Supporting Information of: Evapotranspiration feedbacks shift annual precipitation-runoff relationships during multi-year droughts in a Mediterranean mixed rain-snow climate

Francesco Avanzi[1], Joseph Rungee[2], Tessa Maurer[1], Roger Bales[2, 1], Steven Glaser[1], and Martha Conklin[2]

[1]Department of Civil and Environmental Engineering, University of California, Berkeley, 94720, Berkeley, California, USA
[1]Sierra Nevada Research Institute, University of California, Merced, 95343, Merced, California, USA

Correspondence: Francesco Avanzi (francesco.avanzi@polimi.it)

Table S1. List of precipitation station used to compute annual statistics of precipitation across the Feather River in Figure 2 and Table 1 (main text). All data available at https://cdec.water.ca.gov/ (visited July 19, 2019).

ID	Name	Elevation (m)
BCM	BRUSH CREEK (DWR-2)	1085
BCR	BRUSH CREEK RS	1072
BUP	BUCKS CREEK POWERHOUSE	536
CNY	CANYON DAM	1390
CBO	CARIBOU PH	910
CHS	CHESTER	1380
PLE	PLUMAS EUREKA PARK	1574
PRT	PORTOLA	1478
QRD	QUINCY RADIO STATION	1042
QNC	QUINCY RS (USFS)	1042
SRR	SIERRAVILLE RS (USFS)	1516
STV	STRAWBERRY VALLEY	1160
VNT	VINTON	1506

Table S2. List of snow-course station used to compute annual statistics of Snow Water Equivalent (SWE) across the Feather River in Figure 2 and Table 1 (main text). All data available at https://cdec.water.ca.gov/ (visited July 19, 2019).

ID	Name	Elevation (m)
ABY	ABBEY	1722
ANR	ANTELOPE RIDGE	1722
BCP	BROWNS CAMP	1645
CHF	CHESTER FLAT	1402
CHU	CHURCH MEADOWS	2042
ERB	EUREKA BOWL	2072
EUR	EUREKA LAKE	1890
FEM	FEATHER RIVER MEADOW	1645
FP3	FREDONYER PASS 3	1783
FCV	FRENCHMAN COVE	1767
GRZ	GRIZZLY RIDGE	2103
HRF	HARKNESS FLAT	1889
HS2	HUMBUG SUMMIT 2	1478
KTL	KETTLE ROCK	2225
LTT	LETTERBOX	1706
LLP	LOWER LASSEN PEAK	2514
MLF	MILL CREEK FLAT	1798
MDY	MOUNT DYER 1	2164
MD2	MOUNT DYER 2	1844
MHG	MOUNT HOUGH	2042
MSV	MOUNT STOVER	1706
PLP	PILOT PEAK (DWR)	2072
RWL	ROWLAND CREEK	2042
3LK	THREE LAKES	1905
WRN	WARNER CREEK	1554

Table S3. Observed shift in precipitation-runoff relationship for the twelve main basins draining the western side of the California Sierra Nevada (in addition to the Feather River) and a representative value of annual precipitation during dry periods; see Section 2.3.1 and Equation 1 in the main text for a definition of all symbols. Contrary to Figure 4 in the main text, precipitation was estimated from PRISM maps with no daily tilting using in-situ data. The asterisk (*) denotes statistically significant values (that is, the sign of the confidence bounds agrees, 95% confidence level).

Basin	P (m)	$Q_{\mathrm{dry,P_I}}$ (m)	$Q_{\mathrm{dry,P}}$ (m)	M_Q (%)
Yuba	1.23	0.52	0.59	-12.06*
American	0.96	0.32	0.38	-13.86*
Cosumnes	0.78	0.12	0.15	-19.27
Mokelumne	0.93	0.34	0.40	-14.76*
Stanislaus	0.87	0.28	0.34	-15.43*
Tuolumne	0.80	0.31	0.37	-16.36*
Merced	0.72	0.21	0.25	-16.49*
San Joaquin	0.68	0.24	0.30	-19.51*
Kings	0.68	0.26	0.31	-16.10*
Kaweah	0.62	0.17	0.20	-13.95
Tule	0.49	0.06	0.07	-18.33
Kern	0.40	0.07	0.08	-12.76

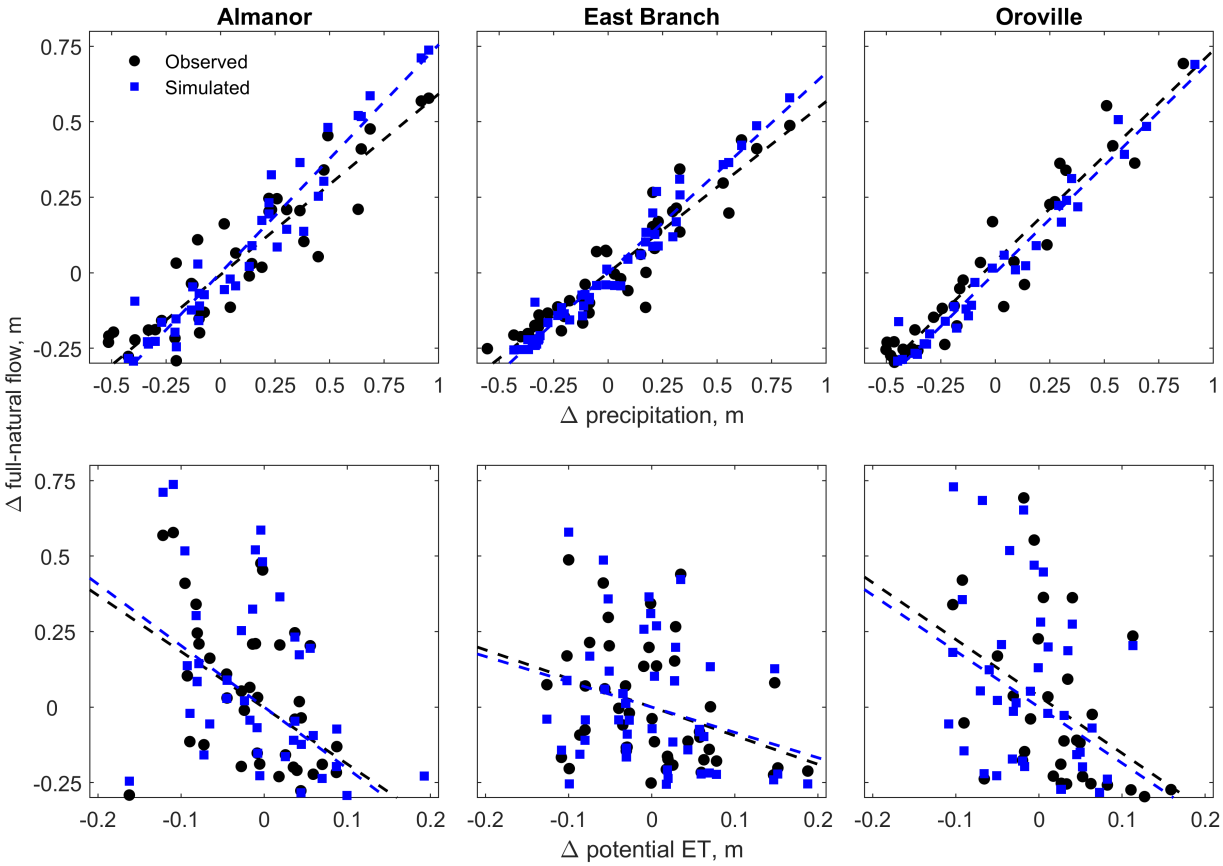

Figure S1. Modeled vs. observed univariate climate elasticity of full-natural flow to annual precipitation and potential evapotranspiration for the three basins under study with complete annual data. Precipitation, potential evapotranspiration, and full-natural flow were reported as differences (Δ) from a long-term mean across the available period of record.

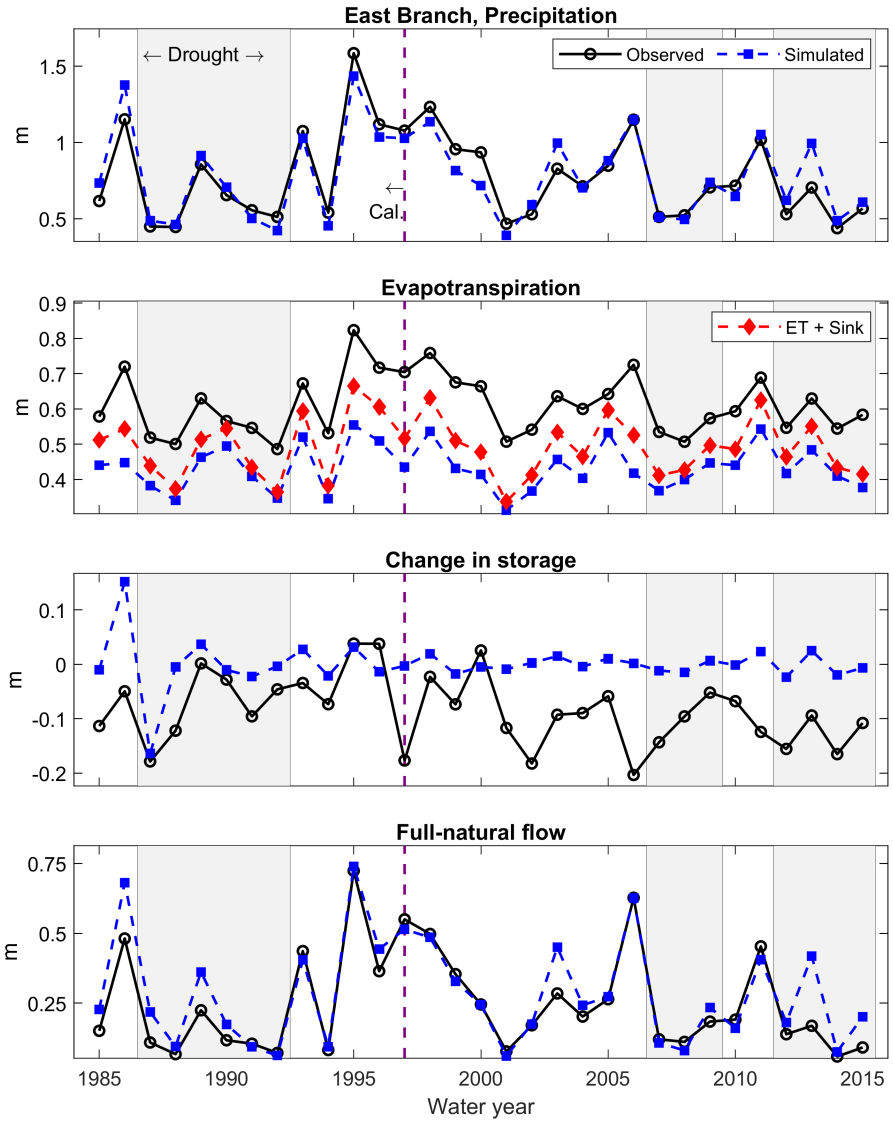

Figure S2. Simulated vs. observed (estimated) annual basin-wide water-balance components (P, ET, ΔS, and Q) for the East Branch sub-basin.

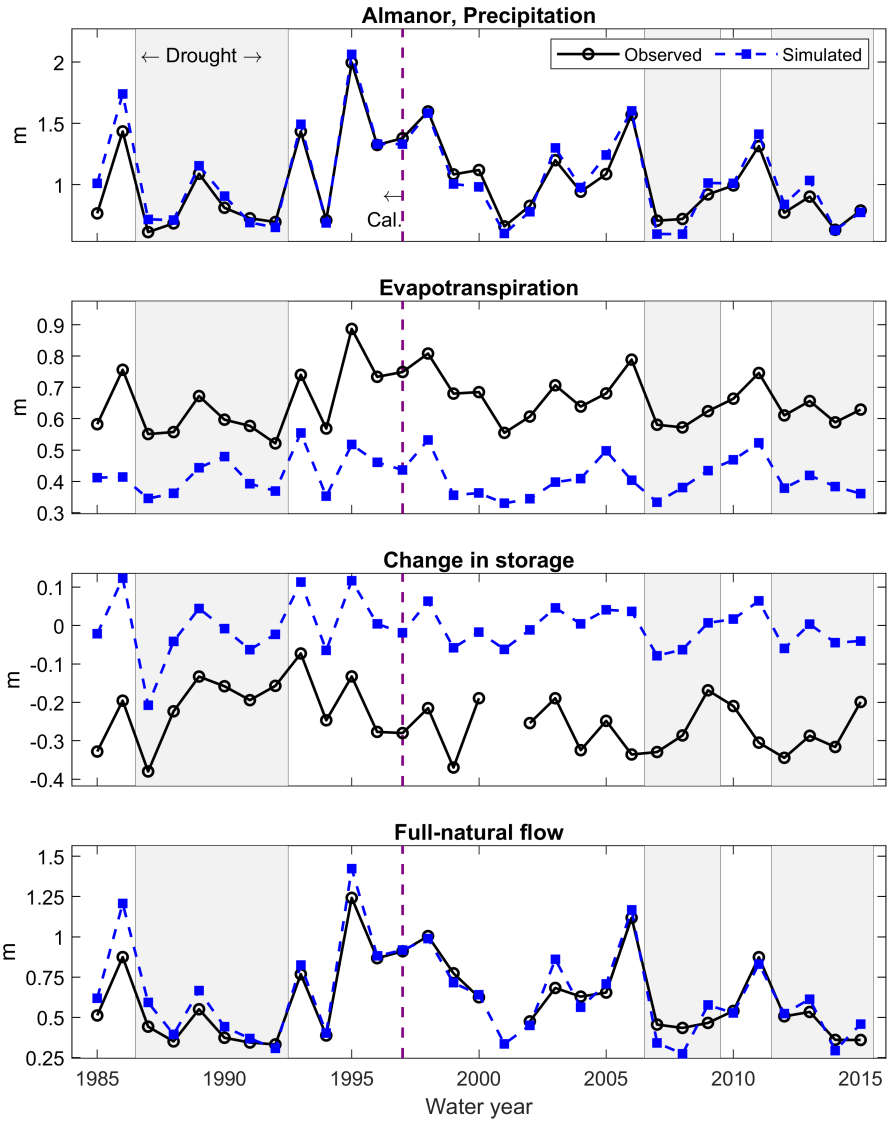

Figure S3. Simulated vs. observed (estimated) annual basin-wide water-balance components (P, ET, ΔS, and Q) for the Almanor sub-basin. The groundwater-sink term in this basin was set to zero during the original calibration.

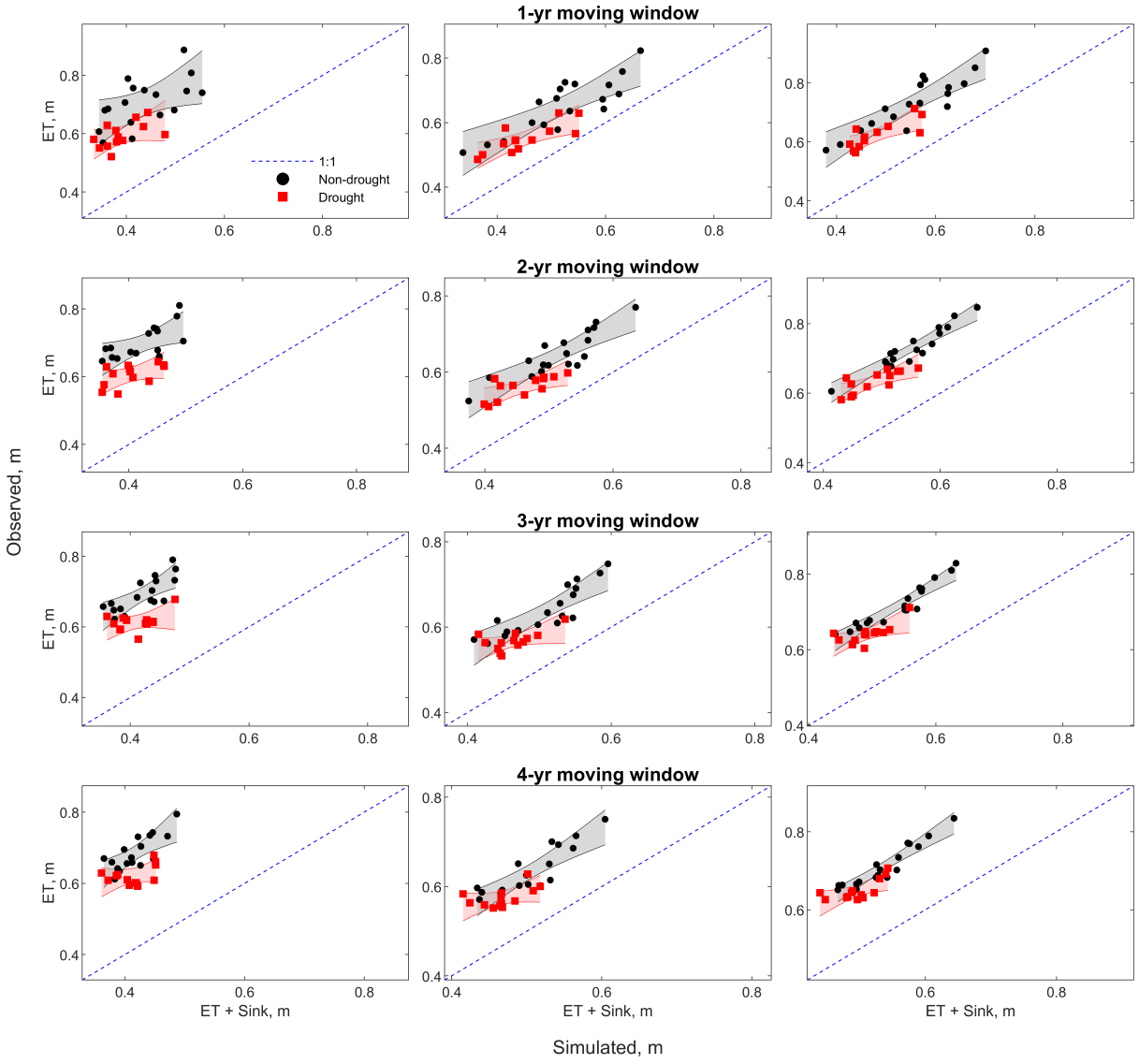

Figure S4. Scatter plot of simulated vs. observed average ET during drought (red) and non-drought (black) water years. Annual ET values were averaged using a moving window of 1 to 4 water years and included the groundwater-sink mass-flux component. The red and grey bands represent 95% confidence intervals for the regressions.

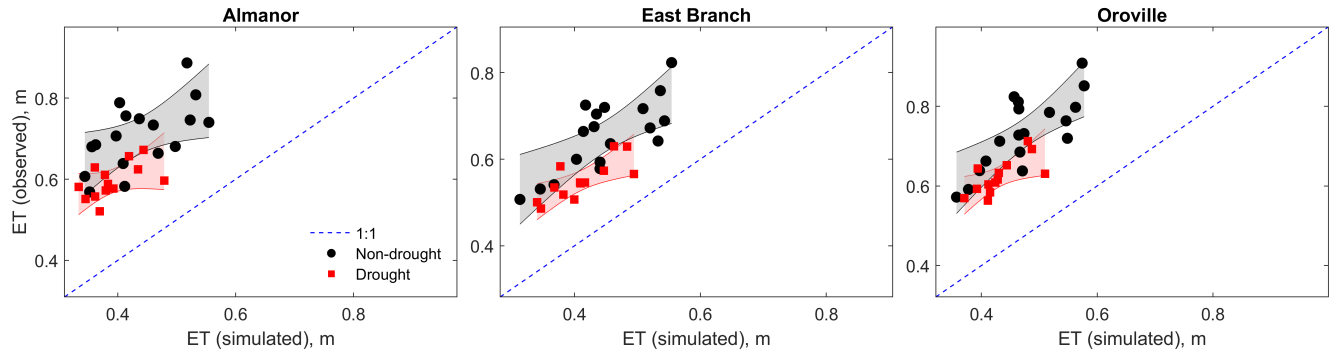

Figure S5. Scatter plot of simulated vs. observed annual basin-wide ET separated between drought (red) and non-drought (black) years. Contrary to Figure 8 in the main text, simulated annual ET here does not include the groundwater-sink mass-flux component. The red and grey bands represent 95% confidence intervals for the regressions.

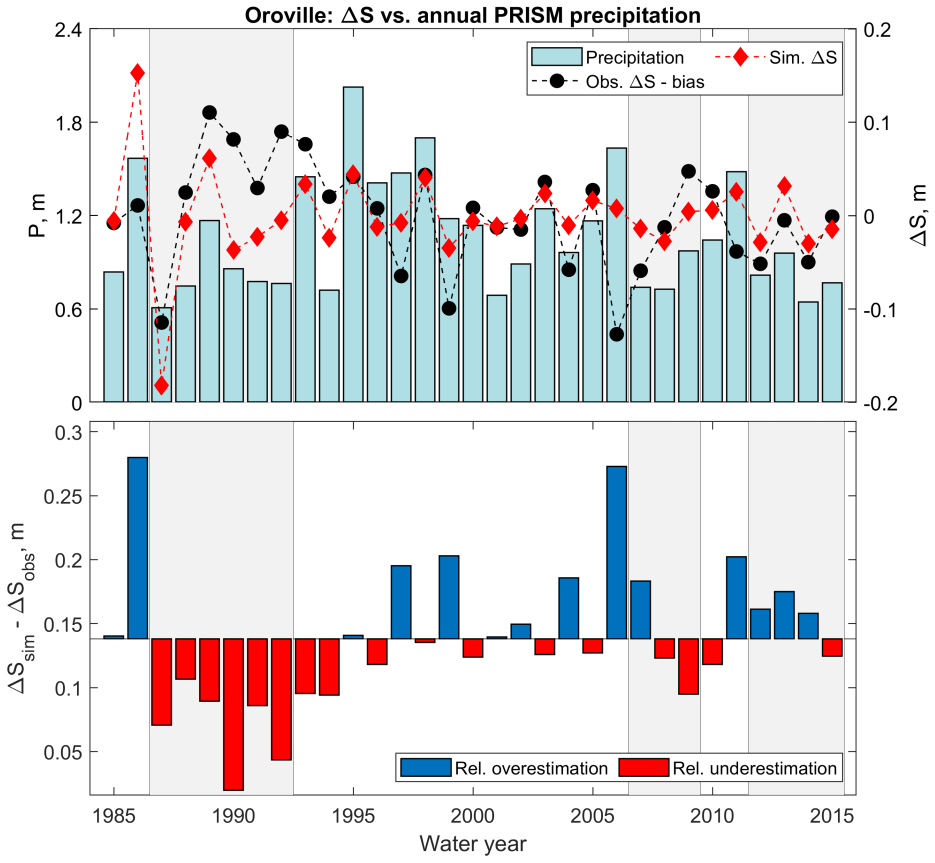

Figure S6. Top panel: simulated and observed annual basin-wide change in storage for the Feather River at Oroville (lines) and observed annual precipitation according to PRISM (bar chart). The systematic bias between simulated and observed values (see the main text) was added to observed values for readability. Bottom panel: annual differences between simulated and observed basin-wide change in storage.