

Interactive comment on “Hygroscopicity of secondary organic aerosols formed by oxidation of cycloalkenes, monoterpenes, sesquiterpenes, and related compounds” by V. Varutbangkul et al.

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We would like to thank the reviewers for their valuable comments and suggestions to improve the manuscript. Below is our point-by-point reply to reviewer #2's concerns or suggestions (which appear in italics).

Reviewer #2:

The literature data of HTDMA is usually difficult to compare with each other as the details of the instrument setup are different and often not explained in detail. One of the important information is the uncertainty of the observed values. The authors give the uncertainty in GF of ± 0.01 . This is very good value and better than most of the

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reported values. However, there is not really possibility for a reader to understand how this value was obtained. I would like to recommend that a separate paragraph or section is added summarising the QC/QA issues and discussing the background of the concluded uncertainty.

The uncertainty was estimated from a pure $(\text{NH}_4)_2\text{SO}_4$ run, which yielded a growth curve that agrees with published model calculations to within 1.5%, with the actual percentage being 1.35% (0.02 off in *GF* compared to theoretical value of 1.484 at 80% RH). We had multiplied this “percent uncertainty” to the nominal organic *GF* of 1.07 (at 80% RH) to arrive at the reported uncertainty value of about ± 0.01 . Upon reviewing the calculation, we realize that this number should have been rounded upward to ± 0.02 . And in fact, the discrepancy of 0.02 between the measured and theoretical $(\text{NH}_4)_2\text{SO}_4$ *GF* probably should have been used as the absolute uncertainty. We would therefore like to modify the reported uncertainty to ± 0.02 . The change has been made in the manuscript and text added to explain the origin of the number.

The experiments with seed aerosol (ammonium sulphate) need somewhat more explanation. The generated aerosol, if I understood correctly is polydisperse, generated using an atomiser. This will naturally influence the fractionated composition during condensation of organics. This could be more specifically pointed out. The width of the size distribution should be given.

Yes, the seed aerosol is generated with an atomizer and is therefore polydisperse. The geometric standard deviation of the size distribution of the seed aerosol is ~ 1.80 , with the mode diameter between 80-100 nm (information added to the manuscript). This does indeed make the particle composition highly size-dependent at least in the beginning of the experiment (as shown in the AMS size-resolved organic fraction in Figure 14a), though this dependence decreases quickly with time as more organics condense onto the particles and the organic fractions increase.

Section 2.1.2. The RH history of the ammonium sulphate particles remains unclear.

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The aerosol is generated evaporating water form solution droplets. However, if the RH goes below 40% or so the particles will crystallise and would not form droplets at 50% again. I assume that this might be a risk as the atomiser uses typically dried compressed air to spray the droplets.

We have made measurements of the RH of the atomizer output, and it was consistently at least 70%. Thus, the particles directly downstream of the atomizer are known to be deliquesced. In the dry cycloalkene ozonolysis experiments, the particles are dried in a diffusion dryer, and remain dry throughout the experiments. In the humid terpene photooxidation experiments, however, the particles from the atomizer are not passed through a dryer—they are injected directly into the chamber, where the RH is at approximately 50% and does not drop below 40% even with the lights on. Thus, we can conclude that the seed remains deliquesced throughout the experiment.

The experiments with SOA formation on inorganic seed aerosol (3.1.1.) show bimodal growth distribution. I wonder if there is any possibility that there is also SOA nucleation within the chamber leading to pure SOA particles together with mixed particles due to condensation on to the seed aerosol.

We also measure the total particle number concentration using the DMA and CPC, and we do not detect any nucleation events. All the organic condensation occurs onto the $(\text{NH}_4)_2\text{SO}_4$ seed, leading to internally mixed particles.

Section 3.2.2. What is meant by “The HTDMA is operated in the drying mode”?

The drying mode involves using the first DMA in the HTDMA to select wet particles from the humid chamber (in terpene photooxidation experiments) and using the Nafion dryer to remove the water in the gas stream, drying out the classified aerosol before the second DMA scans for the dried size distribution. This is described at the end of Section 2.2.2 on the HTDMA operation.

Fig 5: Original dry diameter should be given in the figure caption. This figure shows a

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nucleation experiment. It would be interesting to see also the evolution of the aerosol mode (diameter) and the total number concentration, perhaps plotted in the same figure.

Time series showing evolution of the mode diameter and total number concentration have been added to the figure as suggested.

Figure 6: What is the time scale of doing all these experimental points (how long does it take to make one scan)? Can we assume that the aerosol composition stays constant during the whole experiment?

Each complete HTDMA scan cycle (including an up and down scan of the high voltage ramping) takes approximately 2.5 minutes to complete. The RH variation to allow complete measurement of *GF* dependence on RH generally takes between 5-7 hours. While there may still be chemistry of long time scales occurring in the chamber during those times, the main reaction of hydrocarbon oxidation and formation of the first and some second generation products would have been completed by the time the RH ramping is started. In the span of several hours when the RH is being varied up and down, we do not observe a variation in *GF* with time at a single RH beyond that within instrument error. Thus, we can assume that even though the exact aerosol composition may be changing slightly during this time, the HTDMA cannot capture such a change.

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