EMPIR Call 2016 – Energy, Environment, Normative and Research Potential

Selected Research Topic number: **SRT-v10**
Version: 1.0

Title: Aerosol metrology for atmospheric science and air quality

Abstract

Reproducible and accurate measurements of aerosol particles are vital for enforcing air quality regulations and protecting human health, as well as determining the effect of aerosol particles on climate change, and understanding relevant atmospheric processes. Currently, important air quality metrics such as Particulate Matter $(PM)_{10}$ and $PM_{2.5}$ (i.e. particles less than or equal to 10 μm and 2.5 μm in diameter, respectively and that make up a large proportion of dust that can be drawn deep into the lungs) are regulated but have a relatively high level of uncertainty. Aerosol particles also play a key role in atmospheric science, and are one of the Essential Climate Variables identified by the Global Climate Observing System (GCOS). A more robust metrological framework for atmospheric aerosol measurements is needed to significantly improve air quality monitoring and help it to meet current EU regulations as well as supporting air monitoring under the GCOS.

Keywords

Air quality; particulate matter (PM); aerosol; fine particles, ultrafine particles; particle number; particle composition; particle number size distribution.

Background to the Metrological Challenges

Ambient aerosol particles are a serious human health issue across Europe and are deemed responsible for 500,000 premature deaths per year within the EU. They have traditionally been regulated for human health purposes by the mass concentration of the size fractions such as PM_{10} and $PM_{2.5}$ within the EU Air Quality Directive 2008/50/EC. However, in parallel with regulations aimed at improving human health, aerosol particles also have an impact on atmospheric science, e.g. their direct effect on the optical properties of the atmosphere via scattering and absorption of radiation, their indirect optical effect via cloud formation, and their chemical interactions. Aerosol properties are one of the Essential Climate Variables identified by the GCOS of the World Meteorological Organisation (WMO) and many of the relevant metrics in the GCOS (such as aerosol particle number concentration and size distribution, and composition) are largely in common with those in the EU Air Quality Directive. Metrology could bring a common basis to these two different fields with benefit to both.

Specific issues associated with measuring ambient aerosol particles are the temporal and spatial variability of their concentrations and composition in ambient air, the range of particle sources (from the directly emitted to those formed by gaseous precursors), the high proportion of semi-volatile particles, their hygroscopicity, and the possible losses of target analyte during sampling and extraction. General rules for the assessment of air quality in the vicinity of point sources, which typically show large spatial and temporal variations, cannot be derived easily. Therefore, it is important to develop strategies for the mobile assessment of point sources, and such strategies should supplement fixed monitoring, modelling and indicative monitoring with flexible in-situ sampling and composition analysis.

Objectives

Proposers should address the objectives stated below, which are based on the PRT submissions. Proposers may identify amendments to the objectives or choose to address a subset of them in order to maximise the overall impact, or address budgetary or scientific / technical constraints, but the reasons for this should be clearly stated in the protocol.

The JRP shall focus on the traceable measurement and characterisation of atmospheric aerosol particles.

The specific objectives are

1. To develop reproducible reference methods for PM_{10} and $PM_{2.5}$, including the design and building of a demonstration chamber system for calibrating PM_{10} and $PM_{2.5}$ instruments using

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representative generated aerosols. The target uncertainties are below 15 %, in line with other major pollutants.

2. To establish traceable validated methods for the major components of particulate matter such as elemental and organic carbon, total carbon, anions and cations and major metals (arsenic, cadmium, mercury, nickel), in order to meet the data quality objectives of current regulation.

3. To develop validated calibration procedures for Mobility Particle Size Spectrometers for ambient measurements in the size range up to 1000 nm, in support of standardisation requirements from ISO TC 24 WG 12 and CEN TC 264 WG 32. In addition, to provide calibration facilities for measuring particle number concentration using Condensation Particle Counters in ambient air according to the standard FprCEN/TS 16976.

4. To develop traceable and reliable analytical techniques (such as electron, optical, x-ray, infrared spectroscopy and mass spectrometry), including flexible particle sampling techniques, for quantifying particle compositions in the field, and in particular for real time analysis.

5. To facilitate the take up of the technology and measurement infrastructure developed in the project by the measurement supply chain (accredited laboratories), by standards developing organisations (such as ISO TC 24 and CEN TC 264 and those linked to the EU Air Quality Directive 2008/50/EC) and end users (e.g. the Network of European Air Quality Reference Laboratories (AQUILA) and European Monitoring and Evaluation Programme (EMEP)).

These objectives will require large-scale approaches that are beyond the capabilities of single National Metrology Institutes and Designated Institutes. To enhance the impact of the research, the involvement of the appropriate user community such as industry, standardisation and regulatory bodies is strongly recommended, both prior to and during methodology development.

Proposers should establish the current state of the art, and explain how their proposed research goes beyond this. In particular, proposers should outline the achievements of the EMRP project ENV01 MACPoll and ENV02 Part Emission, and how their proposal will build on those.

EURAMET expects the average EU Contribution for the selected JRPs in this TP to be 2.0 M€, and has defined an upper limit of 2.3 M€ for this project.

EURAMET also expects the EU Contribution to the external funded partners to not exceed 35 % of the total EU Contribution to the project.

Any industrial partners that will receive significant benefit from the results of the proposed project are expected to be unfunded partners.

Potential Impact

Proposals must demonstrate adequate and appropriate participation/links to the “end user” community, describing how the project partners will engage with relevant communities during the project to facilitate knowledge transfer and accelerate the uptake of project outputs. Evidence of support from the “end user” community (e.g. letters of support) is also encouraged.

You should detail how your JRP results are going to:

- Address the SRT objectives and deliver solutions to the documented needs,
- Feed into the development of urgent documentary standards through appropriate standards bodies,
- Transfer knowledge to the environmental and climate monitoring sectors.

You should detail other impacts of your proposed JRP as specified in the document “Guide 4: Writing Joint Research Projects (JRPs)”

You should also detail how your approach to realising the objectives will further the aim of EMPIR to develop a coherent approach at the European level in the field of metrology and include the best available contributions from across the metrology community. Specifically the opportunities for:

- improvement of the efficiency of use of available resources to better meet metrological needs and to assure the traceability of national standards
- the metrology capacity of EURAMET Member States whose metrology programmes are at an early stage of development to be increased
- organisations other than NMIs and DIs to be involved in the work

Time-scale

The project should be of up to 3 years duration.