Reviewer comments for manuscript acp-2015-512: Size-resolved measurements of ice nucleating particles at six locations in North America and one in Europe

General remarks: The manuscript by Mason et al. (2015) presents ground-based, size resolved ice nucleating particle (INP) number concentration measurements at seven different locations in North America and Europe. Measurements were conducted with a micro-orifice uniform impactor - droplet freezing technique (MOUDI-DFT) at temperatures of -15, -20 and -25°C. The authors observed a great fraction of INPs at sizes larger than 1 µm (91 % on average at -15°C). The results are compared to earlier observations of INP size distributions as well as to reported INP – aerosol correlations. The results of the study contribute to our understanding of ice nucleation in the atmosphere and the manuscript is thus of interest to the readers of Atmospheric Chemistry and Physics.

I recommend this manuscript for publication after the following adjustments are addressed.

The manuscript is very well written and the quantification of INPs larger than 1 µm and 2.5 µm, respectively, is very interesting. Generally, I think, the topic of uncertainty is addressed too little in the manuscript. Measurement uncertainties of the MOUDI-DFT and of equation (1), used to calculate atmospheric INP number concentrations should be given and discussed more. For instance, what are the average and standard deviation of the blank freezing temperature? As the observed INP concentrations are rather small as well as the sample size (especially the marine and agricultural sample), uncertainties should be treated even more carefully. Also, the atmospheric relevance of the ground-based observations is only discussed very briefly in section 4. Since the manuscript is making a rather strong statement by claiming earlier observations (e.g. by CFDC techniques) underestimated total INP number concentrations, the mentioned wet and dry deposition processes of supermicron particles during atmospheric transport may be discussed earlier in the manuscript and in more detail.

Specific remarks:

p 20523, l 10 and l 12: What are the standard deviations of the average percentages?

p 20524 l 29: The causal connection of the first and last part of this sentence is not clear to me (need for INP size distribution for aerial dispersal of fungi?). The sentence should be rephrased and the aerial dispersal part might be deleted.

p 20525 l 125ff: Here, the issue of atmospheric relevance of surface based measurements of INP number concentrations could be addressed.

p 20531 l 6ff: Here, more details on the uncertainty of the correction factors could be given as well as the average freezing temperatures of blank measurements.

p 20531 l 11: Quantify what is meant with ‘rare’, e.g. give a detection limit.

p 20531 l 21ff: The ice nucleation mode and INP size ranges of the mentioned studies should be provided.

p 20532 l 14: Does it play any role that air flow came off the ‘eastern’ coasts of ‘continents’. Consider deleting ‘eastern’ and ‘of continents’.

p 20536 l 5ff: A comment on the physical plausibility of the differences reported by Rosinski et al. (1986) between condensation and immersion freezing would be interesting and helpful.

p 20536 l 9: The sentence in brackets is not fully clear to me.

p 20536 l 22: The Rucklidge (1965) study could be included in the table since the '86 % of INP smaller than 1 µm' are a lower limit considering that always the largest aerosol particle found in the residuals was assumed to be the INP. This means that in this study the majority of INP was clearly found to be below 1µm which is in contrast to the current observations.

p 20536 l 23ff: A comparison to studies of ice crystal residuals size distributions (e.g. Seifert et al. 2003 or Mertes et al. 2007) as well as to laboratory studies of aerosol particle size-dependency of ice nucleation (e.g. Welti et al. 2009) would add to this paragraph.

p 20553 Table 1: The elevation should be given both, a.s.l. and a.g.l., for all locations to be able to compare them.

p 20556 Figure 2: The standard error of the mean given in this figure appears in some cases rather small to me compared to other measurements of ambient INP concentrations. Is the calculation done in Poisson statistics or for a normally distributed error? A comment on this could go into the discussion of the uncertainties.

Technical remarks:

p 20523 l 17: replace 'ice nuclei' with 'INP'

p 20525 l 10 - 11: insert 'D50' before ≤ 2.4 and ≤ 0.75 µm

p 20525 l 14: is 'size' really what's meant here? Consider replacing 'size' with 'sites'

p 20532 l 4: replace 'ice nuclei' with 'INP'

p 20537 l 12: replace 'ice nuclei' with 'INP'

p 20538 l 20: insert 'would like' before 'to thank'

p 20553 Table 1: The ordering of the sampling sites could be the same as in the plots

References:

S. **Mertes** , B. Verheggen , S. Walter , P. Connolly , M. Ebert , J. Schneider , K. N. Bower , J. Cozic , S. Weinbruch , U. Baltensperger & E. Weingartner (2007) Counterflow Virtual Impactor Based Collection of Small Ice Particles in Mixed-Phase Clouds for the Physico-Chemical Characterization of Tropospheric

Ice Nuclei: Sampler Description and First Case Study, Aerosol Science and Technology, 41:9, 848-864, doi:10.1080/02786820701501881

M. **Seifert**, J. Ström, R. Krejci, A. Minikin, A. Petzold, J.-F. Gayet, U. Schumann, and J. Ovarlez (2003) In-situ observations of aerosol particles remaining from evaporated cirrus crystals: Comparing clean and polluted air masses, Atmospheric Chemistry and Physics, 3, 1037-1049, doi:10.5194/acp-3-1037-2003

A. **Welti**, F. Lüönd, O. Stetzer and U. Lohmann (2009) Influence of particle size on the ice nucleating ability ofmineral dusts, Atmospheric Chemistry and Physics, 9, 6705-6715, doi:10.5194/acp-9-6705-2009