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Atmospheric Measurement Techniques Discussions

Interactive comment on "Intercomparison study of six HTDMAs: results and general recommendations for HTDMA operation" *by* J. Duplissy et al.

Anonymous Referee #1

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General Statement

The manuscript describes the intercomparison of six hygroscopicity tandem differential mobility analyzer (HTDMA). The goal of the comparison was to develop recommendations for construction and operation of HTDMA for use in monitoring efforts within the EUSAAR project. It is an interesting and important contribution, however in some parts the manuscript is difficult to read/understand (see below). The parts dealing with the hygroscopicity of SOA state the problems, but the explanations remain vague and inconclusive. Overall manuscript should be published in AMT after the following comments and revisions were considered.

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Interactive Discussion
Discussion Paper

Page 128, line 26ff

Should read: ...and the hygroscopicity tandem differential mobility analyser technique (HTDMA; Liu et al., 1978; Swietlicki et al., 2008).

Page 130, line 14f

Should read: The sizing of the aerosol after humidification can be done in two alternative ways.

Page 132, line 4 f

In HTDMA the aerosol should not pass a pump before measured. Mostly one protects the pumps (in the sheath air cycle) by particle filters. Insofar aerosols inside a pump at higher temperatures here seems to be an unimportant aspect.

Page 132, line 10

What is a recalculating air stream ? Should read: recirculating air stream ?

Page 132, line 11

The phrase *only possible* should be replaced by *only meaningful*.

Page 132, line 23 and other places in the manuscript

I suggest not to decline abbreviations like *DMA2s*

Page 133, line 7f

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The open sheath air systems does not apply to the described instruments. There must be good reasons, why all use closed sheath air cycles. Please, describe the advantage here.

Page 133, line 19ff

Alternatively, Nafion dryers ...This sentence is difficult to understand, please rephrase it.

Page 133, line 26

New paragraph after (Cruz and Pandis, 2000).

Page 134, line 3

Should read: ...are summarised in Table 1 and Fig. 1.

Page 134, line 5

What exactly is meant by *growth factor equilibration* ? *growth factor observed at equilibrium* ?

Page 134, line 21

The loss of semivolatile dicarboxylic acids in HTDMA was discussed in Koehler et al. ACP, 2006 (and references therein)

Page 135, line 9

Should read: ...(Johnson et al. 2008)

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Page 135, line 13f

This sentence is difficult to read, please rephrase.

Page 135, line 19f

Should read ...thus illustrating the large *uncertainty of GF* imposed through the *uncertainty in/of the RH*.

Page 135, line 24f

For this study the temperature probes... Really, only for this study ? How was T measured in HTDMA5 and 6 ?

Page 135, line 5f

The temperature in DMA2 must be measured mandatory. Therefore in case of capacitive RH measurements only *one* extra temperature measurement is needed together with the RH measurement e.g. in the excess air.

Page 136, line 8

Should read:...measure at RH < 90

Page 137, line 3

a-Pinene (capital P at beginning sentence)

Page 138, line 4

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Should read: Eventually DMA2 will stabilize at the same RH as DMA1 and hence the true GF of aerosol particles passing the HTDMA *should* be unity.

Page 138, line 8

Should read better: ...growth factors as proposed by Gysel et al. (2008).

Page 138, line 10

Should read: Additionally, the final RH in DMA2 shows whether the RH in DMA1 is sufficiently low, when operated in dry mode. ?

Page 139, line 15ff

Rood et al., Nature 1989 stated early the ubiquitous nature of metastable ambient aerosols

Page 139, line 24f

Should read: A validation at a single RH is only a weak test because *of possible* compensating effects from DMA performance, shape factors, restructuration, RH bias or impurities cannot be *always* excluded.

Otherwise I start to loose trust in HTDMA measurements in general.

Page 140, line 13

Should read: ...at a nominally constant RH the *actual* RH in DMA2...

Page 140,line 14ff

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I suggest to show Gysels equation here. I understand that it is not a correction, but a recalculation to the nominal RH as long as deviations are smaller than +/-2%. Please, rephrase and state this more clearly here.

Page 140, line 25ff

Secondly... This is a complicated sentence for the relative simple fact that neglecting doubly (multiply) charged particles leads to an underestimation of the growth factor because they carry less than the double (triple etc.) of the mass due to slip (non-Stokes behavior). Please, rephrase and explain simpler.

Page 141, line 5

There is not much extra gain in Fig. 2 panel b. It is not even mentioned in the captions of Figure 2 at all. You should skip panel 2b.

Page 142, line 21f

Do you mean the accuracy at 90% RH ? If so state it clearly. Fig. 1 does not contain information of the accuracy of RH measurements.

Page 143, line 16

Why were HTDMA2 and 3 measuring something different. Please, you must explain!

Page 143, line 17

RH variations in DMA2 are undesirable though acceptable if they remain within limits. Is a soft statement. Please, make more precise statement, which limits. The next sentence starting with *However ...* is also difficult to understand. Please rephrase.

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Page 144, line 24

Since HTDMA 3 did something different, you may consider to skip this data in Fig. 4. The behavior at low RH is anyhow difficult to recognize.

Page145, line 15f

Should read better: 8230;wherein only data points with an RH gradient <1% during a scan were considered.

Page 145, line 20

What other instruments do you refer to ? References or rephrase the statement.

Page 146, line 12

You start to use *2ndDMA* instead of the previously used DMA 2, please stay with DMA2.

Page 147, line 10

Should read: ...because the measurements *were* done at different RH in different studies. The performance of HTDMA for SOA can therefore *be best* assessed by simultaneous measurements.

SOA generated at the same conditions should have the same properties.

Page 147, line 15

Do you have independent information on this ? It is a highly speculative and also dangerous statement. The difference in growth factors in the exp 1/2 and exp3 observed

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by HTDMA1 is quite significant. If it is really due to the bag, can we then still trust the older measurements? The higher growth factors in exp1/2 may be also due to wall effects, e.g. uptake of water soluble material evaporated from the walls (memory effects).

Page 147, line 24

By not cycling through a series... This is difficult to follow, please rephrase positive.

Page 148, line 10

Should read: In experiment 3 (Fig. 7) HTDMA1 measured a slightly lower growth factor than in experiments 1 and 2. The difference measured by HTDMA1 between exp3 (GF = 1.14 - 1.22 over 5 hours) and Exp1,2 (GF =1.25 - 1.4 in 8 hours) seems to be but quite significant. What is the reason for that difference. Can emanating (oxidized) impurities from the new Teflon bag cause such a large decrease ?

Page 148, line 13

If two instruments measure a difference in GF for the same SOA the reason must be in the instrument performance or construction and it cannot be in the SOA.

Page 150, line 20

The introducing sentence is too complicated, it should be rephrased.

Page 153, line 5

With exception of the first bullet, these points are anyhow mandatory for any DMA or SMPS measurement. I don't see them as a special outcome of the two workshops ! That was known before, wasn't it ?

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Page 153, line 11

Should read better: Certified PSL spheres should be used to verify the sizing of the DMA. This should have been also mandatory for each DMA measurement !

Table 1

The use of *DMA1, DMA2* and *first, second DMA* should be homogenized Some headers in column 1 do not start with capital lette: *Water source, Sizing*

Table 2

What exactly is the difference between no of measurements and number of points.

Fig. 2

Total number is shown by blue lines. Panel b is not mentioned.

Fig, 4

You may consider to take out the data of HTDMA3.

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