Author's response to the anonymous reviewer#1

This manuscript describes a method for calibrating the number concentrations obtained from a particle number size distribution (PNSD) instrument. This system is designed to run autonomously and reliably, which would result in criteria for judging the accuracy of the PNSD. This method addresses the need for well-defined standards for the performance of PNSD measurements, which are critically needed for assessing the impacts of aerosols on climate and air quality. Therefore it is worthy of consideration for publication in AMT. I have one rather major concern about this manuscript, and a few minor issues about which I would like to see clarification.

Answer:
The authors thank the anonymous reviewer for his useful comments.

My primary concern is about the size range that the investigators have chosen for their concentration calibration method. On page 10556, line 7, the authors begin a paragraph that describes the importance of resolving uncertainties in PNSD measurements below 20 nm in mobility diameter. Issues such as CPC detection efficiency (shown in Fig. 2), transfer efficiency and voltage setpoints of the DMA, and charging efficiency all contribute to the greatest need for a calibration standard at particle diameters that range from the cutoff diameter of the CPC (_5 nm) to around 20 nm, at which point the above-mentioned issues become somewhat less important. However, for the method described in this manuscript the investigators chose a diffusion cell with a cutoff at about 20 nm (Fig. 5). As such, this setup does not appear to address the authors' requirement (line 11 of page 10556): "Therefore, a main objective of the automated function control with diffusion screens is the elimination of such uncertainties, which appear when total PNCs derived from mobility particle size spectrometers and CPCs are compared." In view of this, I would like for the authors to state why the cutoff diameter of their diffusion cell was specified at _20 nm in diameter, and not smaller. Was it not possible to build a system that has a cutoff diameter at 10 nm mobility diameter? It would seem to me that the method as presented in this manuscript would result in an underestimate of the uncertainty of the PNSD measurement, since most of these uncertainties are derived from the diameter range of 5 – 20 nm and often this size range dominates the PNSD.

Answer:
The scope of this paper is to present a method to check long-term stability of mobility particle size spectrometers, leaving the sub-20nm particles unattended. To clarify, why the cut-off at 20 nm was chosen, we will add the following paragraph in the revised manuscript:
"…Thus, to ensure comparability between total PNCs derived from mobility particle size spectrometers and CPCs, the automated function control should be equipped with diffusion screens with a 50% cut-off diameter around 20 nm. The purpose of the diffusion screens is, thereby, the removal of the high fluctuating sub-20 nm particles and the reduction of the total particle number concentration below 1×10^{4} cm^{-3} in order to comply the particle concentration range for this CPC type…."

Some minor comments/questions:

1. page 10555, line 13: the phrase "in that order" does not follow the rest of the sentence. I believe the authors mean to say that the 2 lpm flow is split equally into flows of 1 lpm for each of the instruments.

Answer:
Exactly, will be corrected in the revised manuscript.

2. Figure 6: I understood that the PNSDs were obtained for a full year, but the data show significant gaps up several months. Is that because the instrument was not operating properly during those periods?

Answer:
This seems to be misunderstanding. The gaps in the measurements are due to the circulation of the transfer CPC between the three measurements sites for fine and ultrafine particles in the Saxon air quality monitoring network as described in line 26 on page 10553 and line 17 on page 10555.