

Quality Control of Precipitation Data from Automatic Weather Stations using Central Integration Platform

Hela Irha, Maja Piljek and Ana Šantić
Croatian Meteorological and Hydrological Service (DHMZ)

Budapest, Hungary 5 – 7 May 2026

PROJECT

METMONIC

Modernization of the National Weather Observation Network in Croatia

Duration

1 Oct 2017 – 28 Feb 2025



Project deliverables

397 Automatic surface meteorological stations

6 Meteorological radars

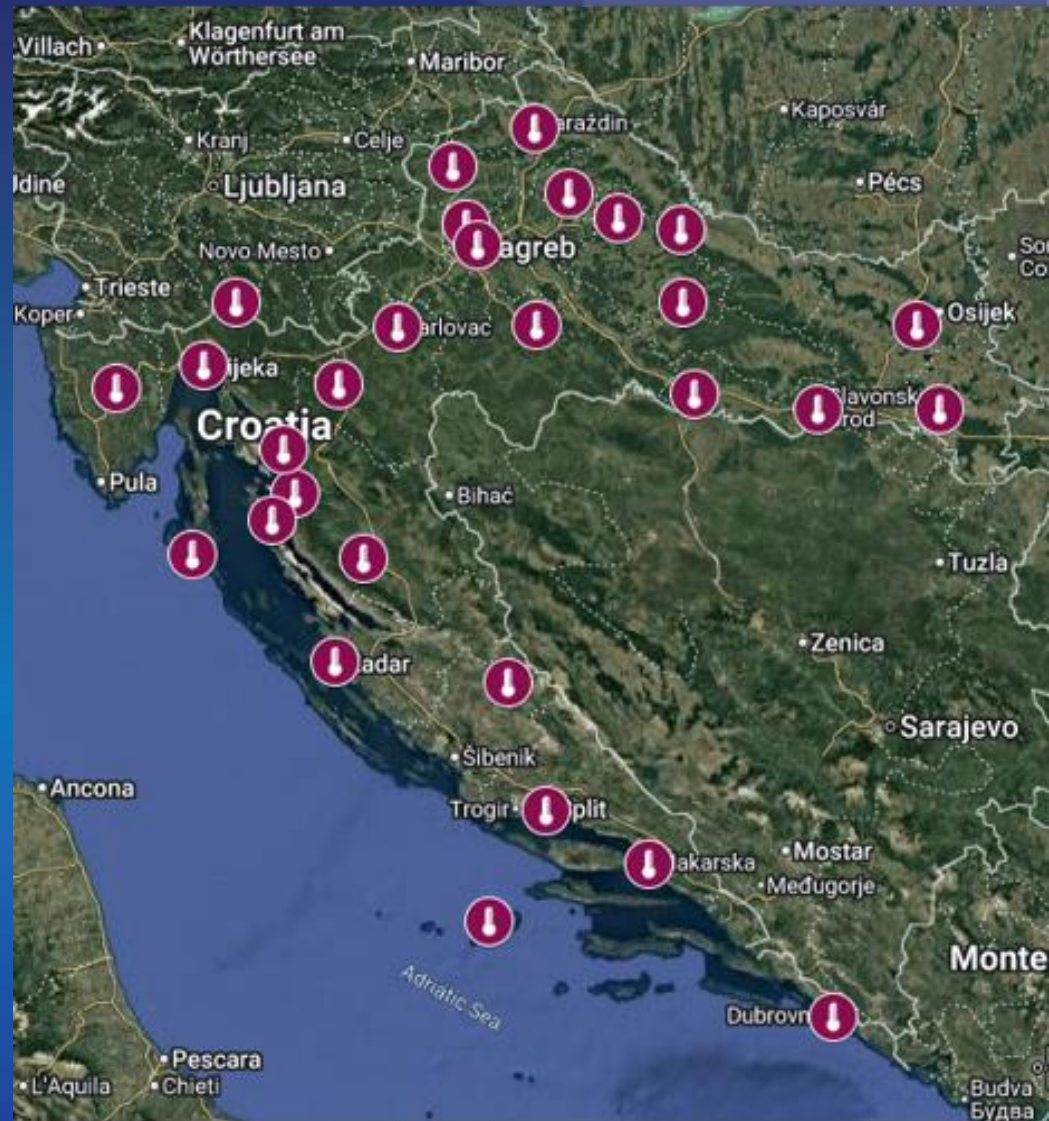
5 Meteorological – oceanographic buoys

→ Every part of DHMZ observation network has been upgraded



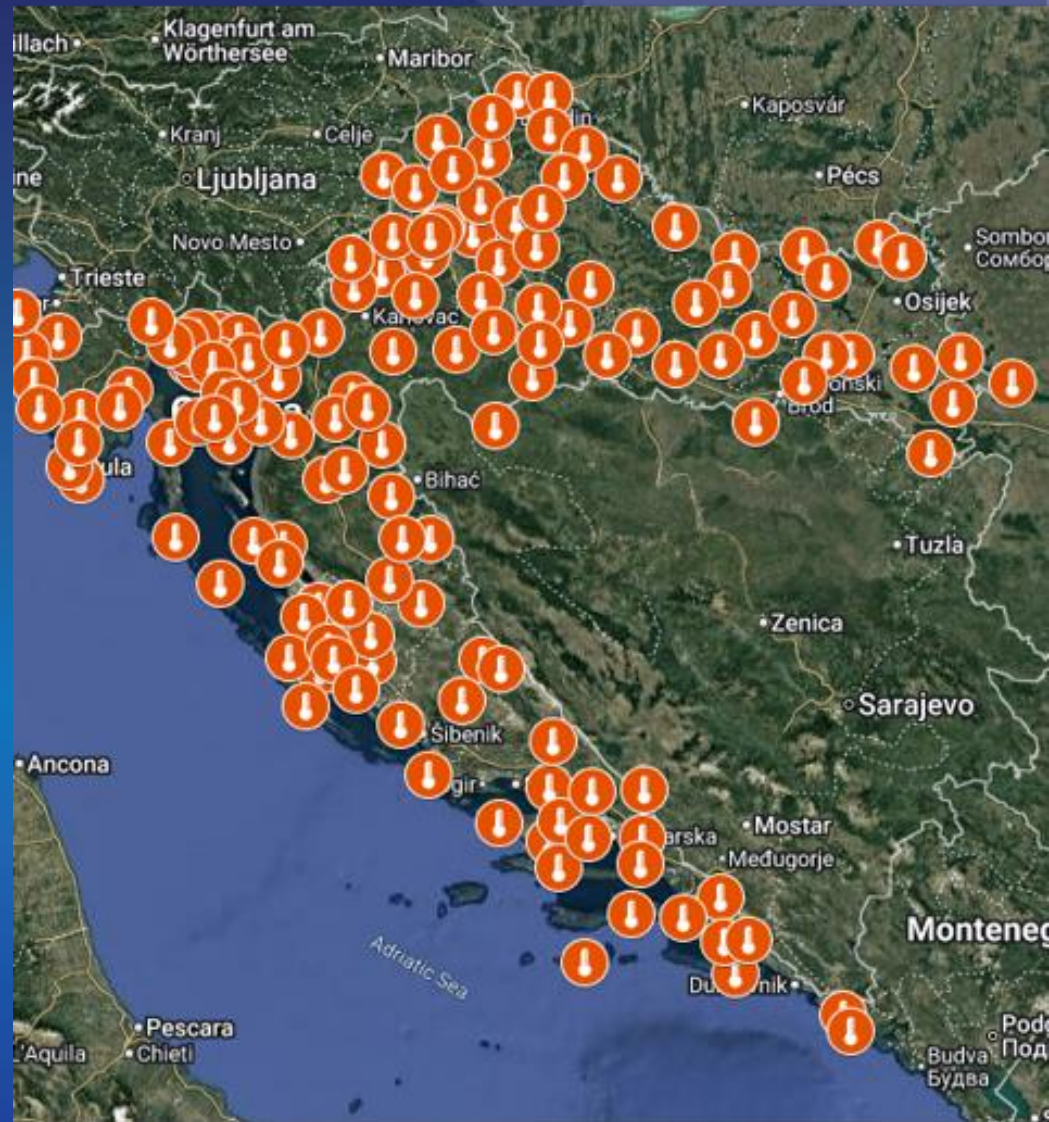
Automatic surface meteorological stations

Main stations



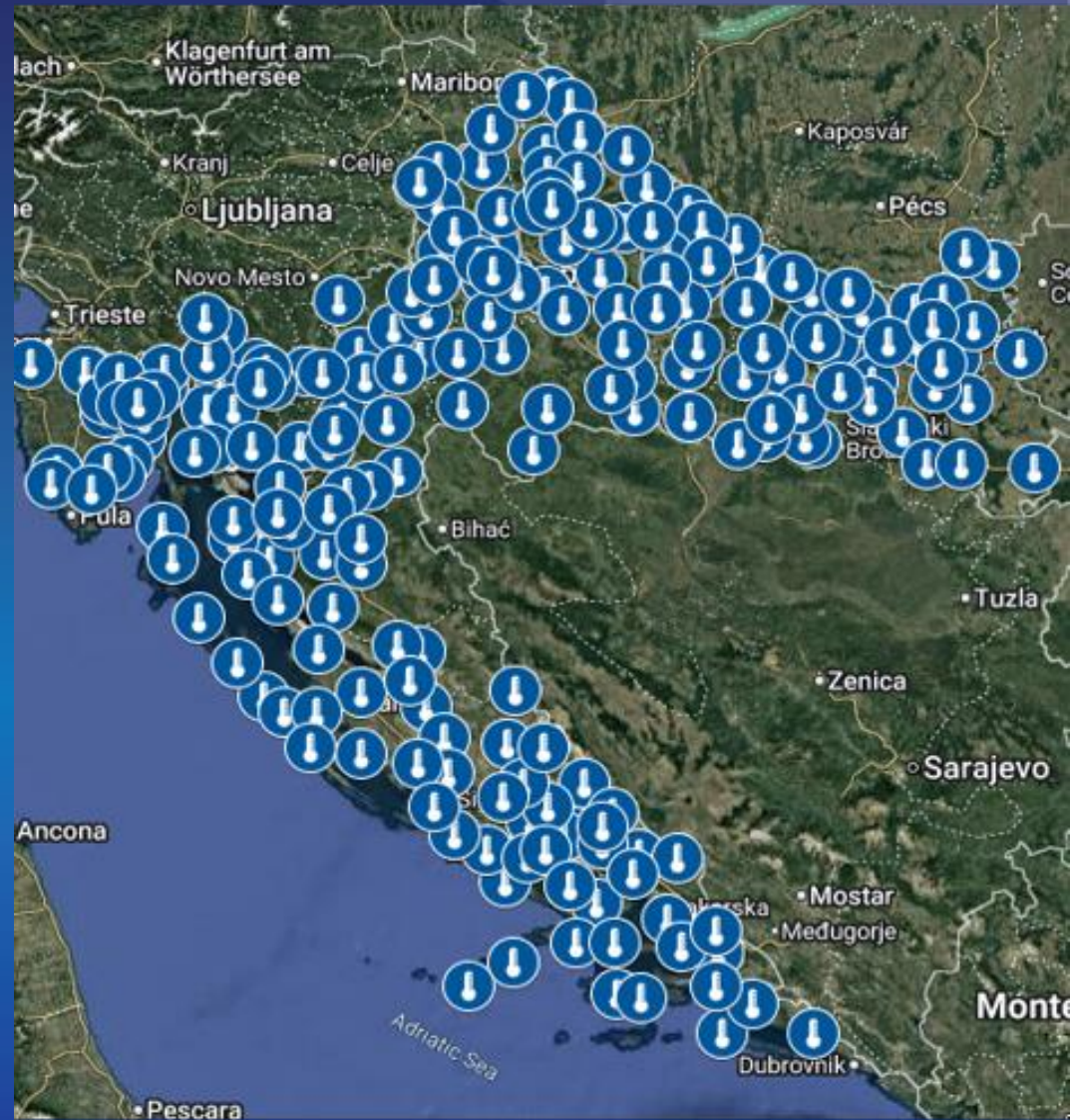
Automatic surface meteorological stations

Climatological stations



Automatic surface meteorological stations

Rain gauge stations



Central Integration Platform (CIP)

- Growing volume of data → new software
- Unified system that handles:

Automatic weather stations network monitoring

Data quality control

Visualization

Central Integration Platform (CIP)

Central Integration platform (CIP)

HOME DISPLAY WEATHER DATA MODULES

HR EN ?

Welcome to the Central Integration Platform of Meteo Data System!

METEO THEMES

PUBLIC

OTHER SPATIAL DATA

AMP

ALL AVAILABLE THEMES

SKMP

RADAR

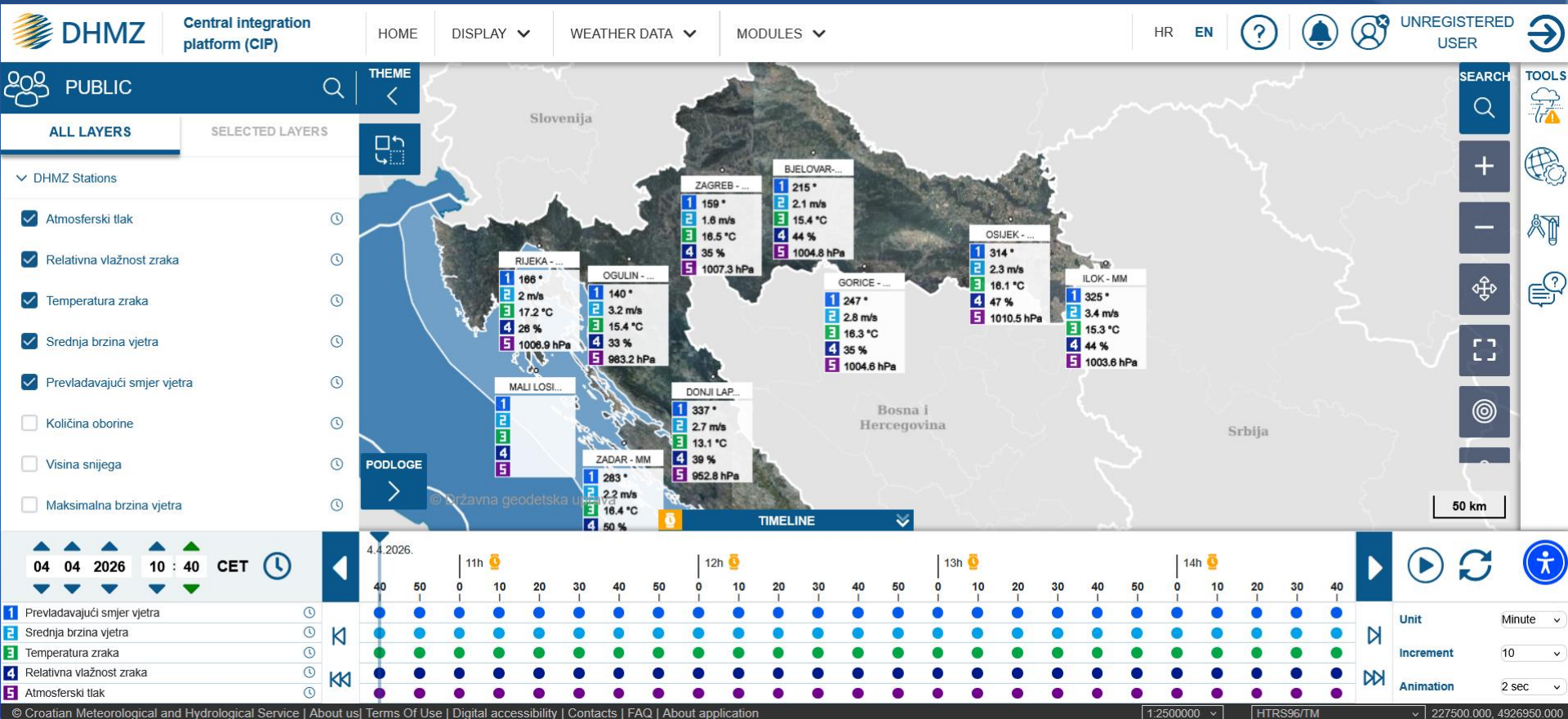
ALADIN

DRŽAVNA AGENCIJA REPUBLIKE HRVATSKE ZA VEŠTAČENJE I IZVJEŠTAČENJE O OKOLIŠU
DHMZ

Central Integration Platform (CIP)

Easier access to archives and databases

www.meteopodaci.dhz.hr



Quality Control Module

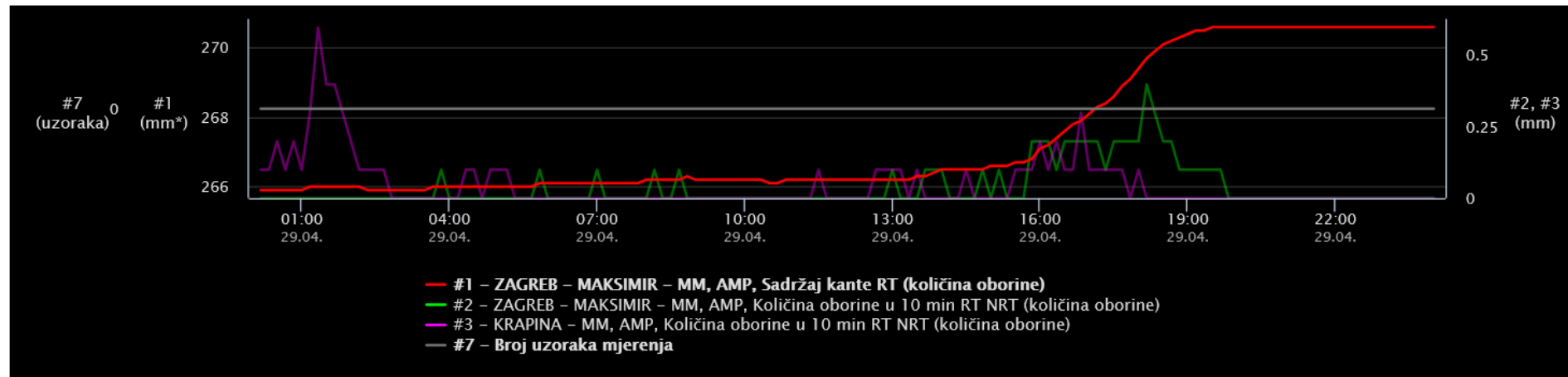
Ručna kontrola kvalitete

Pronađi i odaberi ▾

Promijeni ▾

Statistika i validacija ▾

Pomoćni grafovi ▾



Kontrolirani MME (3)

Odabrana mjerenja (288)

Izvorna mjerenja (za jedno odabrano)



#	Postaja	Izvor (kod izvora)	Meteo-mjerni element	Tip vrij.	Interval osvjež.	Min	Max	Izmjene	Simbol	Prijave	Akcije
<input checked="" type="radio"/>	1 ZAGREB - MAKSIMIR - MM [1048]	AMP [1] (AMP-CMP)	Sadržaj kante RT (količina oborine) [916]	TR	10 minutni	263 mm*	1.760 mm*		—		↑ ↓ 🛡️ ✕
<input type="radio"/>	2 ZAGREB - MAKSIMIR - MM [1048]	AMP [1] (AMP-CMP)	Količina oborine u 10 min RT NRT (količina oborine) [909]	TR	10 minutni	0 mm	35 mm		—		↑ ↓ 🛡️ ✕
<input type="radio"/>	3 KRAPINA - MM [1169]	AMP [1] (AMP-CMP)	Količina oborine u 10 min RT NRT (količina oborine) [909]	TR	10 minutni	0 mm	35 mm		—		↑ ↓ 🛡️ ✕

Goals

Testing the new Quality Control Module

Validating the accuracy and reliability of observations from the new automated network

Focus on precipitation data quality

Data & methods

New automatic (METMONIC) weather stations data compared with **older** automatic systems

Manual conventional measurements used as benchmark

Precipitation data (2025)

9 selected meteorological stations ; all 3 measurement systems operational during study period

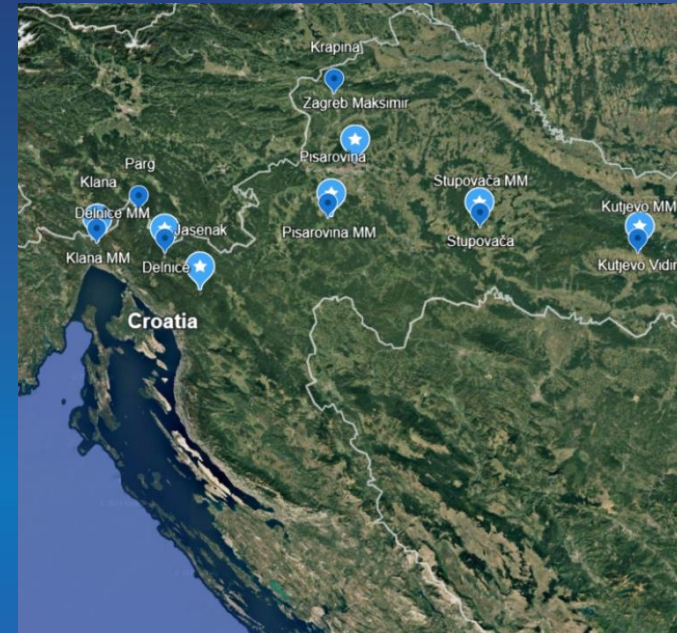


Sensor Deployment & Location

Conventional & Old Automatic Systems: Fully co-located at every station;

METMONIC (New System) Configuration:

- 3 stations: New sensors share the same location with manual and old automatic systems;
- 4 stations: New sensors are located with an average offset of ~ 300 m from the benchmark site;
- 2 stations: New sensors are approximately 1 km away from the benchmark site.



Results

General Performance and Systematic Trends

- **Strong correlation** between manual and automatic systems: correlation coefficients are very high — mostly above 0.90;
- **High temporal consistency:**
Both automatic systems (old and new) reliable at detecting precipitation.

Station	R ²	
	Old	New
Delnice	0.9947	0.9771
Jasenak	0.9751	0.9773
Klana	0.9835	0.9814
Pisarovina	0.9745	0.9195
Stupovaca	0.9898	0.7812
Parg	0.9898	0.9989
Zagreb - Maksimir	0.9959	0.9785
Krapina	0.9800	0.9985
Kutjevo	0.9781	0.8369

Results

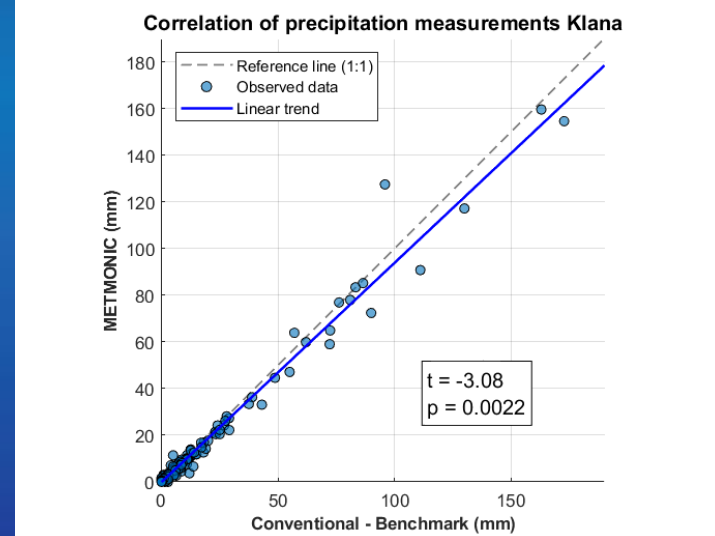
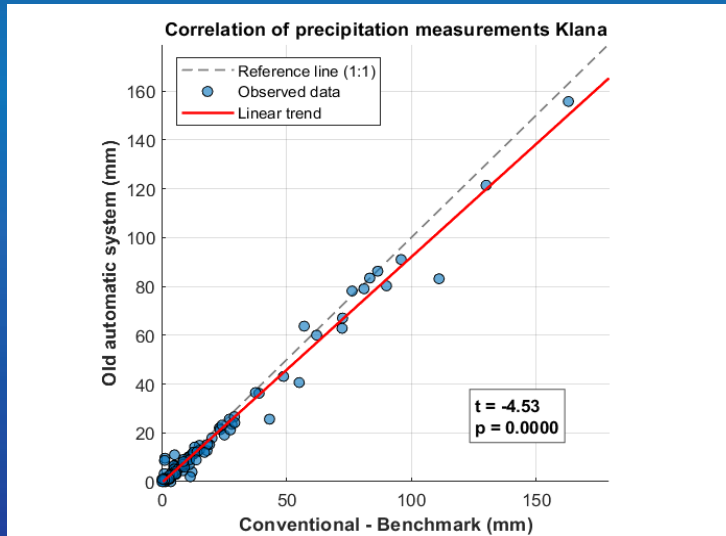
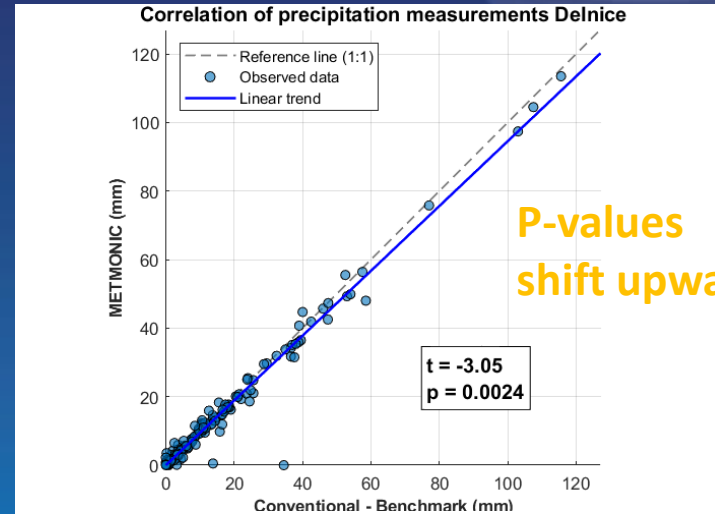
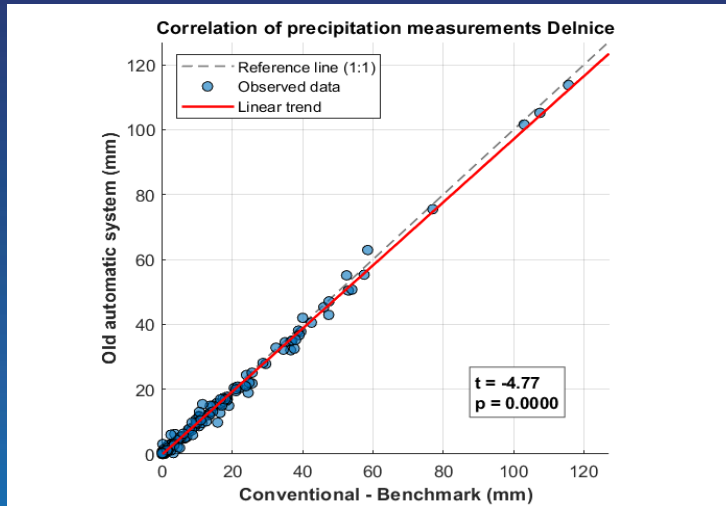
General Performance and Systematic Trends

- **Systematic Bias:** Despite high R^2 , t-test shows statistically significant differences ($p < 0.05$) at the majority of locations;
- Automatic sensors tend to systematically underestimate total precipitation amounts compared to manual measurements.
- Comparison of p-values suggests that new stations generally show **better alignment** with manual benchmarks than old automatic;

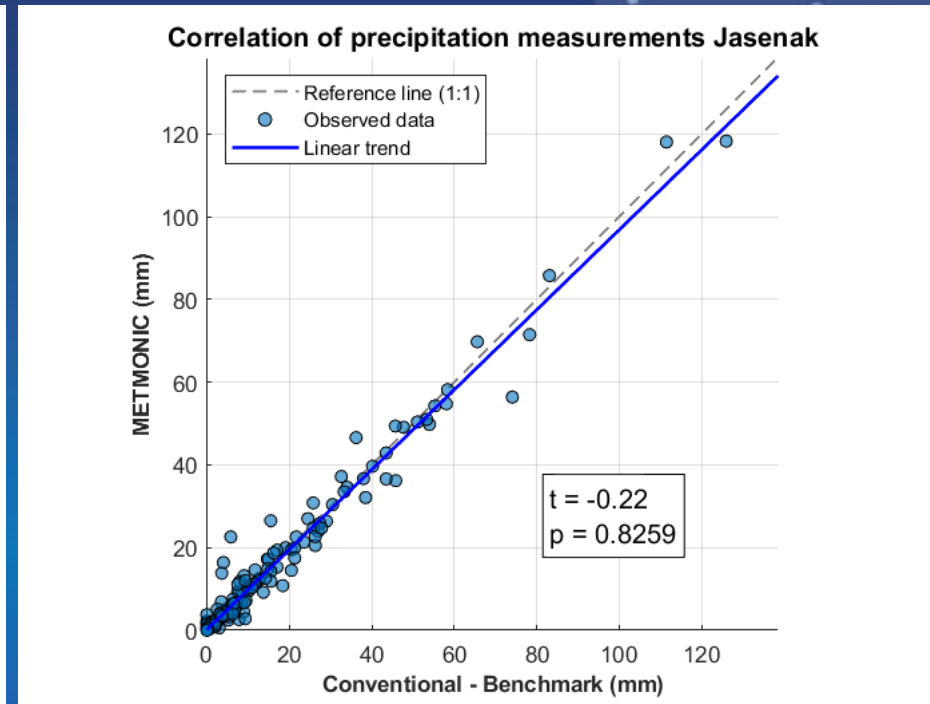
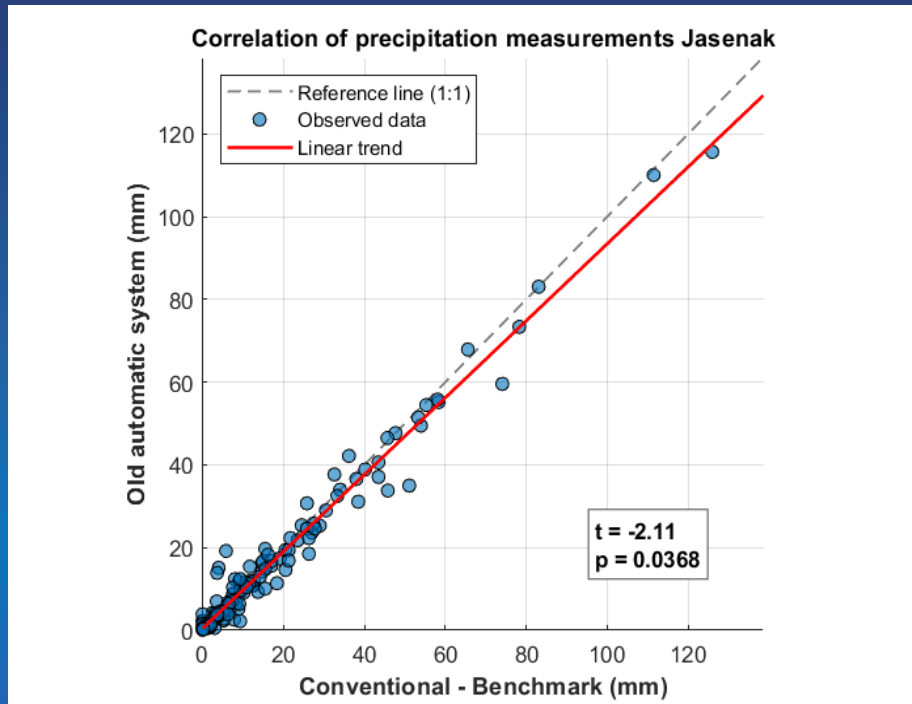
Station	Old		New	
	t	p	t	p
Delnice	-4.77	0.0000	-3.05	0.0024
Jasenak	-2.11	0.0368	-0.22	0.8259
Klana	-4.53	0.0000	-3.08	0.0022
Pisarovina	-4	0.0001	-3.04	0.0025
Stupovaca	-3.88	0.0001	2.01	0.0456
Parg	-1.08	0.2818	-8.03	0.0000
Zagreb -				
Maksimir	4.91	0.0000	-5.3	0.0000
Krapina	4.08	0.0001	-6.17	0.0000
Kutjevo	-4.34	0.0000	-2.27	0.0240

*T-test: old automatic vs. manual
new automatic vs. manual

Old System vs. METMONIC



Old System vs. METMONIC



- Significant improvement over the old system's performance at the same site

Conclusions

Both automatic systems highly reliable at detecting precipitation ($R^2 > 0.90$);

The transition to METMONIC stations → measurable reduction of systematic bias;

Most stations still slightly underestimate the precipitation amounts – calibration could further improve the data;

The case of the Jasenak station proves that with proper maintenance and technology, automatic stations can eventually be a proper replacement for manual observations.

Thank you for your
attention