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Interactive comment on "Measurement of non-volatile particle number size distribution" *by* G. I. Gkatzelis et al.

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(1) *This is a well-written and clear manuscript describing studies of the effects of a thermal denuder on the size distribution and composition aerosol particles generated in the laboratory, produced by oxidation in a smog chamber, and measured in ambient air in a city. The paper is suitable for publication in AMT with only minor revision.*

We do appreciate the positive assessment. We have done our best to address the various comments and suggestion of the referee as described below.

Comments:

(2) *p. 6357, line 8. Define exactly what is meant by "fine particles" and "PM2.5". PM2.5*

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is the dry mass of particles collected behind a particle separator with a 50 percent cut point of 2.5 um aerodynamic diameters.

We have added the above definition of PM2.5 in the same point.

(3) *p. 6358, line 4. Define what a thermodenuder is–a laminar flow tube or tubes with heated walls designed to remove semi-volatile components from particles.*

We have rephrased this sentence to include the suggested definition of a thermodenuder.

(4) *p. 6359, line 23. Is the total residence time 15 s, or is that the residence times each in the heater and cooler? What is the temperature at the exit of the cooler, and how is this controlled?*

We now explain that the corresponding residence time is the average residence time in the heating section at 400 C. The average residence time in the cooling section is approximately 30 s. The cooling section was cooled by convection. The sample exiting the thermodenuder is within 5 degrees of the room temperature for all operating conditions.

(5) *p. 6362, line 5. What is the model number of the SMPS?*

We have added the SMPS model number: TSI, model 3936.

(6) *p. 6362 line 23. Is 2 percent remaining by number or by mass? This is important to always specify since you talk about mass removal as well.*

It is 2 percent remaining by number. This is now clarified in the revised manuscript.

(7) *p. 6362 line 28. Here and in many places later in the text you talk about "98 percent particle removal". What you mean is that 98 percent of the particles had a residue no*

larger than your minimum detectable size of 10 nm. Although unlikely, there may be smaller cores remaining. Please go through the text and make sure you are precise when talking about the "complete removal" of particles.

This is a good point. Particles with sizes below the detection limit of our system (around 10 nm) are assumed throughout the paper to have evaporated completely. We clarify in this point that the removal efficiency reported in this work corresponds to particles that either evaporated completely or had a residue no larger than the minimum detectable size of 10 nm.

(8) *p. 6363, line 19. Is this NFR or a mass fraction?*

We clarify that this refers to the remaining particle number (NFR).

(9) *p. 6364. Remove "furthermore" and change "this technique" to "the TD".*

We have rephrased this sentence following the referee's suggestions.

(10) *p. 6366 line 5. Define PM1. The AMS does not measure PM1; it measures the mass of non-refractory components with vacuum aerodynamic diameters less than the upper limit of the lens, which can vary from unit to unit. Clearly define the size range of the instrument in VAD and then translate those to physical size for comparison with the SMPS size range.*

We now clarify that the AMS measures the mass concentration of the non-refractory components of particles with vacuum aerodynamic diameter less than approximately 1 micrometer (Canagaratna et al., 2007). This corresponds roughly to a particle with a physical size of 0.7 micrometers assuming a density of 1.4 μg m^{-3}.

(11) *p. 6367 line 3. NFR is already defined.*

We changed "number fraction remaining (NFR)" to "NFR".

(12) *p. 6368, lines 6-10. I was confused by the definition of MFR. You seem to say here that the organic mass was 45 percent of the remaining particle mass, and then you say the MFR for organics was 20 percent. Clearly define MFR as the fraction of the particular constituent remaining after heating in the TD, not as the mass fraction of the total remaining particle mass.*

This is a valid point. We have rephrased these sentences clarifying that in the first we use as basis the total particulate mass in the second the organic aerosol concentration.

(13) *p. 6369 line 22. Remove the sentence beginning "All the result. . . ." You've already said this in the experimental description.*

Done.

(14) *p. 6370 line 9 and p. 6371 line 11. Why do you think the sulfate might be due to larger particles evaporating? This seems quite conjectural and does not keep attention focused on the more important results.*

We have rephrased this sentence just mentioning that this has also been observed in other field studies (Huffman et al., 2009). We agree that speculating about the causes of this behavior does not add much to the manuscript.

(15) *Conclusions. I'd like to see a paragraph discussing the possible implications of the residual organic fraction on studies looking at thermodenuded optical properties and size distributions of residual particles. For example, Lack et al. ("Brown carbon and internal mixing in biomass burning particles", PNAS, 2012) use a thermodenuder to examine the optical properties of coated and "uncoated" BC particles. If these particles are still coated with clear or brown carbon, the results and interpretation could be*

biased. A listing of the types of studies that might be influenced by your findings would be helpful.

We agree with this point and we have added a paragraph explaining that our results suggest that it is very difficult or almost impossible to evaporate all organics from ambient aerosol particles using thermodenuders. Therefore, the assumption that has been used in previous studies that the particles coming from these devices are organic free is not valid. This could bias studies attempting to quantify the physical and/or chemical properties of ambient particles without their organic content including the one cited by the referee.

(16) *Fig. 10. Title should be "PHASE C"*

We have deleted this extra information from the figure and the corresponding text in the manuscript.

(17) *Figure 11 is very difficult to make sense of. For Fig. 11a could you please use a box-and-whiskers plot broken into four groups for the four periods of day? For Fig. 11b, could you please plot four categories of data (the four periods of the day) underneath each of the box plots from Fig. 11a? The Y-axis for this plot would be BC mass concentration, and then use a color scale and color each individual point by number fraction remaining? I think this would be much clearer than the current scattered points in 4 hard-to-distinguish colors using symbols of similar (small) size.*

We have redrawn Figure 11 following the suggestion of the referee.

Interactive comment on Atmos. Meas. Tech. Discuss., 8, 6355, 2015.

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