Atmos. Chem. Phys. Discuss.,
doi:10.5194/acp-2017-311-RC1, 2017

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Features in air ions measured by an Air Ion Spectrometer (AIS) at Dome C" *by* Xuemeng Chen et al.

Anonymous Referee #1

Received and published: 12 May 2017

The article at hand reports on virtually year-round air ion size distribution spectra measured for the first time in continental Antarctica (Dome C). An in-depth evaluation of the comprehensive AIS record along with simultaneous differential mobility analyser (DMA) as well as LIDAR measurements revealed several highly interesting and novel findings considering (i) seasonality of air ion occurrence, (ii) new particle formation (NPF), (iii) size dependent growth rates, wind induced ion formation and (iv) the impact of cloud/fog formation on air ion production. In my opinion, this clearly written manuscript presents invaluable results to elucidate aerosol formation processes above continental Antarctica in general and in particular with respect to ion induced NPF. Thus, the manuscript is certainly appropriate to ACP and I recommend a publication after few rather minor revisions specified below.

Specific comments: Abstract (page 2, lines 11-13): Odd sentence, consider revision.

Introduction (page 4). For non-experts, I especially miss a short statement about cosmic ray intensity at Dome C compared to mid-latitudes. In addition: Is the total intensity of ionising radiation comparable to continental mid-latitudes?

Methods (page 4, lines 16-19): I wonder if the experiments were installed in a separate hut somewhat upwind to the main station as described in Järvinen et al. (2013) or Becagli et al. (2012). In this regard, the authors should briefly address the potential problem of local contamination.

Chapter 3.2.1 (page 13): Is it possible to assess the impact of neutral clusters on NPF? Definitely, this may be an additional important issue for dedicated future investigations at this site (see Conclusions, page 21, last section).

Chapter 3.2.2 and 3.2.3: Evaluation of particle growth rates and ion formation rates as described presupposes that NPF occurred in homogeneous air masses, thus neglecting the potential role transport and mixing processes. I think it is worthwhile to allude to (and discuss) the impact of these processes on the variance of particle growth- and ion formation rates, especially in regard with the derived extraordinarily high instantaneous growth rates up to some 100 nm/h.

Chapter 3.3.2 and Figure 9: In the Introduction, the particular conditions at Dome C, i.e. pronounced ionisation rates but limited source of vapours for clustering, were stressed (page 4, lines 3-7). Looking at Fig. 9a, I realized that ion concentrations in the size range 0.9 – 1.9 nm were roughly about a few hundred at low wind speeds (< 5m/s), which is in turn comparable to ion concentrations observed in a boreal forest (Chen et al., 2016; Figure 9 therein, sum over size range 0.8 – 1.7 nm), a site where sources of condensable vapours should not be limited. Does this analogy indicate that higher ionisation counterbalanced the lack of condensable vapours at Dome C? I think it may be worthwhile to speculate about this point.

Table 1: This table is redundant and can readily be removed, because it provides no further information as already presented in the main text (Chapter 3.1, page 11). If

at all, a plot showing the occurrence of the different features during the observation period on a time scale could be much more enlightening.

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