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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Statistics of vertical velocities in supercooled cloud layers over Leipzig and Praia measured with Doppler lidar" *by* Johannes Bühl et al.

Anonymous Referee #3

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This paper described the vertical velocity statistics in supercooled shallow cloud layers for mixed-phase and liquid-only clouds over a sub-tropical site and a mid-latitudinal site based on ground base remote sensing. I appreciate the author analyzed statistics of vertical velocities over both sites, which is interesting for me, however this paper is not suitable for publishing in ACP for two reasons:

1. The main conclusion of this paper is "other factors besides cloud dynamics are responsible for the differences in ice formation efficiency reported previously for both sites." Also in the introduction the author posted the question "if this apparent effect of aerosols on ice formation could also be attributed to differences in vertical wind statis-

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Discussion paper

tics within mid-latitudinal and tropical cloud layers." I don't know why the author want to study the relationship between vertical wind statistics and ice formation. Based on classical nucleation theory, ice nucleation mainly depends on two variables temperature and ice nuclei efficiency. I don't know why ice nucleation should be related to vertical velocity statistics, and I didn't see any literature about this topic before. If this is "new physics", the author should address why they want to study this physically, not only just post a question without any base.

A more physically-based research topic for me is to study the source of ice nucleus. Figure 1 (adapted from Kanitz 2011) is very interesting for me, where at the same temperature, for example at -30, clouds at Praia and Punta show lower fraction of ice containing clouds than Leipzig. This study shows similar results as shown in Figure 3 a and b. Figure 3b shows that even at -33C (240 K), the fraction of ice containing clouds is still less than 50%. The only physically-based reason I can think about is that those liquid-only cloud don't have efficient ice nucleus. Because -33C is already a very low temperature for mixed phase cloud, as long as moderate efficient ice nucleus exists in those cloud (e.g., dust with freezing temperature around -25C) , ice nucleation would occurs. As far as I know, ice nucleation doesn't depend on vertical velocity statistics. It means that ice nucleation always occurs as long as supercooled water with dust inside stays at -33C, no matter whether it is in still environment, or in strong turbulence.

2. This paper compared several variables between two sites, including cloud top temperature, cloud top height, wind speed, wind direction, mean vertical velocity, STD, SKEW, KURT, however I didn't see enough discussions about the physics. For example, Figure 3h shows that more fraction of mixed-phase clouds over Praia when blowing westerly wind. So is it because the temperature is colder when blowing westerly, or is it lack of ice nucleus when blowing easterly?

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