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Metrology for NO_2: validation of a selective spectroscopic technique for measuring NO_2 and a field-based comparison with the standard chemiluminescence method

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Nitrogen dioxide (NO_2) is a toxic air pollutant associated with many adverse effects on human health. Short-term exposure to elevated NO_2 levels can irritate airways in the respiratory system, whilst longer exposures may contribute to the development of asthma and potentially increase susceptibility to lung infections. NO_2 plays an important role in ozone and secondary particle formation and can substantially influence the oxidation capacity of the atmosphere. The nature of NO_2 as an acidifying gas has important implications for acid deposition, nutrient deposition and ecosystem damage.

There is increasing pressure across Europe to implement more effective air pollution mitigation strategies for the reduction of NO_2, to reduce the health and economic burden associated with exposure to high levels. To achieve this, improved NO_2 measurement accuracy is required to enable greater confidence in measured NO_2 concentrations and emissions. The European Metrology for Nitrogen Dioxide ($MetNO_2$) project aims to make the necessary improvements by developing direct NO_2 measurement techniques and calibrating instruments with more accurate NO_2 standards, in addition to fully characterising and minimising impurities in NO_2 reference standards.

Cavity attenuated phase shift spectroscopy (CAPS) is a NO_2 measurement technique capable of performing fast, trace-level measurements of NO_2 in ambient air. Unlike indirect techniques, where NO_2 is calculated as the difference between NO and total NO_x, the CAPS NO_2 analyser is a spectroscopic technique that measures NO_2 directly. The low maintenance, low power consumption and portability of the instrument means that it is suitable for deployment at long-term ambient monitoring stations. This study will present the results from a series of instrument performance tests carried out to characterise and validate the CAPS NO_2 analyser. Evaluated parameters include instrument drift, response time, linearity and potential interferences from NO and H_2O.

Initial results from a field-based instrument comparison study will also be presented. Deployment of the CAPS NO_2 analyser at an urban traffic air quality monitoring site in London (UK) has allowed for an assessment of ambient NO_2 data quality using an indirect method (the standard reference method of chemiluminescence detection) versus a direct method (CAPS NO_2 analyser). Instrument calibration has relied on the use of new, highly accurate static primary reference standards of NO_2, developed as part of the $MetNO_2$ project. In summary, this study presents an important contribution towards validating selective spectroscopic techniques for directly measuring NO_2 and comparison with the standard reference method used across the air quality monitoring network.