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

Selected Research Topic number: **SRT-v08**
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 multi-scale monitoring of soil moisture

Abstract

Fresh water at the land surface, primarily in the form of soil moisture, is a key resource influencing agriculture, weather and climate, and it is seriously affected by climate change and environmental degradation. Any monitoring that targets global and European soil moisture assessment will require the use of a multi-scale approach, which includes techniques from point-scale sensors, cosmic-ray neutron sensing (CRNS) to satellite remote sensing. Nevertheless, these techniques will require metrological traceability to be harmonised and to provide validated data useful for water management strategies and climate change monitoring.

Keywords

Soil moisture, point-scale measurement, cosmic-ray neutron sensing, satellite remote sensing, multi-scale monitoring, cross-disciplinary harmonisation system, modelling, metrological traceability, intercomparison campaigns, climate change monitoring.

Background to the Metrological Challenges

Water content in soil is an element of energy and mass transfer involved in global heating and related global net gains in atmospheric water. Long-term carbon storage and release in soil is strongly influenced by soil moisture because only a healthy and adequately moist soil can act as carbon sink in the strategies for greenhouse gases (GHG) to reduce climate change impacts. Water retention is a major hydrological property of soil that governs soil functioning in agriculture and ecosystems. Soils are a cross-cutting theme within the European Green Deal (EGD) as the water sector, agriculture, forestry, and biodiversity are inherently strongly interdependent. Soil quality and soil moisture play a key role in future EGD policies, namely in the future Common Agricultural Policies unified under the Farm to Fork Strategy, policies for environmental protection (Biodiversity Strategy for 2030) and the climate change action (The European Climate Law).

Currently, soil moisture is most frequently measured on the point-scale using various invasive (in-situ) and often labour-intensive methods. These methods require considerable maintenance and they are costly when transferred to larger scales. On the other hand, the cosmic-ray neutron sensing (CRNS) method is currently a promising candidate for soil moisture monitoring on the intermediate scale and it is capable of bridging the spatial and temporal gaps between the in-situ (e.g. point-scale) and satellite remote sensing (large scale) techniques. A big advantage of CRNS is the coverage of a substantial part of the root zone (depth of the order of 50 cm) which otherwise remains inaccessible to the shallow-depth remote sensing. The CRNS technique is used for monitoring soil moisture and snow in a non-invasive and low-maintenance way, on lateral scales ~10 ha, using stationary and mobile platforms. However, improvements in metrological traceability are needed to address problems such as: (i) the calibration and validation of the devices and models in accordance with metrological standards; and (ii) the hardware and data processing harmonisation within its own research field and with the already established methods for soil moisture determination.

Worldwide, there are today five major hydrological monitoring networks deploying the CRNS method. The major issue is understanding the effect of atmospheric and land use-specific variables as well as hydrogen sources (e.g. biomass, ponded water, snow, building materials) on the neutron signal. Reliable characterisation, harmonisation, and improvements of the neutron detection and their soil moisture results are major challenges which need to be addressed.

The future monitoring of soil moisture will require a multi-scale system including point-scale, CRNS (medium scale) and satellite remote sending data for global and European actions such climate change monitoring. Nevertheless, this multi-scale approach will require the development of a cross-disciplinary harmonisation system based on metrologically sound techniques used for the three different scales and fit for purpose modelling. Validation will be required using intercomparison campaigns for point-scale and remote sensing techniques to provide further knowledge on how to resolve problems such as temporal and spatial differences regarding the sensing domains of soil moisture measurement methods, the influence of other state variables such as air humidity and soil temperature and the constraints and accuracy of soil moisture measurement methodologies.

Reliable data will strongly support climate change monitoring, hydrological assessment and climate modelling. The necessity of a metrologically sound approach for soil moisture measurements has been recognised by the established European Metrology Network for Climate and Ocean Observation (EMN COO). Furthermore, harmonised soil moisture data and products will support major stakeholders, relevant for the implementation of the EGD policies, such as the European Environment Agency (EEA), the European Space Agency (ESA),

the International Soil Moisture Network (ISMN) and WMO. Soil moisture is one of the Essential Climate Variables (ECVs) as defined by the Global Climate Observing System managed by WMO.

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 for multi-scale monitoring of soil moisture.

The specific objectives are:

1. To develop metrologically traceable methods for multi-scale soil moisture measurements. The methods should assess soil moisture measurements by using lateral scales ranging from decimetre to kilometre and a depth up to about 1 metre, with traceable relative uncertainty of 20 % or better.
2. To improve the metrological traceability of existing cosmic-ray neutron sensing (CRNS) devices currently available in the market. This improvement will require the development and validation of the neutron transport models used to interpret CRNS detector signals specific to the soil moisture measurand.
3. To develop a multi-scale metrological system for soil moisture monitoring. The multi-scale system will require the development of a cross-disciplinary harmonisation system on the medium sub-kilometre-scale and the establishment of (i) metrological traceability of soil moisture measurements using point-scale sensors and satellite measurement techniques and (ii) fit for purpose modelling. To develop techniques to support the harmonisation of soil moisture assessment.
4. To investigate the constraints and accuracy of soil moisture measurement methodologies using intercomparison campaigns on local and remote sensing. To develop procedures to overcome (i) temporal and spatial differences regarding the sensing domains of soil moisture measurement methods and (ii) the influence of other state variables such as air humidity and soil temperature that affect the measurements.
5. To cooperate with user communities to define design criteria for emerging and future hydrological and meteorological/climatological soil moisture networks using the combination of point-scale measurements, non-invasive intermediate-scale methods such as CRNS, and remote sensing. To cooperate with the European Metrology Network for Climate and Ocean Observation to facilitate the stakeholder interaction and the take up of the proposal's outputs by stakeholders (e.g. weather and climate observation instruments, agricultural forecast's devices and its modelling, (ground) water supplies as well as relevant international organisations (e.g. WMO)).

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.

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 weather and climate monitoring, agricultural forecasts and water 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 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.