RESPONSE TO COMMENTS
Title: Mapping the performance of a versatile water-based condensation particle counter (vWCPC) with COMSOL simulation and experimental study
Journal: Atmospheric Measurement Techniques
Ref: AMT-2023-45

Reviewer #1:

Comment: The only thing which is missing in this interesting work is the response time vers the diameters of the tube.
Response: Thank you for your positive feedback. In this study, we varied the diameter of the growth tube to examine how it affects the particle activation and growth under the assumption that the introduction of aerosols is under steady state. Therefore, the response time of the vWCPC is not considered, and it does not affect the particle activation efficiency. However, if the aerosols are introduced into the vWCPC in a pulsed manner, the wider diameter of the growth tube will lead to a longer residence time of the particles, which will eventually lead to a longer response time. Assuming that the flow rate through the growth tube is constant, the residence time of particles in the growth tube is proportional to the volume, and therefore, to the cross section area of the growth tube or the square of tube diameter. Under the same assumption, we would expect that the response time is also proportional to the square of the tube diameter.

Comment: Few questions and comments on the other hand:

The details given by the authors about the changes made in the 'modified commercial water CPC' are not clear or not enough. Indeed the authors are talking about changes in a 'commercial' version of the CPC. That could be taken to mean by the reader as some thing doable by any body who has a TSI 3789 CPC. Few details about the 'modified commercial water CPC' will be very helpful for the reader. What was the change made in the CPC compared to the commercial version? What are the benefits or advantages provided by these changes?It will help the readers to have an exhaustive description of the modified commercial instrument.

Response: We have comprehensively revised and enhanced the details of the modified commercial water CPC in Section 2.2. This incorporates more thorough information from the previously published work by Mei et al., 2021. The main benefit of these revisions is to make this version of the water CPC usable for low-pressure applications, which is the goal of this study to characterize the performance of the vWCPC at low pressures. To clarify the name, we use "modified vWCPC" throughout the paper. A detailed description of the modified water CPC is provided in Section 2.2, as below.

"The modified vWCPC 3789 (TSI Inc, Shoreview, MN, USA) was tested in this study. Given that the standard commercially available vWCPC 3789 is not specifically designed for low-pressure applications, some modifications were made to the instrument for this study. First, the vWCPC 3789 was tested to ensure its vacuum tightness, and the exhaust line was filtered and returned back to the make-up flow line after a flow buffer. Second, we added pressure transducers to the inlet and exhaust lines of the vWCPC 3789 to monitor the inline pressure variation. Note that the aerosol flow rate through the condenser tube and optical particle detector

was 0.3 L min^{-1}. When we operated with 0.6 L min^{-1} inlet aerosol flow, we blocked the make-up flow port. Details of operating flow, temperatures and geometry are provided in Section 2.1.1. Further specifics can be found in our previous study (Mei et al., 2021)."

Why this particular temperature of the initiator 59°C (default value) rather than 60°C for example?

Response: Although our experiments did not include specific tests at initiator temperatures of 59 ℃ and 60 ℃, our simulations showed that particle activation and droplet growth performance are similar within this temperature range. Consequently, we adhered to the default temperature of 59 ℃ for the TSI vWCPC throughout this study. To further investigate the potential impacts of temperature differences on particle activation and droplet growth performance, we evaluated and conducted tests under a diverse set of temperature conditions.

Comment: Is their a large difference if one takes 60°C. What is the precision on the temperature measurement?

Response: Our simulation work did not show significant differences in the vWCPC performance between 59 ℃ and 60 ℃. However, it is important to note that the simulated temperature may not exactly reflect the actual temperature in the vWCPC. As for temperature measurement accuracy, the sensor in the vWCPC may present an error margin of ±1 ℃, and it may potentially degrade over time. In this study, we adhered to the default temperature precision settings in the simulation and measurements.

Comment: The authors should cite the previous work of Ahn & Liu

Ahn, Kang-Ho and Liu, B. Y. H. (1990) Particle activation and droplet growth processes in condensation nucleus counter--I. Theoretical background J. Aerosol Sci. 21, 249-261.

Ahn, Kang-Ho and Liu, B. Y. H. (1990): Particle activation and droplet growth processes in condensation nucleus counter—II. Experimental study. J. Aerosol Sci. 21, 263-275.

Response: Thank you for providing the references. We have cited these two valuable papers in our revised manuscript.

We thank the reviewer for his comments. This has improved our manuscript and we look forward to the paper being accepted for publication.