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Interactive comment on "Evaluation of the performance of a particle concentrator for on-line instrumentation" *by* S. Saarikoski et al.

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Final Author Comments to amt-2014-39

Referee #2:

We thank for the comments of Referee #2. The comments are numbered and each of them is followed by a response from the authors.

Specific comments:

1. COMMENT, Abstract and conclusions: "The authors state that the operation of the m-VACES was not found to lead to any severe sampling artifacts. However, the time period for the ambient measurement was too short to draw definitive conclusions. In

fact, there seems to be substantial uncertainty in the PMF analysis due to limitation of the dataset (section 3.2.5). I recommend the authors clearly show the time period in the abstract and conclusions and state that further ambient tests are needed. This is important for organic aerosols because the chemical properties of organics may significantly vary depending on time and locations. On the other hand, the current abstract is somewhat redundant. It should be more focused on the important findings".

REPLY: Time period of ambient measurements and time period applied for PMF analysis was added to abstract and conclusions. Also the need of additional ambient tests was added. Abstract was edited and refocused.

2. COMMENT, Figures 7: "The size-dependent EF data in ambient air (Figure 7) are quite different from those in the laboratory (Figures 2 and 3), and I guess it was partially due to the mixing state of particles. Is there any possibility that particle morphology and phase were altered by water condensation and drying processes depending on the mixing state (and size) of particles? Does it affect the particle detection efficiency by the SP-AMS as mentioned in section 2.3.2?"

REPLY: Referee is right that the size-dependent EF's are different for laboratory data with ammonium sulfate and for ambient data with various chemical species. The difference could be partially due to the change in particle morphology as in principle some re-structuring of fractal agglomerates (mostly soot) might occur in the m-VACES due to the water condensation and drying process. This would result in a shift in the size distribution of the concentrated aerosols towards smaller sizes, since the condensation –evaporation process might make fractal agglomerate particles more compact. However, most ambient particles in Helsinki, unless they have been emitted very shortly (hrs maybe) before the measurement, had already gone through clouds, which is the same progress as in the m-VACES in terms of gaining and then losing liquid H2O. The preservation of particle morphological characteristics in the VACES has been investigated in the paper of Kim et al. (2001) in which they concluded that the concentrated and ambient particles have very similar morphology as the median fractal dimension is comparable (between 1.6 and 1.8) for both concentrated and ambient particles.

If the particle morphology and phase were altered in the m-VACES, it can change the collection efficiency (CE) of the SP-AMS. E.g. particle nonsphericity causes the loss of particle transmission due to the broadening of particle beam, and previous studies have indicated that particles with liquid surfaces have higher CE in the AMS than solid particles. The factors affecting the AMS CE are described e.g. in Huffman et al. (2005), Matthew et al. (2008) and Middlebrook et al. (2012). A comment of the effect of particle phase on AMS CE has been added to Section 2.3.2 (SP-AMS).

Also in Section 3.1.3 (Particle size) the effect of particle shape was discussed in order to rule out an effect of particle shape on the DMA measurements and on the shift in particle size (especially for small particles). For dry AS particles, that are approximately but not perfectly spherical, and for DOS particles, that are liquid and spherical, the shift in size was rather similar (Fig. 3b; Table S1), which confirmed that the shift was not due to a change in particle shape in the concentrator but more like the absorption of gaseous water-soluble organic compounds on the water droplets.

3. COMMENT, Section 3.2.6: “The detection of trace elements is interesting but the results are mostly qualitative and not very conclusive. I suggest that the whole section should be moved to SI.”

REPLY: Section 3.2.6. has been removed to Supplements. A small paragraph regarding the trace elements was added at the end of Section 3.2.3. (Inorganic species): “The m-VACES together with the SP-AMS enabled the investigation of trace elements. Five trace elements were detected in ambient air without the m-VACES; aluminum, vanadium, iron, zinc and rubidium. The use of the m-VACES also allowed the detection of additional trace elements, strontium, zirconium and cadmium that could not be observed without the concentrator. As the detection of trace elements was only qualitative it is discussed in more detail in Supplements.” Observations regarding the trace elements have been removed from introduction and conclusions, and trace elements were removed from Table 2.

References

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