

Regional instrument centers: towards new roles for even better measures

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Abstract:

The Regional instrument centers (RICs) are regional bodies whose main mission is to maintain high quality meteorological standard instruments and to provide the necessary support to the member countries of the regional association in the calibration and quality assurance of their instruments.

RICs are therefore levers that normally have to pull up the capacities of these countries in the fields related to metrology and the determination of the uncertainty of measures. Some RICs have more than thirty years of existence. In the last decade, the scientific community and the WMO Technical Commissions and related programs recognized the importance of RICs and praised their positive contribution in mitigating the risks of natural disasters and in enhancing the traceability of measurements to the International System of Units (SI) standards. As such, new functionalities and new requirements have been assigned to RICs, such as the adoption of a quality approach preferably according to the ISO 17025 standard and the participation in inter-laboratory comparisons.

It was also expected that RICs should be assessed by recognized authority at least each five years. Up to now, the evaluation process of RICs is not established yet. In 2018, it is perfectly legitimate to open up the debate on the future roles of RICs starting from the study of the constraints opposing the achievement of their missions (obsolescence of equipment, qualification of staff, operating costs, the technical environment laboratories, regulations in force ...), emerging challenges mainly related to new technologies and measurement methods that are thriving on the world market, the massive transition to automatic stations with the abolition of mercury instruments and obsolete instruments (Minamata convention) by 2020, the openness to partner's and third parties observing networks and taking into account the opportunities that lie ahead beyond the geographical frontiers of regional associations such as the implementation of WIGOS, collaborative projects for inter-laboratory comparison, the E-training, the WMO calibration strategy ...

This paper is an attempt to understand the many facets of RIC operation by focusing on threats and opportunities, areas of weakness and points for improvement to identify future roles for RICs for even better measurements within national observing networks.

1. Introduction

The Regional instrument centers (RICs) are regional bodies whose main mission is to maintain high quality meteorological standard instruments and to provide the necessary support to the member countries of the regional association in the calibration and quality assurance of their instruments.

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and the determination of the uncertainty of measures.

The general terms of reference of Regional Instrument Centers were established as recommended by CIMO-IX held in early 1985, and updated by CIMO-XIV in 2006.

Since their creation in the early 1990s of the last century, the Regional Instrumentation Centers have been able to prove that they were a reliable and an indispensable organ for the introduction

and the promotion, within the National Meteorological and Hydrological Services (NMHSs), of a new culture related to the quality assurance of measures and the compliance with standards applied in metrology. Their role has been widely recognized over time by the regional associations (RA) and by the various programs of the World Meteorological Organization. Such recognition is very visible when reading following paragraphs of the Annex 1.A, Chapter I, Part I of the WMO Guide to Meteorological Instruments and Methods of Observation (WMO No. 8):

“Considering the need for regular calibration and maintenance of meteorological instruments to meet the increasing needs for high-quality meteorological and hydrological data, the need for building the hierarchy of the traceability of measurements to the International System of Units (SI) standards, Members' requirements for standardization of meteorological and related environmental instruments, the need for international instrument comparisons and evaluations in support of worldwide data compatibility and homogeneity, the need for training instrument experts and the role played by Regional Instrument Centres (RICs) in the Global Earth Observing System of Systems, the Natural Disaster Prevention and Mitigation Programme and other WMO cross-cutting programmes, it has been recommended that RICs should have the capabilities to carry out their corresponding functions as specified below, under the Terms of Reference”.

As for the reverse of this success story, the first evaluation report conducted by the WMO in 2005 for the 13 CRIs functioning at that time showed that there are two categories of RICs: very advanced centers, especially in developed countries and centers in developing countries facing to many challenges that prevent them from fulfilling their missions.

This was at the origin of the distinction introduced at the CIMO-XIV in 2006 by defining RICs with full capabilities and others with basic capabilities.

Today, after ten years of operation and following the various monitoring rules imposed by the WMO and the effective involvement of member countries, especially after the implementation of WIGOS, the situation of the RICs has clearly improved but several areas of improvement remain to be overcome.

Furthermore, RICs are nowadays faced to recent challenges related to the new technologies and measurement methods that are thriving on the world market, the massive transition to automatic stations with the abolition of mercury instruments and obsolete instruments (Minanata convention) by 2020, the openness to partner's and third parties observing networks and the CIMO future missions and strategies ...

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2. First RICs assessment report

The conclusion of this report was too simple but very relevant: “The level of a RIC is quite related to the richness of the country. The RICs of most rich countries are certified and accredited” (Jerome Duvernoy, 2006).

Based on a survey conducted with the 13 RICs functioning at that time and following site visits conducted to 7 RICs in developing countries, the following points raised:

- Few of the RICs are capable of carrying out calibrations to the level of uncertainty recommended by the CIMO Guide,
- Most of the NMHS surveyed claimed that instrumentation and traceability were given a low priority by their organizations. This has led to a lack of staff and resources for instrument calibrations and their traceability,

- There was a clear divide between the less developed laboratories which have people and time, and the more developed laboratories which have state-of-the-art instruments, but few staff,
- Developed RICs have expended considerable resources on automating calibration processes using electronic instruments and standards,
- Lower staffing levels imply that the manual calibration of instruments is avoided in developed RICs.

This situation has been very constraining and has pushed member countries, regional associations and the WMO Executive Council (EC) to adopt more realistic terms of references that took into account the capabilities of each RIC. We thus witnessed the adoption of two categories of RICs by defining RICs with full capabilities and others with basic capabilities.

RIC with full capability can assist Members of the Region in calibrating their national meteorological standards and related environmental monitoring instruments for the following variables: temperature, humidity, pressure and possibly others; while RICs with basic capability propose this service for at least one of these variables.

In parallel, the CIMO-XIV (2006) emphasized also the need to further enhance the partnership between RICs of developing and developed countries and it encouraged Members to use the system of internship in RICs in the various WMO Regions. It was agreed that a regular meeting mechanism be established in order to strengthen the exchanges and coordination among RICs.

The 14th session of CIMO was a real opportunity to face the facts and to recognize the difficulties faced by RICs in developing countries that require serious efforts to raise the level of their staff and to renew and modernize the equipment they have.

The CIMO-XIV was therefore an occasion to ask that a very specific intention be

given to RICs to ensure the traceability of meteorological measurements to the International System of Units (SI) standards. The commission stated in this context that: "The Commission recognized that further improvements in quality and worldwide compatibility of data strongly depend on assuring traceability of measurements to the SI. It agreed that this is a critical issue for most of the NMHSs and requested CIMO OPAGs to develop a strategy on how to best address the current deficiencies of traceability of measurements to SI standards".

3. Monitoring the functions and capabilities of the RICs

Although the need for the regular assessment of RICs, by a recognized authority to verify their capabilities and performances as requested by the Executive Council at its sixtieth session, is part of the terms of references agreed, it is only during the 15th CIMO session (2010) that we note very clearly the call that these evaluations should be conducted and that the obtained results to be communicated to the members.

Considering the availability of an Evaluation Scheme for the auditing of RICs based on the terms of reference of the RICs and on the International Organization for Standardization standard ISO 17025 – General requirements for the competence of testing and calibration laboratories developed by the CIMO dedicated expert team, the 15th CIMO session recommends that RICs make regular use of this scheme, communicate the results to Members of the Region and to the president of the respective regional association to enable the regional association to assess whether the existing RICs meet their stated requirements; and that regional associations inform the Commission whether any capacity-building actions are needed.

One can note that this need for regular communication of information was so strong that the CIMO-XV recommended that RICs develop websites to improve communication with the Members of their Region, providing information on their capabilities and the services they

provide including relevant contact information, and maintain a database of the standards used by the Members of the Region and already calibrated by the RIC. The idea behind is to avoid silent RICs as in the past.

Till now, 70% of the RICs (11 among 16 RICs) are publishing regularly their annual report on their capabilities and operation conducted during the past year. They are also providing up to date information on their Calibration and measurement Capability (CMC) defined as the smallest uncertainty of measurement that can be expected to be achieved by the RIC during a calibration.

4. Inetr-Laboratory Comparisons (ILC) and quality certification

CIMO-XV recalled that the capabilities of metrology laboratories, such as RICs, can be demonstrated and tested through inter-laboratory comparisons and recommended as consequence that RICs organize regular inter-laboratory comparison between RICs, preferably within their Region, and publish their results on their dedicated websites and on the WMO Website.

Since that time, regular ILCs are conducted mainly in RA IV (Europe) and RA II (Asia).

The RA VI ILC has served as a model for organizing a similar ILC involving RAs II (Asia) and V (South-West pacific). A Memorandum of Cooperation and an ILC protocol have been prepared for this purpose.

Till now, only six RICs (40%) are reporting that they had participated to inter-laboratory comparisons. RICs of developing countries encountered several technical and administrative constraints that prevent their effective participation to the ILCs organized.

Following the RICs terms of references established in 2006, a RIC must, as far as possible, apply international standards applicable for calibration laboratories, such as ISO 17025.

Nowadays, only three RICs (20%) are accredited ISO 17025 and three other centers had launched the process of

certification with regards to the ISO 17025 standard.

5. Contribution to WIGOS

It is widely recognized that Regional Instrument Centers should play an important role in WIGOS in order to ensure the quality of observations, considering that worldwide compatibility of data strongly depends on assuring traceability of measurements to SI.

The Commission noted in its 16th session (2014) that regional associations have emphasized in their Regional WIGOS Implementation Plans the need to strengthen RICs to ensure their full functionality and to enhance the support they provide to Members especially for those that do not have calibration laboratories. Furthermore, the Commission stressed that traceability of observations to international standards is essential for the full potential of WIGOS to be achieved.

One major concern, in this context, is that many NMHSs were not aware of the existence of RICs and the services they provide.

The second important issue is related to the nature of calibrating services that RIC could provide to NMHSs that do not have a calibration laboratory.

A survey conducted in the RA II (Asia) shown that there are still instruments in use that have not been calibrated and that almost 25% of NMHS didn't have calibration laboratories (IOM N°122). The situation could be worst for RA I and III.

A possible way of improvement in the traceability of instruments could be expected from a broader use of travelling standards (available at reasonable prices), which could be used by NMHSs that do not have a calibration laboratory to do on-site verifications, as well as for RICs to verify the standards of Members of the Region, if not possible in another manner.

A successful example of this proposal is given by the project conducted in the western Balkans under the supervision of

the CRI of Slovenia (RA VI). The project consisted of providing each of the 18 NMHSs of the region with a calibration kit that will enable them to conduct on-site inspections at their respective national territory. The CRI of Slovenia piloted the purchase of these kits and conducted the laboratory calibration of the kits as well as all necessary training activities.

A calibrating strategy developed by CIMO could help, once adopted, in the implementation of such projects world wide and therefore contributing to achieving one of the main goals of the WIGOS.

6. New roles of RICs in the face of new challenges

At the global scale, several new drivers are impacting WMO the various measurement components of WIGOS, including the opportunity and challenges of Big Data and its myriad of sources, the Minamata Convention, and the pressing need to be more agile, innovative and informative.

At the national level, NMHS are faced to emerging challenges mainly related to new technologies and measurement methods that are thriving on the world market, the massive transition to automatic stations with the abolition of mercury instruments and obsolete instruments (Minamata convention) by 2020 and the openness to partner's and third parties observing networks.

At the regional level, WIGOS is offering new opportunities that lie ahead beyond the geographical frontiers of NMHS through collaborative projects for data share and exchange, optimization of observing networks, inter-laboratory comparison, E-training, the WMO calibration strategy ...

The assignment of the quality of a measurement has always been dependent on being fit for a user's requirements. In the past the focus on making all measurements fit for climate analysis has dominated the measurement regime. That is no longer the case with tiering of

networks (for example, climate, weather, aviation), third party data availability, and crowd sourcing. As the methods and sources of the same measurement, for example, 'temperature', become more heterogeneous there is a temptation to use an instrumental method (if known) to estimate the quality through assumptions, rather than finding a quantitative measure based on the facts of the process of measurements. One solution to replacing belief with knowledge for some quantities is traceability where there is a framework of physics and chemistry metrology. However, some existing measurements and new measurements being integrated into the WIGOS framework either require a significant amount of work to achieve traceability (for example, satellite radiances), or have yet to consider traceability (for example, third party data), or where traceability is impracticable (for example, crowd sourcing, camera imagery).

The work of the Regional Instrument Centers must continue as should increasing the collaboration on the propagation of traceability with the hydrological and atmospheric chemistry calibration centers. While likely to be difficult, the role of RICs and their client base should be expanded to include active and passive remote sensing measurements when methods of traceability to SI become available for those measurement types.

7. Conclusion

This paper traces the history of RICs, the highlights and strengths and also the weaknesses that prevent them from carrying out their missions within the region. More than a quarter of a century after their creation, RICs are far from being perfect, while the advent of WIGOS has re-emphasized the positive contribution of these centers in quality assurance of the measurements made being the levers for the promotion of the metrological activity within the meteorological services.

New technologies, Minamata convention, big data and the openness to partner's and third parties networks are also new challenges facing RICs and therefore we have to expect new roles that will be assigned to CRIs in the near future.

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