

Interactive comment on “Seasonal cycle and modal structure of particle number size distribution at Dome C, Antarctica” by E. Järvinen et al.

Anonymous Referee #1

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General comments

This article presents for the first time year-round aerosol size distribution spectra from continental Antarctica (Dome C). Such kind of studies in continental Antarctica offers the opportunity to study natural aerosol processes within a large spatial area that is thought to be virtually completely free of secondary aerosol sources. Notwithstanding, several new particle formation (NPF) events could be detected in this field study, most surprisingly even during polar winter. Hence, this work presents unique data which can be regarded as a cornerstone in elucidating aerosol formation processes above continental Antarctica. The conclusions drawn from about two years of nearly continuous

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measurements are in general supported by a thorough analysis. Necessary assumptions are clearly identified. Thus, this manuscript is certainly appropriate to ACP and I recommend a publication after some (minor) revisions specified below.

As mentioned above, the most striking discovery is the appearance of a persistent and dominating nucleation mode during polar winter. Given that the atmospheric lifetime of such kind of particles is usually in the range of some hours, their origin remains largely unclear considering that oceanic sources are hundreds of miles away. I suggest that this point should be discussed in some more detail and at this stage even preliminary speculations might be helpful. One possibility to elucidate this point would be a more thorough discussion of the characteristics of the planetary boundary layer, which was treated somewhat stepmotherly in the present manuscript. Is it possible, with available meteorological data, to assess the temporal evolution of the inversion strength? Could downward mixing of free tropospheric air be a potential nucleation mode source? Another issue tightly linked with this point is, of course, the potential impact of local contamination. I am sure that the authors were well aware of this potential impact and treated this challenge with great care. Nevertheless, especially considering the typically low wind velocities around 5 m/s, emissions from the exhaust fumes of the diesel generators may dwell within the flat and strong inversion layer potentially causing an enduring background contamination. Could this peculiarity be ruled out?

Detailed scientific comments:

Page 5735, chapter 2.2.3; figure 9 and table 3: Regarding figure 9, a comparison of the results derived from two different growth rate calculation methods showed tremendous discrepancies (here: 2.3 nm/h compared to 14.1 nm/h). Please describe in more detail your criteria preferring from case to case a particular method.

Page 5738, lines 22-29 and page 5739, lines 1-14: It should be mentioned that impactor measurements by Udisti et al. were done outside on the roof of the building, while the DMPS was installed inside the (certainly heated) building. Thus I surmise

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that impactor samples refer to ambient relative humidity (provided the impactor was not heated) in contrast to the DMPS data reflecting the size distribution of (bone-) dry aerosol.

Page 5743, lines 13-14 and page 5744, lines 9-18: Calculated growth rates appear astonishingly high, while particle formation rates are particular low. Given the low background particle concentrations, I would expect higher particle formation rates. As stated by the authors, realistic H₂SO₄ vapour concentrations could explain only a minor part of the growth rate. Do the authors have any ideas about the nature of the condensable gas(es) responsible for the observed particle growth?

Figure 1: It would be reasonable to use smaller symbols in the third graph (like in the last one) to better distinguish the different traces.

Figure 11: I am not really sure whether I understood this plot correctly: I am surprised that your statistics software package generates box-plots in case of a sample size of just 2! Anyway, to me this does not make much sense. I suggest simply plotting all measured values for each season in the diagrams. This would be a reasonable presentation.

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 5729, 2013.