Supplementary Materials

Upscaling dryland carbon and water fluxes with artificial neural networks of optical, thermal, and microwave satellite remote sensing

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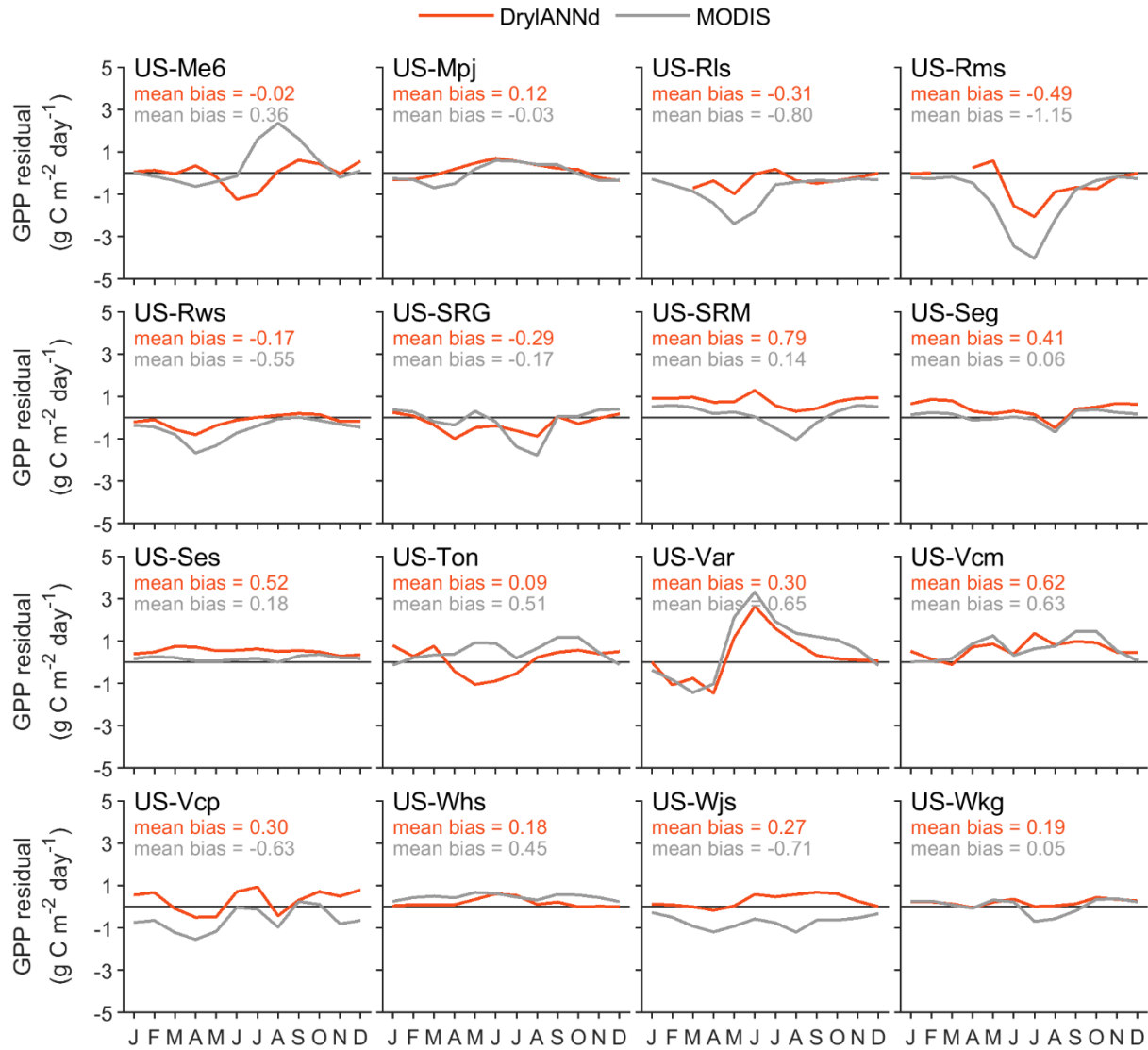
Figure S1. Residual between the mean seasonality of observed GPP vs. DrylANNd GPP (red) and MODIS GPP (gray) at the sixteen sites with complete flux records. Monthly means were estimated using all available observations during the period 2015-2020. Mean bias is the average of the residuals across the full calendar year.
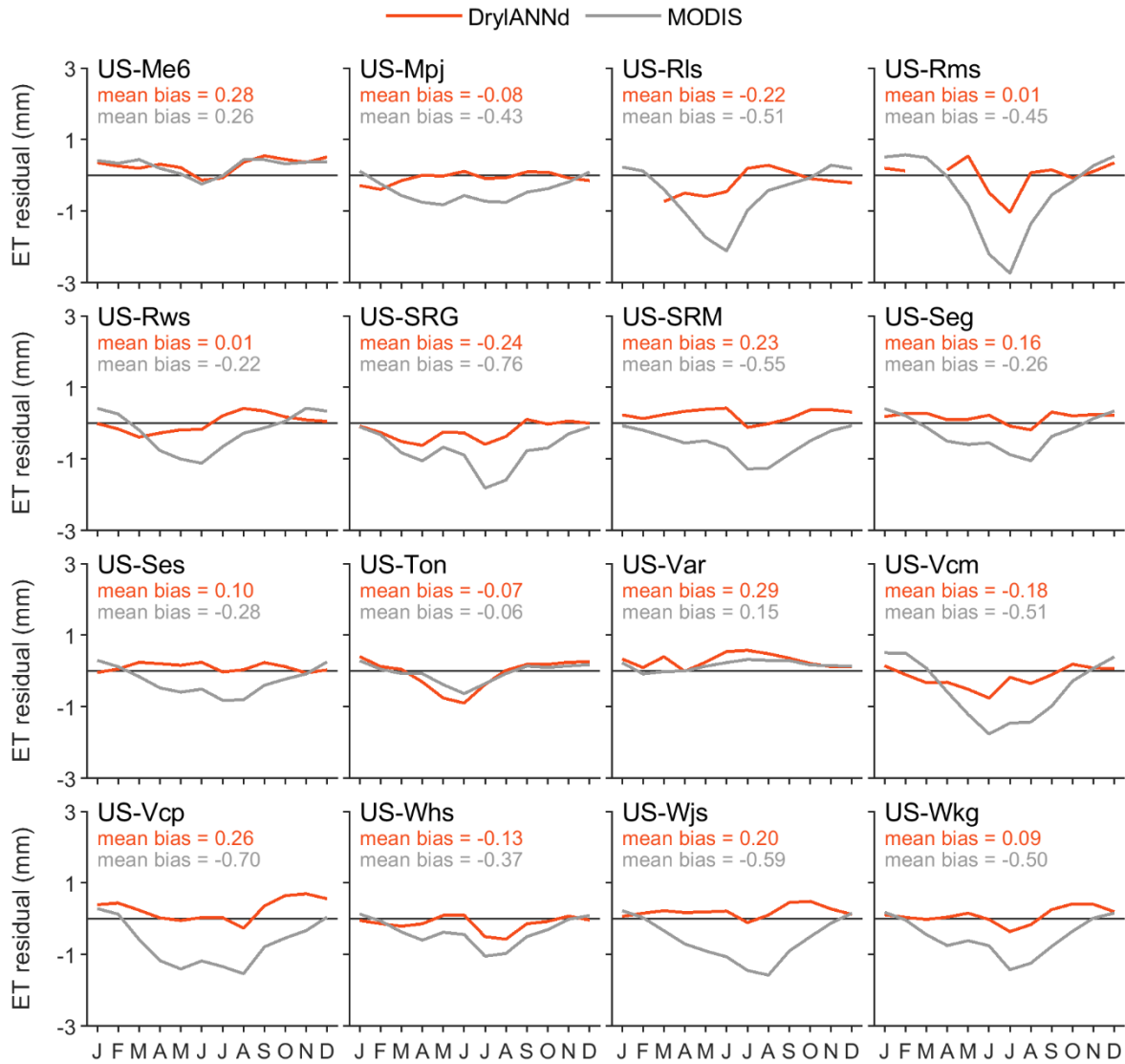
Figure S2. Residual between the mean seasonality of observed ET vs. DrylANNd ET (red) and MODIS ET (gray) at the sixteen sites with complete flux records. Monthly means were estimated using all available observations during the period 2015-2020. Mean bias is the average of the residuals across the full calendar year.
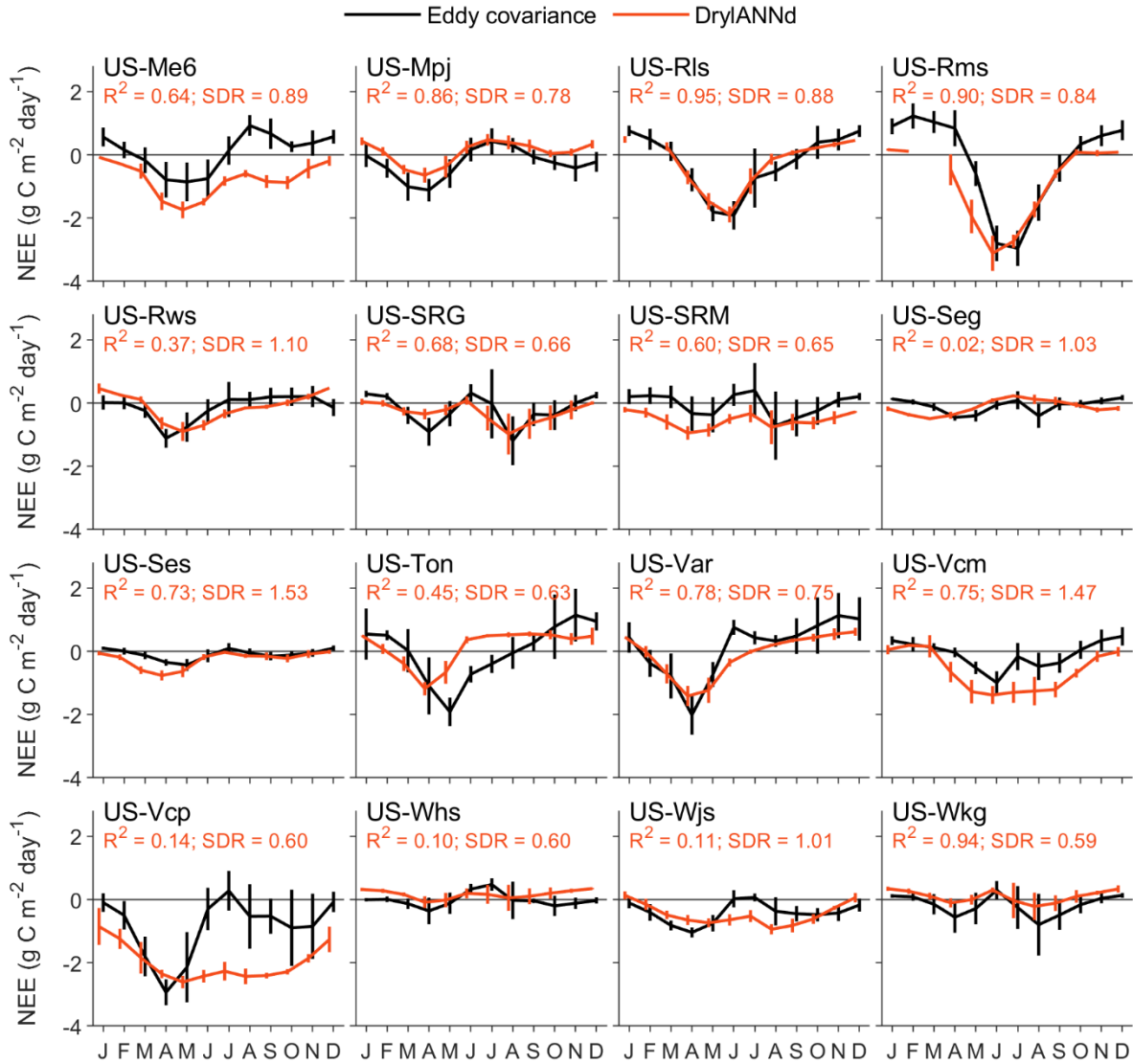
Figure S3. Mean (±1 standard deviation) seasonality of eddy covariance NEE (black) and DrylANNd NEE (red) at the sixteen sites with complete flux records. Monthly means and standard deviations were estimated using all available observations during the period 2015-2020. Standard deviation ratio (SDR)<1 indicates that the model underestimated the magnitude of seasonal variability and SDR>1 indicates that the model overestimated the magnitude of seasonal variability.
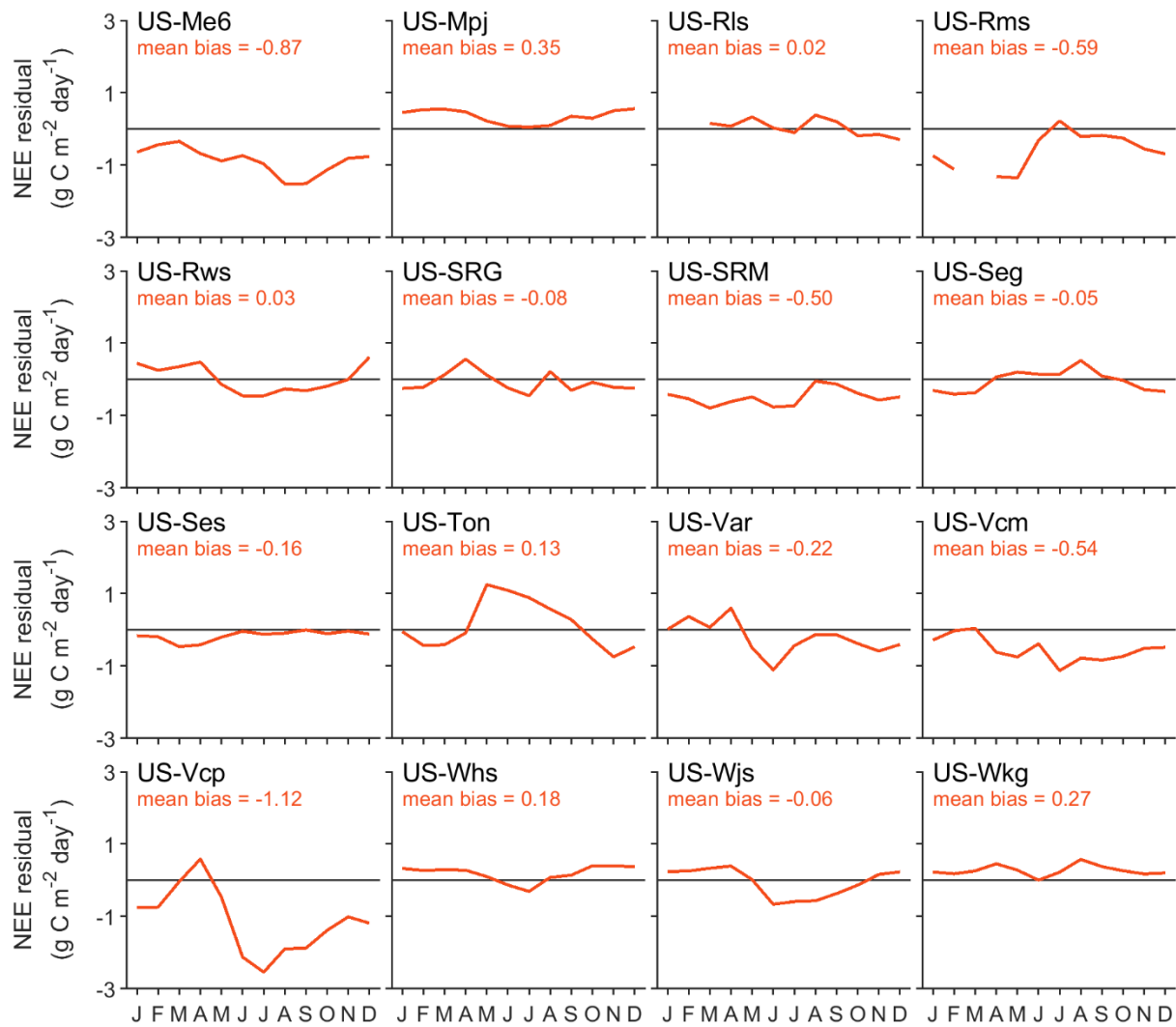
Figure S4. Residual between the mean seasonality of observed NEE vs. DrylANNd NEE at the sixteen sites with complete flux records. Monthly means were estimated using all available observations during the period 2015-2020. Mean bias is the average of the residuals across the full calendar year.

Table S1. AmeriFlux sites used for DrylANNd model calibration and validation. Aridity is the ratio of mean annual precipitation to mean annual potential evapotranspiration from the TerraClimate database.

Site_ID	Name	Lat	Lon	Aridity	Biome	Elev (m)	Start	End
US-CZ2	Sierra Critical Zone: Ponderosa Pine Forest, Soaproot Saddle	37.03	-119.26	0.57	ENF	1160	2010	2016
US-CZ3	Sierra Critical Zone: Sierran Mixed Conifer, P301	37.07	-119.20	0.74	ENF	2015	2008	2016
US-Hn2	Hanford 100H grassland	46.69	-119.46	0.13	GRS	117.5	2015	2018
US-Hn3	Hanford 100H sagebrush	46.69	-119.46	0.13	SHB	120.9	2017	2018
US-Jo2	Jornada Experimental Range Mixed Shrubland	32.58	-106.60	0.17	SHB	1469	2010	2019
US-KLS	Kansas Land Institute	38.77	-97.57	0.62	GRS	373	2012	2017
US-Me6	Metolius Young Pine Burn	44.32	-121.61	0.55	ENF	998	2010	2020
US-Mpj	Mountainair Pinyon-Juniper Woodland	34.44	-106.24	0.29	SAV	2196	2008	2019
US-MtB	Mt Bigelow	32.42	-110.73	0.45	ENF	2573	2009	2019
US-Rls	RCEW Low Sagebrush	43.14	-116.74	0.34	SHB	1608	2014	2018
US-Rms	RCEW Mountain Big Sagebrush	43.06	-116.75	0.45	SHB	2111	2014	2018
US-Rwf	RCEW Upper Sheep Prescibed Fire	43.12	-116.72	0.44	SHB	1878	2014	2018
US-Rws	Reynolds Creek Wyoming big sagebrush	43.17	-116.71	0.26	SHB	1425	2014	2018
US-SCg	Southern California Climate Gradient: Grassland	33.74	-117.69	0.28	GRS	465	2006	2016
US-SCs	Southern California Climate Gradient: Coastal Sage	33.73	-117.70	0.28	SHB	470	2006	2016
US-SCw	Southern California Climate Gradient: Pinyon/Juniper Woodland	33.60	-116.45	0.19	SHB	1281	2006	2016
US-Seg	Sevilleta grassland	34.36	-106.70	0.33	GRS	1596	2007	2019
US-Ses	Sevilleta shrubland	34.33	-106.74	0.26	SHB	1593	2007	2019
US-SRG	Santa Rita Grassland	31.79	-110.83	0.26	GRS	1291	2008	2020
US-SRM	Santa Rita Mesquite	31.82	-110.87	0.16	SAV	1120	2003	2020
US-SRS	Santa Rita Experimental Range Mesquite Savanna	31.82	-110.85	0.16	SAV	1169	2011	2018
US-Ton	Tonzi Ranch	38.43	-120.97	0.45	SAV	177	2001	2020
US-Var	Vaira Ranch	38.41	-120.95	0.46	GRS	129	2000	2020
US-Vcm	Valles Caldera Mixed Conifer	35.89	-106.53	0.85	ENF	3030	2007	2019
US-Vcp	Valles Caldera Ponderosa Pine	35.86	-106.60	0.63	ENF	2500	2007	2019
US-Whs	Walnut Gulch Lucky Hills Shrub	31.74	-110.05	0.20	SHB	1370	2007	2020
US-Wjs	Willard Juniper Savannah	34.43	-105.86	0.23	SAV	1931	2007	2019
US-Wkg	Walnut Gulch Kendall Grasslands	31.74	-109.94	0.23	GRS	1531	2004	2020