



Evaluation of OPC-N3 in an Urban Environment in Western India

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Low-cost optical particle counters (OPCs) are increasingly used to supplement regulatory air quality measurements, yet their performance remains strongly dependent on aerosol characteristics and environmental conditions. In this study, five OPC-N3 sensors were co-located with a research-grade GRIMM 11-D aerosol spectrometer and evaluated using hourly measurements from an urban polluted site in western India (Ahmedabad) during September 2025. Mean \pm standard deviation $PM_{2.5}$ (PM_{10}) concentrations during the colocation period were 25 ± 10 (82 ± 37) $\mu g/m^3$, whereas temperature and relative humidity (RH) were 30 ± 3 °C and 74 ± 14 %.

OPC-N3 sensors show moderate to strong correlations with the GRIMM for PM_1 , $PM_{2.5}$, and PM_{10} ($r \approx 0.7$ - 0.9), demonstrating good capture of temporal variability, but consistently underestimate PM mass ($PM_{2.5}$: normalized RMSE ≈ 23 - 37%). The regression slopes increase from PM_1 (0.3-0.5) to $PM_{2.5}$ (0.5-0.7) and remain similar for PM_{10} , indicating relatively better performance for coarser fractions. To diagnose the drivers of OPC response, the influence of meteorological parameters and the reference $PM_{2.5}/PM_{10}$ ratio was quantified using their correlations with normalized OPC measurements (OPC/GRIMM PM ratio). The normalized OPC PM shows moderate positive correlations with RH ($r \approx 0.4$ - 0.5) and moderate negative correlations with temperature ($r \approx -0.3$ to -0.5), highlighting the important role of meteorology and hygroscopic growth in governing OPC response. The normalized OPC PM showed near-zero correlations with the reference $PM_{2.5}/PM_{10}$ indicating that the underlying aerosol size distribution is probably not playing a big role in OPC performance in this environment. OPC-derived aerosol size distribution captures broad features similar to the reference, with minimal diurnal variability.

Overall, the results demonstrate that OPC-N3 sensors are suitable for capturing relative variability and trends but require environment- and size-fraction-specific calibration. In particular, OPC performance is primarily governed by meteorological conditions in polluted urban environments, underscoring the need to explicitly account for meteorology for reliable PM mass estimation across diverse environments.