

## ***Interactive comment on “Ice nucleation properties of fine ash particles from the Eyjafjallajökull eruption in April 2010” by I. Steinke et al.***

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Received and published: 14 July 2011

Review of Steinke et al.

Steinke et al. present an interesting study of the ice nucleating ability of ash from the recent Icelandic volcanic eruptions in 2010. They use the well established AIDA cloud simulation chamber to quantify ice nucleation in both the immersion and deposition modes and parameterise the results according to the singular model. This paper is suitable for publication in ACP once a few minor points are addressed.

1) P 17670, ln 1-5. The ice active surface site density was first employed by Connolly et al. But, it has its roots in Vali's work who expressed a comparable quantity in terms of per unit volume rather than per unit surface area (see references in Connolly). This

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should be mentioned. Also, in the list of papers making use of this model, Murray et al. (ACP, 11, 4191–4207, 2011) has also been omitted.

2) P17673, ln 15,16. Water saturation is not reached during the second experiment – the sentence as it is written implies it is.

3) P17674, ln 1-2. I think 'droplet concentration' is intended rather than 'particle concentration'.

4) P17674, ln 15. 'long run' what does this mean/refer to?

5) P17674, ln 25 (and also later on P17677). How uncertain is the estimate of surface area based on the assumption of spherical particles. This is critical for the derivation of  $n_s$  values. The ESEM pictures clearly show non-spherical particles, how much larger might the actual surface area be? In other work researchers have used gas adsorption measurements to quantify ice surface area and then derive  $n_s$  values from this (Murray et al., ACP, 11, 4191–4207, 2011). This takes into account the non-spherical nature of particles. It is therefore important to quantify the uncertainty here in order to compare the data sets.

6) P17676, ln 4. What is the density based on?

7) Section 3.1. What is the physical state of the volcanic ash? Is it crystalline or amorphous? If crystalline then it may be comparable to mineral dusts from arid regions, but if amorphous then comparison with studies of ice nucleation on amorphous solids from the AIDA chamber would be relevant. According to the lattice match idea, amorphous solids wouldn't represent effective ice nuclei since they have no organised structure.

8) P17677 ln 25. Uncertainty in RH with respect to water is discussed here, but in the figure RH with respect to ice is used. It would make more sense to stick to RH<sub>ice</sub>.

9) P17678, ln 10-15. This discussion would be helped by an example plot of  $n_s$  vs T.

10) P17679, ln 5-15. Reference to an unpublished manuscript is unacceptable here.

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Justify why eq 1 is a good approximation for the determination of  $n_s$  or use the established method. The other authors who have used this (which are published) used a different set of equations. Are the values derived here really comparable?

11) P17679. The singular model is used here and it is stated that the time dependence is neglected. Some studies have shown that time dependence can be significant (e.g. Murray et al., ACP, 11, 4191–4207, 2011). What justification can be given to support the assumption for volcanic ash?

12) P17681, ln 5-10. There are two other studies which report  $n_s$  values in a form which can be compared to the present study, which have been omitted. Both of these studies were done with different instruments, and highlights the benefit of  $n_s$  values for comparison of different ice nucleating species from different studies. Neidermeier et al.(2010) report  $n_s$  values for ATD and Murray et al.(2011) report values for the single mineral kaolinite. These should be referred to. In fact, it may help the discussion on p P17683 to include a comparison plot of  $n_s$  values from different experiments rather than simply discussing it in words.

#### Technical points

1) The referencing to the figures is incorrect throughout the manuscript.

2) The term 'British Islands' refers to the United Kingdom of Great Britain, the channel islands and the isle of Mann. The terms British Isles which refers to the geographical region which includes Ireland might be more appropriate. For simplicity perhaps just say Northern and North Western Europe.

3) I think it is helpful to create figures which can be read in black and white if possible. In Figures 5 and 7 this could be done by using different symbols as well as colours to distinguish between data.

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Interactive comment on Atmos. Chem. Phys. Discuss., 11, 17665, 2011.