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Atmospheric Measurement Techniques Discussions

Interactive comment on "Development of an H-TDMA for long-term unattended measurement of the hygroscopic properties of atmospheric aerosol particles" *by* E. Nilsson et al.

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1) I would ask the authors to better describe the temperature control of the second DMA (page 1062, line 17). How were the peltier elements installed? Were there any measurements of potential temperature gradients in the DMA column?

Answer:

To answer these questions, the following sentence on page 5:

"The temperature of DMA1 and the humidification system is kept at laboratory temperature (20° C) while the second DMA is set two degrees lower."

has been replaced by

"The Peltier elements were fixed to the aluminium walls of the insulated box. They were delivered with two blowers mounted to each element, one on the outside of the box, and one recirculating the air inside the box. The inner dimensions of the DMA1 box were 400 x 460 x 950 mm, the last one being the height. The Peltier elements (110 x 130 x 80 mm, the last one being the thickness) were mounted on the centre of the short side, with their base 360 and 690 mm from the floor of the box respectively. The temperature gradient inside the box was measured to be less than 0.1 K from one bottom corner to the diagonal opposite upper corner with DMA2 and all tubing and sensors mounted, using the same three Pt100 elements later tapered to the surface of DMA2. The temperature of DMA1 and the humidification system is kept at laboratory temperature (20° C), with the same setup as previously described for DMA2, but with only one Peltier element used, since potential temperature gradients are not a problem for dry measurements. The inner dimensions of box 1 were 360 x 460 x 950 mm. The Peltier element was mounted with its base 600 mm from the floor of box 2."

2) Another important issue concerning long term experiments is the need for presence of personnel. How long time could this instrument be used unattained on a typical situation? What about issues like power cuts? Is the instrument able to start operating automatically as the power returns?

Answer:

The following text was added on page 8, to answer these questions:

The limiting factor for maintenance is that the water used in the humidification ultimately ends up in the CPC, which gradually lowers its performance, until finally the number of counted particles is virtually zero. In a typical case, the instrument can operate around 2 weeks, before the CPC has to be drained on water and filled with new butanol working fluid to prevent too low counting statistics. This problem could be corrected using a water based CPC instead of a butanol based. Since the CPC is operating well beyond

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its cutoff size, which is around 10 nm, the choice of working fluid should not affect the results of this particular instrument Another drawback is that the instrument is not able to recover from a power cut. This is due to the software used for the temperature control of the two DMA boxes, which has not been LabView implemented, but is run through a separate problem. However, if that serial communication were to be run through LabView, and a computer with automatic booting upon power return, there is no theoretical reason to why an automatic restart of the system after power failures should not be possible.

3) Page 1059, line 2: I recommend using terminology in which “saturation ratio”=S= p/p_saturation and “supersaturation”=SS=S-1. Use of “super saturation ratio” is somewhat strange.

Answer:

The referees suggestion has been implemented in the text.

4) Page 1059, line 22: Delete the second “constructed”.

Answer:

It has been deleted.

5) Page 1064, line 2: This effect could also result if there is not constant relative humidity along the aerosol trajectory. What is the typical time scale for scanning the RH? Is it possible that the RH has not been stabilised within the instrument when the new GF is determined?

Answer:

The timescale on the scanning was very long (around 7 hours for a humidogram), and there was very little fluctuation in the RH values. For this reason we believe that it is not a question of stability. The fact that we did not see any bimodal raw data suggested that it was not a question of some particles deliquescing and others not. The only thing

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we are left with (as we can think of) is that the particles deliquesced inside the second DMA, but if that was the case, we should see some fluctuations, with time, since this would be a highly unstable environment. For all these reasons we tent to lean towards the contamination theory.

6) Page 1064, line 24: Explain DP

Answer:

DP has been replaced by dew point.

7) Figure 5: Could you explain why the water activity is lower for smaller particles? I understand that water activity is the value of RH that is set in the instrument (typically 90%) and the GF is measured (and is obviously smaller for smaller particles).

Answer:

The water activity is defined according to

pw=p0*aw*exp((4*Mw*σ)/(R*T*w*Dp))

Where pw/p0 = RH. This means that for a given RH, the water activity, aw, will be smaller for smaller sizes, Dp. The H-TDMA constantly operates at 90% RH, but this translates to different water activities for different dry sizes. The reason for plotting water activity and not RH on the x-axis is that we wanted to show all data in the same plot.

Best regards on behalf of the authors,

Erik Nilsson

Interactive comment on Atmos. Meas. Tech. Discuss., 2, 1057, 2009.