

## Review of “Effects of variation in background mixing ratios of N<sub>2</sub>, O<sub>2</sub>, and Ar on the measurement of δ<sup>18</sup>O-H<sub>2</sub>O and δ<sup>2</sup>H-H<sub>2</sub>O values by cavity ring-down spectroscopy” by Johnson and Rella 2017

This study presents a detailed analysis of the artifacts caused by variations in background mixing ratios for stable water isotope measurements using commercially available and largely used cavity ring-down spectrometers by Picarro (L2120-i). These artifacts are due to the influence of the background gas matrix on the exact shape of the target absorption lines. This paper very clearly shows that these background-induced effects can affect the measurement uncertainty when large variations in the carrier gas composition occur either during measurements and/or calibration. Possible correction schemes are discussed and the authors show that a correction to within the inherent measurement precision cannot be achieved with these schemes.

I recommend rapid publication of this very well written, important and scientifically relevant paper, which I found was a pleasure to read.

I have only a few minor comments that I listed in the following:

- 1) Check the order of citations and make sure they are cited chronologically (e.g. p. 2, L.8)
- 2) p. 2, L.32: Isn't it Demtröder?
- 3) p. 2, L. 35: “how specific CRDS analyzers are designed” do the authors mean in terms of hardware, software (i.e. scanning strategy)?
- 4) I do not fully understand why the authors always mention δ<sup>18</sup>O-H<sub>2</sub>O in pairs. Is this notation really justified and what does it exactly mean? For example on p. 4 at line 34 and in other instances.
- 5) p. 7, L. 30: What do “apparent” and “true” exactly mean? This was a bit confusing to me. Could this be defined more explicitly?
- 6) Eq. 3-5: Why do the author use this sort of linear multivariate model? Is there a physical justification for it?
- 7) p. 9, L. 25-30: Is this result likely to be consistent for different instruments of the same version?
- 8) Section 3.2 or elsewhere: could the authors add a short discussion about the impact of variations in the background gas composition on dexcess?
- 9) p. 12, L. 1-8: Could the authors compare the values in L. 1-2 to ambient values? Do these artifacts affect measurements in ambient near-surface and aircraft-based atmospheric water vapour? Or only in specific environments? This might have consequences for many current measurement applications and a short discussion on where to expect relevant impacts would be helpful.
- 10) p. 15, L. 7: What does “calibration-free” spectral fitting strategies mean? Could the authors add 1-2 sentences to explain this?
- 11) Very nice conclusions!
- 12) Fig. 2: It would be helpful to have a sentence in the caption saying what the different point for a given value on the x-axis mean. (I suppose Δδ<sup>18</sup>O for different H<sub>2</sub>O mixing ratio levels?) Also here I am not sure whether the notation Δδ<sup>18</sup>O-H<sub>2</sub>O (‰) makes sense. As far as I understood it, I would opt for only Δδ<sup>18</sup>O-H<sub>2</sub>O (‰).
- 13) Fig. 12c: I did not understand the difference between the thick and the thin lines. Maybe the authors could mention it more clearly in the caption or in the panel.