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Atmospheric Measurement Techniques Discussions

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

Anonymous Referee #2

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This paper presents an intercomparison of several different types of air ion spectrometer from the Finnish/Estonian school. The experiments are detailed, and make use of reference instruments, mobility standards and comparisons between the individual instruments, all carried out in a number of different environments. The differences between the different instruments are explained, and a new particle formation event is used as an example of their consistent behavior.

This is a careful and thorough piece of experimental work which is completely sound, but could be presented more clearly to non-specialist readers, or those who are perhaps more users of ion spectrometers than developers of them. The major omission is any sort of diagram of the equipment used. The inlets and air flow are mentioned as a key difference between the instruments, and it would help to see schematics of each

of the instruments compared, perhaps including basic layout and electronics.

For such a detailed piece of experimental work, the abstract and text are both lacking quantitative comparisons. The text uses words like "agreed", but it would be more helpful for the authors to state the variability range of the different instruments. For example, in one place where the instruments "agreed fairly well", referring to figure 4a, there was an order of magnitude difference between the maximum and minimum values recorded. These measurements are known to be difficult, and the results obtained are impressive, so it is best to be absolutely clear about the disagreements that are occasionally seen. Along the same lines, the use of notched box plots in Figure 5 would allow the authors to show statistically significant agreements between the instruments, rather than the 25/75th percentiles, which hold no real significance.

The errors and fundamental limitations in the instruments are not mentioned, but in Figure 4, the currents go down to 0.01fA which is approaching the limits of what can be measured. What is the resolution and sensitivity of the electrometers used in this and the other instruments, and how do they propagate through the inversions to affect the final results? Presumably these errors are smaller than the variability between different instruments, but it would be more rigorous to demonstrate this.

The paper is quite long as it stands and the use of more diagrams would break up the text and also perhaps reduce the words needed for explanation of the instruments. The introduction could also be shortened, for example, definitions of the aerosol indirect/direct effects are not needed, and the full list of exotic locations of air ion measurements is also unnecessary.

The discussion of other types of air ion spectrometer in the introduction is not especially well written and could usefully be improved. In particular, the first part of paragraph 2 on page 1 contain various repetitions and ambiguities. Do the techniques bringing particles to charge equilibrium charge them artificially, for example? The first full paragraph on page 4 implies that air ion spectrometers were only developed in response to the

need for better measurement of new particle formation events. However, in the next paragraph, the long-established Estonian work is referred to. All the spectrometers used in this paper appear to be based on the highly-respected Estonian ion spectrometer heritage which goes back many years, and this should be explained before the discussion of new particle formation, which is a relatively recent motivation.

Finally, the title should be shortened to "Intercomparison of air ion spectrometers" since the paper is only "a basis for data interpretation" for the relatively small group of people working with these specific instruments. The broader community will not be reading this paper to learn about data interpretation, but rather to learn about the results obtained, therefore the shorter title seems more relevant. The specific "data interpretation" motivation could instead be mentioned in the text.

Technical corrections:

Abstract: define all acronyms used

Page 9 line 202: define a Hauke-type DMA

Page 16 line 369: second column of what?

Page 18 line 418: units are missing

Figure 4 units of concentration are missing

Table 2 define acronyms in caption

References: update papers in ACPD to ACP (eg Hirsikko et al)

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