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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Scanning rotational Raman lidar at 355 nm for the measurement of tropospheric temperature fields" *by* M. Radlach et al.

M. Radlach et al.

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We thank the reviewer for his/her comments which definitely helped to improve the manuscript.

1. Section 2 (System setup). What is the specification of telescope? Diameter? Focal length? etc.

The technical specifications are listed in Table 1. We have added this information now also to the text.

2. Section 3 (Filter optimization), P. 7575 L. 8. "we used a modified Gaussian

curves with very steep edges and an idealized transmittion of 100 % to extract....". I do not understand this description. Please explan more about the fitler transmission characteristics.

We have added the equation of the modified Gauss-function to the text.

3. Section 3, P.7575 L.28 - 29. What is the definition of delta-lambda-FWHM1 and FMHM2? Are they of IF 2 and 3 or IF 2a and 2b?

In order to avoid any confusion we have clarified this point in section 3.

Section 3, P.7575 L. 26. What is delta-T?

Delta-T is the statistical 1-sigma uncertainty of the temperature measurement and is defined in Eq. (1).

5. Section 3, P. 7576 L.8 "7 orders of magnitude" Does this include IF1?

Yes, the statement that a suppression of the elastic backscatter signal in the rotational Raman channels of 7 orders of magnitude is reached includes IF1. We have clarified this point in the text in Section 2.

6. Section 3, P.7576 L.14 What is T1 and T2?

This is explained in Eq. (1). We added a reference to Eq. (1) here.

7. Section 4, P. 7578 L.18-20 It is strange to me that all the radiosonde data is within 1-sigma of lidar measurement, because usually 1-sigma means about 70 % of the data are within this limit (if this is 2-sigma, 95 %). If there is 10 independent observation points (heights), 3 of them are expected out of 1-sigma

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limit. Are you overestimating the 1-sigma error?

The reviewer is right to point out that in this example the agreement between the temperature measurements of the lidar and the radiosonde is astonishingly good. As explained in the text, we have derived the 1-sigma uncertainty with the photon-counting signals by Delta-P=$\sqrt{P}$, with P the lidar signal, assuming that the uncertainty follows Poisson statistics. Furthermore, for altitudes lower than 4 km, we calculated a virtual counting rate by fitting the analog signals to the photon-counting signals in the height range of 3 to 4 km. The equation for the uncertainty of the temperature measurement is written in Eq.(1) derived by error propagation. Whether the assumptions, on which this error estimation is based, are strictly valid or we overestimate the error by them, can of course not be judged by this one example alone. In this context it is also important to note that there are much more measurement points for the lidar shown than for the radiosonde in this example because the radiosonde data with full resolution are unfortunately not available here. Thus, the complete picture might look different in case there are more data for the radiosonde (like it is the case in Fig. 9). In the meantime, an upgraded version of the lidar system was deployed extensively in the field campaign COPS (Convective and Orographically-induced Precipitation Study, Wulfmeyer et al., 2007). In this campaign, the lidar performed measurements during 3 months with 170 collocated radiosonde launches. We will use this data set to study the error characteristics in more detail applying also an independent technique given by a spectral analysis of the lidar data (e.g. Kiemle et al., 1997 and Lenschow et al., 2000).

8. P. 7581 L. 6-7 and table 3. In contrast, table 3 shows larger difference between lidar and radiosonde. At Scan 6 and 9, the difference is about 3 sigma and 2.3 sigma, respectively, They should be a rare case since there are only 5 comparisons. I suspect the difference between the two measurement is large, and there might be some factor of increasing error when lidar beam is scanned. The distance between the lidar and sonde may not be a problem because this is of the

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same order witj the above case (7. Section 4, P.7578 L.18-20). I request some comment on it in the text.

As we derived the statistical uncertainty merely from the signals intensities as written above, we do not expect any difference between vertical or scanning measurements. But when comparing the differences between radiosounding and lidar measurement of Section 4 and 6, the specialties of both measurement sites need to be kept in mind. Section 4 shows an example of vertical measurement in quite flat terrain at around noontime whereas Section 6 is a scanning measurement example at night from a mountain peak which is about 1160 m above sea level with steep slopes to both sides. Furthermore, as mentioned in the text the radiosonde in Section 6 was always separated by about 1 km from the point of the lidar measurement which can easily result in the observed temperature differences of the sampled airmasses, e.g., by mountain induced slope flows or gravity wave activity Like stated above, we will investigate this question in more detail in the future with the large COPS data set.

References:

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Interactive comment on Atmos. Chem. Phys. Discuss., 7, 7569, 2007.