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Form for
Regular Reporting of CIMO Testbeds and Lead Centres

(expand the cells as required to properly reflect your activities)

Terms of Reference for CIMO Testbeds and Lead Centres are available under:
ttp://www.wmo.int/pages/prog/www/IMOP/Testbeds-and-LC.html

Name of Testbed / Lead Centre	**WMO – CIMO Lead Centre on Precipitation Intensity - "Benedetto Castelli"**
Location of Testbed / Lead Centre	**Italy (Genova, Vigna di Valle and Monte Cimone)**

Contact Person for the Testbed/Lead Centre	
Courtesy Title	Dr. Major
Family name	**Vuerich**
First name	**Emanuele**
Full Postal Address	**Aeronautica Militare - Centro Tecnico Meteorologia** **Air Force Technical Centre for Meteorology (CTM)** **Via R. Giacomelli, 2** **00062 Bracciano – loc. Vigna di Valle (Rome)**
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Has contact person changed in last 2 years?	No
If yes, who was the previous contact person?	N/A

Report on Activities

Main activities that TB/LC carried out in the last 2 years for which results are already available:

- Collaboration with the WMO SPICE project (Solid Precipitation InterComparison Experiment): effect of time resolution of snow measurements on the efficacy of correction algorithms based on

empirical/modeled collection efficiency curves.

- Participation to the WMO SPICE-IOC-5 meeting in Sodankyla, Finland, 17 – 24 May 2014.
- Low Precipitation Intensity Calibrator presented at the WMO SPICE-IOC-5 meeting in Sodankyla, Finland, 17 – 24 May 2014: development of a field portable device for field calibration verification of catching-type precipitation gauges in low precipitation rates (0.5 - 12 mm/h); especially suitable to gauges intended for snow measurements.
- 1st low precipitation intensity field campaign for calibration verification in collaboration with Environmental Canada: CARE Site of WMO SPICE project, Canada, 24 – 27 June 2014.
- Colli, M., Stagnaro, M., Lanza, L. and E. Vuerich (2015). Precipitation Intensity. WMO SPICE meeting, 30 April 2015.
- Colli, M., Lanza, L. and R. Rasmussen (2015) Influence of the sampling time on the assessment and application of the Transfer Function and use of the snow intensity variable. WMO SPICE meeting, 25 November 2015
- Participation to the WMO SPICE-IOC-6 meeting in Zaragoza, Spain, 18 – 22 May 2015.
- Collaboration with EURAMET (European Association of National Metrology Institutes) on the reliability of liquid and solid atmospheric precipitation measurements and instrument calibration issues through an active participation in the EMRP METEOMET-2 Project (2015-2017), REG3.
- Laboratory testing of simple farmers' rain gauges for the WMO/CAgM METAGRI Operational Project. Results presented at the METAGRI Final Workshop in Abidijan, Cotè d'Ivoire, 23-27 November 2015.
- Visit of Dr Jose Camacho, WMO Agricoltural Meteorology Division, to Vigna di Valle field test site, 11 – 12 February 2015, for an operational workshop on METAGRI.
- New web site of the Lead Centre made available at www.precipitation-intensity.it
- New logo of the Lead Centre adopted.
- Hosting of the METEOMET-2, WP3 meeting on Precipitation Measurements in Genoa, 11th March 2015. Documentation available at: http://www.precipitation-intensity.it/meteomet2.html
- Presentation of precipitation measurement issues at Arctic Metrology Workshop held at INRIM in Turin, ITALY, 23rd April 2015.
- Presentation of precipitation measurement issues at the Arctic Metrology breakout session of the 2015 Arctic Circle Assembly, 16 - 18 October 2015 (available at: http://www.precipitation-intensity.it/pdf/arctic_iceland.pdf).
- Collaboration with the National Centre for Atmospheric Research (NCAR/NOAA) in Boulder (CO, USA) for the development of collection efficiency curves for shielded and unshielded solid precipitation gauges.
- Laboratory testing and calibration of tipping-bucket rain gauges and weighing rain gauges (2015-2016).
- Continued collaboration with the Hong-Kong Observatory (China) for the development of calibration facilities for catching-type rain gauges at the Hong-Kong Observatory.
- Technical/scientific support to meteorological instrument manufacturers about calibration issues and improving the performance of their instruments in accurately measuring rainfall intensity, including accounting for the wind-induced undercatch.

Main activities that TB/LC carried out in the last 2 years for which results will soon be available:

- METAGRI Operational Project, testing of simple farmers' rain gauges in the field. Final report available in June 2016.
- Use of the snow intensity variable for the assessment and application of the Transfer Function to correct snow measurements as a function of wind speed.

Which guidance documents/standard procedures were developed during the last 2 years (please include full reference and web-link if available)?

- Procedure for algorithms for the improvement of RI observations obtained by tipping-bucket type gauges (Deliverable REG D6 of the EURAMET JRP ENV58 MeteoMet2)
- Design of a laboratory rainfall simulation system able to control the drops particle distribution and the rate of precipitation (Deliverable REG D2 of the EURAMET JRP ENV58 MeteoMet2)

Which IOM reports / peer-reviewed publications were published in the last 2 years (please include full reference and web-link if available)?

Peer-reviewed journals

- Santana, M.A.A., Guimarães, P.L.O., Lanza, L.G. and E. Vuerich (2015). Metrological analysis of a gravimetric calibration system for tipping-bucket rain gauges. Meteorol. Appl., 22, 879-885. http://dx.doi.org/10.1002/met.1540.
- Thèriault, J.M., Rasmussen, R.M., Petro, E., Trépanier; J.Y., Colli, M. and L.G. Lanza (2015). Impact of wind direction, wind speed and particle characteristics on the collection efficiency of the Double Fence Intercomparison Reference. J. Appl. Meteorol. Climatol., 54(9), 1918–1930. http://dx.doi.org/10.1175/JAMC-D-15-0034.1.
- Colli, M., Rasmussen, R.M., Thèriault, J.M., Lanza, L.G., Baker, B.C. and J. Kochendorfer (2015). An improved trajectory model to evaluate the collection performance of snow gauges. *J. Appl. Meteorol. Climatol.*, **54**(8), 1826–1836. http://dx.doi.org/10.1175/JAMC-D-15-0035.1.
- Colli, M., Lanza, L.G., Rasmussen, R.M. and J.M. Thèriault (2016). The collection efficiency of shielded and unshielded precipitation gauges. Part I: CFD airflow modelling. *J. of Hydrometeorol.*, **17**(1), 231–243. http://dx.doi.org/10.1175/JHM-D-15-0010.1.
- Colli, M., Lanza, L.G., Rasmussen, R.M. and J.M. Thèriault (2016). The collection efficiency of shielded and unshielded precipitation gauges. Part II: modelling particle trajectories. *J. of Hydrometeorol.*, **17**(1), 245–255. http://dx.doi.org/10.1175/JHM-D-15-0011.1.

IOM reports

- Colli, M., Lanza, L.G., Rasmussen, R. and E. Vuerich (2014). Using laboratory experiments to improve reliability in liquid and solid precipitation weighing-gauge measurements. Proc. TECO-2014: WMO Techn. Conf. on Meteorological and Environmental Instruments and Methods of Observation. St. Petersburg, Russia, July 2014. (published on CD-ROM as WMO/IOM Rep. No. 116).
- Colli, M., Lanza, L.G., Rasmussen, R. and J.M. Thériault (2014). A CFD evaluation of wind induced errors in solid precipitation measurements. Proc. TECO-2014: WMO Techn. Conf. on Meteorological and Environmental Instruments and Methods of Observation. St. Petersburg, Russia, July 2014. (published on CD-ROM as WMO/IOM Rep. No. 116).
- Colli, M., Rasmussen, R.M., Landolt, S., Baker, B., Kochendorfer, J., Collins, B., Colli, M., Lanza, L. and J.M. Thériault (2014). Examination of the Performance of Single Alter Shielded and Unshielded Snowgauges Using Observations from the Marshall Field Site during the SPICE WMO Field Program and Numerical Model Simulations. Proc. TECO-2014: WMO Techn. Conf. on Meteorological and Environmental Instruments and Methods of Observation. St. Petersburg, Russia, July 2014. (published on CD-ROM as WMO/IOM Rep. No. 116).

Conference papers/abstracts (international)

- Colli, M. and L.G. Lanza (2014). A laboratory evaluation of the influence of weighing gauges performance on extreme events statistics (Abstract). EGU General Assembly, Geophys. Res. Abstr., 16, EGU2014-11879.
- Colli, M., Lanza, L.G., Rasmussen, R. and J. M. Thériault (2014). Wind induced errors on solid precipitation measurements: an evaluation using time-dependent turbulence simulations (Abstract). EGU General Assembly, Geophys. Res. Abstr., 16, EGU2014-15956.
- Colli, M., Lanza, L.G. and E. Vuerich (2014). The accuracy of ground-based rainfall intensity measurements. Proc. Int. Conf. on Metrology for Meteorology and Climate, MMC-2014, Brdo

(Slovenia), 15-18 September 2014, p. 109.

- Santana, M., Guimarães, P., Lanza, L.G. and E. Vuerich (2014). Metrological analysis of gravimetric calibration systems for tipping-bucket rain gauges. Proc. Int. Conf. on Metrology for Meteorology and Climate, MMC-2014, Brdo (Slovenia), 15-18 September 2014, p. 110.
- Colli, M., Lanza, L.G. and P. La Barbera (2014). The design of a laboratory rainfall simulator. Proc. Int. Conf. on Metrology for Meteorology and Climate, MMC-2014, Brdo (Slovenia), 15-18 September 2014, p. 94.
- Lanza, L.G. and M. Colli (2015). Accuracy of solid precipitation measurements in the Arctic: the impact of wind on the collection efficiency of snow gauges. Arctic Metrology Workshop, INRIM, Torino, 23 April 2015.
- Colli, M., Lanza, L.G. and E. Vuerich (2015). A reference group for precipitation measurements at the WMO/CIMO Lead Centre "B.Castelli" on Precipitation Intensity (Abstract). EGU General Assembly, Geophys. Res. Abstr., 17, EGU2015-13020.
- Colli, M., Lanza, L.G. and P. La Barbera (2015). Metrological requirements for a laboratory rainfall simulator (Abstract). EGU General Assembly, Geophys. Res. Abstr., 17, EGU2015-12084.
- Colli, M., Lanza, L.G., Rasmussen, R.M. and J.M. Thèriault (2015). Advances in the evaluation of wind-induced undercatch using CFD-based simulations of snow gauge performance (Abstract). EGU General Assembly, Geophys. Res. Abstr., 17, EGU2015-13334.
- Lanza, L.G. and M. Colli (2015). On the accuracy of precipitation measurements in the Arctic. Arctic Circle Assembly, Breakout session on "Metrology for Environment in the Arctic", Reykjavík, Iceland, October 15-18, 2015.
- Pollock, M., Colli, M., Stagnaro, M., Dutton, M., Lanza, L.G., Quinn, P. and E. O'Connell (2015). Evaluating wind-induced uncertainty on rainfall measurements by means of CFD modelling and field observations. Proc. UrbanRain 2015, 10th Int. Workshop on Precipitation in Urban Areas, 1-5 December 2015, Pontresina, Switzerland (published in electronic format).
- Stagnaro M., Colli M., Lanza L.G. and P. La Barbera (2015). Metrological requirements for a laboratory rainfall simulator. Proc. UrbanRain 2015, 10th Int. Workshop on Precipitation in Urban Areas, 1-5 December 2015, Pontresina, Switzerland (published in electronic format).
- Colli, M., Thériault, J.M., Stagnaro, M., Lanza, L.G. and R.M. Rasmussen (2016). Study of the Solid Precipitation Wind Induced Under-Catch Using Snowfall Intensity (Abstract 9B.4). 96th Americal Meteorological Society (AMS) Annual Meeting, January 10-14, New Orleans, Louisiana (US).
- Thériault, J.M., Rasmussen, R.M., Colli, M. and L.G. Lanza (2016). Examination of the Catch Efficiency of Snow Gauges based on the Observed Characteristics of Snow (Abstract 9B.5). 96th Americal Meteorological Society (AMS) Annual Meeting, January 10-14, New Orleans, Louisiana (US).

Title(s) of IOM report(s) presently being developed by your Testbed/Lead Centre:
(please specify level of development: draft, ready for review, …)

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Has your Testbed/Lead Centre collaborated with one or more CIMO Expert Teams in developing guidance material? Yes

If yes, with which CIMO Expert Team(s)?

- CIMO - ET on Instrument Intercomparisons (involvement in pre-SPICE and SPICE)
- CIMO Guide Editorial Board (to include the outcomes of the Field Intercomparison of RI gauge)
- CIMO - ET on Operational In Situ Technologies (WMO/ISO standard on the accuracy of rainfall intensity measurements)

Capacity Building and Training Activities

Which capacity building/training activities have been carried out by the Testbed in the last 2 years?

- Seminar on the accuracy of precipitation measurements at Newcastle University, April 2014, within the

Knowledge Transfer Partnership between Environmental Measurements Ltd and the School of Civil Engineering & Geosciences, Newcastle University.

Has your testbed developed a twinning activity / special relationship with a companion station/site from a developing country? No

If yes, with which station/site?

Is your Testbed/Lead Centre making an oral/poster presentation at this year's TECO? Yes

(If yes, please specify Title(s) and Author(s) of the presentation(s))

- TBD

Recent Changes in Circumstance

Have there been any recent changes in your Test Bed/Lead Centre's capabilities? If so, please specify:

- Improved Computational Fluid Dynamics (CFD) modeling capabilities
- Low precipitation intensities field calibration capabilities (0.5 – 12mm/h)

Have there been any recent changes in your Test Bed/Lead Centre's infrastructure? If so, please specify:

- Working reference group improved and completed at the field test site
- Laboratory calibration setup for non-catching rain gauges nearly completed
- Access to the wind tunnel facility of the University of Genoa for testing wind effects on rain gauges

Have there been any recent changes in your staffing? If so, please specify, and advise whether replacement staff have the required competencies:

- None

Future Plans

What are your plans for the next two years?

- Continuation of the activities related to improving the accuracy of precipitation measurements, instrument calibration, technological developments etc.
- CEN and common WMO-ISO standards on precipitation measurements

Is your Testbed/Lead Centre able to continue in the role of a Test Bed/Lead Centre during the coming two years?	**Yes**

Other relevant information (other activities of special interest to CIMO, etc…)

- None

2016, the 18th of March — **Date**

Major Emanuele Vuerich, Prof. Luca Lanza — **Name of Person Filling the Form**