

## Measuring air pollution with sensor systems

How can we use new technology to better measure the air we breathe?

### Sensor testing @ European level

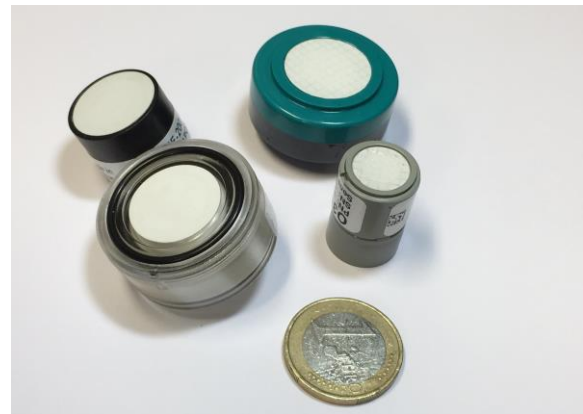
The European Commission's Joint Research Centre carries out a research project related to air pollution measurements with sensors. Within the *sensEURcity* project, sensor networks will be deployed and evaluated in the cities of Antwerp (BE), Oslo (NO) and Zagreb (HR). These campaigns aim at testing the suitability of sensor systems to complement classical air monitoring stations and networks.



### Air Quality Sensors

#### The attractiveness of sensors and sensor systems

Low-cost air pollution sensors are attracting more and more attention. They offer air pollution monitoring at a lower cost than conventional methods, in theory making air pollution monitoring possible in many more locations. Too good to be true? At the current stage of development, unfortunately we have to conclude yes. However, due to their lower cost and compactness, they offer opportunities to install more dense networks. If the quality of the sensor based measurements can be improved, sensors could become a game changer in monitoring air pollution, traffic management, personal exposure and health assessment, citizen science and air pollution assessment in developing countries.



#### What types are existing?

There are several categories of sensors currently available: Electrochemical sensors are based on a chemical reaction between gases in the air and the electrode in a liquid inside a sensor. In a metal oxide sensor (resistive sensor, semiconductor) gases in the air react on the sensor surface and modify its resistance.

A photo ionization detector ionises volatile organic compounds and measures the resulting electrical current. Optical particle counters detect particulate pollution by measuring the light scattered by particles. Optical sensors detect gases like carbon monoxide and carbon dioxide by measuring the absorption of infrared light.

#### How reliable are those measurements?

The signals from sensors not only depend on the air pollutant of interest, but also on a combination of several effects, such as other interfering compounds, temperature, humidity, pressure and signal drift/stability. At high concentrations the signal from the air pollutant is strong, but at ambient air levels the signal can be weaker in comparison to the interfering effects. The quality of sensor results therefore depends on technology and implementation (application, site, conditions, set-up).

Calibration models applied for one location, are not always transferrable to other type of locations or at other meteorological conditions. Reproducing sensor responses at different measurement sites or under different conditions can be difficult, and simple correction or calibration is not always possible.

Nevertheless, in certain well-defined situations, the measurement uncertainty of these devices may approach the level of 'official' measurement methods.

### Why do measurements from a sensor and from an official monitoring station differ?

An air pollution analyser inside an official monitoring station uses a well-defined, standardised and selective principle. Analysers are type approved and tested for interferences and under varying conditions. The environment in official monitoring stations is controlled, their instruments are regularly checked, and the measurements are subject to rigorous quality control and calibration procedures, in accordance with European legislation and international standards.

Sensors can be sensitive to weather conditions (wind speed, temperature, humidity) or can have difficulties distinguishing pollutants. When using sensors, the measurements should be carefully evaluated and validated.

## sensEURcity

### What is the project about?

In this project, an air quality sensor network is deployed in Antwerp, Oslo and Zagreb. This project will support the JRC with the performance and capability evaluation of lower-cost ambient air quality sensor systems and with the comparison of lower-cost air quality sensor systems to conventional air quality monitoring. Sensors are tested under different environmental and meteorological conditions in different cities over different seasons.

### What is exactly happening in this sensor project?

The project is mainly focussing on the air pollutants nitrogen monoxide (NO), nitrogen dioxide (NO<sub>2</sub>), ozone (O<sub>3</sub>) and particulate matter (PM). Sensors for those pollutants have been installed in a sensorbox, called the "AirSensEUR" sensor system. The sensor system additionally measures temperature, humidity and the ge-positioning of the system. More than 30 sensor systems are installed in the city of Antwerp and Oslo and nearly 20 sensor systems are installed in the city of Zagreb. Installation is done at reference stations and at locations where no measurement data is yet available. Data are sent to a database for further processing and analysis, such as a comparison with data of reference stations and air quality modelling results. The final aim is on one hand to define best practices for deployment and quality control, including the application of calibration models for sensors, and on the other hand to advise on how sensor based measurements can complement the existing networks and air quality assessments.

### Who is involved?

sensEURcity is carried out by four institutes with experience in the field of (sensor based) air quality measurements: **VITO**, the Flemish Institute for Technological Research, **VMM**, Flanders Environment Agency, **NILU**, the Norwegian Air Research Institute and **IMI**, the Croatian Institute for Medial Research. The project is supported by the respective city authorities.

sensEURcity is performed in close cooperation with the European Commission's Joint Research Centre and based on their research and development work in the field of lower-cost ambient air quality sensors.

The project is funded by the EC under contract "Deployment of a lower-cost ambient air quality sensor system in three cities: Antwerp, Oslo, Zagreb"

07027747/2019/812686/SER/ENV.C.3 and is referred as "SensEURcity".



### Where can I find the data measured during the campaigns?

The data delivered by the sensor systems have to undergo a post-processing, where signals are calibrated and corrected. For example the raw data need to be further corrected for temperature, humidity or interference dependencies. Therefore it is not possible to make the sensor data available in real time.

At a later point all results of the measurement campaigns and the project will be published by the Joint Research Centre.

Air pollution online data delivered by the official air monitoring stations are publically available at the following websites:

Belgium: <https://en.vmm.be/air> or

<https://www.vmm.be/lucht/luchtkwaliteit>

Norway: <http://luftkvalitet.info/>

Croatia: <https://zrak.imi.hr>

Europe: <https://www.eea.europa.eu/data-and-maps/explore-interactive-maps/up-to-date-air-quality-data>