Reply to Reviewer#1

**General comments:**
**I have been following studies in this region and I was always wondering about the generation mechanism of the Angola-Benguela Frontal Zone (ABFZ). As such, I read this manuscript with great interest. In this paper, the authors showed that the strength of ABFZ undergoes semiannual variation with the maxima in Apr.-May and Nov.-Dec.,but the mechanism for the two peaks is quite different. The first maximum is due the tilting term, while the second maximum is due to the confluence term. Although this manuscript presents new insight into the seasonal variation of the ABFZ, there are some issues with their frontogenesis equation. Therefore, I recommend publication of this manuscript after major revision.**

We greatly appreciate the reviewer for his/her quite constructive and helpful comments on our manuscript. As below, we have replied to all the comments and added more figure, sentences, and descriptions in the revised manuscript. Please note that the corrections in the revised manuscript are shown by **blue-colored font**.
Please note that we changed the title of this manuscript to "**Frontogenesis of the Angola-Benguela Frontal Zone**" replying to the reviewer's comments of Reviewer#2. Also, please note that the number of equation in section 3 decreases from 5 to 4 following revisions.

**1) Equation (3.4): To obtain Eq. (3.4) from Eq. (3.2), we need to integrate Eq. (3.2) from the surface to the bottom of the OML and divide by the OML depth. If the OML depth were not constant in time and space, terms containing the derivatives of the OML depth should appear, but those terms are missing in Eq. (3.4). Please check the appendix of Moissan and Niiler (1998), for example.**
**Moisan, J. R., and P. P. Niiler (1998), The seasonal heat budget of the North Pacific: Net heat flux and heat storage rates (1950-1990), J. Phys. Oceanogr., 28, 401-421.**

Thank you so much for the reviewer's careful checking our OFGF. Before the estimation of all OFGF terms, we calculated the OML-mean quantities like,

$$A_{oml} = \frac{1}{D}\int_{D}^{surface} A \cdot dz$$

, here *A* is arbitrary variable (temperature and currents) and *D* is the OML depth. Therefore, our OFGF includes the changes in the OML depth itself implicitly. However, we did not sub-divided each partially-differeciation term like,

$$\left(\frac{\partial \theta_{oml}}{\partial y}\right) = \frac{1}{D}\frac{\partial \int_{D}^{surface} \theta}{\partial y} + \int_{D}^{surface} \theta\left(\frac{\partial (1/D)}{\partial y}\right)$$

in order to keep our discussions more simplified like, for example, Tozuka and Cronin (2014, *GRL*). The spatial-temporal changes in the OML depth also appear as the entrainment velocity according to Moissan and Niiler (1998) and we considered this term as residual term (because the accurate estimation of entrainment velocity is difficult from CFSR outputs). But, we did not mention this point explicitly in the previous manuscript. Now, we added more careful explanation on our OFGF and its

simplification in this study in the revised manuscript. Please see lines 152-178.

**2) Equation (3.5): The assumption that there is "no penetration of shortwave radiation beyond the OML to deeper ocean layers" may not be a good assumption considering that the OML depth could be as shallow as 20 m in the region during austral summer.**

Yes, this is a rough approximation. On the other hand, by even such approximation, the surface heat flux does not play a vital role for the frontogenesis of the ABFZ. Therefore, we could think that this rough assumption does not make large difference in terms of frontogenesis in this region. And probably, the frontogenetic effects of solar radiation are much less important than the longwave surface fluxes reslting from the combination of the SST front and cloud cover.

**3) How is the OML depth determined? Is it based on some density criterion? Also, how is delta theta calculated.**

We used the output of CFSR for the OML depth. The OML depth of CFSR is defined based on K-profile parametrization. We added this explanation. Please see lines 176. Delta(Theta) is estimated as the difference between the OML-mean value and the value at one-below layer of the OML. We had missed this explanation, and now it is added in the revised manuscript. Please see lines 167-169.

**4) Lines 389-392: Since the authors are using a reanalysis product, effects of data assimilation are also included in the residual term.**

We agree with it. We added more discussion on the data assimilation in the final section. Please see lines 493-495.

**5) Figure 5b: The tendency term should also be shown.**

Thank you so much for the suggestion. We added the tendency of ABFZ front in Fig.5a by green-colored line. Please note that the tendency is filtered through moving 30days filter. We added a description of the tendency in the revised manuscript. Please see lines 289-293 and new Fig.5a.

**Minor Comments**
**1) Figure 1: Label the left panel as Fig. 1a and the right panel as Fig. 1b (Line 169).**

Thank you so much for the comment. We added the labels to Fig.1.

**2) Although the editor provided many comments on their writing, there are still some grammatical errors etc.**

**Line 10: Replace "form" with "from".**

Corrected.

**Line 11: Delete ", respectively".**

Deleted.

**Line 30: Replace "Resason" with "Reason".**

Corrected.

**Line 36: Delete “over the southern African Continent” as this phrase is redundant.**

Deleted.

**Line 38: Replace “model” with “mode”.**

Corrected.

**Line 49: Replace “GCM” with “CGCMs”.**

Corrected.

**Line 57: Replace “insightfully” with “quantitatively”.**

Corrected.

**Line 62: Replace “at” with “in”.**

Corrected.

**Line 70: Replace “opposite “ “opposing”.**

Corrected.

**Line 72: Replace “more” with”most”.**

Corrected.

**Line 86: Replace “put” with “make”.**

Corrected.

**Lines 92-93: Replace “National Ocean and Atmosphere Association” with “National Oceanic and Atmospheric Administration”.**

Corrected.

**Line 119: Replace “current velocity” with “zonal, meridional, and vertical current velocity,respectively,”**

Corrected.

**Line 129: Add “of” after “exchange”.**

Added.

**Line 138: Replace “3,4” with “3.4”.**

Corrected.

**Line 143: Replace “velocity,” with “velocity and”.**

Corrected.

**Line 144: Add “, respectively” after “depth”.**

Added.

**Line 158: Replace “reminder” with “remainder”.**

Corrected.

**Line 161: Replace “29-years” with “29-year”.**

Corrected.

**Line 172: Delete “a” before “weak”.**

Deleted.

**Line 176: Replace “shows” with “showed”.**

Corrected.

**Line 193: Replace “exceed” with “exceeding”.**

Corrected.

**Line 227: Replace “One” with “On”.**

Corrected.