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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Updraft and downdraft characterization with Doppler lidar: cloud-free versus cumuli-topped mixed-layer" *by* A. Ansmann et al.

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Three cases are selected to study the structure of the convective boundary layer by means of the Doppler lidar. Two cases are cloudless and one is influenced by the formation and presence of shallow boundary layer clouds. The research stresses the differences in intensity and structure between clear and cloudy boundary layers. I found the results very interesting and well supported by the observational quantification of the turbulent structure. Moreover, the observational study adds new information on previous research. A positive point is that the results can be used for future modeling (for instance, large-eddy studies). However, the discussion level is a bit too phenomeno-

logical and descriptive. I miss therefore a more thorough physical reasoning of their findings. Below my major and specific comments:

Major comments

1.- Although the characterization and quantification of the coherent structures is very thorough, there is hardly any description on the surface forcing, thermodynamic structure (including the cloud structure) and boundary layer evolution (only and very briefly for the case 5 April 2005). In my opinion, it is necessary to include the magnitude and evolution of the surface forcing; the potential temperature, specific moisture and wind profiles and interrelate them to the thermal structure of the three cases described. The inclusion of the profiles will also allow showing the role of entrainment process on the intensity and form of the updraft and downdraft motions. Moreover, by adding and discussing a more complete and comprehensive information of the three cases, the research would become very useful for future large-eddy simulation studies.

2.- One of the main findings is related to the differences in the updraft and downdraft characteristics between clear and cloudy boundary layers. The authors do not provide any explanation on the reason of these differences. Do they occur on the sub-cloud layer (normally with very similar characteristics to the cloud free boundary layer? Were these differences related to the thermodynamic structure, role of entrainment in warming and drying the CBL, or to the surface forcing? These points should become clearer and making the necessary connections through all the paper. I also think that the reader will appreciate a conceptual explanation of these differences.

Specific comments

1.- p. 9222 It should be Lothon et al. (2006).

2.- p. 9224. Does the assumption w=0 hold during all the period? Why is it only checked in the early morning and late afternoon?

3.- P. 9224. It is necessary to include information on the spatial surface conditions dur-

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ing the AVEC experiment. The mesoscale circulation induced by surface heterogeneity can have a strong influence on the boundary layer dynamics and in the development of updrafts and downdrafts (see Patton et al, Journal of Atmospheric Sciences, 62, 2078-2097, 2005) and in cloud formation (see van Heerwaarden et al, Journal of Atmospheric Science 65, 3262-3276, 2008).

4.- p. 9225. Please include and discuss equation (6) in figure 2.

5.- p. 9228. What do you mean by “By keeping the mean wind speed at 4.2 m/s into account”?

6.- p. 9229. How do they know that shear is a small contribution? Furthermore there are relative recent papers (Pino et al., Journal of Atmospheric Science 60, 1913-1926, 2003; and Conzemius et al. Journal of Atmospheric Sciences 63, 1151-1175, 2006) which point out the relevance of shear in the evolution of the turbulent structure and the boundary layer dynamics.

7.- What was the role of wind in the other two cases?

8.- p. 9229. What is the criterion in estimating zi?

9.- p. 9230. The impact of the dust layer on the thermals in the case 18 September is hardly discussed. In addition of the explanation based on the wave activity, Do the updraft and downdraft characteristics decrease in intensity due to the decrease of the surface forcing or the stratification in the upper part of the boundary layer because of the aerosol absorption properties? In my opinion, these two factors can have a larger influence on the structure of the thermals that the wave activity (see for instance Yu et al. Journal of Geophysical Research 107, D124142, 2002)

10.- p. 9233. As mentioned it, it is necessary to distinguish between the updraft and downdraft characteristics within the sub-cloud layer and the cloud layer.

11.- Figure 11. Do the continuous line show the shallow cumulus? How is it estimated? In the text (p. 9233) is mentioned that the cloud base is 500 m? How is it estimated?

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Please provide all the necessary information to understand the figure

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Interactive Comment