

On the Use of Low-Cost Sensors for Particulate Matter Monitoring

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Abstract

Low-cost sensors (LCS) have brought the promise of expanding particulate matter (PM) monitoring by facilitating a simpler deployment of monitoring equipment. The use of LCS side-by-side with traditional, research-grade equipment has however shown significant discrepancies and, as the literature is now rich in showing, methodologies have been developed to overcome the differences by applying diverse calibration strategies. Such strategies often rely on machine-learning techniques and make use of environmental variables, e.g., relative humidity. However, applying the developed calibration to other settings (other sensor units, other meteorological settings or other source mixes) is not trivial and often results in degraded performances. In this work, we investigated a possible cause behind such behavior. In particular, we researched the performance of a widespread LCS in terms of particle counting, which is the basis of any calibration (be it the proprietary calibration from the manufacturer or any in-house calibration). As such, the particle counting was checked against the readings of a research-grade instrument. The LCS exhibited erratic performance, which can be parameterized as a function of the ambient particle number concentration, albeit the result spanning up to two orders of magnitude. The LCS exhibited a large range in terms of performance related to particle number concentration. The results showed that it is possible to parameterize the performance as a function of the ambient particle number concentration, albeit with the error term spanning up to two orders of magnitude. Despite such issues with performance for certain particle sizes, we show that the information derived from LCS for PM monitoring can still be relevant for research, either by using the units to investigate changes in PM concentrations caused by the onset of a policy, or using the PM reported by LCS units as indicative measurements as defined by the European Directive on Air Quality.

Early Career Scientist

NO, I am not an early career scientist.

IGAC Activities

Allin-Wayra: Small Sensors for Atmospheric Science