (2004) and Nagai and Hibiya, (2015), constructed baroclinic ocean models to compute the energy flux from barotropic tides into internal waves. The Navier-Stokes equations with accurate tidal potential forcing, tidal open boundary conditions and non-static approximation (especially for the regional modeling) can be calculated to simulate the generation, development, propagation and dissipation processes of the internal tides in high-resolution numerical experiments. The induced turbulent mixing coefficients then can be estimated in terms of the local dissipation efficiency, the barotropic to baroclinic energy conversion and the buoyancy frequency. In fact, the estimation of the IT-generated turbulent mixing in these previous studies was implicit.

On the contrary, we attempt to derive an analytic and explicit expression of the viscosity and diffusivity (mixing coefficients) induced by the NBSWs and ITs, based on the theory about the turbulence dynamics and the surface and internal wave statistics. The three mixing schemes introduced in this study can be calculated directly in terms of some parameters of the surface waves and ITs. There should be no need to simulate the ITs accurately in a high resolution modeling using the ocean circulation model.

In addition, it is worth noting that direct modeling of the ITs in the expeirments of this study is inappropriate. There are three main reasons. Firstly, the horizontal and vertical resolutions should be insufficient to simulate the generation and propagation of the ITs because of the relatively rough topography and coastlines. The modeling area of the whole IO should be also too large, some regional high-resolution simulations (such as Bay of Bengal, east of the Madagascar Island) will be implemented to simulate the ITs and the related patterns in future works. Secondly, the MASNUM ocean model used in this study has not yet included the tidal forcing and tidal open boundary conditions, so the conversion from barotropic to baroclinic energy cannot be described exactly. Finally, the climatologic experiments are not good at simulating the ITs, because the multi-year mean (climatologic) surface forcing should be very smooth and partly lack the local small-scale information. The climatologic current, temperature and salinity input in the open boundary is also inappropriate for the IT modeling. Therefore, more optimization and improvement of the real-time hindcast experimental design will be implemented in future work to make the simulated results more accurate.

The explanation and discussion have been added in the revised manuscript.

Also, the authors presented the results only up to 130 m which does not represent insight into the mixing process related to internal tides since its effect could be seen in the deeper layers. A very recent study by Lozovatsky et al. (2022) showed that the observed eddy diffusivity in the ocean pycnocline over the southeastern BoB is likely related to internal-wave generated turbulence.

As the reviewer's suggested, we have compared the thermal structure and the velocity fields in the region with depths from 130 m to 1000 m (the region with depths larger than 200 m is often called the deep ocean). However, the difference of the simulated temperature in Exp 3 and 5 from the WOA13 data is generally the most in the whole IO, this is caused by that the simulated temperature in the deep ocean (from about 300 m to about 1000 m) is too warm. The reason is that the Haney equation (Haney, 1971) was used to modify the climatologic surface heat flux and improve the large-scale thermal coupling of ocean and atmosphere, but a disadvantage of the Haney modifying method is the destruction of the heat balance, so excessive heat may be transmitted into the ocean interior. Some more accurate surface forcing data, such as ERA5 and GFS, will be used in future simulation. For the current simulation, the mean velocities, the eddy kinetic energy and the vertical vorticity have been calculated, but the difference among the five experiments was too complicated (irregular distribution of positive and negative difference) to summarize some dynamic processes and physical mechanisms. This should be related to thermal and salinity structure. It is worth noting that the vertical mixing in the upper ocean (0 ~ 100 m) is the main focus of this study. Additional improvements of the MASNUM model and the mixing schemes will be studied further in future.

Lozovatsky et al. (2022) demonstrated that the internal wave instabilities appear to be a dominant mechanism for generating the energetic mixing based on the analysis of the in-situ observations of the turbulent kinetic energy dissipation rate and buoyancy frequency profiles. Actually, designing a universal and flexible IT-induced mixing scheme for oncea modeling based on the in-situ observations still needs a lot of works. The three schemes introduced in this study are just preliminary research on the contribution of the upper-ocean vertical mixing.

The explanation and discussion have been added in the revised manuscript.

In line-121-22 the authors wrote "….., the mode-1 M2 internal tides, which mainly originate from regions with steep topographic gradients, are considered…." . Doesn't it imply that the mixing will be more over the steep topographic gradients?. But the author did not show any results related to this.

As we explained above, the MASNUM ocean model has not been used to directly simulate the ITs, the topography in the experiments has been smoothed using the dual-step five-point-involved spatial smoothing method (Han, 2014) to make the calculation more stable, the relatively low resolution is also inappropriate to accurately simulate the ITs. Therefore, the topographic gradients were not considered to be a key factor in this study.

The IT-generated turbulent mixing scheme as an independent sub-model was incorporated into the ocean model. The explanation has been added in the revised manuscript.

The authors implemented the mixing schemes in the momentum equations. This implementation will also affect the dynamics as well. But the authors did not show any results on whether any changes are there in the circulations. The authors should show a few results about how the upper ocean currents improved with implementations of NBSW, IT, and WTFR mixing schemes.

As the reviewer and reviewer #1 suggested, we have added sub-section "4.4 Effects on simulation of ocean currents" to discuss the effects of the NBSWs and ITs on the ocean dynamic processes. Because the WTFR-induced mixing has a little effects on the simulated results, there is little difference between the simulation with and without the WTFR-induced mixing scheme, so we only compared the results in Exp1 – Exp 3. The monthly mean Ocean Surface Current Analyses Real-time (OSCAR) data, which are able to provide accurate estimates of the surface time-mean circulation, were used in the comparison as a reference. The comparison results showed that the NBSW and the IT somewhat improve the simulated surface currents. Please refer to the revised manuscript for details.

It will be good if the authors also can show spatial comparisons of model-simulated temperature diffusivities with Argo observations (Whalen et al. 2012).

Many thanks for the reviewer's suggestions about the comparisons of the model results with Argo observations. We designed climatologic experiments in this study, so all of the model simulations including the temperature diffusivities can be regarded as the multi-year mean results. In our opinion, it is inappropriate for our simulations to be compared with the Argo data, because there should be considerable difference between the climatologic data and the real-time in-situ observations. The WOA13 data, which is the multi-year (1955 - 2012) mean results, will be a good choice to evaluate the ocean model. The explanation has been added in the revised manuscript.

I am unable to recommend this manuscript for publication in this form. However, it can be considered for publication if they address my above queries and the below comments.

1. Line 173-174: "The initial temperature and salinity are interpolated based on the annually mean Levitus data with the horizontal resolution of 1° by 1° and 33 vertical layers.." Which Levitus data authors have used? Should give the version and reference.

The Levitus94 Ocean Climatology data were used in this study. The version and reference of the Levitus data has been added in the revised manuscript.

Reference:

Levitus S., R. Burgett and T.P. Boyer. 1994. World Ocean Atlas 1994. Volume 3: Salinity. NOAA Atlas NESDIS 3. U.S. Department of Commerce, Washington, D.C. 99 pp.

Levitus S. and T.P. Boyer. 1994. World Ocean Atlas 1994 Volume 4: Temperature. NOAA Atlas NESDIS 4. U.S. Department of Commerce, Washington, D.C. 117 pp.

2. The author used a regional model in which the lateral boundary condition is very important for any basin-scale model, particularly for the Indian Ocean which is affected by the Indonesian Throughflow in the eastern boundary. The author did not give any details about how the boundary condition is prescribed. Is it a boundary condition with a sponge layer? The authors should provide the details about the lateral boundary conditions used in this study.

We agree with the reviewer's suggestions, the lateral boundary condition is very important for the basin-scale model. We have described the calculation of the lateral boundary conditions in detail. The gravity-wave radiation conditions (Chapman, 1985) were used as the lateral boundary conditions. The simulated variables, including velocities, temperature, salinity and SSH, on the lateral boundary grids are calculated in an explicit numerical form. In the explicit form, the values of the related variables obtained from the daily global climatologic model results by the MASNUM model with the horizontal resolution of 1°/2 by 1°/2 are also used. The lateral boundary conditions are time-dependent with an updating period of 1 day.

Reference:

Chapman, D. C. 1985. Numerical Treatment of Cross-Shelf Open Boundaries in a Barotropic Coastal Ocean Model. Journal of Physical Oceanography, 15(8), 1060-1075.

3. Line 175-180: The initialization strategy and the experimental details are also not very clear. It looks like the author used a cold start and then inter-annual forcing from NCEP/NCAR (1948-2021). This means its inter-annual simulations. On the other hand, they wrote "The model is integrated from the quiescent state for 10 climatological years. The simulated temperature in the last 1 year is compared with the monthly World Ocean Atlas 2013 (WOA13) climatologic data" . This implies it's only 10 years of simulations. It's confusing what experiments the authors exactly carried out. It seems 10 years of simulation may not be sufficient to reach the steady-state. The authors should give the evidence that the model reached steady-state in 10th year of simulation.

The description about the time interval of the simulation is not clear, which will make the readers confused. We have revised this part. At first, we calculated the multi-year monthly mean (climatologic) surface forcing results based on the time series of the NCEP/NCAR data (1948-2021). Then the model is driven by the monthly mean surface forcing results, which repeats in every climatologic year.

In our opinion, the time interval of 10 years should be appropriate for ocean simulation from the quiescent state to a relatively stable circulation background. The average kinetic energy was estimated in the experiments of this study, which can be regarded as a model stability index. The results show that obviously large fluctuation of the average kinetic energy occurs in the first two years, and the average kinetic energy become stable gradually in the third year and is completely steady from the forth to the tenth year. The conclusion is similar to many previous studies (e.g. Xia et al., 2006; Qiao et al., 2010; Han, 2014; Yu et al., 2020).

The explanation has been added in the revised manuscript.

4. The author used MASNUM wave spectrum model simulations to get the inputs for the NBSW parameterizations scheme they incorporated. But how good the model simulations compare with observations?

The MASNUM wave spectrum model was constructed by Yuan et al., (1991). The wave model has been validated by the observations (Yu et al., 1997) and widely accepted in ocean engineering and numerical simulation (e.g. Qiao et al., 1999; Xia et al., 2006; Qiao et al., 2010; Shi et al., 2016; Yang et al., 2019; Yu et al., 2020; Sun et al., 2021). The results showed that the simulated significant wave height (SWH) and mean wave period (MWP) were consistent with the satellite observations. Actually, the configuration of the wave model is relatively simple, and the model design in this study is almost the same as that in Xia et al., (2006) and Qiao et al., (2010). Therefore, we believe that the experiment using the MASNUM wave model is able to characterize the spatial pattern and variation of the surface waves. The explanation and discussion have been added in the revised manuscript.

Reference:

Yuan, Y., Hua, F., Pan, Z., and Sun, L. 1991. LAGFD-WAM numerical wave model - I Basic physical model, Acta Oceanologica Sinica, 10, 483-488

Yu, W., Qiao F., Yuan Y., Pan Z. 1997. Numerical modeling of wind and waves for Typhoon Betty (8710), Acta Oceanologica Sinica, 16, 459– 473

Qiao, F., Chen S., Li C., Zhao W., Pan Z. 1999. The study of wind, wave, current extreme parameters and climatic characters of the South China Sea, J. Mar. Technol., 33, 61–68

Xia, C., Qiao F., Yang Y., Ma J., Yuan Y. 2006. Three-dimensional structure of the summertime circulation in the Yellow Sea from a wave-tide-circulation coupled model, Journal of Geophysical Research Oceans, 111, C11S03

Qiao, F., Yuan Y., Ezer T., et al. 2010. A three-dimensional surface wave–ocean circulation coupled model and its initial testing, Ocean Dynamics, 60(5), 1339-1355

Shi, Y., Wu K., Yang Y. 2016. Preliminary Results of Assessing the Mixing of Wave Transport Flux Residualin the Upper Ocean with ROMS, Journal of Ocean University of China, 15(2), 193-200

Yang, Y., Shi Y., Yu C., et al. 2019. Study on surface wave-induced mixing of transport flux residue under typhoon conditions, Journal of Oceanology and Limnology, 37(6), 1837-1845

Yu, C., Yang Y., Yin X., et al. 2020. Impact of Enhanced Wave-Induced Mixing on the Ocean Upper Mixed Layer during Typhoon Nepartak in a Regional Model of the Northwest Pacific Ocean, Remote Sensing, 12, 2808

Sun, M., Du J., Yang Y., Yin X. 2021. Evaluation of Assimilation in the MASNUM Wave Model Based on Jason-3 and CFOSAT, Remote Sensing, 13(19), 3833

5. In Figures 2c and 3c authors represented it as the IT-generated turbulent mixing scheme based on Exp-3 but in this experiment, NBSW is also included, then how can it be an IT-generated turbulent mixing scheme?

Many thanks for this comment. The description is not very clear and will make the readers confusing. The IT-generated turbulent mixing coefficients can be calculated independently, so Figures 2c and 3c exactly show the diffusive terms relating to the ITs which are a part of the diffusive terms in Exp 3. The description has been revised in the revised manuscript.

6. In Figures 2 and 3 for the vertical profiles of the monthly mean vertical temperature diffusive terms, the author choose to show the results for 5 °S, and for the temperature comparison, they showed 30.5 °S. What is the physical basis to choose these sections? Authors should show such results for the Arabian Sea and Bay of Bengal as well.

We chose the 10.5°S Section for the diffusive term comparisons. As the response to the reviewer #1, there are two reasons for the choice of the 10.5°S Section. Firstly, the Madagascar-Mascarene regions (0° ~ 25°S in the West Indian Ocean) are considered to be a hot spot for generation of semidiurnal internal tides. Both of the surface waves and internal tides should grow fully and become large enough for the comparison of the diffusive terms. Secondly, the 10.5°S Section is typical to the different pattern among the diffusion terms obviously, which include that, the k_h calculated from the classic M-Y 2.5 scheme is relatively small, the NBSW-generated turbulent mixing is the largest in the ocean surface and decays exponentially with the depth, and the IT-generated turbulent mixing is obviously larger than other schemes in the ocean interior.

We chose the 30.5°S Section for the temperature comparisons. Along the 10.5°S Section, there is non-ignorable difference between the WOA13 data and the simulation results in the East Indian Ocean, we have analyzed the reasons in the manuscript and more optimization and improvement of the experimental design will be implemented in future work to make the simulated results more accurate. Furthermore, the effect of the three schemes in the tropical area are relatively non-obvious, which is regarded as a long-standing issue (Qiao et al., 2010; Zhuang et al., 2020). Therefore, we have chosen another more typical transect (the 30.5°S Section) to show the effects of the three schemes on the temperature modeling.

As the reviewer suggested, the temperature structure in the Arabian Sea and Bay of Bengal was plotted and analyzed, the results are very similar to those along the 7.5° N Section, which is located in the south of the Arabian Sea and Bay of Bengal. Furthermore, the climatologic patterns of the temperature and current in the Arabian Sea and Bay of Bengal are similar because of the relatively low resolution and the monthly mean surface forcing. Some local meso- and small-scale features in the nearshore areas should be non-obvious. Therefore, we think that the temperature structure along the 7.5° N Section should be enough to show the pattern in the NIO.

The explanation and statement have been added in the revised manuscript.

7. In Figure 4 in exp1& 4 why the model does show the cooler temperature in the thermocline depth region? In general, over the Indian Ocean, almost all forced model shows warm bias (Rahaman et al. 2020). Although the thermocline bias was reduced in Exp 2 and 3, it became reversed with similar magnitude why does it so? Why there

is no difference between exp-1 and exp-4 in Figures 4 and 5? Does it mean WTFR does not impact temperature simulations? Authors should show such results for the Arabian Sea and Bay of Bengal as well.

The reason for the cooler temperature in the thermocline depth region in Exp 1 should be that the multi-year monthly mean surface forcing fields were smaller than the actual values, which leads to insufficient heat transfer from the atmosphere to the ocean. After 10 climatologic years modeling, the temperature in the ocean interior became cooler obviously than the WOA13 data.

On the contrary, The NBSWs and ITs enhanced the vertical mixing and then the heat transfer, so more heat entered into the ocean interior and the SST became cooler. Additionally, the Haney equation modified the surface forcing and made more solar radiation in the surface. Therefore, the accumulation of the heat during the 10-year modeling will make the temperature bias in Exp 2 and Exp 3 reversed with similar magnitude in Exp 1.

As we discussed in the manuscript, the simulation is slightly improved in Exp 4 compared with Exp 1 because the WTFR-induced mixing is remarkably weaker than the NBSW-generated turbulent mixing (the values of the WTFR-induced diffusion terms are about 4 to 6 orders smaller than those for the NBSW). Previous studies (Yang et al., 2019; Yu et al., 2021) demonstrated that the WTFR may play an important role in the SST cooling, if the wind and surface waves are strong. Therefore, the effects of the WTFR under the typhoon conditions will be further examined in the future work.

As we explained above, we think that the temperature structure along the 7.5° N Section, which is located in the south of the Arabian Sea and the Bay of Bengal, should be enough to show the pattern in the NIO.

The explanation and discussion have been added in the revised manuscript.

8. Figure 8 What is the physical basis of choosing the different zone? Looks like the present defined zones will not give true representation, for example in zone 1 since the

dynamics and thermodynamics are different in the Arabian Sea, Bay of Bengal and South China Sea, hence the mixing characteristics are also different. I suggest excluding the regions outside of the Indian Ocean such as South China Sea and Atlantic Ocean as included in the present zone 2 and zone 3. I also suggest the author should select the zones based on past studies or based on the dynamics and thermodynamic properties of the Indian Ocean basin.

We have replotted Figures 2 ~ 7 that the regions outside of the IO were removed. Actually, the RMSEs of the temperature shown in Figures 8 were calculated based on the simulated temperature only in the whole IO. The zone partition of the IO in this study were designed based on the previous studies and the dynamic patterns of the IO. On one hand, previous studies (e.g. Talley et al., 2011; E. Kumar et al., 2013; P. Kumar et al., 2019) showed different zone partitioning criteria which often included the NIO, the SIO and the tropical regions. On the other hand, the principal upper ocean flow regimes of the IO are the subtropical gyre of the SIO and the monsoonally forced circulation of the tropics and NIO. The whole effects of the Indonesian throughflow (ITF) should be also considered. Taking the above factors into account, the whole IO was divided into three parts, Zone 1 represented the NIO including the Arabian Sea and the Bay of Bengal, Zone 2 represented the tropics and the subtropical regions in the SIO containing the whole effects of the subtropical gyre and the ITF, and Zone 3 represented the region on the south of Zone 2 in the SIO. The description has been added in the revised manuscript.

9. How the RMSE is statistically robust when the authors used the seasonal cycle and computed the RMSE?

The monthly mean temperature in the upper-100 m layers between the WOA13 data and the model results were used to calculate the RMSEs as the following expression

$$\mathrm{RMSE} = \sqrt{\frac{\sum_{i=1}^{\mathrm{im}}\sum_{j=1}^{\mathrm{jm}}\sum_{k=1}^{\mathrm{ks}}\left(t_{m\ i,j,k} - t_{w\ i,j,k}\right)^2}{\mathrm{im}\times\mathrm{jm}\times\mathrm{ks}}}$$

where t_m and t_w represent the model results and the WOA13 data of the monthly mean temperature, im, jm and ks means the number of grids in the whole IO in horizontal and vertical directions. The RMSE can be regarded as a spatially average deviation of the three-dimensional temperature fields. Therefore, in our opinion, the RMSE is statistically robust because the calculation result is unique if the spatial range of the monthly mean results is determined. The discuss has been added in the revised manuscript.

10. As already pointed out in the case of the thermocline in the MLD bias given in Figure 9 for Exp-1 too looks not consistent with the previous works. In general OGCMs simulates deeper MLD in the Indian Ocean (de Boyer Montégut et al. 2007). A very recent study by Pottapinjara et al. (2022) too shows similar results. Hence, how the MLD simulation, in this case, shows shallower than observations? The authors need to explain why the model simulated MLD is shallower as compared to observations. Also, the criteria used to compute MLD is not very widely used. The authors did not provide any reference to compute MLD or any explanation why they choose the 1 °C criterion to compute MLD.

Many thanks for the comments about the MLD simulation. The simulated MLDs were generally shallower than the observations globally because of underestimation of the vertical mixing in the upper ocean, especially during summer. The conclusion is similar to previous studies, such as Kantha and Clayson 1994; Mellor, (2001), Qiao et al., (2010), Shu et al., (2011), Huang et al., (2012), Wang et al., (2019). The accumulation of the weak vertical mixing during the 10-year climatologic modeling will make more heat staying in the surface layer, which will lead to warmer SST and shallower MLDs. In fact, from Figures 10 one can see that, the obviously shallower MLDs are generally in the Antarctic Circumpolar Current (ACC) regions, where the simulated vertical mixing from the original experiment is weak dramatically.

Another reason for the shallower MLD simulation, which is not consistent with previous studies including de Boyer Montégut et al., (2007) and Pottapinjara et al., (2022), should be different methods used to define the MLD. The threshold criterion, which is used in this study, is the most widely favored and simplest method for finding the MLD (Kara et al., 2000; de Boyer Montegut et al., 2004). In threshold method, the MLD is defined as the depth at which the temperature or density profiles change by a predefined amount relative to a surface reference value. Various threshold criteria were used to determine the MLD globally, such as 0.2 ℃ in de Boyer Montégut et al., (2004), 0.5 ℃ in Monterey and Levitus, (1997), 0.8 ℃ in Kara et al., (2000) and 1.0 ℃ in Qiao et al., (2010). Therefore, we chose one of the threshold criteria to define the MLD and attempt to make the effects of the NBSWs and ITs on the simulated MLD more obvious. Adopting the threshold criterion of 1.0 ℃, the simulated MLDs were shallower than the WOA13 data because of the warmer SST and cooler temperature in the ocean interior.

The explanation has been added in the revised manuscript.

Reference:

Kantha, H. L., and A. C. Clayson. 2004. On the effect of surface gravity waves on mixing in the oceanic mixed layer, Ocean Modelling, 6(2), 101-124

Mellor, G. L. 2001. One dimensional, ocean surface layer modeling: a problem and a solution. J Phys Oceanogr 31:790–809

Qiao, F., Y. Yuan, T. Ezer, C. Xia, Y. Yang, X. Lü, and Z. Song. 2010. A three-dimensional surface wave–ocean circulation coupled model and its initial testing, Ocean Dynamics, 60(5), 1339-1355

Shu, Q., F. Qiao, Z. Song, C. Xia, and Y. Yang. 2011. Improvement of MOM4 by including surface wave-induced vertical mixing, Ocean Modelling, 40(1), 42-51

Huang, C. J., F. Qiao, Q. Shu, and Z. Song. 2012. Evaluating austral summer mixed-layer response to surface wave–induced mixing in the Southern Ocean, Journal of Geophysical Research Oceans, 117, C00J18

Wang, S., Q. Wang, Q. Shu, P. Scholz, G. Lohmann, and F. Qiao. 2019. Improving the Upper-ocean Temperature in an Ocean Climate Model (FESOM 1.4): Shortwave Penetration vs. Mixing Induced by Non-breaking Surface Waves, Journal of Advances in Modeling Earth Systems, 11, 1-13

de Boyer Montégut, C., J. Vialard, S. S. C. Shenoi, D. Shankar, F. Durand, C. Ethé, and G. Madec. 2007. Simulated Seasonal and Interannual Variability of the Mixed Layer Heat Budget in the Northern Indian Ocean, Journal of Climate, 20(13), 3249-3268

Monterey, G., S. Levitus. 1997. Seasonal Variability of Mixed Layer Depth for the World Ocean. NOAA Atlas NESDIS 14, 96 pp

Kara, A. B., A. J. Wallcraft, and H. E. Hurlburt. 2003. Climatological SST and MLD predictions from a global layered ocean model with an embedded mixed layer, Journal of Atmospheric and Oceanic Technology, 20(11), 1616-1632