Scientific Research Abstracts
Vol. 8, p. 11, 2018
ISSN 2464-9147 (Online)
Atmospheric Dust - DUST 2018


# SUITABILITY OF THE LOW-COST SDS011 PARTICLE SENSOR FOR URBAN PM MONITORING

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In Particulate Matter (PM) monitoring, a paradigm shift towards incorporating distributed sensing approaches using low-cost sensors has begun [1]. In past research, early generations of low-cost particle sensors based on IR light scattering have been compared with official measurement stations, showing that these sensors can in principle capture the dynamics of ambient PM levels [2,3], but may suffer from low calibration stability [2], are unable to differentiate size classes [3], and may be susceptible to other sources of error [4]. Current low-cost sensor generations that rely on laser scattering claim to exhibit a better level of stability and feature internal digital processing in order to achieve more accurate results. While they are mostly designated as PM2.5 sensors, some also output values for PM10 and/or PM1.

As a representative of this class of sensors, we examine the SDS011 laser-scattering PM sensor [5]. It is already widely used in deployments around the world, e.g. in the German grassroots citizen science project “luftdaten.info” (http://www.luftdaten.info), in which volunteers have deployed hundreds of these sensors in urban areas. In previous work, co-location measurements between the SDS011 have already been performed [6], the results of which indicate that the sensor delivers adequate correlation under typical conditions (relative humidity of 20-50% and PM10 mass concentrations < 20 $\mu g/m^3$) but performs less well under other ambient conditions, especially high humidity. To further explore the sensor's data quality in-depth, we present the key influencing factors on measurement uncertainty of the low-cost sensor, along with a series of experiments to appropriately assess its potential and limitations:

• Investigation of the humidity influence and possibilities for its compensation.
• Comparison of the SDS011 sensor and a Welas2100 monitor using monodisperse aerosol of different sizes.
• Characterization of the mass distributions the SDS011 can capture, based on experiments with different generated particle spectra and using the Grimm 1.108 aerosol spectrometer as reference.
• Longer-term comparison (days) of 13 SDS011 and a Scanning Mobility Particle Sizer (SMPS) exposed to (1) ambient air, (2) artificial aerosol (ammonium sulfate) levels, and (3) black carbon/soot.

From the results of these experiments, we present the causes of the sensor's measurement uncertainty in our talk. We show that the sensor generally does not capture PM10 satisfactorily and discuss under which conditions PM2.5 readings reflect the ambient air quality adequately.

[Acknowledgements: Partially funded as part of BMBF project "Software Campus" (grant no. 01IS12051) and BMVI project "SmartAQnet" (grant no. 19F2003B).]

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