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Interactive comment on "Particle Wall-loss Correction Methods in Smog Chamber Experiments" *by* N. Wang et al.

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Wang et al. reviewed and presented a comprehensive study about current methods to evaluate the particle wall-loss rate in CMU smog chambers. Particle wall-loss correction in smog chamber is a very important topic and can be applied by the chamber community in both experimental data interpretation and chamber simulations. This manuscript is well organized and very informative. But I found several parts confusing, which have to be clarified before considering for publication.

We address the various comments of the reviewer below. Our responses (regular font) and corresponding changes in the paper follow each comment (in italics).

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Discussion paper

General comments:

(1) *About k_c. My understanding of the difference between k_c and k_a is that (correct me if I am wrong): the coagulation-corrected k_c is actually the inherent particle wall-loss rate, which reflects the effect of all physics other than coagulation inside the chamber; while the apparent k_a is the synergistic effects of diffusion, gravity, eddy intensity, coagulation, and even charge, among which coagulation can be isolated to derive k_c. Then it is very confusing when the experimental data is corrected by kc: should coagulation effect be counted? For example, to clarify that coagulation is important in particle number concentration decay but not in volume concentration decay in Fig. 2, I think k_c-corrected curve does not count coagulation (Eq. (6)), otherwise, it should overlap with k_a-corrected curve. How about in other cases? I thought the right way to perform particle wall-loss correction was to insert the derived coagulation-free k_c into the general dynamic equation to get the right particle number concentration. The authors may want to clarify this point in the revised manuscript.*

The reviewer's understanding of k_a and k_c is accurate. The reviewer is also correct about the fact that the k_c-corrected curve in Fig. 2 shows the evolution of the particle number concentration correcting for their losses to the wall. The change in the number concentration in this case of a non-reacting system is only due to coagulation. This is the goal of these wall corrections, to correct for this process. The method used for the correction here is for all practical purposes equivalent to that proposed by the reviewer because the measured concentration is used for the correction at each time step. This concentration is continuously changing due to condensation and coagulation, but the effects on these processes that are described by the general dynamic equation are "included" in the measurements. A brief explanation has been added to the revised paper.

(2) *About SOA correction. How are the particles deposited on wall treated in the SOA correction? Are they still acting as a condensation sink of VOC molecules or just re-*

moved from the system during the correction? It looks like that Eq. (7) treats the deposited particles the same as suspended particles. Moreover, what time does V_s refer to? The beginning of the injection of seeds or the beginning of the SOA experiment? These points should be clarified in the revised manuscript.

The interaction of the condensing vapors with the walls (including the particles deposited on the walls) is clearly an important research topic but has been out of the scope of this work. Our approach implicitly assumes that the particles deposited on the walls are removed from the system and stop interacting with the gas phase. V_s refers to the corrected seed volume concentration right before SOA formation. Note that the V_s is for all practical purposes constant during the seed-only periods after particle wall-loss correction. These points are clarified in the revised paper.

Specific comments:

(3) *In Section 2, what are sampling rates in both 12 m^3 and 1.5 m^3 chambers? Are there any significant volume changes during the experiment, especially for 1.5 m^3 chamber?*

For both experiments, the SMPS was sampling at 0.3 L/min. For a 5-hour experiment, the volume lost due to sampling is 0.09 m^3. This is a small change for both the 12 m^3 and the 1.5 m^3 chambers. This information has been added to the paper.

(4) *What is the scanning time of SMPS? How does this reconcile with the coagulation correction algorithm, i.e., is the time step the same as SMPS scanning time? Or is the time step just 15 min as mentioned in Line 196? More details should be included in Section 3.1.1.*

The SMPS scanning time was 5 min for each sample. The time step of 15 min mentioned in Line 196 is the result of averaging of 3 consecutive samples and use of the corresponding average particle number distribution as input for the model. We added the corresponding information in Section 3.1.1 in the revised manuscript.

(5) *In Section 4.1, notes should be added that the particle number concentrations in Exp. 1 and Exp. 2 have 1 order of magnitude difference, thus coagulation effect is more significant in the small chamber.*

We made the corresponding change in Section 4.1 in the revised manuscript.

(6) *The authors may want to replace Fig. 3 with Fig. S1. There are no uncertainties in Fig. 3 but Fig. 1S has. Also, I suggest changing the name of legends. Is the first number referring to the experiment times? Over the past four years, is the chamber renewed? If so, is there any effect? This should be clarified.*

We used Fig. 3 in the main text because the uncertainty area (as shown in Fig. S1) can be distracting and may not allow the reader to see the differences of the various measurements. We now direct the readers interested in the uncertainties to Fig. S1. The first number refers to the month when the corresponding experiment was performed. We changed the name of the legends as suggested. The experiments discussed in the paper refer to the same chamber. This is now clarified in Section 2.1 of the revised manuscript.

(7) *In Figure 4b, the number distribution may be more straightforward than the volume distribution to explain the difference between k_1, k_2, and k_3. It will be beneficial to mention in the caption that Figure 4c is from Period 1.*

Our rationale of showing the volume distribution is that it indicates where the majority of the particle mass are distributed. This aids in our later discussion of the wall-loss corrected SOA mass concentration. We added the recommended information in the caption of Fig. 4c in the revised manuscript.

(8) *Figures 67 are very similar to Figures 67 in Wang et al. (2018, doi.org/10.5194/ acp-18-3589-2018). I am not sure if this is allowed in the policy of EGU publication.*

Since Figures 67 are from the same authors, I guess it is fine. In addition, it will be beneficial to mention about the conversion from D_{va} to D_p in Section 4.4 as in Wang et al. (2018).

We have replaced these two figures with similar ones depicting results from another experiment. We have added the information about the diameter conversion in Section 4.4 in the revised manuscript.

(9) *In Figure 8, which k_c is more representative of the condition inside the chamber?*

Both k_c profiles are representative of the chamber condition, but at their corresponding time periods. When the chamber is under "disturbed" conditions, the wall-loss rate constants were observed to be time-dependent as discussed in Section 4.5. A brief discussion has been added to the paper.

(10) *The authors may want to replace Fig. 9 with Fig. S3, or mention in the manuscript that Fig. S3 has uncertainties.*

We used Fig. 9 in the main text because the uncertainty areas (as shown in Fig. S3) can be quite confusing for a lot of readers. We are now directing the interested readers to Fig. S3 for the corresponding uncertainties.

(11) *The authors may want to pay attention to a just accepted manuscript in AST (https://www.tandfonline.com/doi/abs/10.1080/02786826.2018.1474167) on the similar topic as in Sections 4.5 and 4.6.*

We have added a reference to the corresponding relevant article in our introduction.