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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Charging of ice-vapor interfaces" *by* J. Nelson and M. Baker

Anonymous Referee #2

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General Comments

With this paper the authors are attempting to explain a broad range of phenomena related to ice and its behavior in the atmosphere. While one may well appreciate the authors' desire to understand the underlying physical causes of thunderstorm electricity and diverse other environmental phenomena, the task is enormous, complicated, and not really treated satisfactorily here. The topical organization of the paper is straightforward and acceptable, but not all components of the subject are treated consistently. In my mind, the manuscript needs substantial modification before it is ready for acceptance as an ACP paper.

An example of the inconsistency with which the subject matter is treated shows up on pages 45 and 46. The first paragraph of Section 3 introduces (via Eq. 1) the continuity relationship for D defects in reasonable detail. Yet, the other equations needed for completion are give virtually no treatment at all (in the final seven lines of the same

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paragraph). Furthermore, it is admitted that difficulties were encountered in trying to solve the complete set numerically. Is it possible that the set of equations was not properly formulated or even consistent with the physical situation being simulated? One cannot begin to sort out the possible causes of the problem without suitable exploration of the physics and mathematics. This one paragraph alone calls into question the credibility of the model on which the present manuscript rests. In my opinion, it is premature to go forth with this paper until the simulation model of surface charging is adequately addressed. A separate paper on this topic may well be what is needed.

Given the theoretical nature of the first half of the manuscript, the latter parts seem especially empirical, qualitative, and speculative (e.g., p. 51 and 52). Overall, too many disparate ideas and approaches are blended together to make for satisfying reading. The topics presented are all scientifically interesting and suitable for ACP, so I hope the authors will continue this line of research and find the best ways to express their results.

A few specific comments are offered below for consideration during revision.

Specific Comments

The introductory paragraph starts out with several unnecessarily long sentences. The second sentence in particular could be broken into two separate thoughts quite readily: "Such charging ... of thunderclouds. Surface charging can also modify ... wind-blown snow (Schmidt, 1982)."

I understand that Bjerrum defects have electrical implications (as mentioned at the bottom of page 43 and "explained" in Fig. 1), but these orientational defects are not ions in the same sense that H3O+ and OH- are. It is both conventional and convenient to designate Bjerrum defects simply as D and L defects. I suggest dropping the + and - superscripts.

Figure 1 presents a nice way of visualizing the movement of defects in ice. However, in

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the present context, no "H atom" is involved. Hydrogen atoms are electrically neutral and could not influence the electrical properties of ice in any way. The entity in question is the proton, which may be designated as H+. The word "proton" is preferred in text, but "H ion" is acceptable.

Allusions to "classic" (page 44) or "well-known" (page 44) do not alleviate the need for citing appropriate references.

An appendix defining the mathematical symbols would be very helpful.

Interactive comment on Atmos. Chem. Phys. Discuss., 3, 41, 2003.

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