# WMO Field Intercomparison of rainfall intensity (RI) gauges at Vigna di Valle (Italy) Poster#2(42)

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### *Introduction:*

- The WMO Field Intercomparison of Rainfall Intensity (RI) rain gauges started on the 1st of October 2007 - Vigna di Valle (Italy).
- First Intercomparison for quantitative 1 minute RI [mm/h] measurements in field conditions and one of the most extensive in terms of numbers of instruments analysed (43).
- Users requirements: hydro-meteorological warnings, interfacing hydro-meteorological models, flood forecasting, disaster prevention and mitigation, urban hydrology and engineering design.
- Site very suitable for Intercomparisons, versatile design and innovative acquisition system, considered as "unique" in the world: *Report of the OPAG co-chairs, 5th Session of CIMO Management Group, Geneva, Switzerland, 28-30 January 2008*

*Italian Met Service - ReSMA Centre – Intercomparison Site Vigna di Valle (Italy)*

### *Objectives:*

- To test the performance of 1 minute RI [mm/h] measuring instruments in high RI conditions;
- To offer advice for RI uncertainty determination and for improving 1 minute RI measurement accuracy;
- To provide guidance on improving the homogeneity of long-term records of rainfall with special consideration given to high RI;
- To provide guidance material for further improvements in the area of Intercomparisons and to draft recommendation for consideration by the WMO-CIMO;
- To compare RI measurements in field conditions of non-catching type rain sensors with respect to catching type rain gauges

## PROCEDURES AND METHODS

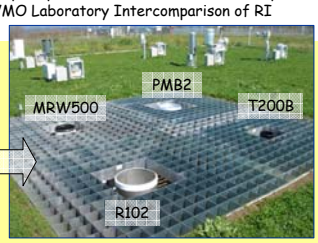
### *Instruments, standards and references:*

- No.26 RI gauges (different measurement principles) after preliminary tests in WMO-recognised Laboratory of the Univ. of Genoa, were installed on dedicated, evenly distributed ground platforms at 1 m height;
- No.4 "Working Reference RI Gauges" (W.R.Gs) were inserted in Reference Rain Gauge Pits (R.R.G.P.) at the centre of the Intercomparison site (collectors at ground level) – Minimization of weather related catching errors (e.g. Jevons effect, 1861);
- No.13 additional meteorological sensors for monitoring environmental conditions were installed on 6 lateral/corner ground platforms at 1 m height;
- Standard adopted: EN-13798: "Specification for a reference rain gauge pit"

### *Working references:*

- Calibrated set of instruments used for controlling/make comparison with measuring instruments (providing the best possible estimation of RI in the field);
- Corrected tipping bucket rain gauges (TBRG) and weighing gauges (WG) with the shortest step response and the lowest uncertainty according to Results of WMO Laboratory Intercomparison of RI 2004-2005

**Working references** in standard reference rain gauge pits: ETG-R102 (TBRG), CAE-PMB2 (TBRG), Meteoservises-MRW500 (WG) and GEONOR-T200B (WG)




*List of participating rain gauges (26+4 working references)*

| # | RAIN GAUGES | MEAS. PRINCIPLE |
|---|---|---|
| 1 | RIMCO 7499 | Tipping bucket |
| 2 | Paar AP23 | Tipping bucket |
| 3 | Precis-Mecanique | Tipping bucket |
| 4 | Thies PT | Tipping bucket |
| **5/27** | **ETG R102** | **Tipping bucket** |
| 6 | LSI-LASTEM DQ031 | Tipping bucket |
| 7 | SIAP-MICROS UM7525/I | Tipping bucket |
| **8/28** | **CAE PMB2** | **Tipping bucket** |
| 9 | Davis Rain Collector II | Tipping bucket |
| 10 | Lambrecht 15188 | Tipping bucket |
| 11 | MTX PP040 | Tipping bucket |
| 12 | Env. Meas. Ltd ARG100 | Tipping bucket |
| **13/29** | **Meteoservis MRW500** | **Weighing gauge** |

| # | RAIN GAUGES | MEAS. PRINCIPLE |
|---|---|---|
| 14 | Vaisala VRG101 | Weighing gauge |
| 15 | OTT Pluvio | Weighing gauge |
| 16 | EWS PG200 | Weighing gauge |
| **17/30** | **GEONOR T-200B** | **Weighing gauge** |
| 18 | MPS TRwS | Weighing gauge |
| 19 | SA „MIRRAD" MPA-1M | Not Participating |
| 20 | Vaisala PWD22 | Optical Disdrometer |
| 21 | OTT Parsivel | Optical Disdrometer |
| 22 | Thies LPT | Optical Disdrometer |
| 23 | Vaisala WXT510 | Acoustic impact |
| 24 | Eigenbrodt ANS 410 | Water pressure |
| 25 | KNMI electric raingauge | Water level |
| 26 | PVK ATTEX "DROP" | Doppler Radar |

### *Data acquisition and processing:*

- Innovative DAQ system based on *Campbell Scientific* CR1000 equipped with serial output filtering peripherals, switch closure/open collector peripherals, multiplexers, serial protocols converters, memory cards backup, local UPS and ethernet module for data transfer to main pc;
- Direct measurements (switch closure gauges, vibrating wires rain gauges, pulses emitting rain gauges, wind monitoring sensors, T/RH sensor, etc) and serial output acquisition for string emitting rain gauges;
- Serial acquisition by application of dedicated string filters for serial strings emitted by different rain gauges
- Raw data of rain gauges with a sampling time of 10 seconds for evaluating the RI [mm/h] of all rain gauges on 1 minute time base


### *Quality assurance:*

- Raw data are processed by the Automatic Quality Control (AQC) to provide quality checked 1-minute data
- Periodic field tests: Field Calibration Device (developed at DICAT Laboratory – Univ. of Genoa)
- Periodic maintenance, daily visual checks, cleaning of instruments, calibration status checks
- **Meeting of Participants and local staff** (Vigna di Valle, 21-22 MAY 2008)

*Field Tests-Calibration Device*

*Meeting of Participants*

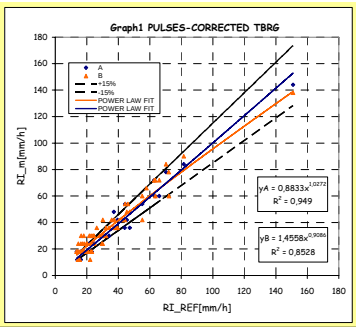
## DATA ANALYSIS AND PRELIMINARY RESULTS

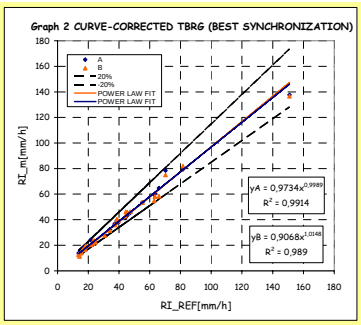
- Main objective of data analysis: performing the best inter-comparison of rain gauges in high RI field conditions through the establishment of the 1 min Reference RI [mm/h] (RI_REF)
- The Reference is the best estimation of the 1 minute RI true value and could be obtained from the intensities of the WRGs in two ways: (A) derivation of the response function of WRGs (dynamic performance characteristics); (B) statistical evaluation of data
- Sample application: The REF is calculated as the Weighted Average of 1-min $RI_i$ measured by WRGs:

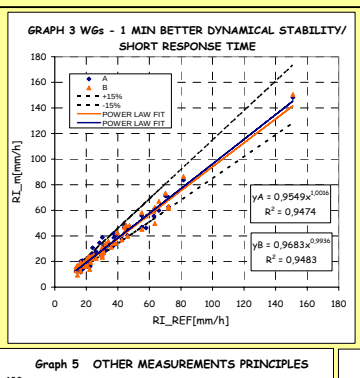
$$RI\_REF = \frac{\sum_i \mu_i RI_i}{\sum_i \mu_i} \quad \mu_i = \frac{S_i \cdot F_i}{\sum_i S_i \cdot F_i}$$

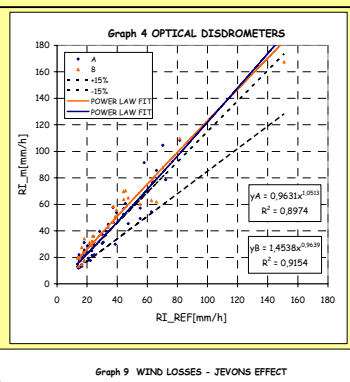
- $S_i$ = *statistical parameter of WRG, calculated throughout the database of all precipitation events*
- $F_i$ = *"gross" parameter (dynamic properties, synchronism) - event-basis assigned*

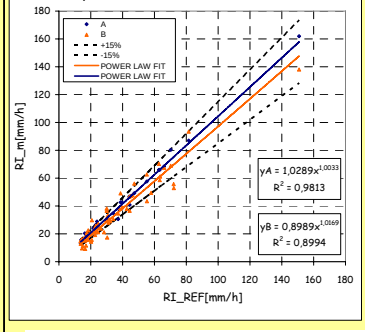
- *To compare the measurements results,* the intensities measured in a few events by the rain gauges (RI_m) in open field are plotted versus 1 minute RI_REF and data are fitted with a power law trend curve: $RI = a \times RI\_REF^{b}$ (a, b constant parameters reported on graphs)
- Graphs are divided in groups-categories according to different measurement principles
- To assess the impact of wind losses (Jevons effect) on catching errors, the ratio $RI_i^{OUT}/RI_i$ is plotted versus wind speed (being $RI_i^{OUT}$ and $RI_i$ the measured intensities by two identical gauges, one in the pit and the other one in the corresponding open field platform)

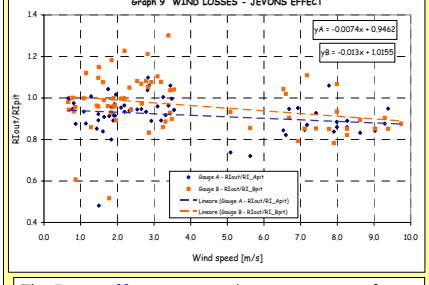



The Jevons effect appears and it is more intense for moderate-strong winds (WS>6m/s) as expected

### *Conclusions:*

A preliminary and partial inter-comparison of several rain gauges at 1 min time scale has been developed and results are very promising, thus the methodology demonstrates its suitability and the possibility to enlarge the procedure to all monitored rain events