NEWSLETTER

IMEKO Technical Committee 12

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Editorial

Dear Colleagues,

welcome to this 2017 Issue of the IMEKO TC12 Newsletter. As usually after the TEMPMEKO events, the newsletter is mainly devoted to reporting information about the Symposium, topics, figures and advances in publishing the papers. Pictures are also selected from the numerous photo-galleries you can find at http://www.tempmeko2016.pl/.

This issue will also bring to your attention news from the thermal metrology community, about events and projects of interest.

I hope you will enjoy the newsletter and we're happy to receive and publish your contributions.

Andrea Merlone
IMEKO TC12
Scientific Secretary

Message from the TC12 Chair

In the wake of TEMPMEKO 2016 in Zakopane, Poland, we all feel that it was a resounding success in all it's aspect – scientific as well as social. We owe it to the organizers: Anna Szmyrka-Grzebyk, Alekandra Kowal and their crew, to IPC chairs: Graham Machin and Richard Rusby (who are still working in the reviewing and publishing pipeline) and to attendees who came to Zakopane to present and share their research and ideas in temperature, humidity and thermophysical properties with all of us. Thanks to all of you! We already know that the necessary conditions for changing the definition of the kelvin have been fulfilled and that the timeline for all contributing measurements to be included in it's new definition is approaching fast. The next CGPM at its 24th meeting in October 2011 is expected to adopt the new definitions for four of the seven base units of the International System of Units (SI). Kilogram, ampere, kelvin, and mole will be defined in terms of fixed numerical values of the Planck constant, elementary charge, Boltzmann constant, and Avogadro constant. The other three, second, meter and candela will only have different wording. Regarding kelvin, the present method, the International Temperature Scale of 1990, ITS-90 will officially remain in place in parallel to soon-to-be new primary thermometers (AGT, DCGT, …). Also the new SI is expected not to be officially implemented in 2018, but on World metrology day (that commemorates the signing of the Metre Convention on May 20, 1875) the following year (20 May 2019). This will immediately precede TEMPMEKO-TEMPBEIJING 2019 So we turn our sights to China and to NIM and the team led by Dr.Yuning Duan. It will be the chance for all of us to meet again and enjoy the presentations and company of our hosts and colleagues. There are numerous institutes in China involved in the thermometry and thermal measurements. Also the enterprises whose products prevail in the international thermometry community have large amount of business in China and we expect them to exhibit their products. So start preparing for our next TEMPMEKO so you can again say: Magna pars fui! (*I was a big part of it!*)

Davor Zvizdic
IMEKO TC12 Chair

TEMPMEKO 2016

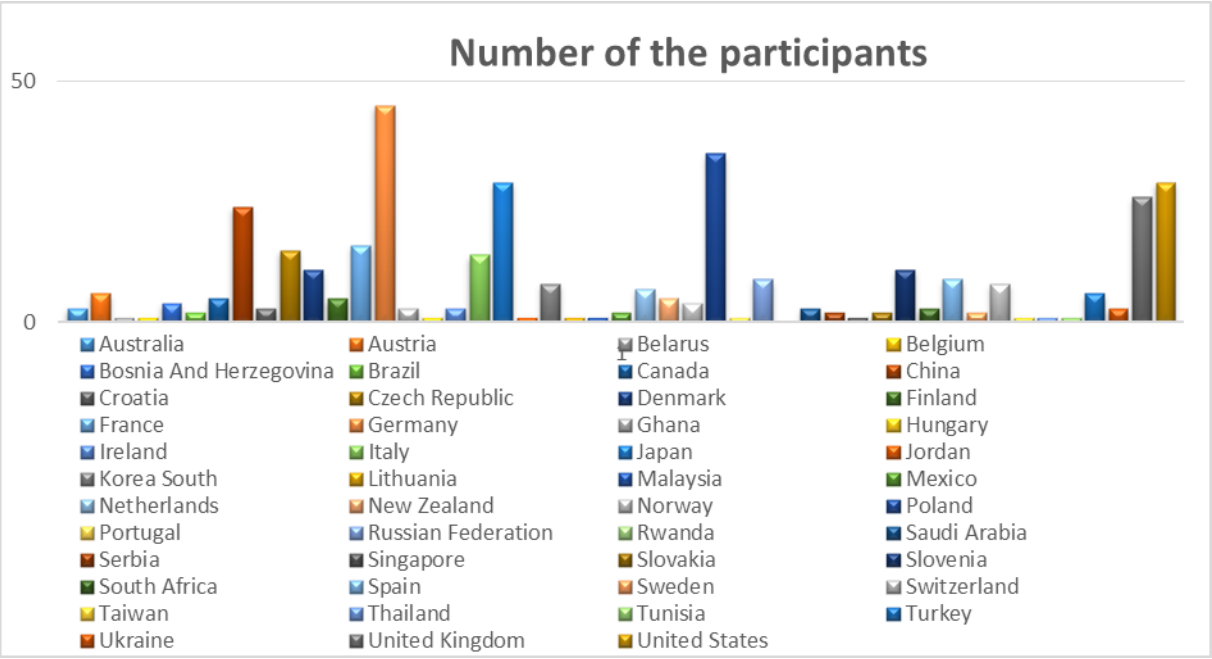
Belvedere Congress Centre, ZAKOPANE, POLAND, 27 June – 1 July 2016

The TEMPMEKO 2016 Symposium was held in Zakopane, the capital of the Polish Tatra mountains. The Symposium was organized by the Institute of Low Temperature and Structure Research of the Polish Academy of Science, the Designated Institute- maintaining the national temperature standard for low temperature range. The organization was supported by the IMEKO TC 12.

Francesco Righini - a longtime secretary of the Committee, one of the TEMPMEKO's father, was an honorary member of the Symposium. Graham Martin and Richard Rusby from the National Physical Laboratory were co-chairs of the International Programme Committee.

The Committee has accepted 188 abstracts for oral and 244 for poster presentation. 186 orals and 188 posters were presented during twelve oral sessions (always four parallel oral sessions were held) and eight poster sessions. Most of the works is going to be published in the International Journal of Thermophysics.

The total number of attendances was 373 from 46 countries of all continents.



Beside recognized scientific authorities, many young active participants were present and five keynote speakers presented invited lectures:

Manola Brunet, URV, Ensuring the development of high-quality and traceable climate time-series in support of more robust climate change studies,

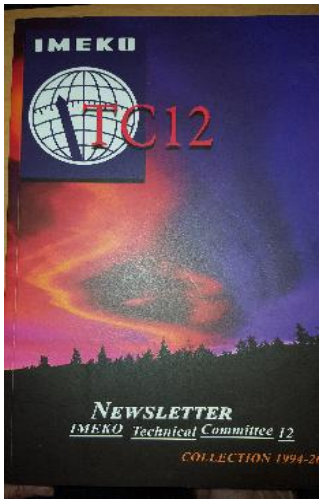
Boris Khlevnoy, VNIIOFI, Advances and prospects in high temperature radiometry,

Michael de Podesta, NPL, The definition of the kelvin in the new SI: its derivation, implementation and implications,

Jifeng Qu, NMI, The status and future of Johnson noise thermometry,

Gregory Strouse, NIST, Thermal measurement challenges in advanced manufacturing.

Gift for the invited speakers



All participant received an interesting booklet, prepared by Andrea Merlone and Francesco Righini: the IMEKO **TC 12 Newsletter – Collection 1994 – 2016**; edited by Francesca Sanna.

The TEMPMEKO history was also presented on posters.

13 satellite events were organized in conjunction with TEMPMEKO 2016 Symposium, including CCT working groups and task groups meeting and the IMEKO TC12 Meeting.

IMEKO TC 12 meeting

Sponsors. The Conference was supported by 14 Sponsors and 2 Exhibitors (ACT, AccuMac, BATEMIK, BIPM – Metrologia, CHINO, DECAGON DEVICES, FLUKE, GUILDLINE, ISOTECH, ITRI, Kambič, Novasina, MI, rotronic, Springer, WIKA).

Exhibition stands

The usual well participated social events were organized during the Symposium: **welcome party** at the Witkacy Theater on **Sunday**, where beside delicious appetizers and wines, guests received…

…a warm welcome from an always smiling Aleksandra!

On Tuesday **regional architecture** tour…

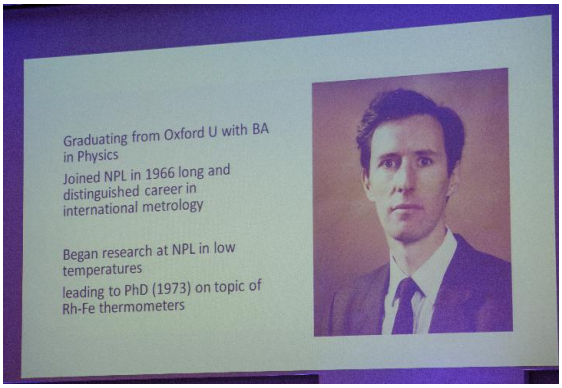
…and barbeque at the Holny Karczma

with folklore music and dance.

On Wednesday **the Polish dinner** was organized…

…and the **Gala dinner** was held on Thursday, with the **Tatra Mood Orchestra** music

During the Gala dinner we celebrated the **fiftieth anniversary of Richard Rusby** scientific work



and Francesco Righini was awarded for his continuous contribution to the series of Tempmeko.

Finally, Alekandra made the closing speech, aware that the great work to organize a perfect TEMPMEKO 2016 was “almost” concluded.

But the series of TEMPMEKO continues and…

Yuning Duan invited us to China for the **next TEMPMEKO** Symposium of 2019.

Yuning Duan presenting Tempmeko 2019

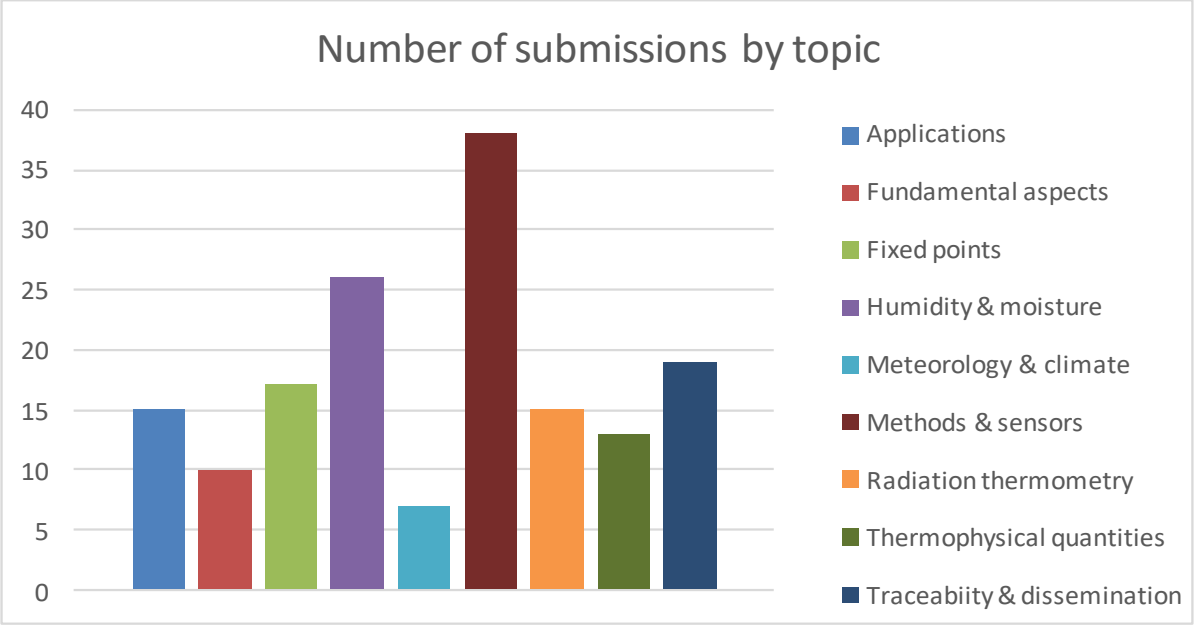
At the end on our own behalf and on behalf of all participants we would like to thank Katarzyna Polakowska-Łyś and the TRIP Group for the professional organization of the Symposium TEMPEMKO 2016 in the Belvedere Congress Centre in Zakopane.

We believe that it was not your last visit in Zakopane, in Poland.

Anna Szmyrka-Grzebyk
Aleksandra Kowal

Progress with Publication of the Proceedings of Tempmeko 2016 in the International Journal of Thermophysics

As with the last three Tempmeko conferences, the Proceedings of Tempmeko 2016 are being published in Special Issues of the International Journal of Thermophysics. At the deadline for submission (31 October) 160 manuscripts had been received for review. The breakdown between regions was APMP (43), COOMET (8), Euramet (91) and SIM (18). The chart indicates the breakdown between the topic areas.



On receipt, the majority of the papers were assigned to additional Guest Editors, who are experts in their fields and whose responsibility was to invite two reviewers for each paper, to oversee the process through the review and revision, and to make the decision regarding acceptance or rejection, after consultation if necessary. We are most grateful to them for their dedication to this task and the time that they have spent in carrying it out.

Guest editors are:
Stephanie Bell, NPL
Jean-Remy Filtz, LNE-Cnam
Jürgen Hartmann, University of Applied Science Würzburg-Schweinfurt
Andrea Merlone, INRiM
Jan Nielsen, DTI
Steffen Rudtsch, PTB
Andrew Todd, NRC.

We are, of course, also most grateful to the many reviewers who undertook to read the papers carefully and to give constructive guidance to authors on what (in their opinion) would usefully be done to make the papers ready for publication. There are no rewards for their time and effort, other than knowing that they have contributed to the process and passing on the benefit of experience to the authors - and, it must be said, most are authors themselves who have benefited from the process. If you have done more than your 'share' of 2 papers for each of yours, please accept our special thanks.

The 160 papers we received is substantially less than the 230 submitted after Tempmeko 2013. It seems that authors have been finding other outlets for their work or not publishing at all, for whatever reason. Some may have been deterred because the journal, mindful of the need to improve its 'impact factor', has raised

its criteria for suitability. We have been acutely aware of the tension between authors' need for citable publications, and the wider interest of the Tempmeko community, which might prefer to have a more inclusive and traditional set of proceedings, with less rigorous review and less professional credit. We cannot answer this dilemma, only raise it for future consideration.

It remains to say that so far 51 papers have been published (on line) in IJoT, up to Volume 38 Issue 6. A further 7 have been accepted and will appear in a forthcoming issue, 21 have been rejected and 7 withdrawn. The remaining 74 are under review or revision. Thus over half of the papers have reached 'final disposition', but clearly much more is still required before the collected Tempmeko 2016 Special Issues can run off the presses.

We thank everyone involved for what they have done so far, and urge you to keep up the good work to bring the project to completion as soon as possible.

Richard Rusby
Graham Machin
National Physical Laboratory

Metrology for Meteorology and Climate – MMC 2016

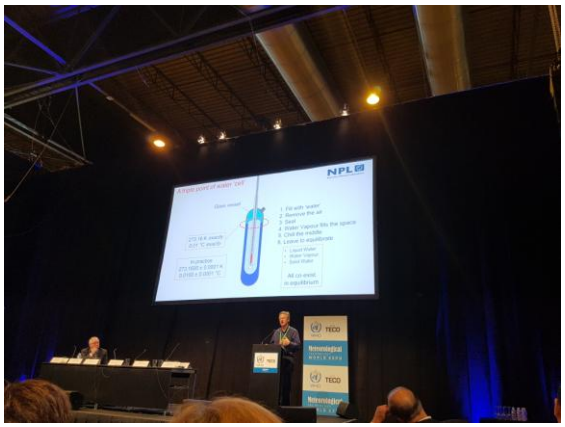
Another international event interested the thermal community in 2016: after the first edition of 2014 in Brdo, Slovenia, **the 2016 Metrology for Meteorology and Climate Conference** was held in Madrid, on 26-29 September 2016, **joint with the WMO TECO World conference** and the World meteorological Expo. Being in conjunction with the main WMO event in the field of instrument and methods of observation and the largest world meteorological instrument expo, MMC 2016 allowed top level liaisons between the communities. MMC hosted a number of satellite events starting with the ENVRIPlus meeting, allowing metrologists to interact directly with the environmental research infrastructure (ENVRI) community. On 28 the workshop "Soil moisture measurement: challenges in calibration and metrological traceability" allowed in-depth discussions on how to progress the state of the art in soil moisture measurements and calibrations. Another key event was organized at CEM on 29: the MeteoMet plenary meeting, where the scientific progress of the project was presented and discussed among the members.

The number of participants and their worldwide provenance, the scientific content of the presentations, the number of satellite events and more in general the program itself, all of those made MMC 2016 a relevant event in the panorama of the conferences on measurements for Climate. Participants to MMC 2016 unanimously recognized the conference in having well scored the scope of mixing in a harmonized balance metrology with meteorology, climate and environmental sciences. A selection of contributions on the advances in this multidisciplinary and interdisciplinary field is presented in this focus issue.

The Conference was closed with the announcement of the next MMC**. MMC 2019 will be held in conjunction with Tempmeko and Tempbeijing**, where the meteorology and climate community will be invited to join a relevant thermal metrology event, with special sessions on MMC topics. This will represent the MMC vision of bridging the two communities from both respective sides.

MMC 2016 just before the opening.

World Meteorological Organization – TECO World Conference Opening Panel.
Left to right:Brian Day, Chair HMEI; Mike Prior-Jones, SatCom chair; Johan Stander, President JCOMM; Miguel Angel Lopez, President AEMET – Sain; Wenjian Zhang, Ass. Secretary General, WMO; Bertrand Calpini, WMO-CIMO President; Andrea Merlone, INRiM, MMC Conference Director and MeteoMet Coordinator; Bruce Forgan, TECO Chair



Andrea Merlone (INriM) and Michael de Podesta (NPL) opened the TECO conference with two invited lectures on metrology for environment and the “new” kelvin, respectively.

News from MeteoMet

Started in 2011 and funded by the European Metrology Research Programme of EURAMET, MeteoMet is the largest EMRP consortium of National Institutes of Metrology, universities, research centres, hydro-meteorological and environmental protection agencies, private companies and manufactures. Activities are devoted to studies on the traceability to the SI of some Essential Climate Variables (ECVs) defined by GCOS[1] and the evaluation of the calibration and measurement uncertainties. The improvement of the quality of the recorded ECV data will lead to strategies for the reduction of the uncertainty. The project tasks are mainly involving the thermal community and the work is structured into three areas of observation: Air, Sea and Land. The ECVs considered are: water vapour in the upper-air and surface atmosphere, surface and deep sea temperature, salinity, air temperature, precipitation, albedo, permafrost temperature and soil moisture.

Here's a list of recent achievement of the project in the three domains.

Air

Calibration of radiosondes under atmospheric conditions. The development of a calibration facility for water-vapour radiosondes in the [0.03, 1.5] □mol/mol interval has been completed. The pressure and temperature limits were decreased to 1 kPa and –80 °C to simulate the conditions met during the ascent in the troposphere and lower stratosphere. The mixing ratio uncertainty is less than 2%.

Measurement of the enhancement factor under atmospheric conditions. A literature review to identify pro and cons of different experimental set-ups was completed. Since there are two measuring methods, a direct one, by measuring the second virial coefficient, and an indirect one, by measuring humidity, studies were carried out to identify the most synergic with other measurements. The design of the apparatus is expected by November 2016, the assembly by March 2017; a measurements campaign will follow.

On-site calibration of airborne instruments. The realization of a portable instrument for on-site calibration airborne instruments with uncertainty in the [1, 20] ppmv interval is progressing. A mobile, compact, and robust water vapour generator, which uses water permeation through air-purged plastic tubing was developed and manufactured. By stabilising the gas flow and the bath temperature a well-defined mixing ratio is achieved. Performance tests are ongoing.

Measurement of fast transients of temperature and humidity. An airborne combined acoustic-thermometer and infrared-hygrometer for the measurement of fast transients during ascents through the atmosphere has been upgraded. The instrument is capable of 2 Hz bandwidth, 0.01 °C resolution, 0.1 °C uncertainty, measurement of water vapour mixing ratios from 100 ppmv to 3E4 ppmv (corresponding to dew points from −42 °C to 24 °C at 1E5 Pa). A prototype of a fast airborne microwave hygrometer (volume 30 cm^3) operating from –50 °C to 10 °C (frost point temperature) and from –20 °C to 20 °C (dew point temperature) has been realised. The measurement range is from ~3 - 10^5 ppmv, the uncertainty is close to 1 ppmv. A comparison with a CETIAT calibrated chilled-mirror hygrometer showed that it could be a standard for humidity measurements. A second generation has been realised and the assembly of the full system is in progress.

Sea

Pressure dependence of deep-sea thermometers. VSL realised a comparison block and carried out measurements on deep-sea thermometers using a high-pressure chamber available at NIOZ. The measured pressure dependence of Sea-Bird Electronics thermistors (the biggest manufacturer and supplier of oceanographic thermometers) performed at 500 bar (–0.30 mK / 100 bar) confirms the values observed in the sea (from –0.17 to –0.33 mK / 100 bar) and the proper operation of the facility.

[1] Global Climate Observing System

Thermodynamic calibration of deep-sea thermometers. An acoustic gas thermometer and the associated calorimeter were modified to integrate and to calibrate deep ocean thermometers from –5 °C to 35 °C and with an uncertainty below 0.5 K.

Test and calibration facility for refractive-index salinometers. To make accurate, in-situ, and absolute salinity-measurements, the European projects NAOSS and NOSATS developed an absolute salinometer based on the refractive index of seawater. To metrologically characterise this instrument – which is necessary to its commercial deployment – CNAM and SHOM are producing a test and calibration facility. The most expensive instruments are acquired; the vessel and calorimeter are expected to be ready by the end of 2016.

Distributed temperature sensors based on optical fibre Bragg gratings. CSIC and CEM designed and realized a fibre Bragg-grating sensor to measure near-surface temperature profiles. The calibration of the grating interrogation equipment was designed, realised, and tested. The thermometer was integrated into the OBSEA underwater observatory in Vilanova i la Geltrú (Barcelona, Spain) and placed at a depth of 20 meters.

Land

Influence of siting, radiation shield, rain, and albedo on air temperature and humidity measurements. The temperature measurement inside a radiation shield is being modelled. A 3 years in-field experiment with 10 different radiation shields has been carried out and the data needed to validate the model has been supplied. A protocol to study influence of obstacles on land, surface-based, air temperature measurements has been defined; the WMO Expert Team on In-situ Operational Technologies gave a positive feedback. The experiments are underway: in Italy, an experiment is running to evaluate the road influence; in the Czech Republic, an experiment is running to evaluate the tree influence; in Spain, an experiment is running to evaluate the building influence. The influence of rain on temperature measurements has been assessed; the relevant experimental set-up is already operational. A protocol for the intercomparison (of temperature, humidity, and pressure measurements) of calibration laboratories of the National Meteorological and Hydrological services has been produced. The WMO agreed to start the comparison and made the protocol an official document of its Commission for Instruments and Methods of Observations. A mountain site to investigate the effect of albedo on temperature measurement has been identified and made operational. Four pairs of shielded temperature sensors with both naturally aspirated and mechanically ventilated shields are used to ensure a representative group of devices. Data was recorded during the 2016-2017 winter and is now being analysed.

Dynamic calibrations of hygrometers. A new water vapour generator was delivered to PTB and was integrated into the calibration facility. A climatic chamber reaching low temperatures (typically –60 °C) is operational at CETIAT. Satisfactory response time measurements were made with the LMD hygrometer and also with a chilled mirror instrument.

Precipitation and soil moisture. A report on the measurement methods of soil moisture and the normative has been produced. A survey on the measurements (more than 100 respondents) and the needs of calibrations has been carried out. The questionnaire was circulated to over 350 contacts, the outcomes will be used to improve traceability. Met Office datasets of weather-station hygrometer calibrations from 2012 to 2014 were collected and added to the initial subset of data already analysed for estimates of the drift; a presentation titled “A study of In-service Drift of Meteorological Humidity Sensors” was given at TEMPMEKO 2016.

A video documentary on MeteoMet can be found at

https://www.youtube.com/watch?v=D0Bt8sF6ExE

www.meteomet.org

Andrea Merlone

MeteoMet Coordinator