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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Depositional ice nucleation onto hydrated NaCl particles: a new mechanism for ice formation in the troposphere" *by* M. E. Wise et al.

Anonymous Referee #2

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The paper by Wise et al. addresses the phase changes that occur under low temperature with pure sodium chloride particles. In particular, the paper presents convincing results that indicate that a hydrate of NaCl effloresces below a certain temperature in preference to the anhydrous crystal. Also, it is shown that ice deposition occurs preferentially onto the hydrate than onto the dry crystal. I have only minor comments (below). In particular, the paper is clearly written, the experiments take advantage of a Raman microscope technique to identify the composition of the particles, the authors are all experienced in such measurements, and the results are directly relevant to phase change and ice nucleation in the mid and upper troposphere.

Comments/questions: 1. In the Abstract, I suggest adding the size of particles that are used and referring to how ice deposition onset is defined. In particular, there is no unique onset value for deposition ice nucleation, being dependent upon particle size, total surface area, numbers of particles that are being observed, observation time, etc. The onset RHs for deposited particle experiments such as that used here, with particles a few microns in size, tend to have substantially lower ice onset supersaturation ratios than do continuous flow diffusion chamber results that use smaller particles. This is important because modellers may be tempted to take the value quoted in the Abstract at face value, without noting the context within which the experiments were conducted.

2. A few experiments details: How was the quartz substrate made hydrophobic? Does the Raman laser probe the full depth of the particle? How is the RH known? I realize some of these points may be in earlier publications but just a sentence on each would help the reader.

3. P23146. Concerning water uptake below the DRH for NaCl. I seem to recall that George Ewing at Indiana was the first to observe this. If so, then his work might deserve a reference.

4. P23148. What is meant by the "cracking of a particle"?

5. Figure 8. This comment follows on from Point 1 above. The definition of ice onset needs to be presented in the Figure caption and the associated text.

6. In the Dubessy et al. 130K work that measured the spectrum of the dihydrate, how was it known that the material under study was the dihydrate? i.e. is it known that both your experiment and the Dubessy et al. work are indeed looking at the same substance?

7. P23153. Typo: Q_exp or ext?

8. P23154. Why are the radiative forcing calculations done at 532nm? It would be a much more convincing calculation (and presumably not so hard to do), to simply do

the calculation over all solar visible wavelengths, weighting the results by the solar flux at each wavelength at the top of the atmosphere. As presented, it is a bit unusual, showing the Mie resonances in Figure 11 that arise because the calculation was done at only one wavelength and particle size. These resonances are not easily observable in the atmosphere. To have more atmospheric relevance, I strongly suggest that a more representative calculation be done.

9. Figure 10. On that note, providing a few more details about the trajectory analysis would also be useful. As presented in the paper, there is really not much detail given for an atmospheric dynamics novice to know how the calculation was done.

10. Just wondering ... was it ever observed that ice nucleation coud induce conversion of an anhydrous particle over to a hydrate? i.e. Did the Raman spectrum ever change after a cycle of ice formation and evaporation?

Interactive comment on Atmos. Chem. Phys. Discuss., 11, 23139, 2011.