



Investigation of the Nitrogen Dioxide Pollution in Urban Areas using a New Portable ICAD Instrument

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Nitrogen oxides (NO_x) and especially nitrogen dioxide (NO_2), are still among of the most problematic pollutants in urban areas not only in developing, but also in industrialized countries. Despite the measures taken to reduce their emissions, NO_2 concentrations in many urban areas exceed the WHO recommended limits of $40 \mu\text{g}/\text{m}^3$ for annual mean and $200 \mu\text{g}/\text{m}^3$ for 1 hour mean. Additionally it is known that the NO_2 concentration in urban areas has a strong spatial and temporal variability, due to the large number of NO_x emitting point sources (mainly traffic) found in densely populated areas. However, the layout of air monitoring networks in most urban areas, installed to continuously monitor the officially prescribed NO_2 limits, does not reflect the high spatial variability because they only conduct measurements at a single or few selected sampling points, mainly on major roads, which are often not representative for the whole urban area. At present these uncertainties about the spatial NO_2 distribution constitute severe limitations for the assessment of health risks, for the quality of chemical model calculations, and for developing effective measures to reduce NO_x emissions.

We developed a new light-weight and portable ICAD (Iterative Cavity Enhanced DOAS) instrument which detects NO_2 at a detection limit as low as $0.2 \mu\text{g}/\text{m}^3$ with a high time resolution of seconds. The instrument is based on the Cavity Enhanced (CE-) DOAS technique, which directly identifies and quantifies NO_2 by its differential optical absorption. Therefore, it does not suffer from interferences by other trace gas species like O_3 or NO_y . This is a great advantage over other NO_2 instruments (e.g. solid state detectors or chemiluminescence instruments).

We present the result of ICAD NO_2 measurements, which we recently performed in more than 10 German cities. The ICAD instrument was mounted on mobile platforms like cars and bicycles, measuring the NO_2 concentrations along carefully selected tracks. Also several stationary measurements were performed at selected sites. We found that high NO_2 concentrations exceeded pollution limits across extensive areas of the cities. Contrary to expectations we found high NO_2 concentrations also away from heavily traveled roads e.g. in residential areas and close to kindergartens and schools and even indoors. Thus, the exposure of the populations to NO_2 is much higher than expected, which results in higher health risks, particularly for children and elderly people who are risk groups.