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Comment on amt-2022-79

Anonymous Referee #2

Referee comment on "Contactless optical hygrometry in LACIS-T" by Jakub L. Nowak et al., Atmos. Meas. Tech. Discuss., <https://doi.org/10.5194/amt-2022-79-RC2>, 2022

In the manuscript "Contactless optical hygrometry in LACIS-T", the authors describe the application of open path tunable diode laser spectroscopy for high temporal resolution measurements of water vapor concentration in a two flow mixing wind tunnel. The manuscript is generally clear, well organized and well written. The topic is highly suitable for Atmospheric Measurement Techniques and I recommend the manuscript for publication following consideration by the authors of the comments and suggestions below.

Comments:

In the description of the LACIS-T facility (Figure 1 and supporting text), it would be helpful to clarify the geometry by showing axes x , y and z and indicate the reference positions for each ($z = 0$ being the tip of the aerosol inlet, and $x = 0$ and $y = 0$ being the centerlines of the two transverse dimensions of the duct) and define the longitudinal (z) position of the FIRH sampling and discuss why that position was chosen (I see in L142 "at the height 39 cm downstream [of] the place where the two streams merge"—meaning $z = 39$ cm downstream of the aerosol inlet?). It would also help to mention that the duct is oriented vertically (it is, right?) so that describing the position of the DPM sampling inlet as "below" (= displaced in z , downstream of) the FIRH beam makes sense (I was originally picturing the inlet offset in y for x "scans" and in x for y "scans"). In Figure 1, I'm not sure what information I am supposed to extract from the picture/diagram to the right of the two (x and y view) schematics of the LACIS-T measurement section, and it seems like it should be omitted or discussed.

L111: "the exact tuning...prevents interferences" isn't quite correct. If one or both of the wavelengths were near an absorption line from another molecule, the measurement would be impacted regardless of how exact (precise) the tuning. It is the choice of the specific H₂O absorption feature that is sufficiently far from interfering absorption lines that is important.

L148: "transverse" might be a better word than "perpendicular", and specify relative to the direction of flow

L149 (and Figure 3): similar to above, it would be helpful to have the origin of the coordinates defined and the range of possible values (-x ... +x, -y ... +y).

L151: since the two wavelengths are achieved by adjusting only the laser diode current, why are the two measurements made in separate (long) periods instead of quasi-simultaneously by rapid tuning between the two?

Figure 5: I think "interferred" is meant to be "interfered", but that is not used as an adjective. I think the appropriate term would be "convolved" as the product of the convolution of the absorption and fringe spectra.

Figure 6: it would be nice to add lines indicating the locations of M and R

L218 (and L265): why is the value of $T_x(g)(\lambda) = 0.87$ so much lower than $T_y = 0.98$?

L264: the systematically high values of n from FIRH would indicate that the determinations of the contributions to the signal from the windows and ambient air were low when applied to the experimental arrangement. Or the DPM was systematically low at low H₂O. Did the DPM-measured value agree with the expected based on the generated H₂O in the flows?

Section 5.1: I'm not sure that the arguments presented here really presents a complete argument explaining the systematically higher values measured by the DPM than FIRH (L284). The values are typically at a mean concentration ($> 2e17$) at which the prior experiments demonstrated good agreement, and anyway, at low values the prior experiments would predict that FIRH would be higher than the DPM measurement. Spatial differences (average vs point) would seem to require a crossover at some position since gradients along the y direction cannot explain it given the statement in L276. Given conservation of H₂O in the flow, the small difference in z of the FIRH and DPM measurements shouldn't produce a significant difference (would require a source of H₂O).

Figure 8: it would be interesting to compare the variance with dn/dx to graphically demonstrate the statement in L296/7 of the coincidence of the peak in variance with the steepness of the gradient.

L315: the hypothesis here could have been tested by comparing with an experiment including a flow (aerosol-free) from the aerosol inlet with $n = (n_A + n_B)/2$ that would be more representative of the typical aerosol-inclusive studies at LACIS-T.

Data availability: per the AMT data policy, it is (at the least) encouraged that authors make the supporting data publicly available via some repository.