Responses to Referee 1

General:

The manuscript presents new combined d(O2/N2) and CO2 values that allows the author to calculate Atmospheric Potential Oxygen (APO). Measurements of these parameters are obtained from flask samplings on board an aircraft between three different stations and an altitude transect at one of the stations. The measurements are analysed for their seasonality and secular trends and are compared to model results. The interpretation adds very valuable information for the understanding of the carbon-oxygen cycle links and helps to improve the budgeting of the global carbon cycle.

The manuscript is very nicely written with detailed information on how the method works and how it is used and applied to data. The figures and their legends are clear and concise.

It was easy to read the manuscript and I would like to congratulate the authors. I have only a few rather minor comments and suggestions. I suggest publishing it once these comments have been taken into consideration.

Thank you very much for your significant and useful comments on the paper "Spatiotemporal variations of the $\delta(O_2/N_2)$, CO_2 and δ(APO) in the troposphere over the Western North Pacific" by Ishidoya et al. We have revised the manuscript, considering your comments and suggestions. Details of our revision are as follows. The line numbers denote those of the revised manuscript.

Minor points:

Abstract: The corrections that are applied to the raw measurements are significant, how robust are these corrections. It is important that the reader gets already an impression of whether the corrections made are robust. I suggest rewording the sentence about the corrections by adding a corresponding statement about the robustness or adding an additional sentence about it.

Lines 192-196: The sentences have been added to discuss the robustness of the corrections.

Abstract: The altitude dependence of d(O2/N2), CO2 are not consistent percent-wise. This is obviously not the case for other locations. This should be discussed and compared to published studies about the altitude dependence in the corresponding section where the altitude dependence is mentioned. See also lines 2018-2019.

Lines 259-264: The sentences have been added to discuss the differences in the altitudinal dependence.

Line 111: Eq. 6 describes how you applied the corrections. Why is the correction based on Ar/N2 and not d15N, because you have excellent correlations with d15N and this parameter is stable in the atmosphere over long time periods?

Lines 139-142: We agree that the correction based on $\delta^{15}N$ is also suitable. Therefore, we have added

following sentence. “It is noted that the correction by using $\delta(^{15}N)$, which is stable in the atmosphere over long time period, is also suitable to obtain $\delta_{cor.}(O_2/N_2)$. Since the uncertainty of the corrected $\delta_{cor.}(O_2/N_2)$ by using $\delta(^{15}N)$ is ±7 per meg (±1.5 x 4.57), which is larger than that by using $\delta(Ar/N_2)$ (±2 per meg), we determined to use $\delta(Ar/N_2)$ rather than $\delta(^{15}N)$ in the present study”.

Line 113: The value for aO2 = (4.57±0.02) is not directly reported in Ishidoya, you may refer here to how you calculated.
Lines 126-127: The sentence has been added to refer to how we obtained the value.

Line 116: The overall uncertainty of dcor(O2/N2) was evaluated to be less than 6 per meg, and the effect of the seasonal d(Ar/N2) cycle on of dcor(O2/N2) was not therefore excluded in this study. This sentence is unclear to me.
Lines 130-135: The sentences have been revised to make the meaning clearer.

Line 285: Fig. 11 instead of Fig. 12.
Line 331: “Fig. 12” has been changed to “Fig. 11”.

Fig. 1: One could indicate in this graph that at MNM altitude profiles are taken.
Fig. 1, caption: The sentence “Latitudinal and vertical distributions are taken during the level flight and descent portion at MNM, respectively” has been added.

Fig. 10: It is not clear how the rate change values on the top panel of Fig. 10 are obtained. The values should be positive and negative. What about uncertainties. The spline functions in Figure 4 have uncertainties associated, could you add shading on the derivatives (e.g. Fig. 10) to illustrate these uncertainties for readability reasons only for one curve.
Fig. 10: Fig. 10(a) has been added to clarify the relationship between the secular trends of APO and its rate change values. Uncertainties of the secular trends can also be seen from the error bands in the figure. Since APO decreases secularly, the rate change value is generally negative.

Other changes
Lines 146-147: The sentence has been modified and Tohjima et al. (2005) has been added to reference since we have noticed that we used X_{O2} of 0.2094 in their study to calculate the observed δ(APO).

Lines 201-203, Figs. 4 and 5: The sentence has been added to note the data selection in the digital filtering technique, and the observational data deviated from the best-fitted curves more than ±3σ have been excluded from Figs. 4 and 5.

Figure 8 caption: The sentence to show the method to calculate the amplitude of seasonal APO and CO_2 cycles have been added.