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Atmospheric Measurement Techniques Discussions

Interactive comment on "Identification of snowfall microphysical processes from vertical gradients of polarimetric radar variables" *by* Noémie Planat et al.

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The authors of the manuscript suggest to use the signs of the vertical gradients of Z and ZDR to identify three key microphysical processes of snow formation: depositional growth, aggregation, and sublimation. Their intent is to recognize particular processes rather than to perform hydrometeor classification which was in the focus of various studies during last two decades. Such motivation is great but I am afraid that the methodology is too simplistic to reflect the complexity of ice / snow formation in real clouds. I am particularly concerned about the notion that any positive vertical gradient of Z is a manifestation of sublimation. Nonmonotonic vertical profiles of Z in ice parts of the clouds are very common. For example, they can be attributed to a "pulse nature" of the ice formation near the tops of the clouds when different pockets of ice generated

aloft sediment one after another producing some periodicity in the vertical profile of Z. Deposition occurs due to supersaturation with respect to ice, and sublimation takes place where air is undersaturated with respect to ice. Therefore, these processes are dictated by the spatial distribution of humidity (as well as temperature) within the clouds. Unfortunately, the authors do not connect the results of radar identification with the thermodynamic structure of the atmosphere in the two cases examined. Referring to the papers of Vignon or Gehring et al. is not sufficient. My suggestion is to modify Figs. 5 and 6 by overlaying the temperature isotherms and a contour of the RHi = 100%, so that the reader will be able to check consistency between the classification results and atmosphere stratification. I also recommend to add similar figures for ZDR. My another concern is that the computation of the gradients is performed along the vertical rather than along the Lagrangian fall trajectories of snowflakes. The paper is overburdened with a secondary stuff which may not be very relevant to the primary idea of the study such as Tables 1 and 2 and Figs. 2 and 3. It may not be necessary to specify the altitudes at which CG, AR, and SUB dominate for the two analyzed events in the abstract and conclusions. These are not typical height intervals where the three processes predominantly occur in the Antarctic region or Korea and this is not a climatological study where such generalization is appropriate. Lines 190 – 195. A primary reason for ZDR to decrease with aggregation is the reduction of the ensemble density of snowflakes (because larger snowflakes have lower density) and more chaotic orientation of aggregated snowflakes. Change of the particles shape (if any) plays a secondary role. Lines 435 – 440. The density of aggregated snowflakes is inversely proportional to their size. Therefore, the ensemble density of snowflakes decreases in the course of aggregation.

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