

Interactive comment on “Abundances of isotopologues and calibration of CO₂ greenhouse gas measurements” by Pieter P. Tans et al.

Anonymous Referee #2

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Recommendation: Publish - minor revisions

General comments:

The manuscript “Abundances of isotopologues and calibration of CO₂ greenhouse gas measurements” is well written and reports on a method and a new calibration system to account for differences in isotopic composition between primary CO₂ reference standards. This is an important development and essential for addressing biases introduced from measurements sensitive to specific isotopologues. The authors point out that these developments can be applied to other molecules. Application to CH₄ and N₂O would be of further benefit to users of optical spectroscopy. This work is a valuable contribution and of significant interest to the atmospheric monitoring community. The document defines the state of the art for the CO₂ calibration scale and it is

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important that this information is in the public domain. I recommend publication subject to the following minor suggestions for revision:

• The section on calibration and system performance refers to measurements of $\delta^{13}\text{C}$ and $\delta^{18}\text{O}$ made at INSTAAR on the primary and secondary standards using IRMS. What was the reference used for these measurements and are these traceable to VPDB?

• The term “mole fraction” and “amount of substance fraction” are used interchangeably throughout. One of these terms should be used for consistency. The second sentence of the abstract mol/mol is the unit and should replace mole fraction. This also applies to the fourth paragraph of the introduction.

• I would suggest keeping all y-axis values on the left hand side of the figure and increasing the size of the interval (perhaps 3 y values per chart). It is not clear whether the bars on the data represent standard deviations or uncertainties. Is there any contribution from the change in composition in the CO₂ reference standards to the trend observed in figure 2? Is it assumed that the changes in CO₂ reference standards is negligible compared to the long term reproducibility of the facility?

• Figures 3 and 4 present the comparability of measurements at INSTAAR and the new calibration system. The offset of non-depleted tanks is attributed to the extrapolation of the calibration at INSTAAR. Is there any data to support this statement?

• Assuming uncertainties are symmetrical, the values presented throughout the manuscript (e.g. $\pm 0.007 \mu\text{mol/mol}$ in the caption to figure 2) do not require the \pm sign.

• The caption to figures 5 and 7 are missing the term mole fraction (e.g. “The top panel shows the INSTAAR $\delta^{13}\text{C}$ values as a function of CO₂ mole fraction.”)