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Comment on acp-2021-787

Anonymous Referee #1

Referee comment on "Spatiotemporal variations of the $\delta(O_2\square/\square N_2)$, CO_2 and δ(APO) in the troposphere over the western North Pacific" by Shigeyuki Ishidoya et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2021-787-RC1, 2021

Review of "Spatiotemporal variations of the d(O_2/N_2), CO_2 and d(APO) in the troposphere over the Western North Pacific" by S. Ishidoya et al, ACPD.

General:

The manuscript presents new combined d(O_2/N_2) and CO_2 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.

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.

Abstract: The altitude dependence of $d(O_2/N_2)$, CO_2 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.

Line 111: Eq. 6 describes how you applied the corrections. Why is the correction based on Ar/N_2 and not $d^{15}N$, because you have excellent correlations with $d^{15}N$ and this parameter is stable in the atmosphere over long time periods?

Line 113: The value for a_{O2} = (4.57±0.02) is not directly reported in Ishidoya, you may refer here to how you calculated.

Line 116: *The overall uncertainty of $d_{cor}(O_2/N_2)$ was evaluated to be less than 6 per meg, and the effect of the seasonal $d(Ar/N_2)$ cycle on of $d_{cor}(O_2/N_2)$ was not therefore excluded in this study*. This sentence is unclear to me.

Line 285: Fig. 11 instead of Fig. 12.

Fig. 1: One could indicate in this graph that at MNM altitude profiles are taken.

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.