Reply to the comments by Fred Brechtel

Overall this is a very good paper describing the key issues involved with performing high quality electrical mobility size distribution measurements. Some very practical solutions are offered and the suggestions will likely find broad use in the community of users of this technology.

Thanks

On page 5536 related to the discussion of the CPC size dependent counting efficiency method: when the location of the electrometer on the manifold is switched with one of the 10 CPCs, is the 'correction' required to the electrometer data the same to match the defined 100% CPC efficiency at 40 nm?

We checked if the position of different CPC or the electrometer would change something. It did not.

The magnitude of the correction that needed to be applied to the electrometer data for the CPC efficiency studies should be stated.

OK, will be done

Discussion of maintenance, especially cleaning of the DMA column and flow measurement components?

We will check this, and may add something to these points.

The results reported on page 5540 of the ambient measurement intercomparison are disappointing. After all the effort expended to upgrade the various instruments according to the proposed standards, the poor intercomparison for sub-20 nm particles and particles larger than 200 nm suggests there is something we still do not understand about operating mobility spectrometers for long-term monitoring applications. Is it possible that the different aerosol neutralizers produced different charge size distributions? This may not have been evident in the PSL studies since the PSL are 'monodisperse' and presumably a multiple charge correction is not applied.

Fred, you are completely right, we have been also disappointed. However, we are also happy that we have been successful for the size range 20-200 nm. In the next infrastructure project, we will concentrate on the nucleation mode. It is likely that the method for the correction of diffusional losses is not appropriate due to enhanced losses in bends. For the accumulation mode, we will check if the individual inversion routines may do slightly different multiple charge corrections. If this is not the case, then different neutralizers may do not produce the same charge distribution for larger particles.

In the processing of our mobility spectrometer data, we propagate measured uncertainties in air flow rates, voltage, temperature, and pressure through the equations defining the size selection process in the DMA to try and establish the 'actual' measurement uncertainty in particle size. Scanning mobility spectrometers are unique in that detected counts by the CPC must be related to a correct size by understanding the plumbing time between the DMA and CPC and CPC smearing time constant. These parameters were not discussed - especially the CPC smearing time constant/delay time should be mentioned. How was this measured?

We need to clarify this. The SMPS never scanned so fast that a significant smearing could have taken place. We will describe this in the text.

On page 5541, five systems were intercompared and much better agreement found. Was the only difference between this study and the previous one the more careful air flow rate calibrations? Was the same charge neutralizer design with similar age sources used on all 5 systems during the Aug 2010 study? Were different neutralizers of different source ages used on the instruments in the previous studies where the intercomparisons were not as good?

These five spectrometers are hardware- and software-wise identical. Here and in the experiment before, we checked carefully the flows. So this should not have been the problem. Each SMPS had a Krypton85 neutralizer with different age. We did not realize so far that there are significant differences by using our Krypton neutralizers. We used however the same inversion routine. We will do this also for run#4 (Figure 5).

Alternatively, even though the different inversions were tested on the same input distribution, it may be that the way in which the multiple charge correction is implemented in the different systems could cause some of the poor measurement intercomparisons. The magnitude of the error resulting from an incorrect charge correction algorithm will likely depend on the shape of the size distribution. For example, if the particle counts in the measurement intercomparison had relatively more large particles compared to the distribution used during the inversion test exercise, then perhaps a problem with how multiple charging is dealt with in the processing could have a relatively larger influence on the measurement intercomparison.

Yes, this is a possibility that we will check by using the same inversion routine.

On page 5546 line 25 I would recommend: 'Most important are regular system maintenance and checks and calibration of ...'

Ok

On page 5547 line 20 I would recommend: '..we can reach uncertainties around 10% with...' (the word 'that' should at least be changed to 'than')

OK

On page 5548 line 22 it is stated that mass flow meters on the aerosol flow should be calibrated at least twice per year but previously it is stated that mass flow meters should not be used on the aerosol flow - please be consistent.

OK, good point!

Grammatical corrections:
page 5535 line 6 should read "Note: the 'Old Grimm' inversion routine is not used in newer software revisions."

OK

page 5536 line 5 should read '...are shown here as an example...'

OK

page 5537 line 26 spell out 'incl.'

OK
page 5539 line 24 should read '...following section are corrected for ...'

OK

page 5546 line 21 should read '...occasionally higher than...'

Ok

page 5548 line 15 should read '...adopted by manufacturers and ...'

OK

page 5549 line 8 remove the word 'Please'

Ok

page 5566 table 2 under 'PKU' listing, the work 'Iterative' is misspelled

OK

I thank the authors for this very useful work.
Fred J. Brechtel

Thank you Fred