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# Status and plans for interlaboratory comparisons in WMO RA VI

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| **Summary and purpose of document**  This document provides information on recently concluded inter-laboratory comparison for basic meteorological parameters (temperature, relative humidity and air pressure) in RA VI and plans for future inter-laboratory comparisons. |

**Action proposed**

The Meeting is invited to get acquainted to the concept and implementation of the inter-laboratory comparison in RA VI.

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**Appendices:** I -

1. **Status and plans for inter-laboratory comparisons in WMO RA VI**

* 1. **Concept of MM-ILC-2015-THP inter-laboratory comparison**

Based on the adopted work plan of RA VI Working Group on Technology Development and Implementation (WG TDI) and its Task Team on Regional Instrument Centres (TT-RIC) and in conjunction with WMO Expert Team on Operational Metrology (ET-OM) work plan, the Laboratory Performance Survey and Inter-laboratory comparison was organised in RA VI.

The Laboratory of Metrology and Quality (UL/FE-LMK) which holds Slovenian national standards for temperature and relative humidity and is accredited by Dutch accreditation service for implementation of inter-laboratory comparisons by ISO/IEC 17043:2010 Conformity assessment - General requirements for proficiency testing. UL/FE-LMK has numerous experiences in inter-laboratory comparisons from BIPM and EURAMET comparisons to bilateral international comparisons.

The principle of ILC was initially discussed within TDI Task Team on Regional Instrument Centres and formalised in ILC protocol adopted and finalized in winter 2016. The invitation letter to 55 RA VI PRs was issued by President of RA VI. In total 25 NMHSs replied to the questionnaire which represents 45% of NMHSs:

* 18 NMHSs applied for ILC: Croatia (CR), Cyprus (CY), Estonia (EE), Finland (FI), France (F), Germany (G1, G2), Hungary (H), Ireland (IE), Latvia (LA), Lithuania (LV), Nederland (NL), Poland (PL), Serbia (RS), Slovakia (SK), Slovenia (SI1, SI2), Spain (S) and Turkey (T)
* 3 NMHSs provided CMC data only: Czech Republic, Belgium, Switzerland
* 3 NMHSs provided basic information only: Sweden, Macedonia, Montenegro
* Russia provided CMC data and applied for ILC, but later withdraw

Since the number of laboratories was relatively large, two loops with same type of instruments were organized in order to reduce time needed for ILC. The availability of participating laboratories was taken into account as well as geographical distribution for transport optimisation. Linking laboratories for both loops were French, Slovenian and Slovakian laboratory. All participating laboratories had three weeks for calibration including transportation to the next laboratory and 4 weeks after the equipment has left the laboratory are allowed for reporting the results using predefined reporting forms. The loops are presented in figure 1:



Figure 1: Two loops of inter-laboratory comparison

* 1. **Measurement equipment**

The kits consisted of capacitive hygrometer HMP155, barometer PTB220 and four wired Pt-100 resistance thermometers ELPRO with display Agilent/HP 34420A. Hygrometer output is voltage, barometer and thermometer have digital display and GIPB output. Instruments are shown on picture 2:



Picture 2: ILC Instruments: hygrometer, barometer and thermometer

* 1. **Start-up and initial inspection**

A procedure was defined for initial check in order to reduce recalibrations at reference laboratories and to determine stability and possible transport influence to the equipment. After setting up the equipment for the calibration, first measurements in the middle of calibration interval must be made and reported to reference laboratory for evaluation.

* 1. **Measuring points**

The ILC protocol predefines calibration points:

* + - Temperature: the calibration was performed in the following measurement points within tolerances ±0.2 °C using standard laboratory procedures: -30 °C, -20 °C, -10 °C, 0 °C, 10 °C, 20 °C, 30 °C and 40 °C.
    - Relative humidity: calibration was be made in the following measurement points within tolerances ±3 %r.h. at temperature of 20°C using standard laboratory procedures: 10 %r.h., 20 %r.h., 35 %r.h., 55 %r.h., 75 %r.h., 90 %r.h., 90 %r.h.. In case of salt solution calibration other calibration points can be used covering as wide measuring range as possible.
    - Air pressure: calibration was started at a minimum calibration point followed by increasing pressure and return steps by decrease of pressure. The calibration was made in the following measurement points within tolerances 20 hPa using standard laboratory procedures: 800 hPa, 850 hPa, 900 hPa, 950 hPa, 1000 hPa, 1050 hPa, 1100 hPa.

Calibration must be carried out at an ambient temperature of (20 ± 5) °C and relative humidity of (30÷ 60) %.

* 1. **Assigned value and its uncertainty**

ILC often consists of comparison of measuring results of a laboratory and an assigned value defined by reference laboratory, which is the highest authority for the particular measurements. In case of WMO RAVI ILC the assigned value was calculated as weighted mean of three reference RIC laboratories (Meteo France, Slovakian Hydrometeorological institute and Slovenian Environment Agency) and the UL-FE/LMK (with exception on air pressure). The weighted mean was used in order to avoid biasing the calculation of the assigned value to either of reference laboratories. The uncertainty of the assigned value was calculated as uncertainty of weighted mean, with uncertainties of reference laboratories at each calibration point and any possible drift of used measurement equipment that occurred during the time of ILC.



where:

 - comparison assigned value,

 - measurement values of reference laboratories,

- expanded measurement uncertainty of measurement values,

 - expanded uncertainty of assigned value.

* 1. **Presentation of the results**

Results of the participants were anonymized (each laboratory with different code). The evaluation of measurement results will be based on En number:



Where:

xlab is the participant’s result,

xref is the assigned value,

Ulab is the expanded (k=2) uncertainty of a participant’s result,

Uref is the expanded (k=2) uncertainty of the assigned value.

Criteria for performance evaluation for En number was:



An absolute En-score of ≤ |1| indicates a satisfactory result. The reported result and reference value are in agreement (within their respective uncertainties). An absolute En-score of > |1| indicates an unsatisfactory result. If the uncertainty reported with the result is large enough, the absolute En-score will always be <1.

* 1. **Conclusions**
* Largest scale ILC in RAVI ever.
* Meteomet2 partner Laboratory of Metrology and Quality is accredited PT provider.
* The reference values were determined by the UL-FE/LMK (except pressure) and three RIC laboratories (Meteo France, Slovakian Hydrometeorological institute and Slovenian Environment Agency) which makes this ILC a bit special.
* Two loops of identical sets of transfer standards were organised.
* Only 52 results out of 1171 have⎟En⎜>1.
* ILC report was submitted to WMO secretariat of be published as IOM report.
* Potential to expand ILC to Regional Association II & V.

1. **Future plans for inter-laboratory comparisons**

The initial discussion took place between DWD and TSMS to explore possibilities for organisation of inter-laboratory comparison of wind speed/direction instruments.

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