Title: Metrology to underpin future regulation of industrial emissions

Abstract

The EU's Climate Change Programme [1] makes a commitment to a 20 % reduction in emissions by 2020 compared to 1990 levels. If the steps taken to reduce emissions by industrial sites (refineries, chemical plant, landfill, shale gas) are to be defensively demonstrated a step-change in the uncertainties of the raft of measurements that are required across all site emission sources is needed. This requires the complete site monitoring problem to be addressed i.e. increased accuracy methods for the calibration of in-situ stack monitoring installations, flow modelling for annualised mass emission, case studies and protocols/standards for remote sensing techniques applied to area sources.

Conformity with the Work Programme

This Call for JRPs conforms to the EMRP Outline 2008, section on "Grand Challenges" related to Energy and Environment on pages 8 and 24.

Keywords

Greenhouse gas, stack emissions, fugitive emissions, regulated species, air pollution, reference methods, calibration, uncertainties, remote sensing, area sources, CEN, IED

Background to the Metrological Challenges

Site emission limits from stack sources have become more stringent for key species (SO_2, NOx, HCl, particulates, etc.) in the EU's Industrial Emissions Directive [2]. Accurate monitoring is critical so that reduction strategies can be seen to be effective in national emission inventories, and site operators can robustly demonstrate compliance to regulators. However, many of these limits are beyond the capabilities of the existing measurement infrastructure. There are a number of key measurement issues in determining the stack sources contribution to site emissions. The EU requires continuous emission monitoring (CEM) systems to be installed on stacks to continually track emitted concentrations. These installations must be calibrated / checked annually, by ISO 17025 [3] accredited stack testing companies, through side-by-side measurements against Standard Reference Methods (SRMs). However, many SRMs are no longer fit for purpose as the uncertainties exceed the concentrations that the CEM systems are monitoring. CEM installations often do not include flow monitoring capability, hence continuous concentration data has to be combined with "snap-shot" flow measurement data recorded by the accredited stack monitoring organisation. This is acceptable from a regulatory point of view. However, there is insufficient guidance on how to carry this out and on how to successfully propagate error sources. National Proficiency Testing schemes independently verify that commercial organisations providing CEM calibrations etc. meet the required performance levels. In the EU this has led to a lack of validated facilities that are able to test sampling capability. This also hinders the development of improved instrumental techniques which could be employed as new SRMs. A number of emissions-related standardisation mandates have been prepared e.g. M/431 and M/503 [5, 6] to address these and other issues.

In addition to controlled site emissions there are also significant uncontrolled area emissions (e.g. from shale gas) that must be measured. However, this is difficult due to the heterogeneous nature of the measurand. Consequently many regulators would like optical remote sensing techniques to be used. When listed in BREF (Best Available Technique Reference) documents site operators will have 4 years to implement these techniques. The barrier to implementing remote sensing techniques is that there are no measurement protocols / standards, nor established traceability, for commercial monitoring organisations to follow, or for accreditation purposes. There is also a perceived lack of validation data, hence further case studies of remote sensing techniques are required.

There are several state-of-the-art approaches for measuring the different elements of site emissions from stack based sources. For calibrating CEM systems the Industrial Emissions Directive (IED) stipulates the uncertainty required for parallel measurements of the Standard Reference Method and expresses it as a function of the emission limit value (ELV), hence, as ELVs decrease so do uncertainty requirements. Many proficiency testing schemes are based purely on artefacts; therefore, the sampling proficiency of teams carrying out CEM calibration remains largely unknown. If a team has a bias in their sampling procedure, the provided calibration function will bias all future CEM data.

The state-of-the-art for site emissions from area sources is generally based on point measurements combined with estimation. Emission factors and models (*e.g.* GasSim™) have been used in landfill for methane whilst the American Petroleum Institute's estimation method has been used for refineries. However, such approaches can lead to underestimation. Remote sensing techniques that are able to scan a complete area avoid these issues, however, standardisation and case studies are needed to provide fully characterised validation data. This will facilitate uptake of these technologies.

Scientific and Technological 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 JRP-Protocol.

The JRP shall focus on the traceable measurement and characterisation of emission sources on industrial sites.

The specific objectives are

1. To target the development of alternative methods/techniques that are able to traceably calibrate (in-situ) on-line stack monitoring instrumentation (as required by EN 14181) [4] at significantly decreased concentration levels.
2. To model stack flow and carry out the characterisation of the uncertainties associated with combining infrequent, independent flow measurements with continuous concentration data. Tools and guidance should be developed for the annualised mass emission rate propagation of such uncertainties.
3. To develop, characterise and validate facilities which are able to test sampling proficiency of accredited monitoring organisations for extracting samples from stacks.
4. To carry out case studies in order to develop methods for improved and robust remote sensing techniques and to compare these with point measurements for fugitive emissions as a mechanism to provide validation for both existing and new area sources.
5. To develop a suite of metrologically robust protocols/standards covering the use of open path techniques for monitoring across a range of area source types enabling uptake by (commercial) environmental organisations and a framework for national accreditation.

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 R&D work, the involvement of the user community such as industry, and standardisation and regulatory bodies, as appropriate, is strongly recommended.

Proposers should establish the current state of the art, and explain how their proposed project goes beyond this.

EURAMET expects the average size of JRPs in this call to be between 3.0 to 3.5 M€, and has defined an upper limit of 5 M€ for any project. The available budget for integral Research Excellence Grants is 30 months of effort.

Potential Impact

Proposals must demonstrate adequate and appropriate participation/links to the "end user" community. This may be through the inclusion of unfunded JRP partners or collaborators, or by including links to industrial/policy advisory committees, standards committees or other bodies. Evidence of support from the “end user” community (eg letters of support) is encouraged.

You should detail how your JRP results are going to:

- feed into the development of urgent documentary standards through appropriate standards bodies
- transfer knowledge on the traceable measurement and characterisation of emission sources on industrial sites

You should detail other impacts of your proposed JRP as detailed in the document “Guide 4: Writing a Joint Research Project”

You should also detail how your approach to realising the objectives will further the aim of the EMRP to develop a coherent approach at the European level in the field of metrology and includes 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 Member States and countries associated with the Seventh Framework Programme whose metrology programmes are at an early stage of development to be increased
- outside researchers & research organisations other than NMIs and DIs to be involved in the work

Time-scale

The project should be of up to 3 years duration.

Additional information

The references were provided by PRT submitters; proposers should therefore establish the relevance of any references.

[1] The European Climate Change Programme, European Communities, 2006.

[2] Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control). OJ EU L334: 17-119.

[3] EN ISO/IEC 17025:2005, General requirements for the competence of testing and calibration laboratories.

[4] EN 14181:2004, Stationary source emissions. Quality assurance of automated measuring systems.

[5] EC Mandate M/431, Mandate addressed to CEN to establish a programme of standards for assessing the greenhouse gas (GHG) emissions in energy-intensive industries.

[6] EC Mandate M/503, Standardisation mandate to CEN, CENELEC and ETSI in support of the implementation of the ambient air quality legislation.