

WORLD METEOROLOGICAL ORGANIZATION

**COMMISSION FOR INSTRUMENTS
AND METHODS OF OBSERVATION**

**EXPERT TEAM ON REGIONAL INSTRUMENT CENTRES,
CALIBRATION AND TRACEABILITY**

First session

**Nairobi, Kenya
23 – 26 September 2013**

FINAL REPORT



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EXECUTIVE SUMMARY

This first session of the CIMO Expert Team on Regional Instrument Centres, Calibration and Traceability was held from 23 to 26 September 2013 at the Kenya Meteorological Service in Nairobi, Kenya.

The meeting reviewed the evaluations received from Regional Instrument Centres (RICs) from all over the world to ensure they were able to meet Members requirements. It noted a significant improvement in the infrastructure and capabilities from some RA-I RICs since an expert visit was organized to assess their status in 2004/5. The meeting agreed that the evaluation scheme that was used for the evaluation was suitable and did not need modifications.

The meeting reviewed the webpages that were developed on the WMO website for each RIC independently and made some recommendations to include additional information. The meeting also reviewed the plans of RICs to conduct interlaboratory intercomparisons.

The meeting addressed how to improve the traceability of observations to SI, especially in the case of Members that do not have a calibration laboratory and agreed upon steps needed to further develop this strategy and to implement it.

The meeting also reviewed draft guidance material for RICs and calibration laboratories on the computation of uncertainties linked to instrument calibration. It reviewed the outcome of a survey conducted to assess the status of obsolete and dangerous instruments in NMHSs and developed a plan to develop updates to a number of chapters of the CIMO Guide before the meeting of the CIMO Guide Editorial Board scheduled to be held in November 2013.

The meeting reviewed its activities to ensure they were contributing to the activity list provided in the WIGOS Implementation Plan. It developed recommendations for future activities to be carried out by CIMO and/or other CIMO Expert Teams towards supporting the implementation of WIGOS in the next intersessional period.

AGENDA

1. **ORGANIZATION OF THE SESSION**
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 - 1.2 Adoption of the Agenda
 - 1.3 Working Arrangements for the Session
2. **REPORT OF THE CHAIRPERSON**
3. **WIGOS CONTEXT**
 - Update on the WIGOS Development
 - Opportunities and requirements for modified RIC scope
4. **RIC CAPABILITIES AND COMMUNICATION WITH MEMBERS**
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GENERAL SUMMARY

1. ORGANIZATION OF THE SESSION

1.1 Opening of the Session

1.1.1 The first session of the CIMO Expert Team on Regional Instrument Centres, Calibration and Traceability (ET-RIC) was opened on Monday, 23 September 2013 at 9:00, by Dr Jérôme Duvernoy, Chairman of ET-RIC. Mr Peter Ambenje, Deputy Director Forecasting and County Meteorological Service Branch welcomed the participants to the Kenya Meteorological Service (KMS). The list of participants is given in [Annex I](#).

1.1.2 Ms Isabelle Rüedi, Head of the Instruments and Methods of Observation Unit, WMO Observing Systems Division, welcomed the participants on behalf of WMO. She stressed the importance of CIMO ET-RIC activities for the development of WIGOS, to ensure data traceability and quality that can meet user requirements and support all WMO Programmes and priority activities such as the Global Framework for Climate Services. She noted that a Training Workshop on Instrument Maintenance and Calibration for RA-I Members was presently held in KMS and encouraged ET-RIC members to liaise with the training workshop participants to identify how CIMO, and in particular ET-RIC could support them through the development of relevant guidance material.

1.1.3 On Wednesday 25 June 2013, Dr Joseph Mukabana, Director of Kenya Meteorological Service and Permanent Representative of Kenya with WMO welcomed the participants to Nairobi. A minute of silence was observed in memory of those who perished during the terrorist attack of the Westgate Mall in Nairobi. He noted that this was the first CIMO Expert Team meeting that Kenya hosted. He mentioned that KMS was hosting a RIC and also presently hosting a Training Workshop on Instrument Maintenance and Calibration for RA-I Members.

1.1.4 Ambassador Julius Kandie, Senior Director of Administration, Ministry for Environment Water and Natural Resources addressed the participants. He stressed the importance of KMS for the region, noting in particular the training courses it organizes and the services provided by the RIC. He said that Kenya RIC (one of the 5 RICs in the region) is doing well. He stressed that any good weather forecast starts with weather observations made by meteorological instrumentation. Instruments must not only be standardized, but also calibrated to ensure the data quality worldwide. The work of ET-RIC is important to ensure the quality of meteorological and hydrological services. He reiterated that Kenya is doing all it can to strengthen the RIC.

1.2 Adoption of the Agenda

The meeting adopted the Agenda as reproduced at the beginning of this report.

1.3 Working Arrangements for the Session

The working hours and tentative timetable for the meeting were agreed upon.

2. REPORT OF THE CHAIRPERSON

2.1 Dr Jérôme Duvernoy presented his report. He reviewed the progress made by the team on each of its tasks since CIMO-XV in 2010. A first teleconference was organized early 2013, which was very important to get a better understanding of the tasks assigned to the team and to make the work progress.

2.2 He stressed the difficulty of working together without knowing each other properly. He recommended that the Secretariat organizes a web meeting of each CIMO ET early in the intersessional period to start the work and to help members getting acquainted to each other.

2.3 He informed ET-RIC and expressed his regrets that this would be his last mandate as Chair of ET-RIC, as he had changed position. A new chairperson will have to be assigned as chair of ET-RIC at CIMO-XVI.

3. WIGOS CONTEXT

3.1 The meeting was informed about the status of development of WIGOS, which is one of the priority areas of WMO. It was also informed in more details about the WIGOS Implementation Plan (WIP), which identifies 10 key activity areas and activities needed to be carried out in the coming years to establish an operational WIGOS. It was noted that all ET-RIC activities are contributing to some of the activities included in the WIP. ET-RIC was invited to identify new and on-going activities that it could carry out in the next intersessional period to further contribute to meeting the objectives of the WIP. Those activities could be targeted at strengthening RICs as well as strengthening NMHSs in general.

3.2 The meeting was then informed on the status of development of all Regional WIGOS Implementation Plans (R-WIPs). It reviewed all the activities of these plans relevant to ET-RIC Terms of Reference to clearly understand the requirements and priorities of all WMO regions in view of providing effective support to these activities. The meeting recognized that all R-WIP had put a strong emphasis on the need to strengthening RICs to ensure their full functionality and to enhance the support they provide to Members. RICs indeed provide a major component of the integrated quality management key area of WIGOS since RICs contribute to ensuring the traceability of observations to international standards. The meeting recognized that financial resources constrain the activities of RICs, as well as the ability of Members to bring/sent their standards for calibration at RICs. The meeting stressed that if the traceability of the observations is not achieved, then the full potential of WIGOS will never be achieved. Therefore, strengthening the RICs and developing an appropriate traceability strategy for those who do not have calibration laboratories should be considered as an utmost priority within WIGOS.

3.3 The status of the RICs of RA-I and RA-II were shortly summarized, as well as the activities they carried out in the last years to support other Members. Their views on the requirements for and options for a wider scope for regional centres in the WIGOS context were presented.

3.4 The meeting explored potential mechanisms for improving the global quality and traceability of observational data from surface-based (incl. remote-sensing) systems. This included consideration of traditional observations, transition from manual to automatic observations, and more complex observing equipment (such as ceilometers, visibilitimeters, weather radars, radar wind profilers, lidars, etc). In particular, the meeting considered how RICs could be strengthened to provide increased support to Members, whether the terms of references of RICs should be modified to cover other systems, whether new centres should be established, etc.

3.5 The meeting recognized the following:

- The capabilities required to calibrate basic field instruments is not at all comparable to those needed to calibrate complex instruments, such as radars and wind profilers. In general, these different expertises are not held by the same people, and frequently also not by the same entities in a number of NMHSs.
- Some RICs still need to be strengthened to be able to effectively support Members of their region.
- Some additional RICs could be established, taking also into account in particular the language specificities of the region.
- A strategy should be developed to help Members organizing the inspection and calibration of their field instruments (especially AWSs) to ensure their performances meet the expectations.
- A common procedure needs to be developed for RIC intercomparisons, mainly concerning the evaluation of the intercomparison results, including the computation of the reference

value. The general principles to do so have been published in an ISO standard, which is targeted at comparisons encompassing a large number of laboratories and at holding the highest level standards. These principles need to be adapted to the small scale intercomparisons envisaged between RICs and to the fact that they address the comparison of secondary standards.

- There is a strong need to ensure Members are aware of the existence of RICs and of the services they can provide. All opportunities should be used to do that, such as direct information from RICs to Region Members (not only to PRs, but also to technical staff), Regional Association sessions, CIMO session, TECOs, etc...
- A number of RICs have made a big effort to modernize their instrumentation, but they now need support to finalize the procedures required to achieve ISO 17025 accreditation.
- The amount of work needed to establish the procedures required to become accredited were generally underestimated when RICs were established. A number of RICs did not have these procedures in place when they were established. Once the procedures are in place, RICs are in a much better position to support Members.
- In RA-I, ASECNA is providing a significant contribution in the implementation of WIGOS by carrying out training and calibration of instruments.
- Most RICs have knowledge on ceilometers and visibilimeters. It will be sensible for RICs to consider providing services related to these instruments in the future. However, clear procedures on how to calibrate such instruments would have to be developed first, as they are still lacking.

3.6 As a conclusion of the discussion, the meeting recognized that RICs are doing their utmost to support Members, but that they are constrained by their financial situation and that of the Members needing to have reference standards calibrated. Also, a number of them still have problems to meet the present RIC Terms of Reference. The meeting agreed that the first priority should be put on ensuring that the calibration of traditional instruments are well coordinated by RICs and recommended that the RICs Terms of Reference be kept as they are.

3.7 However, the meeting fully agreed on the relevance of addressing the data quality, standardization and calibration of more complex instruments in the context of WIGOS. The meeting strongly recommended that this be carried out by other centres of excellence, which have expertise on these technologies. In this context, it should be remembered that the difficulties that a number of RICs are facing now, originated because they did not have the appropriate procedures in place when they were established. The meeting recommended that this be given high attention when establishing new centres of excellence/regional centres.

4. RICS CAPABILITIES AND COMMUNICATION WITH MEMBERS

4.1 RICs evaluations

4.1.1 The sixteenth WMO Congress stressed that Regional Instrument Centres should provide effective support to Members in ensuring the traceability of their standards and reaffirmed the need to regularly assess their capabilities making use of the evaluation scheme that was developed to this effect. It requested regional associations, in collaboration with CIMO, to monitor these evaluations to ensure RICs meet the requirements of their Regions.

4.1.2 In May 2013, Mr Duvernoy, contacted all RICs requesting them to provide their evaluations. As only few replies were received following this initiative, the WMO Secretariat followed up with a letter to the Permanent Representatives of WMO Members hosting RICs, which had not yet provided their evaluation. Replies from 8 out of 16 RICs were received prior to the meeting. In addition, the evaluation of the RIC Nairobi (Kenya) was completed with the help of CIMO ET-RIC during the meeting. RIC Nairobi informed the meeting that becoming accredited according to ISO 17025 was one of their priorities.

4.1.3 The meeting reviewed all the evaluations received from RICs to be confident that they are able to meet Member requirements. Two groups of responses could be identified: those which are ISO 17025 accredited and those which are not. The performance of the RICs which are accredited (in particular the uncertainties they can achieve in performing calibrations) can be compared, while it is much more difficult in the case of the other group. At present, the RICs of Japan, Slovakia and Slovenia have reported that they are accredited. ET-RIC congratulated those RICs for this important achievement and is confident with their performances.

4.1.4 The meeting was confident that France would be reaccredited soon and that Morocco which is presently undergoing the accreditation process would achieve the level of accreditation in a near future as well.

4.1.5 The meeting recognized significant improvement in the equipment and/or competencies available at the RICs of Kenya, Morocco and Egypt and congratulated them for these achievements. The meeting had some concerns with the traceability of the RICs of Cairo and Nairobi and recommended that they consider improving the traceability of their standards to the National Metrology Institute of their respective countries, and to provide the calibration certificates of their reference standards as requested in the evaluation scheme.

4.1.6 The meeting expressed concerns that no replies were received from RA-III (hosting 1 RIC) and RA-IV (hosting 3 RICs). The meeting recommended to Mr Duvernoy to contact personally all RICs that had not replied and to give them advice on how to respond to fill the evaluation scheme based on the knowledge he has of the performance of these RICs that he visited in 2004/5. Three Regional Associations (RA II, RA IV and RA VI) have decided to request Members hosting RICs to reconfirm their willingness to provide this support to their Region. The meeting recommended that the Secretariat requests clarification on the plans of all Members hosting RICs which had not provided their evaluation yet.

4.1.7 The meeting's participants agreed that the evaluation scheme was suitable to perform the RIC evaluations and that none of them had experienced problems with it. The term "best capability" appearing in the evaluation scheme needs to be replaced by "Calibration and Measurement Capability (CMC)" and a footnote needs to be included to clarify its meaning. That footnote should be included both in the evaluation scheme, and the RICs websites. Its text should be "A CMC (calibration and measurement capability) is the smallest uncertainty of measurement that can be expected to be achieved by the RIC during a calibration. This CMC is evaluated by the RIC itself and described in the scope of accreditation of the RIC, if available."

4.1.8 The RICs Terms of Reference state "A recognized authority must assess a RIC, at least every five years, to verify its capabilities and performance". A recognized authority could be for example an accreditation body, or a CIMO expert with appropriate expertise mandated to do that. The meeting recommended organizing audits of opportunity when a CIMO ET-RIC expert is already on mission at a RIC location, or expert missions to specific RICs.

4.1.9 The meeting also recalled that assessing the performance of RICs could be done through the organization of a RIC intercomparison and therefore urged all RICs to take part and/or organize such activities to demonstrate their performance and to report on their results.

4.1.10 Some meeting participants mentioned that having prepared the documentation required for achieving certification according to ISO 9001, and/or ISO17025 accreditation had helped them to strongly improve the capabilities of their laboratories, as well as the recognition of their work within their services and beyond. The meeting therefore strongly encouraged all RICs to consider undergoing an accreditation process

4.2 RICs websites

4.2.1 RICs should play an important role in WIGOS in order to ensure the quality of observations, as worldwide compatibility of data strongly depends on assuring traceability of measurements to SI. Unfortunately, a number of NMHSs are not aware of the existence of RICs and of the services they can provide. The establishment of dedicated RIC websites would facilitate communication of RICs capabilities and services to Members.

4.2.2 ET-RIC, in collaboration with the Secretariat agreed on a template for RICs websites to be hosted on the WMO website. These websites would be based on the information provided in the RIC evaluation scheme which is to be reported periodically, to minimize the workload for both the RICs and the Secretariat. Additional information could be provided on the RICs own websites.

4.2.3 The contents of the RIC webpages on the WMO website are composed of "General Contact Information" and "Specific Information on instrument calibration capabilities". "General Contact Information" includes address, website, contact person, calibration capabilities for each RIC. "Specific Information on instrument calibration capabilities" includes instrument undergoing calibration, calibration range, reference standard, equipment, calibration and measurement capability, traceability of reference equipment, and status of accreditation. The webpage for 6 RICs have been completed at this stage and are available from the main WMO RIC webpage.

4.2.4 The meeting recommended that the WMO Secretariat also includes links to reports providing the results of intercomparisons in which the RICs participated, as well as information on currently on-going activities, such as announcement of intercomparisons and training courses organized by the RICs, as well as a footnote on the meaning of a CMC as described in paragraph 4.1.7 of this report. In order to make best use of the Secretariat resources, it is recommended that RICs provide updates to the Secretariat to update the WMO RIC webpages on a yearly basis (in accordance to the ToRs of RICs).

4.2.5 The meeting recommended that RICs establish also their own websites on which they should provide additional information, such as for example:

- Detailed procedure and conditions to accept requests for calibration of instruments by Members,
- Calibration equipment (climatic chambers, generators, facilities, etc.),
- Training courses or materials which can be shared among Members,
- Links to reports providing the results of intercomparisons in which the RICs took part,
- Link to annual reports on past activities relevant to RIC ToRs,
- Etc.

4.3 RICs intercomparisons

4.3.1 Capabilities of metrology laboratories, such as RICs, can be demonstrated and tested through inter-laboratory intercomparisons. CIMO recommended that such intercomparisons be regularly organized by RICs and the results published on both the RICs and WMO websites to provide evidence of RICs' performances to the users.

4.3.2 The meeting was informed about the status of intercomparisons carried out between RICs. The only RIC intercomparisons results which were published took place in 2008 and involved only 3 RICs. ET-RIC members presented their proposals to carry out RIC intercomparisons in RA-I, RA-II & V, and RA-VI.

4.3.3 Mr Merrouchi presented the plan for an intercomparison for RA-I RICs to be conducted in collaboration with the RIC of a developed country as provided in [Annex II](#). The meeting reviewed the proposal and recognized its merit as it could be easily organized, noting that it represents a collection of bilateral comparisons rather than a real inter-laboratory intercomparison. Unfortunately, as the RICs of other regions would also have to organize their own intercomparisons, it was not possible to identify a RIC from another region who could serve as pilot for the RA-I intercomparison. Also, it was recognized that it would be preferable to first obtain some information on the capabilities of the RICs of Algeria and Botswana before organizing specific training for RA I RICs.

4.3.4 The meeting welcomed and highly encouraged the proposal from Morocco to pilot a bilateral intercomparison with Kenya, as well as with France and to combine the results of both. ET-RIC members offered their support to RIC Morocco to finalize the procedure of the

intercomparison, as well as to provide advice on the data evaluation. The meeting further recommended that the results of this intercomparison be presented at TECO-2014.

4.3.5 The meeting welcomed and strongly supported the plan for a combined RIC intercomparison for RA II and RA V, presented by He Xiaoley (see [Annex III](#)) and provided the following guidance and recommendations for modification of the proposal:

- In RIC Beijing, the standard to be used shall be its highest level standard, which is directly traceable to the NMI (see Section 5. 1) of [Annex III](#)).
- The transfer standard used for the intercomparison (“intercomparison kit”) should have a low uncertainty to be able to demonstrate the CMC of every laboratory (see Section 6 .2) of [Annex III](#)).
- The temperature upper limit of the temperature intercomparison should be reduced to 50°C.
- The temperatures at which the humidity intercomparison will be performed should be clarified. ET-RIC members recommended performing it at 20°C.
- Include a calibration point in RIC Beijing at the end of the intercomparison to ensure there is no drift of the standard available in the “intercomparison kit”.
- Consider inviting the RIC of Manilla to join the intercomparison.
- If China, does not have the needed transfer standards for the intercomparison kit, an alternative would be to ask the RIC of Australia for its intercomparison kit, as purchasing a sensor through WMO would be problematic and would delay the intercomparison plan.

4.3.6 The meeting welcomed the proposal from He Xiaoley and Kouichi Nakashima to work together to make this intercomparison happen and to invite RA-V RICs to participate in it.

4.3.7 The meeting recommended that the intercomparison plan be finalised following the guidance above, in collaboration with all the participants of the intercomparison, and to present the results of the intercomparison at TECO-2014.

4.3.8 Mr Groselj presented the plan for an intercomparison of RA-VI RICs (see [Annex IV](#)), to be possibly conducted in collaboration with other accredited calibration laboratories from RA-VI NMHSs. Informal consultations with other Members already took place. The proposal was reviewed by the meeting, as well as the detailed procedure for carrying out the intercomparison that is already available. It is planned that the intercomparison reference value would be derived from the 3 RICs of RA-VI, which all are, or used to be accredited. The duration of the whole process could be of the order of a year, but would depend on the number of participants. As there are no customs costs within Europe, the only costs that the laboratories would have to bear would be those for shipping the intercomparison kit to the next participating laboratory and would be minimal.

4.3.9 The meeting strongly supported the plan for this intercomparison and recommended that the protocol developed for this intercomparison be used as a base for a general protocol to be used for all RIC intercomparisons. It could be expanded with the protocol that will be used for the evaluation of the intercomparison results and possibly published as an IOM report.

4.3.10 The Meteomet 2 project has been recently submitted for funding to the EMRP (European Metrology Research Programme) and will include as one deliverable the development of a protocol for NMHSs calibration laboratory intercomparisons. The meeting therefore strongly recommended that WMO sends a support letter in favour of Meteomet 2 as the outcome of this deliverable would be of high relevance to RIC intercomparisons.

4.3.11 Mr Groselj also informed the meeting, that in the context of the RA-VI RWIP, he will collect information on the CMCs of all Members of RA-VI with the view to publish them at an appropriate place to ensure Members have information on laboratories which could support them in calibrating specific sensors, as a complement to the services provided by the RICs. The meeting recommended that the outcome of this project be presented to CIMO and possibly expanded to cover all WMO regions.

4.3.12 Though RIC intercomparisons are aimed at demonstrating the capabilities of RICs in achieving the CMCs they are declaring, the publication of bad intercomparison results could be detrimental to the concerned RICs. The meeting therefore strongly recommended that all participants agree before the beginning of the intercomparison on whether the results would be published in an anonymous manner or not.

4.3.13 The meeting recognized the need to clarify the difference between “traceability” and “interlaboratory comparisons”, which have totally different meanings and purposes. As described in International Vocabulary of Metrology (VIM) metrological traceability is a property of a measurement result whereby the result can be related to a reference through a documented unbroken chain of calibrations, each contributing to the measurement uncertainty. Metrological traceability requires an established calibration hierarchy what means that each piece of equipment, used in calibration process, must be calibrated which links instruments to national/ international standard.

4.3.14 Laboratories continually try to improve the quality of calibrations, procedures, and capabilities. Even if these internal checks are preformed carefully, systematic deviations can often go unnoticed. The comparison of measurement results with other laboratories is very important. Participation in interlaboratory comparisons is a criterion for accreditation, but is also a important assessment of reliability, operational certitude, staff confidence and measurement accuracy. It represents a vertical assessment of overall performance in a calibration laboratory. The participating laboratories are sent measurement instruments (transfer standards) on which measurements (calibrations) have to be performed using their standard procedures.

4.3.15 The meeting reiterated the importance of organizing RIC intercomparisons to assess the performances of calibration laboratories, as they cover all the areas which influence the calibration (operator, method, reference standard, traceability, staff competencies, lab procedures,...) and felt it was worth pursuing the plan to organize RIC intercomparisons, even if very few had been organized to date. The possible shortcomings or problems that could have prevented holding RIC intercomparisons were reviewed. It was concluded that the following factors were the major drawbacks: cost for customs and sometimes difficult customs clearance procedures (apart from within Europe), costs of shipping the intercomparison kit (especially if the intercomparison kit is large), workload for the pilot laboratory, and computation of the reference value. It was also recognized that a number of RICs concentrated recently on describing their internal procedures towards becoming accredited before considering participating in an intercomparison and some RICs felt that their first duty was to support other Members in achieving traceability and domestic needs for calibration, while taking part in an intercomparison had a lower priority. Since there are many RICs in accreditation process, the importance of interlaboratory comparisons will increase, because it represents an excellent tool for assessing the performance of calibration laboratory and offers opportunity to improve quality system.

4.3.16 The meeting strongly encouraged RICs to collaborate more closely and in particular to carry out regular interlaboratory comparisons.

5. TOWARDS IMPROVED MEASUREMENT TRACEABILITY

5.1 Guidance on the computation of calibration uncertainties

5.1.1 Congress requested CIMO to support further strengthening of RICs and NMHSs calibration laboratories, particularly with respect to the technical calibration procedure estimating the uncertainties of the calibrations performed. The meeting reviewed the outline of a draft IOM report on the subject as well as a few examples of uncertainty calculations. It emphasized that there is no universal procedure for calculating the uncertainty budget, as it is directly dependent on the equipment used to perform the calibration, as well as on the instrument to be calibrated. Therefore, the IOM report will have to make it clear that the document presents only examples, which can be used as guidance, but which will have to be adapted to each calibration’s laboratory specific conditions.

5.1.2 The meeting agreed that there was no need to repeat the theoretical procedures for calculating uncertainties from other documents that are widely available, such as the GUM, etc., but that the report should include only a short section on this matter and provide links and reference the appropriate documents. The document should include a number of examples concerning the typical types of equipments used for temperature, pressure and humidity calibrations. It should also put emphasis on how to evaluate the different uncertainty components, such as self-heating, temporal and spatial homogeneity of a temperature bath, hysteresis, etc....It should include some basic as well as some advanced examples.

5.1.3 The meeting participants that were presently preparing themselves for the accreditation of their laboratory recognized that such a document would provide a significant help for achieving accreditation. It was agreed that examples would be collected from the accredited RICs in the coming month, towards finalizing the report at the beginning of 2014.

5.1.4 The meeting reiterated the recommendation to collaborate with Regional Associations to organize workshops on the subject of uncertainty calibrations. In order for the participants to benefit most from such a workshop, it would be preferable if they were using similar type of instrumentation. The workshop should be organized preferably in one RIC presently preparing itself for the accreditation process in order to apply the process on the real situation of a RIC, rather than organizing it in an accredited RIC, which may have quite different instrumentation.

5.2 Calibration Strategy

5.2.1 The lack of observations traceability was recognized as a major concern by CIMO-XV. To improve measurement traceability to SI, CIMO recognized the need to sensitize NMHSs to the necessity of regular instrument calibration and to develop relevant training and capacity-building material. It also recalled that preventive maintenance, in particular periodical instrument checks, is essential to ensure the required quality of measurements. ET-RIC was tasked to develop a strategy that will ensure that the traceability of measurements to SI standards is implemented by WMO Members, together with the appropriate outreach material. Mr Merrouchi gave a presentation proposing some principles for developing a strategy aiming at improving calibration activities at the national level, including the potential role of RICs for its implementation.

5.2.2 Though the principles of traceability are clearly laid down in the CIMO Guide, numerous developing country Members have no calibration laboratory at all to ensure the traceability of their instruments. Some developed country Members are also facing challenges with the calibration of their network instruments and are applying a strategy consisting of carrying out field inspection checks, to identify instruments which are out of the calibration tolerances and to perform complete laboratory calibrations only of those instruments which were identified as not meeting the expected tolerances during the field inspection check. The meeting stressed that a field inspection is not equivalent to a proper calibration. It is only meant to identify faulty instruments, which absolutely have to undergo a full calibration to ensure expected data quality is achieved.

5.2.3 The aim of the strategy should always be to ensure the proper traceability of observations to SI through an uninterrupted calibration chain of the instruments. The following options could be chosen to achieve this goal, listed in order of preference:

- 1) Instrument calibrated in an accredited laboratory,
- 2) Instrument calibrated in the laboratory with a transfer standard, which was itself calibrated in an accredited laboratory,
- 3) In the absence of a laboratory, make use of a field inspection kit that is traceable to a RIC or an accredited laboratory for the inspection of all the network instruments and ensure those which are out of the specified tolerance range are calibrated in a laboratory as described in option 1) and 2) above.

5.2.4 The meeting agreed on the following steps to be taken to complete this task. First a document of a few pages should be developed to document the options mentioned above and which could possibly be included as an Annex of the CIMO Guide at a later stage. Some outreach

material should also be developed to sensitize Members, and in particular Permanent Representatives, on the need and requirement to ensure instrument traceability.

5.2.5 The meeting noted that CIMO ET-Standardization was in the process of developing a sustained performance classification for observing stations on land. It also noted that this classification does not make a difference between networks on which regular field inspections are carried out and those which do not perform any inspection at all. The meeting was of the opinion that these categories needed to be reconsidered to account for the option of a field inspection which could be an acceptable mean of ensuring the network observations quality. (The field inspection can be considered as a “one-point calibration”). The meeting recommended that ET-Standardization reconsiders this as it is the reality of a number of Members and can be used as an option to ensure appropriate data quality.

5.2.6 Mr Groselj reported on the positive experience made in South-Eastern Europe. One of the deliverables of the Project »Disaster Risk Reduction in South Eastern Europe« was a recommendation for a 'field inspection kit'. Many NHMSs in SE Europe do not have a calibration laboratory in their structure and only a few calibrations of field instruments were made in recent years. The kit consists of a set of basic meteorological instruments (temperature, relative humidity and air pressure) for on-site testing of field measuring instruments. Within the frame of follow-up project "Building resilience To Disasters in the Western Balkans and Turkey" (activity “Assistance and calibration and maintenance of hydro-meteorological instruments”) two 'field inspection kits' were purchased. The beneficiary countries are: Albania, Bosnia and Herzegovina, Montenegro, Kosovo and the Former Yugoslav Republic of Macedonia. The project is in implementation stage: the kits were deployed to first beneficiaries (Kosovo and Montenegro) for 2 months field testing. Training for operating the kits was performed. After exercise the kits will remain in the sub-region as donation and will be available at any time to beneficiaries. Role of RIC Ljubljana is to provide (periodically) traceability of transfer standards used for on-site instrument testing.

5.2.7 The meeting recommended that Members be requested to provide information on the status of calibration of their instruments on a regular basis to the WMO Secretariat to share and inform users on observations traceability to SI. It also recommended that upon completion of this document, the CIMO Guide be thoroughly reviewed to ensure the meteorological principles throughout the CIMO Guide are consistent with this strategy. Also, some training material will need to be developed on the proper use of a field inspection kit, including the need to regularly recalibrate it in an accredited laboratory and on the actions to be carried out in case an instrument is found not to meet the expected tolerances.

5.2.8 The meeting noted the need to clarify that the “field inspection kit” is not the same thing as the “laboratory intercomparison kit” mentioned in Section 4.3 of this report. The 'field inspection kits' are usually used within NHMSs to ensure on-site testing of field instruments. The criteria must also be developed in terms of permissible deviations for different types of instrumentation. The instruments of 'field inspection kit' should have good metrological properties (drift, accuracy...).

5.2.9 The purpose of 'laboratory intercomparison kit' is to evaluate performance of calibration laboratories (laboratory conditions). As laboratory measurement uncertainties are smaller compared to on-site measurement uncertainties, the transfer standards of 'laboratory intercomparison kit' must be high quality instrument in order to meet target uncertainties

6. COMPETENCIES OF AND RISKS TO PERSONEL

6.1 Competencies of personnel

6.1.1 In the context of WIGOS and of the WMO Quality Management Framework (QMF), it is needed to ensure that personnel performing tasks such as making meteorological observations, and calibrating or maintaining equipment have the appropriate skills, knowledge and behaviours to do the tasks to the level outlined in the CIMO Guide. ET-RIC was tasked to start developing such competency implementation guidance.

6.1.2 In the absence of a contribution from the ET Members to this agenda item, the meeting developed a strategy to ensure the timely progress of this task. The meeting reviewed the

competencies developed in the context of Aeronautical Meteorology Programme (<http://www.wmo.int/pages/prog/dra/etrp/documents/AMFcompetencies.pdf> and <http://www.wmo.int/pages/prog/dra/etrp/documents/AMOcompetencies.pdf>) and decided to base the CIMO competencies on the same model. It was decided that ET-RIC would at present concentrate on the competencies required for performing calibrations and recognized that the competencies are independent from the job descriptions.

6.1.3 It was recognized that the RICs which are accredited had had to define competencies. The meeting therefore decided to request all ET-RIC members, which have an accredited laboratory, or which are in the process of preparation for ISO 17025 accreditation to provide the competencies used in their laboratory to Mr Merrouchi by November 2013. The meeting further tasked Mr Merrouchi to develop a document with competencies relevant to calibration, which could be provided to the CIMO MG for review at its next session in March 2014. It is expected that these competencies would, at a later stage, be included as an Annex of the CIMO Guide.

6.2 Alternatives for dangerous and obsolete instruments

6.2.1 A questionnaire on the Alternatives for Dangerous and Obsolete Instruments was developed among the ET members during the last years. It was sent to all WMO Members in July 2013. The meeting was informed about the preliminary results of this survey.

6.2.2 Approximately 50 responses were received, which covered all WMO regions. However, it should be noted that the response rate is very inhomogeneous among the regions. The meeting therefore recommended caution in finalizing the evaluation and in developing recommendations based on the outcome of this survey. It recommended verifying whether there are some significant differences depending on the regions.

6.2.3 The meeting reviewed the outcome of the survey and congratulated Ms Amudha B. for the work she did in preparing the survey and evaluating the replies. It noted that a lot of instruments containing mercury are still in use around the world.

6.2.4 A number of respondents inferred that CIMO had recommended abandoning mercury instruments. The meeting stressed that this was a misunderstanding and that at present there was no recommendation from CIMO requesting Members to stop using mercury-instruments. However, CIMO, at a number of occasions, stressed the dangers of mercury for health and environment. The meeting stressed the need to ensure that the replacement of mercury instruments be a slow and planned process to ensure sufficient duration of parallel measurements.

6.2.5 The meeting was aware of the development of the Minamata Convention on Mercury (<http://www.unep.org/hazardoussubstances/MinamataConvention/tabid/106191/Default.aspx>), which was developed by UNEP and which will be ratified in October 2013. It noted that CIMO is also aware of the preoccupation presented in the Minamata Convention on Mercury. The understanding from the meeting is that this convention would ban the production, import and export of instruments containing mercury for meteorological purposes from 2020. Should this be the case, it would have a strong impact on meteorological measurements. The meeting therefore decided to thoroughly review the text of the Minamata Convention on Mercury once it will be signed and to develop relevant recommendations to WMO Members depending on its final content and its implications for the use of mercury-based meteorological instruments for the next session of the CIMO Management Group (March 2014).

6.2.6 Mr Merrouchi made a presentation on the experience made in Morocco with the renewal of its observing system, and in abandoning the use of mercury-based instruments in the national network (see [Annex V](#)). He noted that modern equipment are available to replace mercury-based instruments and obsolete instruments, like barographs, thermographs, etc. and that, in view of the relative price of the instruments, it was also very cost-effective to move from conventional instrumentation to digital instrumentation.

6.2.7 The meeting was pleased to hear about this experience. It recognized that alternatives for dangerous and obsolete instruments were available, could be calibrated and provided cost-effective solutions for these instruments. A large variety of instruments and providers are available. However, they also vary in their performances and prices. ET-RIC recommended that Members

investigate the metrological properties of these instruments and share these results so that these experiences could be compiled to provide appropriate guidance to Members. The meeting also recommended that Members keep in mind that the replacement of dangerous and obsolete instruments should be considered in their strategy to improve the quality of their observing networks. The meeting also cautioned that the transition from the conventional to modern instruments required rethinking the whole concept of the observing network and of the traceability chain.

6.2.8 The meeting recommended that guidance on the regular maintenance, inspection and calibration required by modern instruments be developed to support the developing countries which will be replacing their instrumentation to ensure the stability of the observation time series.

6.2.9 The meeting questioned the continuous need for Regional Standard Barometers list published in the CIMO Guide (Part I, Chapter 3, Annex 3B). The meeting recommended including this item in the workplan of ET-RIC for the next intersessional period. This task should assess the need for these regional standards, their status (whether they are still existing and calibrated) and the implications and possible solutions to be implemented to be compliant with the Minamata Convention.

7. UPDATE OF THE CIMO GUIDE

7.1 Keeping the CIMO Guide up-to date is one of the key tasks of CIMO, as it serves as reference document throughout the world for instruments and methods of observations. The meeting agreed on a plan to ensure the review and update of the metrology principles presented in a number of chapters of the Guide, so that they would be available for consideration by the CIMO Guide Editorial board, which will be meeting in November 2013.

7.2 The task to thoroughly review a number of chapters was divided among ET-RIC members. Deadlines for reviewing the chapters and proposing an updated chapter for review to the whole team were fixed, as well as dates and times for teleconferences to collectively review and agree on the proposed changes as follows:

- Part I, Chapter 1 & Part III, Chapter 4: Jérôme Duvernoy, deadline for sharing proposed update: **13 October 2013**,
- Part I, Chapter 2 Temperature: Kouichi Nakashima & He Xiaoley, deadline for sharing proposed update: **7 October 2013**,
- Part I Chapter 3 Pressure: Rabia Merrouchi, deadline for sharing proposed update: **7 October 2013**,
- Part I, Chapter 4 Humidity: Drago Groselj, deadline for sharing proposed update: **13 October 2013**,
- Part II, Chapter 10 Filling gas for balloons: Amudha & Jean-Blaise Ngamini, deadline for sharing proposed update: **7 October 2013**,
- Teleconference to agree on updated text of Part I, Chapter 2 & 3, and Part II, Chapter 10: **Friday 11 October at 08:00 UTC**,
- Teleconference to agree on updated text of Part I, Chapter 1 & 4, and Part III, Chapter 4: **Friday 18 October at 08:00 UTC**.

7.3 The meeting recommended that an Annex to Part III, Chapter 4 be developed in the next intersessional period, which should deal with the organization of interlaboratory intercomparisons and be based on the experience gained in the currently planned intercomparisons of RA-I, RA II & V and RA-VI.

7.4 In the context of the development of the WIGOS, the WMO Technical Regulations are being completely rewritten and a Manual on WIGOS is being developed. The meeting recommended to the Task Team on WMO Regulatory Material to include the following in the WMO

Technical Regulations: “Members have to ensure the traceability of their observations to SI, and to the WRR for solar radiation” or an equivalent text with similar meaning.

8. OTHER BUSINESS

8.1 When purchasing instruments, Members need to gather information on the performance of specific instruments. Some Members perform very valuable instruments test. However, only few of them are published and made available openly. The meeting recommended that Members strive at publishing the results of the instrument tests they perform for the benefit of all and that the CIMO Secretariat links them to the CIMO website for easy access.

Workplan Review

8.2 Mr Nakashima presented to the meeting lecture notes on meteorological instruments that had been prepared at the occasion of the JMA/WMO training workshop for instrument specialist (Class III and IV) of RA-II (Tsukuba, 9-13 November 1998). Based on the recommendations made by CIMO ET-RIC (the Expert Team on Regional Instrument Centres, Quality Management Systems and Commercial Instruments Initiatives), second (reduced) session (Casablanca, 4-5 December 2009), the lecture notes were revised to account for more modern instruments as well.

8.3 The meeting reviewed the proposed document and recognized the value of the information provided in it, especially with respect to the use and maintenance procedures for a number of instruments that are still in operational use in many observing networks. However, the meeting recognized that it would still have to include more information on present-day technology to be suitable for publication as an IOM report. Instead of publishing as an IOM report, the meeting suggested possible alternatives for publishing this document, possibly as a JMA report that could be linked from the CIMO website, because the lecture notes, which are already available on RIC-Tsukuba website (http://www.jma.go.jp/jma/jma-eng/jma-center/ric/RIC_HP.html), include various contents helpful for WMO Members regarding meteorological instruments, traceability and calibration.

Workplan Review

8.4 The meeting revised its workplan to incorporate the decisions taken during this meeting, as well as to ensure the alignment of its activities with WIGOS Implementation Plan. The updated workplan is provided in [Annex VI](#).

Proposals for new activities

8.5 The meeting recalled was most Regional WIGOS Implementation Plans include the need to improve traceability of observations in their region through capacity building activities. CIMO had been organizing training workshops on metrology in a number of regions and ET-RIC members have actively participated in these trainings as trainers. The capabilities of Members with respect to metrology and the possible impact of such training workshop varies strongly, even within a region, depending on whether Members are in possession of have concrete plans for acquiring a calibration laboratory.

8.6 In view of the draft strategy presented above (Section 5.) for improving instrument traceability, the meeting recommended considering targeting more specifically the training to the participants, depending on whether they have or not a calibration laboratory. One training course could be targeted at those having a laboratory and focusing on the use of typical laboratory equipment. Another course could be developed to supporting better the Members which have no calibration laboratory and focusing on the use of a “field inspection kit”. For this later course, the meeting recommended that CIMO consider approaching relevant donors which could provide filed inspection kits for the trainees having no laboratory, which they would use during the course and bring back to their NMHSs to verify the performances of their field instruments.

8.7 Furthermore, the meeting recommended that CIMO considers extending the concept of the training workshop on metrology to additional parameters, such as precipitation and solar radiation in the future.

8.8 Based on its deliberations, the meeting considered activities, which CIMO may consider assigning as tasks for ET-RIC or other relevant CIMO expert teams during the next intersessional period. All these tasks are aimed at supporting the implementation of WIGOS at the global, regional and national levels, and in particular at strengthening Members to improving the observational data quality and traceability of their networks to enable fully achieving the WIGOS objectives. The topics identified below are listed in no specific order:

- Investigate how to ensure the traceability of ultrasonic wind sensors, ceilometers and transmissometers.
- Follow-up consequences of Minamata Convention on Mercury for meteorological instruments.
- Assess the need for the regional standard barometers, their status (whether they are still existing and calibrated) and the implications and possible solutions to be implemented to be compliant with the Minamata Convention on Mercury.
- Continue organizing interlaboratory comparison.
- Develop and document a common interlaboratory comparison method, including computation of the reference (IOM Report).
- Develop Annex to Part III Chapter 4 of the CIMO Guide on interlaboratory intercomparisons.
- Support RIC audits, on an opportunity basis.
- Training on computation of uncertainties (to be preferably carried out in a RIC preparing itself for accreditation).
- Finalize the strategy for improving the traceability of observations, develop corresponding update of the CIMO Guide and recommendations to Members to implement it.
- Develop Guidance material on use of field inspection kit, including what to do when an instrument is found to be out of the expected tolerance range.
- Develop guidance material on the inspection and calibration of field instruments (especially AWSs) to ensure their performances meet the expectations.
- Develop training material on calibration of wind sensors, precipitation gauge and solar radiation instruments.
- Consider widening the scope of the RA-VI action listing accredited NMHSs laboratories to all regions.
- Continue development of competencies.

Discussion session with the Instrument Maintenance and Calibration Course

8.9 A Training Course on Instrument Maintenance and Calibration for RA I Members took place at the Regional Training Centre of Nairobi, Kenya, from 16 September to 11 October 2013. This opportunity was used to organize a joint session between the participants of the training course and ET-RIC members (on 27 Sept. 2013), as well as with the WMO Secretariat representative (on 20 Sept. 2013). The aim of these sessions was to inform the training course participants on the CIMO ET activities, and specially to identify the problems faced by these participants in their countries and how CIMO could support them in improving the quality of their observations by developing relevant guidance material.

8.10 The following proposals were made by the participants:

- Guidance on the maintenance procedures and checks for modern digital equipments to ensure they perform correctly. (Which adjustments can be made to the sensors? How to be sure of the maintained performance of modern digital sensors? How to detect an instrument drift? What to do when a drift is noted?)
- Need for competencies: Need to be qualified to be allowed to go and intervene on instruments and calibrate them. To obtain such qualifications, competencies have to be clearly defined!
- Sensitization of PRs to the importance of maintenance (and calibration), so that staff would get adequate support to perform those tasks. Maybe develop a flyer for all PRs.
- Include “requirement for instrument maintenance” in Technical Regulations.
- Request Members to regularly report on the maintenance plans and status of maintenance of their equipment.
- Many sensors do not last long in African conditions. How can that be improved?
- Develop specifications for harsh climate conditions encountered in Africa.
- How to make AWS more compatible?
- Include specifications of Stevenson screen into the CIMO Guide so that they could be manufactured by Members.
- Guidance on procurement practices, in particular for new digital equipment. A lot of cheap sensors were purchased, but do not seem to perform as expected/needed.
- AWS Intercomparisons or guidance on the performances of the different models/manufacturers.
- How to issue “certificates/reports” of field inspections, so that they could be “recognized”?

9. **CLOSURE OF THE SESSION**

The session closed on Thursday, 26 September 2013 at 18:00 hours.

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PROPOSAL FOR A RIC INTERCOMPARISON IN RA-I

In order to achieve the CIMO-XV requirement and to perform RICs intercomparison for RA-I, the following suggestion is submitted for discussion during the ET-RIC-1 meeting.

Intercomparison Item:

Including: Air Pressure, Humidity and Temperature.

Laboratories concerned by the Intercomparison

All RICs of RA-I.

Pilot Laboratory or RIC in charge of the intercomparison organisation

RIC of developed countries in particular RIC of RA-VI (France or Slovenia or any other RIC volunteer for the action).

Intercomparison Route

Most of the RICs of RA-I have purchased new digital standards as working or transfer standards for the three parameters: pressure, humidity and temperature. One operator of each RA-I RICs is designated to attend an intercomparison/training session. The designated candidate should bring with him his own calibrating kit and also the procedure followed, in his RIC, to determine uncertainty.

Intercomparison pilot will take note of information reported by each RIC regarding the documentation of the calibrating kit, the competence of the RIC operator and the methods followed for calibration and will prepare a training session explaining the intercomparison method but also to remind basic knowledge in matter of calibration and uncertainty determination.

At the end of the intercomparison session, the pilot of the intercomparison and the participants should prepare a proposal for conducting the up-coming intercomparison events in RA-I. This proposal should be submitted to ET-RIC-1 and RA-I council for discussion and endorsement.

Standards to be intercompared

Digital standards or equipment used in the RIC for calibration that will constitute the calibrating kit for the RIC.

Transfer Standard

Each RIC should calibrate the calibrating kit before sending it to the intercomparison session. The designated operator should bring also calibrating certificate.

Intercomparison Method:

The intercomparison Pilot will define the intercomparison method that could be applicable taking into account the nature of the calibrating kit of each RIC, its own standards and the general conditions of the intercomparison session (intercomparison time allocated, competence of participants...etc).

Results

Results of the intercomparison of RICs of RA-I will be published in each RIC dedicated website and in the WMO website.

Assistance

Financial assistance is only requested to take into charge 6 participants representing RICs of RA-I. The financial assistance includes travel costs and daily subsistence allowance.

Work plan

The intercomparison could be achieved in the first part of 2014 if the financial support is provided.

PROPOSAL FOR A RIC INTERCOMPARISON IN RA-II & V

According to the requirements of WP-ET-C1, the International Intercomparisons work of RA-II & RA-V should be finished before the January 2014. But because of some reasons, this work hasn't been start yet. In order to finish the work plan of WP-ET-C1 ASAP, we propose the Intercomparison Proposal below to be discussed during the meeting:

Intercomparison Item:

Including: Air Pressure, Humidity and Temperature.

Intercomparison Country

In considering of RA-II has a lot of member countries, to complete the whole intercomparison work within the two regions will be very difficult for the huge working amount, long period and high cost. So we suggest that the intercomparison will be taken place just in the three countries which in charge of the Instrument Centre work of RA-II and RA-V. They are China, Japan and Australia.

Pilot Laboratory

The intercomparison will be in charged of by RIC-BEIJING.

Intercomparison Route

Loop Route would be the Intercomparison Line which means the pilot laboratory start the intercomparison by calibrating the standard and sending to the laboratory in Australia. The Australian Laboratory will send the standard back to the pilot laboratory after the measurement. And the pilot laboratory will re-measure the standard and compare to the first data. Then the standard will be sent to Japan if there isn't too much difference between two measurement data. Reciprocally, the standard will be sent back to Australia if the difference is too big and we must find the reason before sending. After the Japanese Laboratory finish the measurement, the standard will be transported back to Beijing and we will start another measurement to make sure the performance has not been shifted during transport.

The standards to be intercompared

Traceability is presented below:

National Institute of Metrology of China → RIC-BEIJING → Provincial Meteorological Metrology Station → City or County → Meteorological Metrology Station

So, there should be some tracing difference from us to Japan and Australia. And, there will be two choices for the Instruments in the intercomparison as below:

- 1) All of China, Japan and Australia use the self-using Meteorological Metrology Reference Standard to do the intercomparison. In the other words, China will use the Reference Standard which RIC-BEIJING use, which tracing to the highest National Institute of Metrology of China Standard.
- 2) China will use the Secondary Standard which used in RIC-BEIJING intercomparison. The Uncertainty of the Standard has the same level with the Provincial Standard in China. Japan and Australia will use the self-using Meteorological Metrology Reference Standard to do the intercomparison.

The difference of the two methods is, the first intercomparison result can show the highest Standard measurement level of every intercomparison countries, but because our Standard Dissemination of value of RIC-BEIJING has this kind of Special Provincial Standard which

transmission from RIC-BEIJING to Station. So our data can not show the uncertainty of the calibration result of station. For the second method, we can show the station Uncertainty but not the highest measurement level in the Chinese Meteorological Department. Which method is better? Please submit this two methods to the meeting to find out the better one.

Transfer Standard

The way of Standard Transferring also has two schemes to be discussed and make the decision to find a better one.

- 1) Adapt the same accuracy standard as the station instrument to be the transfer standard. Detail like below:
 - a) Air Pressure: PTB220, produced by Vaisala, the Max Error is ± 0.25 hPa;
 - b) Air Humidity: 45D, produced by Vaisala, the Max Error is $\pm 2\%$ RH— $\pm 3\%$ RH;
 - c) Temperature: PT100 Sensor, produced by Huayun China, the Max Error is ± 0.2 °C.
- 2) To choice a kind of instrument which is similar to the accuracy and uncertainty of the intercomparison instrument to be the transfer standard. Detail like below:
 - d) Air Pressure: 745-16B, produced by PAROSCIENTIFIC, the Max Error is ± 0.08 hPa;
 - e) Air Humidity: HC2-S3H, produced by ROTRONIC, the Max Error is $\pm 1\%$ RH;
 - f) Temperature: RCY-1A, produced by Huage China, the Max Error is ± 0.06 °C

The difference between the two schemes is: the first one can show the reference standard uncertainty calculated according to the station intercomparison result and the second can show the Best Measurement Capability of every laboratory. (CMC, Calibration and measurement capability).

Intercomparison Method:

- 1) Preparation work
 - a) The transfer standard should be stayed in the laboratory for 12h before intercomparison;
 - b) The Working Substance is AIR during the Air Pressure intercomparison.
- 2) Intercomparison Points:
 - a) Air Pressure: 500hPa、600hPa、700hPa、800hPa、900hPa、1000hPa、1100hPa、1100hPa
;
 - b) Humidity: 30%RH,50%RH,70%RH,90%RH
 - c) Temperature: -20 °C, 0 °C, $+20$ °C, $+40$ °C, $+60$ °C
- 3) Measuring Times: 3 times.
- 4) Data Processing
The measuring result of this point of pressure (temperature and humidity) is the mean value of the 3 times data . And then evaluate the Uncertainty according to the result.
- 5) Intercomparison Result and Report
The intercomparison result calculation and the report will be finished by the Pilot Laboratory. And the evaluation of the intercomparison result should use E_n Algorithm.

Working Plan of the intercomparison

- 1) On Sept. 26th, 2013, We should decide the intercomparison laboratories, Pilot Laboratory, intercomparison standard and the transfer standard;
- 2) On Dec. 31st, 2013, stability identification of the transfer standard should be finished;
- 3) On Jan. 15th, 2014, RIC-BEIJING will measure the transfer standard as the first time and transfer to Australia;
- 4) On Feb. 15th, 2014, Australia will transfer back the standard to RIC-BEIJING after the measurement;
- 5) On Mar. 2nd, 2014, RIC-BEIJING transfer the standard to Japan after the second measurement;
- 6) On Apr. 2nd, 2014, Japan transfer back the standard to RIC-BEIJING after the second measurement;
- 7) On Apr. 10th, 2014, Every laboratory finish the measurement result calculation and uncertainty evaluation. And then send to the Pilot Laboratory;
- 8) On Apr. 25th, 2014, the Intercomparison report will be finished by the Pilot Laboratory and inquire about the opinions for the other laboratories;
- 9) On May 20th, 2014, after the agreement of the result, the Pilot Laboratory will submit the Intercomparison Report to WMO. The period may be delayed due to the measuring performance shifting caused by the transportation of standard.

Assistant

If choice the PTB220, 45D or HC2-S3H to be the reference standard, we hope to find the finance assistant from WMO.

PROPOSAL FOR A RIC INTERCOMPARISON IN RA VI

1. INTRODUCTION

Interlaboratory comparison (ILC) serves as a tool for comparison of measurement results carried out by accredited or non-accredited calibration laboratories in the relevant field of measurement. ILC represents very effective means to demonstrate technical competence of the participant and also serves as a technical base for accreditation. Furthermore, it is the most important element for monitoring of quality of measurement results as required by ISO/IEC 17025:2005 standard for laboratories in part 5.9.

According to the CIMO Guide, valid observational data can only be obtained when a comprehensive quality control system is applied to the instruments and the network. Inherent elements of such quality system are the calibration and testing of instruments. On an international scale, the extension of quality control systems to include inter-comparisons is important to the establishment of compatible datasets.

Regional Instrument Centres (RICs) have been established for calibration and maintenance needs. According to the Terms of Reference, a RIC must participate in, or organize inter-laboratory comparisons of standard calibration instruments and methods.

2. REVIEW OF RECENT INTERLABORATORY COMPARISONS IN RA VI

2.1 Intercomparison between Météo-France (RA VI RIC) and Australian Bureau of Meteorology (RA II RIC)

The Australian Bureau of Meteorology has developed a suitable set of instruments to allow such inter-comparisons to take place in the field of temperature, relative humidity and air pressure.

The analysis of data using normalized bias (En) showed quality of the provided results is of high level. The ILC report was published at TECO-2008 in St. Petersburg, Russian Federation in November 2008.

2.2 Intercomparisons between RA VI regional instrument centers

The French Metrology Laboratory of Météo-France subsequently organized an inter-comparison in the field of temperature, relative humidity and air pressure within the RA VI with RIC Slovakia and RIC Slovenia to demonstrate the use of such a set in 2008.

Conclusions of the ILC:

- From the results made by the participants as well as from the analysis of the results, it can be concluded that quality of the provided results is of high order. The RICs of RA VI are operating within their stated uncertainties with respect to temperature, pressure and humidity.
- The instruments chosen for the inter-comparison are stable for international transport by air and are therefore suitable for future inter-comparisons between RICs and NMHSs.
- The procedures adopted for this inter-comparison are suitable for international inter-comparisons.

The ILC report was published at TECO-2008 in St. Petersburg, Russian Federation in November 2008.

2.3 Intercomparison between Calibration Laboratories of Central and Eastern European Countries

ILC was organized by RIC Bratislava (Calibration Laboratory of SHMU) as a pilot laboratory in the field of temperature, barometric pressure and relative humidity for Meteo services calibration laboratories in the Central and Eastern European Countries. There were six participants involved: Czech Hydrometeorological Institute (Czech Republic), IMGW (Poland), Estonian Meteorological and Hydrological Institute (Estonia), Latvian Vides Geologijasun meteorologijas agentura, (Latvia), Lithuanian Hydrometeorological Service (Lithuania) and Slovakian RIC. The ILC took place from 10.2007 to 6.2008.

The ILC report was published at TECO-2008 in St. Petersburg, Russian Federation in November 2008.

2.4 Intercomparison of meteorological service calibration laboratories in South Eastern Europe

ILC was organized by the Slovenian RIC in 2008. RIC has invited National Hydrometeorological Services (NHMS) in the South Eastern part of Europe to take part in the ILC: Austria, Croatia, Hungary, Bosnia and Herzegovina, Serbia, Montenegro, Macedonia, Albania, Greece, Turkey, Romania, Bulgaria and Moldova. Additionally, Laboratory of Metrology and Quality (LMQ - holder of a Slovenian national standard for temperature and relative humidity) was also invited to participate in calibration and data analysis. The LMQ is accredited as a provider of proficiency testing/interlaboratory comparisons by the Dutch Accreditation Council (RvA) under the number R-014. Three NHMSs participated in the ILC: Meteorological and Hydrological Institute of Croatia, Hungarian Meteorological Service and RIC Slovenia and Slovenian Laboratory of Metrology and Quality.

In all three fields of ILC (pressure, relative humidity and temperature), typical meteorological ranges, where majority of the measurements and calibrations are made, has been chosen.

From the results made by the participants as well as from the analysis of the results, it can be concluded that quality of the provided results is of high order.

The ILC report was published at TECO-2008 in St. Petersburg, Russian Federation in November 2008.

3. PROPOSED INTERCOMPARISON IN RA VI

In the frame of Working Group on Technology Development and Implementation (WG-TDI) of the Regional Association VI, Task team on Regional Instrument Center proposed organization of round-robin interlaboratory comparison for Meteo services (not just RICs) in RA VI. The interlaboratory comparison is in initial phase: transfer standards (for temperature, relative humidity and air pressure) are selected and calibrated:

- Air pressure: Vaisala PTB220
- Temperature: Vaisala DTS12G (four fire resistance)
- Relative humidity: Vaisala HMP155



EXPERIENCE OF MOROCCO IN REPLACING TRADITIONAL INSTRUMENTS

1. ALTERNATIVES OF THE RAIN GAUGE WITH TIPPING BUCKET RECORDER

For the measurement of precipitations, the NMHS of Morocco is using three types of rain gauges:

- Ordinary rain gauge (Hellman),



- Rain gauge with mechanical tipping bucket recorder



- AWOS Tipping bucket rain gauge



The NMHS have experienced since 2009 the replacement of the mechanical tipping bucket recorder rain gauge with an automatic recording rain gauge allowing the same functions: rain episode duration (starting hour and ending hour) and also the computation of rain intensity.

The new recording rain gauge tested includes: the tipping bucket mechanism, an internal datalogger functioning with alkaline batteries, special battery for time, internal memory and RS232 port. The equipment has the following characteristics:

- Functioning with Alkaline batteries for a long time,
- Is used for delayed time data access using laptop in very distant or isolated sites,
- Could be also used for real time measurement if the equipment is directly connected to the PC of the meteorological station using RS232 connection for short distance or using RS232/RS485 convertor for a long distance,
- Data archive includes: date and time, beginning and end of rain episode and also intensity if requested.



Many manufacturers are providing such equipment. The NMHS of Morocco have tested three types provided by manufacturers from France, England and Turkey. In terms of cost, the price of the new rain gauge is at least 50% cheaper than the traditional tipping bucket rain recorder.

2. ALTERNATIVES OF THE TRADITIONAL INSTRUMENTS MEASURING TEMPERATURE AND HUMIDITY

For the measurement of air temperature and humidity, the NMHS of Morocco is using the following types of traditional instruments:

- Psychrometer,
- Thermograph,
- Hair Hygograph,
- Mercury thermometer for the measurement of the maximum temperature of the day
- Alcohol thermometer for the measurement of the minimum temperature of the day



The NMHS have experienced since 2009 a digital reading system taking measurements from a combined temperature/humidity sensor. The system is functioning with alkaline batteries and displaying measurements on the screen.

Two types of this equipment were tested:

The first one is a datalogger with internal memory allowing data archive and RS232 port for data transfer to laptop. Dedicated software provided by the manufacturer allows us to read and archive

data from the datalogger. The minimum and maximum temperature of the day could be extracted from the daily record (each 30 second).



The second one is a simple reading unit associated to screen for data display.



The inconvenient of these equipments is that the alkaline batteries allow a continuous use of the instrument for a few days only (Three or four days only: 72 hours for the second type).

Measurements of soil temperature:

As a replacement of the traditional mercury thermometers used for measurements of temperature of soil (at -5cm, -10cm, -20cm, -50cm and -100cm in the ground), the same device of the first solution can be used adding a specific accessory to connect four temperature sensors Pt100. The Pt100 measurements are recorded by the same datalogger and displayed on the screen for direct reading or accessible trough laptop connection.

A real time access to the data could be made using a Pc connected to the datalogger using a suitable wire and RS232 connection.



The cost of the new solution with four pt100 for soil measurements and the dedicated accessory is cheaper than the total cost of a thermograph, a hair hygograph, a psychrometer and soil mercury thermometers.

3. ALTERNATIVES OF THE TRADITIONAL INSTRUMENTS MEASURING ATMOSPHERIC PRESSURE

For the measurement of atmospheric pressure, the NMHS of Morocco is using three types of traditional instruments:

- Mercury barometer,
- Barograph,
- Digital barometer of AWOS



Since 2008, the NMHS is using first class digital barometers as replacement of the traditional mercury barometers and barographs. The acquired digital barometers include two internal independent sensors and a LCD screen for direct reading display.



All meteorological stations at airports are equipped with those devices as a backup of the measurements made by the AWOS.

The new digital barometers are easily calibrated using the calibrating solutions applied in the calibrating laboratory or in site (example: automatic pressure generator for site calibration).

The cost of the acquired digital barometer including two internal independent sensors and screen display is three times cheaper than a mercury barometer.

4. ALTERNATIVES OF THE TRADITIONAL INSTRUMENTS MEASURING WIND

For the measurement of surface wind, the NMHS of Morocco is using a traditional wind recorder using specific diagram. Each year, the NMHS of Morocco is spending more than 20 000 Euros to

provide the needed annual quantity of diagram. The spare parts of this system are also too expensive.



This equipment is not manufactured since 2008. So the NMHS of Morocco acquired a new automatic solution for wind measurements as backup of the measurements made by the AWOS. The solution includes: Solar panel, mast, ultrasonic wind sensor and datalogger, deported display screens for both: the air traffic control tower (ATC TWR) in the airport and the meteorological station, wireless connection (radio, wifi...) between the sensor (near of the runway) and the TWR and dedicated software (2 minutes wind average, gust, archiving...etc).



The price of this solution is at least 40% cheaper than the oldest equipment.

REVISED WORKPLAN

C1: CIMO Expert Team on Regional Instrument Centres, Calibration and Traceability
(2011-2014)

No.	Task description	Person responsible	Action	Deliverable	Deadline for deliv.	Status [%]	Comments
1.	Template for RIC websites (capabilities, contacts, etc)	K. Nakashima D. Grosej R. Merrouchi	1. Develop list of information a RIC website should contain	1 List with minimum information that a RIC website should contain	09/2011	100%	CIMO-XV, para 6.3 + Spanish-speaking expert
			2. Develop template to report RIC capabilities on WMO website	2 Template to report capabilities to WMO Secretariat (WMO website)	09/2011	100%	Contribute to WIP Activity 9.1.1
		3. All ET-Members	3. Fill template for own RIC	3 Provide filled template for own RIC	12/2011	80%	
			4. Contact RIC without websites	4 E-mail	2012 12/2013	100% 0%	One to One contact needed between RICs and ET-RIC Chair
			5. Liaise with Secretariat to inform Members once the information is available		In phase with availability of websites	50%	
2.	Estimation of calibration uncertainty – traceability to SI	J. Duvernoy D. Grosej J. Gorman	1. Review available material	1 List of available documents (also for WMO website update)	2012	100%	CIMO-XV, para 6.13 (In collab. with Theme Leader Training Material & Training Activities)
			2. Compile set of examples of computation of calibration uncertainties (ex. extracted from own RIC procedures and made anonymous, or extracted from bibliography)	2 Set of examples	2012	75%	Contribute to WIP Activity 5.1.1, 6.1.1, 9.1.1
			3. Develop guidance document on how to use the examples, ensure traceability and make calibration certificates	3 Guidance document (IOM report)	Jan. 2014	30%	
			4. Carry-out workshop on uncertainty calculations (possibly in conjunction with TECO 2012)	4 Workshop	TBD, upon request	N/A	Target TECO-2016

3.	Strategy to ensure traceability of measurements to SI units	J. Gorman R. Merrouchi	<ol style="list-style-type: none"> 1. Develop Strategy for RICs and NMHS calibration laboratories <ol style="list-style-type: none"> a. for RICs and NMHS calibration laboratories b. for network observations 2. Develop relevant guidance and outreach material 	<ol style="list-style-type: none"> 1. Document with strategies 2. Brochure, IOM report and or update of CIMO Guide 	2012 (MG-10) 12/2013	10%	<p>CIMO-XV, para 6.2</p> <p>Contribute to WIP Activity 5.1.1, 6.1.1</p>
4.	RIC Evaluations	J. Duvernoy W. Burnett TBD, as required	<ol style="list-style-type: none"> 1. Contact all RICs to ensure they have carried out self-evaluation (using evaluation scheme and guidance developed by CIMO) and collect outcomes of all self-evaluations 2. On request, provide Support to evaluation of RICs 	<ol style="list-style-type: none"> 1.1 Information on calibration capability (uncertainties) and contact points of all RICs published on CIMO website 1.2 Report to MG (ev. TECO paper) on RIC capabilities & evaluation results 2 Report on RIC audit 	2012 2012 (next MG-Mtg, TECO-2012) TBD 10/2012	50%	<p>CIMO-XV, para 6.3</p> <p>One to One contact needed between RICs and ET-RIC Chair</p> <p>Contribute to WIP Activity 6.1.1, 9.1.1</p> <p>Audit of RIC Nairobi</p>
5.	RIC intercomparisons	HE Xiaolei (RA-II&V) D. Groselj (RA-VI) R. Merrouchi (RA-I) W. Burnett (RA-III&IV)	<ol style="list-style-type: none"> 1. Set-up intercomparison kit for temperature, humidity and pressure (at least one, but preferably all 3 parameters) 2. Schedule intercomparisons with other RICs of Regions 3. Publish intercomparison report 	<ol style="list-style-type: none"> 1. Travel intercomparison kit 2. Schedule of intercomp. 3. Report on intercomparison results / problems encountered 	2011 2012 TECO-2014	66% 66%	<p>CIMO-XV, para 6.5</p> <p>Each person is responsible for comparison inside one or two RA</p> <p>No information from RA-III & IV</p> <p>Contribute to WIP Activity 5.1.1, 6.1.1, 9.1.1</p>
6.	Alternatives for dangerous and obsolete instruments	Amudha B. J. Gorman J. Ngamini HE Xiaolei	<ol style="list-style-type: none"> 1. Approach Members on their needs regarding replacement of dangerous (mercury) and obsolete instruments (barographs, thermographs) 2. Collaborate with manufacturers (HMEI) to identify possible alternative instruments 3. Develop advice to Members on alternatives 	<ol style="list-style-type: none"> 1.1 Personal approach or questionnaire to chosen countries 1.2 Document on member needs/problems 2. Contact to HMEI taken 3. Document reporting on possible alternatives 	2011 1/2014 2012 6/2014	100% 90% 100% 0%	<p>CIMO-XV, para 6.8 and ET-RIC-2, para. 4.5</p> <p>Contribute to WIP Activity 5.1.1, 6.1.1, 9.1.1</p> <p>Done based on ET-RIC members knowledge</p>

		4. K. Nakashima	4. Check text of Minimata convention and its implication to Members	4. Short text with information to Members	12/2013		
7.	Improvement of CIMO Guide	J. Duvernoy J. Gorman	1. Review relevant parts of CIMO Guide (Part I, Chap. 2, 3.10, 4.9) 2. Review CIMO Guide on need for update based on new IOM publications 3. Make proposals for updates, if needed	1. Proposals for update of CIMO Guide (Part I, Chap. 2, 3.10, 4.9)	Nov. 2011	10% 50%	Contribute to WIP Activity 1.1.1, 5.1.1, 6.1.1
8.	Competencies for personal performing observations, maintenance and calibration of instruments	J. Gorman D. Groselj (In collab. with TL-C3) 2. All ET members 4.1 K. Nakashima	1. Review existing relevant material and examples (ex. competencies developed by CAeM) 2. Provide example of competencies used in own QMS 3. Develop competencies for meteorological observations, calibration and maintenance of instruments 4. Arrange for inclusion of competencies in CIMO Guide 5. Identify need for and develop relevant training material, if appropriate and finalize update of training notes developed for RA-II training workshop	1. Document with required competencies for consideration of CIMO MG 2. Own examples 3.1 Report to MG 3.2 Document 4. Update of relevant CIMO Guide chapter 5.1 IOM report on RA-II training 5.2 Report to CIMO-MG 5.3 IOM report with training material	April 2012 11/2013 2012 (TECO) 2013 Apr.2014 Dec. 2011 2012 (MG-10) 2014	20%	CIMO-XV, para 6.20 Contribute to WIP Activity 1.1.1, 5.1.1, 6.1.1, 9.1.1 Will be done for calibration only by ET-RIC 3&4: Need to be carried forward to next inter-session period. Guidance will be needed on whether first draft is ok before going on. 5. Lecture notes were published on JMA website
9.	Contribute to the implementation of WIGOS and provide relevant advice and support to the CIMO-MG	TBD	1. Address relevant items of WIGOS Implementation Strategy approved by Cg-XVI and subsequent WIGOS IP	TBD after Cg-XVI			