

Interactive comment on “Aerosol effective density measurement using scanning mobility particle sizer and quartz crystal microbalance with the estimation of involved uncertainty” by B. Sarangi et al.

Anonymous Referee #1

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The article presents a SMPS–QCM method to determine the effective density of airborne submicron particles with time resolution of about 120 seconds per scan. The system successfully determined the mass of different laboratory generated inorganic salt nanoparticles with deviation less than about 10 %. The uncertainties of the system were discussed in detail and the major factors were revealed. After that, the system was applied to measure the effective density of atmospheric submicron particles at an urban site successfully. The correlation between the effective density of the particles and their electrical mobility diameter and other meteorological data was discussed.

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The study is a great contribution to the real-time measurement of particle effective density in a simple manner. The following points need to be clarified: 1) In the section of the Experimental setup, an assumption was made that the salt particles were spherical and thus the electrical mobility diameter is the same as the aerodynamic diameter. Do you think it is a fair assumption? If the density of a sphere is greater than 1 g/cm³, the aerodynamic diameter becomes larger than the electrical mobility diameter due to the heavier mass compared to the droplet of the same size. Similarly, the aerodynamic diameter becomes smaller than the electrical mobility if the particle density is smaller than 1 g/cm³. Would the assumption contribute to the uncertainty of the determination of the effective density? 2) Some major uncertainties to the SMPS–QCM system have been uncovered. It would be greatly appreciated to provide some suggestions or solutions to reduce the uncertainties. For example, as discussed in 3.2.3, one of major uncertainties is that the volume of particles derived from the CPC and the QCM data would not be equal, which is opposite to the assumption made in the study. It would be appreciated to provide the details about how the volume was derived from the QCM. If the QCM-derived volume was based on the mass data and the literature density, then the error may directly come from the mass sensed by the QCM. In contrast, if the volume was based on the size distribution in aerodynamic diameter, then the particles bounced from collecting stage to lower stage may shift the size distribution to smaller side and result in the underestimation of the QCM-derived volume. Moreover, does the assumption that the electrical mobility diameter is the same as the aerodynamic diameter contribute to the discrepancy? 3) The standard deviation in figure 4 is large that the difference between the data in each day become insignificantly. In the study, the daily average data of the CMD, number concentration and effective density of the atmospheric particles taken over 10:00 to 13:00 were used to correlate to various meteorological data. The SMPS–QCM determines the effective density real-time, while the meteorological data were taken hourly. Would the use of the hourly particle information reduce the standard deviations and refine clearer trends in the correlation analysis? 4) As discussed in section 3.3 at page 27, the daily mean particle number

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concentration is strongly correlated to CO and NO_x, of which is related to traffic related emission. However, both the CO and NO_x dropped significantly on Dec 16 with unclear reason. Is there any information or data about the traffic in related regions? For example, the field sampling was done 7 days in a row. Daily and hourly traffic flow as well as traffic types in ordinary days and holidays may be different and thus could be directly related to the drop. It would be appreciated to have more information to support the inference of the traffic exhaust. Other points: 1) In section 3.2.2.3 at page 17, an unit of cm³ should be noted for the value shown in the sentence of "The uncertainty estimated from DMA calibration using PSL-60 nm by Eq. (20) is 55.62 ± 1.53 (with coverage factor $k=2$)."

2) It would be appreciate to notify the Monday to Sunday for the sampling day in the article for more complete information for readers.

Interactive comment on Atmos. Meas. Tech. Discuss., 8, 12887, 2015.