

Interactive comment on “Intercomparison of air ion spectrometers: a basis for data interpretation” by S. Gagné et al.

Anonymous Referee #1

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General Comment: The authors compare an impressive number of (N)AIS. No other research group in the world would be able to carry out the experiments performed in this paper, which makes this study original and definitely deserve to be published in this journal.

Specific Comments: Line 156: Assuming that the corona charger is not 100% efficient there should still remain electrically neutral particles; therefore, it seems inappropriate to state "particle-free" air. Also, it is not clear how the offset measurements are done. Is the classifying voltage applied during the offset measurements? Is the offset current affected by the presence of the classifying voltage?

Line 174: It is not clear how the offset current measurement is done in the measurement protocol of the NAIS. Reader would think of two potential methods. One method

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is to create ion & particle-free air and apply classifying voltage and measure the offset current, which is the type of experiment performed in this paper. Another method is to apply zero classifying voltage and measure the offset current.

Line 216-220: I believe that a schematic for the experimental setup is needed. It is hard to understand how these 5-flow system works.

Line 236: Was filtered air free of ions as well? If any ions remain in the filtered air they should affect the background measurements. How is the geometry and dimensions of the (N)AIS inlet? How was the challenge aerosol mixed to create a realistic concentration profile across the (N)AIS inlet? Was there any extra efforts needed to keep the inlet pressure of the (N)AIS close to value of the room environment? I believe that giving more detail of the experimental setup would improve the credibility of the calibration procedure described in this paper. Most readers do not have time to read any previous work. This paper should independently describe the experimental setup.

Line 244: The phrase "ion-spectrometer DMA transfer function" is a confusing term. It is better to mention ion spectrometer transfer function. I believe that the author is not trying to evaluate the transfer function of a system consisting of DMA and ion-spectrometer in series since the author assumes that the DMA generates monodisperse particles. If I were to be the author of this paper I would not to use the word DMA unless I am referring to the DMA as the monodisperse aerosol generator.

Line 326-331: Authors should state at the beginning of the paragraph that the Ion-DMPS was used as a reference for the measured charged fraction. The difference between charge ratio and charged fraction are not clearly explained.

Line 349-354: Although the turbulence causes ions to land onto wrong mobility channel the ion deposition rate should be conserved. Equivalently, although the width of the transfer function is broader and extra signal is present at the tail, the area under the transfer function should be conserved. For this reason the suggested reasoning for the increased total concentration sounds inconsistent. In addition, it might be a bit careless

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to use the word "background" in this paragraph because authors mention in line 174 that offset (or background) is already subtracted from the signals of a sample aerosol.

Line 382-385 & Line 388-389: It is hard to understand these reasoning. If the reference detector is measuring concentration at the DMA exit under the same flow settings regardless of the DMA type why the difference observed in Figure 2 (middle row & center column and middle row & right column) are affected by concentration and losses? One source of this confusion is the insufficient description of the experimental setup.

Line 390-392: I believe that the background measurement of the AIS during the actual atmospheric aerosol sampling is performed by applying HV to the ESP installed at AIS inlet, not by sending ion & particle free air into the inlet as it was done in this experiment. Potential user of the AIS would like to know whether the expected background level measured in this study well represent the expected values during the actual atmospheric aerosol sampling.

Line 417-418: Since the background level is significant, as commented previously, it is important to state how the background measurement is performed and accounted in the inversion procedure of the (N)AIS. Kulmala et al (2007, Science) used NAIS in their field measurements and concluded in the abstract "A pool of numerous neutral clusters in the sub-3 nanometer size range is continuously present". Careful reader of this manuscript may wonder whether Helsinki group checked that the NAIS inversion procedure properly subtracted the background level due to corona ions from the values measured during field sampling before Helsinki group proved the presence of the thermodynamically stable neutral clusters in Kulmala et al (2007, Science).

Line 421-424: Careful reader may wonder whether the Fuchs surface area of the sampled atmospheric aerosol large enough to deplete a significant fraction of the corona ions within the residence time of the charging region or not.

Figure 2 It is good to add somewhere in the caption that the test particle is silver for the results shown in this figure. It is difficult to understand how the measurements were

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performed to obtain the results in bottom row and left column of Figure 2. Were the charged particles once neutralized then charged again by NAIS or ANAIS? One source of this confusion is the lack of experimental schematic in this paper.

Interactive comment on Atmos. Meas. Tech. Discuss., 4, 1139, 2011.

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