Potential European Partnership on Metrology
Call 2021 – Green Deal and Normative

Selected Research Topic number: **SRT-v18**
Version: 1.1

Important information about these documents

This call is being held ahead of any agreement from the Commission that the relevant funding will be available. At present the relevant legislation is still under discussion in both Council and Parliament, and there is no certainty on the detailed arrangements for funding selected projects. The funding of any selected project, and the terms and conditions of participation in the projects, are dependent on completion of the legislative process and the subsequent contractual processes between the European Commission and EURAMET. Proposers submit to this call at their own risk.

Background

Last year, EURAMET submitted a draft proposal to the EC for a further research programme to be established under article 185 of the Treaty on the Functioning of the European Union (TFEU) to follow on from EMRP and EMPIR. This was published by the EC at https://ec.europa.eu/info/research-and-innovation/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe/european-partnerships-horizon-europe/candidates-digital-industry-and-space_en

The initiative would be called the European Partnership on Metrology and would aim to create, by 2030, a sustainable and effective system for metrology at European level that ensures Europe has a world-class metrology system that:

- Provides metrology solutions, fundamental metrological reference data and methods, offering fit-for-purpose solutions supporting and stimulating European innovation and responding to societal challenges.
- Supports and enables effective design and implementation of regulation and standards that underpin public policies that address societal challenges.

The Commission commissioned an impact assessment into this proposal and 11 others in similar priority areas, and, based on those findings, published their own proposal for the Partnership, their response to the impact assessment and a draft of the Decision on 23rd February 2021. See:

https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM:2021:89:FIN

https://ec.europa.eu/commission/presscorner/detail/en/ip_21_702

https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52021SC0035&qid=1614677899327

That draft Decision is currently under discussion in the European Council and the European Parliament.

Under the assumption that the Council and Parliament pass the basic act which would form the legal basis for this research programme, and that the participating countries named in the Draft Decision submit the required commitment letters, EURAMET is publishing these potential Selected Research Topics and draft guidance notes. These documents are not approved by the Commission nor will they lead to a binding decision by EURAMET e.V. for any further negotiation or funding. All published guides and templates are subject to amendment by the EC and EURAMET e.V. as further information becomes known.

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Title: Metrology for European emissions verification on methane isotopes

Abstract

Methane (CH_4) is the second most important greenhouse gas (GHG) for global warming and 95 % of its emissions in Europe come from the agricultural, waste and energy sectors. Monitoring of methane emissions to provide Europe-wide top-down emission estimates with sectoral resolution and metrological traceability will require further studies and validation of isotopic methods currently used. Proposals are sought to create the framework for an integrated European monitoring effort for stable methane isotope ratios. Improvements in the verification system are needed to provide support to European strategies (European Green Deal), inform policy decisions for climate change mitigation directed by the European Commission and trusted data for organisations in charge of Methane monitoring such as the Global Atmosphere Watch (GAW) by the World Meteorological Organization (WMO) and Integrated Carbon Observing System (ICOS).

Keywords

Methane isotopes, Isotope ratio mass spectrometry (IRMS), Optical isotope ratio spectrometry (OIRS), harmonisation of datasets, digitised dataset, $^{13}CH_3D$ and $^{12}CH_2D_2$ isotopologues, inverse modelling frameworks, emission estimate uncertainties, climate monitoring.

Background to the Metrological Challenges

Methane is a gas contributing to tropospheric ozone formation and it is one of the most important greenhouse gases (GHG), only second in importance after carbon dioxide (CO_2). Methane has a high radiative efficiency but short atmospheric lifetime (~decade) meaning it has the potential to make a large impact on shorter societal scales, either positively through efficient mitigating action to offset rising emissions of other GHGs, or negatively via shifts in the Earth system that could trigger rapid global warming. Key source categories for anthropogenic CH_4 emissions in Europe are the agricultural sector (~50 %), waste (~22 %) and energy (~15 %). The reported distribution of emissions per sector continues to evolve as reporting and data collection improve. These three sectors account for up to 95 % of global anthropogenic CH_4 emissions and are therefore the focus of mitigation action within the EU through the European Green Deal and the EU Methane Strategy, which describes stronger actions to address CH_4 emissions in each sector.

Despite the importance of CH_4 for climate change, an independent verification of national inventories with sectorial resolution is still pending. Since around 2015 the Integrated Carbon Observation System, ICOS, started to provide high-precision observations of the carbon (C) cycle and GHGs (CO_2, CH_4, N_2O). To ensure that measurements are of sufficient quality to meet scientific needs, measurement stations and data handling are standardised and GHG mole fractions calibrated against scales provided by the WMO GAW Central Calibration Laboratories. Nevertheless, there are significant gaps in the characterisation of source signatures, which are needed to interpret ambient isotope ratio measurements (e.g. $\delta^{13}C(CH_4)$ and $\delta^{2}H(CH_4)$). For example, data for microbial and biomass burning sources are missing due to their diffuse nature, temporal and spatial variations in isotopic source signatures and drivers. New types of optical measurements have been developed for *in-situ* isotope ratio measurements; however, these are yet to be integrated into established atmospheric monitoring networks to generate the impact needed in this area.

An emerging novel tracer for CH_4 source processes are the rare, doubly substituted isotopologues (e.g. $^{13}CH_3D$, CH_2D_2), which have recently shown to be a powerful tool to understand the origin and fate of thermogenic and biogenic CH_4 in the environment. IRMS, in which mass spectrometric methods are used to measure the relative abundance of isotopes in a given sample, is traditionally used for the analysis of $^{13}CH_4$ and $^{12}CH_3D$. Optical isotope ratio spectroscopy (OIRS) in the mid-infrared spectral range has been established as a powerful alternative to IRMS for the analysis of $^{13}CH4$ and $^{12}CH_3D$ in field applications, and doubly-substituted $^{13}CH_3D$ and $^{12}CH_2D_2$ analysis in pure CH_4. For $^{13}CH_3D$, and in particular $^{12}CH_2D_2$, automated preconcentration coupled to OIRS is required. OIRS uses two reference materials (also called scales), the carbon isotope reference frame, a hypothetical material called the Vienna PeeDee Belemnite (VPDB) and the Vienna Standard Mean Ocean Water (VSMOW), an isotopic standard for water. The major benefits of laser spectrometric techniques include their potential for automation and continuous measurement, allowing deployment outside a usual laboratory setting, and their ability to measure more than one isotope system simultaneously without forgetting compatibility with WMO goals.

The ratios of the stable isotopic variants of CH_4 molecules (e. g. $^{13}CH_3D$ and $^{12}CH_2D_2$), serve as quantitative tracers of various processes involving CH_4 in the environment. Different formation, transport, and removal

processes of CH_4 often impart distinctive isotopic fractionation. As a result, the stable isotopes of CH_4 (e.g. $\delta^{13}C(CH_4)$ and $\delta^{2}H(CH_4)$) can be used to reconstruct and quantify those processes. There are, however, significant metrological challenges in making isotope ratio measurements at the precision needed to detect regional pollution and at the temporal and spatial frequency to gain the statistical certainty for quantitative emissions estimation. Finally, the operational generation and curation of European integrated datasets of isotope ratio measurements are sorely needed, and work on how to convert isotope ratios and amount fractions into sectoral emissions breakdown for verification of 'bottom-up' calculations is a priority.

In 2020 the EU adopted a strategy to reduce CH_4 emissions as part of the European Green Deal. One of the priorities under the strategy is to improve measurement and reporting of CH_4 emissions. The level of monitoring currently varies between European Member States and sectors and across the international community, any improvement in the infrastructure will affect global monitoring networks such as WMO GAW and ICOS and ICOS and MEMENTO databases. The impact on policy decisions for climate change mitigation measures could be significant and has been identified by the European Metrology Network (EMN) for Climate and Ocean Observation as a priority area.

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 a methane isotope monitoring network for European emissions verification.

The specific objectives are

1. To develop a harmonised *in-situ* CH_4 isotope dataset of ambient air in Europe to resolve compatibility issues of datasets when combining measurements of $\delta^{13}C(CH_4)$ and $\delta^{2}H(CH_4)$. This harmonisation should include a) improved methodologies and procedures for comparability of independent *in situ* analyses of ambient air CH_4 for $\delta^{13}C(CH_4)$ and $\delta^{2}H(CH_4)$ by OIRS to the VPDB and VSMOW scales and b) IRMS and OIRS methodologies validated through interlaboratory comparisons in Europe using WMO goals.
2. To develop a sustainable metrological infrastructure for a digitised dataset for $\delta^{13}C(CH_4)$ and $\delta^{2}H(CH_4)$-source measurements in Europe. To evaluate the potential source apportionment of rare doubly-substituted $^{13}CH_3D$ and $^{12}CH_2D_2$ isotopologues analysis for selected campaigns.
3. To develop inverse modelling frameworks to employ the full dataset of measurements across Europe from Objectives 1 and 2 in atmospheric transport models and inverse statistical methods, to enable estimates of emissions. This modelling work shall direct the priorities for measurements within Objectives 1 and 2. To investigate the theoretical model studies for the optimal spatial and temporal frequency of sampling in order to reduce overall emission estimate uncertainties.
4. To facilitate – in cooperation with the EMN for Climate and Ocean Observation and the EMPIR project 20NET03 POLMO – the take up of the data and measurement infrastructure developed in the proposal by key stakeholders such as the global monitoring networks WMO GAW and ICOS and the inclusion in the ICOS and MEMENTO databases.

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 project goes beyond this. In particular, proposers should outline the achievements of the EMPIR JRP 19ENV05 STELLAR and how their proposal will build on those.

EURAMET expects the average EU Contribution for the selected JRPs in this TP to be 2.2 M€, and has defined an upper limit of 2.7 M€ for this project.

EURAMET also expects the EU Contribution to the external funded partners to not exceed 35 % of the total EU Contribution across all selected projects in this TP.

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 climate related organisations, global monitoring networks and atmospheric monitoring sector and regulators.

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 the potential European Partnership on Metrology 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.