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Observation of the NO_2 distribution in cities with mobile ICAD measurements

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Nitrogen Dioxide (NO_2) is currently the most critical air pollutant in Europe. The main source is traffic, especially of diesel engines. However, our knowledge of the NO_2 concentration, its distribution and real personal exposure is relatively low, as its based only on very few measurement stations per city and models. Smaller cities have even no measurement station at all.
On order to improve our knowledge, we performed mobile NO_2 measurements in different German cities (Mannheim, Heidelberg and Walldorf) to produce representative distribution maps. Measurements were conducted on a bicycle at $\sim$1.6m height and as good as possible next to the road to be comparable to data from permanent measurement stations. Along a predefined route through the city, covering very different pollution levels, we performed repeated measurements. Different traffic and weather conditions were covered.
In order to realize such type of measurements, we use the new mobile ICAD NO_2 instrument (Airyx GmbH), which can achieve an accuracy of better 1ppb even at 2 seconds integration time. The robust and low power setup is ideal for this kind of fast and mobile measurements with high accuracy.
The distribution maps show clear features with highest concentrations at high traffic roads with low air ventilation. Just few meters in a side road, the concentrations drop quickly to background levels. At several high traffic locations even with good air ventilation like on bridges, along the river or broad roads, we found high concentrations, much higher than in the basic models used by the city. The reason is the close location to the vehicle emissions. Additionally along a high traffic road, the concentrations vary significantly even if traffic is similar. We observe regularly the same local variation. They do not only correlate to traffic lights but also to local air ventilations in the street. The data shows that the real NO_2 distribution is much more complex than often expected. From a single point measurement, it is difficult to derive a representative emission level as it depends highly on the detailed location. This may also have a significant influence on the existing stationary measurement network.
Measurements in the city of Walldorf focus to investigate a representative location of a new permanent measurement station. We demonstrate that derived distribution maps from such mobile measurements are a good tool to investigate such locations.