**Atmospheric Measurement Techniques**
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Discussions

# Comment on amt-2022-276

Anonymous Referee #3

Referee comment on "Spectrometric fluorescence and Raman lidar: absolute calibration of aerosol fluorescence spectra and fluorescence correction of humidity measurements" by Jens Reichardt et al., Atmos. Meas. Tech. Discuss., https://doi.org/10.5194/amt-2022-276-RC3, 2022

**General comments:**

The paper introduces the latest upgrade of the lidar system RAMSES and describes in great detail the procedures for setting up the instrument and characterizing it. Strong efforts were done to guarantee the quality of the measurements and products of RAMSES, which with its discrete and spectrometric channels, is the most advanced lidar in terms of fluorescence backscattering right now. The authors also evaluated the possibility of correcting the intrusion of fluorescence backscattering into water vapor channels, demonstrating that a correction is needed when fluorescence is strong and the ambiance is rather dry. The article is well-organized and well-written, and its relevance for the community can be quite high, given the rising demand for knowledge in terms of atmospheric fluorescence. There are some specific comments that I would like to be addressed by the authors.

**Specific comments:**

**1) p.4, lines 91-93:** What I get from the text is that (usually) during the night you let all signal go directly into the UVA spectrometer and during the day you habilitate the discrete channels by placing the beam splitter DBS1 on the way with the linear stage, as one can visualize in Fig. 1. I was wondering what is the reasoning behind that configuration? I would expect, e.g., the discrete channels to be off during the day because of the strong atmospheric background.

**2) P.5, Sec 3:** As I could follow, the calibration has three steps: the wavelength calibration, the relative intensity response calibration, and finally the absolute intensity calibration. In the case of the VIS spectrometer, the second and third calibration procedures were not possible, so you proposed an alternative to these procedures. In order to do so, first, for the relative intensity calibration, you take the results from the libRadtran package. Could this process bring uncertainties to be considered by the approach? And regarding the absolute calibration, you scale the VIS relative-intensity spectra to the UV absolute-calibrated spectra. Can this scaling in the range between 441-456 nm carry uncertainties into the full calibrated spectra? What about extending this wavelength range?

**3) P.6, Line 135:** What was exactly the issue with the relative intensity calibration at the BSRN station in the case of the VIS spectrometer? In general, I would assume there is more trouble when calibrating UV spectrometers. Could you provide a more precise comment on that?

**4) P. 6, Lines 166-167**: You talk here about the high accuracy of the elastic particle properties. Could you provide more details about this processing? following your measurement strategy, it seems that during the night of 21-22 August, only the discrete channel 355 nm was on, but not the Raman channels. This means that you are using the Klett method to retrieve the aerosol properties. Or are you indeed using the Raman channels during the night, so that you can get the elastic backscattering by using the combination of Raman and elastic signals? Or are they from the far-range channels? Please provide information on where the information comes from. This would be helpful for the reader considering the complex lidar system you have.

**5) P. 8, Fig. 3:** similar to my last comment. When presenting the first results it seems there is missing information in the description of them, especially given the variety of receiver units and detectors you have. For example Fig. 3 a. Is this from the near-range or the far-range receiver? It s calculated from the Raman or Klett method? Did you have a fixed reference height for the whole period (for the high-resolution retrieval)? In Fig. 3b, I assume the depolarization is coming from the far-range channels, as you do not have them in the near-range receiver.  For someone who read about the RAMSES for the first time, can be difficult to follow, considering that only a part of the system is described in this article. Most of the technical aspects can only be found in Reichardt et al 2012, which one can get only via institutional access. A more clear description in the text would be appreciated.

**6) Figs. 3, 6, 8, 9:** why do the products always start at 2 km height?

**7) 11, Line 225:** The calibration constant (also named coefficient) was introduced in Sec. 3.2 instead of 3.1 as it is written.

**8) 16, Table 1:** What were the temporal windows considered on each individual

measurement? +/- some minutes, or +/- tens of them?

**9) 18, Lines 344-346:** I am not sure I agree with the conclusion that an accurate correction is impossible. What do you mean by saying that *the induced error in water vapor mixing ratio varies widely*? You meant that the gradient varies widely? In that case, I would say it depends, on e.g., the bandwidth of the water vapor channel, at least for the discrete channels (0.22 nm bandwidth) the three gradient values you obtained (for the correction) are not so different from each other (0.013, 0.017, 0.019). In my opinion, a given value will provide a more accurate water vapor profile than a zero gradient (no correction). In general, what would your feasibility approach says if a discrete fluorescence channel is placed right next to the water vapor range, such as in Chouza et al., 2022, in which the fluorescence channel was intended for correcting the mentioned effect on the water vapor products?