Atmos. Chem. Phys. Discuss., 11, C6376–C6377, 2011
www.atmos-chem-phys-discuss.net/11/C6376/2011/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Cloud condensation nuclei as a modulator of ice processes in Arctic mixed-phase clouds" *by* S. Lance et al.

Anonymous Referee #2

Received and published: 13 July 2011

The paper could be published as-is. I have a couple of comments that the authors may wish to consider, but, overall, the paper is well written and well argued; the data are well presented and support the conclusions.

I have some trouble with the following sentence, which appears at the bottom of page 6753 (lines 25-26): "Our observations suggest that, while IN clearly must be present for ice to form in these clouds, IN concentrations are not the primary limiting factor for ice formation." If I am following the logic correctly, the authors conclude that IN must be present because there's ice and it's not cold enough for homogeneous freezing to have occurred. I agree with that. To go on to conclude that IN concentrations are _not_ the "primary limiting factor" is a stretch, in my opinion. Given the data in this paper, I would have concluded that there's a process responsible for ice formation that we

don't understand very well. -14 °C is quite warm! What's causing freezing at those temperatures? The authors seem to say that they don't really understand what it could be. The series of papers by Hobbs and Rangno state essentially the same thing.

I have trouble finding support for anything that will catalyze freezing for temperatures that high. (Of course, stuff like AgI would give you freezing temperatures like that (or warmer), but I doubt there's much AgI in most natural clouds.) For example, Luond et al. (JGR, 2010) found that 50% of droplets containing submicron kaolinite dust froze only at 240 K or colder – and kaolinite is one of the better nucleators that we know of. What's catalyzing freezing at temperatures that high? I don't think we know.

There are two mysteries in the phenomena that the authors describe. The first is that you see freezing at temperatures as high as -10 to -14 °C. The second is that you only see freezing at those temperatures when there are large droplets present. I don't think the data presented in this paper support the conclusion that IN concentrations are not the limiting factor.

Interactive comment on Atmos. Chem. Phys. Discuss., 11, 6737, 2011.