

In this study, Fleming et al. investigated the performance of a new cavity ring down spectroscopy analyzer developed for high-precision atmospheric O₂ measurements. The atmospheric O₂ measurements, combined with the CO₂ measurements, could potentially give us useful information about the origin of the CO₂ change because most of CO₂ sources have the specific O₂:C exchange ratios except air-sea gas exchange. Nevertheless, the atmospheric O₂ measurements are still challenging compared with the CO₂ measurements. Recently developed CRDS O₂ analyzer (Picarro G2207-i) nominally require no continuous working reference gas and no water vapor trap for the precise atmospheric O₂ measurements. Such analyzer could enhance the possibility to extend the atmospheric O₂ observation network. The authors carefully evaluated the precision, stability, influence of water vapor, and so on of the G2207-i O₂ analyzer through the tank air and ambient air measurements and found that the evaluated repeatability and compatibility didn't reach the levels required for the atmospheric measurements. Although the resulting performance was regrettable, such information is quite useful to researchers in the field of the atmospheric studies and to improve the CRDS analyzer. I found that the paper is well written, well organized and contains material that should be published in AMT. I recommend this paper for publication with the following technical corrections.

We thank the referee very much for their positive review of our manuscript. We have addressed each of their comments below, with their comments shown in black and our responses in blue.

Minor comments:

Page 2, line 32: "Tohjima et al., 2005a" should be "Tohjima et al. 2005".

We decided to delete this citation, and to change the value from 20.94 % to 20.9 % (the word "approximately" was already in the text, so it is quite appropriate to do this). We made this decision because since that 2005 paper was published, the background atmospheric O₂ mole fraction has continued to decrease, and is now closer to 20.93 %. Whereas the O₂ scientific community continues to use 20.94 % as part of the formal definition for reporting all O₂ data in "per meg" units – which we clarify later in the paper, e.g. in equations 4 and 5.

Page 2, line 32-33: I believe that the authors well understand it that the mole fraction of a major atmospheric component, like O₂, is affected by changes in the abundance of not only trace species but also the major species because of the dilution effect. So, I think that it would be better to emphasize the above point to explain why the O₂/N₂ ratio is used to express the concentration change instead of the mole fraction.

This has been reworded to: "Due to this large atmospheric background, O₂ measurements are sensitive to variations in the mole fractions of other atmospheric species, such as carbon dioxide (CO₂), due to dilution effects."

Page 2, line 46: "(e.g. Pickers et al., 2017; Resplendy et al., 2019; ...)?"

This has been corrected.

Page 2, line 49-50: The average OR of fuel types are summarized in Keeling (1988a) not Keeling (1988b).

The reference we used for the average OR of fuel types is already Keeling (1988a).

Page 4, line 109: What are the precision and accuracy for the water vapour mole fraction measured by G2207-i? I think such information is crucially important to evaluate the precision of the dry O₂ value (O_{2,WC}) after water vapour correction.

Picarro datasheet information for the H₂O measurement precision has been added: “The G2207-i datasheet states a measurement precision of 5 ppm + 0.1 % of reading (1-σ, 5 sec) for the water vapour mole fraction.”

Page 6, line153: “((52°75'...))”?

Extra open bracket removed.

Page 7, line 174-175: It's a just idea that how about giving the extended expression of Eq. (4) including H₂O mole fraction: that is

$$\delta(O_2/N_2) = \delta O_2 / (S_{O_2} \times (1 - S_{O_2})) + (CO_2 - 363.29) / (1 - S_{O_2}) + H_2O / (1 - S_{O_2}).$$

From above equation, we can easily obtain the dilution effect. Additionally, the equation is probably helpful to understand the temporal variations in the O_{2,NC} by G2207-i associated with the H₂O variations shown in Figure 4 and 5 and correlation plots in Figure 6.

This is an interesting suggestion from the referee. But we have chosen to leave Eq. (4) as it was for the following reason: the water correction needed for the Picarro analyser includes a significant spectroscopic interference effect, not only the dilution correction; in fact problems with this spectroscopic correction is something we discuss in detail in the paper. So if we included a dilution-only correction in Eq. (4), it could mislead the reader.

Page 9, Section 2.5: Eq. (4) and (5) should read as Eq. (5) and (6) because Eq. (4) already appears in Page 6 (line 148).

This has now been corrected.

Page 9, line 233: “Tohjima et al, 2005b” should be “Tohjima et al., 2005”.

This reference has been corrected.

Page 10, line 265: What's the unit of the slope of -4.26×10^{-6} ? Is it ppm/s?

Yes, the units have now been added.

Page 11, Figure 3: Is the coefficient of determination, $R^2 = 5.37 \times 10^{-5}$, correct? I think it may be $R^2 = 5.37 \times 10^{-5}$.

Yes, this has now been corrected to $R^2 = 5.37 \times 10^{-5}$.

Page 11, line 272-274: Some figures of the chemical formula are not subscripted.

Figures have now been subscripted.

Page 12, Table 2: Please check the average values of the cylinder #4 in the 8th column, the cylinder #5 in the 5th and 8th columns and the cylinder #6 in the 5th and 8th columns.

We checked and these values are correct. Note that in columns 5 and 8, we have calculated the mean of the absolute values of the differences (as stated in the column headings). We have done this because if the first run had a difference of -20 per meg and the second run had a difference of 20 per meg, then the average difference would be 0 per meg, which would be very misleading in terms of the imprecision of the analyses.

Page 12, line 289: The value of 36.0 is not standard deviation but average value in Table 2. Please check it.

This value has been corrected to 19.5 per meg, as per Table 2.

Page 14, line 321: Is “(Fig. 6c and d)” correct?

This has been corrected to “(Fig. 6a and b)”.

Page 15, line 336: Is “(Fig. 6a and b)” correct?

This has been corrected to “(Fig. 6c and d)”.

Page 17, line 375: The color of the dashed lines in Figure 8 seems to be black.

Line colour has been removed.

Page 17, Figure 8, caption: “The solid line indicates zero ... and the dashed lines indicate the WMO...”

This correction has been made.

Page 24, line 576-581: Tohjima et al., 2005a and 2005b are same.

The duplication of this reference has been fixed.