

## **Review's comments**

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**Title:** 12 years of continuous atmospheric O<sub>2</sub>, CO<sub>2</sub> and APO data from Weybourne Atmospheric Observatory in the United Kingdom

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## **General comments:**

The authors of this study present high-quality record of the atmospheric CO<sub>2</sub>, O<sub>2</sub>, and APO data observed at Weybourne Atmospheric Observatory (WAO) in UK for decadal period between May 2010 and December 2021. They carefully assess the stability of CO<sub>2</sub> and O<sub>2</sub> scales and the repeatability and compatibility based on the measurements of variety of cylinders including intercomparison round robin cylinders, Target Tanks, Zero Tanks, Working Secondary Standards and so on. These results reveal that the data at WAO have high quality and significantly reliable. They also investigate the characteristic features of the trend, seasonal cycles, and diurnal variations of CO<sub>2</sub>, O<sub>2</sub>, and APO. The data at WAO would contribute to various studies including the global carbon cycle, air-sea gas exchanges and so on. I found that the paper is well written and contains material that should be published in Earth System Science Data. I highly recommend the manuscript to be published with the minor corrections as suggested below.

## **Specific comments:**

Page 2, line 51: The authors described that a standard with a known O<sub>2</sub>/N<sub>2</sub> ratio is used to report the change in atmospheric O<sub>2</sub>/N<sub>2</sub> ratio. Is it possible to show the exact number of the O<sub>2</sub>/N<sub>2</sub> ratio of the standard scale of this study?

Page 2, line 52: I think the sentence "O<sub>2</sub> and N<sub>2</sub> mole fractions are affected by changes in trace gases" is a little misleading. The major atmospheric components like O<sub>2</sub> and N<sub>2</sub> are affected by the change in the total amount of the air caused by changes in any atmospheric components, which is called as a dilution effect. Therefore, O<sub>2</sub> mole fraction is affected not only by trace gases, such as CO<sub>2</sub>, but also O<sub>2</sub> itself. The dilution effect is, however, negligible for the trace

gases. Therefore, the direct comparison between O<sub>2</sub> and CO<sub>2</sub> concentrations is rather confusing when they are expressed as mole fractions.

Page 2, line 56-57: As far as I know, a mass spectrometric method, which is adopted by many laboratories, directly measure the O<sub>2</sub>/N<sub>2</sub> ratio.

Page 2, line 58-59: The authors describe that O<sub>2</sub> variations are refer to as O<sub>2</sub> mole fraction changes rather than  $\delta(\text{O}_2/\text{N}_2)$  ratio changes in this manuscript. But  $\delta(\text{O}_2/\text{N}_2)$  ratios are used in the most of this manuscript.

Page 5, Figure 2: I think it would be better to add an aspirator and a differential pressure transducer in the legend.

Page 6, line 147-150: I'm curious about how to balance the pressures and flow rates between the sample air and WT air streams. In the manuscript, the authors described that the balance is manually achieved by adjusting the two needle valves. Is it possible to keep the balance for long period? In the Figure 2, the differential pressure transducer and the solenoid vale are connected to the "MKS" differential pressure gauge via green lines. Does it mean that the solenoid valve is automatically controlled to achieve the balance of the pressures between the sample air and WT air streams?

Page 6, line 149-150: Is "the two manual needles valves" a typo?

Page 6, line 152: Does "A solenoid valve" correspond to "4-way switching valve" in Figure 2? Are those same things?

Page 6: I think it would be better to clarify the flow rates of the sample air and WT air in this section of "Analytical set up". I know the flow rate (about 100 ml/min) is mentioned in in line 599, but it would be better to mention it here too.

Page 8, line 189-190: Don't the authors use the interpolated calibration coefficients from the bracketing calibrations?

Page 13, Figure 3: The shade of  $\pm 10$  per meg range is unclear.

Page 14, line 340 (Figure 4 caption): “Target Tank (TT) measurements of CO<sub>2</sub> (top panel) and O<sub>2</sub> (bottom panel) at ...”

Page 15, line 351-352: “... with slopes (in ppm year<sup>-1</sup> and per meg per year<sup>-1</sup> for CO<sub>2</sub> and O<sub>2</sub>, respectively) ...” “...each TT, for CO<sub>2</sub> (top panel) and O<sub>2</sub> (bottom panel) ...”

Page 27, line 618-619: “Manning, 2001” is not listed in References.

Page 33, line 725-726: It would be better to clarify what the ranges in the parentheses mean. Are they 95% confidence intervals?

Page 35, line 767-768: I think that the effect derived from seasonal and/or diurnal covariance between surface fluxes and atmospheric transport including PBL dynamics is termed as rectification effect. The seasonal cycle of PBL height itself isn't termed as the rectification effect.

Page 46, line 1036-1037: “Stephens, B. B., ..., 2000” has been already listed in line 1033-1035.