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Local Physical Chemistry Statements for Low cost sensor added value

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Air quality monitoring with a high spatial and temporal resolution is essential to understand the sources, processes, and impacts of air quality (AQ) on human health and the environment, especially in densely populated urban areas. Current state-of-the-art instruments don't allow for such a high spatial resolution AQ monitoring due to costs. Low cost sensors (LCS) provide an opportunity to bridge this divide. There is a large volume of research papers assessing the performance of LCS for particulate matter (PM) against reference PM instrumentation. Across most studies, a general observation is that LCS PM sensors as offered by the commercial and research markets have an inherent problem with accuracy at high relative humidities and for varying PM composition.

This study uses measured and modelled chemical composition of $PM_{2.5}$ at the Manchester UK urban supersite to addresses the underlying physical chemistry which leads to the mass of the measured PM. Measurements from LCS and reference PM instruments co-located with state-of-the-art research chemical composition and meteorology. To calculate the composition of $PM_{2.5}$, we used XACT for metals, the ACSM for salt ion concentrations, and an Aethalometer for Black Carbon. From this, the LCSs variability in data can be understood. We present a comparison of LCS $PM_{2.5}$ concentrations with measured and calculated total $PM_{2.5}$ concentrations from reference instruments for time periods with different Air Quality characteristics and discuss the physico-chemical characteristics leading to varying results of low cost PM sensors. The future research will apply methodology to modelled UK wide data and develop tools for non specialist users to understand LCS in terms of local air pollution and specifically $PM_{2.5}$ chemical composition and meteorology.