water

Improvement of Hargreaves-Samani Reference Evapotranspiration Estimates with Local Calibration

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Weather stations in relation to climate zones and biomes

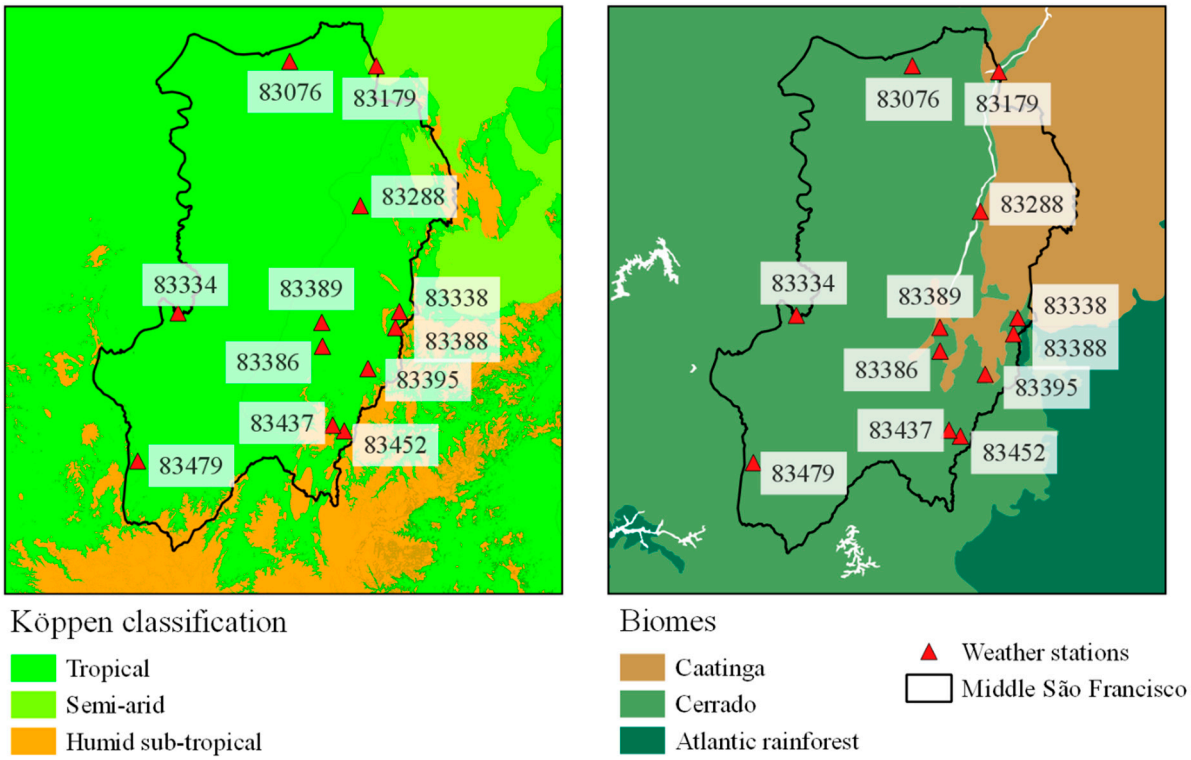

Figure S1. Weather stations in relation to climate zones and biomes.

Meteorological parameters by month and station

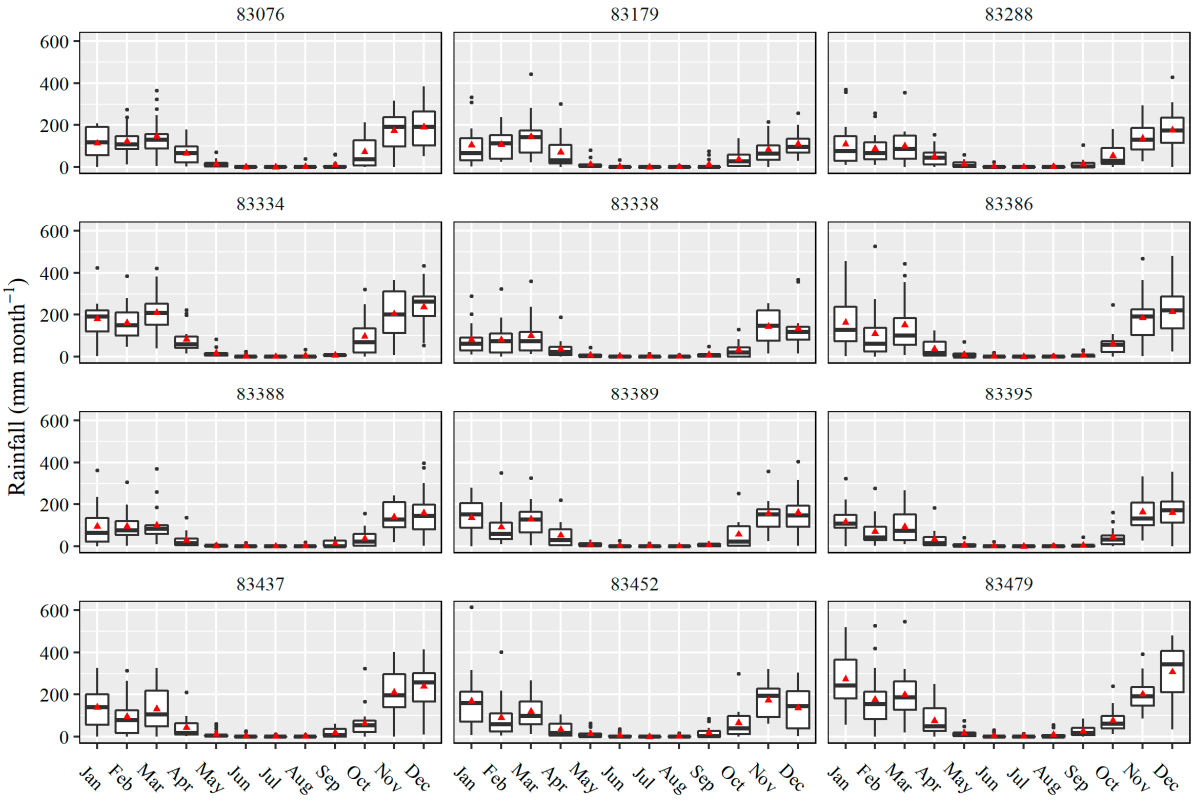

Figure S2. Monthly rainfall by month and station.

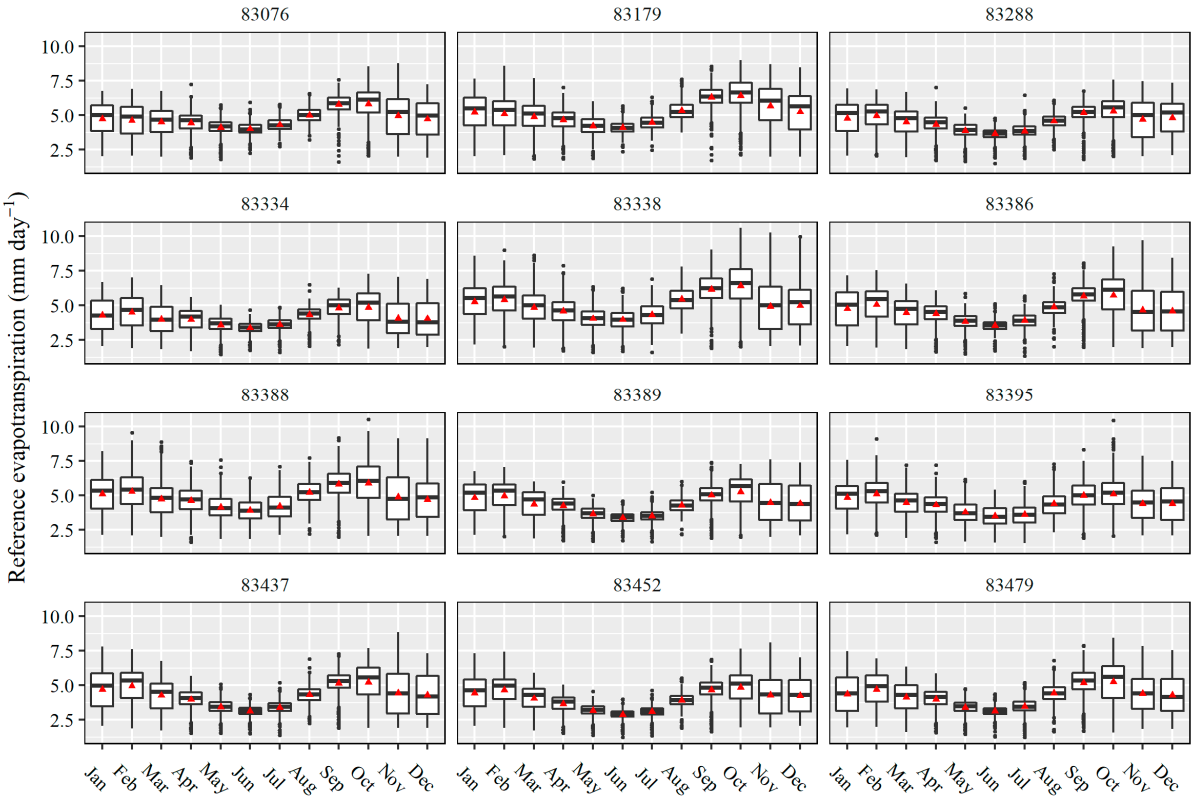

Figure S3. Daily reference evapotranspiration by month and station.

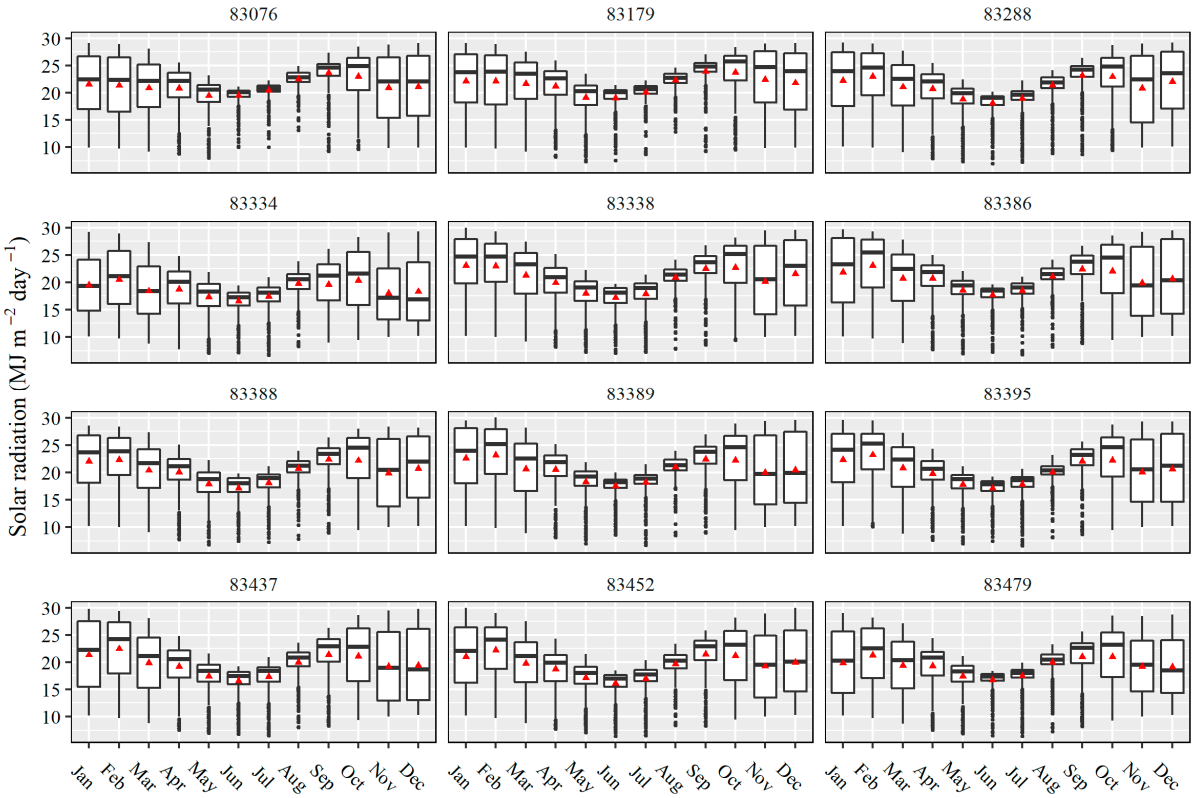

Figure S4. Daily solar radiation by month and station.

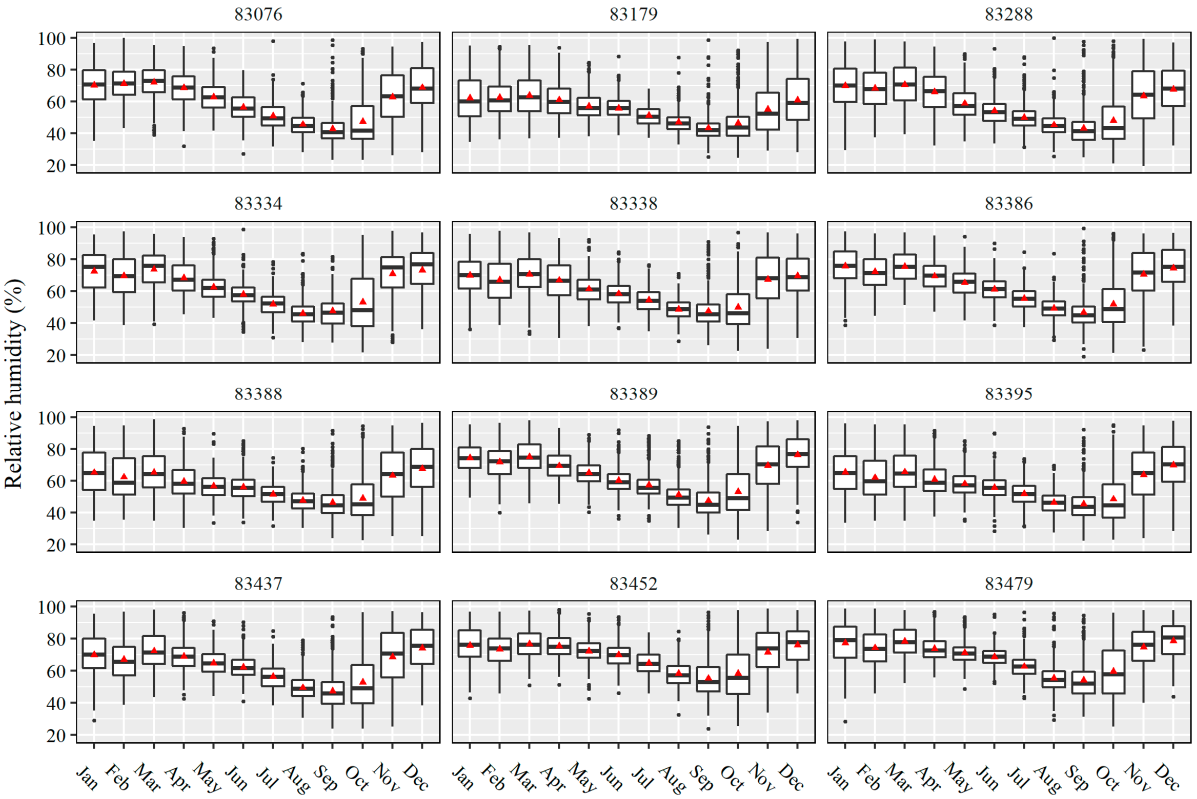

Figure S5. Daily relative humidity by month and station.

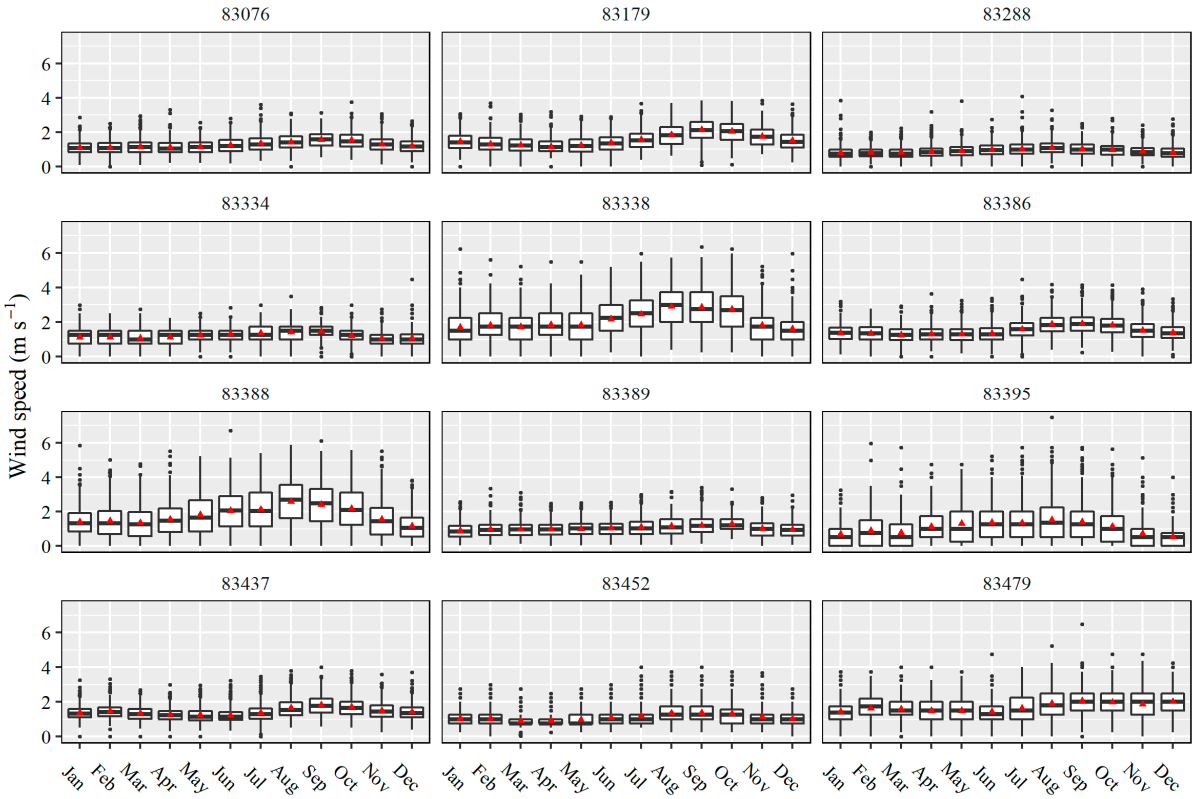

Figure S6. Daily wind speed by month and station.

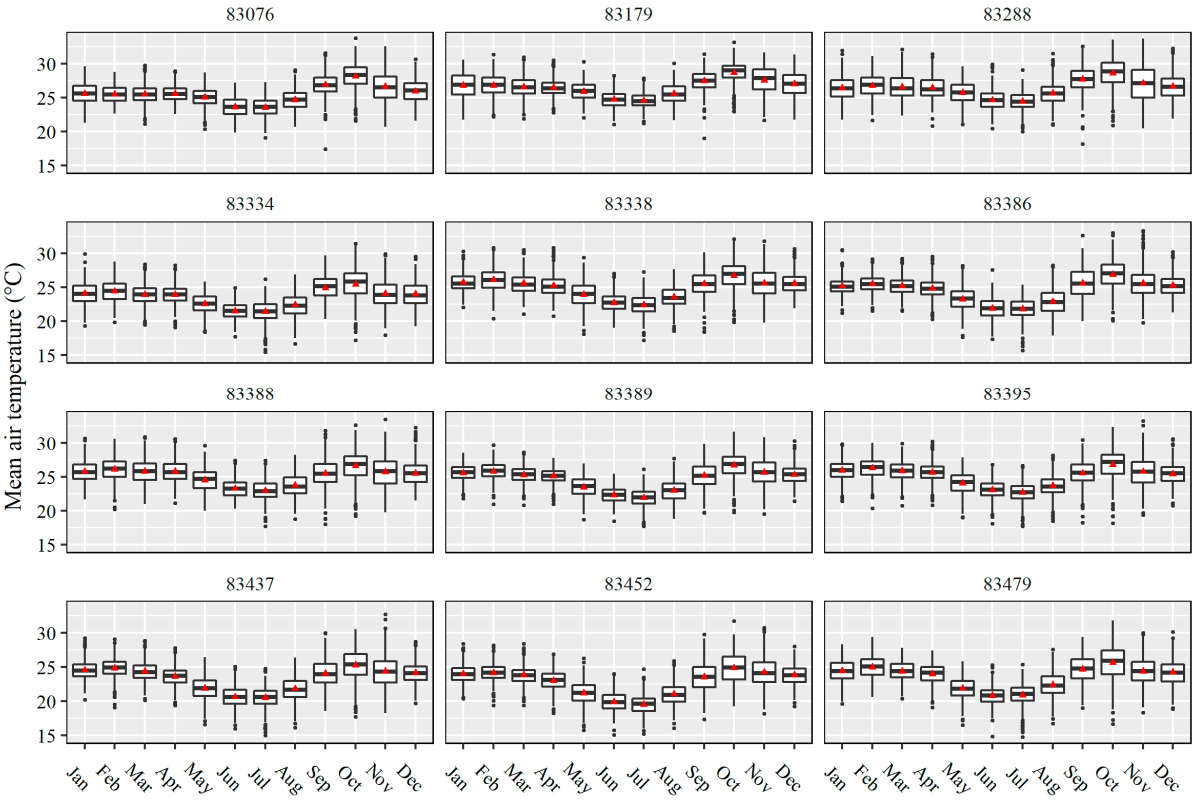

Figure S7. Daily mean air temperature by month and station.

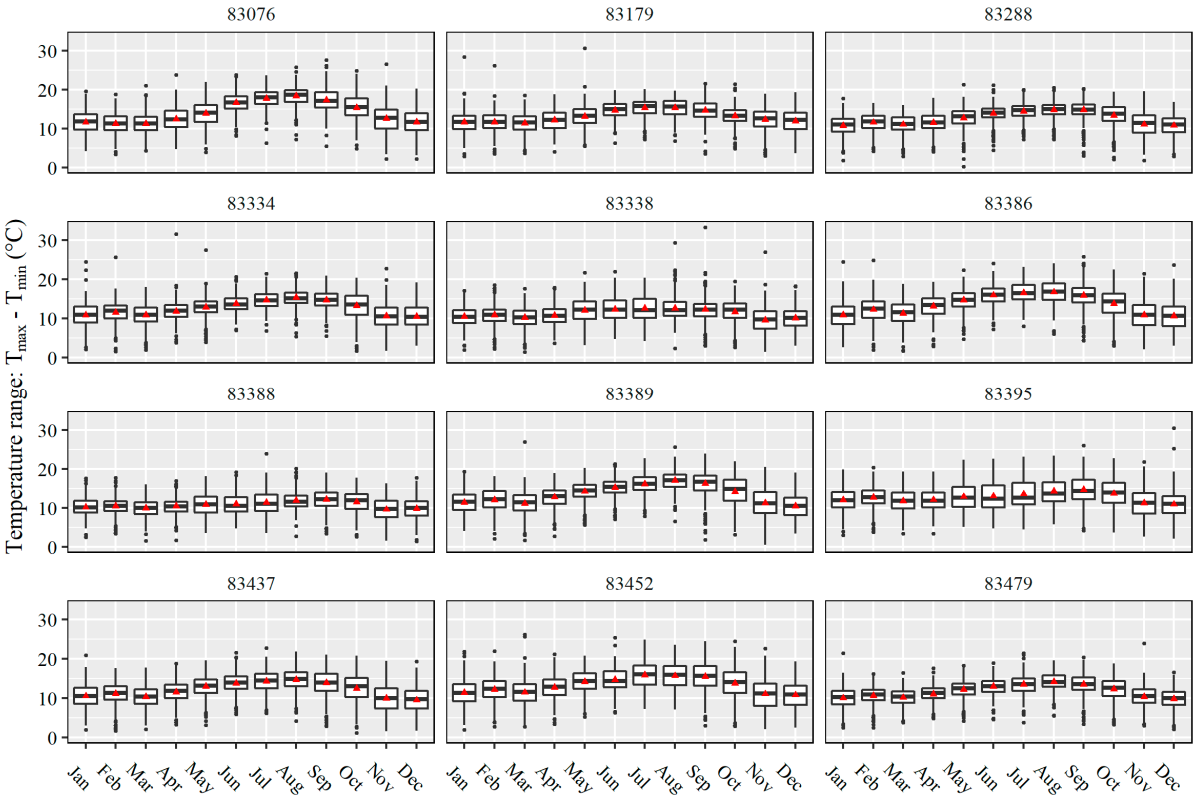

Figure S8. Daily temperature range by month and station.

Performance of improved Hargreaves-Samani models by month and by station

Table S1. Performance by month of reference evapotranspiration predictions made by the Hargreaves-Samani model.

ETo models	ME	MAE	RMSE	R^2	FTO slope
January	0.66	0.85	1.04	0.69	1.09
February	0.44	0.77	0.97	0.50	1.05
March	0.52	0.79	0.96	0.60	1.07
April	0.27	0.58	0.73	0.41	1.04
May	0.23	0.60	0.76	0.23	1.03
June	0.19	0.61	0.77	0.04	1.02
July	0.15	0.63	0.81	0.04	1.01
August	0.00	0.73	0.94	0.03	0.98
September	0.05	0.86	1.08	0.04	0.99
October	0.37	0.90	1.12	0.49	1.03
November	0.80	1.01	1.19	0.69	1.11
December	0.74	0.90	1.07	0.72	1.11

ME = mean bias error (mm day^{-1}); MAE = mean absolute error (mm day^{-1}); RMSE = root mean square error (mm day^{-1}); R^2 = coefficient of determination; FTO = forced to the origin regression.

Table S2. Performance by month of reference evapotranspiration predictions made by the Hargreaves-Samani model calibrated with approach A1.

ETo models	ME	MAE	RMSE	R^2	FTO slope
January	0.21	0.69	0.85	0.70	1.00
February	-0.02	0.67	0.87	0.50	0.96
March	0.10	0.63	0.83	0.61	0.98
April	-0.11	0.51	0.68	0.42	0.95
May	-0.11	0.52	0.71	0.24	0.95
June	-0.13	0.53	0.73	0.05	0.94
July	-0.19	0.59	0.80	0.04	0.92
August	-0.39	0.76	0.99	0.03	0.89
September	-0.40	0.89	1.13	0.05	0.91
October	-0.10	0.83	1.06	0.49	0.95
November	0.36	0.79	0.97	0.69	1.02
December	0.29	0.69	0.84	0.72	1.02

ME = mean bias error (mm day^{-1}); MAE = mean absolute error (mm day^{-1}); RMSE = root mean square error (mm day^{-1}); R^2 = coefficient of determination; FTO = forced to the origin regression.

Table S3. Performance by month of reference evapotranspiration predictions made by the Hargreaves-Samani model calibrated with approach A2.

ETo models	ME	MAE	RMSE	R^2	FTO slope
January	0.10	0.68	0.83	0.70	0.98
February	-0.14	0.69	0.89	0.50	0.94
March	0.00	0.63	0.83	0.61	0.96
April	-0.20	0.53	0.70	0.42	0.93
May	0.05	0.54	0.71	0.24	0.99
June	0.01	0.55	0.73	0.05	0.98
July	-0.04	0.59	0.79	0.04	0.96
August	-0.22	0.73	0.95	0.03	0.93
September	-0.19	0.86	1.08	0.05	0.94
October	-0.21	0.85	1.08	0.49	0.93
November	0.26	0.76	0.94	0.69	1.00
December	0.18	0.67	0.82	0.72	1.00

ME = mean bias error (mm day^{-1}); MAE = mean absolute error (mm day^{-1}); RMSE = root mean square error (mm day^{-1}); R^2 = coefficient of determination; FTO = forced to the origin regression.

Table S4. Performance by month of reference evapotranspiration predictions made by the Hargreaves-Samani model calibrated with approach A3.

ETo models	ME	MAE	RMSE	R^2	FTO slope
January	0.22	0.68	0.83	0.70	1.01
February	-0.02	0.65	0.83	0.55	0.97
March	0.10	0.62	0.80	0.64	0.99
April	-0.10	0.50	0.65	0.46	0.96
May	-0.10	0.50	0.68	0.30	0.95
June	-0.13	0.51	0.69	0.10	0.94
July	-0.19	0.57	0.77	0.08	0.92
August	-0.39	0.75	0.96	0.06	0.89
September	-0.39	0.88	1.11	0.06	0.91
October	-0.11	0.82	1.04	0.51	0.95
November	0.36	0.79	0.97	0.69	1.02
December	0.29	0.70	0.85	0.70	1.02

ME = mean bias error (mm day^{-1}); MAE = mean absolute error (mm day^{-1}); RMSE = root mean square error (mm day^{-1}); R^2 = coefficient of determination; FTO = forced to the origin regression.

Table S5. Performance by month of reference evapotranspiration predictions made by the Hargreaves-Samani model calibrated with approach A4.

ETo models	ME	MAE	RMSE	R^2	FTO slope
January	0.10	0.67	0.82	0.71	0.98
February	-0.14	0.68	0.86	0.54	0.95
March	0.00	0.62	0.80	0.64	0.96
April	-0.20	0.52	0.68	0.45	0.93
May	0.06	0.50	0.67	0.32	0.99
June	0.03	0.50	0.67	0.13	0.98
July	-0.04	0.56	0.75	0.09	0.96
August	-0.20	0.71	0.91	0.07	0.94
September	-0.16	0.84	1.07	0.06	0.95
October	-0.22	0.84	1.07	0.50	0.92
November	0.25	0.76	0.94	0.69	1.00
December	0.18	0.68	0.82	0.71	1.00

ME = mean bias error (mm day^{-1}); MAE = mean absolute error (mm day^{-1}); RMSE = root mean square error (mm day^{-1}); R^2 = coefficient of determination; FTO = forced to the origin regression.

Table S6. Performance by station of reference evapotranspiration predictions made by the Hargreaves-Samani model.

ETo models	ME	MAE	RMSE	R^2	FTO slope
83076	0.70	0.80	0.97	0.65	1.12
83179	0.25	0.57	0.73	0.59	1.03
83288	0.54	0.67	0.84	0.64	1.10
83334	0.71	0.79	0.97	0.67	1.15
83338	-0.52	0.94	1.18	0.40	0.87
83386	0.38	0.67	0.85	0.69	1.05
83388	-0.38	1.00	1.24	0.34	0.89
83389	0.90	0.92	1.04	0.76	1.19
83395	0.45	0.96	1.15	0.38	1.06
83437	0.28	0.54	0.69	0.75	1.04
83452	0.80	0.87	1.03	0.68	1.16
83479	0.26	0.63	0.81	0.66	1.02

ME = mean bias error (mm day^{-1}); MAE = mean absolute error (mm day^{-1}); RMSE = root mean square error (mm day^{-1}); R^2 = coefficient of determination; FTO = forced to the origin regression.

Table S7. Performance by station of reference evapotranspiration predictions made by the Hargreaves-Samani model calibrated with approach A1.

ETo models	ME	MAE	RMSE	R^2	FTO slope
83076	0.26	0.58	0.73	0.65	1.03
83179	-0.18	0.57	0.71	0.59	0.95
83288	0.13	0.50	0.64	0.64	1.01
83334	0.32	0.57	0.72	0.67	1.05
83338	-0.90	1.12	1.38	0.40	0.80
83386	-0.04	0.60	0.77	0.69	0.96
83388	-0.76	1.13	1.39	0.34	0.82
83389	0.48	0.58	0.72	0.76	1.09
83395	0.03	0.85	1.03	0.38	0.98
83437	-0.11	0.49	0.64	0.75	0.95
83452	0.38	0.59	0.75	0.68	1.07
83479	-0.13	0.62	0.78	0.66	0.94

ME = mean bias error (mm day^{-1}); MAE = mean absolute error (mm day^{-1}); RMSE = root mean square error (mm day^{-1}); R^2 = coefficient of determination; FTO = forced to the origin regression.

Table S8. Performance by station of reference evapotranspiration predictions made by the Hargreaves-Samani model calibrated with approach A2.

ETo models	ME	MAE	RMSE	R^2	FTO slope
83076	0.24	0.57	0.71	0.66	1.02
83179	-0.18	0.59	0.72	0.58	0.94
83288	0.14	0.50	0.64	0.64	1.01
83334	0.31	0.56	0.71	0.68	1.05
83338	-0.88	1.11	1.36	0.42	0.80
83386	-0.04	0.60	0.77	0.70	0.96
83388	-0.76	1.12	1.38	0.35	0.82
83389	0.50	0.62	0.76	0.74	1.09
83395	0.04	0.83	1.01	0.38	0.97
83437	-0.10	0.51	0.64	0.75	0.95
83452	0.38	0.59	0.74	0.69	1.06
83479	-0.12	0.60	0.75	0.70	0.94

ME = mean bias error (mm day^{-1}); MAE = mean absolute error (mm day^{-1}); RMSE = root mean square error (mm day^{-1}); R^2 = coefficient of determination; FTO = forced to the origin regression.

Table S9. Performance by station of reference evapotranspiration predictions made by the Hargreaves-Samani model calibrated with approach A3.

ETo models	ME	MAE	RMSE	R^2	FTO slope
83076	0.16	0.55	0.70	0.65	1.01
83179	-0.27	0.60	0.74	0.59	0.93
83288	0.04	0.49	0.63	0.64	0.99
83334	0.23	0.55	0.69	0.67	1.03
83338	-0.61	0.98	1.22	0.40	0.85
83386	-0.14	0.61	0.79	0.69	0.94
83388	-0.47	1.03	1.27	0.34	0.87
83389	0.40	0.53	0.67	0.76	1.07
83395	0.34	0.92	1.10	0.38	1.04
83437	-0.19	0.51	0.66	0.75	0.93
83452	0.29	0.55	0.70	0.68	1.05
83479	-0.21	0.64	0.80	0.66	0.92

ME = mean bias error (mm day^{-1}); MAE = mean absolute error (mm day^{-1}); RMSE = root mean square error (mm day^{-1}); R^2 = coefficient of determination; FTO = forced to the origin regression.

Table S10. Performance by station of reference evapotranspiration predictions made by the Hargreaves-Samani model calibrated with approach A4.

ETo models	ME	MAE	RMSE	R^2	FTO slope
83076	0.14	0.55	0.69	0.66	1.00
83179	-0.27	0.61	0.75	0.59	0.93
83288	0.04	0.49	0.63	0.64	0.99
83334	0.22	0.54	0.68	0.68	1.03
83338	-0.57	0.95	1.18	0.43	0.86
83386	-0.13	0.61	0.78	0.70	0.94
83388	-0.45	1.00	1.24	0.35	0.87
83389	0.41	0.56	0.69	0.75	1.07
83395	0.37	0.90	1.10	0.36	1.04
83437	-0.19	0.52	0.66	0.75	0.93
83452	0.29	0.55	0.70	0.69	1.04
83479	-0.21	0.63	0.78	0.69	0.92

ME = mean bias error (mm day^{-1}); MAE = mean absolute error (mm day^{-1}); RMSE = root mean square error (mm day^{-1}); R^2 = coefficient of determination; FTO = forced to the origin regression.