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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Role of updrafts in aerosol-cloud interactions: lidar observations of layered warm clouds over central Europe" *by* J. Schmidt et al.

Anonymous Referee #1

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Review of the article titled "Role of updrafts in aerosol-cloud interactions: lidar observations of layered warm clouds over central Europe" by Schmidt and coauthors for publication in the Journal of Atmospheric Chemistry Physics. The authors have used data collected by a vertically pointing Doppler Lidar and a Raman Lidar in Leipzig, Germany to study the aerosol-cloud-dynamics interactions associated with layered (stratocumulus) clouds. They have retrieved the aerosol extinction coefficient below the cloud base using the Raman Lidar data, while have observed the vertical air motion in the lower part of the cloud and below the cloud base using the data collected by the Doppler lidar. The data analysis suggests that a dependence of cloud drop number concentration on

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the aerosol number concentration within the updrafts in the lower part of the cloud. Additionally the results also suggest that the impact of aerosols on cloud drop number concentration within updrafts to decrease away from the cloud base. The primary conclusion of the article is that the vertical air motion (dynamics) needs to be taken into account while studying aerosol-cloud interactions. I agree with the premise of the article and think that it is worthy of publication. However, it can be vastly improved to make the results more robust. Additionally in the current state, the conclusions drawn from the analyses seem little far-fetched. Hence, I recommend this article for publication only after they have addressed my concerns below. I am particularly concerned about (c) below.

a) The authors have not shown any statistics of cloud boundaries, phase etc. I suggest the authors to characterize the cloud base heights, cloud top heights, cloud thickness, cloud fraction etc. The aerosol cloud interactions are highly dependent on cloud characteristics, the authors mention warm clouds yet do not provide any evidence. Additionally, I suggest the authors to tabulate the mean and standard deviation of these and the aerosol properties for each case. The location of your site suggests that most of the clouds might be mixed phase and possibly that is the reason why the Doppler lidar is able to penetrated 100 m above cloud base. This issue needs to be fully discussed.

b) One of the big issues in quantifying aerosol-cloud interactions is the lack of significant number of samples. I would like the authors to do an error/uncertainty characterization of the reported results. I understand that they have done it in Schmidt et al. (2014 JGR), but the sample size here is little bigger. A simple t-test should suffice to test whether the differences in ACIN, vertical velocity, cloud drop number concentration between updrafts and downdrafts are statistically significant.

c) The cloud dynamics needs to be characterized properly. The authors have stated that the resolution of Doppler Lidar is 70 m (Line 23, Page 31413). So then how were they able to report vertical velocities at a resolution less than that (0-30 m) in Fig 5 and 6. This makes me question the data and the data processing technique itself. Please

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list the instrumentation along with the resolution at which they operate. Also section 2 should include how you have calculated the statistics. How were the updrafts defined? By a simple sign of some threshold (0.25 m/s and -0.25 m/s) was applied.

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