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Interactive comment on “Aircraft millimeter-wave retrievals of cloud liquid water path during VOCALS-REx” by P. Zuidema et al.

Anonymous Referee #1

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General comments: The manuscript “Aircraft millimeter-wave retrievals of cloud liquid water path during VOCALS-REx” by P. Zuidema, D. Leon, A. Pazmany, and M. Cadeddu, presents statistics of WVP and LWP retrieved by the zenith-pointing, millimeter-wavelength radiometer GVR (G-band Vapor Radiometer) installed onboard the NCAR C-130 plane in the framework of VOCALS-REx project. The manuscript is well written and well structured providing useful information on latitude-constant offshore flight legs of GVR-retrieved LWP compared to in-situ-retrieved thermodynamics and liquid water profiles from ship-launched soundings. Statistics are based on reasonably large dataset obtained in coastal and open SEP conditions. The comparison between the GVR-retrieved and adiabatically (by radiosondes)-retrieved LWP is interesting especially for the interpretation of the high correlation and implications on stratocumulus cloud high adiabatic rate in the probed portion of the above-SEP atmo-

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sphere. If this will be confirmed by future studies it will mark an important point on the knowledge of liquid cloud dynamics in open ocean conditions. However, the error/uncertainty analysis is not well-developed leaving the reader with only a qualitative idea about the different sources of uncertainty. Moreover, the lack of quantification of the error introduced by the missing cloud boundaries detection should be addressed. Other minor aspects of the description and of the data interpretation need more explanation and precision (see Specific comments). In general, I recommend the manuscript for publication in ACP after minor revisions.

Specific comments: Pg 19583, In 11-12: While I agree on what the GVR gives the opportunity to characterize the stratocumulus microphysics I doubt the GVR alone can “characterize...the cloud-aerosol interactions”. I suggest dropping this part by keeping the rest of the statement.

Pg 19590, In 20-21: state in brackets how cloud boundaries are retrieved (e.g., LIDAR-retrieved and RADAR-retrieved cloud base and top, respectively).

Pg 19591, In 9-17: the practice of retrieving the cloud base temperature (and height) by infrared emission from the cloud base while correct and very useful, suffers significant uncertainty when the cloud is optically thin (emissivity<0.8). How sensitive is the boundary-layer retrieval of WVP to that source of uncertainty?

Pg 19591, In 14-15: Where is the cloud radar located? What is the wavelength? The radar-lidar specifications should be introduced at the beginning of this section along with a brief description of the instrumentation aboard the NCAR C-130.

Pg 19591, In 14: the fact of removing the LWP adiabatically from the WV mixing ratio imposes an adiabatic LWC profile through the cloud. This is, in general, hardly an assumption to be taken as standard, the departure from pure adiabatic conditions in marine stratocumulus being often of the order of 5-30%. Although I understand that the calculation of cloud subadiabaticity would be difficult and would probably require a separate study, this fact should be mentioned in the text.

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Pg 19591, In 15-17: was the cloud temperature an averaged value over each westward sub-leg? If so, that requires the cloud field to be homogeneous (temperature and cloud thickness) along each sub-leg. How can temperature be inferred from the RH profiles shown in Fig. 6?

Pg 19591, In 18-end of paragraph: for all cases when the cloud radar (again, what's the wavelength?) was not working, how could the authors be sure that the cloud layer was unique along the atmospheric column? LWP attribution by GVR must rely on the fact that the liquid water comes entirely from one cloud layer only. The risk is to retrieve significantly overestimated LWP and to provide wrong cloud microphysics.

Pg 19592, In 5-6: provide range/mean values of cloud thickness. What is used to define "well-mixed"? Potential temperature profiles? Please state it clearly.

Pg 19592, In 7: replace "clear-sky LWP" with "non-zero LWP retrievals in clear-sky conditions". See comments thereafter.

Pg 19592, In 23-24: Provide lidar vertical resolution. The 125-m threshold alone does not tell too much without the knowledge of the lidar vertical resolution.

Pg 19594, In 16-18: Do the authors mean that the cloud radar reflectivity can not be detected due to too small droplets near the cloud top? Do the authors infer large evaporation of droplets and reduction of droplets effective radius? If so, the cloud should be, at some extent, subadiabatic due to diluted free-tropospheric air, but the matching with the adiabatic LWP is almost 1:1. Please comment.

Pg 19595, Sect. 5.2: The term "clear-sky LWP" can be misleading and is a contradiction in terms. I would rather suggest changing to "non-zero LWP retrievals in clear-sky conditions".

Technical comments: Pg 19582, In 23-24: list citations in chronological order and apply to the entire manuscript.

Fig. 8: add "a)" and "b)" labels to the panels.

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