Supporting Information (SI)

Using radiative signatures to diagnose the cause of warming during the 2013–2014 Californian Drought

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SI Tables

Table S1. Comparison of the PRISM, CRU and NOAA-NCEI datasets for precipitation (*P*) and temperature (*T*) anomalies during the water years 2013 and 2014 compared to the decadal mean of 2001–2012 across California. Accordingly, the choice of the climate dataset has only minor effects on our analyses.

	PRISM						CRU						NOAA-NCEI					
	2013			2014			2013			2014			2013			2014		
	WY	Wet	Dry	WY	Wet	Dry	WY	Wet	Dry	WY	Wet	Dry	WY	Wet	Dry	WY	Wet	Dry
ΔP (mm)	–91	–124	+33	–248	–266	+18	–143	–159	+16	–264	–286	+22	–107	–133	+26	–223	–240	+16
ΔT (°C)	+0.4	+0.5	+0.2	+1.0	+1.2	+0.5	+0.6	+0.7	+0.5	+1.3	+1.3	+1.3	+0.8	+1.0	+0.4	+1.1	+1.3	+0.7

Table S2. Mean temperature (*T*, °C) anomalies during the 2001–2012 and 2013–2014 water years relative to different baselines across California based on PRISM data. Please note the changing duration of the baselines (12–100 years). In addition, the mean ± standard deviation (SD) and the change (in °C per period) are reported during each baseline, with change calculated as the slope of a linear regression times the number of years during that period.

Baseline	mean ± SD	Δ2001–2012	Δ2013–2014	Change
2001–2012	15.4 ± 0.4	n/a	+0.7	–0.5
1981–2010	15.3 ± 0.6	+0.1	+0.8	+0.5
1971–2000	15.0 ± 0.6	+0.4	+1.1	+1.1
1961–1990	14.8 ± 0.5	+0.6	+1.3	+0.6
1901–1930	14.3 ± 0.5	+1.1	+1.8	+0.2
1901–2000	14.7 ± 0.6	+0.7	+1.4	+0.9

Table S3. Total precipitation (P, mm yr^{-1}) anomalies during the 2001–2012 and 2013–2014 water years relative to different baselines across California based on PRISM data. Please note the changing duration of the baselines (12–100 years). In addition, the mean ± standard deviation (SD) and the change (in mm per period) are reported during each baseline, with change calculated as the slope of a linear regression times the number of years during that period.

Baseline	mean ± SD	Δ2001–2012	Δ2013–2014	Change
2001–2012	590 ± 147	n/a	–170	+65
1981–2010	628 ± 193	–38	–208	–85
1971–2000	641 ± 199	–52	–221	+58
1961–1990	621 ± 176	–31	–201	–1
1901–1930	621 ± 136	–31	–201	–224
1901–2000	622 ± 157	–33	–202	+16

Table S4. Same as Table 2 (main text) but for the combined two year period 2013–2014 compared to the mean of 2001–2012 based on PRISM (P & T), MODIS (LE) and CERES observations.

	California		
	WY	Wet	Dry
ΔP (mm)	–170	–195	25
ΔT (°C)	0.7	0.9	0.4
ΔR_{Si} (W m^{-2})	5.7	10.0	–2.8
ΔR_{So} (W m^{-2})	0.5	1.0	–0.4
ΔR_{Li} (W m^{-2})	–2.2	–3.8	1.0
ΔR_{Lo} (W m^{-2})	–2.2	–0.1	–6.4
ΔR_N (W m^{-2})	5.2	5.2	5.0
ΔLE (W m^{-2})	–2.6	–2.9	–1.8
ΔH (W m^{-2})	7.8	8.1	6.8

Table S5. Same as Table 2 (main text) but for 2013–2014 compared to the mean of 2001–2012 (based on CMIP5 projections).

	California		
	WY	**Wet**	**Dry**
ΔP (mm)	–10.5	–15.4	5.0
ΔT (°C)	0.2	0.1	0.2
ΔR_{Si} (W m^{-2})	0.2	0.3	0.2
ΔR_{So} (W m^{-2})	0.1	0.0	0.2
ΔR_{Li} (W m^{-2})	1.0	0.6	1.8
ΔR_{Lo} (W m^{-2})	0.9	0.7	1.4
ΔR_N (W m^{-2})	0.3	0.2	0.4
ΔLE (W m^{-2})	0.3	0.5	0.1
ΔH (W m^{-2})	0.0	0.0	0.1

Table S6. Same as Table 2 (main text) but for 2013–2014 compared to the mean of 1901–1912. (based on CMIP5 projections).

	California		
	WY	**Wet**	**Dry**
ΔP (mm)	–4.8	0.3	–5.2
ΔT (°C)	1.1	1.0	1.5
ΔR_{Si} (W m^{-2})	–0.4	–0.5	–0.1
ΔR_{So} (W m^{-2})	–0.2	–0.5	0.4
ΔR_{Li} (W m^{-2})	7.6	6.1	10.7
ΔR_{Lo} (W m^{-2})	6.2	5.0	8.8
ΔR_N (W m^{-2})	1.2	1.0	1.4
ΔLE (W m^{-2})	–0.1	0.6	–1.5
ΔH (W m^{-2})	1.1	0.7	2.0

Table S7. Same as Table 2 (main text) but for 2001–2012 compared to the mean of 1901–1912. (based on CMIP5 projections).

	California		
	WY	**Wet**	**Dry**
ΔP (mm)	5.6	15.8	–10.1
ΔT (°C)	1.0	0.8	1.2
ΔR_{Si} (W m^{-2})	–0.7	–0.9	–0.2
ΔR_{So} (W m^{-2})	–0.3	–0.6	0.2
ΔR_{Li} (W m^{-2})	6.6	5.5	8.9
ΔR_{Lo} (W m^{-2})	5.3	4.3	7.4
ΔR_N (W m^{-2})	0.9	0.8	1.0
ΔLE (W m^{-2})	–0.4	0.1	–1.6
ΔH (W m^{-2})	1.1	0.7	1.9

SI Figures

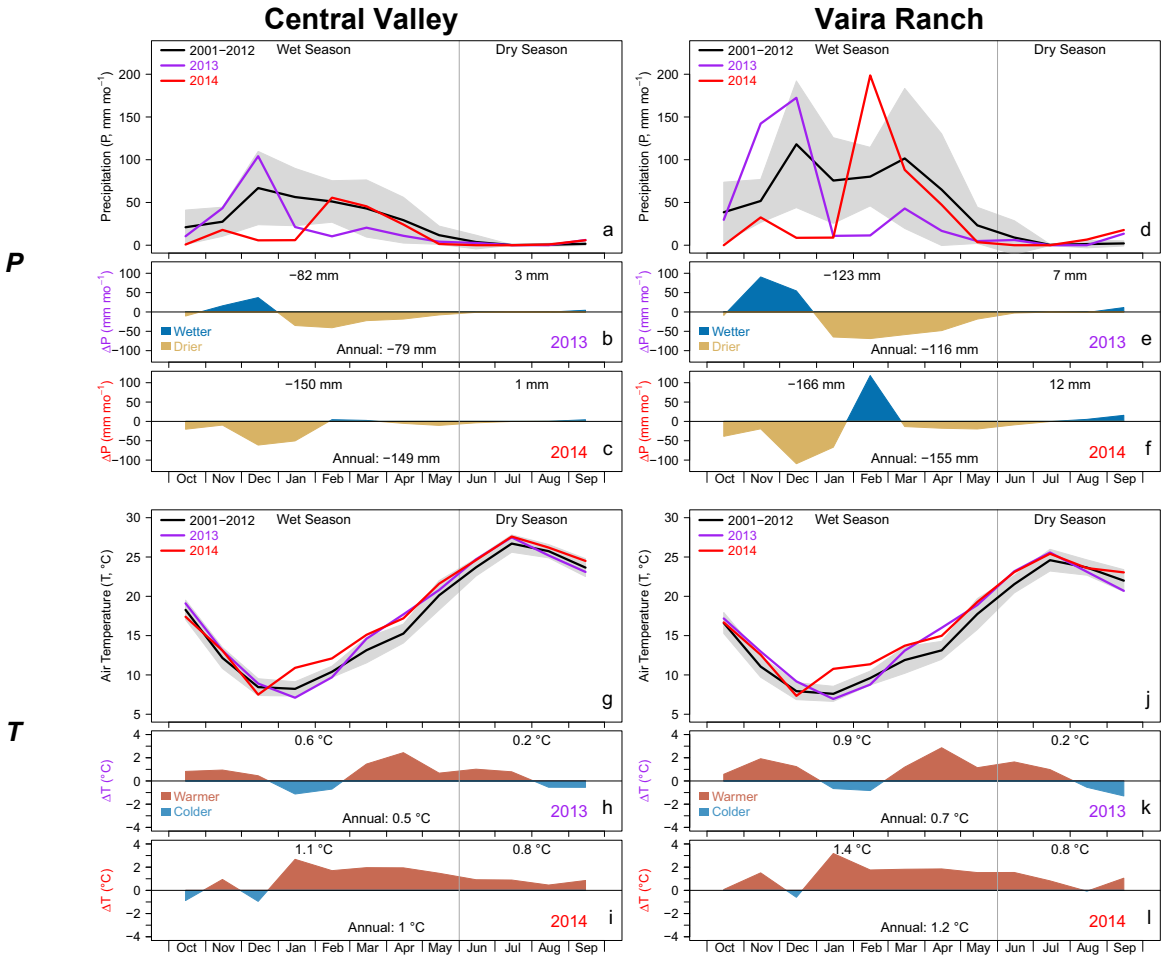

Figure S1. Same as Figure 2 (main text) but for (left) Central Valley and (right) Vaira Ranch.

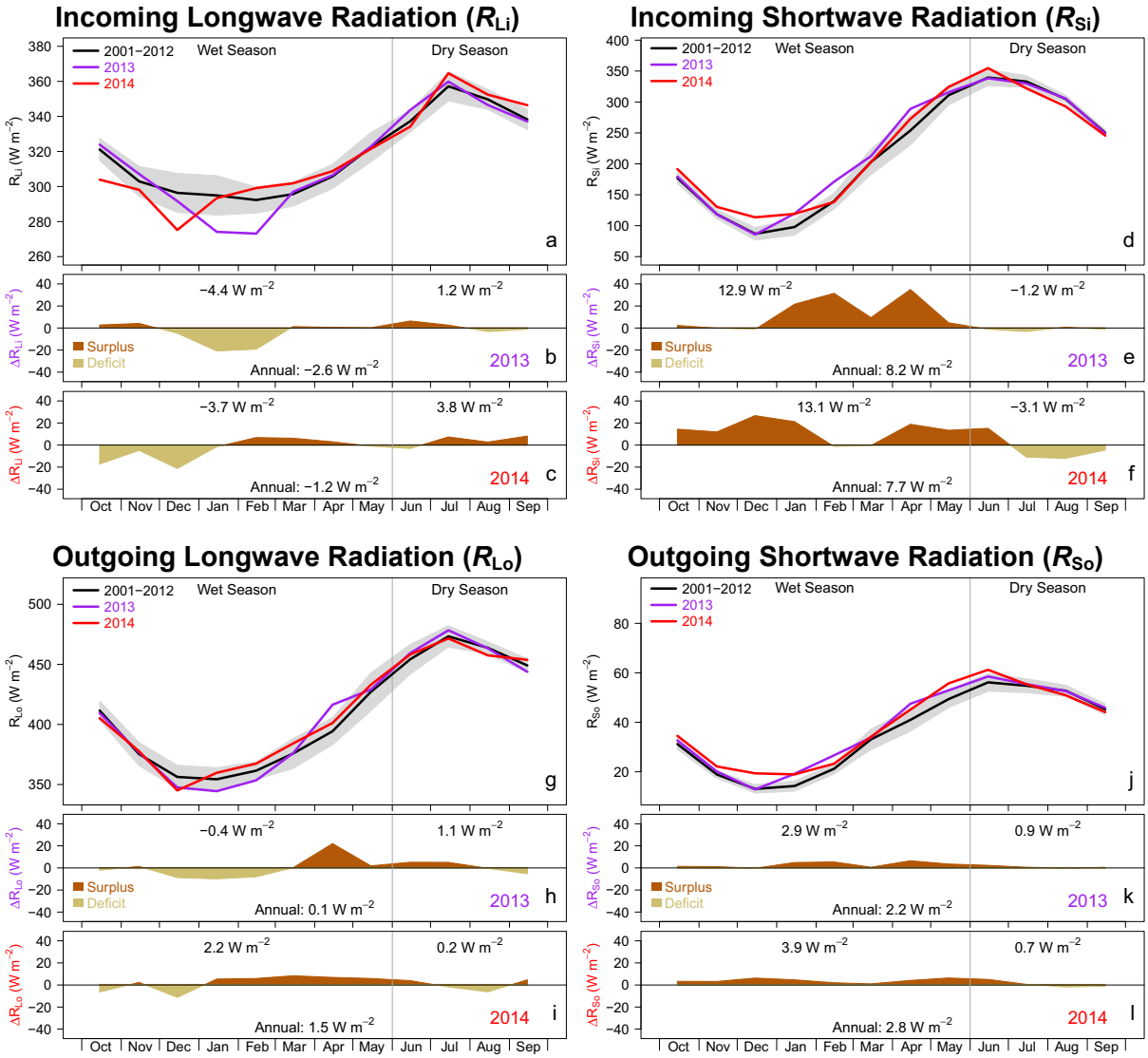

Figure S2. Same as Figure 3 (main text) but for Central Valley.

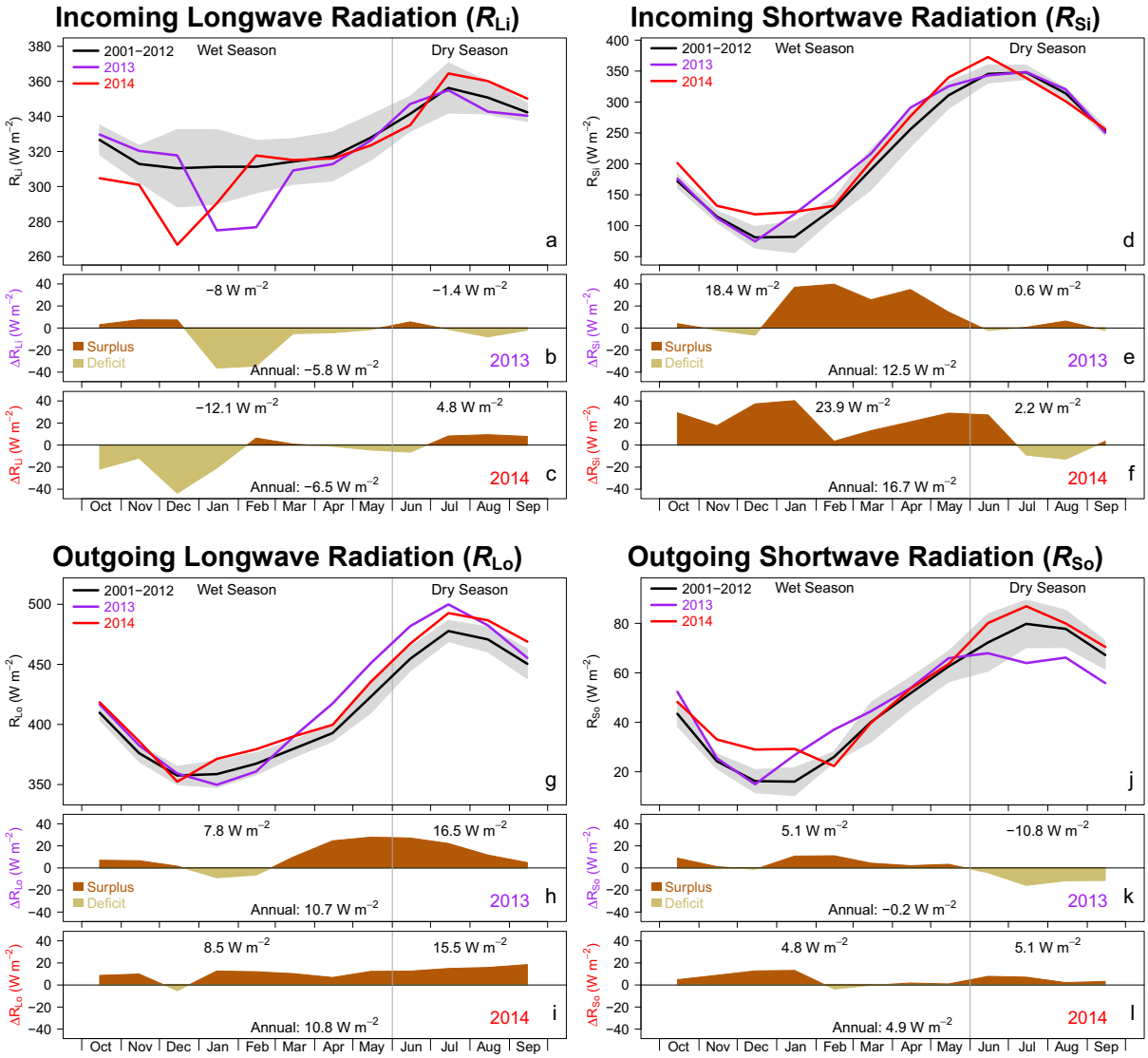

Figure S3. Same as Figure 3 (main text) but for Vaira Ranch.

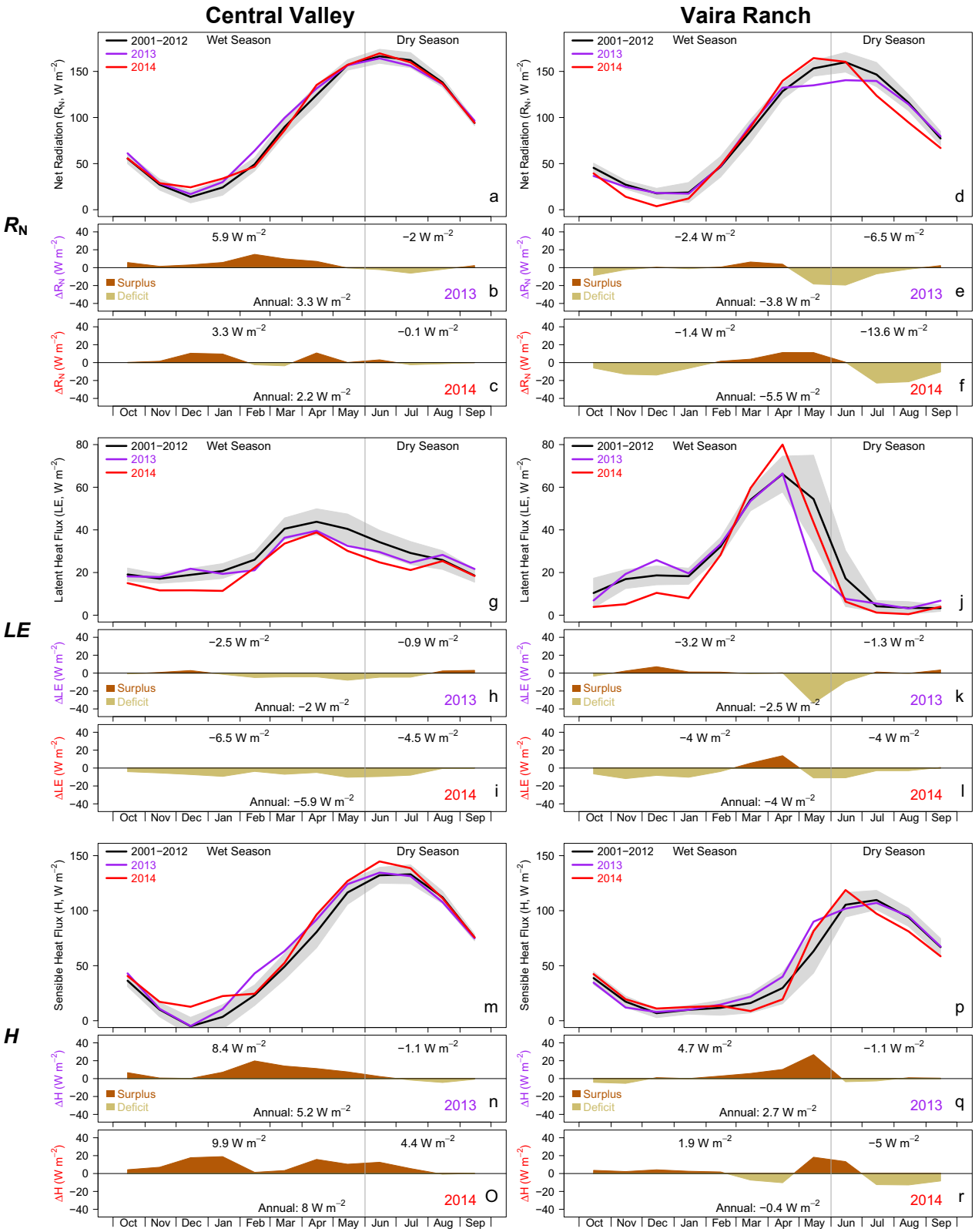

Figure S4. Same as Figure 5 (main text) but for (left) Central Valley and (right) Vaira Ranch.

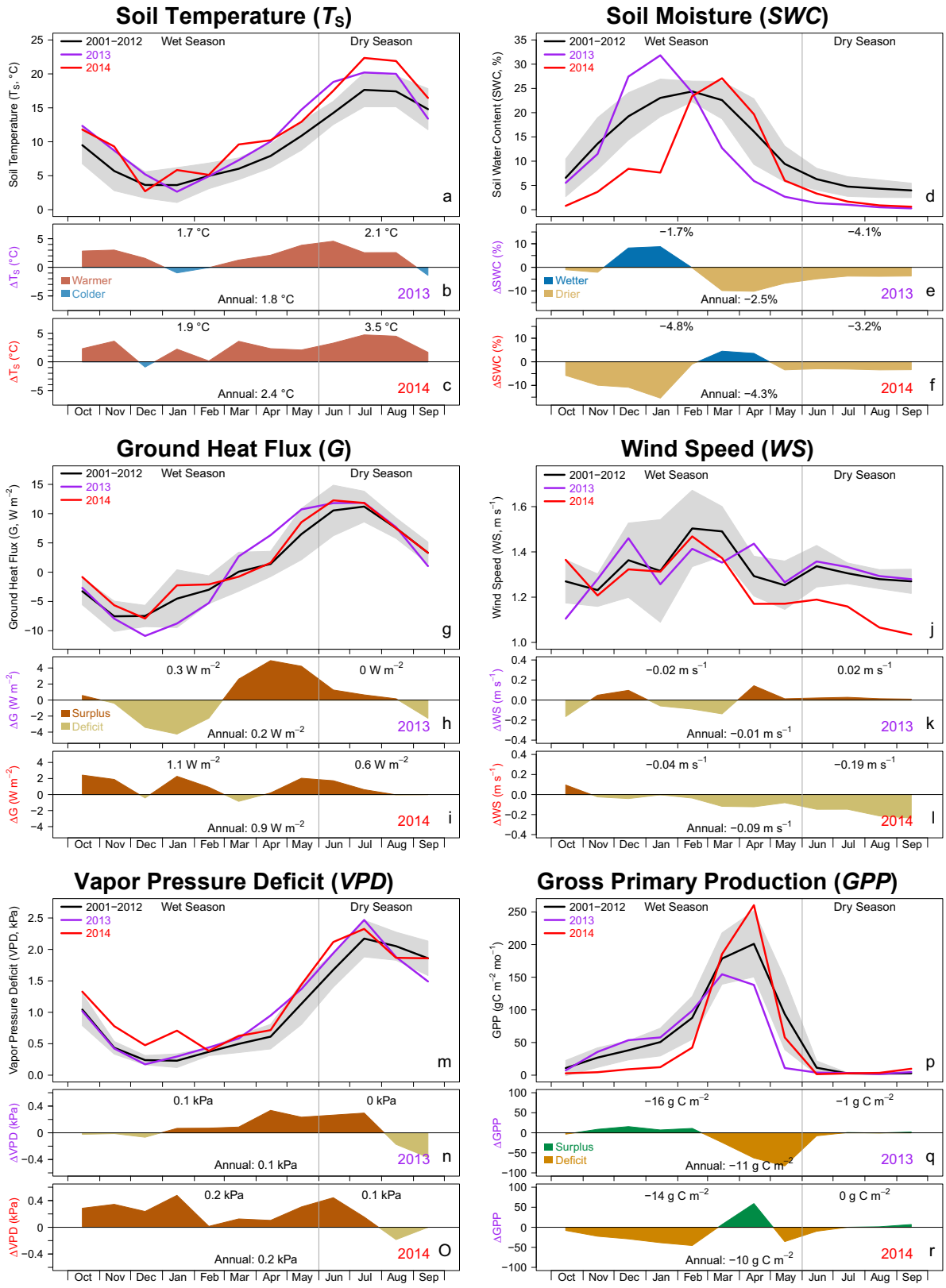

Figure S5. Monthly mean (2001–2012) of various environmental data measured at Vaira Ranch.

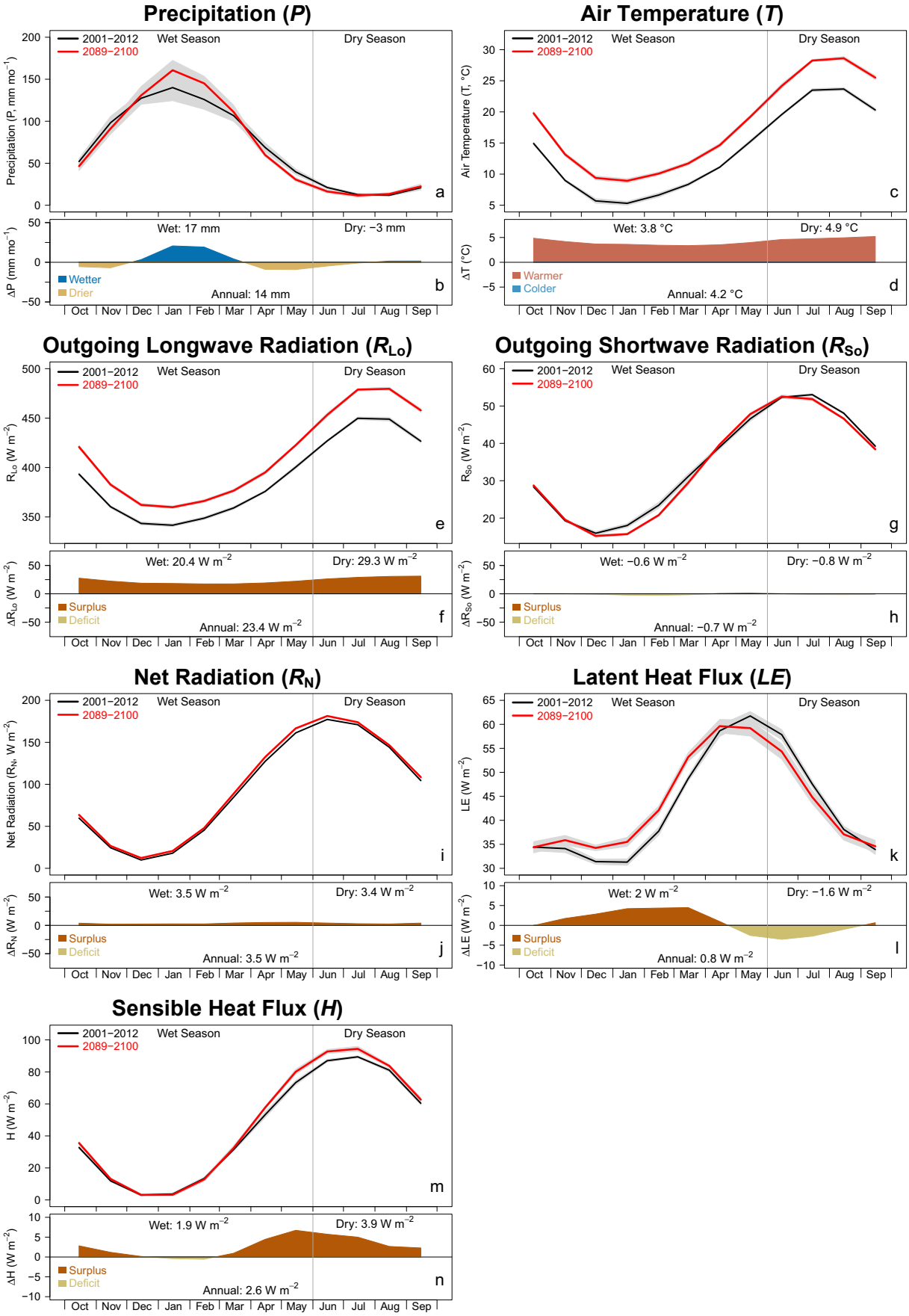

Figure S6. Same as Figure 7 (main text) but for monthly mean precipitation (*P*), air temperature (*T*), outgoing longwave radiation (R_{Lo}), outgoing shortwave radiation (R_{So}), net radiation (R_N), latent heat flux (*LE*) and sensible heat flux (H) across California based on multi-model mean of CMIP5 climate model projections (RCP8.5 scenario).

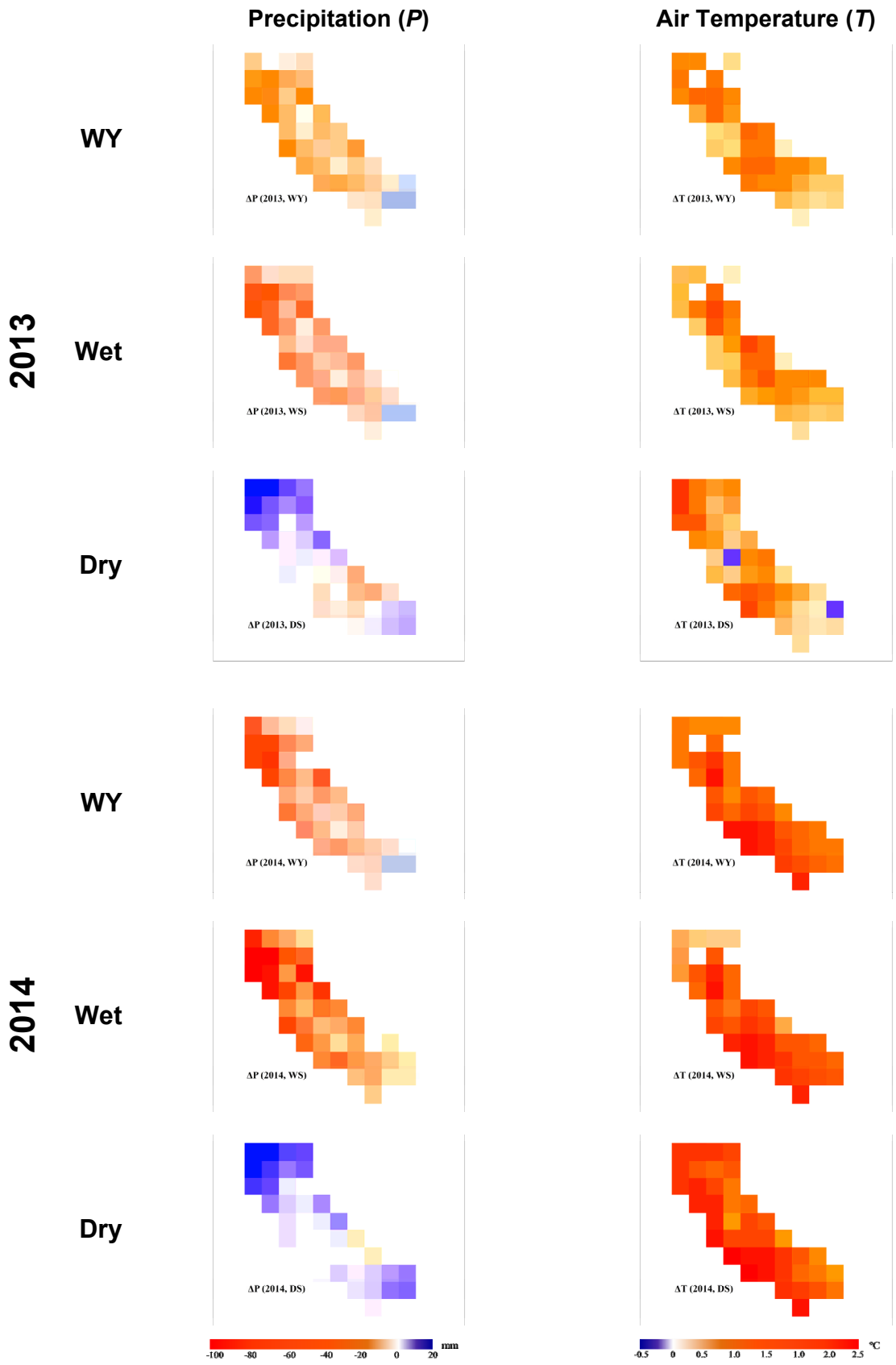

Figure S7. Same as Figure 4 (main text) but for precipitation (*P*) and air temperature (*T*) based on CRU.

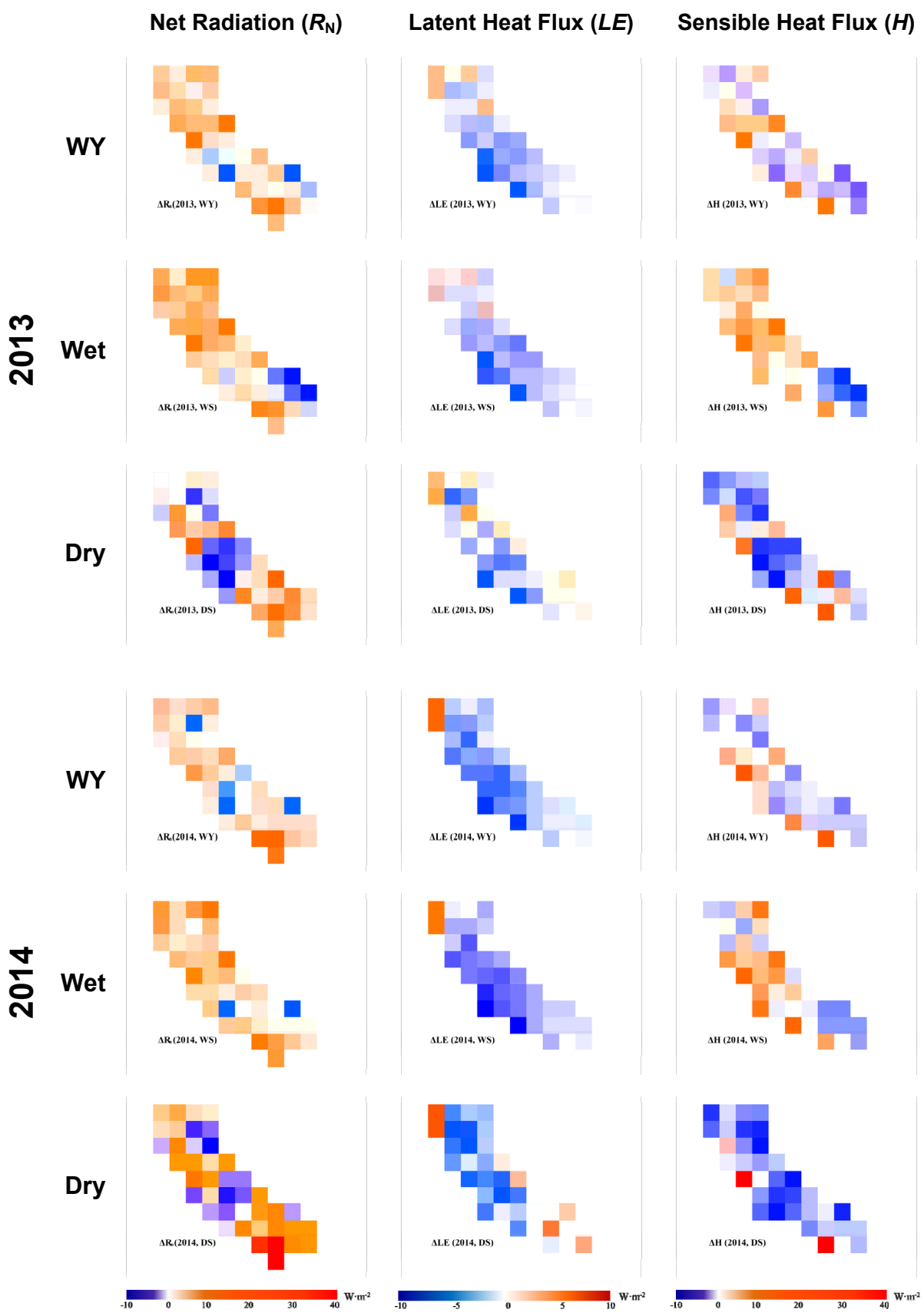

Figure S8. Same as Figure 4 (main text) but for net radiation (R_N), latent (LE) and sensible (H) heat fluxes.

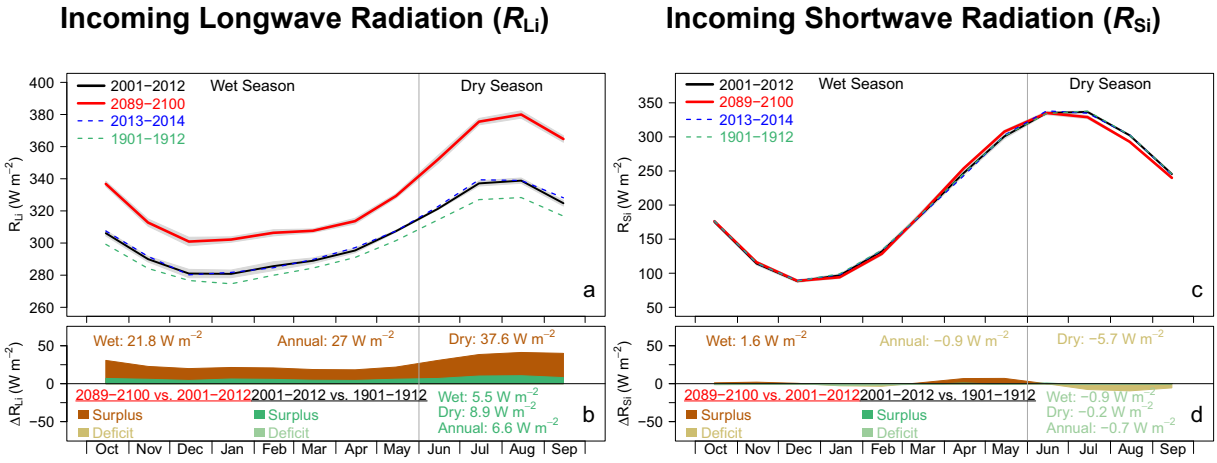

Figure S9. Same as Figure 7 (main text) but with added periods 2013–2014 and 1901–1912, and the anomalies of the 2001–2012 baseline compared to the early 20th century based on CMIP5. The color coding of the anomaly text matches the legend coding.