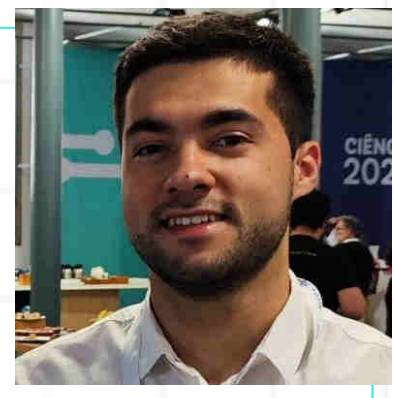


Olive grove area expansion under drying climate: a CMIP6–SWAT+ basin-scale water balance and demand assessment (Sado River Basin, Portugal)

From Knowledge to Competitiveness

Portugal-US Partnerships 2026 Summit

Portugal Program



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Goal

Estimate the basin's future water balance and olive irrigation demand under climate change (F1) and olive grove area expansion (F2) scenarios

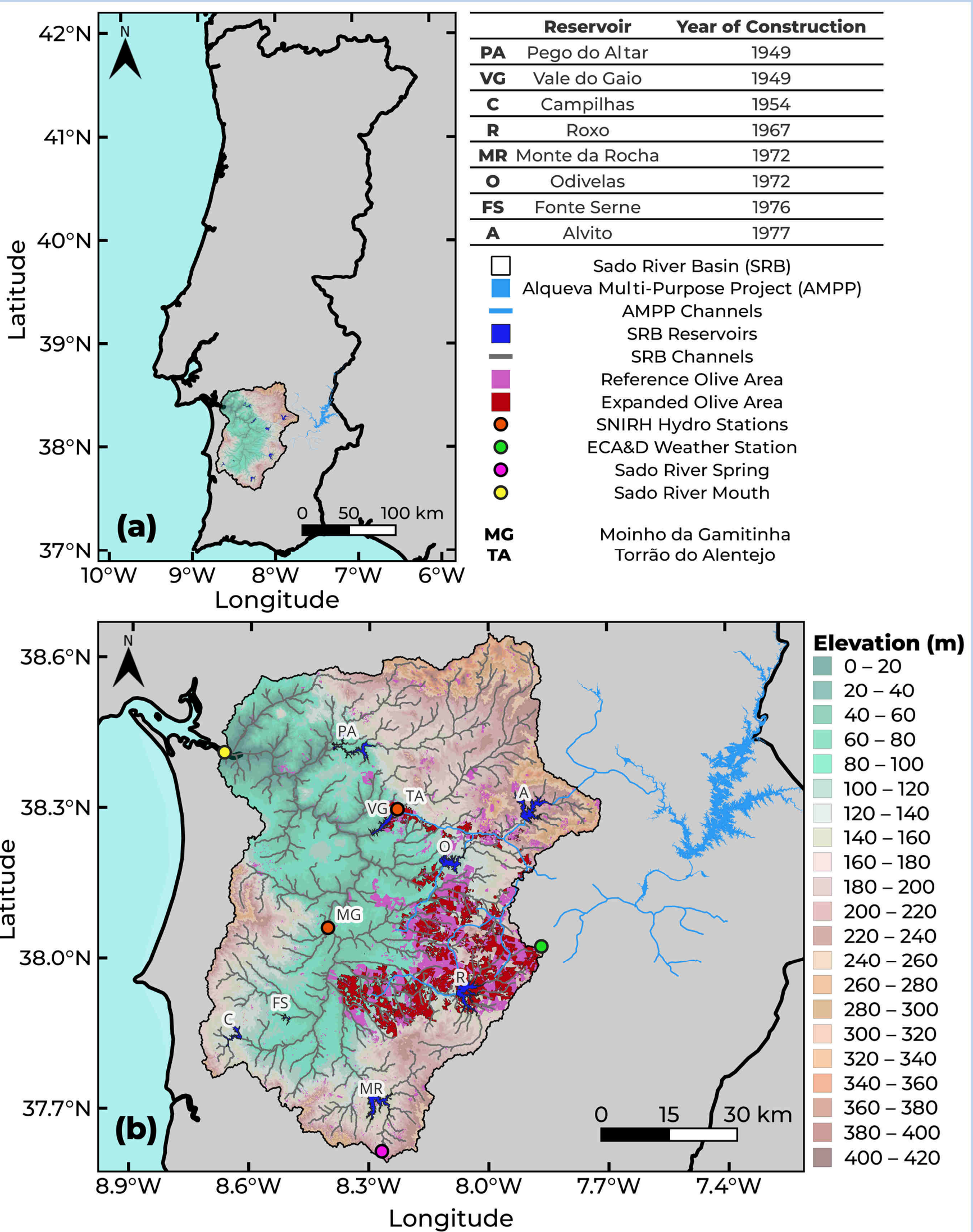


Figure. Location of the Sado River Basin (SRB) in Portugal (a). The SRB topography, water channels, and other key elements are presented in (b). The reference and expanded olive areas are also presented in (b).

F2 scenario considers a +106% olive area increase (+7% of SRB total area) under an SSP5-8.5 future climate

Motivation

- Iberian Peninsula produces 65% of the world's olive oil, and 90% of Portuguese olive production comes from southern regions.
- SRB olive production has continuously increased in the last 20 years (+2.5%/decade of the basin's total area).
- SRB crop water supply already affected by current climate aridification.
- U.S. is the world's largest olive oil importer.

under the Doctoral Grant PRT/BD/154652/2023

Climate Science + Climate Change

Conclusions

- Mid-century climate aridification could further increase olive water demand and decrease the basin's soil moisture, surface/ground flows, and aquifer recharge.
- Feasibility of SRB olive area expansion depends on the integration of reservoir operations and AMPP water allocation plans in SWAT+.
- U.S.-developed open science can help improve the climate resilience of Mediterranean olive production.

Results

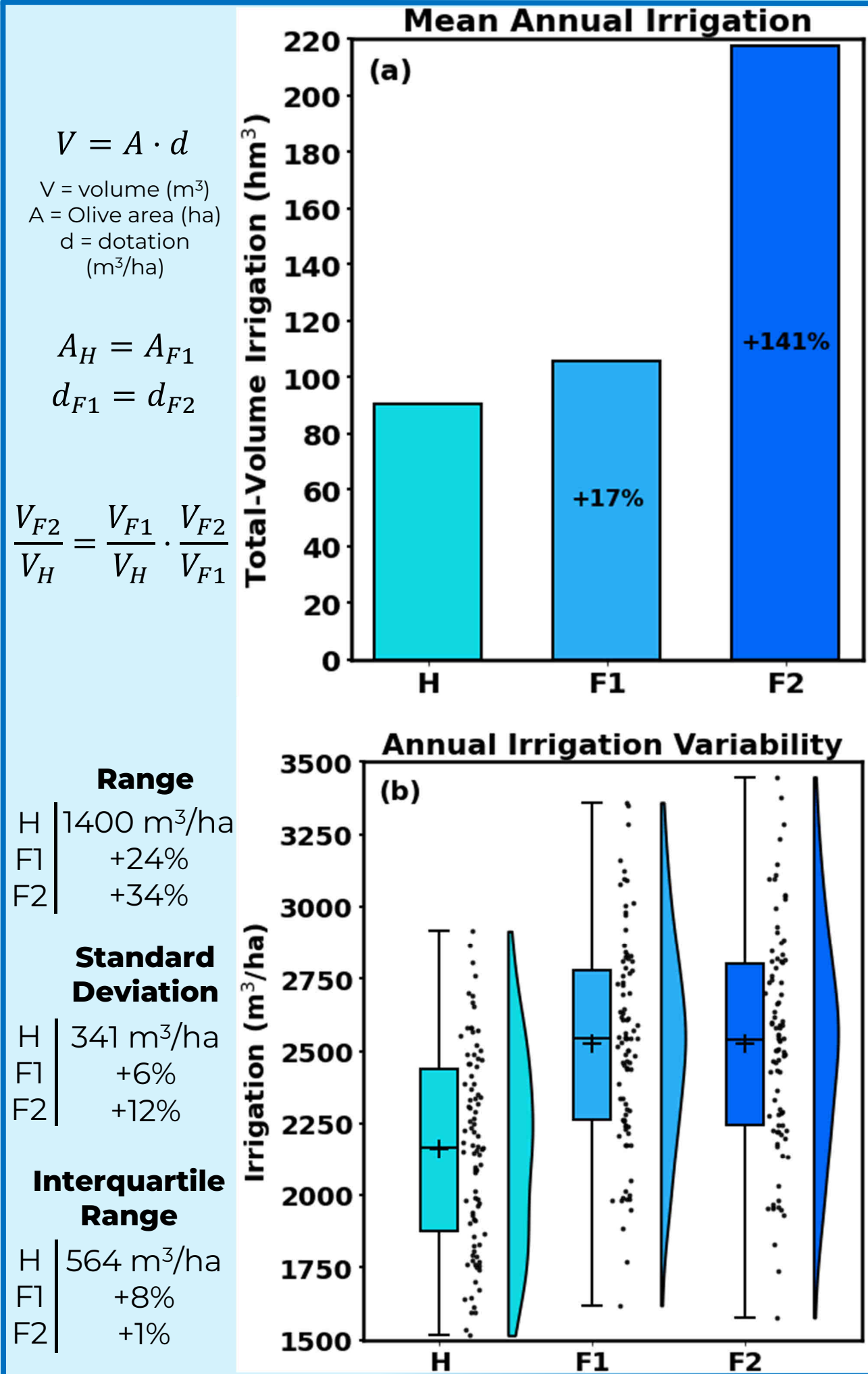
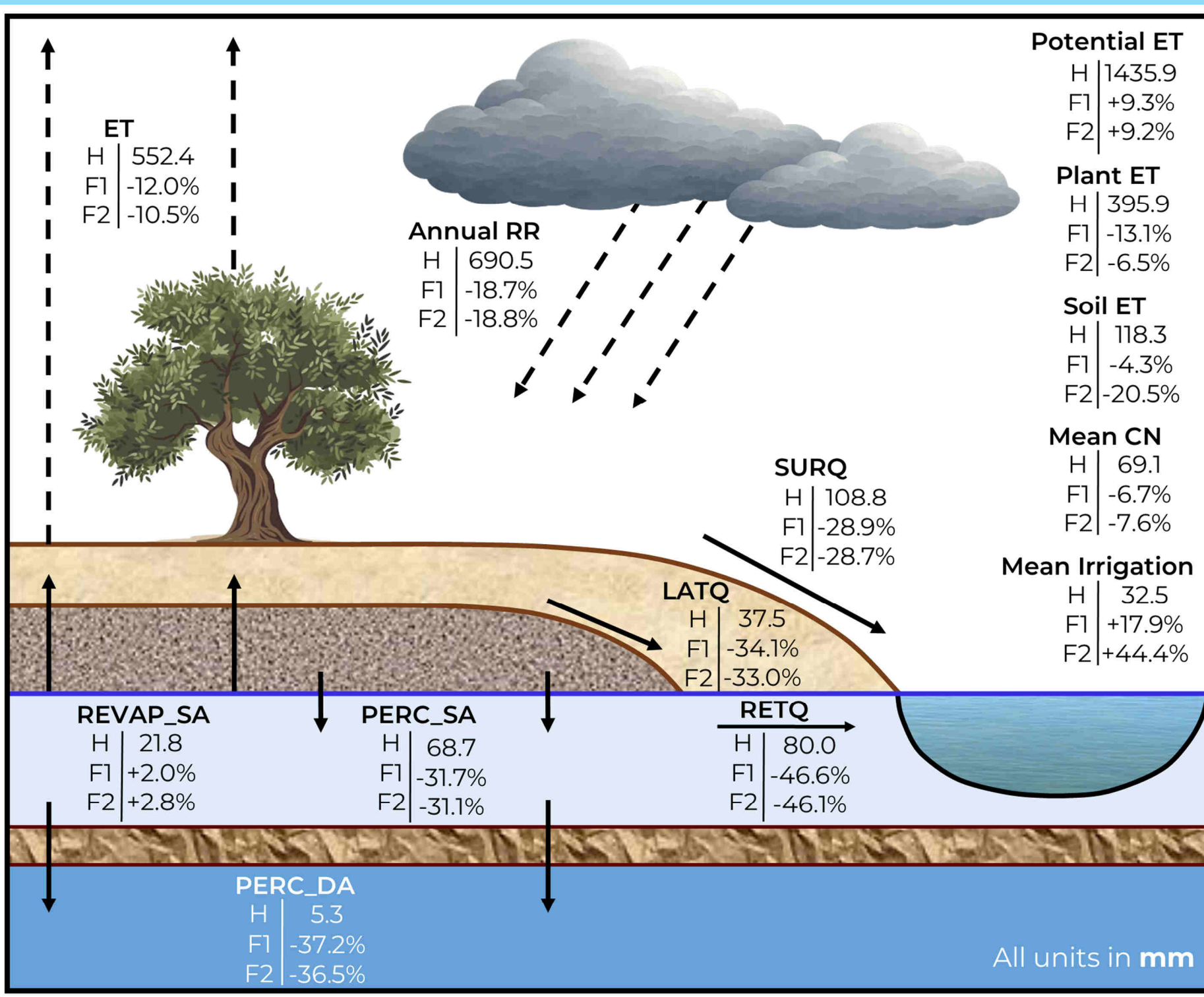


Figure. 30-year and GCM-ensemble mean SRB water balance (mm) under the combined 1981–2010 climate and reference olive grove area scenario (H), and its relative changes under the combined 2041–2070 climate and reference olive grove area scenario (F1), and the combined 2041–2070 climate and expanded olive grove area scenario (F2). 30-year GCM-ensemble mean water balance ratios are also presented (top right table).

Figure. Inter-GCM and inter-annual mean total-volume irrigation (a, hm³) and annual irrigation variability (b, m³/ha) of the SRB olive groves under the combined reference climate and olive grove area scenario (H), the combined 2041–2070 climate and reference olive grove area scenario (F1), and the combined 2041–2070 climate and expanded olive grove area scenario (F2). Black crosses indicate the mean value, and the percentage values indicate the relative changes.

Methodology

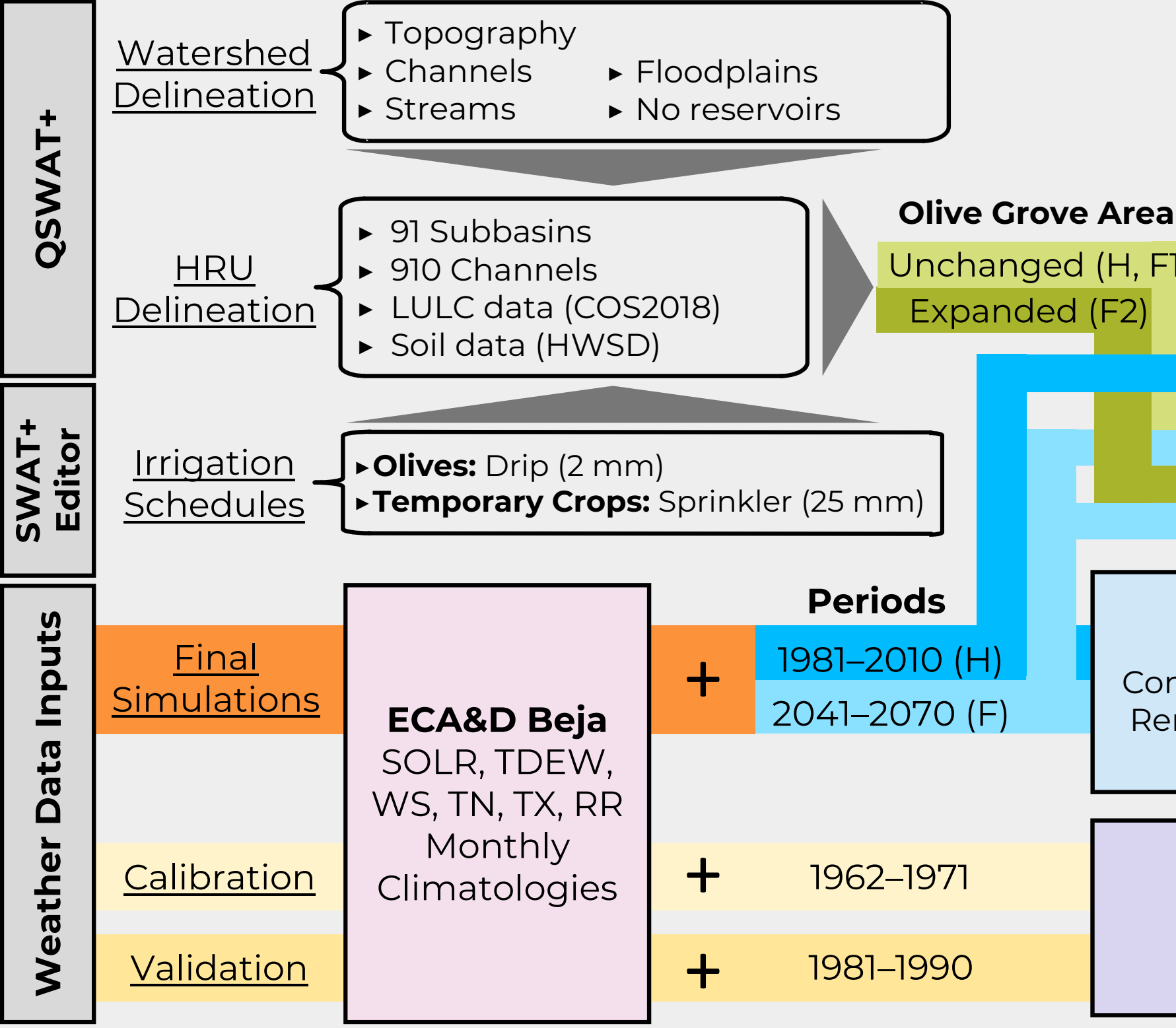
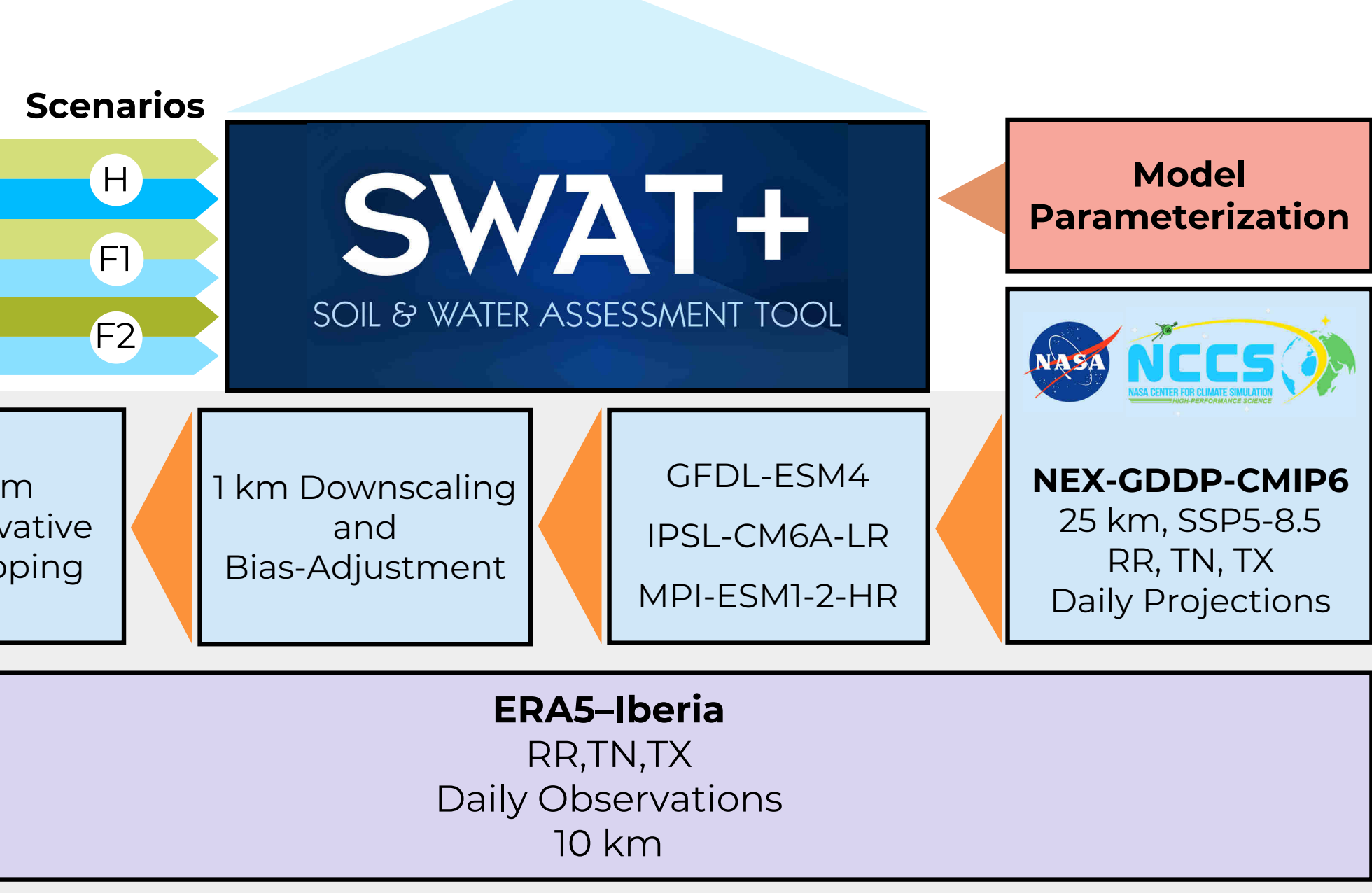
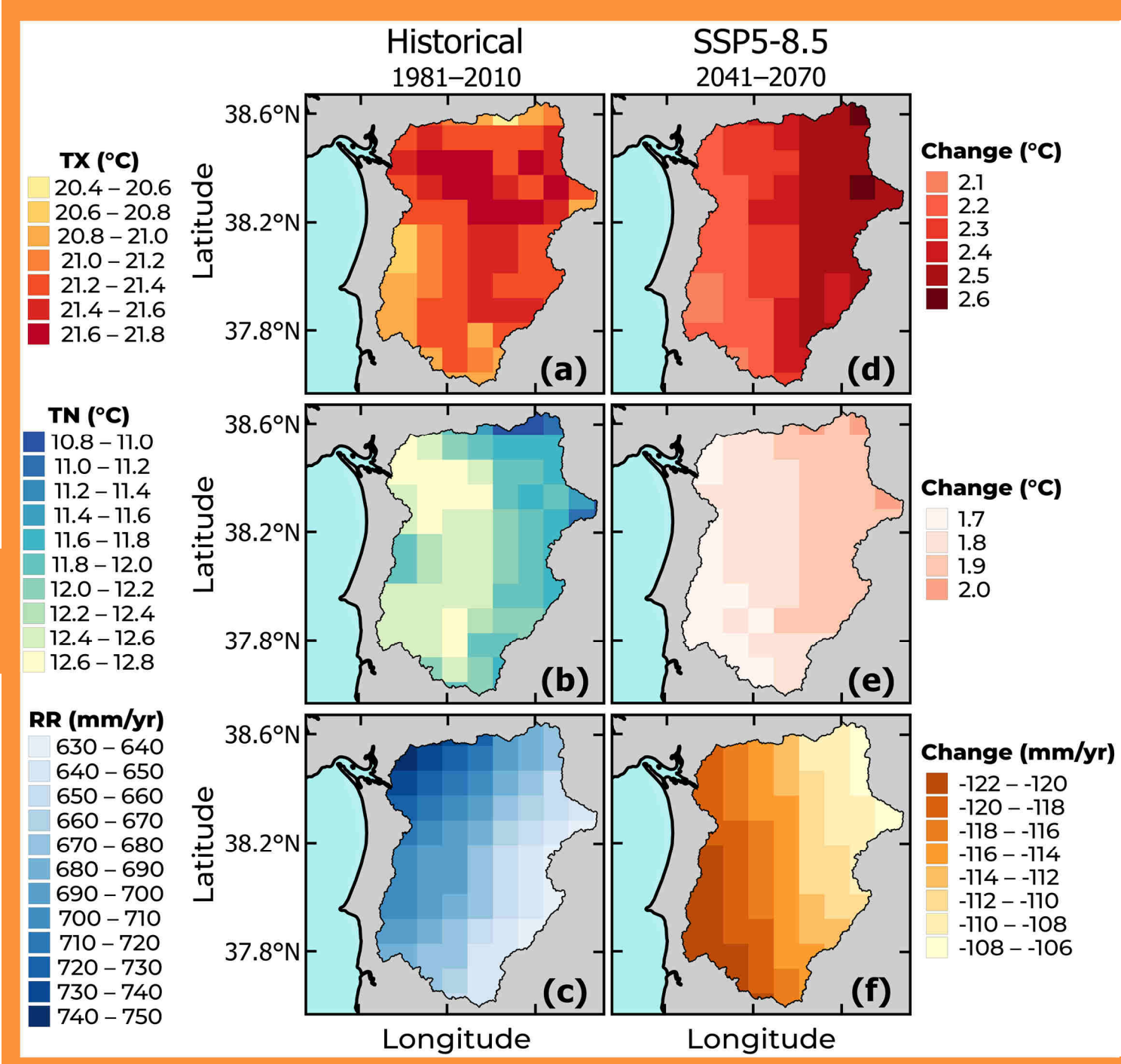
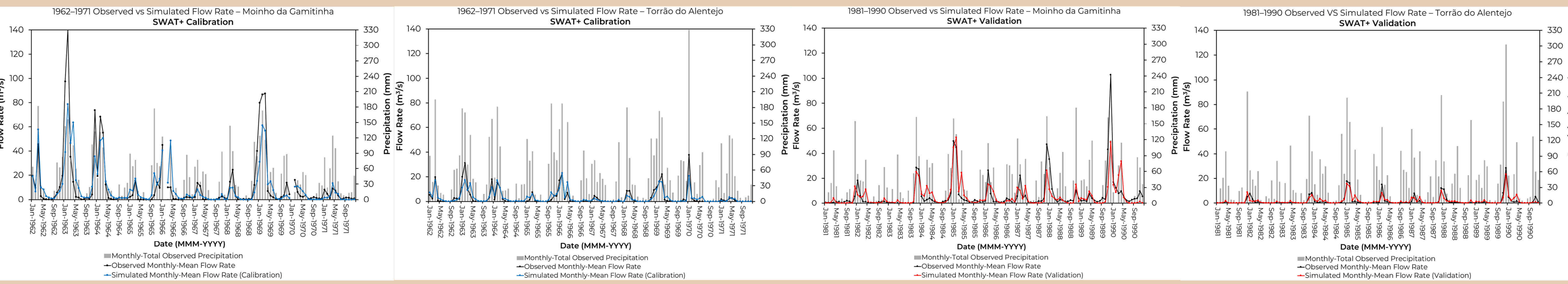


Figure. GCM-ensemble median of the 30-year mean maximum temperature (TX, (a,d)), minimum temperature (TN, (b,e)), and annual precipitation (RR, (c,f)) during the 1981–2010 (1st column) period, and the respective 2041–2070 changes under SSP5-8.5 (2nd column).

Model Calibration & Validation

- 2 hydrometric stations covering upstream SRB
- Calibrated for higher (1962–1971) flow rates (FR)
- Validated for lower (1981–1990) flow rates



Monthly FR							Annual RR (mm/yr)	Annual Mean FR (m ³ /s)	
		NSE	KGE	R ²	R _{Pearson}	PBIAS	Obs	Obs	Sim
1962–1971	MG	0.62	0.64	0.70	0.84	-9%	545	10.7	9.8
	TA	0.77	0.73	0.80	0.90	-1%	662	3.1	3.0
1981–1990	MG	0.60	0.65	0.64	0.80	-9%	517	6.2	5.7
	TA	0.80	0.77	0.83	0.91	-8%	590	1.7	1.8

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