

# Calibration capabilities of NMHSs in the South Eastern Europe

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## 1. Introduction

The WMO project on “Regional cooperation in South Eastern Europe for meteorological, hydrological and climate data management and exchange in support of disaster risk reduction” (DRR/SEE Project) which is financed by the Directorate General Enlargement of the European Commission, includes an activity on enhancing the capacity of the NMHSs of the Western Balkans countries for standardized calibration and maintenance of observational instruments. The main objective of the activity is to ensure sustainable quality of the meteorological and hydrological data produced and exchanged in the region. The action was targeted to the following beneficiaries: Albania, Bosnia and Herzegovina, Croatia, Montenegro, Serbia, Kosovo (under UNSCR 1244/99), the Former Yugoslav Republic of Macedonia, and Turkey. The capacity building activity was divided in two components:

- 1) An assessment mission to each target country. The objective of expert mission to each project county was to assess status of calibration laboratory and its standards and to determine what actions has to be taken to improve the systems.
- 2) Training Workshop on Calibration at the EARS Regional Instrument Centre. The training is an important element for ensuring proper use and maintenance of instruments and the generation of high-quality data. The Training Workshop was aimed to improve the knowledge and skills of senior operational personnel in-charge of the calibration and maintenance. It is hoped that the participants should be able to share the newly acquired knowledge with their counterparts so that the knowledge and skill of other personnel employed in the calibration and maintenance of national networks will also be improved.

The overview of current calibration capabilities in the South Eastern Europe will be presented and areas of opportunities to straighten cooperation between RIC and NMHSs in the region.



Figure 1: Beneficiaries countries

### **1.1. Expert mission to each target country**

The main objective of the activity 4.2 - "Assess Capability for maintenance and calibration system of hydrometeorological instruments" of the Regional Programme on Disaster Risk Reduction in South East Europe is to ensure meteorological and hydrological data quality. The Regional Instrument Centre - RIC of Environmental Agency of the Republic of Slovenia - EARS is one of three RICs in RAVI. The responsibilities of RICs are clearly defined in WMO's Terms of References. The RICs share responsibilities on a geographic basis and EARS RIC therefore covers Western Balkans.

The objective of expert mission to each project county was to assess status of calibration laboratory and its standards and to determine what actions has to be taken to improve the systems. The objectives of this first part of the project were:

- To visit National Meteorological services to asses the present state of the calibration and maintenance activities, instruments and equipment.
- To specify areas for strengthening cooperation between NMHSs and EARS Regional instrument centre in the field of calibration.
- To asses the training of the personnel needed.

### **1.2. Training workshop on calibration at RIC Ljubljana**

The Training workshop on calibration was hosted by Environmental Agency of the Republic of Slovenia in Ljubljana from 10<sup>th</sup> to 14<sup>th</sup> of May 2010. Training workshop was proposed for two persons from each NMHS - calibration laboratory manager and technician. First two days were dedicated to quality assurance issues and last three days of workshop were dedicated to practical work in laboratory. Managers were invited to be present first two days and technical personal were be present all five days of the workshop.

The lectures in first two days were dedicated to quality assurance issues. Organisers tried to emphases the importance of quality assurance and presented the EARS 'case study' – how the principles of QA issues are implemented at Environmental Agency of the Republic of Slovenia.

The practical sessions took place in the RIC Ljubljana premises. Some theoretical background was initially presented. Three measuring sites were visited: meteorological site at Ljubljana and two hydrology sites: underground water site at Hrastje and hydrology site at Šmartno.

National Metrology Institute for temperature and relative humidity, located at Laboratory for metrology and Quality, was also visited.

Practical work included presentations of liquid-in-glass thermometer calibration, resistance thermometer calibration and thermograph calibration. Water triple point was realized and calibration in two fixed points was demonstrated.

Relative humidity practical work also included initial theoretical background supported by practical presentation of capacitive hygrometer in humidity generator and hygrophograph calibration in climatic chamber.

The last day of the Workshop was dedicated to air pressure quantity. After theoretical background, the practical demonstration of electronic barometer calibration using pressure balance was performed.

During practical work lots of discussions on technical issues took place.

## **2. Overview of calibration capabilities of target countries**

### **2.1. Albania**

Institute of Energy, Water and Environment does not have calibration laboratory in its structure. Institute of Energy, Water and Environment had calibration/maintenance unit in the part, but in last decade the work in this unit stopped. There has been no cooperation of EARS RIC with Institute of Energy, Water and Environment (INEUM) in the field of calibration in the past. The possibilities for future cooperation between EARS RIC and Institute of Energy, Water and Environment are:

- Traceability: EARS RIC is available for calibrations of certain amount of instruments used in the meteorological network in the field of temperature, relative humidity and air pressure..
- The Institute of Energy, Water and Environment has plans to purchase a mobile calibration/maintenance unit. The idea is to purchase reference standards for basic meteorological parameters and also calibration units (mobile furnaces, portable pressure calibrator) to perform calibration of instruments in meteorological range. In this case RIC Ljubljana could help with calibration issues of the travelling standards.
- The second option, which could be implemented immediately, could be to define a set of field measuring instrument as a 'travelling standards'. This set would after calibration be usable for 'on-site' checking of field measuring instruments.

## **2.2. Bosnia and Herzegovina**

Neither Federal Hydrometeorological Institute of Bosnia and Herzegovina nor Republic Hydrometeorological Service Banja Luka do not have calibration laboratory in its structure, therefore they cannot perform meteorological instrument calibrations.

Due to the fact that Federal Hydrometeorological Institute of B-H does not have calibration laboratory in its structure, the almost all field instruments calibrations are out of date. Almost all the calibrations of meteorological instruments were performed before 1992. The calibrations were done in SHMZ calibration laboratory in Belgrade with recalibration period three to five years.

Today, the problem of instrument calibration in B-H is partly solved by using services of EARS RIC in Ljubljana, which performed calibration of 16 liquid-in-glass thermometers and a small number of meteorological thermographs and hygrographs. However, the activity on external instruments calibration stopped due to the lack of resources and complex transportation.

EARS RIC has established traceability of liquid-in-glass thermometers and some hygrographs in 2001. The possibilities for future cooperation between EARS RIC, FHI and RHS are:

- Traceability: EARS RIC is available for calibrations of certain amount of instruments used in the meteorological network in the field of temperature, relative humidity and air pressure.
- Training: The technical officers in maintenance department have good basic education and experience but trainings on maintenance and calibration of classic and electronic instruments are recommended.

Maintenance of the basic meteorological instruments is performed regularly by maintenance personal and according to "Recommendations for monitoring and measuring at major meteorological stations" published by Federal Hydrometeorological Institute in Belgrade in 1974.

## **2.3. Croatia**

Meteorological and Hydrological Service has Calibration laboratory service which performs calibration of temperature, relative humidity and air pressure calibrations. Calibration laboratory is located at premises of MHS. MHS has a long tradition in calibrating measuring instruments with the beginning in late 90. of the 20. century. According to the possibilities, the development of new calibration methods and the acquisition of sophisticated calibration equipment have been set as a priority in the operation of laboratories. In 2002 Calibration laboratory was supplied from the primary standard for pressure (pressure balance) and the primary standard with a generator for ground-level ozone. In 2004 Calibration laboratory acquired a primary calibration system for temperature scale that ensures traceability to ITS-90. In recent years, Calibration laboratory has modern equipment for solar radiation calibration, which is calibrated in the World radiation centre in Davos.

In accordance with the recommendations of the World Meteorological Organization, Meteorological Laboratory participates in all comparative tests and calibration which are held in the framework of relevant regional centres for instruments or other institutions.

The cooperation between EARS RIC and MNS has been very good in the past:

- MNS has participated in interlaboratory comparison in the south-eastern part of WMO RA-VI using calibration kit (temperature, relative humidity, pressure) organised by EARS RIC in 2007.

- MNS has organised a Sub-regional Pyranometer Intercomparison of the WMO RA-VI members from south-eastern Europe – Split in 2007.
- Almost permanent exchange of information via email, phone or in personal contacts on bilateral level.

The possibilities for future cooperation between EARS RIC and MHS are as follows:

- Traceability: EARS RIC is available for calibrations of reference standards.
- Accreditation process: EARS RIC has 1 years experience in accreditation. EARS RIC could help MNS Calibration laboratory in the field of technical issues (uncertainty evaluation, assessment of technical documents).
- Intercomparison: RIC Ljubljana has organised interlaboratory comparison (ILC) using set of field measuring instruments in 2008. Due to the importance of such ILCs (accreditation, direct vertical assessment) there is a opportunity for future cooperation in the filed of bilateral or multilateral ILC.

## **2.4. Kosovo (under UNSCR 1244/99)**

Hydrometeorological Institute does not have calibration laboratory in its structure but has plans to establish a calibration laboratory in the future.

## **2.5. The Former Yugoslav Republic of Macedonia**

Hydrometeorological Service does not have calibration laboratory in its structure. NHMS has a temperature liquid bath, which is in implementation stage. Reference platinum resistance thermometer (Pt100) exists, but needs to be calibrated and installed in liquid bath. To complete a measurement system for calibration of liquid-in-glass thermometer or resistance thermometer, a data acquisition unit is still missing. Hydrometeorological Service has also plans to purchase a travelling standard precision aneroid for on-site mercury barometer calibrations/check.

There has been no cooperation with Hydrometeorological Service in the field of calibration in the past. The possibilities for future cooperation between EARS RIC and Hydrometeorological Service are:

- Traceability: EARS RIC is available for calibrations of reference standards.
- Training: The technical officers in maintenance department have good basic education and experience but trainings on maintenance and calibration of classic and electronic instruments are recommended.
- Technical support by EARS RIC in order to establish our laboratory due to Hydrometeorological Service liquid bath which is not in use.
- Hydrometeorological Service Calibration Laboratory will define a set of classic and electronic instruments to be sent to field RIC Ljubljana (temperature, humidity, solar radiation).
- EARS RIC may send its calibration kit with Hydrometeorological Service to test field instruments in future.

## **2.6. Montenegro**

Hydrological and Meteorological Service of Montenegro do not have calibration laboratory in its structure. Hydrological and Meteorological Service of Montenegro does not have any plans to build a calibration laboratory in the future.

Meteorological Service of Montenegro was mainly bounded to RHMS in Belgrade for calibration purposes in the past. They have calibrated temperature instruments, relative humidity instruments and air pressure instruments. As far as they don't posses calibration reference or working standards of travelling standards, they have calibrated field instruments abroad. Possible fields of cooperation between EARS Regional Instrument Centre and Meteorological Service of Montenegro are:

- Traceability: EARS RIC is available for calibrations of certain amount of instruments used in the meteorological network in the field of temperature, relative humidity and air pressure.

- Hydrological and Meteorological Service of Montenegro Calibration Laboratory will purchase define a set of classic and electronic instruments to be sent to field RIC Ljubljana (temperature, humidity, solar radiation).
- EARS RIC may send its calibration kit with Hydrological and Meteorological Service of Montenegro to test field instruments in future.

Maintenance of the basic meteorological instruments is performed regularly by maintenance personal. Based on long experience and knowledge, a professional employee performs the checking of thermographs in the meteorological shelter, which houses according to which other instruments are adjusted.

## **2.7. Serbia**

Hydrometeorological Service of Serbia has Calibration laboratory service for temperature, relative humidity, air pressure and wind speed and direction calibrations. The calibration laboratory facility at Zeleno Brdo is equipped for calibrations of mercury barometers, anemometers calibration and electronic temperature instruments calibration. The calibration laboratory facilities at Košutnjak are dedicated for calibration of electronic hygrometers and liquid in glass thermometers.

RHMS Calibration laboratory is well equipped for classic meteorological instrument calibrations. The new equipment in the field of air pressure (reference standards) and relative humidity (humidity calibrator with a reference) enables development of calibration system for calibrations of electronic instruments in the near future. The next step towards quality assurance of metrological data is development a computer based calibration system for electronic instruments due to increasing number of automatic weather stations. In the field of temperature calibration the reference standard (SPRT 25) can be used in dissemination of traceability to a working standard Pt100. The planned new reference standard for wind speed combined with wind tunnel will enable accurate calibration of anemometers.

The cooperation with RHMS has been very good in the past. EARS RIC has established traceability of reference standards in pressure calibrations. The possibilities for future cooperation are as follows:

- Traceability: EARS RIC is available for calibrations of reference standards, especially for air pressure and relative humidity. Temperature reference standards can be calibrated by comparison, but if case of fixed points calibrations should be done in NMI or other institutes.
- Wind speed: EARS is interested to calibrate cup anemometers, if the RHMS wind tunnel calibration system is in operation with new reference standard.
- Accreditation process: EARS RIC could help RHMS Calibration laboratory in the field of technical issues (uncertainty evaluation, assessment of technical documents).
- Training: The technical officers in calibration and maintenance have good basic education and they are experienced, but for a proper use of new instrumentation additional training is of course required.
- Intercomparison: RHMS Calibration laboratory is interested to participate electronic barometers and liquid-in-glass thermometers intercomparison.

Initiated accreditation process of RHMS Calibration laboratory and implementation of requirements of standard ISO/IEC 17025:2005 will challenge a laboratory's system to continuously improve quality and the technical competency of its laboratories and personnel.

## **2.8. Turkey**

Turkish State Meteorological Service has Calibration laboratory service in its structure. The Calibration laboratory is nowadays accredited according to the ISO/IEC 17025:2005 standard for calibration of all major meteorological qualities (temperature, relative humidity, air pressure,)

TSMS Calibration laboratory is very well equipped for meteorological instrument calibrations. Due to modern equipment of TSMS Calibration laboratory, some of the calibration procedures could be easily automated (data acquisition).

There was no cooperation between TSMS Calibration laboratory and RIC Ljubljana in the past. The possibilities for future cooperation are as follows:

- Wind speed: EARS is interested to calibrate cup anemometers at TSMS Calibration laboratory but RIC has requirement for calibration up to 50m/s.
- Intercomparison: RIC Ljubljana has organised interlaboratory comparison (ILC) using set of field measuring instruments in 2008. TSMS Calibration laboratory was not a participant of that ILC. Due to the importance of such ILCs (accreditation, direct vertical assessment) there is a opportunity for future cooperation in the filed of bilateral or multilateral ILC.

Granted initial accreditation of TSMS Calibration laboratory and implementation of requirements of standard ISO/IEC 17025:2005 has proven quality of work in the filed of calibration. By the initial accreditation the NMHSs prove their competence in the area of meteorological measuring and testing methods by an independent certifying agency to a recognised standard. Once accreditation is established, there is an on-going periodic external audit, which provides additional proof that standards have been maintained, but more importantly it assists the organization to ensure that its own internal quality requirements are met.

### **3. Conclusion**

During the Workshop some recommendations or suggestions for further cooperation between EARS RIC and NMHSs were posted:

1. Set-up a calibration kit with a set of basic meteorological quantities (temperature, relative humidity, air pressure) for on-site testing/calibration of field measuring instruments. RIC Ljubljana would assure traceability of travelling instruments.
2. Calibration of some filed measuring instruments at Regional Instrument Centre to be used for the testing/calibration of the instruments in the network.
3. RIC interlaboratory comparisons and cooperation organization within the Sub-region.
4. Assistance in improvement of calibration facilities (accreditation, equipment...).
5. Assurance of regular exchanging information.
6. Support by Regional Instrument Centres in order to establish calibration laboratory.

### **4. Reference**

1. WMO project "Regional cooperation in South Eastern Europe for meteorological, hydrological and climate data management and exchange in support of disaster risk reduction", Expert mission reports, June 2010
2. WMO project "Regional cooperation in South Eastern Europe for meteorological, hydrological and climate data management and exchange in support of disaster risk reduction", Workshop report, June 2010