Comment on amt-2022-207
Anonymous Referee #1


In this study, Fleming et al. investigated the performance of a new cavity ring down spectroscopy analyzer developed for high-precision atmospheric O\textsubscript{2} measurements. The atmospheric O\textsubscript{2} measurements, combined with the CO\textsubscript{2} measurements, could potentially give us useful information about the origin of the CO\textsubscript{2} change because most of CO\textsubscript{2} sources have the specific O\textsubscript{2}:C exchange ratios except air-sea gas exchange. Nevertheless, the atmospheric O\textsubscript{2} measurements are still challenging compared with the CO\textsubscript{2} measurements. Recently developed CRDS O\textsubscript{2} analyzer (Picarro G2207-i) nominally require no continuous working reference gas and no water vapor trap for the precise atmospheric O\textsubscript{2} measurements. Such analyzer could enhance the possibility to extend the atmospheric O\textsubscript{2} observation network. The authors carefully evaluated the precision, stability, influence of water vapor, and so on of the G2207-i O\textsubscript{2} 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 O\textsubscript{2}, 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 $O_2/N_2$ 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 $O_2$ 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 $H_2O$ mole fraction: that is

$$\delta(O_2/N_2)=\delta O_2/(S_{O2}(1-S_{O2})) + (CO_2-363.29)/(1-S_{O2}) + H_2O/(1-S_{O2}).$$

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 $H_2O$ 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 $-4.26 \times 10^{-6}$? Is it ppm/s?

Page 11, Figure 3: Is the coefficient of determination, $R^2=5.37\times10^5$, correct? I think it may be $R^2=5.37\times10^{-5}$.
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 8\textsuperscript{th} column, the cylinder #5 in the 5\textsuperscript{th} and 8\textsuperscript{th} columns and the cylinder #6 in the 5\textsuperscript{th} and 8\textsuperscript{th} 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., 2005\textsuperscript{a} and 2005\textsuperscript{b} are same.

Please also note the supplement to this comment: