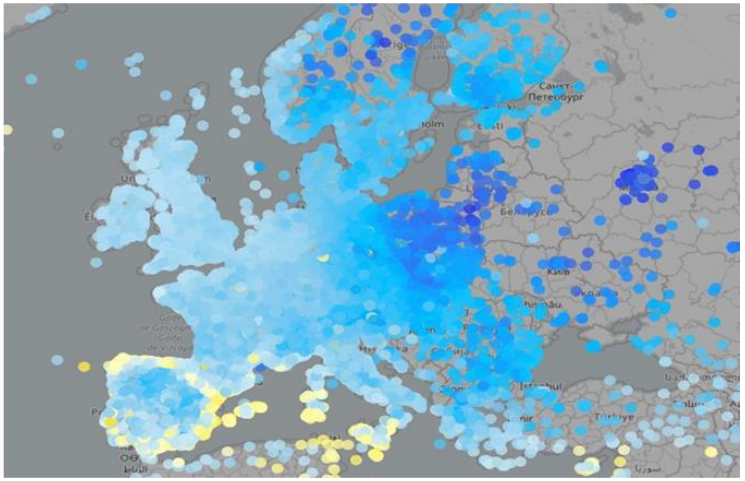
Priority Task: EPOCS (Evaluate Personal Weather Station and Opportunistic Sensor Data CrowdSourcing)



IMGW-PIB: Joanna Linkowska, Jan Szturc, Anna Jurczyk, Katarzyna Ośródka, Marcin Grzelczyk, +Radosław Droździoł
CIMA: Massimo Milelli, Elena Obert, Umberto Pellegrini
CNMCA: Francesco Sudati

COSMO GENERAL MEETING, Gdańsk, 11-14.09.2023

The aim of PT EPOCS is to assess the use of weather data from Personal Weather Stations (PWS) and other Opportunistic Sensors (OS).

The main scientific aims of this PT are:

1. The development and testing of data Quality Control (QC) algorithms.
2. The evaluation of quality and usefulness of this data for potential applications in nowcasting, NWP and model forecast verification.

COSMO PT EPOCS

- PT EPOCS accepted by WG5/SMC, final approval by STC in March 2023
- Participants: IMGW-PIB, CIMA foundation, CNMCA – The Italian Air Force Met. Service
- PT Leader: Joanna Linkowska (IMGW-PIB)
- Start: early Spring 2023, duration 1 year
- **Total FTEs:** 1.00

Task	IMGW-PIB	CIMA	CNMCA
0	0.05		
1	0.2	0.07	0.15
2	0.2	0.08	
3	0.2		
4	0.05		
Total FTEs	0.7	0.15	0.15

COSMO PT EPOCS Tasks

1. **PWS databases survey and exploitation**

2. **QC algorithms for precipitation**

3. **Analysis of PWS based gridded rainfall products**

4. **Suggestions for the follow up activities**

COSMO PT EPOCS Tasks

1. PWS databases survey and exploitation

1.1 Comprehensive survey of available data platforms at the European and Global level.

Participants: Marcin Grzelczyk, Francesco Sudati, Massimo Milelli (March 2023 - June 2023: **completed**)

1.2 Testing the process of collection of a real-time PWS data (from IMGW-PIB employees who are using their own stations) by starting new internal database server.

Participant: Marcin Grzelczyk (March 2023 – October 2023: **ongoing**)

1.3 Testing integrity and correctness of stored data, assess usefulness of external databases/projects (CENAGIS).

Participant: Marcin Grzelczyk (November 2023 – February 2024, **started earlier – ongoing**)

1.4 Analysis of the mobile PWS sensors: testing QC characteristics of a new mobile weather sensors from Meteotracker.

Participants: Francesco Sudati, Massimo Milelli (March 2023 - February 2024 – **ongoing**)

2. QC algorithms for precipitation

2.1 Development and testing automatic QC methods based on the RainGaugeQC algorithms developed at IMGW-PIB.

Participants: Katarzyna Ośródka, Jan Szturc, Anna Jurczyk (March 2023 - February 2024: **ongoing**)

2.2 Testing and application of the open-source software package TITAN for a quality control of ground data.

Participants: Elena Oberto, Umberto Pellegrini (March 2023 - February 2024: **ongoing**)

Purpose: potential of further use of PWS for data assimilation in NWP/Nowcasting models or verification of model forecast.

3. Analysis of PWS based gridded rainfall products

3.1 Processing different rainfall data sources (private rain gauges, commercial microwave links, sewer/water service stations, etc.)

Participants: Katarzyna Ośródka, Jan Szturc, Anna Jurczyk (March 2023 - February 2024: **ongoing**)

Combine PWS with other standard data (telemetry, radar, satellite) into new enhanced rainfall estimates (RainGRS+)

3.2 Reliability analysis of a gridded RainGRS+ high-resolution estimates of precipitation.

Participant: Joanna Linkowska (September 2023 - February 2024 **ongoing**)

Sample data of RAINGRS+ and RAINGRS (without PWS) fields will be verified against chosen independent precipitation data.

4. Suggestions for the follow up activities (ongoing)

- Planning a collaboration for a longer Priority Project (PP)

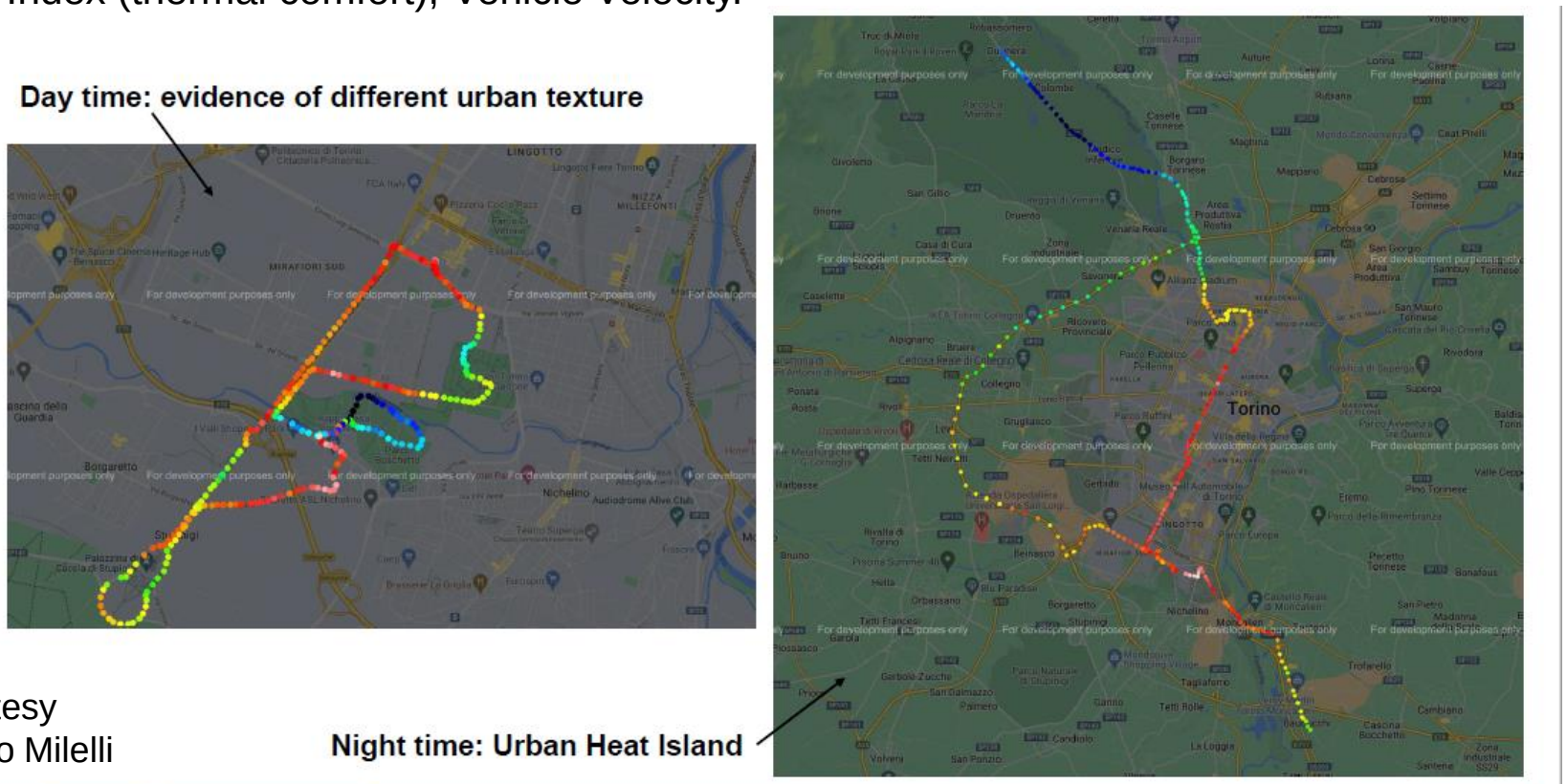
- Assessment for application of project results in supporting other COSMO R&D activities.

  - forecast verification,
  - data assimilation of NWP/Nowcasting models,
  - postprocessing (machine learning), etc.

1.4 Analysis of the mobile PWS sensors: testing QC proprieties of a new mobile weather sensors from Meteotracker

MeteoTracker is a mini weather station specifically designed and patented for measurements taken on the move: ✓ Air temperature, ✓ Relative Humidity, ✓ Pressure.

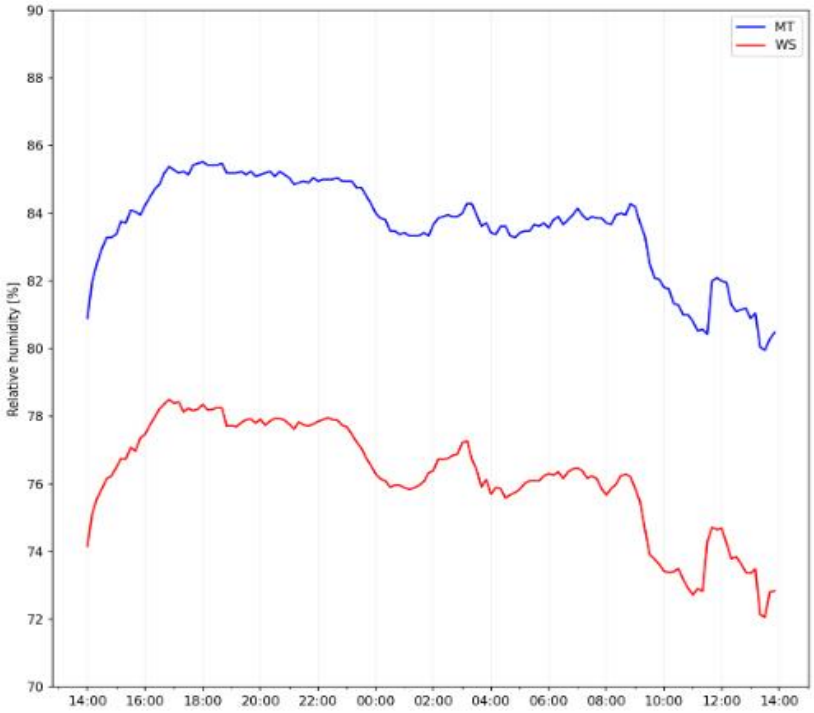
Derived parameters: Dew Point, Altitude, Vertical Temperature Gradient, Solar Radiation Intensity, Humidex Index (thermal comfort), Vehicle Velocity.



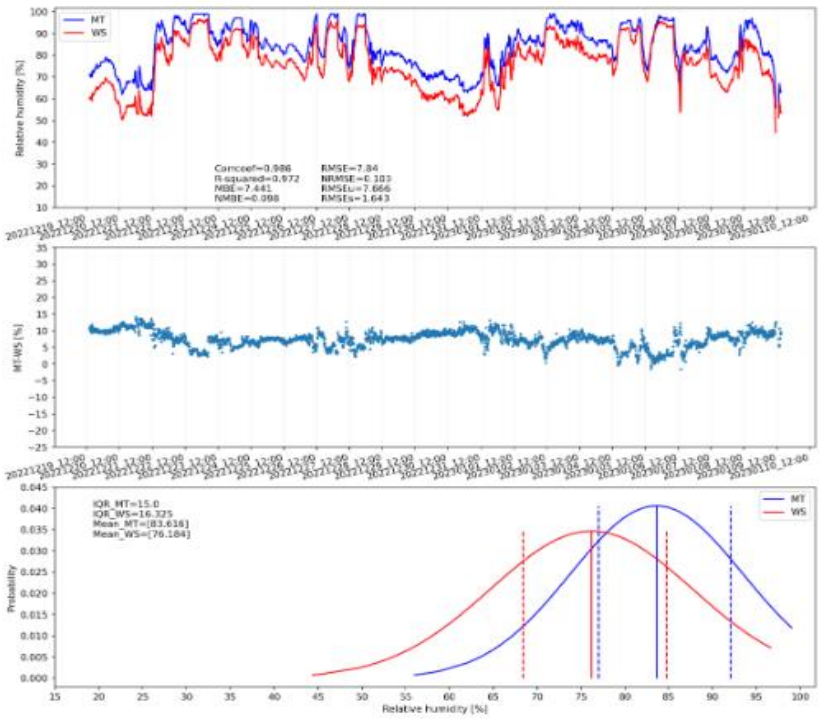
Slide courtesy
of Massimo Milelli

1.4 Analysis of the mobile PWS sensors: testing QC proprieties of a new mobile weather sensors from Meteotracker

Comparison between a MT in a Stevenson box and a WMO sensor (WS) on the roof of CIMA.
Relative Humidity, Winter period (19/12/2022 - 10/01/2023)



Mean daily cycle



Slide courtesy of Massimo Milelli

RH accuracy is poorer and MT tends to overestimate RH (~10% difference in winter and ~20% difference in summer).

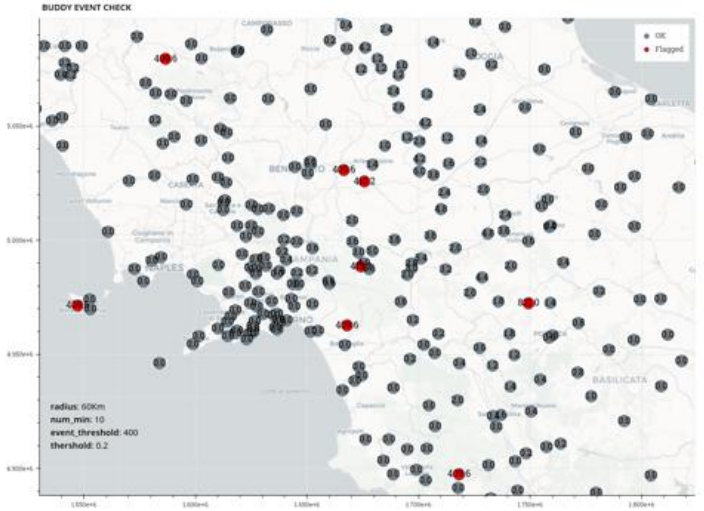
2.2 Testing and application of the open-source software package TITAN for a quality control of ground data

TITANLIB is an open source software developed at the Norwegian meteorological institute. It is a library of automatic quality control routines for weather observations. The main goal of the task is to prepare a “clean” precipitation field for model verification, for instance. Starting point – test on the official Italian network, not on personal weather stations (PWS).

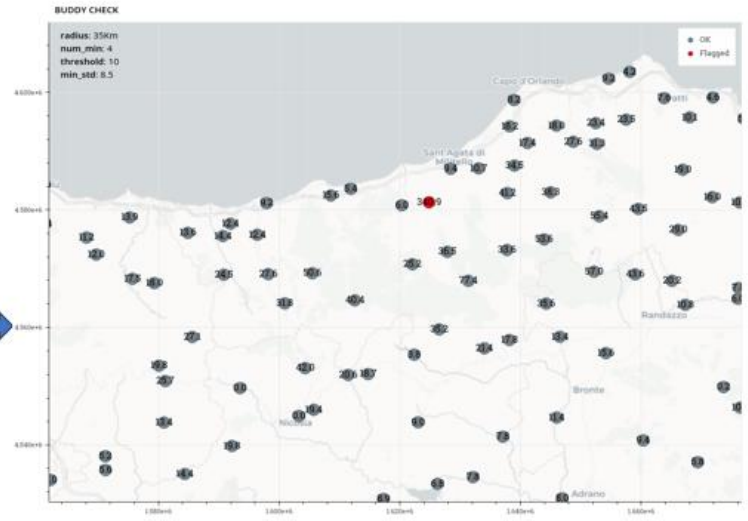
TITANLIB main tests

Buddy event check →

The observations are converted into yes/no values of exceeding a specified threshold (**event_threshold**).
The **threshold** argument in this test is minimum fraction of other observations in the neighbourhood that must agree with the observation being inspected.



Buddy check →



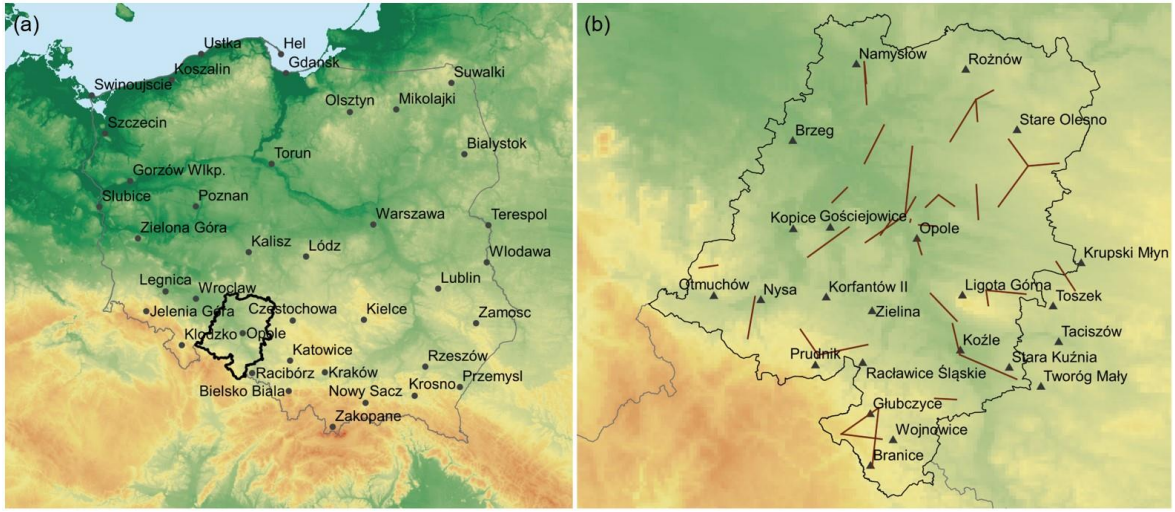
The buddy check compares an observation against its neighbours (i.e. buddies) and flags outliers in a radius specified by the user.
The buddy check flags observations if the (absolute value of the) difference between the observations and the average of the neighbours normalized by the standard deviation in the circle is greater than a predefined **threshold**.

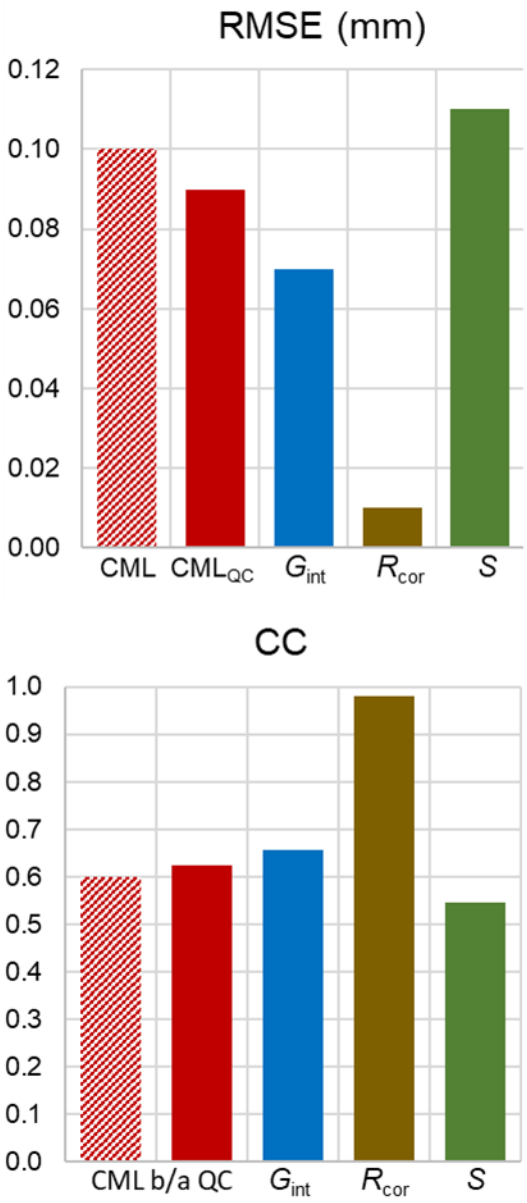
Slide courtesy of Elena Oberto

3.1. Multi-source precipitation (RainGRS+) CML-based data

METEO IMGW-PIB meteo.imgw.pl

CMLs (commercial microwave links) provide precipitation estimates based on attenuation on the links.





RMSE and correlation coefficient (CC) of CML-based precipitation determined before and after quality control, telemetric rain gauges (G_{int}), corrected radar (R_{cor}), and satellite (S) data.

RainGRS as a reference.

Half-hourly accumulations (July 19 – August 18, 2022)

Slide courtesy of Jan Szturc