Development of airbox (NO2, PM10, PM2.5) and its application as network in city of Eindhoven

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DEVELOPMENT OF AIRBOX (NO_2, PM10, PM2.5) AND ITS APPLICATION AS NETWORK IN CITY OF EINDHOVEN

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Abstract
During recent years ECN developed high quality sensors for pollutants in ambient air. Currently developed sensors for PM2.5, PM10 and NO_2 are applied for third parties. Field of application are urban air quality and emission monitoring from transit storage and handling of dry bulk like ore and coal. Low cost high quality sensors are of importance to operate high density networks which are desired both for urban areas and around transit areas but are not available.

Figure 1. Airbox

The sensors are placed in a weatherproof enclosure, the AirBox. The AirBox communicates by GPRS every 10 minutes with a server to upload the data and to accept new firmware if requested. Meanwhile data is kept safe locally on a SD card. The sensor set up is modular. The box is battery operated and usually mounted on a streetlight for charging at night time.

The first urban air quality network was installed in October 2013 in Eindhoven, The Netherlands. The network represents 35 locations at relevant places like hospitals, traffic hotspots, construction sites, railways and back ground stations. The project is funded and operated by members of the Aireas community [1], a joint venture of local authorities, active citizens, technological institutes and universities. A driver was to create a network platform that could form the basis for various types of new initiatives, scientifically, commercially and to enhance sustainability. These activities are currently taking off. City hotspots become visible at low wind speed conditions. Figure 2 was made in cooperation with TU Twente.

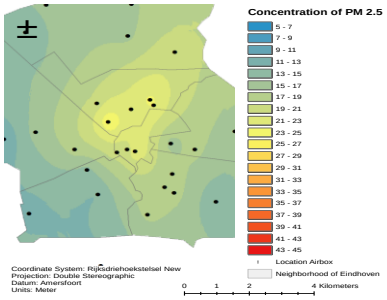

Figure 2. PM2.5 distribution

The sensors are commercially available low cost detectors that have been enhanced. We improved sensors by using the knowledge acquired by 30 years of experience with development of highly sophisticated instrumentation like MARGA [2]. The PM sensor is a simple optical sensor smartly interfaced, revealing also the size distribution and operational information. The UFP fraction can still not be detected. NO_2 is detected by means of an electrochemical sensor. This sensor type is however highly sensitive for variation in relative humidity and other gases. We applied a method to deal with these issues in situ (patent pending).

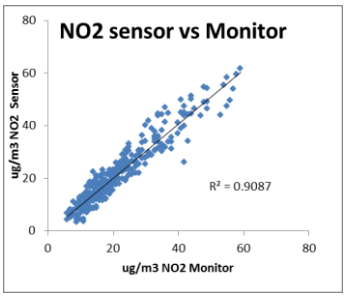

Figure 3. NO_2 sensor performance

In the field the sensors are calibrated against reference methods. Precision and variation of accuracy were characterised at rural and urban locations. Figure 3 for NO_2 is a comparison with a chemiluminescence monitor. Hourly averages are shown for a period of 2 weeks.

During an October storm in 2013 the precision of the installed PM sensors (25 at that time) in Eindhoven was assessed by means of the relative standard deviation. Above 5 ug/m^3 the RSD converge to 10%. Taking into account residual local effects the RSD is at least better than the results shown. For hourly averaged values the RSD converge at 8%.
Currently equivalence testing with reference methods are performed by GGD Amsterdam for PM and NO_2. According to the directives tests will be executed at 4 different locations and seasons.

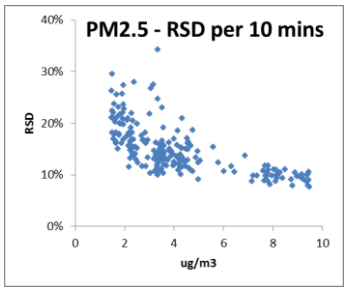

Figure 4. Precision PM sensor

References

1. www.aireas.com
2. I. C. Rumsey, K. A. Cowen, J. T. Walker, T. J. Kelly, E. A. Hanft, K. Mishoe, C. Rogers, R. Proost, G. M. Beachley, G. Lear, T. Frelink, and R. P. Otjes, An assessment of the performance of the Monitor for AeRosols and GAses in ambient air (MARGA): a semi-continuous method for soluble compounds, *Atmos. Chem. Phys., 14 (2014) 5639-5658*

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