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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Growth-deviation model to understand the perceived variety of falling snow" *by* J. Nelson

Anonymous Referee #2

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General Comments/Suggestions:

The topic of snow crystal variety has had a long and varied history. Whether one considers the seventeenth century observations of Kepler, Descartes, and Hooke, or the many scientific investigations of the twentieth century, one is forced to recognize not only the complexity of the snow forms themselves, but also the difficulty of studying the problem. The author in effect breaks the ice and opens up a new line of investigation. As my comments below show, as do those of Referee #1, the paper needs modification, but it warrants, I believe, publication. Bringing this article to a large audience may stimulate others to advance the methods.

The subject of snow crystal diversity is more than just a matter of human curiosity.

Rather, it is needed as a direction toward understanding the physical origins of the many so-called irregular forms found in aircraft studies (e.g., Korolev et al., 2000).

Specific Comments:

a. Simplifying assumptions are necessary for making progress in a topic as complicated as quantifying snow diversity. However, as Referee #1 discussed, the assumptions must be clearly identified and justified to the extent possible. A good attempt was made in Section 2.4 to justify the assumption that the humidity can be ignored as an independent factor, but the argument could be strengthened further perhaps by providing a counter example, growth of ice at sub-water saturation. Just as the author has restricted attention to plate-like crystals (Section 2.3), so too could he stipulate that the results apply only to obviously liquid-rich mixed-phase clouds.

b. Having shape diversity related to thermodynamic entropy makes sense. Could the idea be developed a bit more deeply? I find the use of the term variety (p. 4410, L. 3) in this context confusing. Is this word really synonymous with diversity?

c. Growth on the prism face, as shown in Fig. 3, appears to be symmetric about the temperature (-14.8 deg C) of maximum r. It was not initially clear how growth on one side of the maximum can be distinguished from that on the other side. Might some clarification be helpful, even before the discussion in Section 6.2?

d. The paper makes use of many symbols, and these symbols are used freely in the text. They in fact become integral to the discussion and flow of ideas. A list of mathematical symbols, including subscripts, would be helpful.

Technical Corrections:

Title: The word perceived has a subjective connotation. Would the word observed not be more appropriate?

Abstract, Line 6: Consider rewording the sentence to make it less personal. For example, Distributions of these deviations were derived from high-resolution measurements.

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Page 4409, L. 9: Replace determined with discussed, or some other word. The previous sentence proclaimed that the cause remains unknown, so it does not seem appropriate to now claim that this paper will actually determine it.

P. 4410, L. 7, 8: Rewording this sentence to be positive (rather than double-negative) will make the meaning clearer. Consider the following: ... as distinguishable if superimposing one image over the other (...) yields an observable difference.

P. 4410, L. 17: Grammar: results, not result.

P. 4411, L. 6: How is relative humidity defined? Should these words be followed by with respect to ice, or is the conventional definition with respect to liquid meant? Please clarify.

P. 4412, L. 3: Here (at the end of the line) and throughout the manuscript, please avoid using this without further specification. To what does this refer?

P. 4412, L. 4: If the initial crystal is characterized solely by the diameter of the frozen droplet, but the implied assumption is made that the crystals grow as plates (tabular forms), are polycrystalline freezing events being ignored? Polycrystalline freezing is likely to be common toward the low end of the temperature range being considered. Please clarify your viewpoint and justify any assumptions made.

P. 4412, L. 24: The last part of this sentence may need to be reworded. Consider … airflow and thus have the greatest drag.

P. 4413, L. 22: I presume that the clause is referring to the variable v, in which case the verb should be singular (is).

P. 4423, L. 2: Please delete the adjective well-known. The birthday paradox is not necessarily well known to all readers, and knowing about it before reading this paper is irrelevant to the arguments. Citing a reference, if one exists, would be a suitable addition to this paper

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Interactive Comment

P. 4433, Fig. 3: The curves should be distinguished better and each labeled appropriately.

References

Korolev, A. V., G. A. Isaac, and J. Hallett, 2000: Ice particle habits in stratiform clouds. Quart. J. Roy. Meteor. Soc., 126, 2873-2902.

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 4407, 2008.