



# RECENT DEVELOPMENTS IN COSMIC RAY SOIL MOISTURE OBSERVING SYSTEM IN SLOVENIA

Rozalija Cvejić<sup>1</sup>, Martina Bavec<sup>2</sup>, Matjaž Glavan<sup>1</sup>, Nejc Golob<sup>1</sup>, Marija Klopčič<sup>1</sup>, Tamara Korošec<sup>3</sup>, Matjaž Mikoš<sup>1</sup>, Boštjan Naglič<sup>4</sup>, Matic Noč<sup>1</sup>, Urša Pečan<sup>1</sup>, Tatjana Pirman<sup>1</sup>, Maja Podgornik<sup>5</sup>, Denis Rusjan<sup>1</sup>, Špela Srdoč<sup>5</sup>, Denis Stajnkó<sup>2</sup>, Žiga Švegelj<sup>6</sup>, Vesna Zupanc<sup>1</sup>

rozalija.cvejic@bf.uni-lj.si

<sup>1</sup>University of Ljubljana, Ljubljana, Slovenia (SI), <sup>2</sup>University of Maribor, Faculty of Agriculture and Life Sciences, Maribor, SI;

<sup>3</sup>Chamber of Agriculture and Forestry of Slovenia, Institute of Agriculture and Forestry Maribor, Maribor, SI;

<sup>4</sup>The Slovenian institute of hop research and brewing, Žalec, SI; <sup>5</sup>Institute for oliveculture, Science and Research Centre Koper, Koper, SI; <sup>6</sup>Atmosferix Ltd., Ljubljana, SI

## SI-COSMOS

Slovenian Cosmic Ray Soil Moisture Observing System

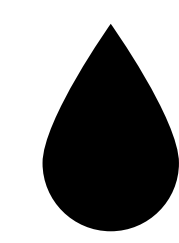


## BACKGROUND & RATIONALE



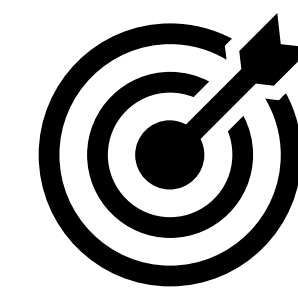
Reliable soil moisture observations are pivotal for informing **sustainable agricultural decisions** under an ongoing changing climate.

In this context cosmic ray neutron sensors (CRNS) are increasingly being used as a **non-invasive, intermediate to large-scale** soil-moisture option for continuous soil moisture sensing.



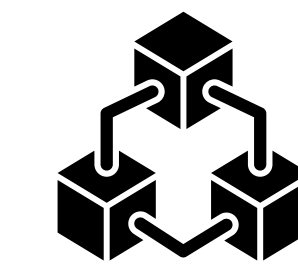
A cosmic-ray soil moisture observing system network was established for the period **2025-2040** to enhance soil moisture monitoring in Slovenia (**SI-COSMOS**).

## AIM



**At the national scale**, the vision of SI-COSMOS is to support investigating soil–water plant–atmosphere interactions under diverse climate, land-use, and soil conditions.

The network aims to support improved drought **detection and management**, as well as hydrological modelling and applications.



**Products** based on SI-COSMOS will support development of transferable real-time land management tools for enhanced water resilience.

## ONGOING EXPERIMENTS



### Unaccounted biomass water equivalent

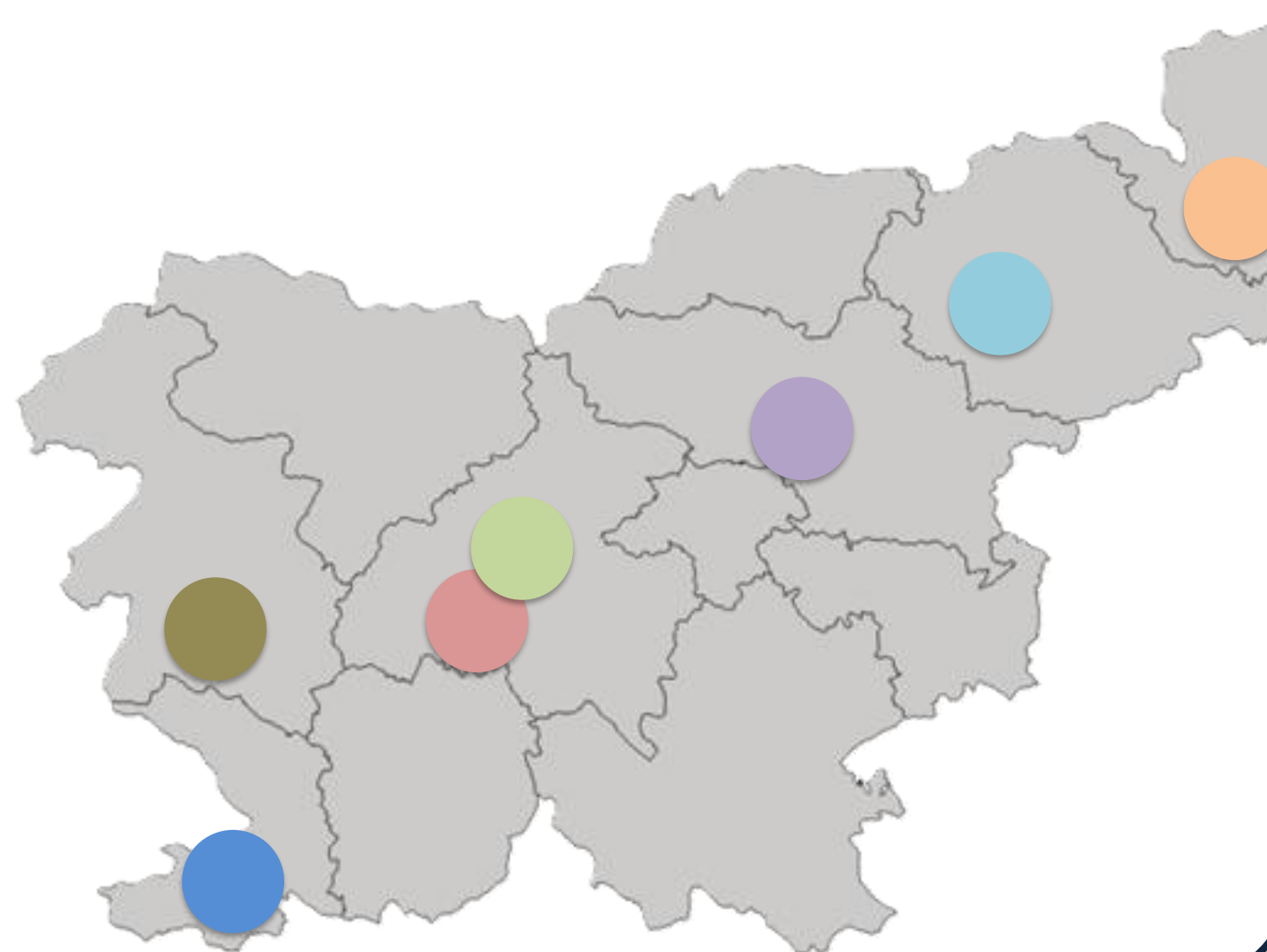
Ongoing research at Coastal-Karst region is focusing on exploring the relationship between vegetation water status and neutron moderation processes within the CRNS footprint by using **continuous non-destructive plant water potential** measurements in sub-mediterranean olive orchards, vineyards, and forests.



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## SI-COSMOS NETWORK

The network spans six statistical regions with 13 CRNS stations (10–500 m a.s.l.), using lithium fluoride and boron carbide sensors to measure soil moisture across diverse soil types under rainfed and irrigated conditions.

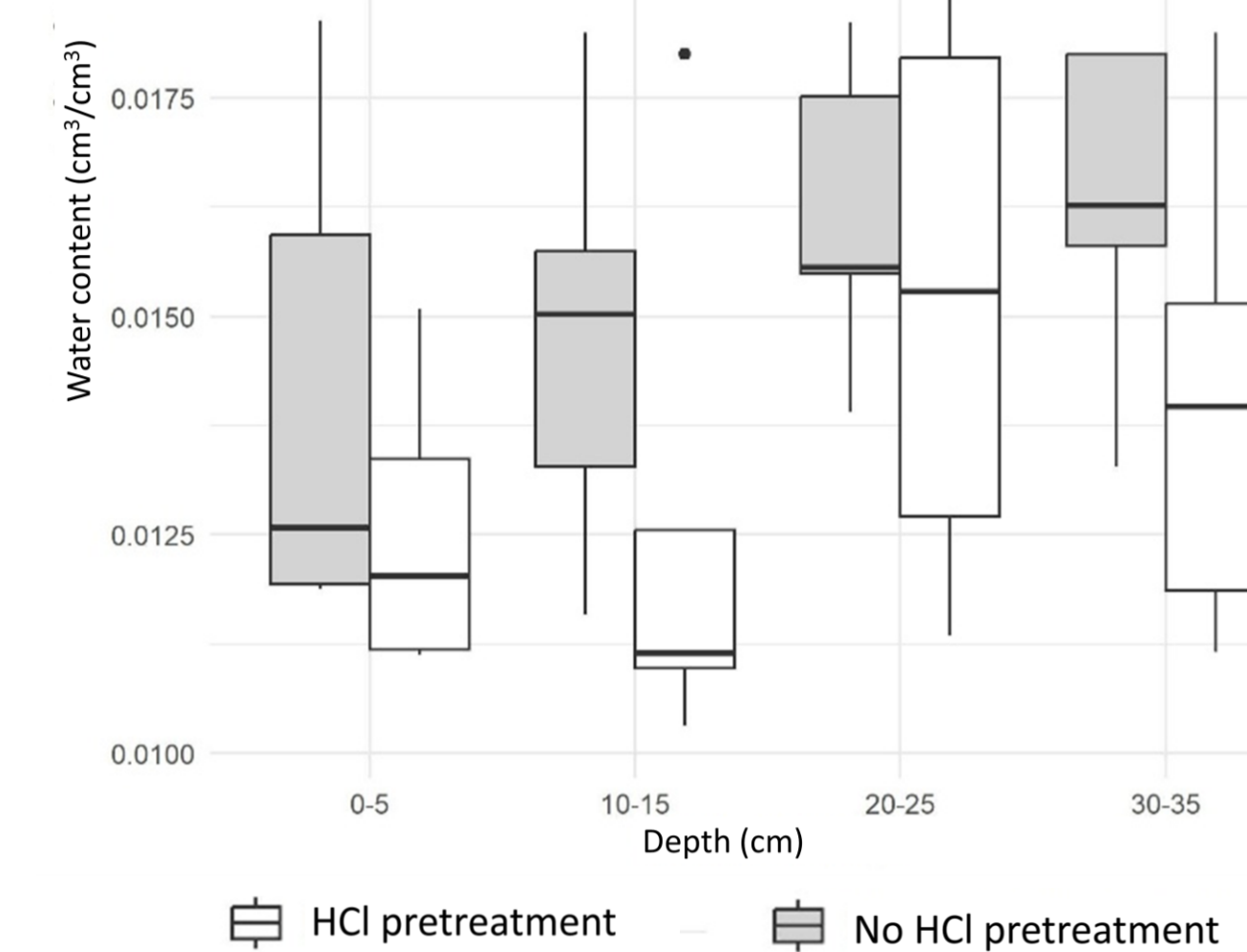


## FIRST RESULTS

### Lattice water determination

Golob et al., 2025  
DOI: doi.org/10.15292/geodetski-vestnik.2025.04.538-553

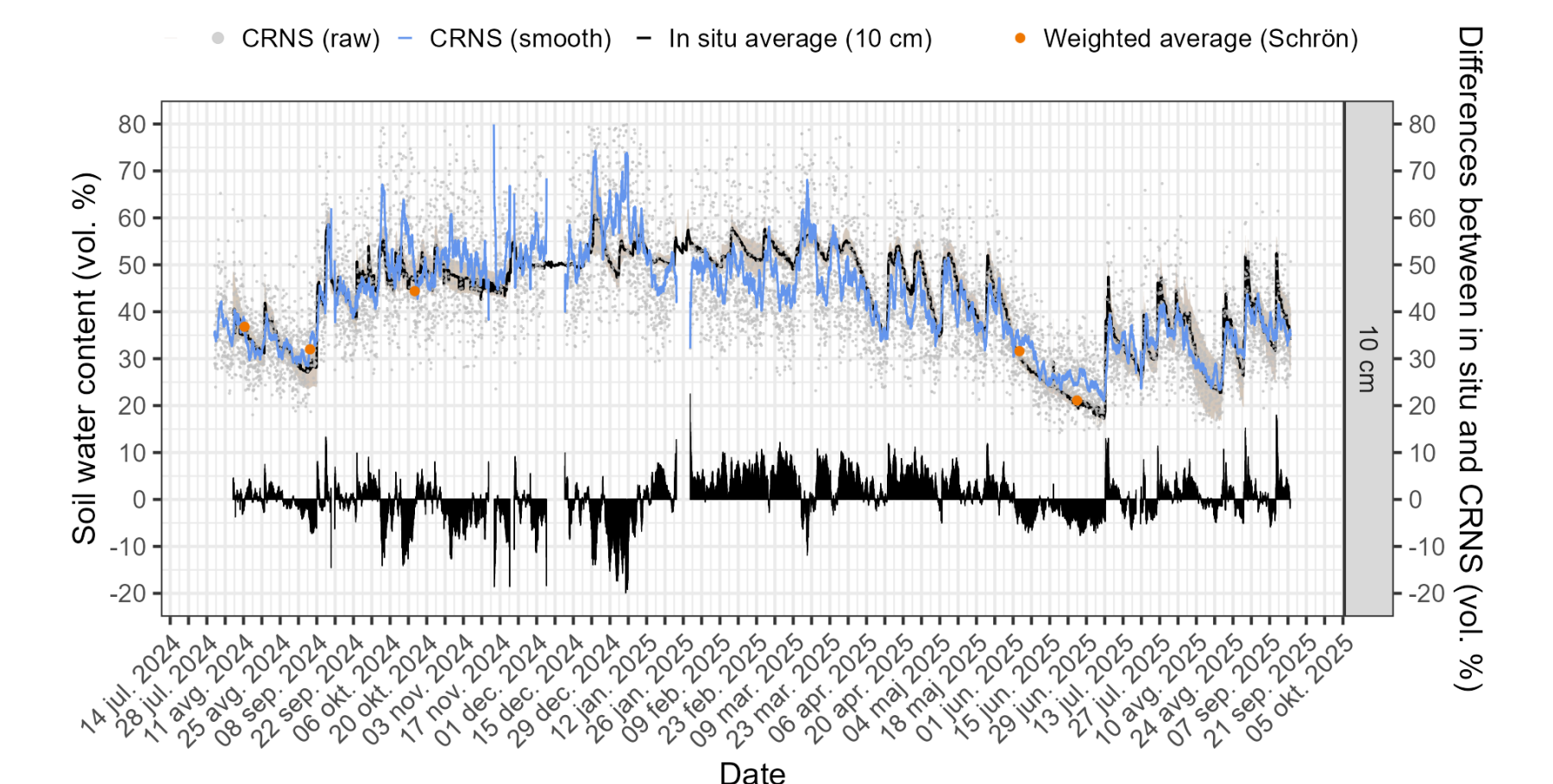
Soil samples that were **pretreated with HCl** demonstrated statistically significantly lower water values, allowing for a more precise estimation of lattice water in carbonate soils.



### Site calibration using muon measurements

underway

CRNS raw and smoothed **soil water content** compared with the 10-cm in situ mean ± SD and footprint-weighted gravimetric soil water content.



COASTAL-KARST  
olives, drip irrigation



GORIZIA  
forest



CENTRAL SLOVENIA  
pastures



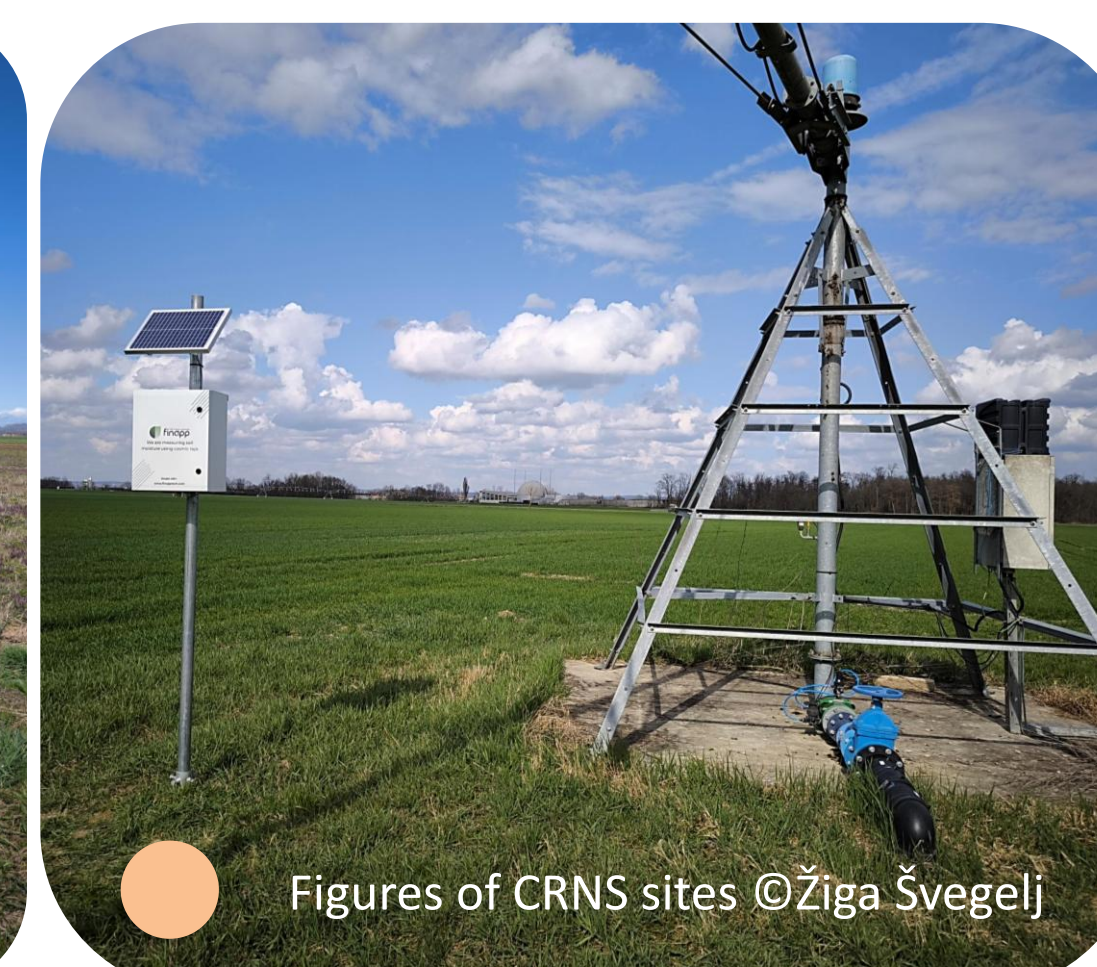
CENTRAL SLOVENIA  
mixed land-use



SAVA REGION  
hops drip irrigation



DRAVA REGION  
mixed land-use



MURA REGION  
Maize, pivot irrigation



## acknowledgments

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Slovenian Institute of Hop Research and Brewing

