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Atmospheric Measurement Techniques Discussions

Interactive comment on "Cirrus crystal fall velocity estimates using the Match method with ground-based lidars: a first case study" *by* D. Dionisi et al.

Anonymous Referee #2

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The main idea of this paper is to investigate the mean changes in the microphysical cirrus cloud properties and characterize life times and vertical structures. A "Match technique" was applied using two ground-based lidar systems with similar instrumental characteristics, connected by a trajectory tracking method in order to capture the same air mass twice, at two different times and locations.

The basic idea of the paper comes across, and the sections are well organized, including a comprehensive introduction and description of the Match technique, and results section. However, I have a number of major scientific issues, which cast doubts on the

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methodology and would require major revisions before the manuscript could be published in ACP. Also, there are formal (mainly language-related) issues, which make it sometimes difficult to understand the authors.

Major comments:

(1) How did you determine/choose the spatial Match condition of 150 km? You mention in the paper that this value strictly depends on the horizontal extension and variability of the cirrus. If you didn't have available any space-borne instruments information, on what basis you have chosen this value?

(2) This also triggers the question how representative it is to use temperatures and pressures measured 80 km away from one of the lidar stations.

(3) From the contour plots of the backscattering ratio one can see that the cirrus cloud at the end of the lidar session at OHP actually vanishes. So the question is whether at all you capture the same cloud and the same air mass. I guess not. So, here I agree with the first referee comment that I'm not convinced that the technique actually works. The results from Hysplit model show about 80 km distance of the air masses to the RTV site. Conversely, the lidar image at RTV shows that the "quasi-stationary" time period is at best 1 hour long, which with ca. 100 km/hr horizontal wind speed means that the "quasi-stationary" length of the cloud is possibly 100 km. Therefore, I think the match distance of 80 km is too large to provide a meaningful match.

(4) I have also to agree with the first referee comment concerning the importance of mesoscale fluctuations. They are not mentioned at all in the paper and for sure they would have a large effect on the cirrus properties, therefore on sedimentation velocity. Some comments about this topic need to be added.

(5) Even when assuming that there is no problem with the match, how do you exclude that new ice nucleation could have happened below the cloud, moving the lower cloud edge to lower altitudes? You determine a model isentropic shift of 100 m upwards, and

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could the corresponding cooling of 1 K have led to new ice formation? If that were the case you would misinterpret a shift in the lower cloud edge as sedimentation, while in reality it was nucleation. Arguments need to be provided that exclude this possibility.

(6) Finally, I do not understand the behavior of the trajectories shown in Figure 4. I look at the narrow time range 20-21 UT on 13 March. In this period the black air parcel rises by 200 m, and if the motion was adiabatic, I would expect the temperature to drop by 2 K. Instead, temperature increases by 1 K. Why? The only reason might be release of latent heat by condensing ice, but this can hardly overcompensate the adiabatic temperature decrease. Possibly this behavior is due to significant mixing processes of the air parcels happening exactly when the air crosses the Sea Alps and is exposed to orographic perturbations? This needs to be discussed in the manuscript.

Smaller issues:

- In general, the paper would have benefitted from a native speaker's reading. There is a (too) large number of lingual imprecisions.

- There is a typo in one of the author's name (Kekchut instead Keckhut). This should be corrected.

- Abstract: It is not clear what the "r" in v_r stands for. Later this symbol changes to v_s.

- Abstract: There is a confusing, long sentence, "These systems have similar. . .". Probably separating the clauses would help, e.g. "Two lidar systems with similar instrumental characteristics are located at the Observatory of Haute Provence (OHP, 43.9 deg N, 5.7 deg E) in France and at Rome Tor Vergata (RTV, 41.8 deg N, 12.6 deg E) in Italy. At a distance of approximately 600 km they provide systematic measurements for many years. . ."

- Abstract: What is "cloud shape"? (And how is it used?)

- Abstract: What is a "balloon size particle"?

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- Intro: What is “ice crystal fall”?

- The quality of the plots is generally bad (fuzzy).

Interactive comment on Atmos. Meas. Tech. Discuss., 5, 5787, 2012.