

Title: Calibration and accuracy of non-catching instruments to measure liquid/solid atmospheric precipitation

Abstract

Climate studies, as well as everyday hydrological, meteorological, and agricultural applications rely on instruments which measure liquid/solid atmospheric precipitation and meaningful comparison and data interpretation can only be performed when a common ground for evaluating the measurement uncertainty is provided. Proposals in response to this SRT should develop standardised procedures for the laboratory calibration of non-catching gauges to measure liquid/solid atmospheric precipitation and the associated calibration uncertainty assessment.

Keywords

Liquid/solid atmospheric precipitation, non-catching instruments, precipitation measurements, non-catching gauges.

Background to the Metrological Challenges

Despite the relevance of atmospheric liquid precipitation among the environmental variables, no relevant international standard yet exists to define rigorous methods and procedures for rain gauge calibration and for the evaluation of the associated uncertainty. Specific testing and measurement needs for non-catching instruments to measure liquid/solid atmospheric precipitation were submitted by CEN/TC 318 "Hydrometry" in October 2017.

Non-catching type instruments have a number of advantages over the more common catching-type gauges, including the possibility to provide further information than the precipitation intensity alone (e.g. drop size distribution, visibility, etc.), and are especially suitable for automatic weather stations. These type of instruments are increasingly employed by national weather services, due to the lower maintenance required and unattended operation capabilities, in particular when automatic weather stations are used. However, having no funnel to collect the rainwater, these measurement instruments cannot be calibrated using an equivalent, reference flow rate. Rather, the actual rain event characteristics have to be reproduced, including drop size distribution, drop frequency and fall velocities. This requires a considerable metrological effort to investigate traceability and uncertainty issues to support new calibration methods and laboratory rainfall generators.

In order to support their wider use, and as a development beyond the recent item adopted under CEN/TC 318 for catching type gauges, traceable instrument calibration methods for non-catching gauges used to measure precipitation amount and intensity must be developed. This involves establishing a sound metrological basis for the evaluation of standard uncertainty for the relevant sources of uncertainty in the instrument calibration procedure.

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 development of traceable and accurate methods to measure liquid/solid atmospheric precipitation using non-catching instruments.

The specific objectives are

1. To develop traceable methods for the calibration of non-catching instruments that are used for liquid/solid atmospheric precipitation measurements. This should include additional tests to detect the possible influence quantities that could affect the measurement results and contribute to the determination of the uncertainty budget.
2. To assess the model functions of the non-catching type gauges calibration, including all relevant input and influence quantities. The calibration uncertainty should be derived from this model function together with a probability distribution associated to each of the input quantities.
3. To validate the calibration methods and uncertainty budgets developed via an appropriate inter-laboratory comparison.
4. To contribute to the identified needs submitted by CEN/TC 318 under the STAIR EMPIR agreement by involvement in development of a standard on precipitation measurement instruments using non-catching type instruments in CEN/TC 318 (Hydrometry) / WG12 (Rainfall Intensity) and the ISO/TC 113 (Hydrometry) committees.
5. To collaborate with the technical committees CEN/TC 318 and ISO/TC 113, and the relevant WMO-CIMO (World Meteorological Organisation-Commission for Instruments and Methods of Observation) Expert Teams and end users of the standards (e.g. WMO, national weather services, manufacturers of environmental measurement instruments) to ensure that the outputs of the project are aligned with their needs. This should include the provision of a report on traceable calibration methods to measure atmospheric liquid/solid precipitation using non-catching instruments and recommendations for incorporation of this information into future standards at the earliest opportunity.

The proposed research shall be justified by clear reference to the measurement needs within strategic documents published by the relevant Regulatory body or Standards Developing Organisation or by a letter signed by the convenor of the respective TC/WG. EURAMET encourages proposals that include representatives from industry, regulators and standardisation bodies actively participating in the projects. The proposal must name a “Chief Stakeholder”, not a member of the consortium, but a representative of the user community that will benefit from the proposed work. The “Chief Stakeholder” should write a letter of support explaining how their organisation will make use of the outcomes from the research, be consulted regularly by the consortium during the project to ensure that the planned outcomes are still relevant, and be prepared to report to EURAMET on the benefits they have gained from the project.

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 ENV58 MeteoMet2 and how their proposal will build on those.

EURAMET expects the average EU Contribution for the selected JRPs in this TP to be 0.6 M€, and has defined an upper limit of 0.8 M€ for this project.

EURAMET also expects the EU Contribution to the external funded partners to not exceed 30 % of the total EU Contribution across all selected projects in this TP.

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 meteorology sector.

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.

Additional information

[1] CEN/CENELEC identified this topic as one of their priorities. Details are available at:

https://msu.euramet.org/current_calls/pre_norm_2018/documents/cen_priority_002.pdf