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Atmospheric Measurement Techniques Discussions

Interactive comment on "Analysis of cloud condensation nuclei composition and growth kinetics using a pumped counterflow virtual impactor and aerosol mass spectrometer" *by* J. G. Slowik et al.

J. G. Slowik et al.

jay.slowik@psi.ch

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Response to Comments by Referee #1

Comment 1

Analyses of cloud condensation nuclei (CCN) properties are usually made either by measuring aerosol particle composition and size and activating the CCN under controlled conditions; or by directly measuring the composition of ambient cloud particles. In this manuscript by Slowik et al., an efficient method is described to analyze CCN

composition with the possibility to both control the CCN activation conditions and to directly measure the chemical and physical properties of the active CCN particles. The advantage with this method is that it provides information of both the conditions and CCN properties at the moment when the particles are being activated. Results from an application of the method, including measurements in downtown Toronto and in Egbert, are also presented and analyzed, with some interesting observations and conclusions on differences in CCN activity for particles in an urban outflow and during a biogenic event. The manuscript is well written and structured. I only have some minor comments seen below:

Response

We appreciate the reviewer's support and address the comments point-by-point below.

Comment 2

Page 287, line 11: The Köhler reference must be included in the reference list.

Response

This oversight has been corrected.

Comment 3

Page 289, line 13: Could you motivate why you have chosen a supersaturation of 0.33 %?

Response

The supersaturation was chosen to facilitate comparison with previous measurements at Egbert (0.32 % by Chang et al., 2007) and concurrent CCN measurements during this campaign (0.42 % by Chang et al, 2010, 0.35 % by Shantz et al., 2010). Additionally, our initial tests suggested that this supersaturation enhanced operation of the TGDC-PCVI-AMS system by increasing the fraction of CCN-active particles that form cloud droplets with diameters greater than the PCVI size cutoff. This (1) increases the

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number of sampled particles, presently a limitation of the technique, and (2) reduces the effect of droplet growth rates on the particles sampled at the maximum residence time, facilitating data interpretation.

Comment 4

Page 293, line 9: The Slowik et al. (2010) reference should be included in the reference list.

Response

The reference list has been corrected.

Comment 5

Page 293, lines 22-23: Should it be “Figure 2 through 4”?

Response

Because the text refers to multiple figures, we retain the plural.

Comment 6

Page 294, line 21: The polydisperse distribution is broader than the CCN-active distribution also on the “large diameter” side in Fig. 2b. Whereas the CCN-active distribution starts below 1 μm diameter, the polydisperse distribution starts at 4 μm diameter. Do the authors have any idea of the reason for this?

Response

This feature results mostly from calculation of a slightly negative baseline for this time period during data analysis, due to unexpected non-zero signal in the tail at large particle sizes. Such signal was erroneously included in the baseline region, resulting in a slight distortion of the distribution. This problem has been corrected, and a revised figure will be included in the final manuscript.

Further, there are several factors inherent in the AMS operation that make the large-

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size tail of the distribution more difficult to interpret. These factors are not expected to bias the polydisperse and CCN-active distributions relative to each other, but rather add uncertainty to the interpretation of the large-size edge of the mass distribution. First, the AMS has very low particle transmission (well below 10%) for particles larger than 1 micron. Second, the large-size tail is a convolution of the real particle size distribution and the vaporization time of the sampled particles. The measured signal from particle vaporization events is not symmetric with time, but rather shows a sharp rising edge and a more gradual trailing edge, with the precise shape depending on particle composition, size, location and dynamics of impaction at the vaporizer, etc.

Comment 7

Page 294, line 23: "size cut off of the PCVI (1 μm)". In page 292 on line 21, it says that the size cut was 2-3 μm?

Response

The reference to 1 micron is erroneous. We estimate the PCVI size cut at 2-3 microns.

Comment 8

Page 303, line 28: The year of the Liou and Ou reference should be 1989.

Response

The reference has been corrected.

Comment 9

Page 304, line 8: Throughout the text the reference Kumar et al. (2003) is used, for instance on page 290, lines 2 and 23. It is better if the references used in the text are consistent with the references in the reference list. Why is not "Kumar, P. P." used in the reference list?

Response

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The text references now refer to “Pradeep Kumar et al.,” as used in the published manuscript.

Comment 10

Page 310: I would prefer if it was mentioned in the figure caption of Fig. 2c that it represents polydisperse distributions of organics (despite that it is mentioned in section 3.1 that the CCN-active organic mass distribution is not shown). The same goes for the figure caption of Fig. 6.

Response

We agree, and have updated the captions.

Interactive comment on Atmos. Meas. Tech. Discuss., 4, 285, 2011.