Atmospheric Measurement Techniques Discussions

Atmos. Meas. Tech. Discuss., referee comment RC1
https://doi.org/10.5194/amt-2022-79-RC1, 2022

Comment on amt-2022-79

Anonymous Referee #1

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-RC1, 2022

The fast and accurate measurement of water vapour in air is still an unsolved, yet relevant issue in atmospheric applications. The main limitation of the most water vapour measuring instruments employed in the lab or airborne is the sampling. Certainly, an open-path measuring setup is desirable, which eliminates the difficulties arising from the disturbance of a sampling tube, e.g., in airflow. The authors present here the application of a novel open-path infrared water vapour measuring instruments, and its demonstration measurements at the LACIS-T of Tropos Institute in Leipzig, Germany. The topic of the manuscript is definitely matches the requirements of Atmospheric Measurement Techniques, but it is also of interest of the broader atmospheric community, and for industrial applications, as well.

In general, the paper is well organized, and clearly written. The language is fluent and the text is easy to follow and to understand. The abstract gives a concise summary of the manuscript. The Tables and Figures are of high quality.

I recommend the paper to be published in Atmospheric Measurement Techniques. Nevertheless, in the following I list some minor comments that can be taken into account for a revision before publication.

General remarks

I really enjoyed reading the first part of the paper. I had the feeling that all the questions risen during reading were answered in the subsequent sentences or paragraphs. Unfortunately, this impression was failed at Section 5 and 6. In my opinion, there was a break in the flow of the manuscript. The presentation of the results, and particularly its discussion remained non-conclusive. In the end I could not tell why the measurement was

conducted for, and why was it important to carry out the measurements in a turbulent flow. How this measurement helps in such applications? I hoped that this question will be addressed in Summary and Discussion, but it was not the case. Anyhow, as I mentioned, the topic is very important, and the results are interesting and promising, but I wish a more detailed discussion with respect to the application in a turbulent flow.

Specific comments

Line 33: The authors list numerous hygrometers, but in my opinion an important type of instrument is missing, namely a photoacoustic based hygrometer. Although such a hygrometer is implicitly cited, but could also be referred here (see e.g., Szakall et al., Frontiers In Physics, 2020; or Tatrai et al., AMT, 2015). These papers address a lot of similar problems as the hygrometer of the present manuscript has, like antireflection coating, and multiple reflection from windows, for instance.

Fig.1, and Fig 3: Probably that was my fault, but it was for me very difficult to figure out what is x direction and what is y direction. The caption in Fig. 3. did not help either ("x position – long path, perpendicular to what is depicted in this scheme"; does not tell for me anything). Then I found the description in line 351 which helped a lot: "across the long and short dimensions of the rectangular measurement section of LACIS-T". (Probably it was written earlier, but I have overseen it?) Please consider showing x and y directions in Figure 1. Further, in caption of Fig. 1 please indicate what DPM means.

Line 97: Please revise: "one can calculate water vapor concentration" – I found the word "easily" superfluous.

Line 132: Why did you use an electrooptic amplitude modulator? Semiconductor lasers can be easily modulated with their currents. Was that because of the disturbing effect of a residual wavelength modulation? Furthermore, in the Summary you mention the difficulties with measuring at two wavelengths with this setup. Would that be possible to apply wavelength-modulation instead of amplitude modulation, and to apply 1f or 2f detection? That would also eliminate the problem with the window signal, I suppose.

Line 192: Are the two windows here the two opposite windows in the setup, i.e. in LACIS-T?

Caption Figure 5: The assumed concentration given here is the water vapor concentration in LACIS-T?

Line 200: I understand that the windows were large, so any antireflection coating or tilting

would not work. But the laser spot is small, so not the whole window should be tilted or coated.

Line 215: What does “perpendicular orientation” here mean?

Line 220: The effects of reflection are discussed. Would such a reflection not worsen the laser efficiency when coming back to the active material of the laser? Or is this somehow avoided?

Line 230: Why is the parasitic absorption so different for the x and y directions?

Line 242. Please consider providing the formula (maybe in the Appendix). It could be interesting for the readers or other researchers with similar applications.

Line 254: Here the measurement was conducted with two air streams. If I understood correctly, the former measurements were carried out without flow. The measurement conditions should be described correctly and at the beginning of the paragraphs. Here it is also not clear how the sampling for the dew point mirror was done. Or was the inlet permanently in LACIS-T, as shown in Figure 1?

End of Section 4: For me the explicit determination of the detection limit or the minimum detectable concentration of FIRH is missing. From the calibration it could be determined, right? Something like 1.5 E17 cm-3.

Line 283: Again the question: was the DPM inlet permanently mounted? Or was that movable? One could perform a scan with DPM if its inlet is movable.

Line 286: That FIRH measurements represent an average along the optical path is not a new information, it is mentioned a few lines earlier.

Line 295: “The profiles of n …” – was already mentioned.

Line 317: Is it possible to measure the air flow and get information about the velocity profile? Applying an LDV, for instance?

Line 333, 335: Vibration and oscillation of the window are the same thing, if I understand correctly. Why were the windows vibrating? Some mechanical vibration from the whole facility?

Figure 12: The inlet figure has no scale, so it is difficult to understand it.

Lines 372-375: I did not understand the motivation of this discussion. Are the results meaningful in this aspect or not?

Line 380: It is claimed here that the measurements "provided new insights into the properties of turbulence and turbulent mixing in LACIS-T". This is not obvious for me and that is what I meant in my General remarks.

Data availability: I suggest the authors using a data repository for publishing the data, at least the ones corresponding to the figures.