Temporal changes in field calibration relationships for Aeroqual S500 O3 and NO2 sensor-based monitors

ABSTRACT

Sensor-based monitors are increasingly used to measure air pollutant concentrations, but require calibration under field conditions. We made intermittent comparisons (6 times over a 6-month period) between ozone and nitrogen dioxide concentrations measured by Aeroqual gas-sensitive semiconductor (O3) and electrochemical (NO2) sensors (two of each) and reference analysers in the UK Automatic Urban and Rural Network. Each deployment period was split into equal (n = 48×1-hour) training and test datasets, to derive and test calibration equations respectively. We observed significant bivariate linear relationships between Aeroqual O3 and Reference O3 concentrations, and significant multiple linear relationships between Aeroqual NO2 and both Reference NO2 and Aeroqual O3 concentrations. Changes in monitor responses over time (including apparent baseline drift in O3 sensor output, and discrepancies between the 2 Aeroqual NO2 sensors) resulted in relatively inaccurate concentrations estimates (cf. reference concentrations) from calibration equations derived in the first training period and applied to subsequent test deployments (e.g. NO2 RMSE = 47.2 μg m−3 (n = 286) for a dataset of all test periods combined, for one of the two monitor pairs). Substantial improvements in accuracy of estimated concentrations were achieved by combination of repeated intermittent training data into a single calibration dataset (NO2 RMSE = 8.5 μg m−3 for same test dataset described above). This latter approach to field calibration is recommended.

Keyword: Air pollution; Sensors; Aeroqual; Nitrogen dioxide; Ozone