Publishable Summary for 18NRM03 INCIPIT
Calibration and accuracy of non-catching instruments to measure liquid/solid atmospheric precipitation

Overview

Climate studies and everyday hydrological, meteorological, and agricultural applications rely on instruments which measure liquid/solid atmospheric precipitation. However, meaningful comparison and interpretation of data is only possible when a common ground for evaluating the measurement uncertainty is provided. This project developed traceable calibration methods for non-catching precipitation gauges that are implemented in a form that can be incorporated into CEN/ISO standards. The results of this project offer end users with methods for standardized and traceable calibration of non-catching rain gauges, as well as with a metrologically rigorous way of evaluating and drafting an uncertainty budget for measurements comparison across different stations, climates, locations and at different times.

Need

Atmospheric precipitation affects our everyday life and impacts on natural ecosystems, transportation, agriculture, safety, tourism, recreation, etc. The characteristics of the precipitation depend on the weather phenomenon and climate at any specific location (temperature, humidity, etc.) together with the fall trajectories of individual particles which are affected by the local conditions at a site.

Non-catching precipitation gauges, which “sense” rather than “catch” the precipitation, have several advantages, including the possibility to provide information in addition to precipitation. However, having no funnel (for tipping bucket gauges) or bucket (weighing gauges) to collect the rainwater, non-catching precipitation gauges cannot be calibrated using a reference flow rate. Instead, the actual characteristics of the rain event have to be reproduced, including the drop size distribution, drop frequency and fall velocities. In order to support their wider use, standardised procedures for the laboratory calibration of non-catching type gauges including the use of laboratory rainfall generators are needed, together with an assessment of the associated calibration uncertainty and repeatability. To estimate the uncertainty of a calibration performed for an instrument based on a specific physical principle it is necessary to model the measurement process i.e. to determine the ‘model function’, including identifying important influence factors which might differ from one technique to another. Comparison of calibration methods between different laboratories is a typical procedure adopted by WMO, the Chief Stakeholder of the project. However, a recent WMO field intercomparison of rainfall intensity gauges indicated unresolved issues with the use of non-catching precipitation gauges in real world applications and challenges in assessing the results of scientific investigations based on such measurements. No standard procedure for non-catching type instruments was available, hence there was a need to compare and evaluate calibration methods and their associated uncertainties for such sensors in different laboratories.

Under the agreement between STAIR and CEN, 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. The need for standardisation in environmental measurements has also been expressed by WMO Commission for Instruments and Methods of Observation (WMO/CIMO) in documents such as the CIMO Guide nº 8, and the report of the meeting of the CIMO MG 2014.

Objectives

The project had two overarching aims, namely (i) to develop calibration methods for non-catching instruments measuring liquid atmospheric precipitation and (ii) to understand and evaluate the uncertainty components and influence parameters for non-catching precipitation gauges.

The specific objectives of the project were:

1. To develop traceable methods and dedicated facilities for the calibration of non-catching precipitation instruments that are used for liquid atmospheric precipitation measurements, including defining the optimal traceability chain, the development and characterisation of at least two different raindrop generators, based on different working principles, and additional tests to detect the possible influence parameters 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 precipitation gauges, including all relevant input and influence parameters. The calibration uncertainty should be derived from this model function together with a probability distribution associated to each of the input parameters.
3. To validate the calibration methods and uncertainty budgets developed via an appropriate laboratory comparison involving the test calibration of different non-catching precipitation gauges.
4. To provide a substantial metrological contribution to CEN/TC 318 (Hydrometry) /WG12 (Rainfall Intensity) and the ISO/TC 113 (Hydrometry) committees on the development of a technical specification or standard on precipitation measurement using non-catching type instruments, following the identified research needs submitted by CEN/TC 318 under the STAIR-EMPIR agreement. This would include the provision of a technical report with guidelines on recommended traceable calibration methods to measure atmospheric liquid precipitation using non-catching instruments and recommendations for incorporation of this information into future standards or technical specifications at the earliest opportunity.
5. To collaborate with 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. national meteorological services, manufacturers of environmental measurement instruments) to ensure that the outputs of the project are aligned with their needs and in a form that can be incorporated into standards at the earliest opportunity.

* The Commissions for Basic Systems, for Instruments and Methods of Observations and the Global Climate Observing System transitioned into the new Commission for Observation, Infrastructures and Information Systems (Infrastructure Commission) following adoption of the WMO Governance Reform package by the Eighteenth Meteorological Congress in June 2019[1]"

Progress beyond the state of the art

Traceable methods and facilities for the calibration of non-catching liquid precipitation instruments

This project took a fundamental step forward by introducing metrological soundness and standardisation into the calibration of non-catching type instruments, so that the uncertainties can be determined, and measurements can be traceable to the SI. Reference methods for the calibration of non-catching gauges, both in the laboratory and in the field, have been developed. Raindrop generators were available in the past but not with the explicit purpose of serving as reference generators for the calibration and characterization of non-catching gauges. This is the first time that such generators, expressly built with different working principles, have been used for this purpose.

Model functions of non-catching precipitation gauges and input and influence parameters

Evaluation of measurement uncertainty is based on knowledge about the measurement process and the (input) quantities which influence the measurement result. Knowledge about the input quantities is represented by appropriate probability density functions, whereas knowledge about the measurement process is expressed by a so-called model equation, which relates the measurand and the input quantities. The project developed model functions corresponding to different operating principles of non-catching precipitation gauges. This is the first time that a comprehensive study on the measurement principles of different non-catching gauges has been performed, along with a metrological evaluation of the influence parameters on the measurands and an explicit formulation of gauges' model functions.

Validation of calibration methods and uncertainty budgets

[1] https://public.wmo.int/en/our-mandate/how-we-do-it/technical-commissions/commission-instruments-and-methods-of-observation-cimo

To validate the calibration methods for non-catching precipitation gauges and their associated uncertainty budgets developed in the project, measurement campaigns were undertaken both in the field, at two WMO recognised field test sites in Payerne (Switzerland) and Vigna di Valle (Italy), and in the laboratory.

This is the first time that such in-field and laboratory validations have been performed.

Standardisation related to non-catching precipitation gauges

Guidelines on recommended procedures for the calibration of non-catching precipitation gauges, including their testing and maintenance, were developed. A Technical Report incorporating these guidelines was prepared and submitted to CEN/TC 318 for consideration and adoption as a New Work Item (NWI). Work towards (a) the adaptation of the Technical Report by WMO/ISO TC 113 and (b) recommendations on non-catching precipitation gauges to be included in the periodic revision of the CIMO Guide on Instruments and Methods of Observation (WMO-Nr. 8), is ongoing. Until now, no documents directed at the normation of calibration and usage of non-catching rain gauges have even been drafted. At the end of this ongoing process, standardized methods and facilities will be available to end users for the calibration of such instruments.

Results

Traceable methods and facilities for the calibration of non-catching liquid precipitation instruments

A report on the overview of existing models and working principles of non-catching precipitation gauges together with test/calibration schemes for different types of non-catching precipitation gauges, was completed. It contains a complete list of all typologies of commercially available non catching precipitation instruments, with full description of all working principles, measurement ‘processes and calibration possibilities. There was nothing similar, at the time of publication, in literature. The report also contains a wide bibliography on the topic, never collected before in other articles or documents. Due to its wide and complete technical content and bibliography, the report has been adjusted in the form of a review paper, published in the international open access peer reviewed journal “Meteorological Applications”. The report was transmitted to CEN TC318 as a contribution to the proposal of a new work item for a Technical Report entitled “Calibration and accuracy on non-catching precipitation measurement instruments”. The proposal was approved by CEN in February 2022.

Prototype of raindrops generator for the calibration of non-catching rain gauges.

Three prototypes of raindrop generator were designed, developed, built, and characterized. Raindrop Generator 1 has been employed successfully for test calibration measurements in the laboratory and in the field tests. Raindrop Generator 2 used a different working principle, and hosted the validation apparatus based on photogrammetry techniques, holding a high-resolution camera and two synchronised flashes to capture drops in flight in three positions, so that the size and fall velocity of each single drop can be accurately detected. Last, raindrop Generator 3 was designed for in-lab tests.

Objective #1, which encompasses the previous two sub-headings, was successfully achieved. As the approval by CEN proves, the report shows methods and technologies currently used by non-catching rain gauges and explores the calibration and accuracy issues of these instruments. Three different raindrop generators were developed, built, and characterized in order to perform experiments and validations for the calibration of the rain gauges.

Model functions of non-catching precipitation gauges and input and influence parameters

A report on the model functions has been produced. In this report, the modelling approach for the uncertainty evaluation for non-catching type precipitation instruments are discussed. The measurand was defined as the rainfall rates and a generic formulation for the determination of this measurand was pursued. For each type of instrument, the size of hydrometeors and their distribution is linked to the physical measurement process. For all types of gauges, a first evaluation of the main sources of uncertainties for each quantity was listed. These quantities are the input quantities for the determination of the rainfall rates.

Three rain generators, allowing the production of control rain drops with known characteristics, have been developed. These controlled raindrops allowed to assess quantitatively the influence parameters and estimate their contribution to the measurement uncertainty budget.

Numerical simulation and wind tunnel experiments were performed to assess the impact of wind on the measurement of an optical gauge, the Thies LPM. Initial results revealed the strong influence of the wind speed and direction on the airflow deformation near the instrument sensing area. This was expected to impact on the detection of the hydrometeors size and fall velocity, and therefore on the measurement of the precipitation intensity. To quantify this effect, based on the obtained results, particle tracking simulations were performed. Results have been presented in a paper published on the journal "Sensors". In addition to this, the influence of air temperature on 3 different types of non-catching precipitation gauges was analysed by measurements performed in a climatic chamber, and the conclusions are included in the report "*Calibration and accuracy of non-catching instruments to measure liquid/solid atmospheric precipitation*".

Objective #2 was successfully achieved. For the first time an uncertainty budget for a quantity measured by a non-catching rain gauge was evaluated with metrological rigour. The already mentioned report lists different model functions for different rain gauges technologies, which makes it possible to evaluate uncertainty budget for a wide variety of non-catching gauge models.

Validation of calibration methods and uncertainty budgets

Three types of non-catching precipitation gauges were calibrated, using a drop generator previously calibrated and characterized for different air temperature conditions. SMD gathered measurements from laboratory test which were included in the first-step quantitative assessment for the uncertainty budget of one type of rain gauge. Analysis of the measurements was made and reported in the accuracy assessment through evaluation of quantities of influence. Based on the results, the first recommendation for proper calibration was made, i.e. limiting the drop rate, calibration as close as possible to the height for obtaining the drop terminal velocity, and using manufacturer information about the rain intensity computation in the device under test.

A model for the calibration uncertainty of non-catching precipitation gauges was proposed and detailed, based on separating uncertainty components into blocks. This gives a flexibility on designing a calibration procedure by combining different blocks (i.e. changing the drop generator or the type of instrument). The main filtering component is related to final velocity of the falling drops, and this might be a major concern when developing an easy to implement calibration procedure.

Further to the laboratory validation, field testing of instruments was performed at the experimental field test sites of Payerne – Switzerland, and Vigna di Valle – Italy, thanks to the availability and support of Météo Suisse and the Italian Meteorological Service, respectively. In Payerne, at the end of March 2022, two rain generators (DG1 and DG2) were mounted used for the verification of the installed Thies laser disdrometer, while in Vigna di Valle, in June 2022, only the DG2 was used for the verification of the Biral light scatter disdrometer. It has been concluded that calibration procedures for NCGs should be limited to the controlled laboratory environment. Indeed, the experienced wind and atmospheric humidity conditions proved to be challenging for both rain generators developed within the project. It is therefore recommended that calibration is only performed in the laboratory, while limited verification tests to check that the instrument does not deviate significantly from the original calibration, must be limited in the field to few intermediate drop sizes (in the order of 2-3 mm in diameter) and in low wind and humidity conditions.

Objective #3 - To validate the calibration methods and uncertainty budgets developed via an appropriate laboratory comparison involving the test calibration of different non-catching precipitation gauges - was successfully achieved.

Standardisation related to non-catching precipitation gauges

Based on the proposal from Prof. Lanza (UNIGE) the chair of WG12, CEN TC 318 "Hydrometry" decided to maintain the working group 12 (Rainfall Intensity) to analyse the results of this project. Therefore, the proposals for calibration procedures developed by the present project now have an appropriate committee to transform the information into normative. A report for WG 12 was presented, and a NWI for a Technical Report was proposed with the title "Measurement of rainfall intensity - Calibration methods and performance assessment of non-catching instruments". The proposal for a European Standard on the same subject was also approved. This activity was also performed at the national level within the mirror committee of the Italian national standardization body (UNI).

In July 2021, a meeting of the Italian UNI/TC 055 "Metrology of flow, pressure and temperature" (decision n. 7), formulated two NWI proposals for a European Technical Report (CEN/TR) and a European Norm (EN) about non-catching precipitation measurement instruments, to be submitted for balloting within the UNI/TC 055 WG/02, so that they could be transmitted to CEN CEN/TC 318 "Hydrometry". The proposal was approved in the national balloting closed on September 1st, 2021.

The two new work item proposals were submitted to CEN/TC 318 by the Secretary of the Italian Mirror Committee UNI CT055 on September 10th, 2021. After balloting among the member countries, the two proposals for a European Standard and a Technical Report were approved and included in the work programme of CEN/TC 318 with the titles: a) EN "Hydrometry - Measurement of precipitation intensity - Metrological requirements and test methods for non-catching type rain gauges" and b) TR "Calibration and accuracy of non-catching precipitation measurement instruments".

Objectives #4 and #5 were successfully achieved. The engagement with committees was constant throughout the project. Standard and regulatory activities were performed at the European scale, and therefore first addressed to CEN/TC 318 as an initial step towards further extension at the global scale (ISO/TC 113). CEN has agreements in force with ISO and the WMO in order to address the development of standards on similar topics, to avoid duplications.

Last, the chair of CEN/TC 318 is an active member of ISO/TC 113 and will keep that committee aware and informed of the normative steps activated within CEN on this subject.

Impact

Dissemination activities included:

a) A training course, attended by ~ 20 people of mixed origin (researchers, technicians, end-users) by UNIGE on the working principles, measurement processes, use and calibration of different typologies of rain gauges (including non-catching ones). This training went beyond the planned expectation, since it was held at one of the most important meteorological sites for measurement of precipitation, linked with the WMO (see “News Stories”). This allowed the course to be extended to practical aspects, with detailed field analysis of such kind of instruments and the way they are compared.

b) The project website was hosted by the MeteoMet main website, since it already attracted a wide size of audience, due to its history and impact. https://www.meteomet.org/incipit

c) The project and its objectives were presented during the environmental and climate session of the international conference CIM 2019 held in Paris in September 2019, under a talk with titled as: “INCIPIT: it started to rain”. Other International Conferences included the 2019 United Nations Framework Convention on Climate Change and the European Geosciences Union General Assembly 2020.

d) The closing meeting was organized and hosted at the University of Genova, one of the WMO Lead Centre “B. Castelli” on precipitation intensity measurement.

Furthermore, three Research Mobility Grants (RMGs) have been linked to this project. The main achievements of the RMG1 are summed up in a scientific report on numerical simulation of free-falling water droplets using COMSOL Multiphysics. First the researcher reviewed the literature on natural rain drops and determined the main expected characteristics such as size, shape and velocity. Then, based on fluid mechanics principles RMG1 described the forces acting on a free-falling drop and the factors that affect its shape during fall. This theoretical study was the basis of the development of a numerical model implemented in COMSOL Multiphysics. After optimization, the numerical model was used to run simulations of drop shape changes during free fall for different drop sizes (ranging from 0.5 to 5.8 mm). In addition, RMG1 calculated, using different available experimental models, the minimal fall distance needed before reaching final velocity. This information was used in INCIPIT project during the experimental in lab campaign to set-up the height of the rain generator with respect to the measuring instrument.

RMG2 was focused on optimising some of the technical features of raindrop generators developed by the parent project. Two key achievements have been produced: a) the evaluation of the drop dispersion from different heights allowed to transfer the knowledge for the infield campaign that followed during the parent project lifetime and improve the positioning and structure for the in-field use and b) a clear distinction between validation and calibration of non-catching rain gauges was also presented.

RMG3 has been cancelled due to logistic and travel difficulties during the COVID-19 pandemic.

Impact on industrial and other user communities

The main industrial sector that will benefit is the hydro-meteorological equipment industry. The calibration procedure and guidance developed in this project will enable manufacturers to certify the performance of non-catching type instruments based on standard procedures. This will respond to the needs of national meteorological services for maintenance-free instrumentation and fully automated weather stations. Manufacturers of laboratory equipment for instrument calibration will be able to provide calibration devices for non-catching type instruments that are compliant with a standardised procedure and possibly included in a

European standard. As a result, users of precipitation gauges, particularly national meteorological services will be able to make decisions about the suitability and performance of equipment based on more robust and reliable information.

Impact on the metrology and scientific communities

The inclusion of the traceability of modern precipitation devices, which is of utmost importance in climate analysis, environmental monitoring and early warnings, will support the growing interest in metrology for environment. The climate community, represented by the relevant WMO Technical Commissions and Standing Committees and by the GCOS with its GSRN, will benefit from improved knowledge on data quality in precipitation records. Data series and standard measurements, which are mainly based on temperature records at present, are extending the focus to other observables. Precipitation is the most important observable after temperature, and the GSRN will design standard climate observing stations in part on the basis of the traceability achievable and uncertainty of the instruments selected. This project's outputs have therefore contributed to better addressing the definition of traceability in precipitation measurements and instrumental quality and uncertainty. The projects outputs have been disseminated and promoted to the end users, the metrology and wider scientific community via peer-reviewed papers and presentations at key international conferences.

Impact on relevant standards

The project prepared a Technical Report on the calibration and accuracy of non-catching precipitation instruments and submitted it to CEN/TC 318 – via WG12 – for adoption as a New Work Item (NWI). The project's outputs have also had an impact on the standardisation activities of ISO/TC 113 (Hydrometry), where a standard on precipitation measurements has been recently developed, though not yet addressing non-catching instrument. Two New Work Item proposals were submitted to CEN TC318 by UNI (Italy) for a Technical Report on "Calibration and accuracy of non-catching precipitation measurement instruments" and for a European Norm on "Hydrometry – Measurement of precipitation intensity – Metrological requirements and test methods for non-catching type rain gauges". These were both accepted to be included in the work programme, with a good participation.

Under the Vienna agreement between CEN and ISO, impact is expected in the form of a proposal to adopt both the Technical Report and the Standard submitted to CEN. Finally, a proposal was submitted to the WMO Editorial Board to include recommendations about non-catching instruments in the Guide WMO-Nr. 8, following the results of this project.

This submitted report on best practice made an outstanding and noteworthy contribution to the issue of comparability and traceability of the measurements coming from non-catching rain gauges, which are increasingly being used in meteorological stations, as data quality and comparability are key factors in the accurate determination of rainfall intensity and will matter even more as these instruments will be of more widespread use.

WMO recognised the impact of project "INCIPIT" as well, as a pre-normative endeavor that will contribute to the standardization of methods and best practices of calibration, maintenance and usage of these instruments. It has been confirmed that these submitted documents on best practices and procedures for the calibration of non-catching precipitation gauges, and their uncertainty evaluation, will be taken into account (as a contribution to the revision of the) for inclusion in WMO GIMO (Guide to Instruments and Methods of Observation) n°8.

This is a first step to activate accelerated adoption by ISO as per the Genève agreement (WMO & ISO) in the form of an ISO standard.

<u>Early Outreach and uptake</u>

During the project lifetime, a field test was made on instruments actually operating in a meteorological network. That was the calibration campaign at the MeteoSwiss operational site in Payerne. Following the results of the campaign, procedure and calibration results, the Measuring Technology Division confirmed that the measurement results provided by this instrument are now made traceable to standards, raising the quality of the data products. The system is now operating in this meteorological network and given the benefit of being calibrated, it raises its role to reference instrument among non-catching rain gauges. This is in particular relevant, because non-catching type instruments show multiple advantages when used operationally, and they are meant to be used intensively in the near future. Among others, they show significant lower maintenance costs compared to traditional rain gauges (tipping bucket or weighing gauge). The generated output offers also additional possibilities, with for instance the drop size and fall velocity distribution, which is not available with traditional gauges. Moreover, the same procedure will be applied to other similar instruments now contributing to our numerical weather predictions and to climate data series, should a rain generator be available, such as those developed by the INCIPIT project.

Longer-term economic, social and environmental impacts

Wider impact from the project is expected on companies operating in the fields of hydro-meteorological warnings, water resources management, flood control, and agriculture. These companies generally provide services based on the monitoring of hydro-meteorological variables (precipitation, flow rate, evaporation, etc.) and the processing of the related measurements to support end users' decisions, even in real time, about the configuration of industrial systems including water diversions, dam overflows, weirs, hydropower turbines, etc. Due to their intrinsic features, non-catching instruments require less maintenance, and the absence of mechanical and moving parts makes them more stable devices for field use, impacting on the required calibration and check intervals, and resulting in reduced maintenance costs for hydro-meteorological agencies and users. The use of calibrated non-catching type instruments to measure liquid precipitation would improve the management capabilities of the users, since decisions would be based on traceable measurements obtained at a lower operational cost than the present networks of catching-type instruments.

Based on a general lack of traceability and data quality in historical observations, the Global Climate Observing System (GCS) is preparing the creation of the GCOS Surface Reference Network (GSRN). During its first meeting the newly formed WMO Commission for Infrastructures approved the creation of the GSRN under its Decision 4.1.1(4)/1 (INFCOM-1), "Development of a draft implementation plan for the GCOS Surface Reference Network". There, *"a set of high-quality long-term fiducial reference measurements of Essential Climate Variables (ECV)* is recommended to *enable future generations to make rigorous assessments of future climate change and variability.* Non-catching gauges will offer more reliable data and are relatively immune to maintenance and mechanical drifts and shocks, thus becoming a more robust candidate for long term data series recording. The calibration procedures and guidance developed by this project are therefore expected to benefit climate science through the GCOS and other similar initiatives, by enabling better environmental and climate data and analysis.

Non-catching instruments are suited to operation in unmanned meteorological stations, e.g. those far from urban settlements or in remote areas and in harsh environments. These remote stations are needed to monitor the whole territory of hydrological basins, whose headwater area is generally located in mountainous or impervious regions, in order to provide improved coverage and completeness of information about incoming precipitation. More reliable early warnings would therefore make it possible to promptly inform weather services, civil protection agencies and the general population about the risk of floods and especially flash floods, which evolve rapidly and have a strong potential for disruption. The accuracy of such data and information is vital for issuing effective and timely warnings, resulting in increased safety for citizens and extended lead time for warnings, with a potential to save lives and properties in case of extreme events.

List of publications

1. Lanza, L. G., Merlone, A., Cauteruccio, A., Chinchella, E., Stagnaro, M., Dobre, M., Garcia Izquierdo, M. C., Nielsen, J., Kjeldsen, H., Roulet, Y. A., Coppa, G., Musacchio, C., Bordianu, C., & Parrondo, M. (2021). Calibration of non-catching precipitation measurement instruments: A review. *Meteorological Applications*, 28(3), e2002. https://doi.org/10.1002/met.2002
2. Chinchella, E.; Cauteruccio, A.; Stagnaro, M.; Lanza, L.G. Investigation of the Wind-Induced Airflow Pattern Near the Thies LPM Precipitation Gauge. Sensors 2021, 21, 4880. https://doi.org/10.3390/s21144880.
3. Baire, Q., Dobre, M., Piette, A.S., Lanza, L.G., Cauteruccio, A., Chinchella, E., Merlone, A., Kjeldsen, H., Nielsen, J., Friis Østergaard, P, Parrondo, M., Garcia Izquierdo, C. (2022). Calibration uncertainty of non-catching precipitation gauges. *Sensors*, 6413 22(17). DOI: 10.3390/S22176413

This list is also available here: https://www.euramet.org/repository/research-publications-repository-link/

<table>
<tr><td colspan="2">Project start date and duration:</td><td colspan="2">01 July 2019, 36 months</td></tr>
<tr><td colspan="4">Coordinator: Dr Andrea Merlone, INRIM, Italy Tel: +39 011 391 9734 E-mail: a.merlone@inrim.it
Project website address: https://www.meteomet.org/incipit/</td></tr>
<tr><td colspan="2">Chief Stakeholder Organisation:
World Meteorological Organisation (WMO)</td><td colspan="2">Chief Stakeholder Contact:
Bertrand Calpini</td></tr>
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1. INRIM, Italy
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3. DTI, Denmark
4. SMD, Belgium</td><td colspan="2">External Funded Partners:
5. UNIGE, Italy</td><td>Unfunded Partners:
6. EDI, Switzerland</td></tr>
<tr><td colspan="4">RMG1: INM, Republic of Moldova (Employing organisation); SMD, Belgium (Guestworking organisation)
RMG2: INTiBS, Poland (Employing organisation); INRIM, Italy (Guestworking organisation)
RMG3: ME, Montenegro (Employing organisation); INRIM, Italy (Guestworking organisation) (cancelled)</td></tr>
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