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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Turbulent dispersion in cloud-topped boundary layers" *by* R. A. Verzijlbergh et al.

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We thank the reviewer for his/her comments, an will treat them point by point.

ad 1 We have altered the methodology to ensure that it is clear how we interpolated and that we did take the subgrid term into account. A thorough account of the LPDM is given by Weil2006 and by Heus2008, and we feel that it is not necessary to repeat those articles here.

ad 2 We did release all particles instantaneously, meaning that there were indeed 16 particles per grid box. The height is dependent on the case; we have added the release heights in this paragraph.

ad 3 There is only a mean horizontal wind in the stratocumulus case, which is fairly constant with height in the bulk of the domain, and does not seem to be a primary source of dispersion here. We have added this information to the case description of the stratocumulus simulations. More information can be found in the referred papers.

ad 4 We have corrected the formula, and clarified the text (also to better explain the reason behind the factor c_1)

ad 5 The formula should define a typical time scale, not a dimensionless time; corrected in the manuscript.

ad 6 We have added very schematic velocity pdfs for clarification; we believe that a mixture of actual results with these conceptual sketches could easily confuse the reader.

ad 7 We have replaced the graphs with color versions, which we hope are more clear. The qualitative message that arises from these graphs is similar regardless of the release height, however, so we feel that the same figures of more heights would not contribute much to the quantitative results presented in the following sections would merely lengthen the paper.

ad 8 Close to the borders of the boundary layer, the skewness of the plume is typically dominated by the fact that the air can only move away from the border. This trivial effect complicates the picture. Therefore, we have chosen not to show these skewnessess here.

ad 9 We have removed figure 5 and its discussion.

ad 10 Since we chose to provide schematic pdfs in the revision of Fig 1, the observed pdfs are still in this Figure. Moreover, this leaves a clear separation between velocity statistics and dispersion statistics.

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ad 11 In all probability, the relatively small horizontal domain of the smoke case leaves the signature of single, coherent, events on the particle dispersion. We have commented on this in the revised version.

ad 12a In a well-coupled case like this, release at the cloud/sub-cloud interface has mainly an effect to increase the dispersion both upward and downward. We have added a brief discussion to address this point.

ad 12b We have added a few comments to discuss the clear departures from the standard CBL-view in the stratocumulus case. However, as has been emphasized in the introduction and the conclusions of the revised manuscript, it is not the aim of this paper to address the role that the multitude of mechanisms that occur in the cloud (decoupling, shear, drizzle, entrainment and detrainment, for instance), since such an in-depth discussion would require an entire new paper.

ad 13 Time has been expressed in seconds in the revised manuscript

ad 14 The labeling has been corrected in the revised manuscript

ad 15a Given the relatively small area of the cloud compared to the environment, many of the characteristics of the entire domain also hold for a release solely in the environment. A release in the cloud is very similar to a release in a CBL updraft, and predominantly shows cloud venting properties, as discussed by for instance Chosson 2008. We discuss this very briefly in section 3.5.2 of the revised version; we feel that further elaboration on this topic would require much more detail, thus requiring a different paper.

ad 15b The difference in dispersion between CBL-alike subcloud layer and cumulus has already been shown in figure 11. Since the CBL and the cumulus dispersion differ so much, addition of the CBL-dispersion to figure 12 would dwarf the current content of the graph.

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ad 15c The skewness of the vertical velocity in the cloud layer is much higher than in the CBL since the cumulus updrafts are much more rare and much stronger than in the CBL; a typical cloud fraction in shallow cumulus convection hovers below 15 %. This increased skewness is typical for the bulk of the cloud layer. Heus et al 2008 shows a velocity pdf for the cloud, subsiding shell and the environment that shows the extremely long tail toward the positive velocities for cumulus. We have added this notion to the revised manuscript.

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 19637, 2008.

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