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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Air pockets and secondary habits in ice from lateral-type growth" *by* Jon Nelson and Brian Swanson

Anonymous Referee #3

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This paper reports an experimental study of ice growth from vapor in air, with a focus on the formation of air pockets and secondary habits. It ultimately looks to explain a wide variety of experimental observations on lateral-type growth and looks to relate the observed behaviour to a surface flux of water molecules, which the authors call "adjoining surface transport" (AST). As a non-expert this specific field (experimental studies of ice growth from vapor), I found this paper rather difficult to read, and I felt I learned very little in reading it. I found it to be not well written, and a bit of a jumble of data and ideas with no clear narrative. Hence, I think it could be considerably improved by shortening (i.e. less would be more here) and organizing the material better. Also, the paper often seems to read more like a review, where it was often unclear where the authors' work started and ended. Perhaps after considerable revision with work might

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Discussion paper

be appropriate for publication.

I was also unable to make sense of their physical model. It has now be very well established that the surface of ice features a layer water molecules that exhibit mobility (this is sometimes referred to as the quasi-liquid-layer – QLL; see Rosenberg, Phys. Today 2005, 58, 50; Li and Somorjai, J. Phys. Chem. C 2007, 111, 9631; Björneholm et al., Chem. Rev. 2016, 116, 7698). While different experiments report different thickness for the QLL, they generally agree on its presence, and that its thickness (and other properties) are strongly temperature dependent. One would expect any surface flux to then depend on the thickness of the QLL and the mobility within the layer (which will also be strongly temperature dependent). Thus, AST should exhibit strong temperature dependence, and one would expect to observed "protruding growth" only when the effect of AST is large compared with the rate of vapor deposition (which will depend on the level of supersaturation). Yet, the authors do a rather poor job of characterizing the conditions, temperatures and supersaturations, in the reported experiments. Moreover, in a carefully designed set of experiments (when one varies one of these, for example), it should be possible to see the effect become manifest. I would find such a set of data much more convincing. As a minimum, the authors should do a much better job of describing the conditions for each experiment, and then comparing and contrast the behaviour on the basis of these conditions.

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