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Atmospheric Measurement Techniques Discussions

Interactive comment on "Determining stages of cirrus life-cycle evolution: A cloud classification scheme" *by* Benedikt Urbanek et al.

Anonymous Referee #3

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Review of 'Determining stages of cirrus life-cycle evolution: A cloud classification scheme' by B. Urbanek et al. submitted to Atmos. Meas. Tech.

This manuscript describes the use of airborne lidar measurements of water vapor to demonstrate a cirrus classification scheme that is able to identify the evolution stages of the cirrus life-cycle using primarily relativity humidity with respect ice thresholds deemed from the literature. This is a interesting idea that would be useful in the analysis of airborne and remotely sensed cirrus clouds and would put measurements of cirrus microphysical properties in context with cirrus lifecycle. Overall the manuscript is well written and well organized, but I have some concerns about the data as presented. First, the uncertainty in the computed relative humidity measurement is only loosely mentioned and should be considered in the context of the classification scheme. Second, I have some concerns about the generating mechanism described in this case.

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I maybe misinterpreting the data as it is represented in the figures. This may influence the lifecycle, formulation, and interpretation of the classification scheme. These can likely be easily addressed by clarifications from the authors. I recommend this manuscript to be published after these concerns are addressed.

Specific Comments

p. 2 L19-25: Heymsfield 1975 was the first to illustrate and document the vertical and dynamical structure of cirrus uncinus clouds and should be stated as such in this paragraph. I am not sure I would agree with the statement '. . .where individual clouds may show strongly different distributions.' It is the cloud type or generating mechanism that will influence this distribution (i.e. anvil, synoptic, in situ generated, orographic). There have been a number of studies (Sassen, Mace, Protat) that have looked at these differences.

p. 2 L19 and p. 7, L27: The Comstock et al. 2004 study was for data over Oklahoma, U.S.A., not France.

p. 4 L20: The stated uncertainty in the relative humidity with respect to ice (RHI) is 10-15%, which is quite large. Your proposed classification scheme relies on thresholds for RHI (Fig. 1, Table 1). There is currently no discussion of how this uncertainty impacts the classification scheme. Clearly a 10-15% uncertainty would have quite an impact on this thresholding approach. This is a major issue that needs addressing.

Vertical velocity plays a key role in the initiation and evolution of cirrus clouds. Did you consider including the in situ vertical velocity measurements from the HALO in your classification scheme? This could help compensate for the errors in the RHI data.

p. 5 L32: It is stated that high dust concentrations were expected. What is the evidence for this statement? Did you look at the lidar ratios or the in situ aerosol data? Please provide some quantitative justification for this statement. Later, depolarization ratio is used (P. 6, L25) but still there is no reference, nor are typical values of dust mentioned.

Fig. 2b - SEVIRI image: Can you provide the time at the northern most point on the white flight track line and also the southern most point? This will help put the lidar profiles in context with the satellite data (I assume the northern most point is roughly 14:20 UTC). Also, I am wondering what type of cloud the green color is associated with? Are these convective clouds? The reason I ask is that the lidar profiles in Fig. 3, 4, and 5 suggest that the clouds are thicker (3-4 km deep) than what I would expect in orographic lee clouds (∼1-2 km deep) and the cloud looks to be more stratiform in its morphology. This suggests to me the cloud is a cirrostratus or anvil, that may have some gravity wave influences from the mountains. This would influence your discussion and conclusions about the formation and evolution of the cloud since anvil cirrus is formed in a much different environment than synoptic or in situ/orographic cirrus. Please consider the possibility if I am interpreting the figure appropriately. Adding a brightness temperature scale to the SEVIRI image would be helpful.

P. 7 L25: '. . .probably caused by large-scale descent.' The ECMWF vertical velocity data could provide some clues to the large-scale dynamics.

Editorial: p. 2 L16: loose -> lose p. 2 L30: ascends -> ascent p. 5 L14: 'a uncertainty' -> 'an uncertainty' p. 5 L18: represent -> represents

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