EGU General Assembly 2025
Vienna, Austria & Online
27 April–2 May 2025

EGU25-4821 – Tuesday, April 29th, 16:40-16:50 – Room 2.44

HS8.3.5: Soil-Plant Interactions

Is there anything new about determining the root-zone water storage capacity over large areas?

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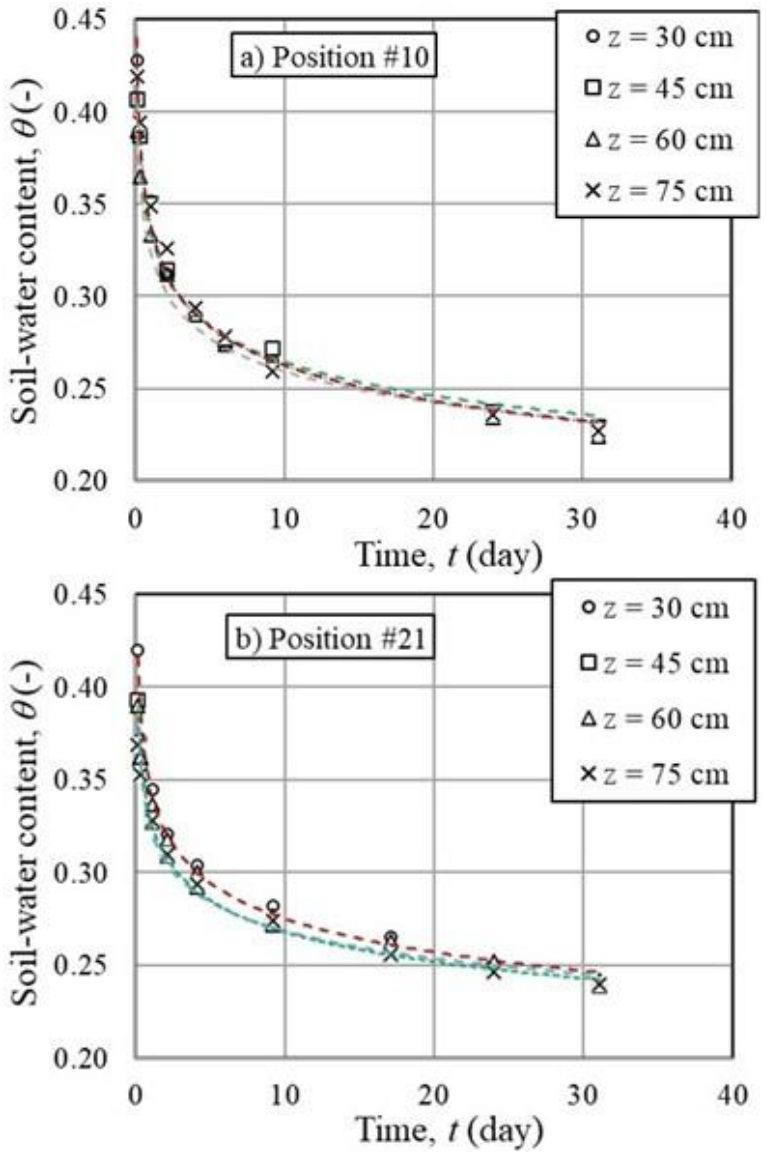
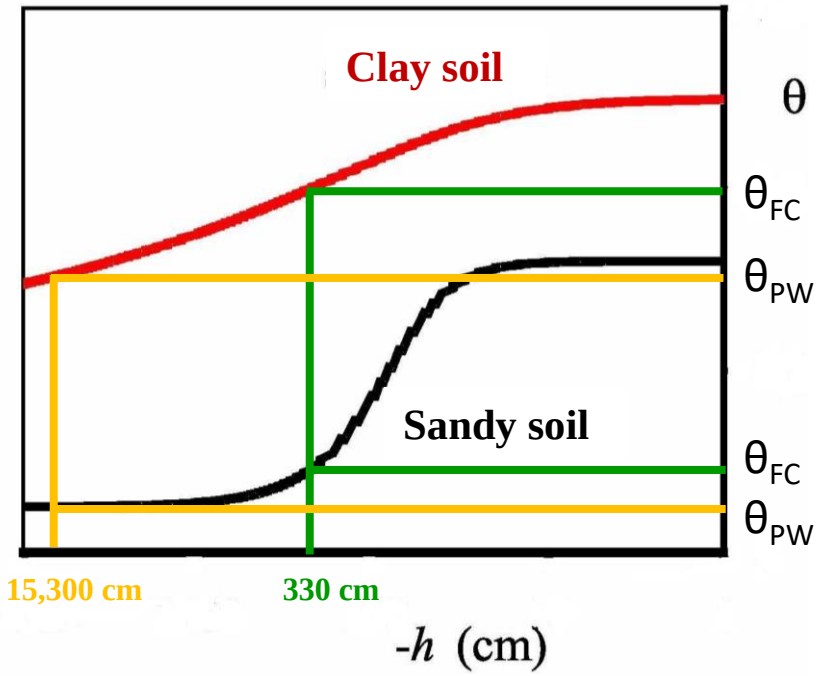
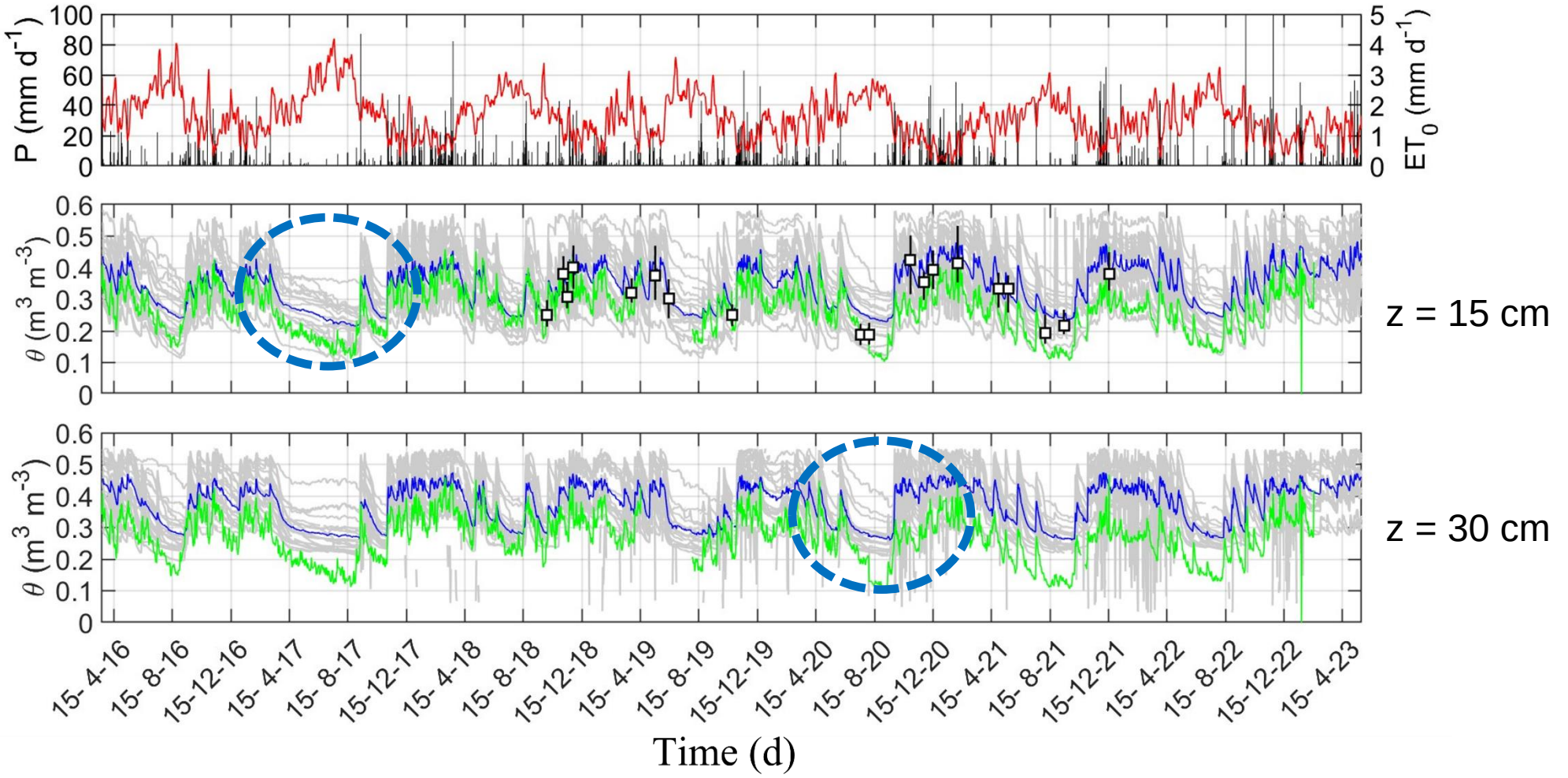
$$S_{\mathrm{R,AW}} = z_R \cdot \mathrm{AW} = z_R \cdot (\theta_{\mathrm{FC}} - \theta_{\mathrm{PW}})$$





FC ≈ θ(*h*=1/3 bar, i.e. 3.3 m_{H2O})

PW ≈ θ(*h*=15 bar, i.e. 150 m_{H2O})

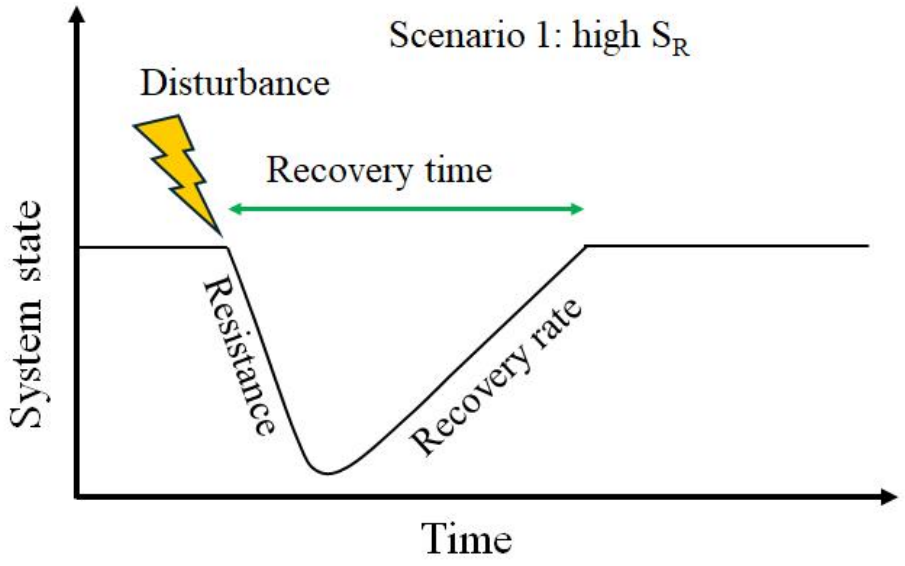


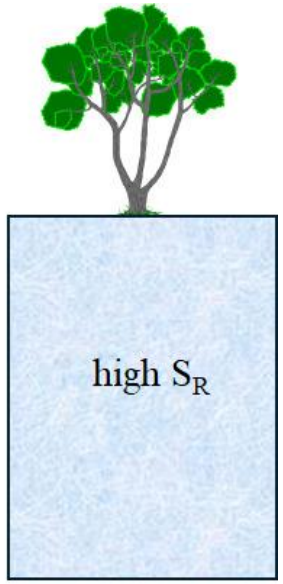
TDR measurements at 20 positions

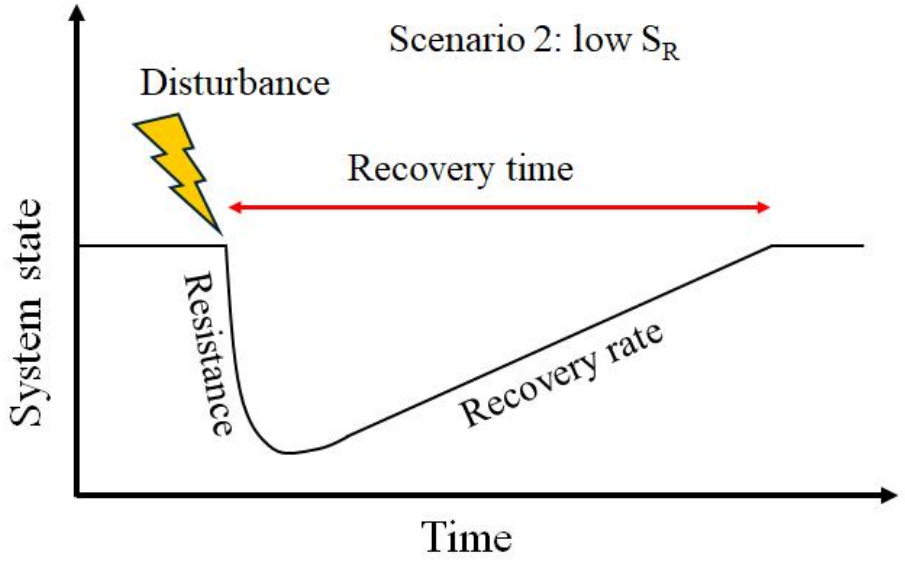
GS3 capacitance soil moisture measured at 20 positions

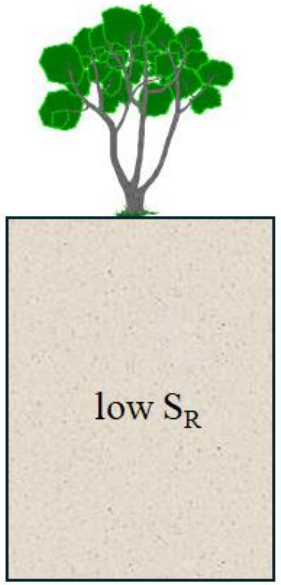
Spatial-averaged GS3 soil moisture

Areal soil moisture values determined by the cosmic-ray neutron probe

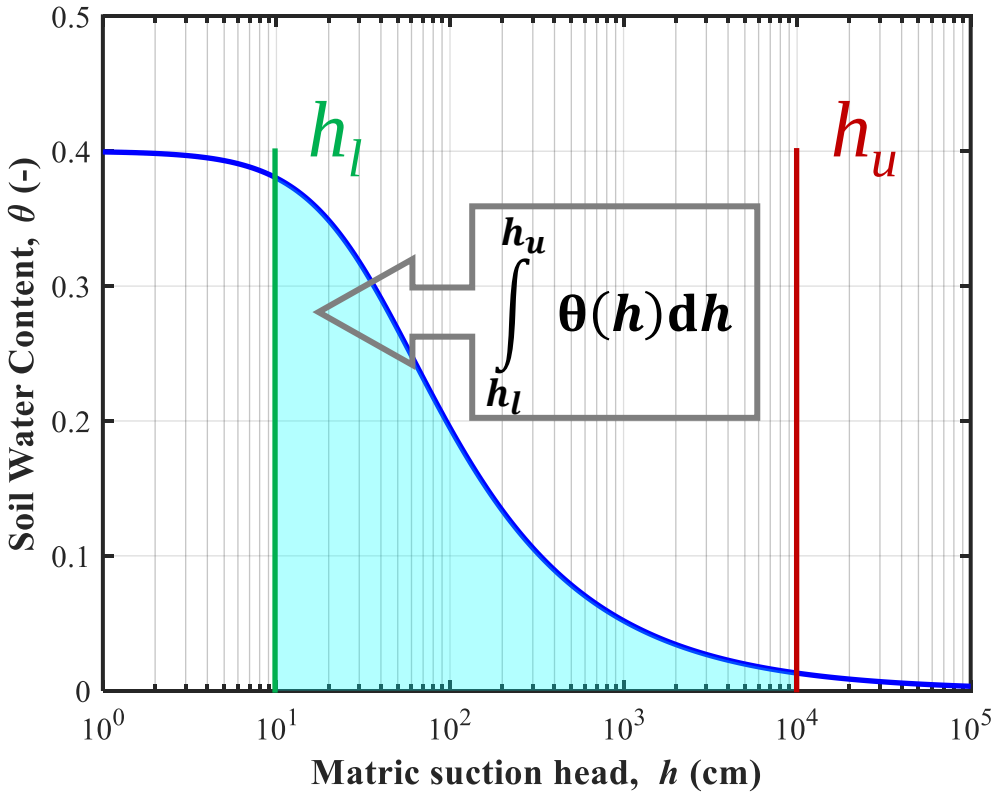




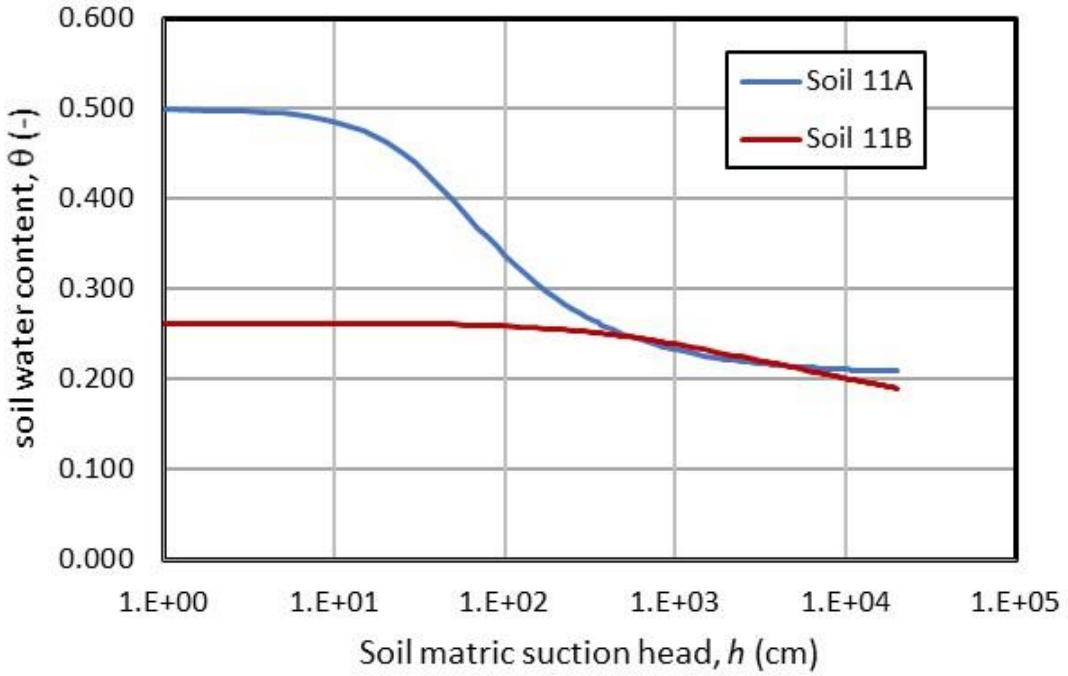


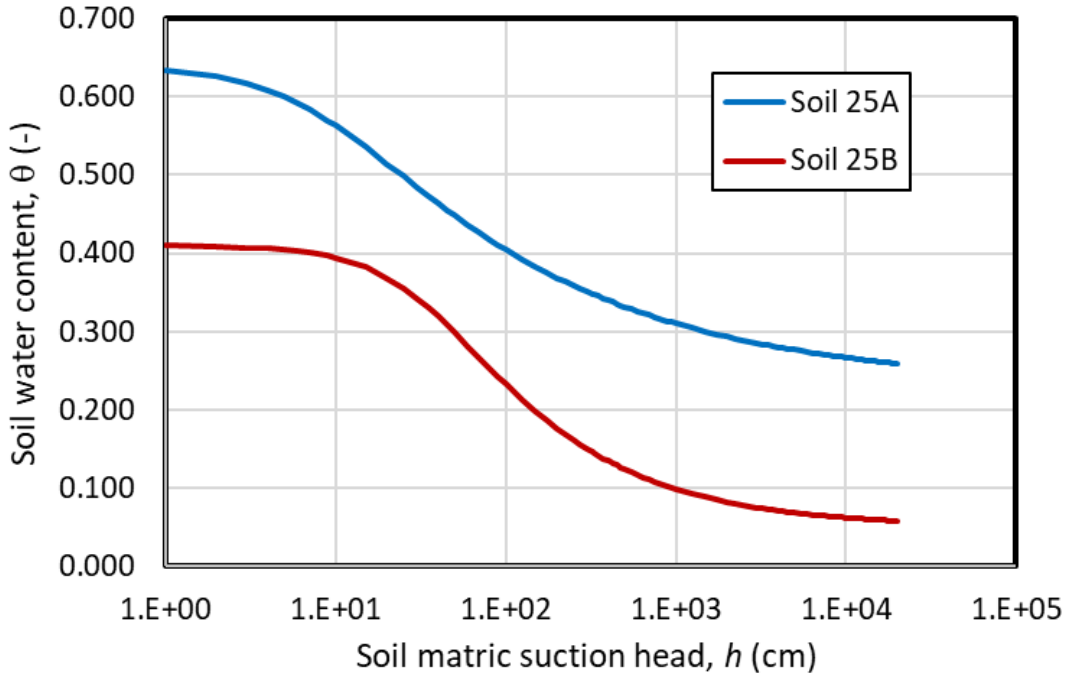


$$S_{\mathrm{R,IMWC}} = z_R \cdot \left\{ \frac{1}{(h_u - h_l)} \int_{h_l}^{h_u} \theta(h)\mathrm{d}h \right\}$$

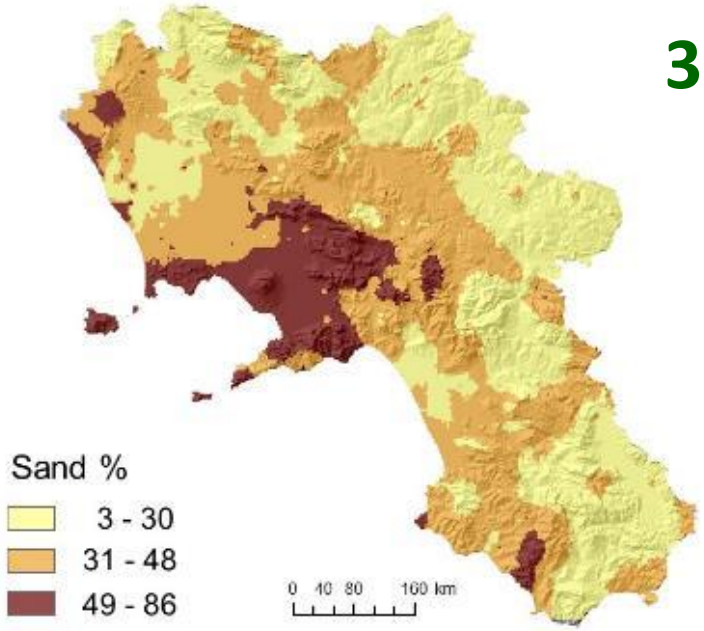


Soil		Soil texture	θ_s	θ_r	α (cm^{-1})	n	$\theta_{FC,333}$	θ_{PW}	AW_{333}	IMWC
11	A**	Clay (light)	0.499	0.205	0.02793	1.710	0.265	0.209	0.056	0.279
	B***	Sandy loam	0.262	0.000	0.00216	1.086	0.251	0.194	0.057	0.237
25	A++	Clay	0.640	0.230	0.1196	1.340	0.347	0.262	0.085	0.345
	B++	Loam	0.410	0.050	0.0275	1.600	0.144	0.060	0.085	0.154

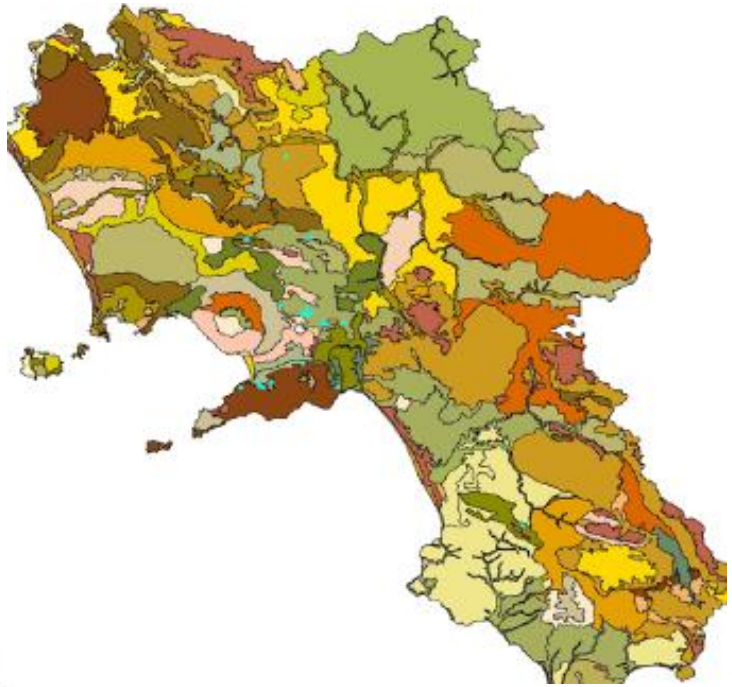


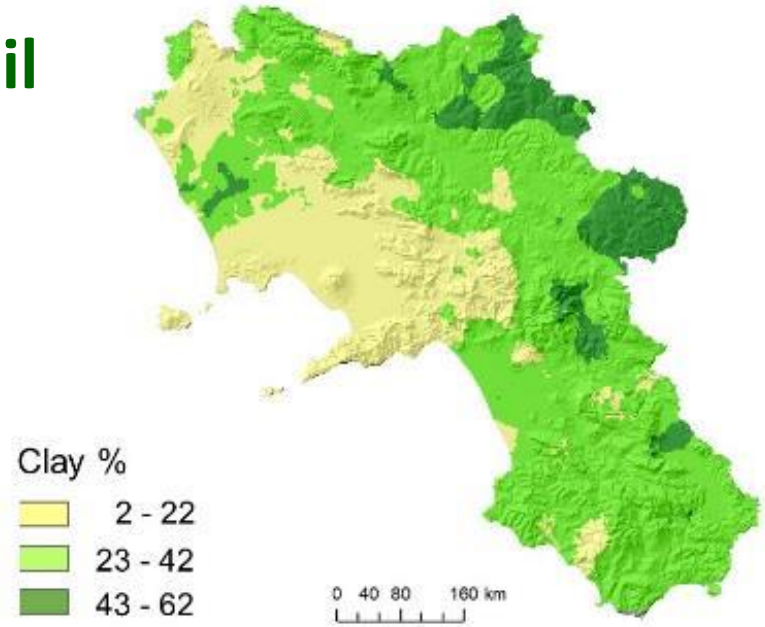


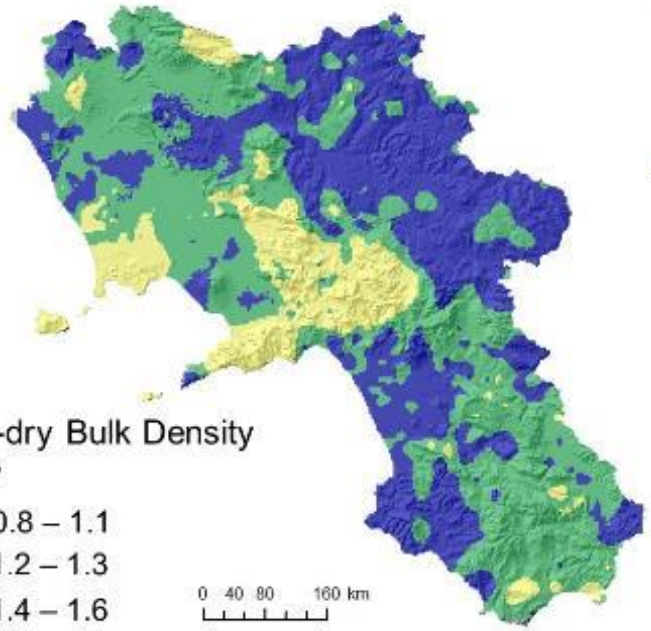
3˙321 intact cores from top-soil

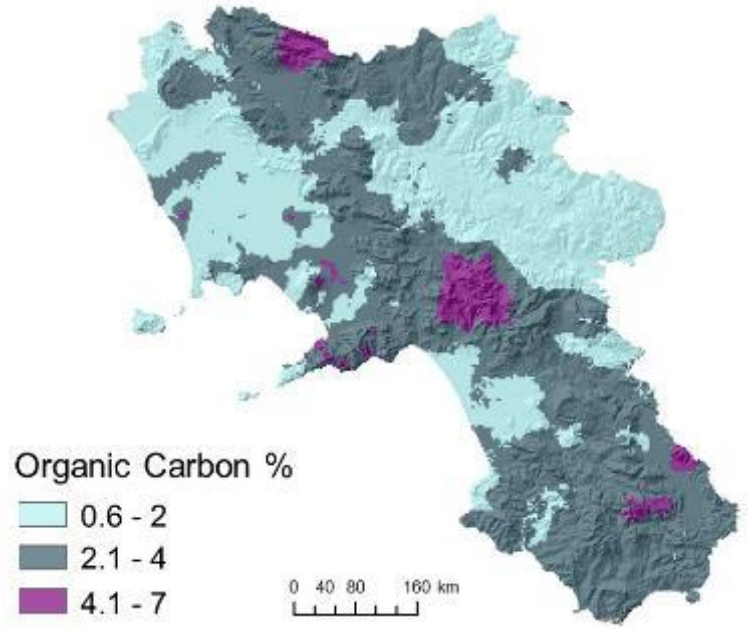


Land Systems map

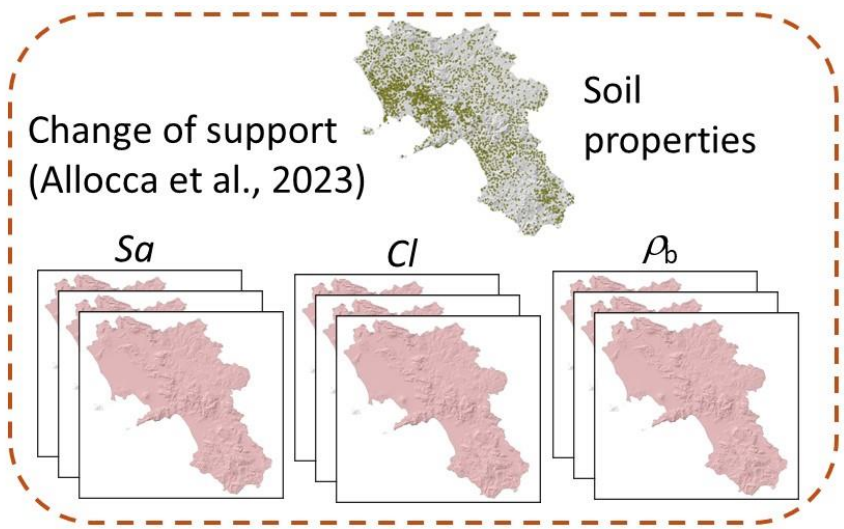


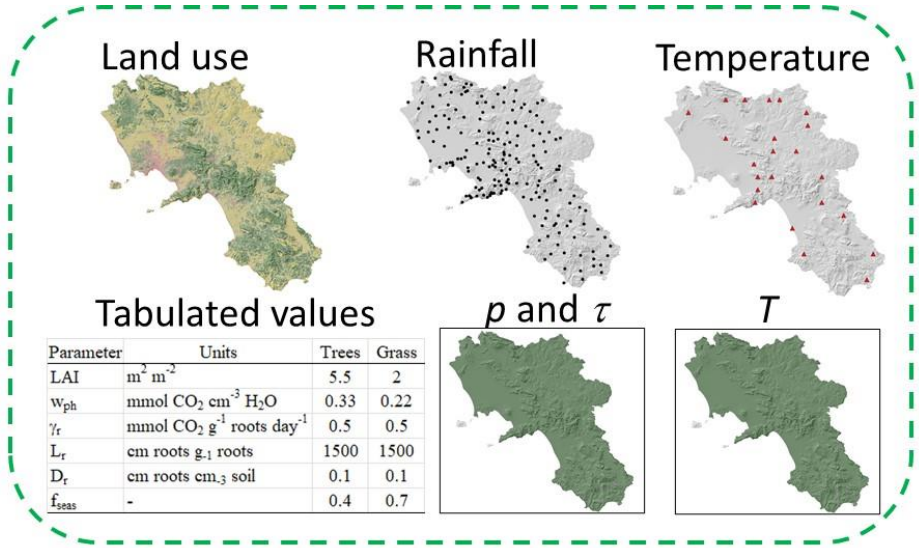






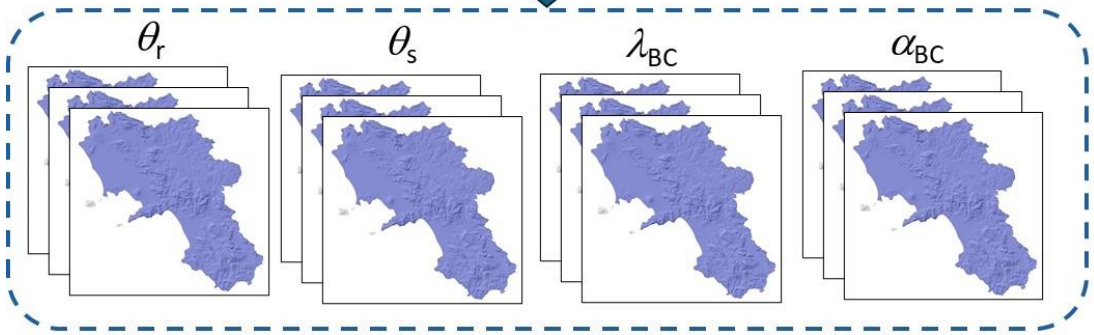
Proposed approach to estimate the maximum root-zone soil-water storage, $S_{R,IMWC}$, at large spatial scale



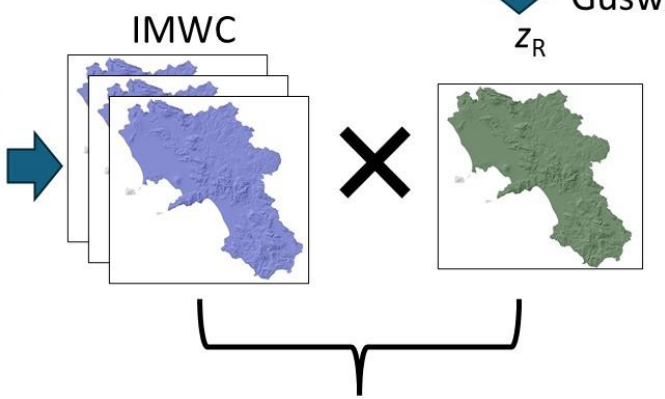


Parameter	Units	Trees	Grass
LAI	$m^2\ m^{-2}$	5.5	2
w_{ph}	mmol CO_2 cm^{-3} H_2O	0.33	0.22
γ_r	mmol CO_2 g^{-1} roots day^{-1}	0.5	0.5
L_r	cm roots g_{-1} roots	1500	1500
D_r	cm roots cm_{-3} soil	0.1	0.1
f_{seas}	-	0.4	0.7

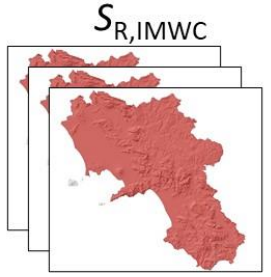
PTF -RB



Guswa (2008)



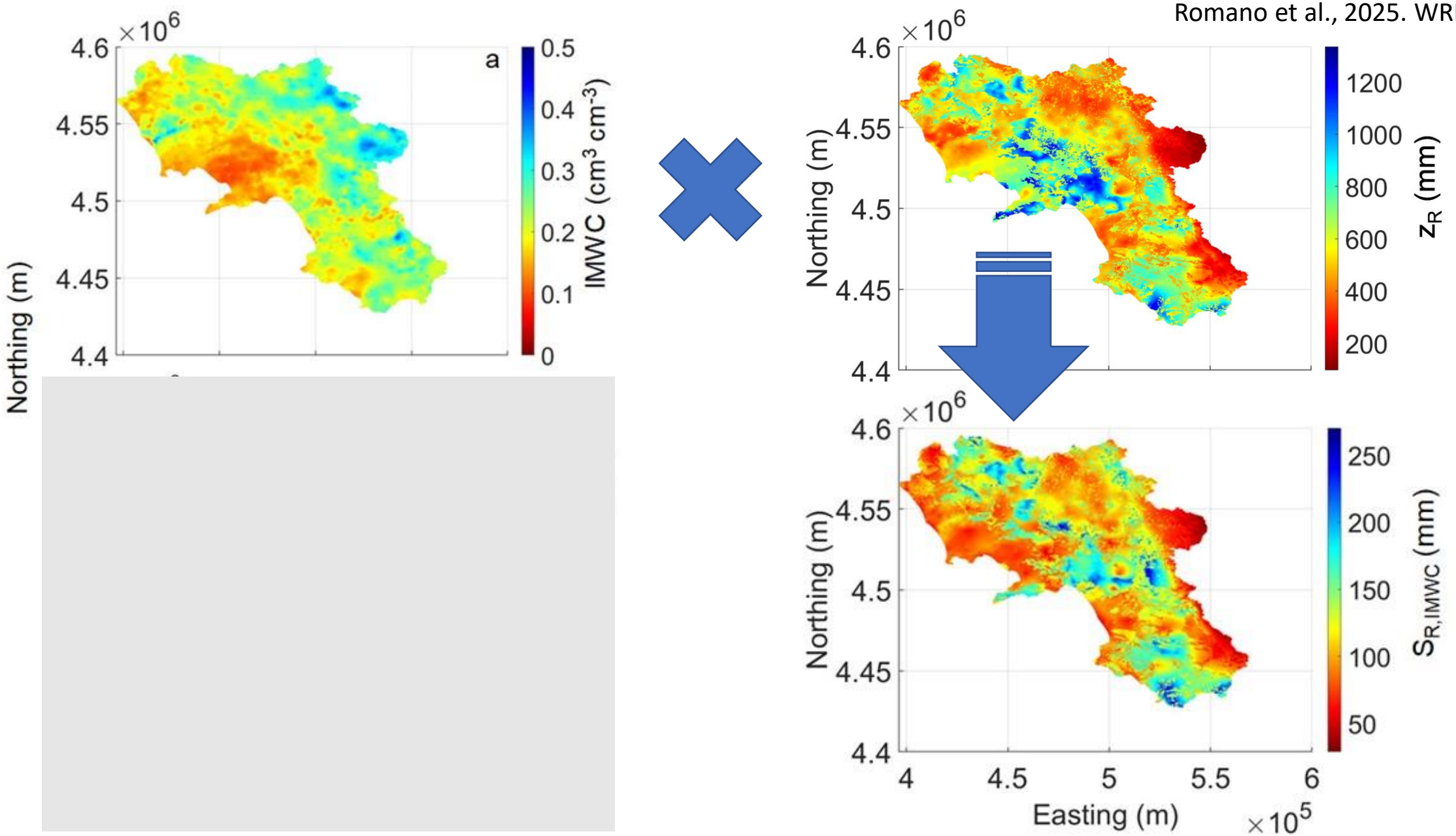
$$z_R \cdot \left[\frac{1}{(\xi_u - \xi_l)} \int_{\xi_l}^{\xi_u} \theta(\xi) \mathrm{d}\xi \right] = z_R \cdot \mathrm{IMWC}(\xi) = S_{R,IMWC}(\xi)$$



Romano et al., 2025. WRR vol. 61

Mapping $S_{R,IMWC}$ in the entire region of Campania

Romano et al., 2025. WRR vol. 61



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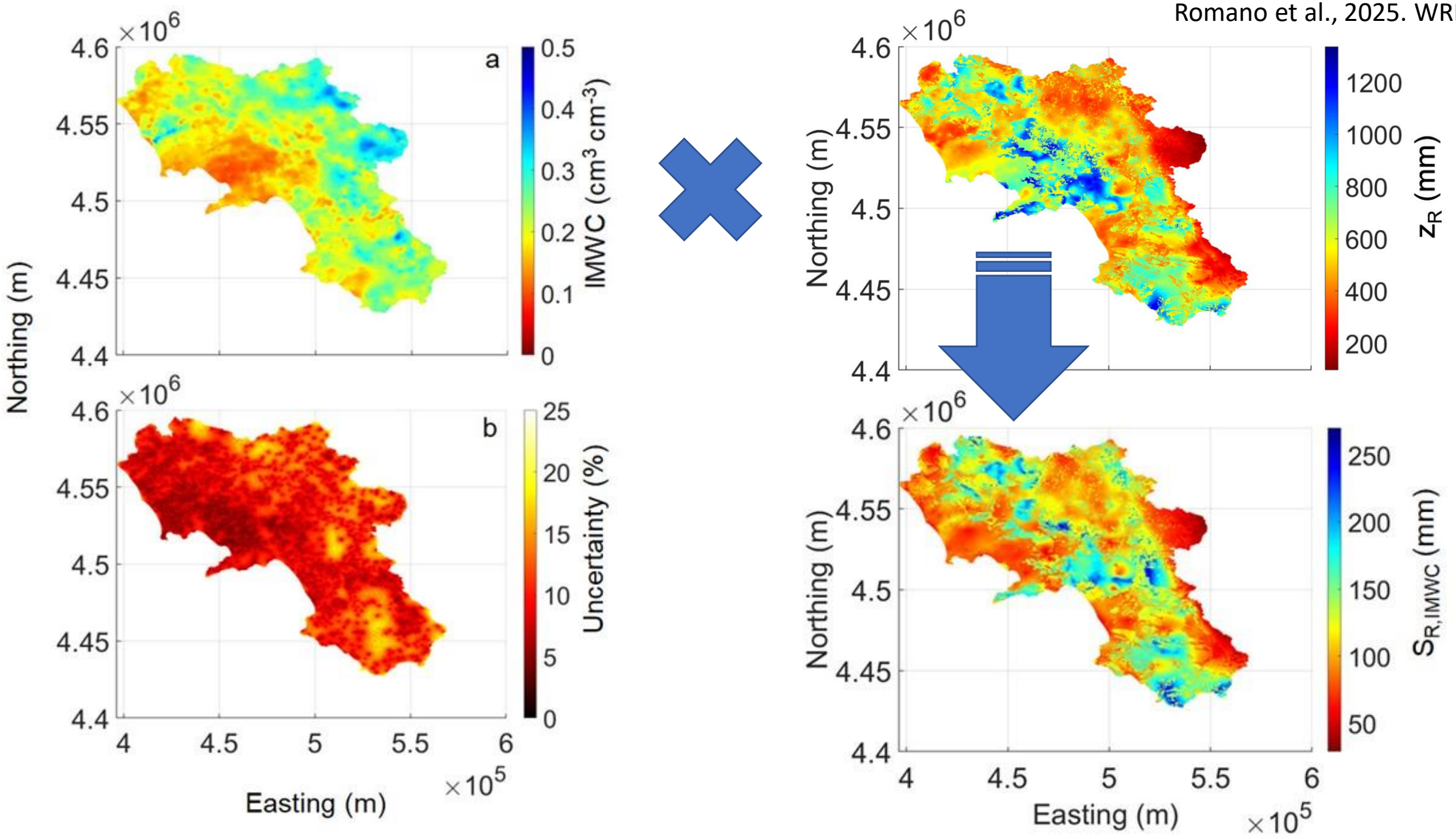

Criticisms to be considered …

- The concepts of FC and PW should not be criticized altogether. Unfortunately, these two parameters are still often determined using simplistic methods. **More importantly, root-zone soil-water storage (S_R) depends not solely on soil properties**.

Proposed method …

- A novel aspect of our study is that the maximum root-zone water storage ($\mathbf{S_{R,I}}$) is determined using information not only on soil type, but also on land-use and local climatic characteristics.
- Modeling the entire WRF better captures the influence of soil on FC.

Soil quality, resilience, and vulnerability …

- Together with other indicators, the proposed $\mathbf{S_{R,I}}$ is efficient in studies designed to assess the resilience of agro-ecosystems.