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From grid to ground: how well do gridded products represent soil moisture dynamics in natural ecosystems during precipitation events?

Daniel A. Núñez-Ibarra et al.

Correspondence to: Mauricio Zambrano-Bigiarini (mauricio.zambrano@ufrontera.cl) and Mauricio Galleguillos (mgalleguillot@uc.cl)

Contents

S1 Description of in situ soil sites

The following section provides a detailed description of the soil profiles at the sites where the soil moisture sensors are installed. For each site, we present a photograph of the soil profile, a schematic representation of the soil horizons with their respective moist Munsell color, a description of each horizon, and the percentage of silt, clay, and sand. This information is available in the Chilean Soil Profile Database (ChSPD_V2; (Seguel et al., 2024)), and the corresponding site ID from the database is also provided.

S1.1 SM01 (ChSPD ID: 13640)

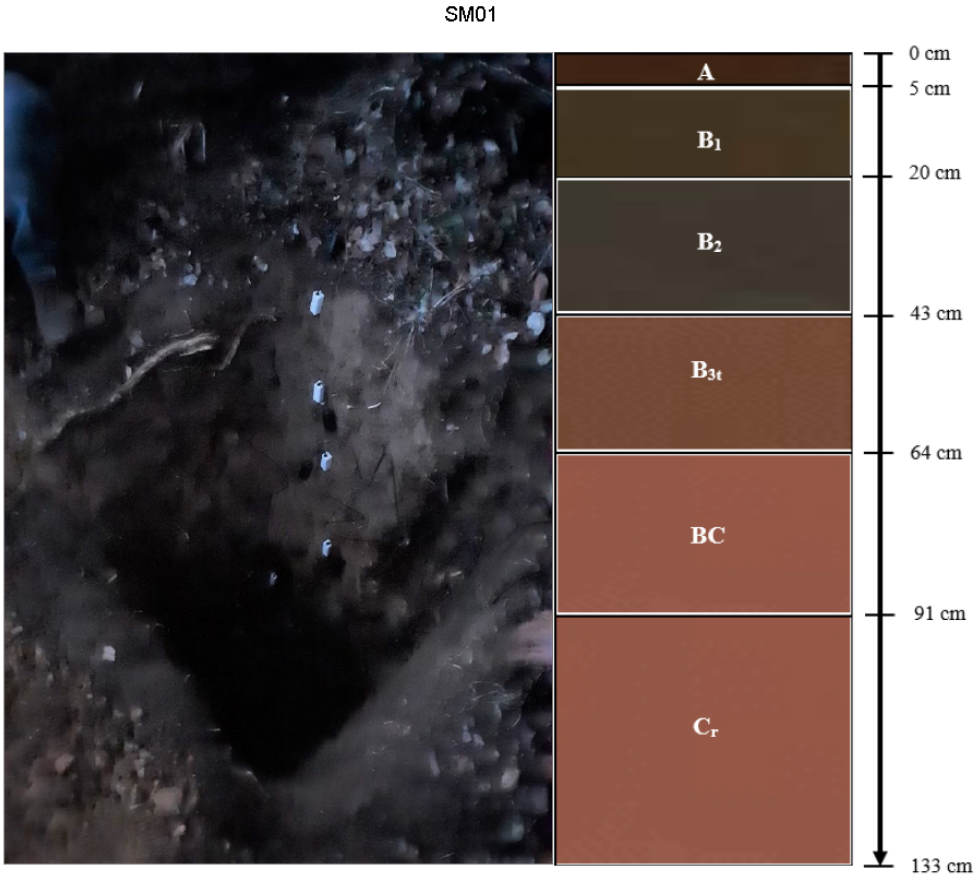

Figure S1: Photograph and schematic of the soil profile at the native forest site, SM01.

Table S1: Soil properties of SM01 (ChSPD ID: 13640)

Depth (cm)	Description	Clay (%)	Silt (%)	Sand (%)	Textural Class
0–5 (A)	Very dark brown (7.5YR 2.5/3); loam to sandy loam; slightly sticky and slightly plastic; strong fine subangular blocky structure in ∼50% and strong fine granular structure in ∼50%; abundant fine and medium roots; abundant fine pores; abrupt linear boundary.	13.60	23.22	63.17	SaL
5–20 (B1)	Dark brown (10YR 3/3); sandy clay loam; slightly sticky and moderately plastic; strong fine and medium subangular blocky structure; abundant fine roots, common medium roots; abundant fine and medium pores, few coarse pores; clear linear boundary.	20.34	19.53	60.12	SaCL
20–43 (B2)	Very dark grayish brown (10YR 3/2); sandy clay loam; moderately sticky and moderately plastic; moderate fine and medium subangular blocky structure, weak coarse blocks; common fine and coarse roots, few medium roots; common fine pores, few medium and coarse pores; ∼10% weathered rock; clear linear boundary.	22.43	20.59	56.99	SaCL
43–64 (B3t)	Yellowish red (5YR 4/6); sandy clay loam to clay loam; moderately sticky and very plastic; weak fine and medium subangular blocky structure; few fine and coarse roots, common medium roots; common fine and medium pores, few coarse pores; abundant cutans; ∼10% fine angular gravel, ∼30% weathered rock; clear linear boundary.	29.63	15.53	54.84	SaCL
64–91 (BC)	∼50% weathered rock; red (2.5YR 5/6); sandy clay loam to clay loam; slightly sticky and moderately plastic; weak fine and medium subangular blocky structure, tending to massive; few fine and coarse roots; abundant fine pores, common medium pores; clear linear boundary.	26.64	13.53	59.83	SaCL
91–133+ (Cr)	∼60% weathered rock; red (2.5YR 5/6); sandy clay loam; slightly sticky and moderately plastic; massive structure; few fine roots; abundant fine pores, common medium pores; ∼20% fine angular gravel.	25.61	14.55	59.83	SaCL

SaCL: Sandy Clay Loam, SaL: Sandy Loam

Table S2: Soil properties of SM01 (ChSPD ID: 13640)

Depth (cm)	Bd(Mg/m3)	Pd(Mg/m3)	TP(%)	Soil water content (2 kPa)	60 kPa	330 kPa	15000
0–5 (A)	Nc	2.24	-	-	-	-	-
5–20 (B1)	1.37	2.71	49.3	0.447	0.286	0.254	0.183
20–43 (B2)	1.53	2.69	42.9	0.466	0.310	0.263	0.167
43–64 (B3t)	1.64	2.56	35.8	0.433	0.323	0.280	0.198
64–91 (BC)	1.46	2.53	42.3	0.456	0.329	0.279	0.171
91–133+ (Cr)	1.55	2.49	37.7	0.467	0.355	0.314	0.195

Bd: bulk density; Pd: Particle density; TP: Total porosity

S1.2 SM02 (ChSPD ID: 13641)

Table S3: Soil properties of SM02 (ChSPD ID: 13641)

Depth (cm)	Description	Clay (%)	Silt (%)	Sand (%)	Textural Class
0–14 (A1)	Very dark brown (10YR 2/2); sandy loam; slightly sticky and slightly plastic; moderate fine and medium subangular blocky structure, strong fine granular; abundant fine roots; common fine pores, abundant medium pores, few coarse pores; ∼10% fine gravel; clear linear boundary.	11.28	21.74	66.97	SaL
14–41 (A2)	Very dark brown (7.5YR 2.5/2); sandy loam; moderately sticky and slightly plastic; strong fine subangular blocky structure, moderate coarse subangular blocks; common fine, medium, and coarse roots; abundant fine and medium pores, common coarse pores; ∼20% fine and medium angular gravel; clear wavy boundary.	10.17	20.54	69.29	SaL
41–67 (B)	Yellowish red (5YR 4/6); sandy clay loam to clay loam; moderately sticky and moderately plastic; weak fine subangular blocky structure, tending to massive; few fine and medium roots; abundant fine pores, common medium pores; ∼10% fine angular gravel, ∼40% medium and coarse angular gravel; clear wavy boundary.	23.80	17.80	58.41	SaCL
67–115 (C1)	Substrate with ∼30% weathered rock, ∼20% fine, medium, and coarse gravel, and ∼20% stones of 30 cm in diameter; variegated, dominated by very pale brown (10YR 8/4), with fine matrix in brown (7.5YR 4/4); sandy clay loam to clay loam; moderately sticky and moderately plastic; massive structure; few fine roots; abundant fine pores, common medium pores; diffuse linear boundary.	27.43	13.92	58.65	SaCL
115–125+ (C2)	Substrate with ∼40% weathered rock, ∼20% fine, medium, and coarse gravel, and ∼20% stones of 30 cm in diameter; yellowish red (5YR 5/6); clay; moderately sticky and very plastic; massive structure; few fine roots; abundant fine pores.	46.85	17.25	35.90	C

C: Clay; SaCL: Sandy Clay Loam; SaL: Sandy Loam

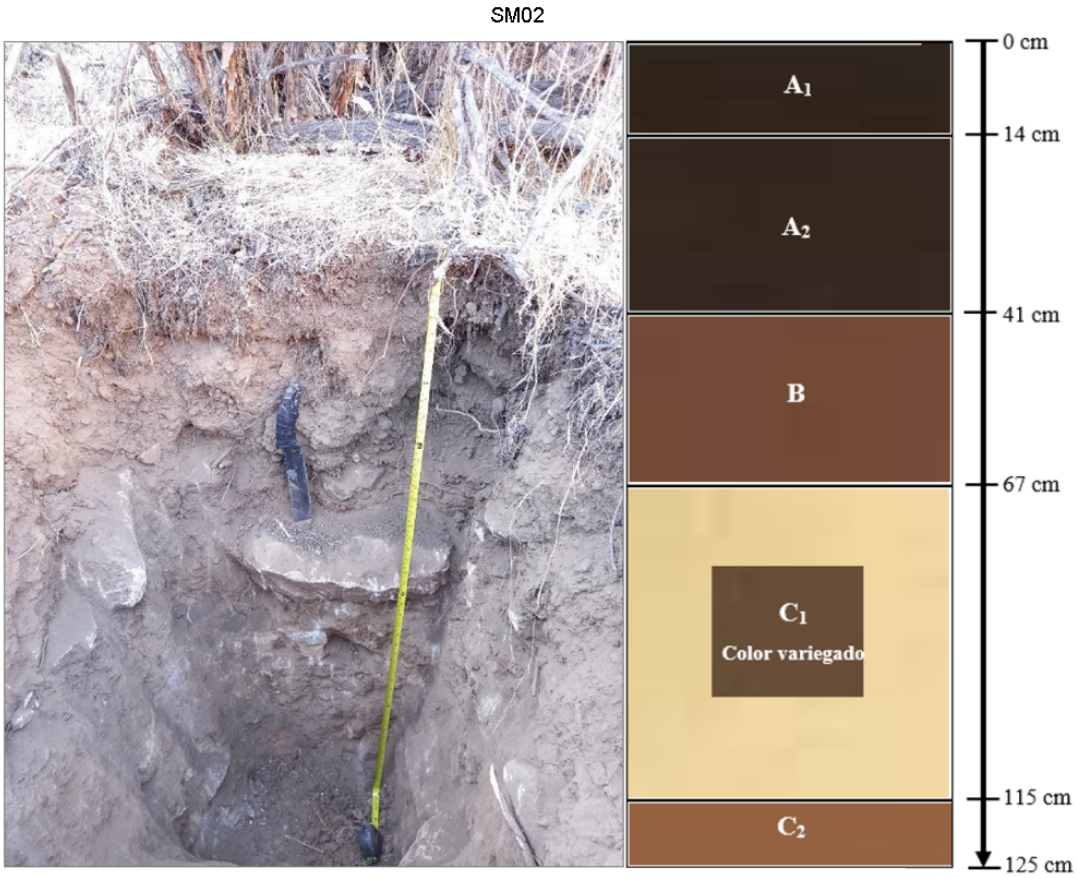

Figure S2: Photograph and schematic of the soil profile at the shrubland site, SM02.

Table S4: Soil properties of SM02 (ChSPD ID: 13641)

				Soil water content			
Depth (cm)	**Bd(Mg/m3)**	**Pd(Mg/m3)**	**TP(%)**	**2 kPa**	**60 kPa**	**330 kPa**	**15000 kPa**
0–14 (A1)	1.17	2.51	53.5	0.519	0.252	0.207	0.110
14–41 (A2)	1.63	2.54	35.8	0.449	0.284	0.196	0.097
41-67 (B)	1.64	2.59	36.5	0.454	0.294	0.216	0.141
67-115 (C1)	1.62	2.68	39.5	0.425	0.340	0.340	0.241
115-125+ (C2)	s/c	2.59	-	-	-	-	-

Bd: bulk density; Pd: Particle density; TP: Total porosity

S1.3 SM04 (ChSPD ID: 13910)

Table S5: Soil properties of SM04 (ChSPD ID: 13910)

Depth (cm)	Description	Clay (%)	Silt (%)	Sand (%)	Textural Class
0–14 (A)	Very dark brown (10YR 2/2); sandy loam; slightly sticky and slightly plastic; strong fine and medium subangular blocky structure; common very fine and fine roots; common fine pores, abundant medium pores, few coarse pores; ∼10% fine angular gravel, ∼10% coarse angular gravel; clear linear boundary.	19.22	27.91	52.87	SaL
14–33 (B)	Dark brown (7.5YR 3/3); sandy clay loam; moderately sticky and moderately plastic; strong fine and medium subangular blocky structure, moderate coarse blocks; abundant fine roots, few medium roots; abundant fine pores, common medium pores; common cutans; ∼10% fine gravel and ∼30% medium gravel; clear linear boundary.	29.78	23.95	46.28	SaCL
33–62 (BC)	Substrate with ∼20% fine gravel and ∼40% medium and coarse gravel; dark brown (7.5YR 3/3); sandy clay loam to clay loam; moderately sticky and very plastic; strong fine and medium subangular blocky structure, moderate coarse blocks; few fine roots, abundant medium roots, common coarse roots; abundant fine pores, common medium pores; clear linear boundary.	31.38	22.27	46.35	SaCL
62–84 (C1)	Substrate with ∼20% fine gravel, ∼40% medium and coarse gravel, and ∼20% weathered rock integrated into the horizon; very dark grayish brown (10YR 3/2); sandy clay loam; slightly sticky and moderately plastic; moderate fine subangular blocky structure; few fine roots; abundant fine pores, common medium pores; clear linear boundary.	20.63	16.84	62.52	SaCL
84–115+ (C2)	Substrate with ∼20% fine gravel, ∼20% medium and coarse gravel, and ∼40% weathered rock; dark bluish gray (GLEY 2 5PB 4/1); sandy loam; slightly sticky and slightly plastic; strong fine subangular blocky structure, weak medium and coarse blocks; few fine roots, common coarse roots; abundant fine pores, few medium pores.	12.07	22.89	65.04	SaCL

SaCL: Sandy Clay Loam; SaL: Sandy Loam

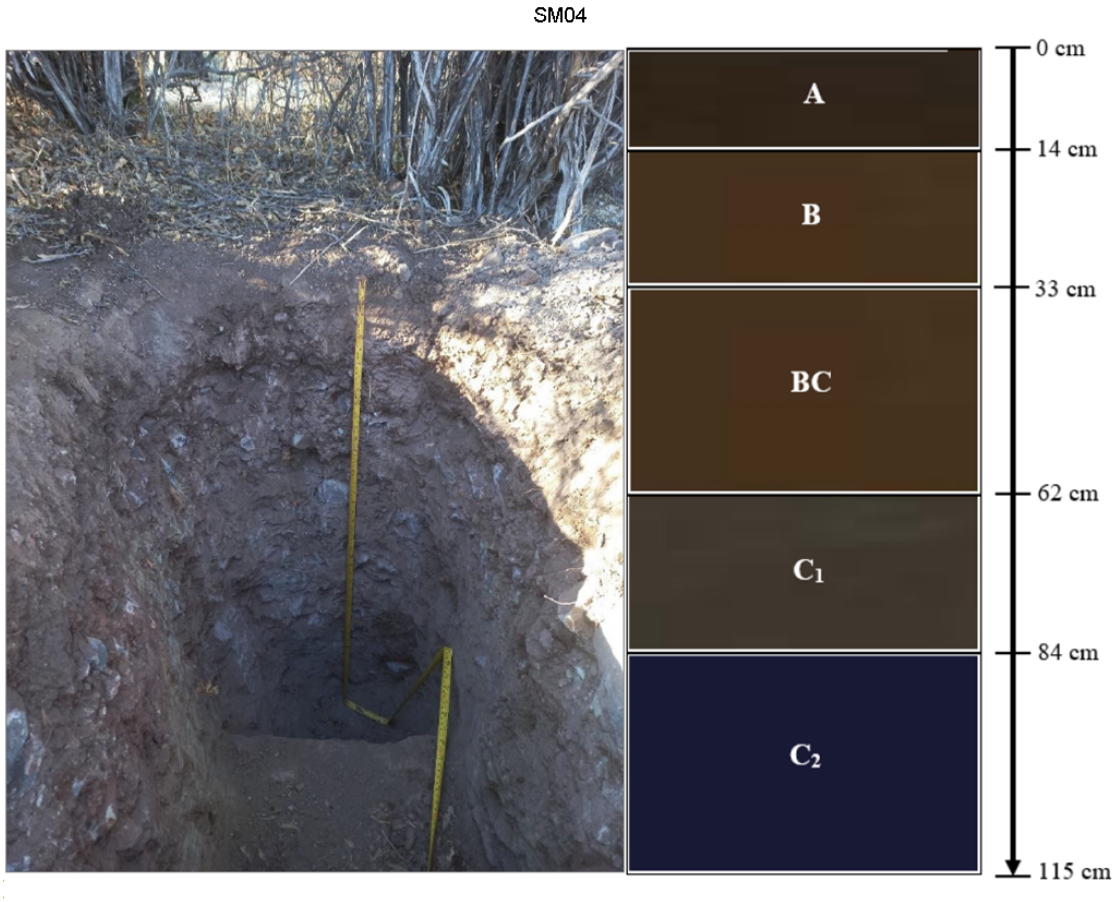

Figure S3: Photograph and schematic of the soil profile at the shrubland site, SM04.

Table S6: Soil properties of SM04 (ChSPD ID: 13910)

				Soil water content			
Depth (cm)	**Bd(Mg/m3)**	**Pd(Mg/m3)**	**TP(%)**	**2 kPa**	**60 kPa**	**330 kPa**	**15000 kPa**
0–14 (A)	1.39	2.69	48.3	0.469	0.273	0.204	0.119
14–33(B)	1.37	2.72	49.6	0.477	0.295	0.224	0.169
33-62 (BC)	1.40	2.72	48.7	0.502	0.343	0.300	0.197
62-84 (C1)	s/c	2.74	-	-	-	-	-
84-115+ (C2)	s/c	2.72	-	-	-	-	-

Bd: bulk density; Pd: Particle density; TP: Total porosity

S1.4 SM05 (ChSPD ID: 13911)

Table S7: Soil properties of SM05 (ChSPD ID: 13911)

Depth (cm)	Description	Clay (%)	Silt (%)	Sand (%)	Textural Class
0–5 (A)	Very dark brown (10YR 2/2); loam to sandy loam; slightly sticky and slightly plastic; strong fine granular and strong fine subangular blocky structure; abundant fine and medium roots, common coarse roots; abundant fine and medium pores, few coarse pores; 10% fine gravel, ∼20% medium gravel; abrupt linear boundary.	10.05	27.22	62.74	SaL
5–20 (B)	Very dark grayish brown (10YR 3/2); sandy loam; slightly sticky and slightly plastic; strong medium and coarse subangular blocky structure; abundant fine and medium roots, few coarse roots; abundant fine pores, common medium pores, few coarse pores; ∼10% fine gravel, ∼40% medium and coarse gravel; clear linear boundary.	11.90	34.87	53.23	SaL
20–75 (BC)	Substrate with ∼10% fine gravel, ∼40% medium and coarse gravel, and ∼10% pebbles; very dark gray (10YR 3/1); sandy loam; slightly sticky and slightly plastic; moderate fine subangular blocky structure, weak medium blocks; abundant fine, medium, and coarse roots; abundant fine pores, common medium and coarse pores; diffuse linear boundary.	15.00	32.87	52.13	SaL
75–120+ (C)	Substrate with ∼80% fine, medium, and coarse gravel, pebbles, and stones ranging from 2 to 30 cm in diameter; variegated, dominated by very dark gray (10YR 3/1); sandy loam; slightly sticky and slightly plastic; weak fine subangular blocky structure; abundant fine and medium roots, few coarse roots; abundant fine pores, common medium pores.	14.89	28.55	56.56	SaL

SaL: Sandy Loam

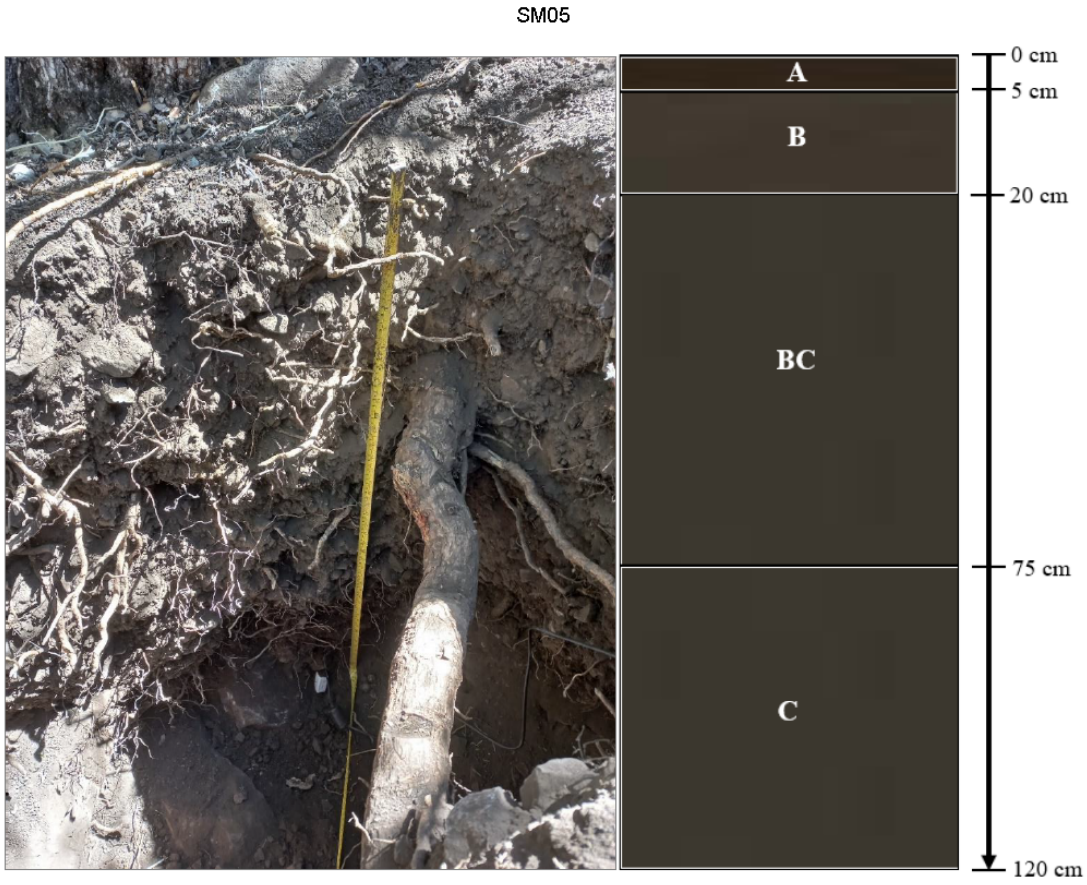

Figure S4: Photograph and schematic of the soil profile at the shrubland site, SM05.

Table S8: Soil properties of SM05 (ChSPD ID: 13911)

				Soil water content			
Depth (cm)	**Bd(Mg/m3)**	**Pd(Mg/m3)**	**TP(%)**	**2 kPa**	**60 kPa**	**330 kPa**	**15000 kPa**
0–5(A)	0.98	2.07	52.5	0.566	0.319	0.235	0.204
5–20(B)	1.12	2.57	56.6	0.528	0.309	0.223	0.113
20–75(BC)	1.27	2.69	52.9	0.452	0.268	0.189	0.090
75–120+ (C)	-	2.57	-	-	-	-	-

Bd: bulk density; Pd: Particle density; TP: Total porosity

S1.5 SM07 (ChSPD ID: 13644)

Table S9: Soil properties of SM07 (ChSPD ID: 13644)

Depth (cm)	Description	Clay (%)	Silt (%)	Sand (%)	Textural Class
0–4 (O1)	Black (10YR 2/1); abundant litter on the surface, this layer thins out away from the canopy of the *Lithraea caustica* (litre); abrupt linear boundary.	–	–	–	–
4–12 (A1)	Very dark brown (10YR 2/2); loam to sandy loam; non-sticky and slightly plastic; strong fine granular structure; abundant fine roots; abundant fine pores, common medium and coarse pores; clear linear boundary.	5.65	19.42	74.94	SaL
12–21 (A2)	Dark brown (7.5YR 3/2); loam to sandy loam; slightly sticky and slightly plastic; weak fine and medium subangular blocky structure in ∼30% and strong fine granular structure in ∼70%; abundant very fine and fine roots, common medium roots; abundant fine pores, common coarse pores; ∼20% medium angular gravel; abrupt linear boundary.	6.84	23.02	70.14	SaL
21–38 (AB)	Dark brown (7.5YR 3/2); sandy loam; moderately sticky and moderately plastic; strong fine and medium subangular blocky structure; common fine and medium roots, abundant coarse roots; common fine and coarse pores, abundant medium pores; ∼20% fine angular gravel, ∼40% coarse angular gravel; gradual linear boundary.	10.96	23.23	65.81	SaL
38–67 (Bt1)	Dark brown (7.5YR 3/2); sandy loam to sandy clay loam; moderately sticky and very plastic; strong fine subangular blocky structure; few fine, medium, and coarse roots; common fine pores, few medium and coarse pores; cutans observed on aggregate faces; ∼40% coarse angular gravel and ∼20% weathered rock; clear linear boundary.	16.71	21.10	62.19	SaL
67–90 (Bt2)	Dark brown (7.5YR 3/3); sandy clay loam; moderately sticky and very plastic; strong medium subangular blocky structure; few fine and medium roots; common fine and medium pores, few coarse pores; cutans observed on aggregate faces; ∼20% fine, medium, and coarse angular gravel and ∼30% weathered rock; diffuse linear boundary.	24.77	18.52	56.71	SaCL
90–133 (BC)	∼50% weathered rock within the horizon; dark reddish brown (5YR 3/4); sandy loam; moderately sticky and moderately plastic; weak fine subangular blocky structure, tending to massive; few fine roots; abundant fine pores, common medium pores; ∼20% fine angular gravel; abrupt linear boundary.	14.82	23.50	61.68	SaL
133–145+ (C)	∼60% weathered rock within the horizon; dark brown (7.5YR 3/4); sandy loam to loamy sand; slightly sticky and slightly plastic; massive structure; no roots; common fine and medium pores; ∼20% fine, medium, and coarse angular gravel.	7.34	14.89	77.76	LoSa

SaCL: Sandy Clay Loam; SaL: Sandy Loam; LoSa: Loamy Sand

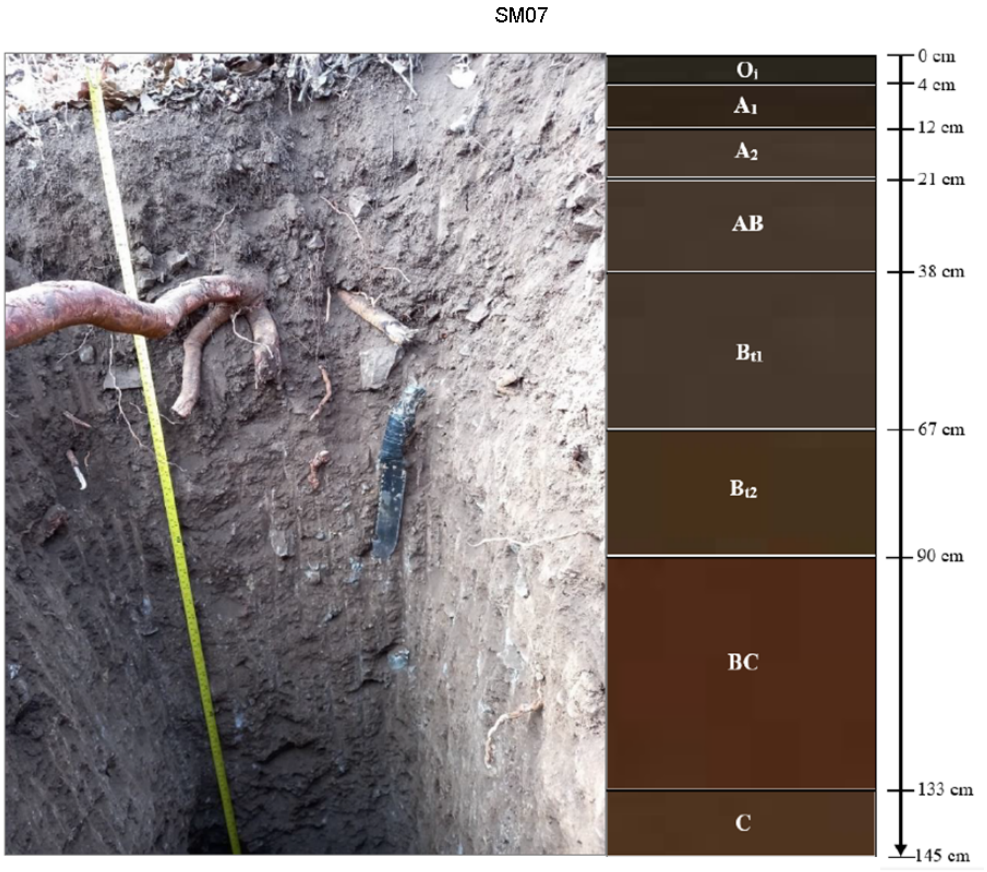

Figure S5: Photograph and schematic of the soil profile at the shrubland site, SM07.

Table S10: Soil properties of SM07 (ChSPD ID: 13644)

				Soil water content			
Depth (cm)	**Bd(Mg/m3)**	**Pd(Mg/m3)**	**TP(%)**	**2 kPa**	**60 kPa**	**330 kPa**	**15000 kPa**
0–4 (O1)	-	-	-	-	-	-	-
4–12 (A1)	0.65	1.97	66.9	0.438	0.269	0.249	0.206
12–21(A2)	0.77	2.12	63.6	0.539	0.282	0.259	0.190
21–38 (AB)	0.97	2.38	59.3	0.490	0.258	0.235	0.107
38–67 (Bt1)	1.45	2.46	41.2	0.439	0.241	0.217	0.152
67–90 (Bt2)	1.50	2.57	41.6	0.462	0.278	0.235	0.186
90–133 (BC)	1.52	2.55	40.4	0.441	0.287	0.249	0.174
133–145+ (C)	1.46	2.66	45.0	0.438	0.234	0.198	0.117

Bd: bulk density; Pd: Particle density; TP: Total porosity

S1.6 SM15 (ChSPD ID: 13667)

Table S11: Soil properties of SM15 (ChSPD ID: 13667)

Depth (cm)	Description	Clay (%)	Silt (%)	Sand (%)	Textural Class
0–4 (Oi)	Senescent litter from the autumn leaf fall of *Nothofagus glauca* trees. Common presence of thin branches from dead tree material; clear linear boundary.	–	–	–	–
4–7 (Oa)	Very dark brown (10YR 2/2); highly decomposed organic material; sandy loam; abundant fine roots; abundant fine and medium pores; clear linear boundary.	6.50	18.41	75.09	SaL
7–23 (A)	Dark brown (10YR 3/3); sandy loam; slightly sticky and slightly plastic; strong fine granular structure; abundant fine roots, few medium and coarse roots; abundant fine pores, few medium pores; ∼10% fine gravel; clear linear boundary.	6.50	18.41	75.09	SaL
23–50 (Bw1)	Strong brown (7.5YR 5/6); sandy loam; moderately sticky and moderately plastic; moderate fine and medium subangular blocky structure; common fine roots, few medium and coarse roots, abundant very coarse roots; abundant fine pores, common medium pores; few fine and coarse gravel; gradual linear boundary.	6.45	20.41	73.14	SaL
50–80 (Bw2)	Strong brown (7.5YR 5/6); sandy clay loam; moderately sticky and moderately plastic; moderate medium and coarse subangular blocky structure; few fine roots, common medium roots; abundant fine and medium pores; few medium and coarse gravel, few pebbles; clear linear boundary.	23.84	16.59	59.57	SaCL
80–130 (BC)	Substrate with ∼40% rocks and ∼30% fine gravel; light yellowish brown (10YR 6/4); sandy loam; slightly sticky and moderately plastic; massive structure; very few fine and medium roots; abundant fine pores, few medium pores; gradual linear boundary.	21.48	15.34	63.18	SaL
130–170+ (C)	Regolith, highly weathered; yellowish brown (10YR 6/6); sandy clay loam; moderately sticky and moderately plastic; massive structure; very few fine roots, few medium roots; abundant fine pores, few medium pores; yellowish red iron masses (7.5YR 6/8) increasing with depth, from less than 5% at the top of the horizon to more than 40% at the bottom.	26.84	18.58	54.57	SaCL

SaCL: Sandy Clay Loam; SaL: Sandy Loam

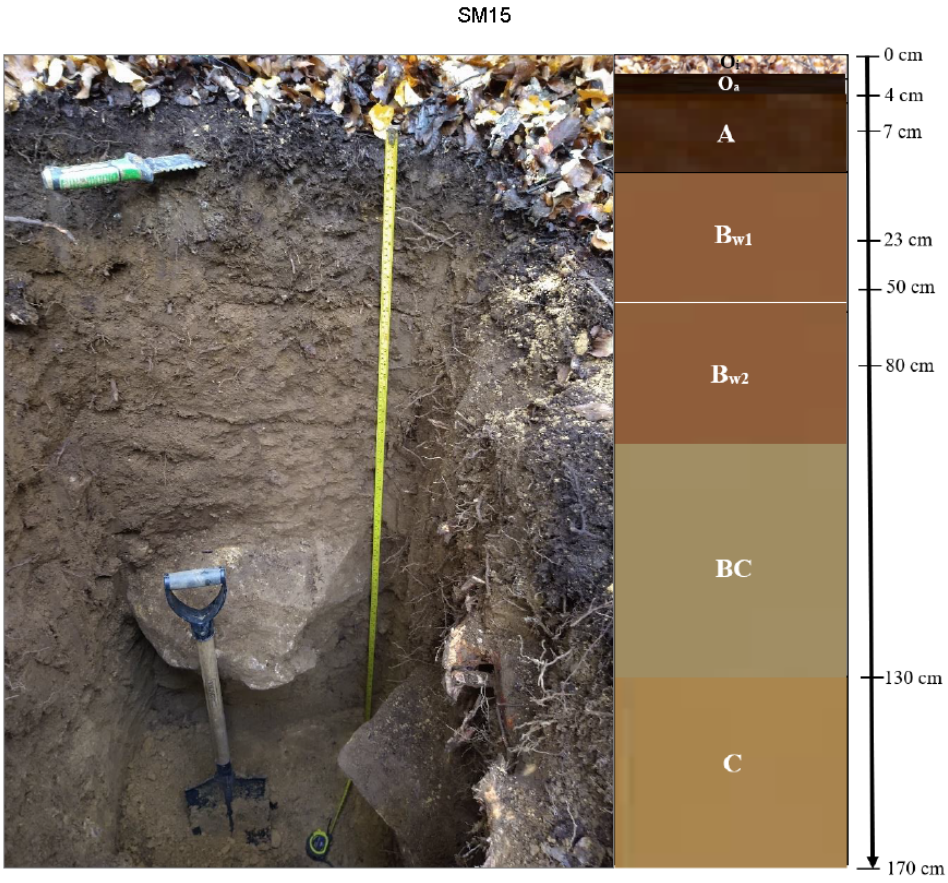

Figure S6: Photograph and schematic of the soil profile at the native forest site, SM15.

Table S12: Soil properties of SM15 (ChSPD ID: 13667)

				Soil water content			
Depth (cm)	**Bd(Mg/m3)**	**Pd(Mg/m3)**	**TP(%)**	**2 kPa**	**60 kPa**	**330 kPa**	**15000 kPa**
0–4 (Oi)	-	-	-	-	-	-	-
7–23 (A)	0.83	2.43	65.8	0.552	0.313	0.278	0.214
23–50 (Bw1)	0.81	2.49	67.5	0.559	0.342	0.273	0.135
50–80 (Bw2)	1.29	2.63	51.1	0.465	0.320	0.284	0.167
80–130 (BC)	1.40	2.63	46.9	0.366	0.259	0.229	0.120
130–170+ (C)	1.53	2.66	42.2	0.389	0.310	0.288	0.152

Bd: bulk density; Pd: Particle density; TP: Total porosity

S1.7 SM10 (ChSPD ID: 13927)

Table S13: Soil properties of SM10 (ChSPD ID: 13927)

Depth (cm)	Description	Clay (%)	Silt (%)	Sand (%)	Textural Class
0–10 (A1)	Very dark grayish brown (10YR 3/2); sandy loam; slightly sticky and slightly plastic; strong medium subangular blocky and strong fine granular structure; abundant fine roots; abundant fine and medium pores, few coarse pores; ∼20% coarse angular gravel; abrupt linear boundary.	8.84	31.58	59.57	SaL
10–26 (A2)	Dark brown (10YR 3/3); sandy loam; slightly sticky and slightly plastic; strong fine subangular blocky structure; abundant fine, medium, and coarse roots; abundant fine and medium pores; ∼10% fine and medium gravel; clear linear boundary.	6.74	31.58	61.68	SaL
26–83 (B1)	Dark brown (10YR 3/2); sandy loam; slightly sticky and slightly plastic; weak fine and moderate medium and coarse subangular blocky structure; abundant fine, medium, and coarse roots; abundant fine, medium, and coarse pores; clear linear boundary.	6.61	28.49	64.91	SaL
83–125 (B2)	Dark yellowish brown (10YR 3/6); sandy loam; slightly sticky and moderately plastic; strong fine and medium subangular blocky structure; few fine roots, abundant medium roots, common coarse roots; abundant fine pores, common medium pores; ∼30% fine and medium gravel, ∼20% coarse gravel; diffuse linear boundary.	11.15	21.01	67.84	SaL
125–205+ (BC)	Dark yellowish brown (10YR 3/6); sandy loam; slightly sticky and slightly plastic; moderate fine and medium subangular blocky structure, tending to massive in some areas; very few fine and medium roots; abundant fine pores, common medium pores; ∼50% of the horizon composed of coarse gravel, stones, and boulders.	8.95	20.45	70.60	SaL

SaL: Sandy Loam

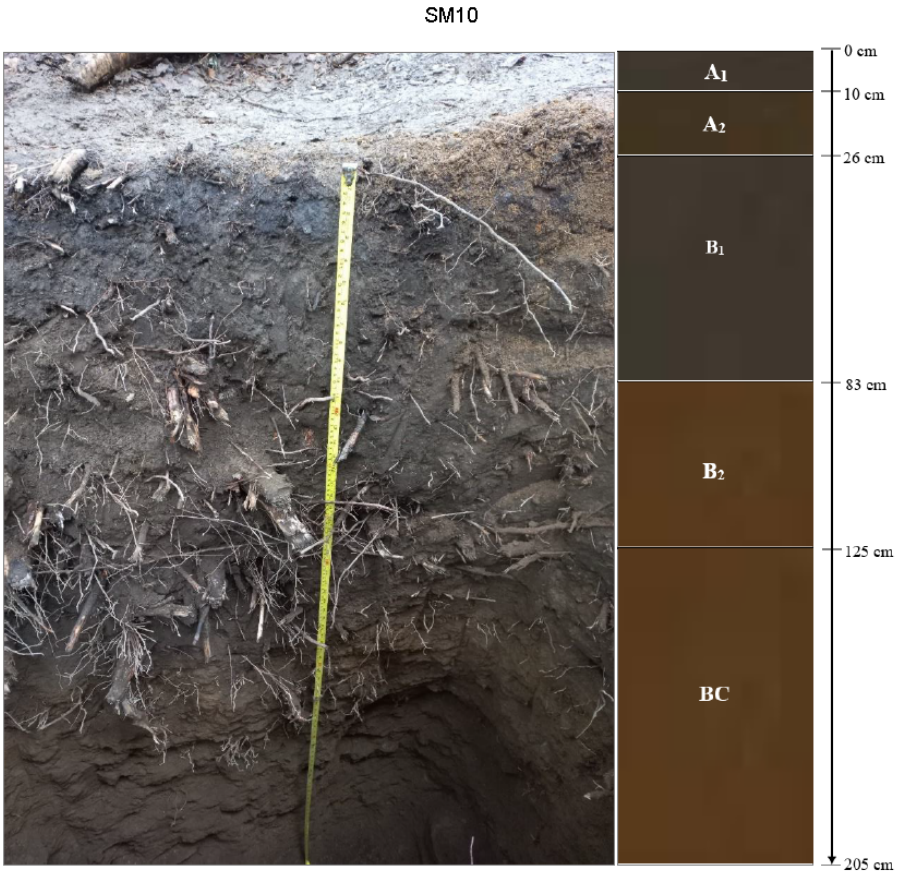

Figure S7: Photograph and schematic of the soil profile at the native forest site, SM10.

Table S14: Soil properties of SM10 (ChSPD ID: 13927)

				Soil water content			
Depth (cm)	**Bd(Mg/m3)**	**Pd(Mg/m3)**	**TP(%)**	**2 kPa**	**60 kPa**	**330 kPa**	**15000 kPa**
0–10(A1)	0.48	2.11	77.3	0.533	0.324	0.279	0.129
10–26 (A2)	0.61	2.34	73.7	0.533	0.329	0.280	0.154
26–83 (B1)	0.66	2.52	73.8	0.634	0.395	0.260	0.136
83–125 (B2)	0.97	2.56	62.0	0.528	0.341	0.278	0.202
125–205+ (Bw2)	1.17	2.66	55.9	0.556	0.341	0.300	0.240

Bd: bulk density; Pd: Particle density; TP: Total porosity

S1.8 SM11 (ChSPD ID: 13928)

Table S15: Soil properties of SM11 (ChSPD ID: 13928)

Depth (cm)	Description	Clay (%)	Silt (%)	Sand (%)	Textural Class
0–10 (A)	Black (10YR 2/1); sandy loam; slightly sticky and slightly plastic; strong medium subangular blocky and strong fine granular structure; abundant fine roots; abundant fine and medium pores, few coarse pores; ∼20% coarse angular gravel; abrupt linear boundary.	6.97	27.44	65.59	SaL
10–30 (C1)	Substrate with ∼60% coarse gravel, stones, and pebbles within the horizon; dark brown (10YR 3/3); sand; non-sticky and slightly plastic; single grain structure; abundant very fine and fine roots; abundant fine and medium pores; ∼20% fine and medium angular gravel; gradual linear boundary.	4.49	7.35	88.16	Sa
30–65 (C2)	Substrate with ∼50% coarse gravel, stones, and pebbles; variegated, dominated by dark yellowish brown (10YR 3/6); loamy sand; slightly sticky and slightly plastic; single grain structure; few fine roots; abundant fine and medium pores; abrupt linear boundary.	4.48	9.36	86.17	LoSa
65–80 (2Ab)	Dark brown (10YR 3/3); sandy loam; slightly sticky and slightly plastic; strong medium and coarse subangular blocky structure; few fine and medium roots; abundant fine and medium pores; common fine iron masses; clear wavy boundary.	6.22	35.95	57.83	SaL
80–120 (2Bc)	Black (GLEY 1 2.5/N); sandy loam; slightly sticky and slightly plastic; moderate fine, medium, and coarse subangular blocky structure; very few fine and medium roots; abundant fine and medium pores; common fine iron masses.	8.24	33.61	58.15	SaL
120+	Water table emerges at this depth.	–	–	–	–

SaL: Sandy Loam; LoSa: Loamy Sand; Sa: Sand

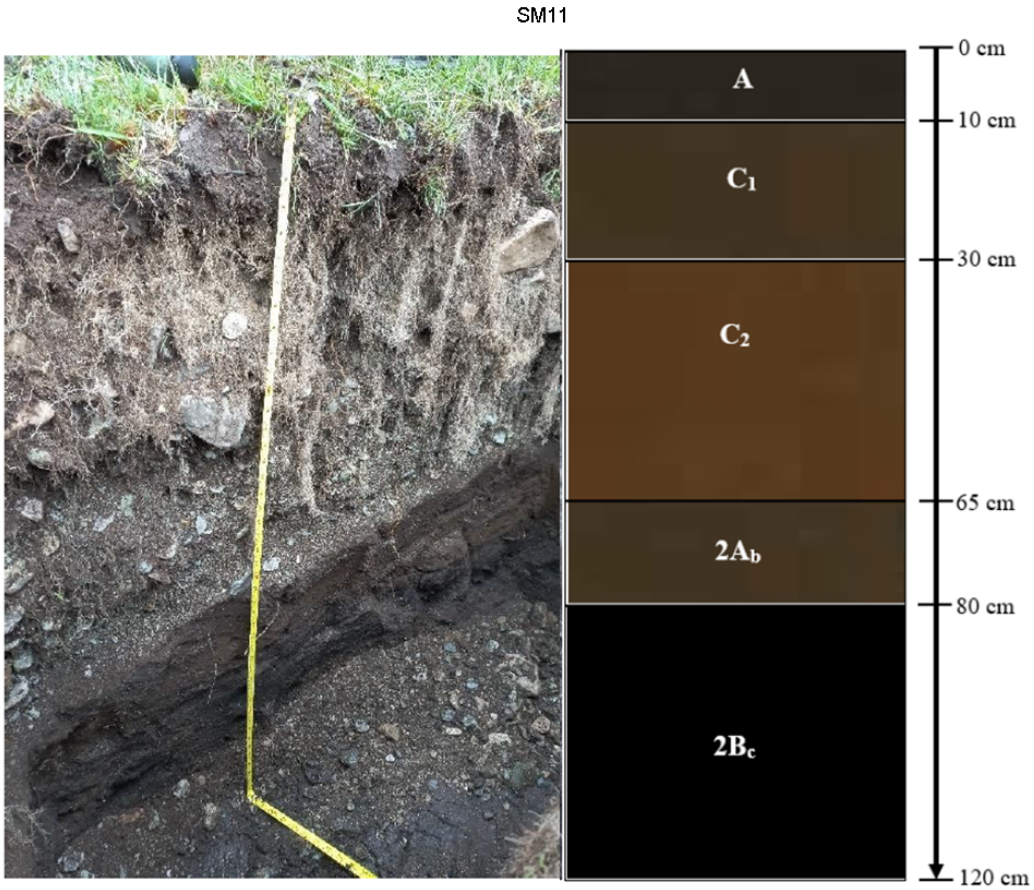

Figure S8: Photograph and schematic of the soil profile at the grassland site, SM11.

Table S16: Soil properties of SM11 (ChSPD ID: 13928)

				Soil water content			
Depth (cm)	**Bd(Mg/m3)**	**Pd(Mg/m3)**	**TP(%)**	**2 kPa**	**60 kPa**	**330 kPa**	**15000 kPa**
0–10 (A)	0.76	2.13	64.2	0.637	0.469	0.427	0.202
10–30 (C1)	1.17	2.60	55.0	0.811	0.606	0.571	0.069
30–65 (C2)	1.62	2.61	38.0	0.325	0.104	0.088	0.074
65–80 (2Ab)	0.63	2.52	74.8	0.695	0.518	0.460	0.248
80–120 (2Bc)	0.75	2.52	70.1	0.675	0.525	0.470	0.189
120+	-	-	-	-	-	-	-

Bd: bulk density; Pd: Particle density; TP: Total porosity

S1.9 SM12 (ChSPD ID: 13929)

Table S17: Soil properties of SM12 (ChSPD ID: 13929)

Depth (cm)	Description	Clay (%)	Silt (%)	Sand (%)	Textural Class
0–18 (A)	Black (10YR 2/1); sandy loam; slightly sticky and slightly plastic; strong fine subangular blocky and moderate fine granular structure; abundant fine, medium, and coarse roots; abundant fine, medium, and coarse pores; clear linear boundary.	5.15	34.19	60.65	SaL
18–40 (B1)	Very dark brown (10YR 2/2); sandy loam; slightly sticky and slightly plastic; strong fine and medium subangular blocky structure; abundant fine, medium, and coarse roots; abundant fine and medium pores, common coarse pores; clear linear boundary.	5.80	34.58	59.62	SaL
40–67 (B2)	Dark yellowish brown (10YR 3/4); sandy loam; slightly sticky and slightly plastic; moderate to strong fine and medium subangular blocky structure; common fine, medium, and coarse roots; abundant fine pores, common medium and coarse pores; clear linear boundary.	8.34	20.52	71.14	SaL
67–88 (BC)	Variegated, dominated by yellowish brown (10YR 5/8); loamy sand; slightly sticky and slightly plastic; single grain structure, tending to form weak medium subangular blocky aggregates; few fine and medium roots; abundant fine and medium pores; clear linear boundary.	4.58	9.58	85.84	LoSa
88–100 (2B)	Dark yellowish brown (10YR 3/6); sandy loam; slightly sticky and slightly plastic; moderate fine and medium subangular blocky structure; few fine roots, common medium roots; abundant fine and medium pores; ∼40% fine and medium gravel; abrupt linear boundary.	4.76	27.72	67.52	SaL
100–104 (2BC)	Variegated, dominated by dark yellowish brown (10YR 3/4); loam; slightly sticky and moderately plastic; massive structure; no roots; few fine pores; ∼50% fine and medium gravel; abundant fine iron masses; abrupt linear boundary.	9.38	41.98	48.64	L
104–132 (3B)	Dark yellowish brown (10YR 3/4); sandy loam; slightly sticky and slightly plastic; weak fine subangular blocky structure; no roots; common fine and medium pores; abrupt linear boundary.	7.93	37.07	55.01	SaL
132–210+ (4Bb)	Dark yellowish brown (10YR 3/4); sandy loam; slightly sticky and slightly plastic; strong medium and coarse subangular blocky structure; few fine, medium, and coarse roots; abundant fine pores, few medium pores.	7.19	35.48	57.33	SaL

SaL: Sandy Loam; LoSa: Loamy Sand; L: Loam

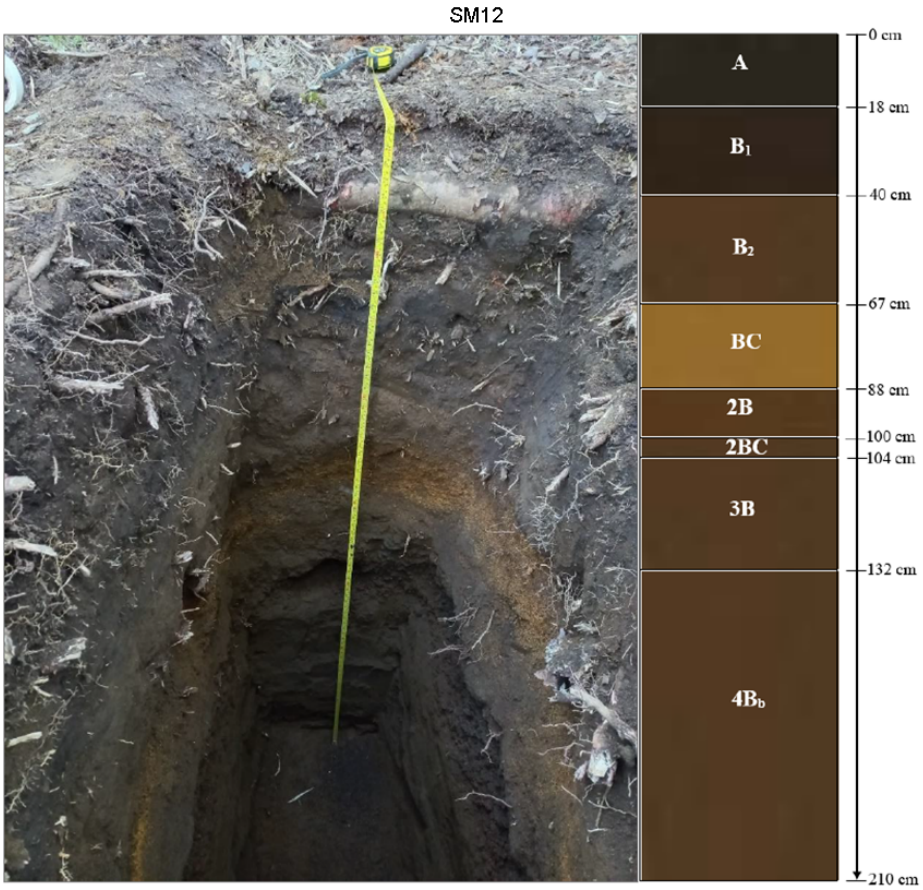

Figure S9: Photograph and schematic of the soil profile at the native forest site, SM12.

Table S18: Soil properties of SM12 (ChSPD ID: 13929)

				Soil water content			
Depth (cm)	**Bd(Mg/m3)**	**Pd(Mg/m3)**	**TP(%)**	**2 kPa**	**60 kPa**	**330 kPa**	**15000 kPa**
0–18 (A)	0.31	1.97	84.3	0.785	0.470	0.439	0.179
18–40 (B1)	0.48	2.29	79.1	0.624	0.398	0.306	0.235
40–67(C2)	0.52	2.25	76.9	0.653	0.489	0.415	0.272
67–88 (BC)	0.48	2.221	78.2	0.641	0.339	0.307	0.130
88–100 (2B)	0.72	2.51	71.4	0.574	0.394	0.333	0.227
100–104 (2BC)	s/c	2.55	-	-	-	-	-
104–132 (3B)	0.69	2.38	71.1	0.465	0.270	0.218	0.151
132–210+ (4Bb)	0.66	2.48	73.6	0.668	0.549	0.502	0.297

Bd: bulk density; Pd: Particle density; TP: Total porosity

S1.10 SM14 (ChSPD ID: 13931)

Table S19: Soil properties of SM14 (ChSPD ID: 13931)

Depth (cm)	Description	Clay (%)	Silt (%)	Sand (%)	Textural Class
0–8 (A1)	Black (10YR 2/1); sandy loam; slightly sticky and slightly plastic; moderate fine and medium subangular blocky and moderate fine granular structure; abundant fine and medium roots, common coarse roots; abundant fine and medium pores; ∼10% fine gravel; clear linear boundary.	6.80	33.57	59.63	SaL
8–20 (A2)	Very dark brown (10YR 2/2); sandy loam; slightly sticky and slightly plastic; strong fine and medium subangular blocky structure; abundant fine and medium roots, few coarse roots; abundant fine and medium pores; gradual linear boundary.	4.71	40.27	55.02	SaL
20–38 (B)	Very dark grayish brown (10YR 3/2); sandy loam; slightly sticky and slightly plastic; moderate fine and medium subangular blocky structure; abundant fine and coarse roots, common medium roots; abundant fine and medium pores; abrupt linear boundary.	6.79	35.62	57.59	SaL
38–48 (BC)	Dark yellowish brown (10YR 4/4); loamy sand; non-sticky and slightly plastic; strong fine and medium subangular blocky structure; common fine and medium roots; abundant fine pores, common medium pores; ∼20% fine and medium gravel; abrupt linear boundary.	4.52	18.10	77.38	LoSa
48–64 (C1)	Substrate with ∼50% medium and coarse gravel and stones ranging from 20 to 30 cm in diameter; dark yellowish brown (10YR 3/4); sand; non-sticky and non-plastic; single grain structure; common fine roots; abundant fine pores; abrupt linear boundary.	2.43	5.26	92.31	Sa
64–125+ (C2)	Substrate with ∼80% medium and coarse gravel, with an increase in stones ranging from 30 to 50 cm in diameter starting at 80 cm depth; variegated, dominated by dark grayish brown (10YR 4/2); sand; non-sticky and non-plastic; single grain structure; very few fine roots; abundant fine pores.	2.42	1.21	96.37	Sa

SaL: Sandy Loam; LoSa: Loamy Sand; Sa: Sand

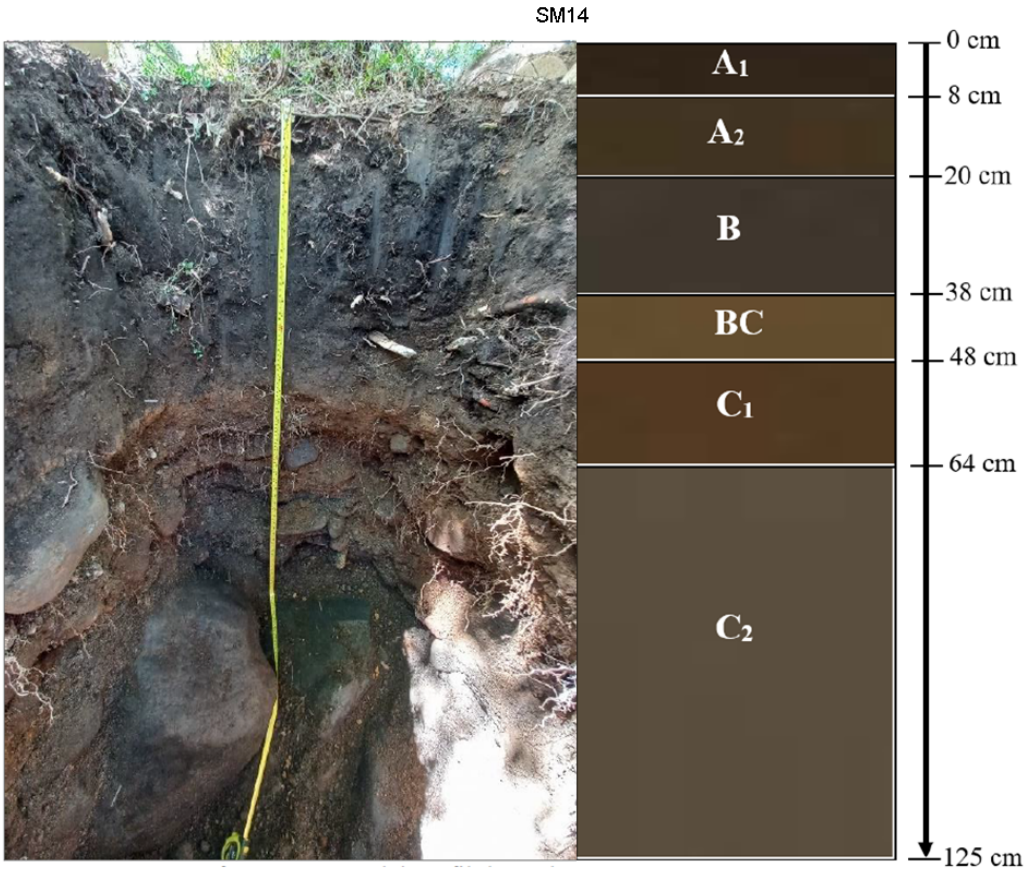

Figure S10: Photograph and schematic of the soil profile at the native forest site, SM14.

Table S20: Soil properties of SM14 (ChSPD ID: 13931)

				Soil water content			
Depth (cm)	**Bd(Mg/m3)**	**Pd(Mg/m3)**	**TP(%)**	**2 kPa**	**60 kPa**	**330 kPa**	**15000 kPa**
0–08 (A1)	0.48	2.10	77.2	0.657	0.352	0.308	0.240
08–20 (A2)	0.61	2.34	74.1	0.618	0.435	0.350	0.259
20–38(B)	0.71	2.48	71.4	0.658	0.463	0.354	0.219
38–48 (BC)	0.97	2.60	62.8	0.566	0.354	0.269	0.156
48–64 (C1)	1.47	2.66	45.0	0.396	0.114	0.093	0.072
64–125+ (C2)	1.17	2.71	57.0	0.487	0.253	0.211	0.059

Bd: bulk density; Pd: Particle density; TP: Total porosity

S2 Time series of SSM, RZSM and P

This section presents the time series of surface soil moisture (SSM), root zone soil moisture (RZSM), and precipitation (P) for each study site during the 2022–2023 period. In addition, performance metrics are provided to evaluate the agreement between gridded products and in situ measurements for both SSM and RZSM. Metrics include the unbiased root mean square error (ubRMSE, m³/m³), percentage bias (PBIAS, %), Pearson's correlation coefficient (r), modified Kling-Gupta efficiency (KGE'), and Spearman correlation coefficient (ρ). In the tables, metrics for SSM are presented directly, while the corresponding values for RZSM are indicated in parentheses.

S2.1 SM01

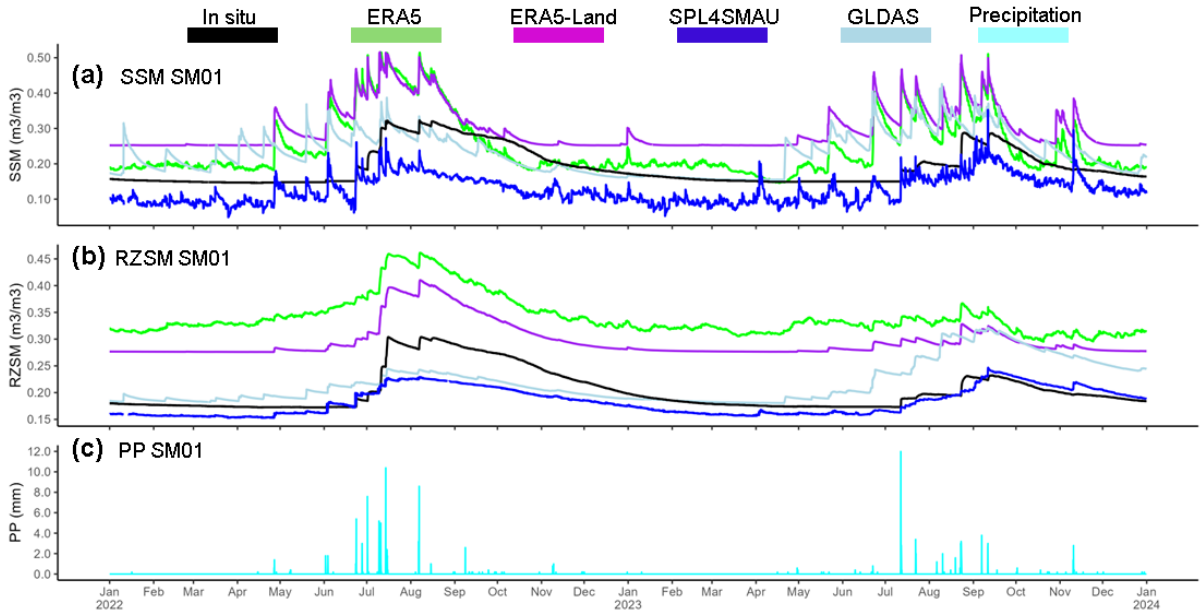

Figure S11: Time series for the 2022–2023 period: (a) Surface soil moisture (SSM), (b) Root zone soil moisture (RZSM), and (c) Precipitation (P) for SM01 (native forest in PRB).

Table S21: Performance metrics for SSM (RZSM) at SM01. Metrics include ubRMSE, PBIAS, r, ρ and KGE'.

Product	ubRMSE	PBIAS	r	KGE'	ρ
ERA5	0.070 (0.027)	-24.1 (68.9)	0.56 (0.71)	0.45 (0.14)	0.34 (0.79)
ERA5-Land	0.057 (0.020)	58.8 (46.3)	0.52 (0.85)	0.22 (0.34)	0.29 (0.92)
SPL4SMAU	0.036 (0.026)	-34.9 (-9.8)	0.68 (0.70)	0.51 (0.60)	0.06 (0.08)
GLDAS-Noah	0.057 (0.044)	20.3 (11.2)	0.39 (0.30)	0.35 (0.29)	-0.37 (-0.68)

S2.2 SM02

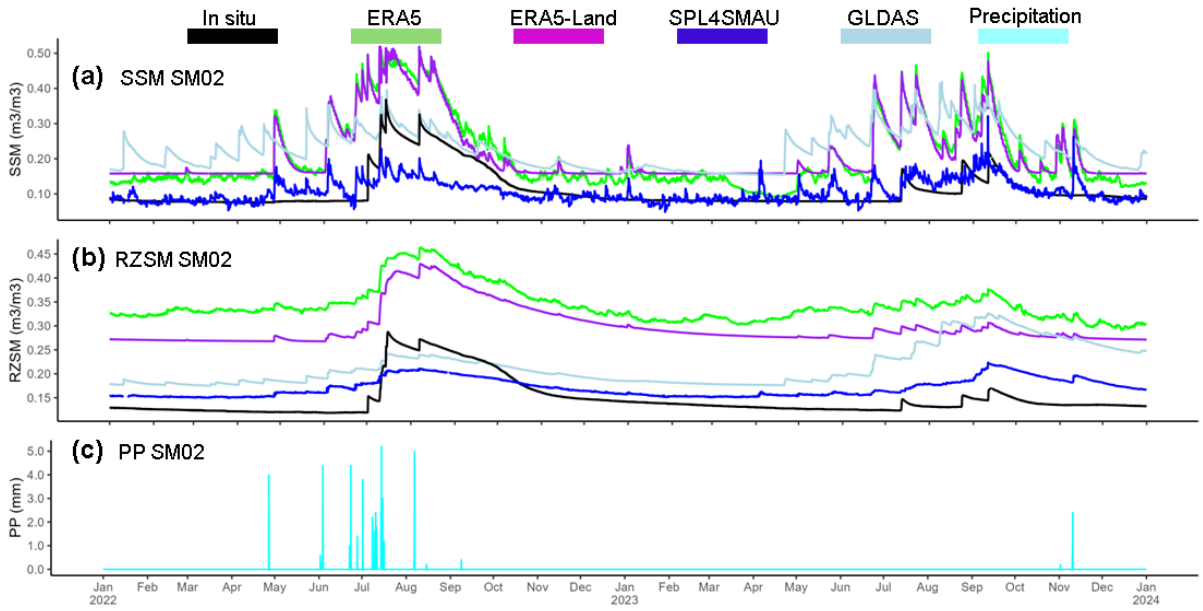

Figure S12: Time series for the 2022–2023 period: (a) Surface soil moisture (SSM), (b) Root zone soil moisture (RZSM), and (c) Precipitation (P) for SM02 (shrubland in PRB).

Table S22: Performance metrics for SSM (RZSM) at SM02. Metrics include ubRMSE, PBIAS, r, ρ and KGE'.

Product	ubRMSE	PBIAS	r	KGE'	ρ
ERA5	0.073 (0.022)	-49.0 (133.7)	0.71 (0.81)	0.43 (-0.47)	0.31 (0.68)
ERA5-Land	0.064 (0.017)	99.5 (102.8)	0.70 (0.90)	-0.05 (-0.15)	0.37 (0.97)
SPL4SMAU	0.041 (0.029)	-3.8 (16.0)	0.60 (0.63)	0.43 (0.30)	0.06 (0.04)
GLDAS-Noah	0.054 (0.051)	108.7 (52.2)	0.45 (0.18)	-0.32 (-0.01)	-0.31 (-0.62)

S2.3 SM04

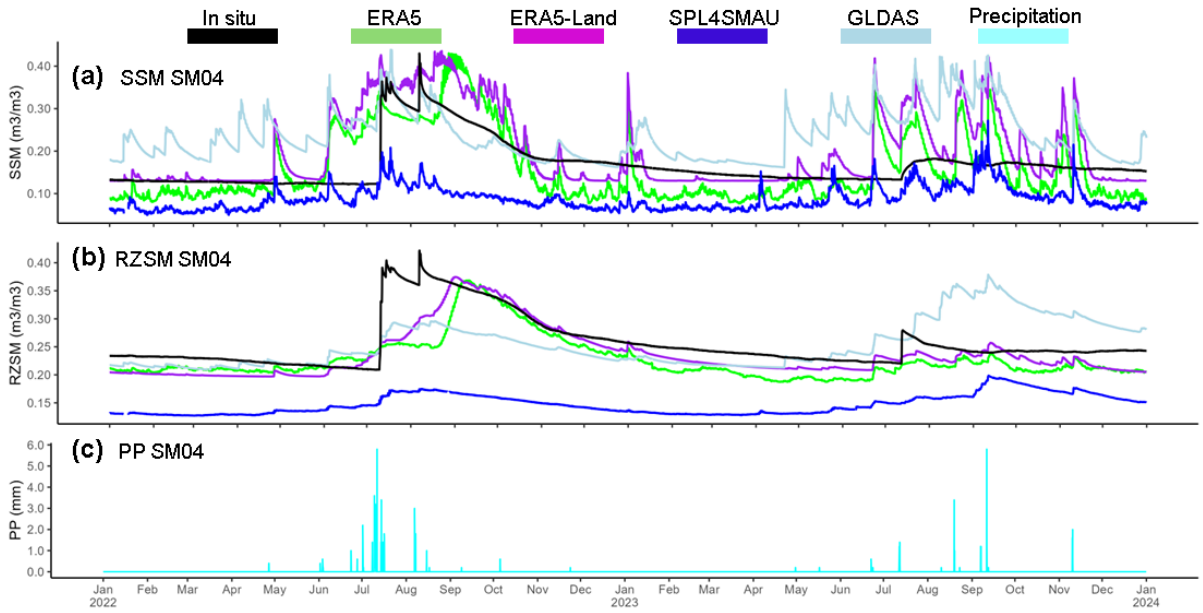

Figure S13: Time series for the 2022–2023 period: (a) Surface soil moisture (SSM), (b) Root zone soil moisture (RZSM), and (c) Precipitation (P) for SM04 (shrubland in PRB).

Table S23: Performance metrics for SSM (RZSM) at SM04. Metrics include ubRMSE, PBIAS, r, ρ and KGE'.

Product	ubRMSE	PBIAS	r	KGE'	ρ
ERA5	0.066 (0.034)	4.8 (-10.8)	0.58 (0.65)	0.41 (0.64)	0.37 (0.74)
ERA5-Land	0.070 (0.032)	21.8 (-7.2)	0.60 (0.73)	0.37 (0.72)	0.36 (0.93)
SPL4SMAU	0.045 (0.040)	-48.6 (-42.4)	0.43 (0.41)	0.25 (0.22)	-0.06 (-0.24)
GLDAS-Noah	0.063 (0.052)	40.9 (2.5)	0.29 (0.25)	0.15 (0.24)	-0.29 (-0.53)

S2.4 SM05

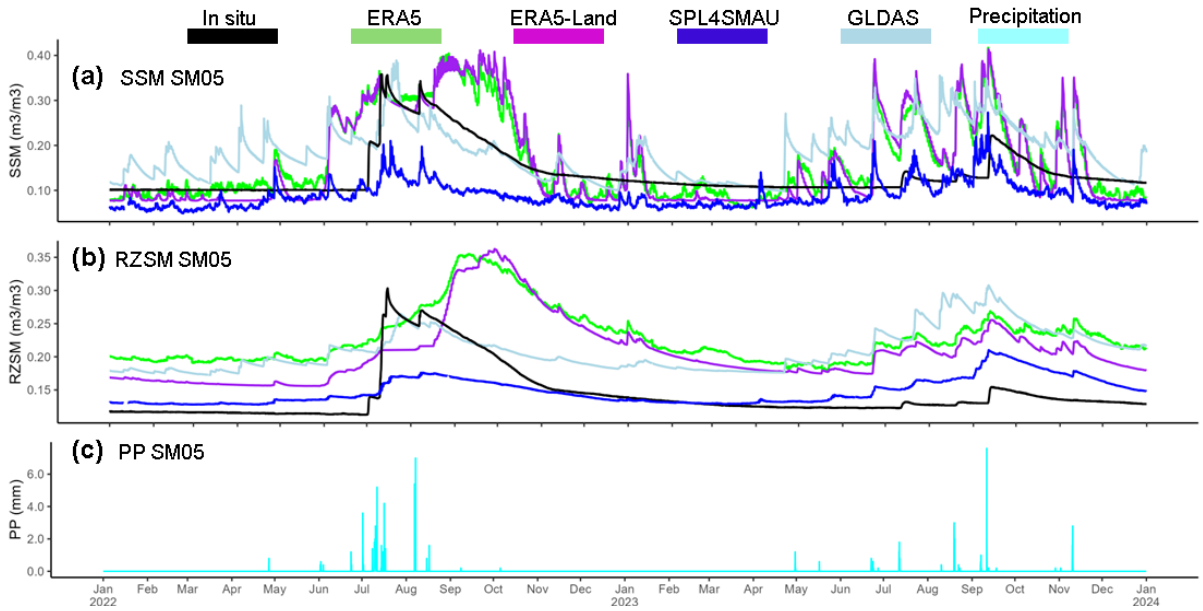

Figure S14: Time series for the 2022–2023 period: (a) Surface soil moisture (SSM), (b) Root zone soil moisture (RZSM), and (c) Precipitation (P) for SM05 (shrubland in PRB).

Table S24: Performance metrics for SSM (RZSM) at SM05. Metrics include ubRMSE, PBIAS, r, ρ and KGE'.

Product	ubRMSE	PBIAS	r	KGE'	ρ
ERA5	0.070 (0.034)	-20.7 (62.0)	0.63 (0.64)	0.49 (0.21)	0.38 (0.81)
ERA5-Land	0.083 (0.044)	22.8 (47.5)	0.60 (0.52)	0.20 (0.31)	0.37 (0.76)
SPL4SMAU	0.044 (0.034)	-36.1 (4.2)	0.51 (0.44)	0.38 (0.25)	0.07 (-0.18)
GLDAS-Noah	0.054 (0.039)	35.8 (49.8)	0.45 (0.33)	0.30 (0.04)	-0.15 (-0.46)

S2.5 SM07

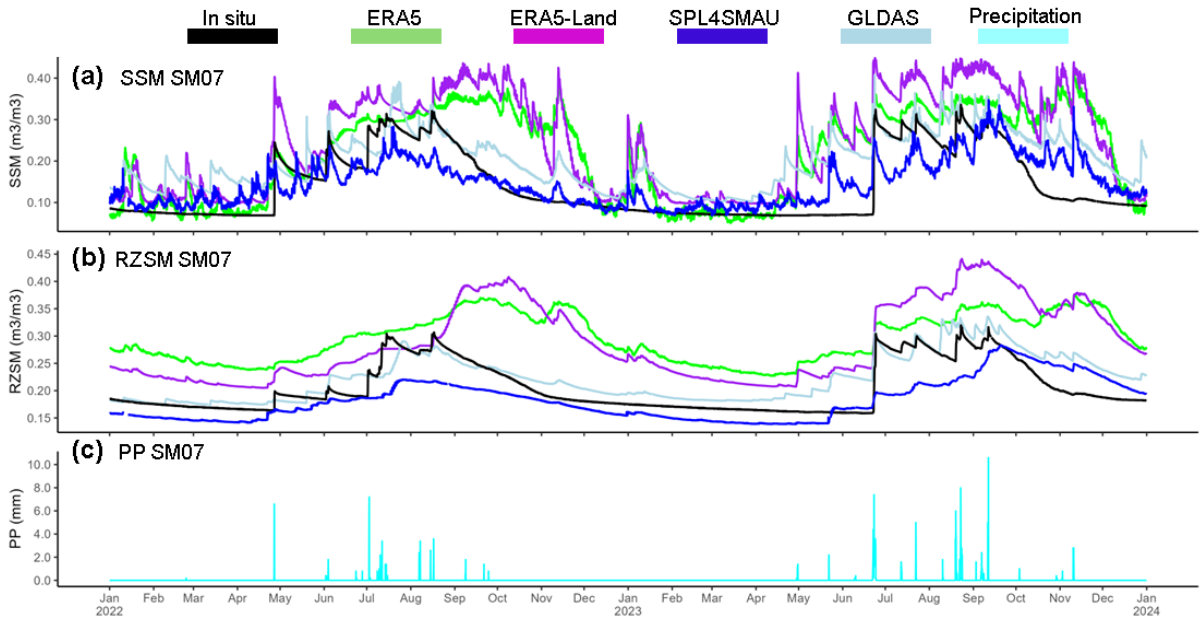

Figure S15: Time series for the 2022–2023 period: (a) Surface soil moisture (SSM), (b) Root zone soil moisture (RZSM), and (c) Precipitation (P) for SM07 (shrubland in MRB).

Table S25: Performance metrics for SSM (RZSM) at SM07. Metrics include ubRMSE, PBIAS, r, ρ and KGE'.

Product	ubRMSE	PBIAS	r	KGE'	ρ
ERA5	0.087 (0.040)	-37.5 (45.7)	0.60 (0.59)	0.43 (0.31)	0.11 (0.26)
ERA5-Land	0.088 (0.053)	82.9 (42.3)	0.66 (0.65)	0.09 (0.44)	0.27 (0.40)
SPL4SMAU	0.055 (0.035)	2.6 (-10.6)	0.71 (0.64)	0.56 (0.62)	0.55 (0.61)
GLDAS-Noah	0.051 (0.027)	46.6 (11.2)	0.75 (0.78)	0.29 (0.69)	0.32 (0.37)

S2.6 SM15

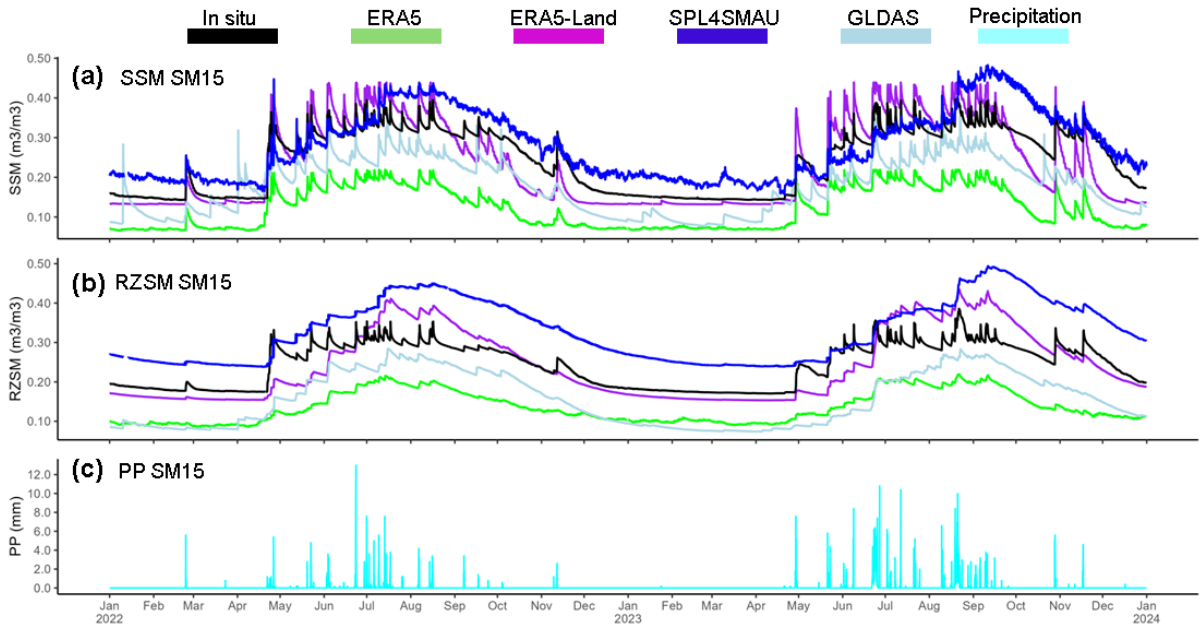

Figure S16: Time series for the 2022–2023 period: (a) Surface soil moisture (SSM), (b) Root zone soil moisture (RZSM), and (c) Precipitation (P) for SM05 (native forest in CRB).

Table S26: Performance metrics for SSM (RZSM) at SM15. Metrics include ubRMSE, PBIAS, r, ρ and KGE'.

Product	ubRMSE	PBIAS	r	KGE'	ρ
ERA5	0.051 (0.035)	99.0 (-44.5)	0.77 (0.77)	-0.04 (0.41)	0.81 (0.57)
ERA5-Land	0.065 (0.057)	-3.6 (-0.7)	0.78 (0.76)	0.57 (0.38)	0.85 (0.79)
SPL4SMAU	0.057 (0.052)	10.5 (32.4)	0.75 (0.72)	0.73 (0.57)	0.68 (0.65)
GLDAS-Noah	0.046 (0.035)	-28.7 (-35.9)	0.82 (0.83)	0.64 (0.13)	0.61 (0.60)

S2.7 SM10

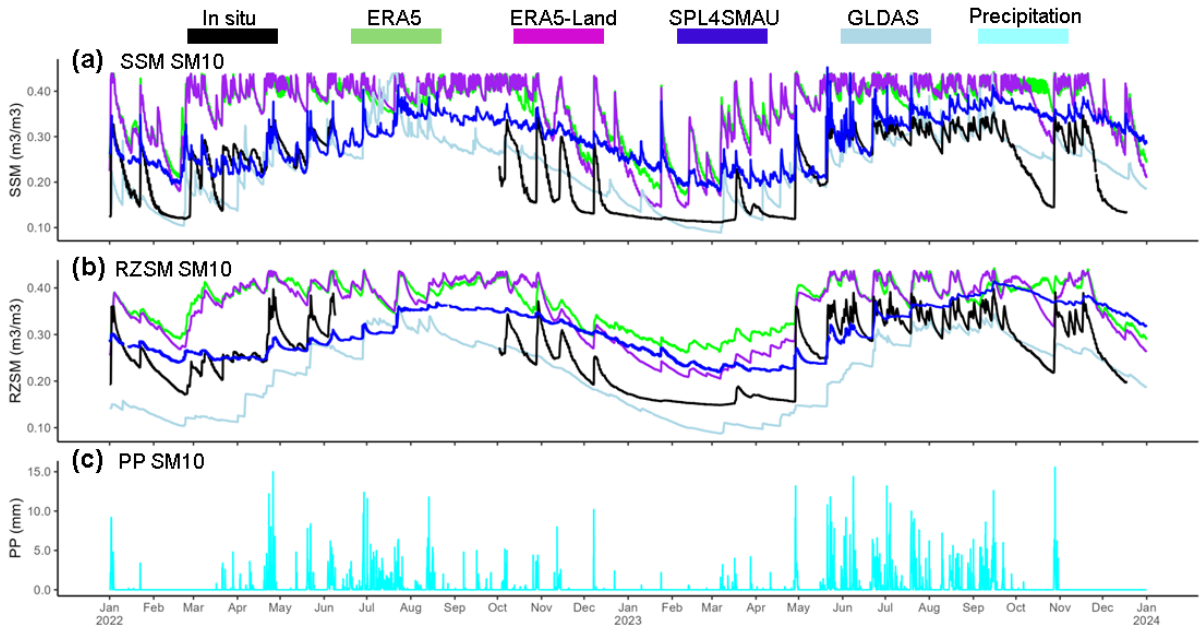

Figure S17: Time series for the 2022–2023 period: (a) Surface soil moisture (SSM), (b) Root zone soil moisture (RZSM), and (c) Precipitation (P) for SM10 (native forest in TRB).

Table S27: Performance metrics for SSM at SM10. Metrics include ubRMSE, PBIAS, r, ρ and KGE'.

Product	ubRMSE	PBIAS	r	KGE'	ρ
ERA5	0.059 (0.042)	-37.1 (40.1)	0.66 (0.78)	0.01 (0.33)	0.61 (0.77)
ERA5-Land	0.062 (0.043)	56.7 (35.2)	0.68 (0.79)	0.26 (0.52)	0.64 (0.82)
SPL4SMAU	0.064 (0.057)	25.0 (14.9)	0.57 (0.58)	0.36 (0.46)	0.58 (0.59)
GLDAS-Noah	0.050 (0.049)	1.5 (-18.2)	0.76 (0.76)	0.73 (0.55)	0.58 (0.62)

S2.8 SM11

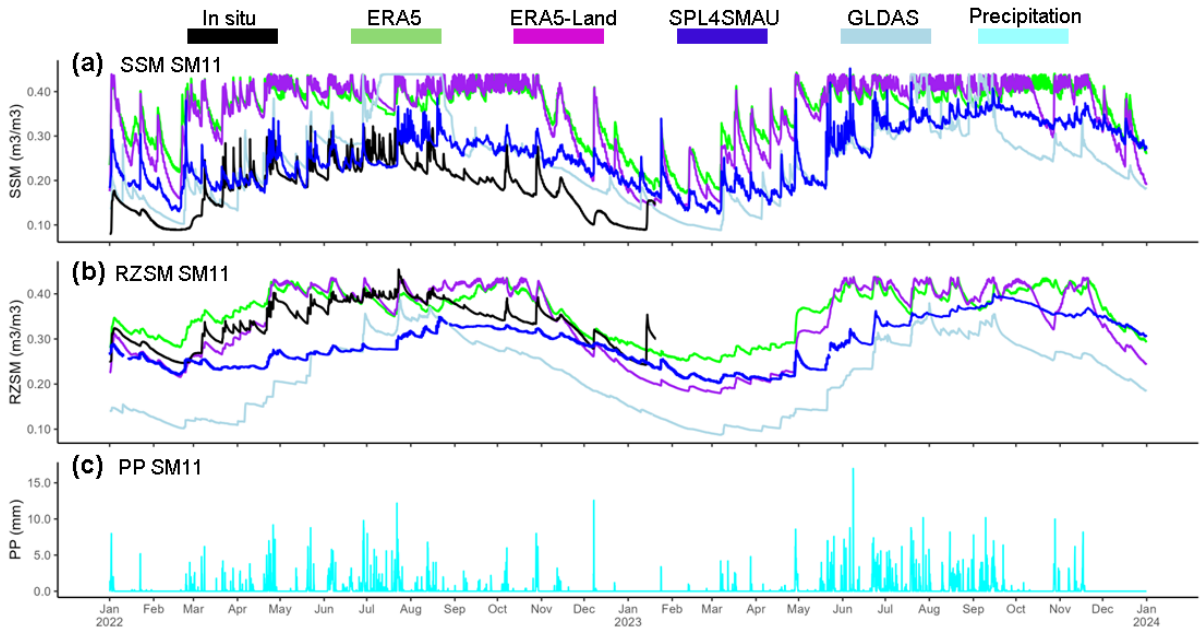

Figure S18: Time series for the 2022–2023 period: (a) Surface soil moisture (SSM), (b) Root zone soil moisture (RZSM), and (c) Precipitation (P) for SM11 (grassland in TRB).

Table S28: Performance metrics for SSM (RZSM) at SM11. Metrics include ubRMSE, PBIAS, r, ρ and KGE'.

Product	ubRMSE	PBIAS	r	KGE'	ρ
ERA5	0.052 (0.035)	-49.4 (8.0)	0.61 (0.69)	0.08 (0.67)	0.38 (0.48)
ERA5-Land	0.060 (0.048)	92.1 (1.9)	0.69 (0.78)	0.01 (0.35)	0.41 (0.62)
SPL4SMAU	0.051 (0.044)	29.2 (-17.1)	0.48 (0.44)	0.33 (0.41)	0.25 (0.51)
GLDAS-Noah	0.055 (0.045)	35.9 (-33.2)	0.79 (0.82)	0.54 (-0.5)	0.16 (0.47)

S2.9 SM12

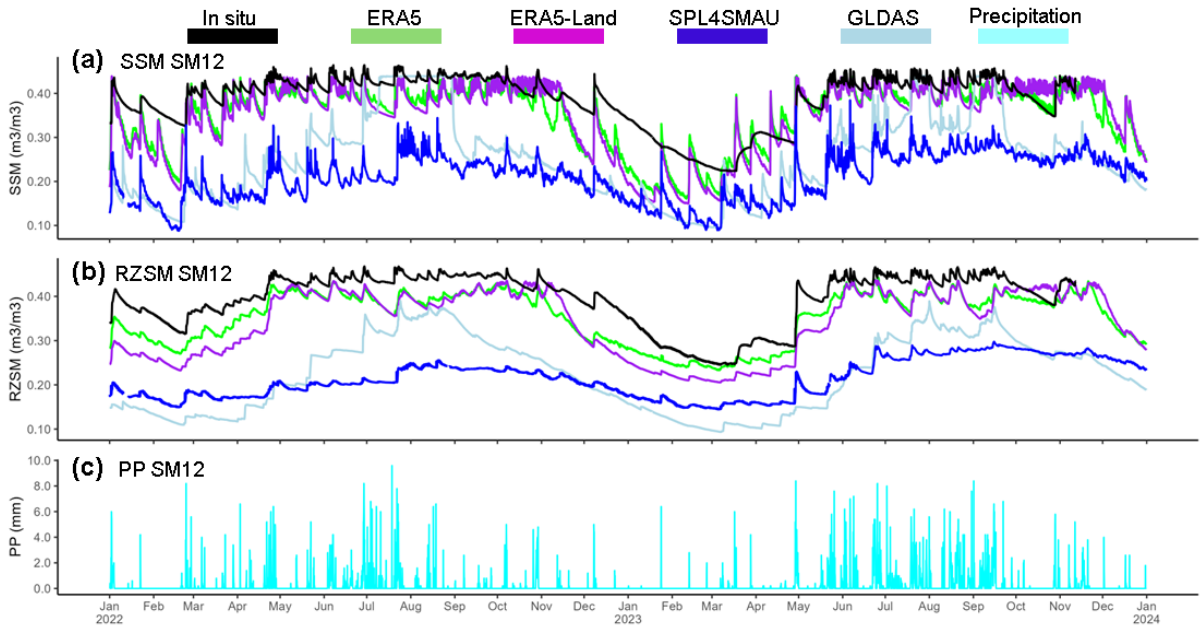

Figure S19: Time series for the 2022–2023 period: (a) Surface soil moisture (SSM), (b) Root zone soil moisture (RZSM), and (c) Precipitation (P) for SM12 (native forest in TRB).

Table S29: Performance metrics for SSM at SM12. Metrics include ubRMSE, PBIAS, r, ρ and KGE'.

Product	ubRMSE	PBIAS	r	KGE'	ρ
ERA5	0.048 (0.032)	9.4 (-10.3)	0.75 (0.85)	0.61 (0.79)	0.76 (0.88)
ERA5-Land	0.055 (0.045)	-10.0 (-13.5)	0.73 (0.80)	0.37 (0.47)	0.69 (0.74)
SPL4SMAU	0.046 (0.045)	-47.7 (-47.0)	0.65 (0.66)	0.04 (0.31)	0.42 (0.33)
GLDAS-Noah	0.065 (0.052)	-35.4 (-42.5)	0.69 (0.77)	-0.49 (-0.47)	0.44 (0.57)

S2.10 SM14

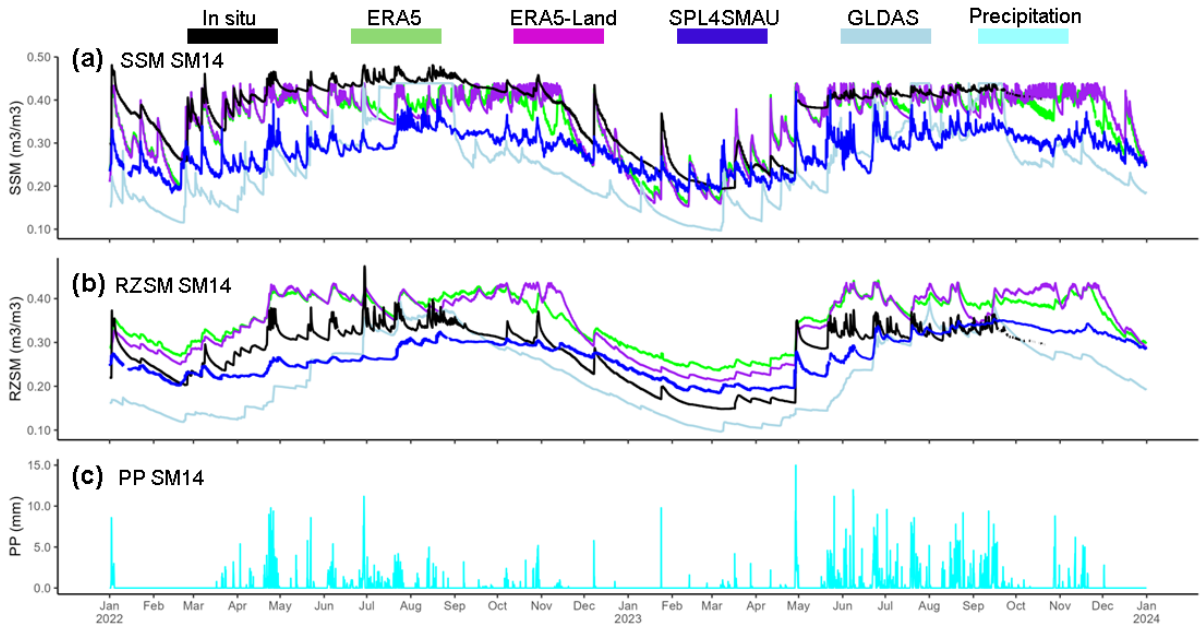

Figure S20: Time series for the 2022–2023 period: (a) Surface soil moisture (SSM), (b) Root zone soil moisture (RZSM), and (c) Precipitation (P) for SM14 (native forest in TRB).

Table S30: Performance metrics for SSM (RZSM) at SM14. Metrics include ubRMSE, PBIAS, r, ρ and KGE'.

Product	ubRMSE	PBIAS	r	KGE'	ρ
ERA5	0.049 (0.033)	7.1 (25.8)	0.78 (0.85)	0.77 (0.60)	0.71 (0.81)
ERA5-Land	0.053 (0.041)	-6.3 (23.6)	0.76 (0.81)	0.72 (0.68)	0.68 (0.73)
SPL4SMAU	0.054 (0.046)	-26.5 (-6.4)	0.71 (0.68)	0.55 (0.60)	0.53 (0.52)
GLDAS-Noah	0.065 (0.053)	-32.9 (-18.5)	0.71 (0.77)	0.07 (0.32)	0.46 (0.62)

S3 Precipitation comparison

This section presents time series comparisons of precipitation between in situ observations and gridded estimates from ERA5 and ERA5-Land for each study site during the 2022-2023 period. In addition, basic performance metrics are provided to characterise the agreement between reanalysis precipitation and in situ rainfall measurements. These results are intended to support the interpretation of soil moisture dynamics rather than to provide a standalone evaluation of precipitation products.

S3.1 SM01

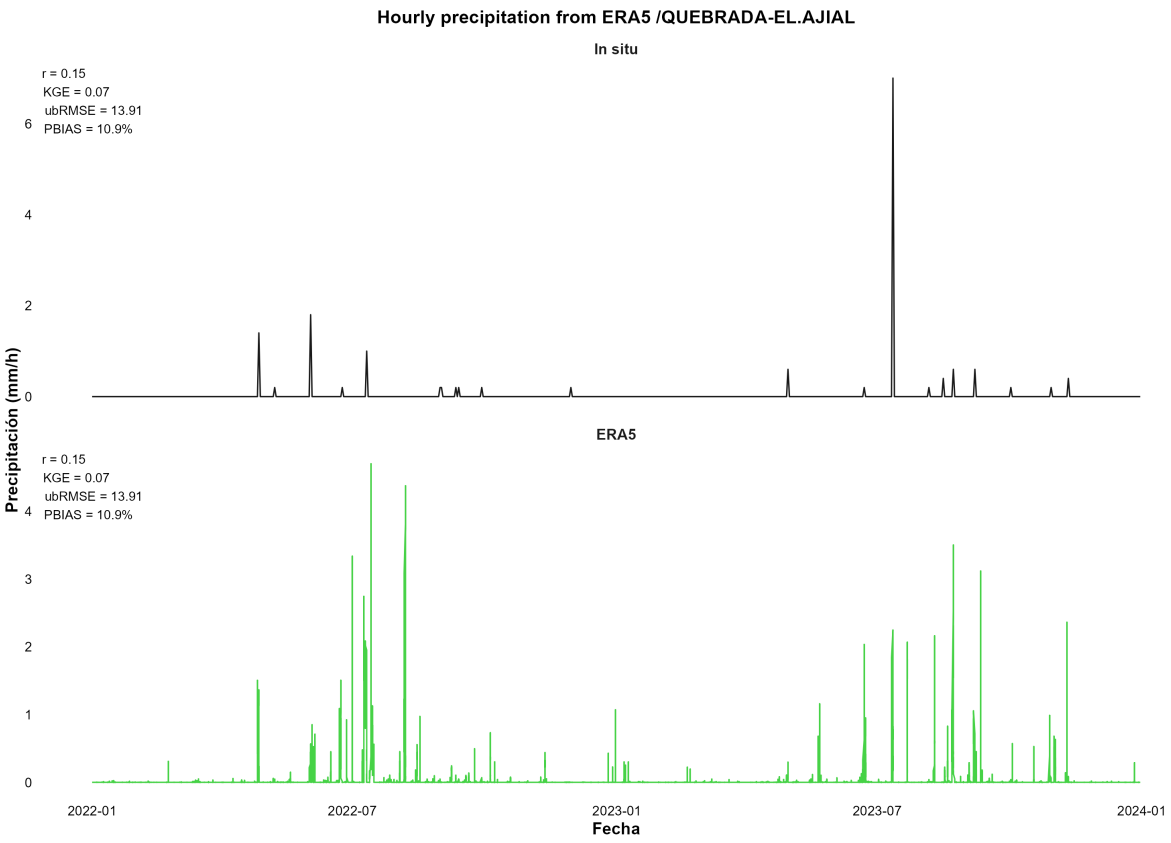

Figure S21: Time series comparison of in situ precipitation and ERA5 estimates at SM01 (native forest, PRB) for the 2022-2023 period.

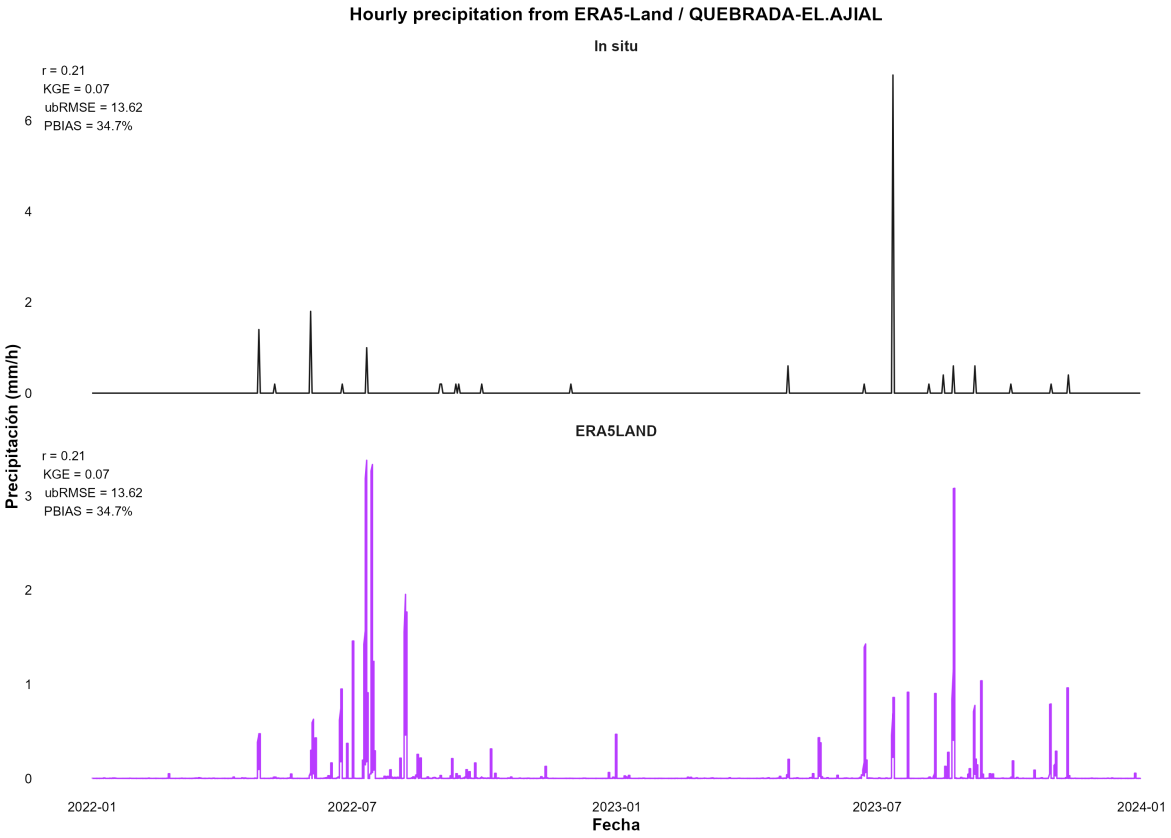

Figure S22: Time series comparison of in situ precipitation and ERA5-Land estimates at SM01 (native forest, PRB) for the 2022-2023 period.

S3.2 SM02

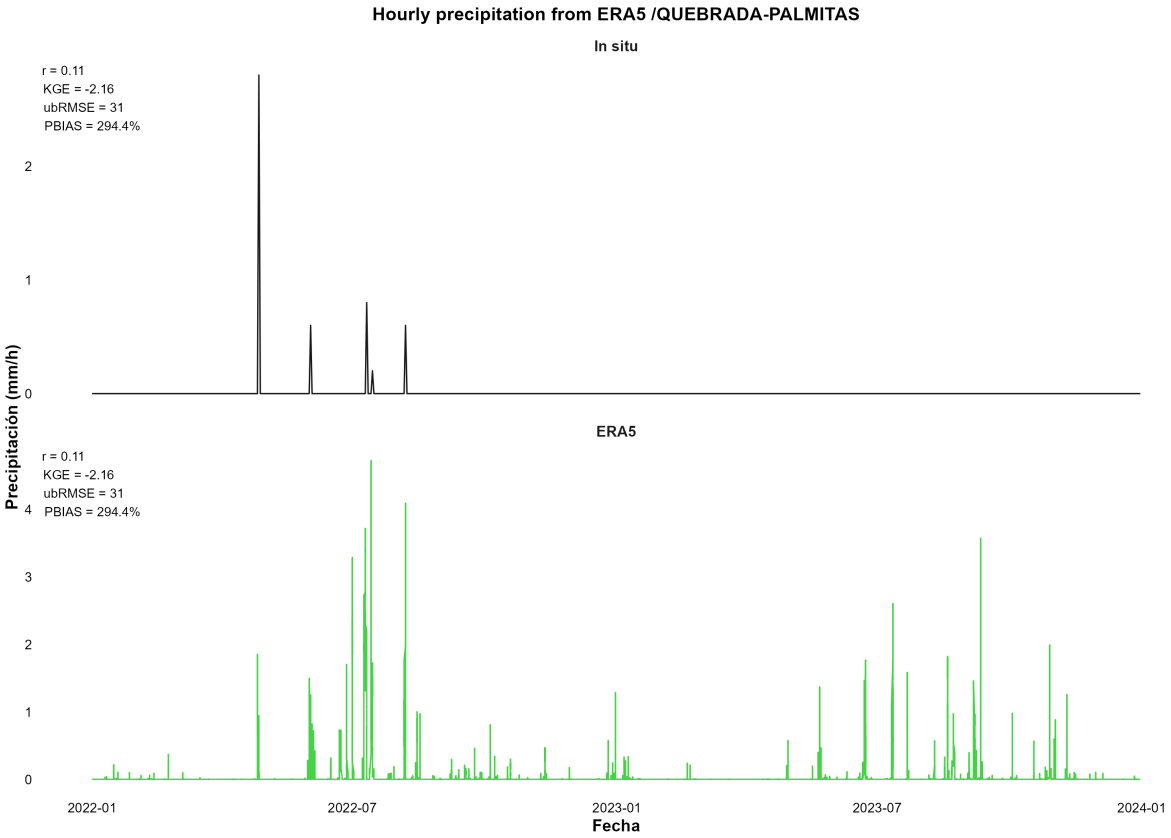

Figure S23: Time series comparison of in situ precipitation and ERA5 estimates at SM02 (shrubland, PRB) for the 2022-2023 period.

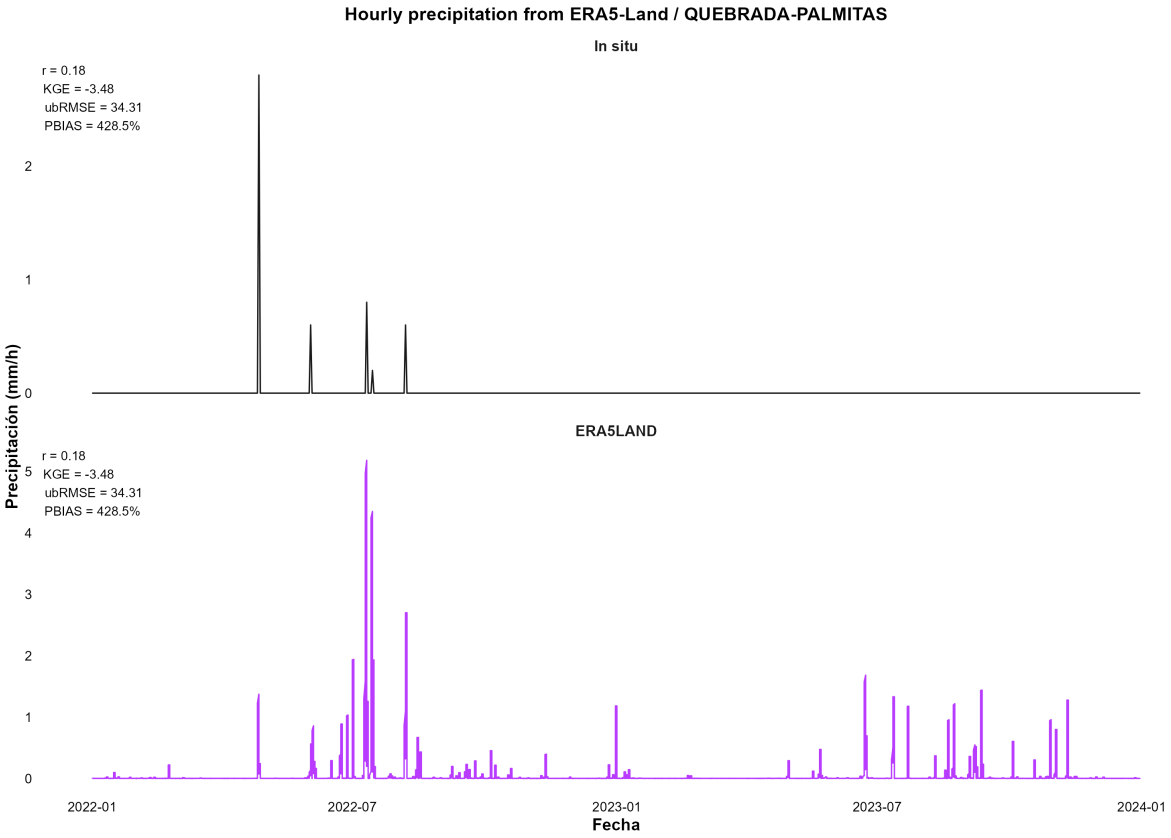

Figure S24: Time series comparison of in situ precipitation and ERA5-Land estimates at SM02 (shrubland, PRB) for the 2022-2023 period.

S3.3 SM04

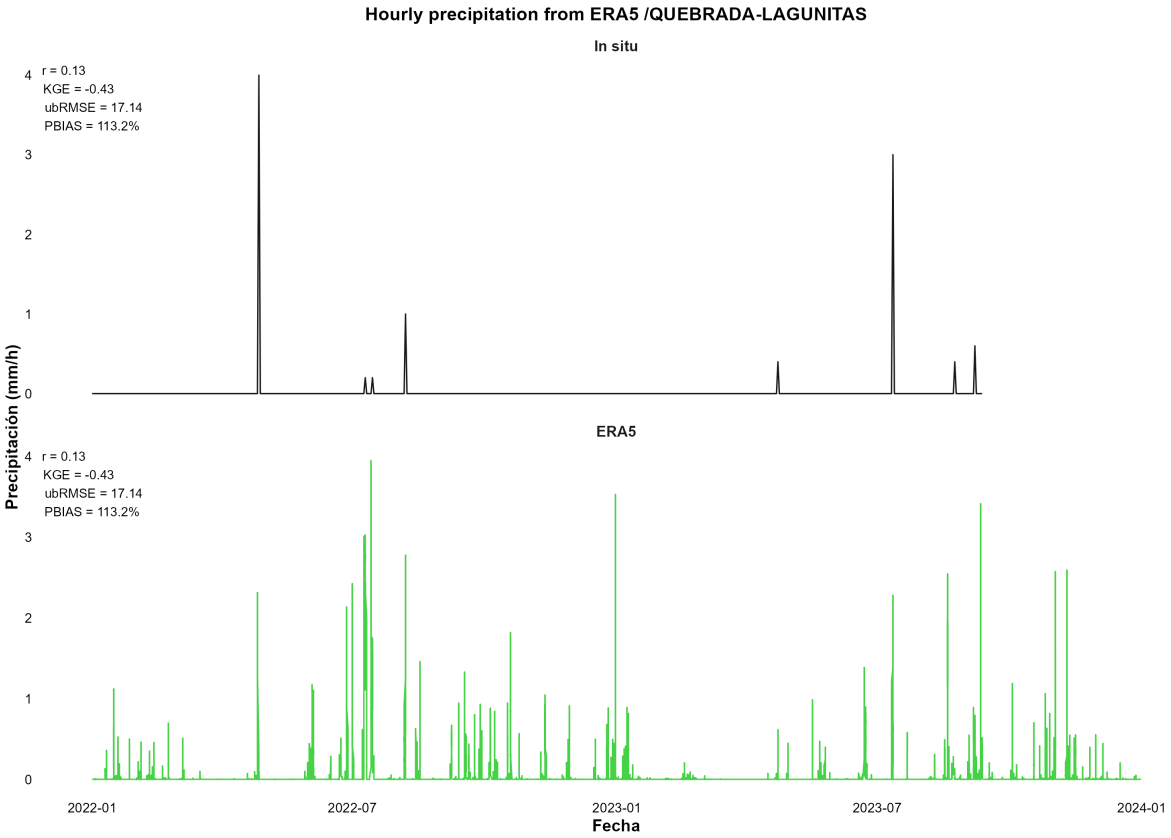

Figure S25: Time series comparison of in situ precipitation and ERA5 estimates at SM05 (shrubland, PRB) for the 2022-2023 period.

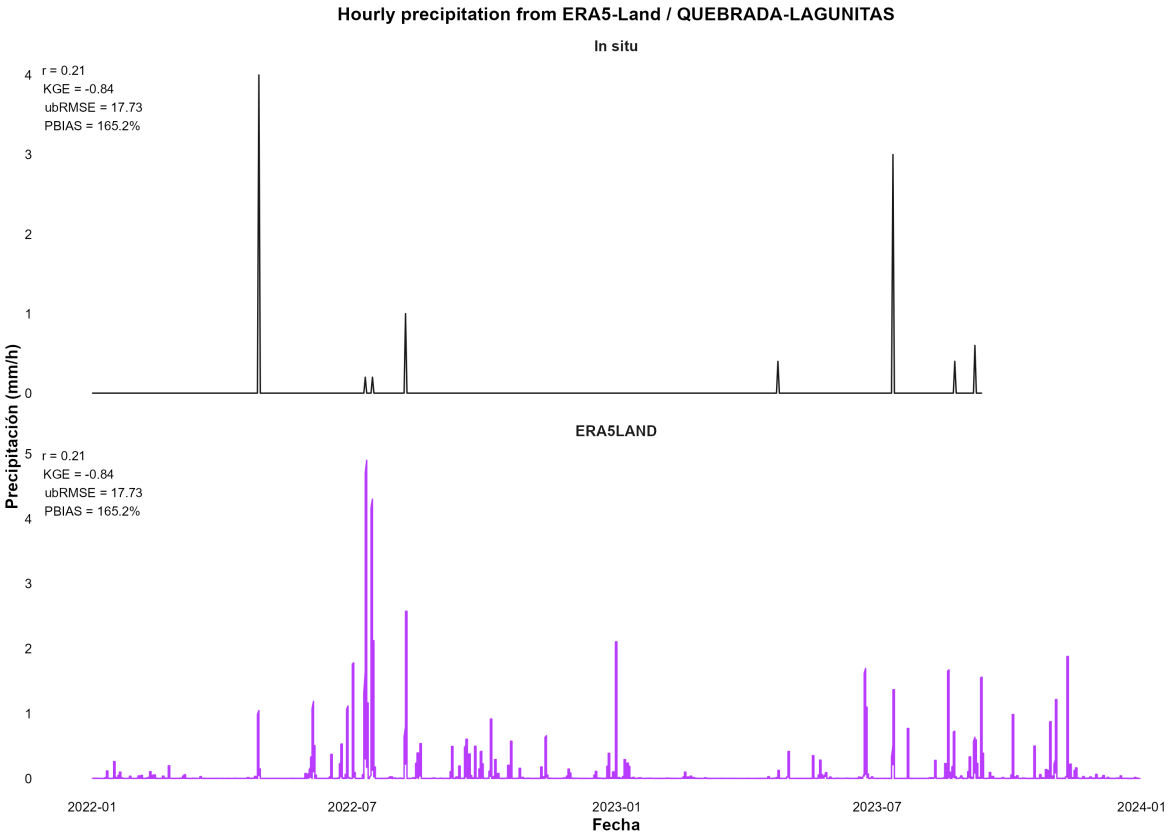

Figure S26: Time series comparison of in situ precipitation and ERA5-Land estimates at SM04 (shrubland, PRB) for the 2022-2023 period.

S3.4 SM05

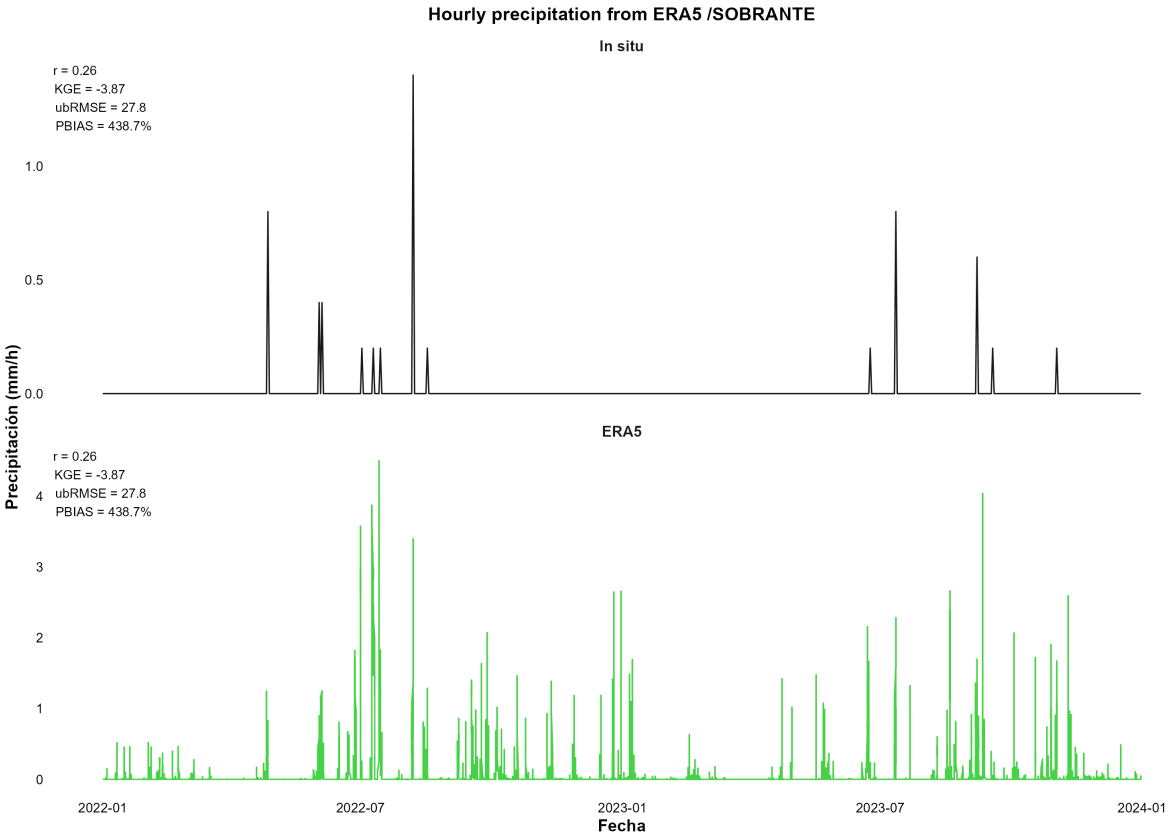

Figure S27: Time series comparison of in situ precipitation and ERA5 estimates at SM05 (shrubland, PRB) for the 2022-2023 period.

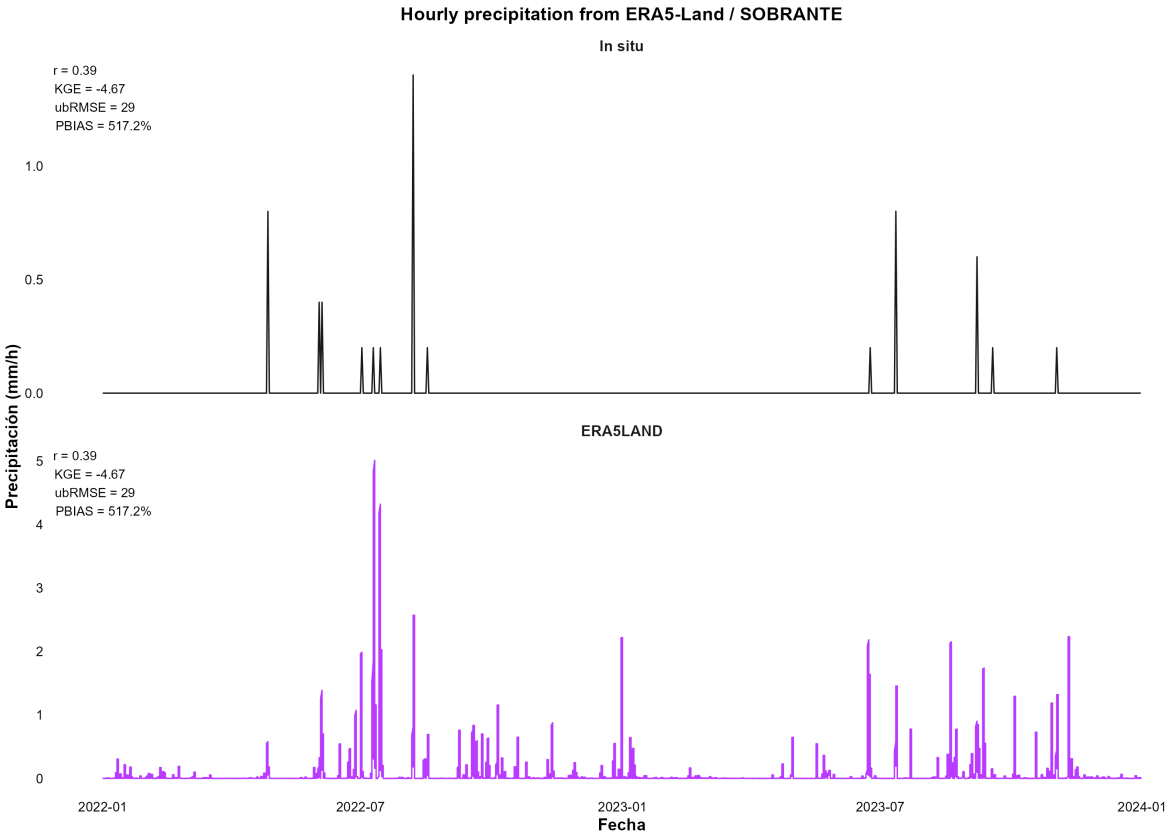

Figure S28: Time series comparison of in situ precipitation and ERA5-Land estimates at SM05 (shrubland, PRB) for the 2022-2023 period.

S3.5 SM07

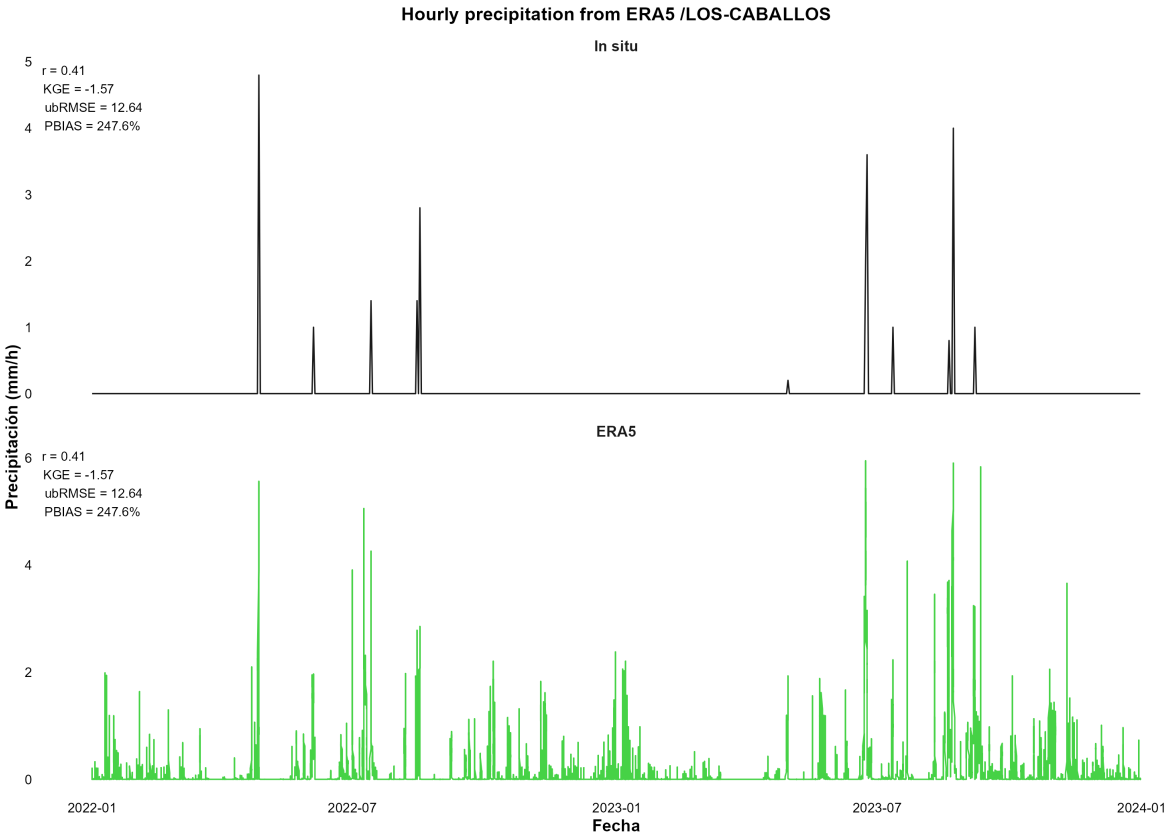

Figure S29: Time series comparison of in situ precipitation and ERA5 estimates at SM07 (shrubland, MRB) for the 2022-2023 period.

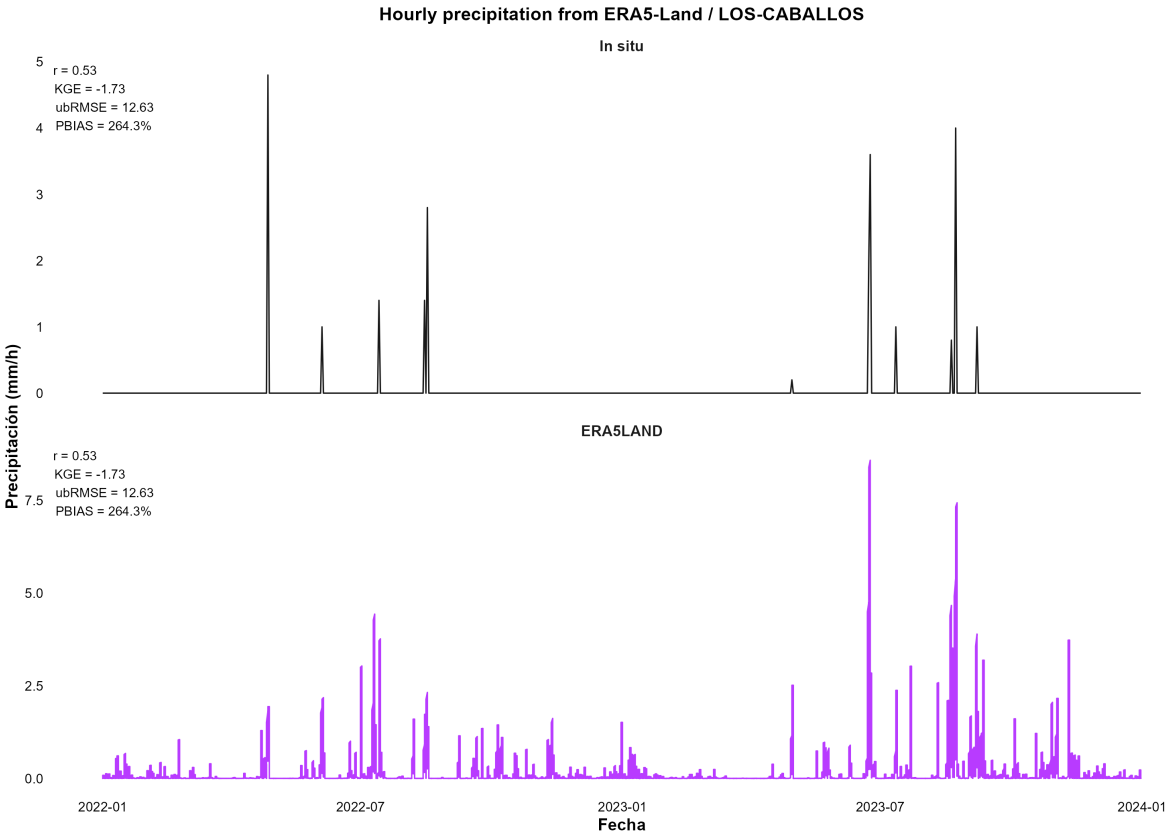

Figure S30: Time series comparison of in situ precipitation and ERA5-Land estimates at SM07 (shrubland, MRB) for the 2022-2023 period.

S3.6 SM15

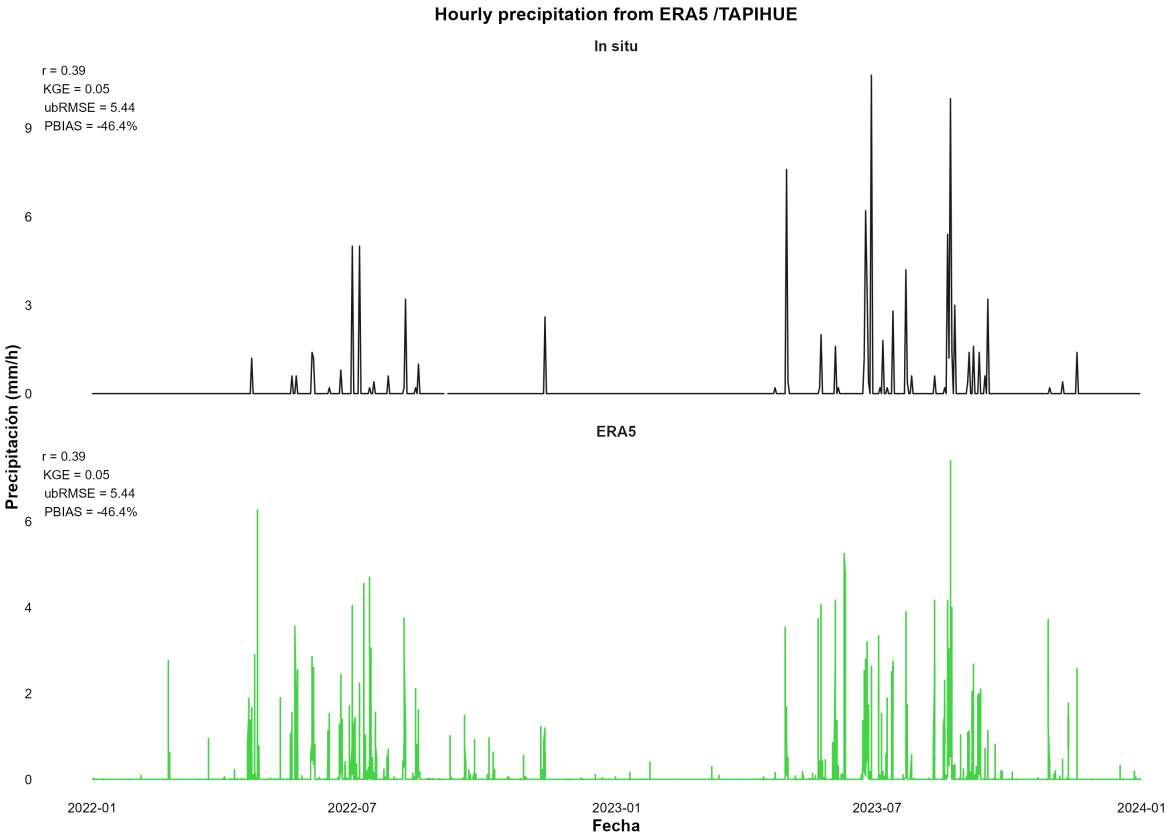

Figure S31: Time series comparison of in situ precipitation and ERA5 estimates at SM15 (native forest, CRB) for the 2022-2023 period.

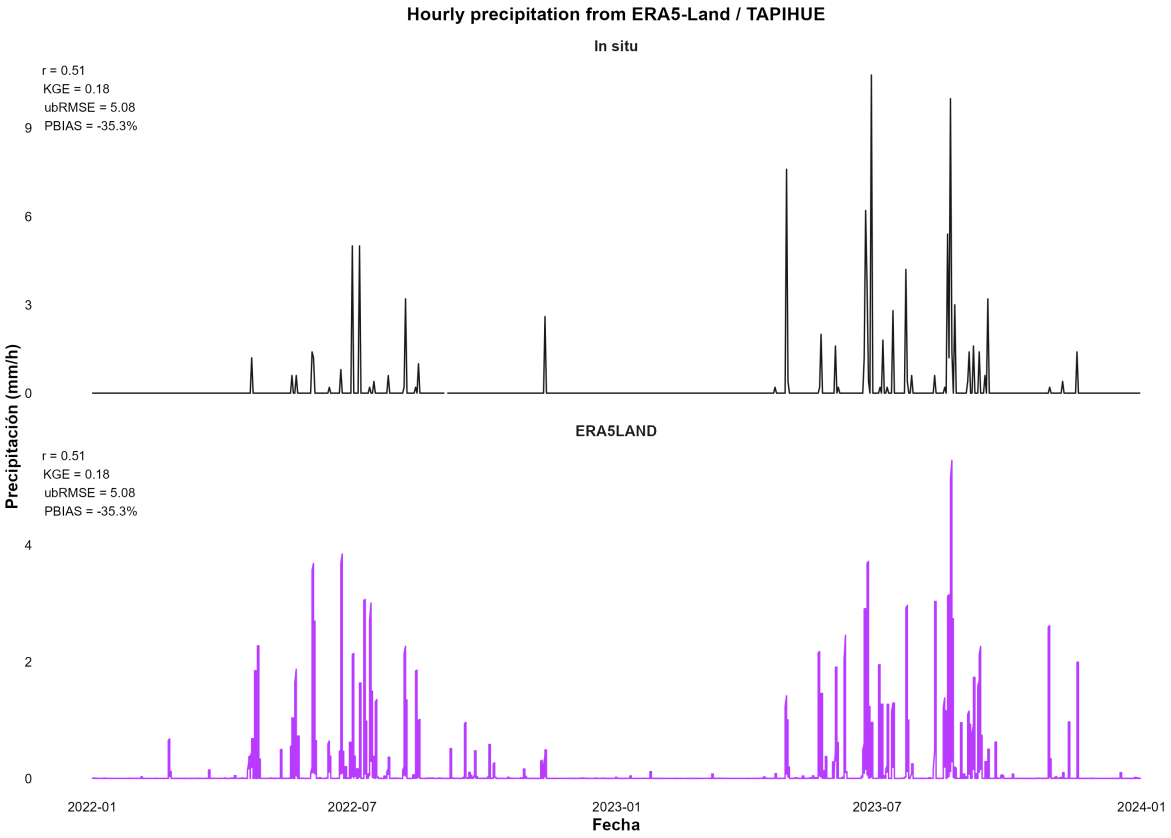

Figure S32: Time series comparison of in situ precipitation and ERA5-Land estimates at SM15 (native forest, CRB) for the 2022-2023 period.

S3.7 SM10

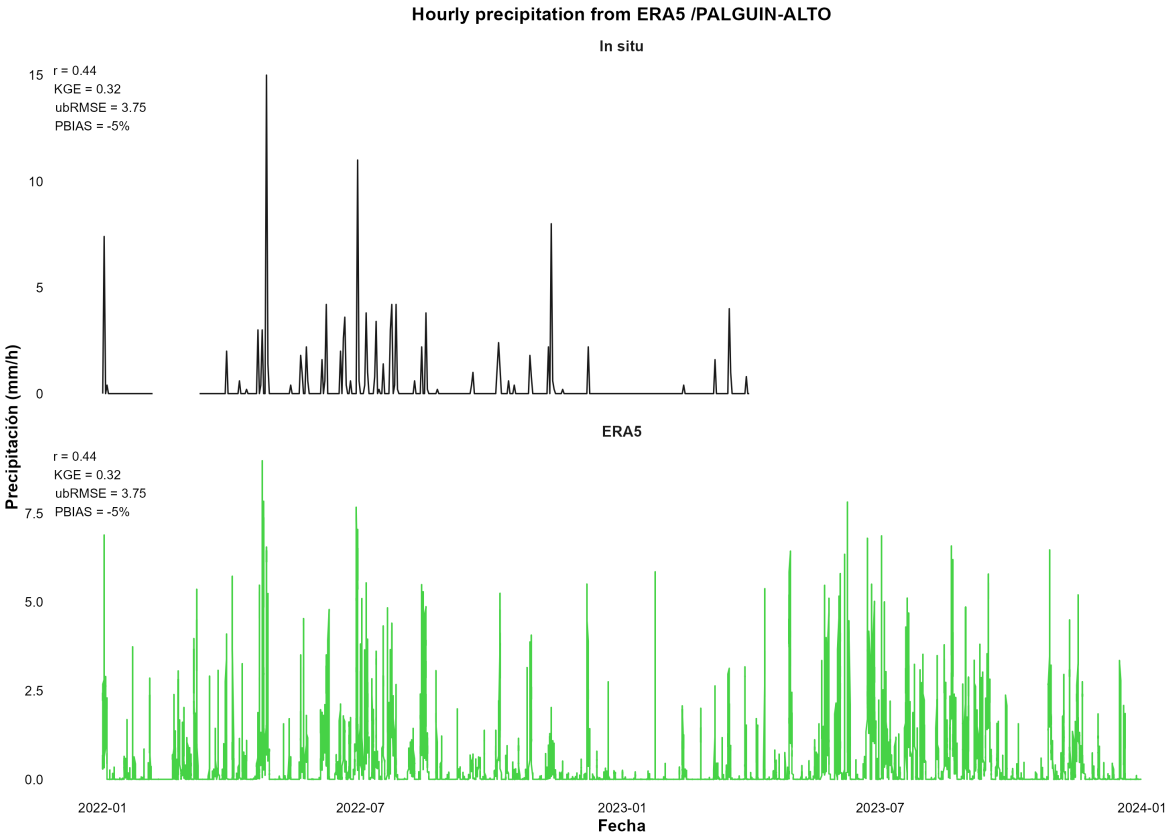

Figure S33: Time series comparison of in situ precipitation and ERA5 estimates at SM10 (native forest, TRB) for the 2022-2023 period.

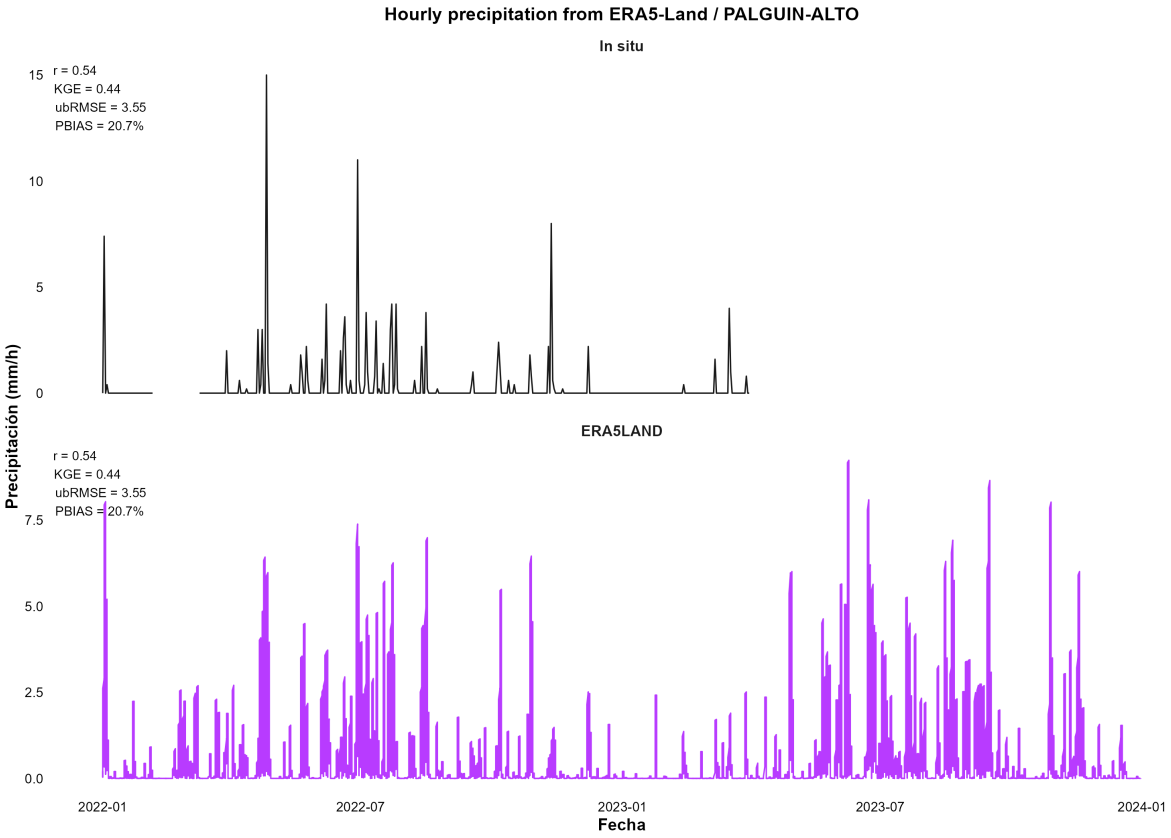

Figure S34: Time series comparison of in situ precipitation and ERA5-Land estimates at SM10 (native forest, TRB) for the 2022-2023 period.

S3.8 SM11

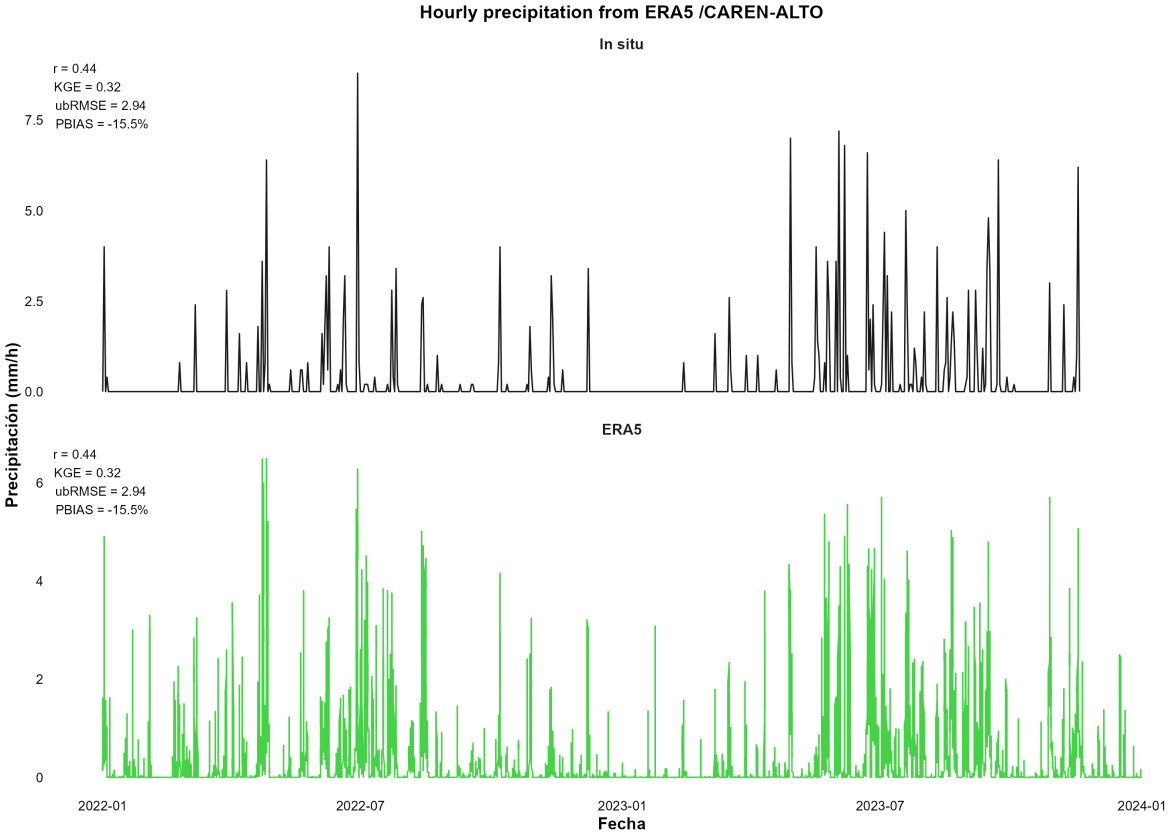

Figure S35: Time series comparison of in situ precipitation and ERA5 estimates at SM11 (grassland, TRB) for the 2022-2023 period.

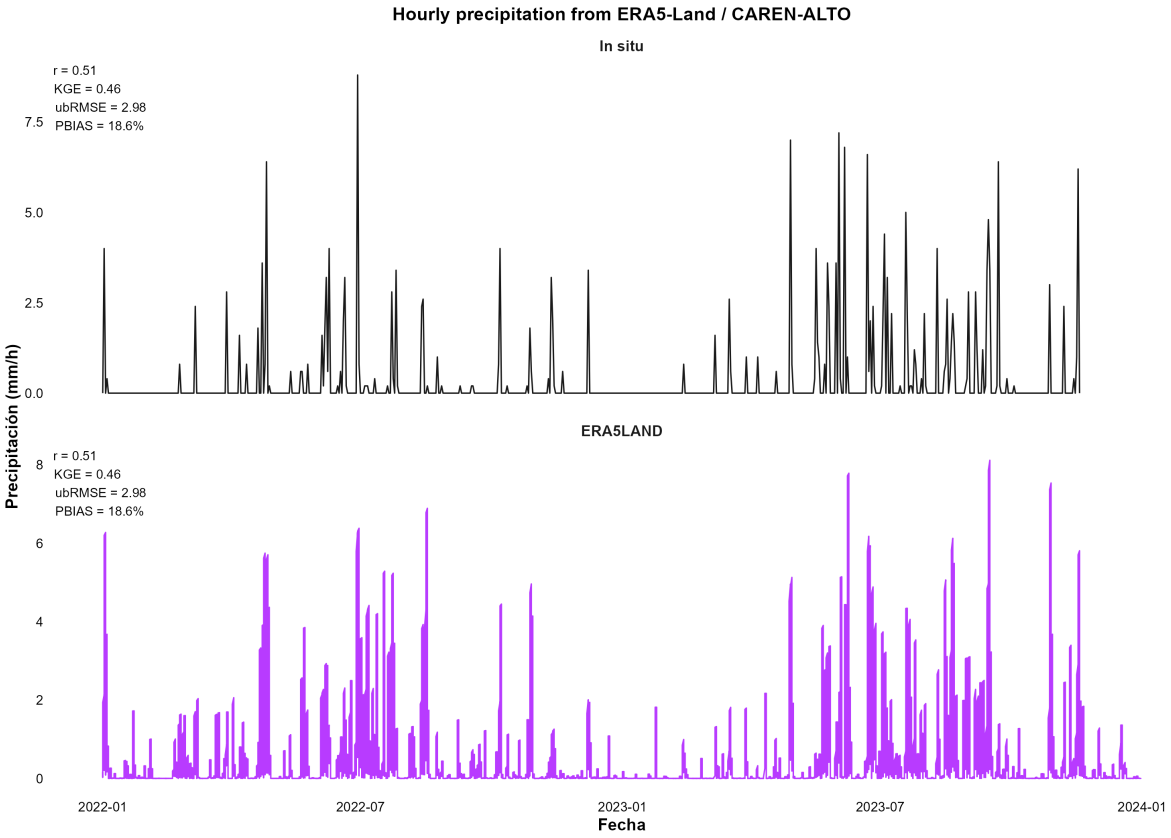

Figure S36: Time series comparison of in situ precipitation and ERA5-Land estimates at SM11 (grassland, TRB) for the 2022-2023 period.

S3.9 SM12

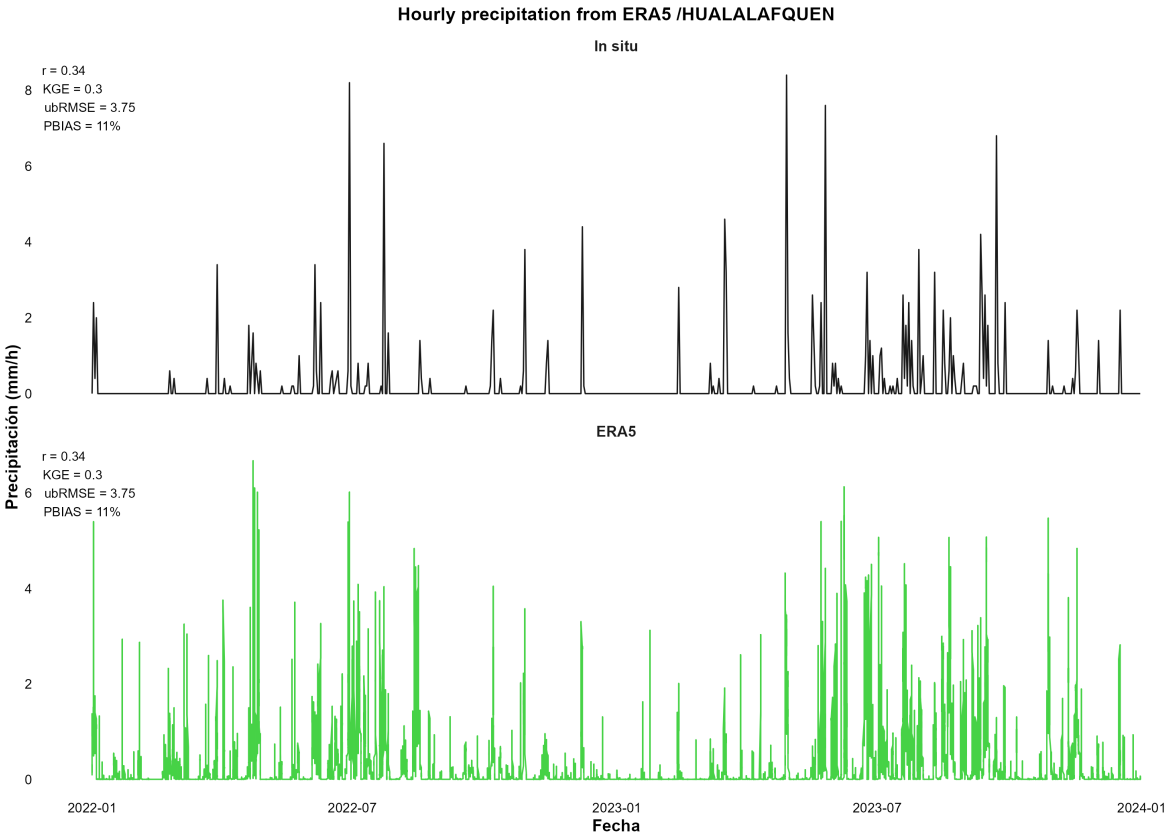

Figure S37: Time series comparison of in situ precipitation and ERA5 estimates at SM12 (native forest, TRB) for the 2022-2023 period.

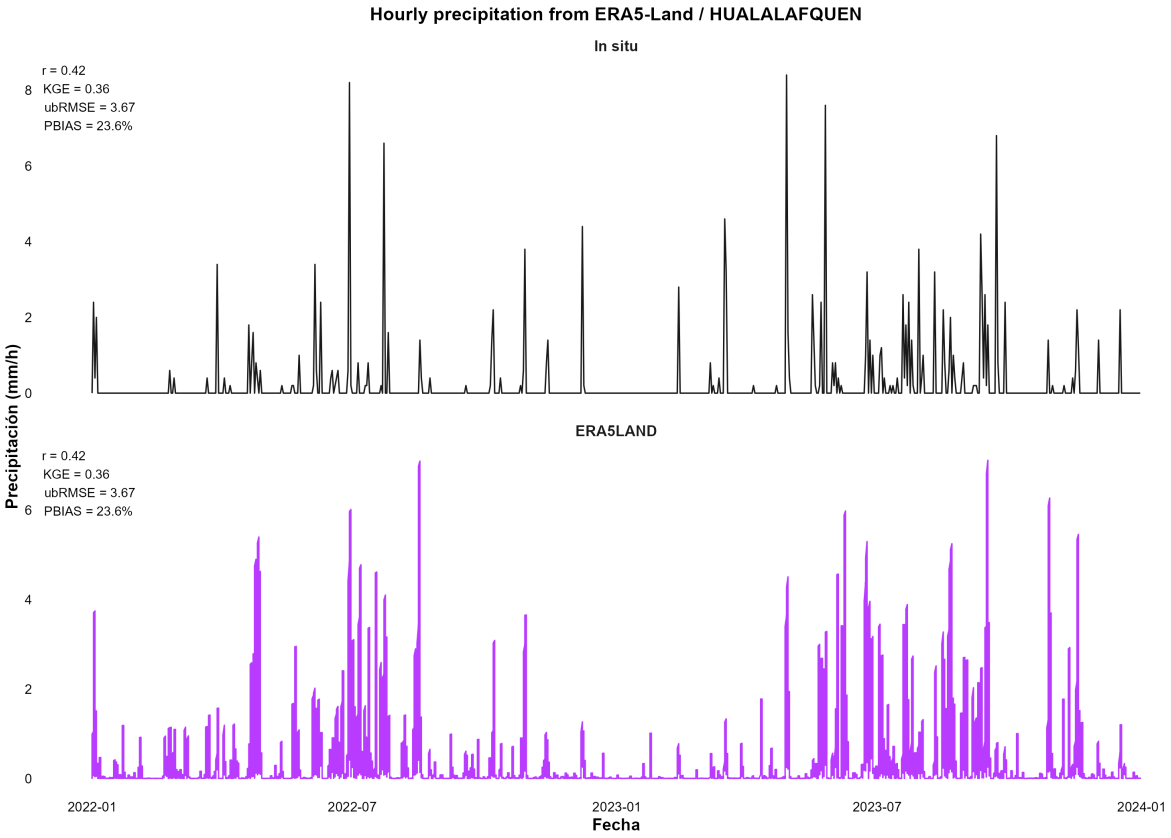

Figure S38: Time series comparison of in situ precipitation and ERA5-Land estimates at SM12 (native forest, TRB) for the 2022-2023 period.

S3.10 SM14

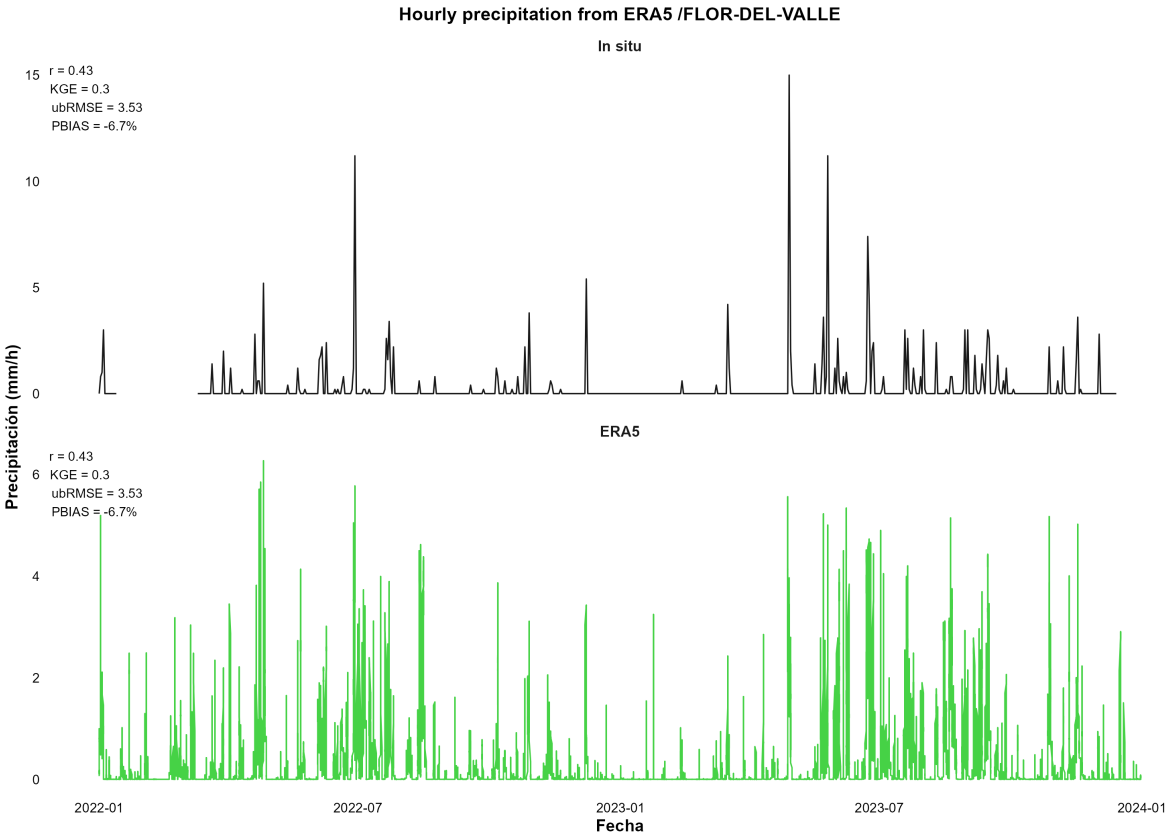

Figure S39: Time series comparison of in situ precipitation and ERA5 estimates at SM14 (native forest, TRB) for the 2022-2023 period.

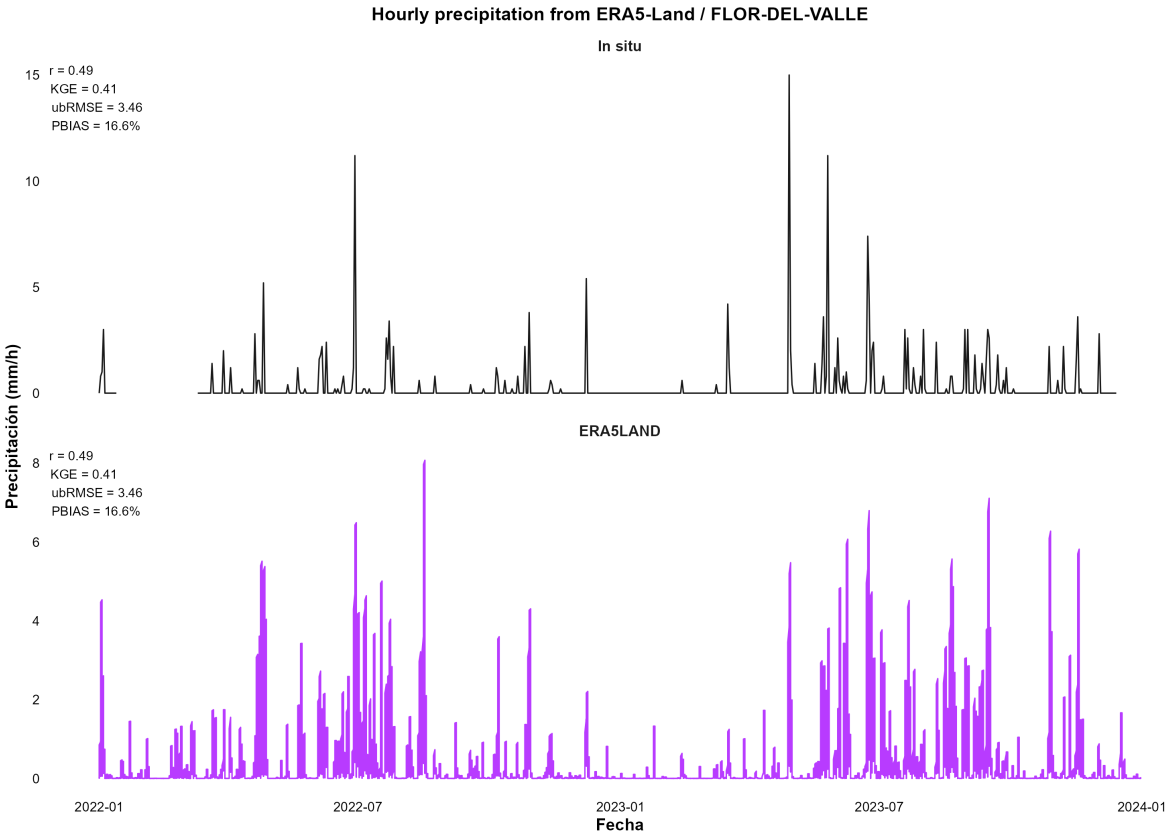

Figure S40: Time series comparison of in situ precipitation and ERA5-Land estimates at SM14 (native forest, TRB) for the 2022-2023 period.

S4 Performance metrics at each in situ monitoring site

To facilitate the identification of the performance level (i.e., excellent, good, satisfactory, or unsatisfactory) of each gridded soil moisture product at each monitoring site, this section presents colour-coded versions of Tables A.1, A.2, A.3, and A.4 from the manuscript. Table S31 is repeated here from the manuscript just to have a self-contained document.

Table S31: Performance metrics, including formulas, ranges of variation, ideal values, and interpretation criteria.

Metric	Formula	Range	Ideal value	Interpretation criteria	Reference
ubRMSE	$\sqrt{\frac{1}{N}\sum_{i=1}^{N}(GP_i - IS_i - \text{Bias})^2}$	$[0, +\infty[$	0	E < 0.04 ; G > 0.04 ; S > 0.08 ; U > 0.12	Entekhabi et al. (2014)
PBIAS	$\frac{1}{N}\sum_{i=1}^{N}(GP_i - IS_i)$	$]-\infty, +\infty[$	0	E $< \lvert 10\% \rvert$; G $< \lvert 20\% \rvert$; S $< \lvert 30\% \rvert$; U $\geq \lvert 30\% \rvert$	Yapo et al. (1996)
ρ	$1 - \frac{6\sum_{i=1}^{N} d_i^2}{N(N^2-1)}$	$[-1, 1]$	1	E ≥ 0.75 ; G ≥ 0.65 ; S ≥ 0.50 ; U < 0.50	**?**
KGE'	$1 - \sqrt{(r-1)^2 + \left(\frac{\text{CV}_{GP}}{\text{CV}_{IS}} - 1\right)^2 + \left(\frac{\overline{IS}}{\overline{GP}} - 1\right)^2}$	$]-\infty, 1]$	1	E ≥ 0.70 ; G ≥ 0.30 ; S $\geq$ -0.40 ; U $<$ -0.40	Kling et al. (2012)

GP: gridded product; IS: in situ observation; CV: coefficient of variation; E: Excellent; G: Good; S: Satisfactory; U: Unsatisfactory

S4.1 SSM: ubRMSE and PBIAS

Table S32: Surface soil moisture metrics: ubRMSE and PBIAS obtained by each gridded soil moisture product at each in situ monitoring site.

N°	ID	ubRMSE (m^3/m^3)				PBIAS (%)			
		ERA5	ERA5-Land	SMAP-L4	GLDAS-Noah	ERA5	ERA5-Land	SMAP-L4	GLDAS-Noah
1	SM01	0.065	0.051	0.034	0.059	30.1	57.1	-33.5	21.5
2	SM02	0.070	0.061	0.043	0.058	90.7	95.7	-3.1	107.5
3	SM04	0.063	0.067	0.047	0.067	-5.1	21.0	-47.4	42.7
4	SM05	0.066	0.077	0.046	0.057	23.4	20.0	-35.1	35.4
5	SM07	0.080	0.077	0.052	0.049	54.2	75.1	4.1	42.8
6	SM15	0.039	0.046	0.040	0.034	-49.8	-3.5	14.3	-26.6
7	SM10	0.051	0.050	0.061	0.048	59.5	57.1	26.7	0.3
8	SM11	0.044	0.051	0.046	0.058	96.6	91.3	29.4	35.4
9	SM12	0.037	0.044	0.040	0.068	-8.5	-10.2	-46.8	-35.1
10	SM14	0.033	0.037	0.049	0.065	-6.6	-6.7	-25.5	-32.6

Coloured according to interpretation criteria (defined in Table S31): E = Excellent (Green), G = Good (Yellow), S = Satisfactory (Orange), U = Unsatisfactory (Red).

S4.2 SSM: ρ and KGE'

Table S33: Surface soil moisture metrics: Spearman correlation (ρ) and modified Kling-Gupta Efficiency (KGE') obtained by each gridded soil moisture product at each in situ monitoring site.

N°	ID	ρ				KGE'			
		ERA5	ERA5-Land	SMAP-L4	GLDAS-Noah	ERA5	ERA5-Land	SMAP-L4	GLDAS-Noah
1	SM01	0.34	0.29	0.06	-0.37	0.46	0.27	0.56	0.36
2	SM02	0.31	0.37	0.06	-0.31	0.06	0.00	0.42	-0.31
3	SM04	0.37	0.36	-0.06	-0.29	0.26	0.43	0.27	0.15
4	SM05	0.38	0.37	0.07	-0.15	0.46	0.30	0.38	0.31
5	SM07	0.11	0.27	0.55	0.32	0.36	0.19	0.58	0.35
6	SM15	0.81	0.85	0.68	0.61	0.41	0.62	0.80	0.67
7	SM10	0.61	0.64	0.58	0.58	0.19	0.28	0.38	0.78
8	SM11	0.38	0.41	0.25	0.16	-0.11	0.03	0.35	0.54
9	SM12	0.76	0.69	0.42	0.44	0.63	0.47	0.16	-0.58
10	SM14	0.71	0.68	0.53	0.46	0.88	0.85	0.61	0.00

Coloured according to interpretation criteria (defined in Table S31): E = Excellent (Green), G = Good (Yellow), S = Satisfactory (Orange), U = Unsatisfactory (Red).

S4.3 RZSM: ubRMSE and PBIAS

Table S34: Root zone soil moisture metrics: ubRMSE and PBIAS obtained by each gridded soil moisture product at each in situ monitoring site.

N°	ID	ubRMSE (m^3/m^3)				PBIAS (%)			
		ERA5	ERA5-Land	SMAP-L4	GLDAS-Noah	ERA5	ERA5-Land	SMAP-L4	GLDAS-Noah
1	SM01	0.024	0.015	0.023	0.043	68.10	46.00	-9.70	7.90
2	SM02	0.018	0.009	0.029	0.050	132.30	101.90	15.80	46.20
3	SM04	0.029	0.024	0.040	0.051	-11.10	-7.50	-42.30	-0.30
4	SM05	0.029	0.039	0.034	0.040	60.60	45.80	3.90	47.00
5	SM07	0.036	0.047	0.031	0.024	44.30	40.60	-10.80	8.90
6	SM15	0.026	0.047	0.041	0.030	-44.10	0.10	35.60	-35.40
7	SM10	0.036	0.032	0.053	0.045	39.40	34.40	15.50	-20.60
8	SM11	0.030	0.039	0.039	0.046	7.60	2.00	-17.10	-34.80
9	SM12	0.019	0.033	0.039	0.051	-10.30	-13.70	-46.60	-43.50
10	SM14	0.021	0.028	0.040	0.052	25.60	23.10	-6.00	-20.00

Coloured according to interpretation criteria (defined in Table S31): E = Excellent (Green), G = Good (Yellow), S = Satisfactory (Orange), U = Unsatisfactory (Red).

S4.4 RZSM: ρ and KGE'

Table S35: Root zone soil moisture metrics: Spearman correlation (ρ) and modified Kling-Gupta Efficiency (KGE') obtained by each gridded soil moisture product at each in situ monitoring site.

N°	ID	ρ				KGE'			
		ERA5	**ERA5-Land**	**SMAP-L4**	**GLDAS**	**ERA5**	**ERA5-Land**	**SMAP-L4**	**GLDAS**
1	SM01	0.79	0.92	0.08	-0.68	0.17	0.37	0.66	0.36
2	SM02	0.68	0.97	0.04	-0.62	-0.45	-0.13	0.33	0.07
3	SM04	0.74	0.93	-0.24	-0.53	0.73	0.83	0.25	0.30
4	SM05	0.81	0.76	-0.18	-0.46	0.25	0.37	0.27	0.09
5	SM07	0.26	0.40	0.61	0.37	0.36	0.51	0.70	0.77
6	SM15	0.57	0.79	0.65	0.60	0.45	0.40	0.61	0.02
7	SM10	0.77	0.82	0.59	0.62	0.36	0.55	0.50	0.51
8	SM11	0.48	0.62	0.51	0.47	0.74	0.46	0.50	-0.61
9	SM12	0.88	0.74	0.33	0.57	0.84	0.51	0.39	-0.61
10	SM14	0.81	0.73	0.52	0.62	0.62	0.73	0.66	0.24

Coloured according to interpretation criteria (defined in Table S31): E = Excellent (Green), G = Good (Yellow), S = Satisfactory (Orange), U = Unsatisfactory (Red).

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