

Interactive comment on “3D Water Vapor Field in the Atmospheric Boundary Layer Observed with Scanning Differential Absorption Lidar” by F. Späth et al.

Anonymous Referee #2

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Please see the review report attached in case the format is not appropriate here:

Review report 3D Water Vapor Field in the Atmospheric Boundary Layer Observed with Scanning Differential Absorption Lidar Author(s): F. Späth et al. MS No.: amt-2015-393 MS Type: Research article

In the manuscript amt-2015-393 authors demonstrated the potential of a new ground-based high-power scanning DIAL system for boundary layer process studies. They also performed detailed error analyses using ACF-based method and compared the results with radiosonde profiles of absolute humidity. The unique aspect of DIAL technique (i.e. no calibration necessary) has been discussed in detail. I found the data analyses tools they have developed for scanning measurements to be unique. Also, the potential of

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the visualization tools explored are of huge advantages for studying 2-3 d field of water vapor mixing ratio in the boundary layer. The amount of data set selected from two different campaigns is extensive and sufficient. The results and discussion presented in the manuscript are convincing. However, I have few specific comments on different aspects of the results presented. Since the authors should explore some detailed explanations at various places, major revisions are triggered. After addressing those, the paper deserves publication in the journal AMT. I encourage the authors to consider the comments during revisions. For instance, they used some general statements in their results section.

Specific comments

In Abstract: At the beginning, an overview statement stating the need for a high-resolution 2-3 d field of water vapor information is required. A clear motivation behind such development could be outlined. A brief statement with specific information on the scanning data analyses tools developed and the unique visualization tools used should be made in the abstract as well. Please mention at the beginning that data obtained from two different field campaigns were used for this study. Otherwise, SABLE comes as an afterthought. General statements like “Volume scans show the water vapor field in three dimensions” needs to be removed from the abstract. Please note that I indicated similar general statements made at various places of the manuscript without specified goals or quantifications. I suggest removing those as well (see minor comments). Could you please specify soil type, moisture regime, land cover, vegetation type where you used the phrase “different land use”? Note that this issue has been discussed in the paper. Introduction: Discussion on the comparison between Raman lidar technique and DIAL is extensive. Please shorten this part since you do not compare the results with Raman lidar retrievals with a different instruments. Some references would suffice here. P4 L4: Low elevation. What’s the elevation angle? Please mention the overlap issue here and the distance from where WV information is retrieved. Furthermore, while the present study is campaign-based, this dataset should

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be highly valuable in future studies involving LES simulations of these events. Therefore, the paper will be a worth addition to the literature. I strongly recommend adding few highlights within an outlook.

Other sections P5 L20: "Firs time.." This need to be mentioned in the abstract Eq 5: There are some discrepancies among Eqns. 4, 5, and relevant discussion and Fig. 2 where Beta_Par is mentioned. In the primitive DIAL equation, Beta_par is not present. I understand that on page 7 you mentioned "Rayleigh-Doppler correction" effect "was not critical as confirmed not only by comparisons with radiosoundings.." Could you please state after the Schotland approximation (i.e. Eqn. 4 without the second term, right?), that this is the equation which has been used as Beta_par is not present in this equation. Or I missed some information here. In any case, all these discussions need to be harmonized and presented at one section. It is not clear also whether or not, you applied the corrections in the measurements shown in the figures. P9 L9: "With small periods" Be specific/quantify. P9 L21: Figure 3: Please explain whether or not any types of interpolation used since for larger ranges (e.g. 3-4 km) at a fixed elevation angle, separation between the circles and crosses would be larger compared to that at closer range (e.g. 1 km) P9 L25: "Finally..." Could you please explain the impact of different temporal averaging here since two different temporal averaging would result in two different angular separation (let's assume r, theta, phi co-ordinate). P11 L17: Below the top. Please quantify P11 L25: Could you please make a note on some of the gaps observed in the 2d field for scan performed between 0714 and 0724 UTC? Also, make a note on the partial overlap effect here. Figure 6a,b: Could you please enlarge the color bar scale limits and color bar title? See Fig. 8 for an example. P12 L8: Could you please make a note on the impact of wind-driven drift of the radiosonde here? P13 L10: Here and elsewhere, for a discussion, could you please mention the changes in the orography in the region? This is important since at many places, you mention this issue. P16-17: An outlook is missing.

Technical corrections/minor comments P1 L6: Add "3d" before fields P1 L13: "range of

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a few kilometers" Please also indicate the height here in addition to the range. P2 L17: rephrase the last part with "nor" Used two times. P2 L 19: 2015 a/b: Please check here and throughout the MS. P6 L3: Replace "initial" by "transmitted", "time resolution" by "sampling resolution" Eq 2: \dot{u}^2 by \dot{u}^2 ? Eq 4: DB: Doppler broadening? P7 L14: "were studying" Rephrase P10: L1: Section 4 header: Tool long for a header title. Please shorten. P10 L31: UTC. Please define w.r.t. local time. P11 L6: 1.6 km. Looks like 1.4 km! P11 L9: 566 s: Please round it to 10 minutes since you do not mention seconds in the time stamps used in the figures. P11 L3: Cirrus: Please mention as found by off-line signals" Right!? P14 L12: Replace "corresponds ..elevation" by "varied according to underlying orography" L30: Heat fluxes: What time? P 15, Section 6.2: Which campaign, which data sets were used need to be mentioned at the beginning. P15 L30: Please make a note on the differences in the terrain/topography.

Remove the following sentences as has been found either general information or repetitions. Please take care on this issue while revising the paper. P3 L 1: "Lidar with. ...processes" P8 L22: "Thus, the DIAL.profile"

Interactive comment on Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2015-393, 2016.

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