European Metrology Research Programme

Delivering Impact

A new facility for ambient-like aerosols

Monitoring pollution is key for protecting public health, as well as understanding and reducing the effects of climate change. However, measurement and calibration methods for monitoring particulate matter in air were either unsuitable or very time-consuming, and there has been a lack of facilities to generate a full range of reference materials for ambient-like aerosols.

Europe's National Measurement Institutes working together

The European Metrology Programme for Innovation and Research (EMPIR) has been developed as part of Horizon 2020, the EU Framework Programme for Research and Innovation. EMPIR funding is drawn from 28 participating EURAMET member states to support collaborative research between Measurement Institutes, academia and industry both within and outside Europe to address key metrology challenges and ensure that measurement science meets the future.

Challenge

Particulate matter (PM) in air – such as dust, soot, and smoke – poses risks to both human health and the environment. It is estimated that over 500,000 deaths in Europe every year are caused by PM exposure and areas of high PM concentration are associated with reduction in life expectancy of 12-36 months. PM is typically monitored by air monitoring networks which connect many in-situ stations. The EU Air Quality Directive requires the measurement of PM mass concentration of particles with diameters smaller than 10 micrometre (PM_{10}) and smaller than 2.5 micrometre ($PM_{2.5}$). Currently, PM monitors and low-cost sensors are compared with the EU reference method based on time-consuming field campaigns, which can last up to several months. Therefore, there has been need to develop a traceable method to create ambient-like aerosols of known concentration and composition. These could then be used for an array of applications such as calibrating aerosol monitors and validating measurement methods in the laboratory.

Solution

During the AEROMET project, METAS, the National Measurement Institute for Switzerland, developed a facility for generating ambient-like aerosols. The facility, known as PALMA, is able to produce samples for an array of PM types, including elemental carbon, inorganic salts, mineral dust and water, and is tuneable to produce the required particle chemistry, size distribution and mass concentration. These aerosols were characterised through a number of methods, including ion chromatography and thermo-optical analysis, and tested via a proof-of-concept intercomparison of three commercial PM monitors. The facility is now in use to simulate ambient aerosols for calibrating PM monitors and low-cost sensors, with two calibration campaigns for instrument manufacturers running every year. Such a laboratory-based calibration is completed within only a few days.

Impact

IQAir is a Swiss-based air quality technology company specialising in air monitoring, air quality data visualisation and air purification. They operate the largest global air quality platform, aggregating data from over 130 countries, and their real-time air quality information has been viewed by over 500 million people. They also provide real-time air pollution monitoring for the United Nations Environmental Programme (UNEP) Environmental Situation Room and publish the Annual World Air Quality Report in collaboration with Greenpeace, based on data from over 30 000 monitoring stations.

Calibrations using the PALMA facility have allowed IQAir to improve the accuracy and precision of their community indoor and outdoor air quality sensors, over 50 000 of which are in operation globally. This has been essential for ensuring the sensors offer adequate air monitoring, on par with equipment used by environmental agencies, and provide communities – often otherwise underrepresented – with reliable, real-time air quality information. The facility has also calibrated sensors used by IQAir for the UNEP Environmental Situation Room and the World Air Quality Report.

Traceable calibration of air quality sensors ensures that air monitoring networks make accurate measurements. This accuracy allows citizens to stay informed about the quality of the air they breathe and allows governments and environmental agencies to monitor and manage sources of pollution.

New metrology for monitoring air pollution

The AEROMET project developed measurement and calibration methods for particulate matter (PM) in air, including a new facility for generating ambient-like aerosols. Model aerosol requirements for testing PM monitors were determined, and four model aerosols were characterised. A prototype Micro Smog Chamber was also further developed and partially automated to enhance reproducibility.

The project developed analysis methods applicable to both outdoor air quality analysis and identifying indoor aerosol sources. It produced a technical report on chemically characterising PM using two complementary types of x-ray fluorescence analysis, reported to ISO TC 201, and a good practice guide on sample preparation.

The project also produced data on carbonaceous emissions from wood burning and candles, characterising the relationship between organic and elemental carbon, and contributed to reviews of ISO 15900:2009 and ISO 27891.

These results have supported accurate measurement of PM in air, improving air quality analysis to protect health and allow environmental agencies to measure and control emissions affecting climate change.

EMPIR EURAMET

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