

Atmos. Meas. Tech. Discuss., referee comment RC1
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Comment on amt-2022-207

Anonymous Referee #1

Referee comment on "Evaluating the performance of a Picarro G2207-*i* analyser for high-precision atmospheric O₂ measurements" by Leigh S. Fleming et al., Atmos. Meas. Tech. Discuss., <https://doi.org/10.5194/amt-2022-207-RC1>, 2022

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.

Minor comments:

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

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.

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

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

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.

Page 6, line 153: "((52°75'...))"?

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.

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).

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

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

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

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

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

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

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

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

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

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

Please also note the supplement to this comment:

<https://amt.copernicus.org/preprints/amt-2022-207/amt-2022-207-RC1-supplement.pdf>