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Atmospheric Measurement Techniques Discussions

Interactive comment on "Differential Absorption Radar Techniques: Water Vapor Retrievals" *by* Luis Millan et al.

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We thank Dr. Wulfmeyer for showing interest in our work. Below are our responses in blue.

1 Dr. Wulfmeyer comment

These results are fairly limited because obviously the authors seem to omit the analysis of noise errors in the derivation of water-vapor profiles in clouds. The DAR ist extremely sensitive to the SNR of the online and offline signals because the relative

error in the derivation of water vapor is inversely proportional to the differential optical thickness. There is a vast of literature from the investigation of water-vapor differential absorption lidar, which is nearly equivalent to DAR but is it not mentioned by the authors. I expect that it will turn out that the SNR of the return signals is far away from enabling reasonable measurements of water vapor in clouds from space. Before this analysis is done and this ommission is healed, it is hardly possible to make a reasonable judgement of this technique. I strongly recommend that the methodological analysis of DAR is extended by system noise error propagation. Therefore, also the argument that the accuracy of the measurement is increased by averaging is incorrect because the authors are dealing with systematic errors but not with uncorrelated noise. In this connection, I am wondering how useful a precision of 89% is (or an error of a factor of 2). In this case, it is probably better to guess the water vapor content of the cloud by the temperature profile. An NWP output will likely produce more accurate results.

We have the impression that Dr. Wulfmeyer believes that we omit the analysis of noise errors. In section 3, (page 4 line 18) we state that we assume a measurement noise error of 0.16dBZ, then, in section 4 and 5 we use end-to-end retrievals algorithms to propagate this error to the retrieval process and investigate its impact. This measurement noise error is similar to the one found in CloudSat (a radar from space) and it was chosen because a similar error should be achievable when such a system is implemented.

Further, Dr. Wulfmeyer is correct when he states that the accuracy will not be increased by averaging because the errors are systematic. However, we do not claim that, we clearly state that it is the precision (determined by the measurement noise) the one that will average out. For reference, in section 4 we explain the difference between precision and accuracy (systematic uncertainties), and in section 5 we state

that it is the precision that averages out.

With respect to the DIAL literature we will add the following sentence in the introduction: In this study we asses the differential absorption radar (DAR) concept to profile water vapor in cloudy and rainy areas. **This technique is analogous to the differential absorption lidar (DIAL) technique [e.g., Schotland, 1966, Browell1979, Wulfmeyer and Walther (2001)].** The DAR concept exploits the difference between the radar reflectivity at different frequencies...

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