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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Size-resolved measurements of ice nucleating particles at six locations in North America and one in Europe" *by* R. H. Mason et al.

Anonymous Referee #3

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Interactive comment on "Size-resolved measurements of ice nucleating particles in six locations in North America and one in Europe" by R.H. Mason et al.

The manuscript reports immersion-mode INP number concentrations as a function of aerodynamic size at six ground sites in North America and one in Europe. Size-resolved particle samples were collected using a model 110R or 120R Moudi. The ice-nucleating ability of particles was then determined by a microscope–based immersion freezing apparatus (MOUDI-DFT technique). The authors found that both supermicron and coarse mode aerosol particles were a significant component of the INP population. The paper is well written and of interest. I suggest publication after the following few

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Interactive Discussion
Discussion Paper

comments have been addressed.

General remarks

A) It is known that not all particles colliding with a plate adhere to it. As offline ice nucleation analysis cannot coat (e.g. with vacuum grease) the substrate located on the impaction plate, particle rebound in the Moudi impactor should be discussed. Generally speaking, the rebound increases with aerosol diameter and decreasing air relative humidity. The average relative humidity values (r.h.) in the seven locations range from 48% to 97%. Therefore, the rebound should differ in the sampling sites. At Amphitrite Point, where r.h. during sampling was 97%, the rebound should be much lower with respect to Colby, where the r.h. was 48%. In marine air the bouncing should be lower due to hygroscopic particles.

A) The interest of the paper would be enhanced if particle number concentration and size distribution were considered in each site during sampling. This information could allow calculation of the ratio between INP number concentration and the corresponding particle concentration in each size bin, and the correlation between INP number concentration and aerosol.

C) Hygroscopic particles sampled in marine sites form droplets on the examined area sooner than insoluble particles (which are considered efficient ice nuclei). Could this feature influence the INP concentrations measured with the MOUDI-DFT technique?

D) Paragraph 2.2: Size-resolved INP number concentrations

This paragraph should be broadened by summarizing the most important points of the technique used, reported in the paper of Huffman et al. (2013) and Mason et al. (2015). For instance, the total area of each stage and of the analyzed area should be indicated, and the problem of the non-uniformity of aerosol deposit in each stage of the MOUDI should be addressed. An additional point should be clarified. Huffman et al. (2013) found that the maximum concentration of IN detected for any given slide with

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the microscope freezing technique is roughly 0.6 -0.9 L-1 (depending on the number of droplets condensed and the total volume of air sampled) and the maximum concentration of IN determined by the microscope technique is small compared to the maximum concentration determined with the CFDC method. The submitted paper reports concentrations up to 10 INPs L-1 (T = -25°C, size interval 5.6 - 10 μm, at Colby, KS). Which is the maximum number of droplets that can be formed on the area (1.2 mm2) analyzed by the DFT?

Minor remarks

A) Page 20531 - Line 12 and following: "Freezing events were rare at temperatures warmer than -15°C and are therefore not reported". This statement appears contradict what it is said afterwards, i.e.: - Page 20532, Line 9 and following: " . . .the major source of INPs at Amphitrite Point during the study period was likely biological particles from local vegetation . . ." - Page 20532, Line 20 and following.: "..the highest concentrations of INPs at a freezing temperature of -25°C were found at the Colby, KS sites. . .. aerosol sampling was conducted adjacent to soya and sorghum fields . . .This high concentration of INPs is consistent with previous work of Garcia et al. (2012) . . .. and Bowers et al. (2011). . ."

For instance, Garcia et al. (2012) measured an INP concentration of about 1 L-1 at T = -10°C. Bowers et al. (2011) found greater INPs downwind of corn fields than in air samples collected from the suburban and forest land-use types, at T> -10°C. Generally speaking, biological aerosols (bacteria, spores, fungi, pollen) are activated as ice nuclei prevalently at temperatures warmer than -10°C (Möhler et al., 2007). Therefore, at sites like Amphitrite Point, Colby and Saclay, a fraction of aerosol particles should be activated even at T> -15°C.

B) At Labrador Sea only one sample was available. What does the uncertainty reported in Fig. 2 and Fig. 4 mean?

C) We note that the lower concentration of INP was obtained at Alert, where higher air

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volume was sampled (about 32 m3) and the highest concentration at Colby, where the sampled air volume was the lowest (about 8 m3). Is this a fortuitous event?

D) As all graphs report in order: Alert NU, Whistler Mountain, Amphitrite Point, Labrador Sea, Saclay France, UBC Campus, Colby, KS, please follow the same order in the Paragraph: 2.1: Samplings Sites and in: Table 1

REFERENCES Möhler et al., 2007. Microbiological and atmospheric processes: the role of biological particles in cloud physics. Biogeosciences, 4, 1059-1071.

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 20521, 2015.