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Supplement of

**Water, Energy, and Carbon with Artificial Neural Networks (WECANN):
a statistically based estimate of global surface turbulent fluxes and gross
primary productivity using solar-induced fluorescence**

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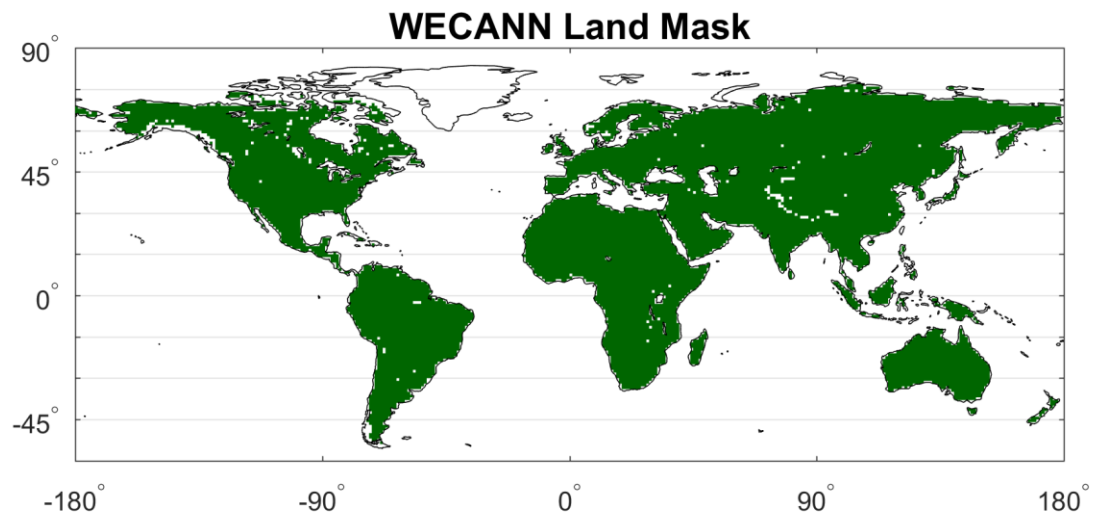


Figure S1: Spatial coverage of WECANN retrievals. Green pixels show where WECANN retrievals are provided.

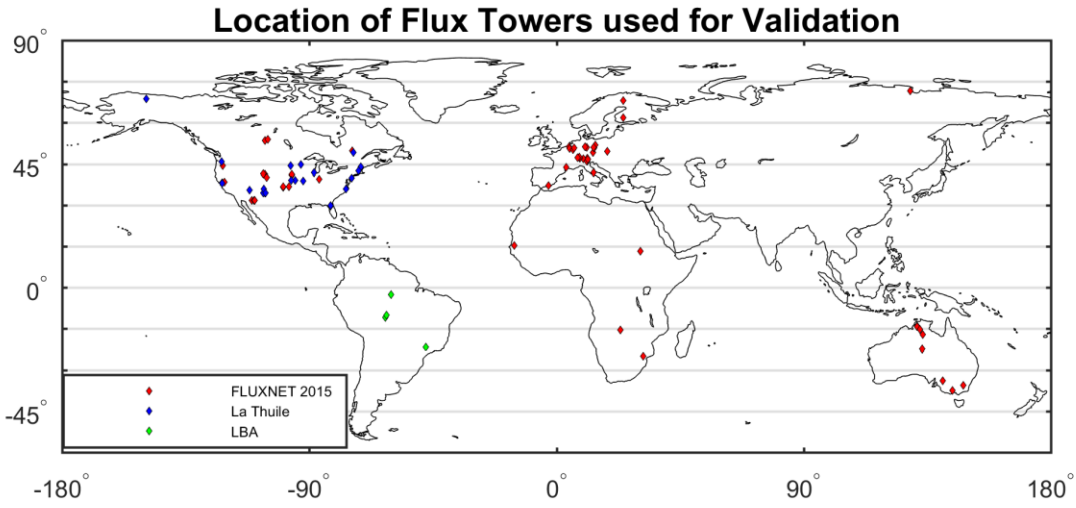


Figure S2: Location of flux towers used in validation of WECANN retrievals. Red diamonds indicate measurements from FLUXNET 2015 dataset, blue diamonds indicate measurements from the AmeriFlux La Thuile Synthesis Dataset, and green diamonds indicate measurements from the Large-scale Biosphere-Atmosphere (LBA) experiment in Brazil.

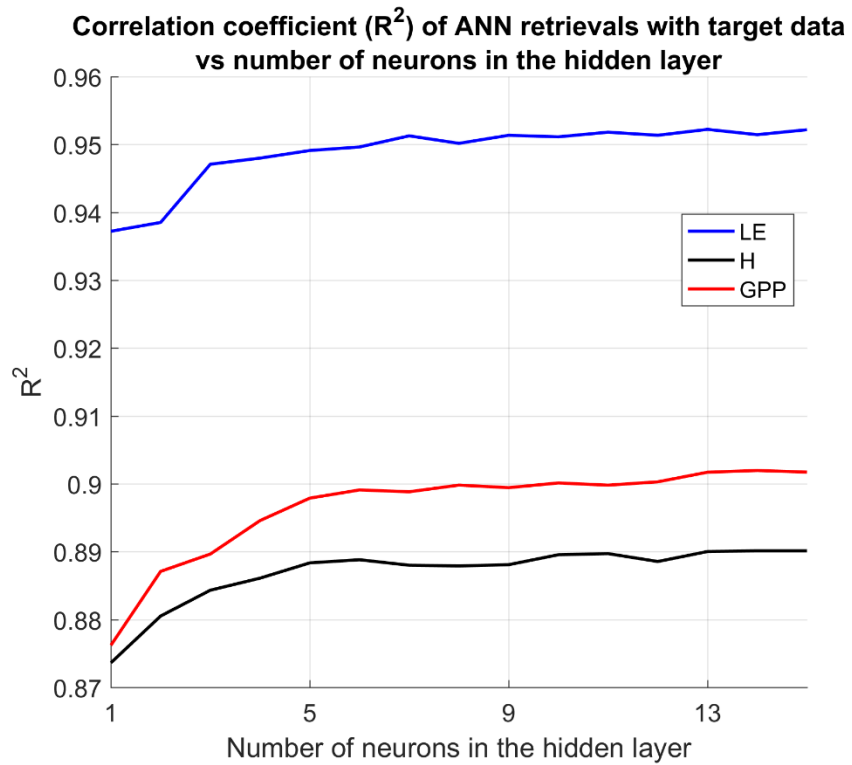


Figure S3: Correlation coefficients (R^2) between ANN retrievals of LE, H, and GPP and target data as a function of number of neurons in hidden layer.

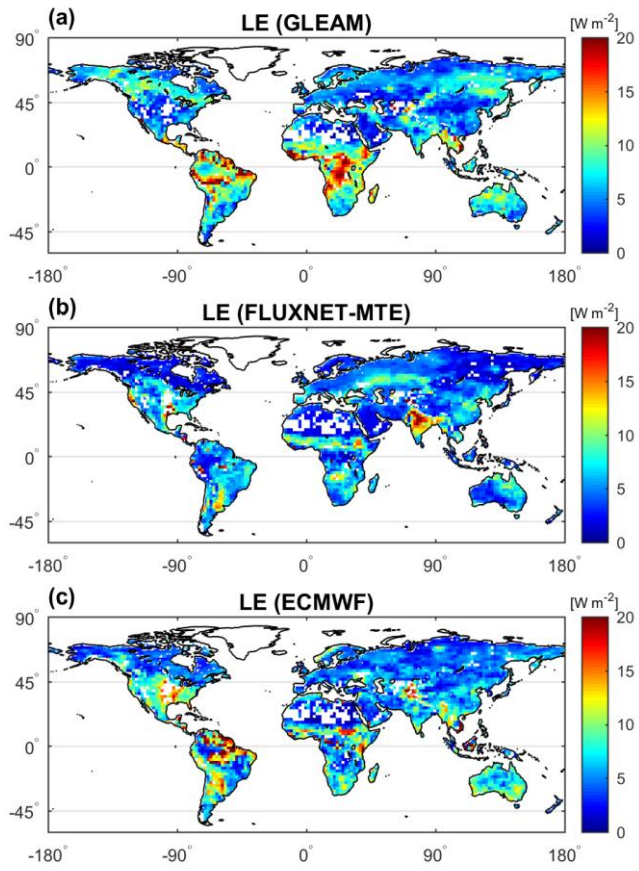


Figure S4: RMSE of LE for each of the three training datasets estimated by Triple Collocation (2008-2010).

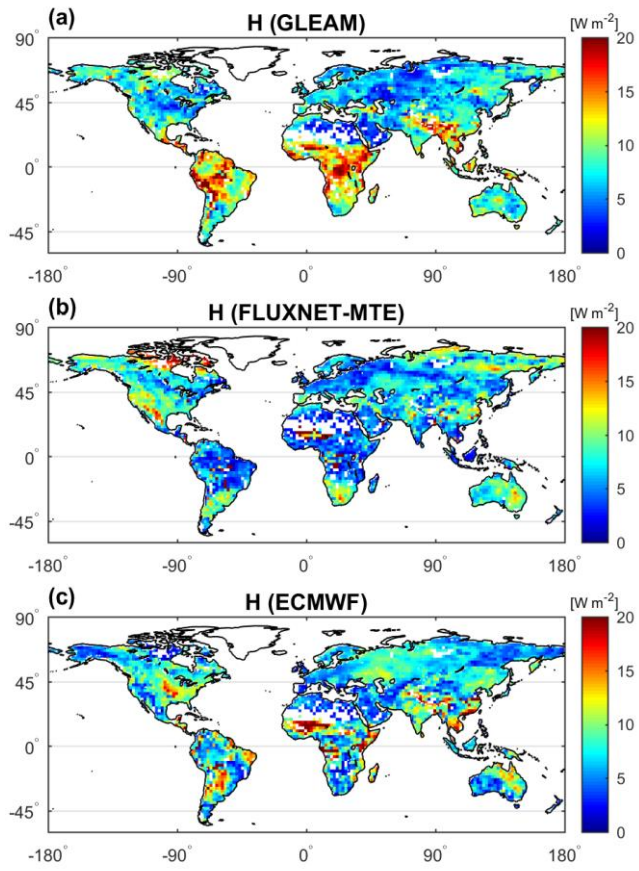


Figure S5: Similar to Figure S1 for H.

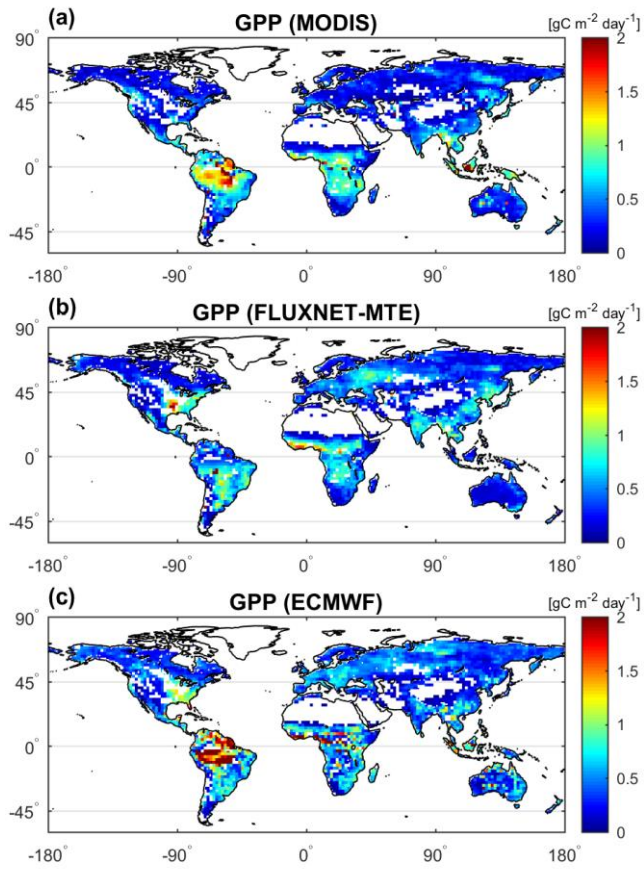


Figure S6: Similar to Figure S1 for GPP.

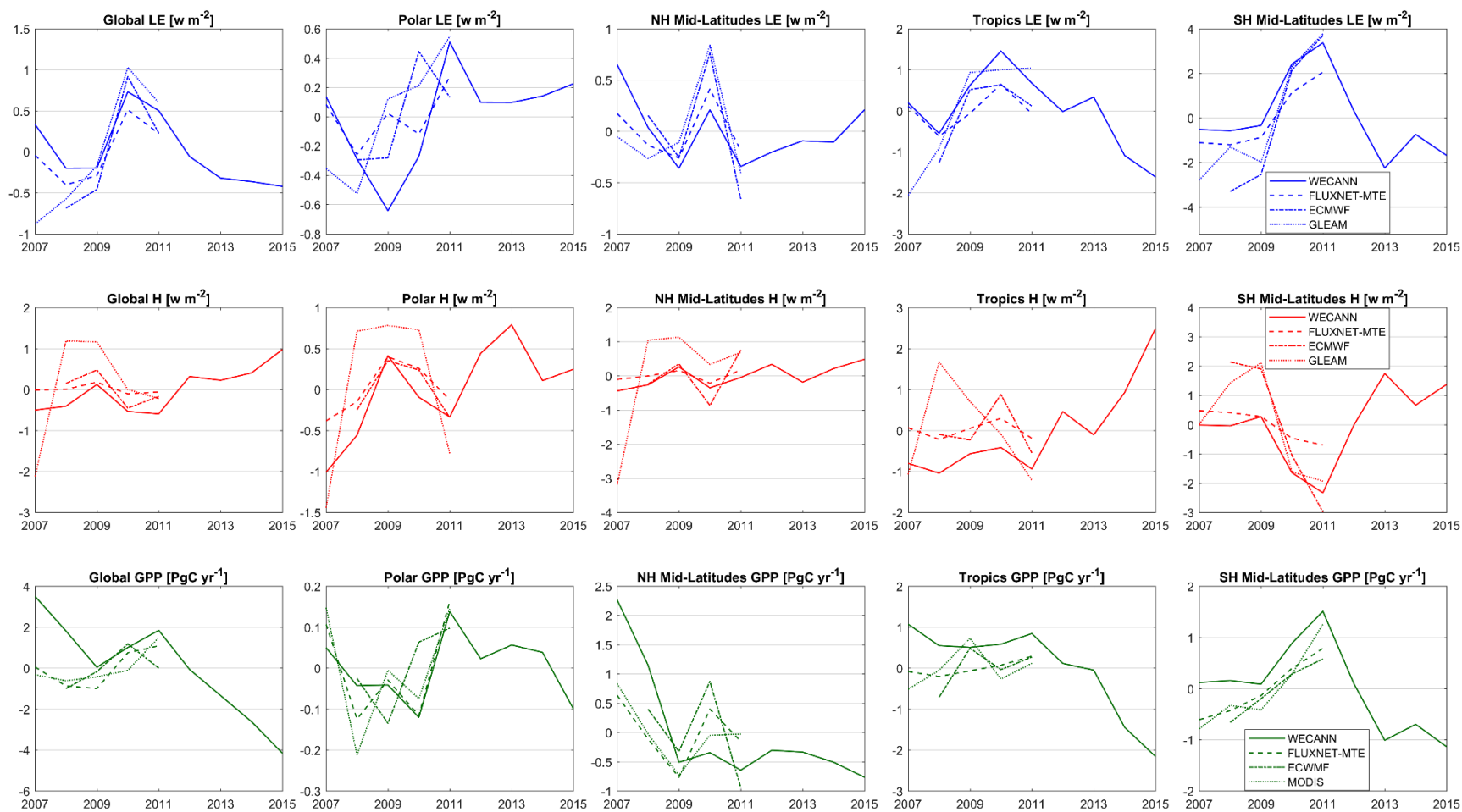


Figure S7- Annual mean anomalies of LE (top row), H (middle row) and GPP (bottom row) retrievals at global (left column) and regional (four right columns) scales for WECANN (solid lines) and three other training products.

Table S1: List of eddy covariance tower sites used for evaluation. FLX refers to data from FLUXNET2015 dataset, LTH refers to measurements from La Thuile Synthesis Dataset, and LBA refers to measurements from Large-scale Biosphere-Atmosphere (LBA) experiment

Site ID	Database	Temporal Coverage	Reference
AT-Neu	FLX	01/2007 - 12/2012	(Wohlfahrt et al., 2008)
AU-ASM	FLX	01/2010 - 12/2014	(Cleverly et al., 2013; Eamus et al., 2013)
AU-Cpr	FLX	01/2010 - 12/2014	(Meyer et al., 2015)
AU-DaP	FLX	01/2007 - 12/2013	(Beringer et al., 2016)
AU-DaS	FLX	01/2008 - 12/2014	(Beringer et al., 2016)
AU-Dry	FLX	01/2008 - 12/2014	(Beringer et al., 2016)
AU-Stp	FLX	01/2008 - 12/2014	(Beringer et al., 2016)
AU-Tum	FLX	01/2007 - 12/2014	(Beringer et al., 2016)
AU-Wom	FLX	01/2010 - 12/2014	(Hinko-Najera et al., 2017)
BE-Bra	FLX	01/2007 - 12/2014	(de Pury and Ceulemans, 1997)
BE-Lon	FLX	01/2007 - 12/2014	(Moureaux et al., 2006)
BE-Vie	FLX	01/2007 - 12/2014	(Aubinet et al., 2001)
BR-Ji1	LBA	01/1999 - 12/2003	(Araújo et al., 2002; Rocha et al., 2002; von Randow et al., 2004)
BR-Ji2	LBA	01/1999 - 12/2003	(Araújo et al., 2002; Rocha et al., 2002; von Randow et al., 2004)
BR-Ma2	LBA	01/1999 - 12/2003	(Araújo et al., 2002; Rocha et al., 2002; von Randow et al., 2004)
BR-Sp1	LBA	01/1999 - 12/2003	(Araújo et al., 2002; Rocha et al., 2002; von Randow et al., 2004)
CA-Oas	FLX	01/2007 - 12/2010	(Barr et al., 2012; Zha et al., 2013)
CA-Obs	FLX	01/2007 - 12/2010	(Barr et al., 2012; Zha et al., 2013)
CA-Qcu	LTH	01/2007 - 12/2010	(Margolis, 2001)
CA-Qfo	FLX	01/2007 - 12/2010	(Bergeron et al., 2007)
CH-Cha	FLX	01/2007 - 12/2014	(Eugster and Zeeman, 2006)
CH-Dav	FLX	01/2007 - 12/2014	(Zweifel et al., 2010)
CH-Fru	FLX	01/2007 - 12/2014	(Eugster and Zeeman, 2006)
CH-Lae	FLX	01/2007 - 12/2014	(Eugster et al., 2007)
CH-Oe2	FLX	01/2007 - 12/2014	(Kutsch et al., 2010)
CZ-BK1	FLX	01/2007 - 12/2014	(Bernhofer et al., 2003)
CZ-BK2	FLX	01/2007 - 12/2012	(Bernhofer et al., 2003)
DE-Geb	FLX	01/2007 - 12/2014	(Anthoni et al., 2004a)
DE-Lkb	FLX	01/2009 - 12/2013	(Westergaard-Nielsen et al., 2013)
DE-Lnf	FLX	01/2007 - 12/2012	(Anthoni et al., 2004b)
DE-Obe	FLX	01/2008 - 12/2014	(Westergaard-Nielsen et al., 2013)
DE-She	FLX	01/2007 - 12/2010	(Eder et al., 2015)
DE-Spw	FLX	01/2010 - 12/2014	(Westergaard-Nielsen et al., 2013)
DE-Tha	FLX	01/2007 - 12/2014	(Bernhofer et al., 2003)
ES-LgS	FLX	01/2007 - 12/2009	(Reverter et al., 2010)
FI-Hyy	FLX	01/2007 - 12/2014	(Suni et al., 2003)
FI-Lom	FLX	01/2007 - 12/2009	(Aurela et al., 2009; Lohila et al., 2010)
FR-Pue	FLX	01/2007 - 12/2014	(Rambal et al., 2004)
IT-Col	FLX	01/2007 - 12/2014	(Valentini et al., 1996)
IT-Lav	FLX	01/2007 - 12/2014	(Cescatti and Marcolla, 2004)
IT-MBo	FLX	01/2007 - 12/2013	(Marcolla et al., 2011)
IT-Ren	FLX	01/2007 - 12/2013	(Marcolla et al., 2005)
RU-Tks	FLX	01/2010 - 12/2014	(Uttal et al., 2016)
SD-Dem	FLX	01/2007 - 12/2009	(Ardo et al., 2008)
SN-Dhr	FLX	01/2010 - 12/2013	(Tagesson et al., 2015)
US-AR1	FLX	01/2009 - 12/2012	(Billesbach et al., 2016)
US-AR2	FLX	01/2009 - 12/2012	(Billesbach et al., 2016)
US-ARM	FLX	01/2010 - 12/2014	(Fischer et al., 2007)
US-Bar	LTH	01/2007 - 12/2011	(Jenkins et al., 2007)
US-Bkg	LTH	01/2007 - 12/2010	(Gilmanov et al., 2005)
US-Fwf	LTH	01/2007 - 12/2010	(Dore et al., 2012)
US-GLE	FLX	01/2007 - 12/2014	(Massman, 2000)

US-Ha1	FLX	01/2007 - 12/2012	(Urbanski et al., 2007)
US-Ha2	LTH	01/2007 - 12/2013	(Urbanski et al., 2007)
US-IB1	LTH	01/2007 - 12/2011	(Matamala et al., 2008)
US-ICb	LTH	01/2007 - 12/2011	(Euskirchen et al., 2012)
US-ICs	LTH	01/2007 - 12/2011	(Euskirchen et al., 2012)
US-ICt	LTH	01/2007 - 12/2011	(Euskirchen et al., 2012)
US-KFS	LTH	01/2007 - 12/2012	(Brunsell et al., 2014)
US-Kon	LTH	01/2007 - 12/2012	(Brunsell et al., 2008)
US-Me2	FLX	01/2007 - 12/2014	(Kwon et al., 2017)
US-Me3	FLX	01/2007 - 12/2009	(Kwon et al., 2017)
US-Me6	FLX	01/2010 - 12/2014	(Kwon et al., 2017)
US-MMS	FLX	01/2007 - 12/2014	(Schmid et al., 2000)
US-MOz	LTH	01/2007 - 12/2013	(Gu et al., 2006)
US-Mpj	LTH	01/2008 - 12/2010	(Anderson-Teixeira et al., 2011)
US-NC2	LTH	01/2007 - 12/2010	(Noormets et al., 2010)
US-Ne1	FLX	01/2007 - 12/2013	(Verma et al., 2005)
US-Ne2	FLX	01/2007 - 12/2013	(Verma et al., 2005)
US-Ne3	FLX	01/2007 - 12/2013	(Verma et al., 2005)
US-NR1	FLX	01/2007 - 12/2014	(Monson et al., 2002)
US-Ro1	LTH	01/2007 - 12/2012	(Griffis et al., 2007)
US-Seg	LTH	01/2007 - 12/2010	(Petrie et al., 2015)
US-Ses	LTH	01/2007 - 12/2010	(Petrie et al., 2015)
US-Slt	LTH	01/2007 - 12/2012	(Clark et al., 2010)
US-Snd	LTH	01/2007 - 12/2014	(Detto et al., 2010)
US-SP1	LTH	01/2007 - 12/2011	(Gholz and Clark, 2002)
US-SP3	LTH	01/2007 - 12/2010	(Gholz and Clark, 2002)
US-SRG	FLX	01/2008 - 12/2014	(Scott et al., 2015)
US-SRM	FLX	01/2007 - 12/2014	(Scott et al., 2009)
US-Sta	FLX	01/2007 - 12/2009	(Ewers and Pendall, 2009)
US-Ton	FLX	01/2007 - 12/2014	(Ma et al., 2007)
US-Twt	FLX	01/2009 - 12/2014	(Hatala et al., 2012)
US-Var	FLX	01/2007 - 12/2014	(Ma et al., 2007)
US-Vcm	LTH	01/2007 - 12/2010	(Anderson-Teixeira et al., 2011)
US-Whs	FLX	01/2007 - 12/2014	(Wang et al., 2010)
US-Wjs	LTH	01/2007 - 12/2010	(Anderson-Teixeira et al., 2011)
US-Wkg	FLX	01/2007 - 12/2014	(Scott et al., 2010)
US-Wrc	LTH	01/2007 - 12/2014	(Falk et al., 2008)
ZA-Kru	FLX	01/2007 - 12/2013	(Archibald et al., 2009; Scholes et al., 2001)
ZM-Mon	FLX	01/2007 - 12/2009	(Merbold et al., 2009)

Table S2: Statistics of WECANN LE retrievals compared to eddy covariance measurements.

Site ID	Correlation Coefficient				RMSE [W m ⁻²]				Bias [W m ⁻²]			
	WECANN	FLUXNET-MTE	GLEAM	ECMWF	WECANN	FLUXNET-MTE	GLEAM	ECMWF	WECANN	FLUXNET-MTE	GLEAM	ECMWF
AT-Neu	0.92	0.94	0.93	0.96	15.91	15.95	14.08	10.19	-4.00	-7.94	0.82	0.54
AU-ASM	0.81	0.60	0.63	0.71	18.97	25.53	25.41	23.54	-5.84	-23.30	-9.65	-9.41
AU-Cpr	0.55	0.24	0.39	0.54	14.04	16.05	19.06	17.74	2.24	-8.87	-4.31	-2.98
AU-DaP	0.80	0.66	0.75	0.82	29.50	34.96	31.27	28.15	-1.69	3.10	7.34	3.50
AU-DaS	0.90	0.88	0.91	0.87	16.16	15.76	17.82	18.29	-21.37	-11.53	-7.50	-4.25
AU-Dry	0.65	0.60	0.60	0.62	31.41	27.63	33.80	35.80	-23.62	-15.60	-4.46	1.42
AU-Stp	0.86	0.66	0.63	0.61	20.41	32.08	33.02	36.57	-1.95	-5.80	6.50	4.53
AU-Tum	0.89	0.78	0.64	0.68	21.39	22.92	30.45	29.70	-20.45	-14.42	-17.60	-22.52
AU-Wom	0.88	0.81	0.77	0.64	15.63	22.13	23.85	27.75	-24.39	-28.17	-26.02	-22.23
BE-Bra	0.95	0.78	0.80	0.79	9.04	18.20	20.89	19.86	10.66	14.02	9.46	23.34
BE-Lon	0.87	0.87	0.86	0.87	16.03	17.40	18.16	17.82	6.61	-0.21	3.15	14.69
BE-Vie	0.94	0.80	0.77	0.78	10.22	20.16	23.01	24.03	10.76	3.93	6.42	16.30
BR-Ji1	0.13	0.09	0.65	0.13	16.67	16.21	13.41	19.06	27.83	29.08	15.52	31.35
BR-Ji2	0.77	0.77	0.04	0.49	4.16	2.93	18.88	11.24	4.85	5.32	-2.02	10.14
BR-Ma2	-0.26	0.17	-0.11	0.45	13.33	9.96	14.01	13.65	7.71	11.16	19.04	29.58
BR-Sp1	0.84	0.90	0.92	0.90	14.74	12.50	11.10	12.70	7.63	-0.69	3.67	15.00
CA-Qcu	0.97	0.84	0.78	0.89	8.00	15.67	23.77	13.89	1.48	-1.64	12.18	6.52
CA-Qfo	0.98	0.85	0.83	0.92	6.97	12.87	22.93	12.30	8.52	0.32	18.24	10.98
CH-Cha	0.91	0.84	0.91	0.93	20.68	23.04	16.38	14.82	-15.29	-22.95	-11.56	-6.69
CH-Dav	0.95	0.84	0.85	0.91	16.43	21.06	21.58	16.43	-21.63	-17.18	-17.19	-21.76
CH-Fru	0.93	0.79	0.86	0.88	16.66	25.34	19.38	18.46	-9.05	-19.93	-7.09	-2.84
DE-Geb	0.89	0.87	0.85	0.83	14.85	16.00	17.02	19.52	10.81	6.13	12.35	18.65
DE-Lkb	0.90	0.89	0.87	0.88	14.49	13.80	17.64	18.42	11.71	5.74	9.82	15.73
DE-Lnf	0.96	0.85	0.86	0.85	9.51	17.22	17.45	18.19	8.92	4.63	6.81	13.58
DE-Obe	0.94	0.89	0.85	0.87	10.84	14.45	18.27	18.29	5.28	1.78	3.32	13.22
DE-Seh	0.78	0.81	0.81	0.89	20.13	18.15	19.36	18.39	3.42	-1.08	2.59	17.80
DE-Tha	0.96	0.87	0.88	0.90	9.13	14.38	16.20	16.64	5.29	3.30	2.82	11.74
ES-LgS	0.74	0.61	-0.03	0.10	14.80	17.46	26.00	27.65	-1.94	-8.91	-18.94	-4.42
FI-Hyy	0.97	0.90	0.82	0.88	6.48	12.23	18.55	16.15	1.09	-0.49	4.47	7.95
FI-Lom	0.89	0.90	0.83	0.89	11.44	10.93	16.85	10.83	8.52	6.90	9.69	9.56
FR-Pue	0.84	0.82	0.84	0.79	16.57	14.92	18.04	18.46	8.55	0.83	3.13	14.99
IT-Col	0.87	0.70	0.43	0.55	24.05	26.34	42.88	36.63	4.27	7.03	3.07	-2.70
IT-Lav	0.94	0.89	0.84	0.86	13.73	13.91	18.52	21.73	4.07	-5.12	-6.71	6.52
IT-MBo	0.95	0.86	0.80	0.88	15.01	22.04	24.19	19.20	-2.82	-9.41	0.66	0.60
IT-Ren	0.94	0.72	0.87	0.91	11.18	21.65	16.78	15.01	1.80	5.02	7.40	6.90
RU-Tks	0.51	0.32	0.31	0.37	19.22	23.95	27.18	24.15	0.12	-3.32	-3.81	6.22
SD-Dem	0.73	0.52	0.66	0.82	20.60	25.78	24.82	18.77	-17.40	-29.93	-22.50	-14.64
SN-Dhr	0.36	0.26	0.27	0.26	47.17	46.83	49.76	48.53	-21.13	-50.71	-50.48	-58.92
US-AR1	0.82	0.77	0.70	0.52	17.42	18.45	20.49	25.70	-3.09	-5.36	-6.01	-3.66
US-AR2	0.52	0.58	0.54	0.37	23.49	21.98	22.02	25.79	3.14	-0.74	-1.39	0.96
US-ARM	0.76	0.82	0.81	0.71	22.47	17.94	22.41	25.07	3.29	-0.16	1.39	4.57
US-Bar	0.92	0.88	0.81	0.82	13.80	15.96	22.23	25.30	20.47	6.66	11.36	24.25
US-Bkg	0.89	0.87	0.77	0.77	22.72	23.98	31.28	30.82	-11.84	-17.43	-16.71	8.67
US-Fwf	0.85	0.72	0.65	0.30	15.38	15.73	16.80	21.56	-9.24	-10.65	-7.82	-9.68
US-GLE	0.79	0.71	0.68	0.55	13.55	16.72	22.03	21.37	-17.33	-23.13	-11.74	-12.73
US-Ha2	0.78	0.79	0.75	0.88	22.60	22.32	24.46	25.42	26.32	11.73	9.68	29.94
US-IB1	0.92	0.86	0.77	0.72	16.80	20.81	28.86	35.96	0.24	-10.40	-6.06	9.62
US-ICb	0.93	0.83	0.81	0.84	8.36	12.53	13.16	13.09	-3.09	-0.93	-3.52	-1.35
US-ICs	0.94	0.83	0.80	0.85	8.58	13.32	14.56	13.19	-4.25	-1.40	-4.29	-1.54
US-ICt	0.92	0.82	0.75	0.83	9.08	13.45	15.93	13.62	-0.36	-1.53	-5.34	-1.24
US-KFS	0.93	0.93	0.88	0.74	15.35	20.47	21.66	31.91	11.46	8.27	4.39	20.78
US-Kon	0.87	0.88	0.82	0.67	22.64	22.47	26.77	37.48	4.18	1.79	1.80	12.88
US-Me2	0.89	0.87	0.77	0.62	13.89	15.25	18.43	23.27	-8.50	-11.82	-3.11	-7.61

US-MMS	0.95	0.91	0.88	0.75	15.58	22.72	24.15	34.48	11.41	-2.20	-1.99	18.33
US-MOz	0.90	0.86	0.85	0.72	17.49	22.13	23.25	33.78	16.49	1.63	4.43	13.55
US-Mpj	0.85	0.58	0.60	0.39	9.14	13.44	15.26	17.92	-5.43	-10.14	-7.46	-7.27
US-NC2	0.95	0.91	0.83	0.85	10.88	15.31	26.17	19.69	-23.05	-14.21	2.27	14.90
US-Ne1	0.84	0.90	0.85	0.65	36.45	25.64	31.10	45.26	-26.85	-14.45	-23.10	-9.08
US-Ne2	0.80	0.84	0.80	0.60	38.38	29.96	32.92	46.33	-22.08	-12.19	-14.52	-0.26
US-Ne3	0.86	0.80	0.80	0.60	25.89	30.72	30.37	45.03	-6.30	-6.42	-7.51	6.52
US-NR1	0.89	0.78	0.71	0.71	13.65	16.82	21.77	19.87	-24.68	-19.77	-13.74	-17.48
US-Ro1	0.93	0.87	0.79	0.77	15.12	18.67	24.95	31.81	5.68	0.66	2.52	20.51
US-Seg	0.85	0.76	0.72	0.65	8.55	10.84	12.54	12.77	4.05	-2.17	1.19	2.36
US-Ses	0.85	0.74	0.75	0.66	8.05	10.40	11.66	12.76	5.38	-0.94	2.42	3.15
US-Slt	0.86	0.83	0.76	0.81	22.42	27.92	29.99	25.54	-3.62	-4.42	9.87	10.35
US-Snd	0.76	0.72	0.36	0.35	17.72	17.71	29.52	29.09	-16.66	-27.13	-39.45	-21.81
US-SP1	0.69	0.49	0.55	0.60	24.29	31.76	29.79	28.80	20.10	16.04	24.32	28.23
US-SP3	0.68	0.66	0.69	0.71	31.33	25.37	31.18	31.76	8.62	3.55	11.93	9.75
US-SRG	0.90	0.84	0.81	0.71	13.87	19.90	17.55	21.53	-7.06	-12.03	-4.91	-13.81
US-SRM	0.87	0.82	0.83	0.67	12.30	15.47	14.99	20.08	-0.77	-4.08	0.92	-8.53
US-Ton	0.55	0.66	0.93	0.88	23.84	23.37	11.35	14.29	11.77	13.49	8.54	2.31
US-Twt	0.77	0.48	-0.21	-0.22	51.52	64.12	82.10	81.42	-42.74	-50.52	-60.37	-43.69
US-Var	0.16	0.36	0.84	0.90	36.06	30.52	17.25	16.73	17.89	24.10	15.84	8.19
US-Vcm	0.83	0.77	0.63	0.40	15.70	19.68	20.65	25.45	-16.43	-21.40	-20.54	-17.10
US-Whs	0.84	0.83	0.84	0.68	11.61	12.50	13.22	16.53	6.09	2.37	8.87	-0.40
US-Wjs	0.89	0.81	0.80	0.76	9.72	12.52	12.93	12.85	-4.64	-8.83	-3.85	0.97
US-Wkg	0.81	0.74	0.79	0.61	14.69	15.18	15.19	19.78	1.16	-0.03	2.24	-3.31
US-Wrc	0.69	0.75	0.49	0.33	17.22	15.59	24.17	24.27	23.54	6.21	27.67	20.13
ZA-Kru	0.50	0.69	0.59	0.65	39.37	28.84	30.30	31.98	-2.94	14.75	-1.71	17.95
ZM-Mon	0.54	0.29	0.62	0.57	33.85	42.48	30.80	34.88	6.63	24.24	-2.60	8.48
Average	0.80	0.74	0.70	0.69	17.95	20.37	22.85	23.91	-1.04	-4.22	-1.97	3.18

Table S3: Similar to Table S1, but for WECANN H retrievals.

Site ID	Correlation Coefficient				RMSE [$W\ m^{-2}$]				Bias [$W\ m^{-2}$]			
	WECANN	FLUXNET-MTE	GLEAM	ECMWF	WECANN	FLUXNET-MTE	GLEAM	ECMWF	WECANN	FLUXNET-MTE	GLEAM	ECMWF
AT-Neu	0.86	0.78	0.71	0.73	6.92	17.45	12.56	10.62	17.37	34.30	7.44	9.29
AU-ASM	0.74	0.10	0.64	0.81	18.09	25.74	18.30	16.21	-38.40	-60.13	-41.78	-22.69
AU-Cpr	0.73	0.74	0.49	0.53	29.02	26.60	31.16	37.02	-12.33	-24.72	-18.29	-0.89
AU-DaP	0.65	-0.75	0.73	0.83	25.55	60.95	21.51	19.42	-4.27	-5.01	-9.44	-1.59
AU-DaS	0.75	-0.38	0.80	0.76	13.90	42.84	15.27	17.82	5.06	4.80	0.79	5.39
AU-Dry	0.58	-0.10	0.49	0.50	22.32	40.84	26.68	29.54	-4.62	-19.76	-10.55	-10.10
AU-Stp	0.66	-0.34	0.60	0.69	14.86	32.39	16.65	18.37	-6.56	-29.90	2.00	7.69
AU-Tum	0.73	0.85	0.67	0.85	18.31	13.52	19.61	19.41	2.35	11.22	-11.35	19.37
AU-Wom	0.87	0.86	0.63	0.84	21.72	19.49	27.67	20.98	3.67	22.87	-6.29	8.69
BE-Bra	0.86	0.78	0.78	0.90	17.89	18.97	22.51	15.06	-9.11	18.71	-21.85	-28.21
BE-Lon	0.77	0.67	0.52	0.68	13.83	22.12	18.09	16.09	5.29	30.41	-4.18	-8.29
BE-Vie	0.87	0.89	0.76	0.81	17.89	13.48	21.40	21.29	-13.92	9.08	-27.22	-31.23
BR-Ji1	0.29	0.42	0.57	0.45	9.27	5.67	10.09	9.27	-4.88	-7.66	-5.70	-11.56
BR-Ji2	0.83	0.64	0.51	0.85	4.79	3.57	14.10	8.09	7.00	4.28	7.92	3.02
BR-Ma2	0.84	0.77	0.71	-0.07	3.18	3.52	10.17	5.77	1.76	-6.15	-8.86	-13.97
BR-Sp1	0.92	0.69	0.70	0.83	5.31	8.40	7.99	7.43	4.05	12.42	-3.47	-1.50
CA-Qcu	0.89	0.89	0.54	0.75	9.22	10.77	19.73	19.60	9.54	12.77	-8.76	10.87
CA-Qfo	0.83	0.80	0.89	0.90	23.35	22.08	23.64	16.08	-17.06	-14.45	-34.42	-15.95
CH-Cha	0.81	0.76	0.74	0.72	7.26	20.60	11.71	9.88	6.73	28.31	0.76	-2.70
CH-Dav	0.75	0.82	0.73	0.73	19.43	18.27	17.64	17.61	-0.55	5.14	2.46	-5.21
CH-Fru	0.87	0.73	0.62	0.66	8.11	18.45	14.37	12.32	8.39	30.25	1.35	-2.17
DE-Geb	0.86	0.72	0.63	0.77	10.80	20.54	16.97	13.26	1.80	23.08	-10.21	-7.93
DE-Lkb	0.82	0.85	0.59	0.71	14.89	15.81	19.62	17.45	-7.72	8.21	-18.50	-19.94
DE-Lnf	0.25	0.26	0.14	0.29	36.73	39.83	41.31	33.23	15.32	29.01	11.99	2.09
DE-Obe	0.82	0.93	0.69	0.85	16.05	11.39	17.98	13.79	-8.54	7.60	-19.99	-22.89
DE-Seh	0.53	0.48	0.37	0.58	13.26	26.04	16.75	14.04	13.70	33.68	0.62	-1.77
DE-Tha	0.92	0.92	0.70	0.88	20.92	11.74	25.21	19.65	-11.99	7.11	-23.80	-25.31
ES-LgS	0.87	0.61	0.77	0.82	26.47	45.19	32.45	31.76	1.26	-22.96	5.01	16.79
FI-Hyy	0.83	0.91	0.87	0.93	16.67	12.74	16.64	12.46	-0.45	5.85	-9.37	-14.34
FI-Lom	0.85	0.84	0.65	0.72	10.74	13.24	16.96	18.45	8.73	14.68	1.34	-0.53
FR-Pue	0.93	0.86	0.88	0.91	21.70	30.43	23.05	17.56	-5.64	2.92	-9.24	-6.27
IT-Col	0.77	0.65	0.60	0.87	20.89	26.81	26.03	16.95	-15.20	-0.67	-16.32	-1.27
IT-Lav	0.95	0.93	0.91	0.85	27.07	17.59	26.99	32.92	-23.03	-0.07	-11.43	-31.34
IT-MBo	0.84	0.79	0.52	0.65	15.47	17.10	22.30	19.25	16.23	29.61	24.80	12.01
IT-Ren	0.91	0.68	0.83	0.88	20.17	23.52	21.81	21.85	-24.96	-3.60	-18.27	-33.91
RU-Tks	0.63	0.37	0.38	0.34	17.46	25.85	34.28	28.15	14.20	2.96	-6.52	-8.02
SD-Dem	0.64	-0.48	0.56	0.54	10.84	21.06	14.80	12.25	4.21	-37.00	-2.45	8.23
SN-Dhr	0.60	-0.81	0.68	0.49	18.18	43.62	20.13	24.53	30.43	-6.25	15.27	41.01
US-AR1	0.86	0.36	0.74	0.78	12.74	27.15	15.92	22.27	12.19	1.35	3.49	18.60
US-AR2	0.63	0.48	0.72	0.75	20.51	24.05	15.69	23.55	3.21	-3.17	-1.03	14.08
US-ARM	0.78	0.55	0.61	0.72	22.93	28.42	24.15	22.35	-3.73	11.33	-15.45	-3.17
US-Bar	0.81	0.55	0.81	0.77	22.65	29.88	20.91	21.31	-12.33	1.10	-12.60	-20.66
US-Bkg	0.68	0.32	0.70	0.77	14.78	37.83	12.50	12.33	1.35	25.79	-1.45	-7.15
US-Fwf	0.83	0.50	0.77	0.82	22.22	32.43	25.33	23.89	24.42	-9.23	13.97	36.08
US-GLE	0.83	0.84	0.82	0.92	23.81	23.73	27.52	15.99	-5.50	-12.95	-26.83	-6.50
US-Ha2	0.86	0.79	0.83	0.46	14.03	23.12	13.09	22.04	-5.76	15.63	3.92	-12.98
US-IB1	0.87	0.45	0.37	0.24	9.50	30.17	17.60	20.45	7.23	24.39	-5.72	-4.99
US-ICH	0.87	0.80	0.71	0.81	12.02	13.25	18.34	12.37	23.78	15.93	9.09	6.12
US-ICs	0.83	0.77	0.73	0.80	13.11	14.15	17.74	12.55	25.86	17.38	10.14	7.55
US-ICt	0.87	0.76	0.70	0.78	11.60	15.21	17.69	12.57	10.12	5.88	2.32	-4.26
US-KFS	0.88	0.62	0.52	0.43	6.17	43.66	9.38	15.94	1.65	34.36	-7.71	-3.98

US-Kon	0.53	-0.16	0.61	-0.10	13.74	49.91	10.90	26.08	-0.79	26.83	-10.04	-4.09
US-Me2	0.92	0.87	0.91	0.92	21.65	33.33	18.97	18.65	-9.08	-13.89	-14.65	2.49
US-MMS	0.66	0.27	0.72	-0.03	16.17	37.09	13.01	22.42	-13.32	19.25	-11.22	-15.85
US-MOz	0.69	0.21	0.66	-0.14	14.12	37.64	12.37	24.56	-9.96	21.04	-10.16	0.28
US-Mpj	0.95	0.77	0.77	0.88	17.52	31.57	25.15	18.55	-29.72	-58.75	-37.50	-22.50
US-NC2	0.73	0.54	0.19	0.86	17.66	25.97	15.94	15.88	17.41	36.46	-11.02	-3.55
US-Ne1	0.51	-0.07	0.66	0.07	19.90	54.54	15.87	25.55	3.22	27.07	-5.25	-1.96
US-Ne2	0.58	0.03	0.68	0.13	18.15	52.78	17.02	25.85	2.87	24.94	-8.36	-5.19
US-Ne3	0.69	0.22	0.61	0.16	17.55	47.02	19.37	27.34	-4.41	24.43	-9.83	-5.82
US-NR1	0.68	0.78	0.83	0.90	23.92	19.57	20.96	15.73	-9.26	-15.22	-26.46	-0.66
US-Ro1	0.84	0.63	0.42	0.33	9.35	27.64	16.87	18.35	8.12	27.42	-0.28	-1.14
US-Seg	0.87	0.73	0.78	0.88	12.32	18.74	15.90	14.85	-10.82	-37.01	-16.85	-0.33
US-Ses	0.92	0.74	0.82	0.92	9.32	17.57	14.08	13.14	-13.86	-41.03	-20.87	-6.25
US-Slt	0.67	0.61	0.61	0.80	20.49	27.16	21.56	16.79	-6.13	1.79	-25.42	-8.51
US-Snd	0.51	0.28	0.47	0.48	24.99	21.24	32.26	39.40	11.37	8.14	19.67	11.49
US-SP1	0.59	0.42	0.36	0.49	14.85	34.59	18.53	22.56	4.99	26.39	-4.77	1.47
US-SP3	0.60	0.63	0.42	0.32	20.46	21.46	22.17	27.81	-16.77	28.77	-26.25	-19.09
US-SRG	0.88	0.02	0.86	0.88	13.80	30.95	14.80	18.01	6.06	-25.52	0.81	28.58
US-SRM	0.90	0.14	0.84	0.91	16.12	35.42	18.58	14.89	-15.69	-45.40	-24.23	5.57
US-Ton	0.96	0.71	0.93	0.92	21.37	32.48	18.21	20.85	-24.53	-16.90	-19.37	-2.64
US-Twt	-0.38	0.14	-0.37	-0.32	51.06	39.17	59.14	64.13	34.92	32.81	41.27	31.95
US-Var	0.91	0.70	0.90	0.89	26.79	31.62	21.41	23.72	-15.70	1.82	-13.08	-0.39
US-Vcm	0.84	0.81	0.82	0.86	15.40	21.01	16.33	17.41	-19.02	-41.44	-22.73	-11.32
US-Whs	0.88	0.12	0.78	0.92	15.11	31.22	18.94	14.46	-16.79	-49.19	-26.28	6.04
US-Wjs	0.89	0.65	0.80	0.94	14.04	24.21	17.88	10.76	-17.76	-45.40	-26.97	-17.24
US-Wkg	0.90	0.32	0.80	0.88	12.95	27.12	18.10	16.34	-3.36	-38.27	-10.84	12.36
US-Wrc	0.90	0.80	0.85	0.92	21.60	27.94	21.71	19.22	-2.98	2.73	-16.65	8.98
ZA-Kru	0.59	0.17	0.47	0.59	13.25	32.70	20.21	17.24	-13.57	-1.73	-16.87	-11.31
ZM-Mon	0.26	-0.14	0.39	0.49	23.10	44.61	21.91	18.74	-15.84	-6.40	-15.41	-4.98
Average	0.75	0.50	0.65	0.66	17.14	26.59	19.85	19.53	-1.63	1.91	-8.42	-2.50

Table S4: Similar to Table S1, but for WECANN GPP retrievals

Site ID	Correlation Coefficient				RMSE [$\text{gC m}^{-2} \text{day}^{-1}$]				Bias [$\text{gC m}^{-2} \text{day}^{-1}$]			
	WECANN	FLUXNET-MTE	MODIS	ECMWF	WECANN	FLUXNET-MTE	MODIS	ECMWF	WECANN	FLUXNET-MTE	MODIS	ECMWF
AT-Neu	0.81	0.92	0.92	0.94	1.55	1.00	1.08	1.03	-0.66	0.16	-0.37	-0.91
AU-ASM	0.68	0.52	0.11	0.71	0.47	0.48	0.55	0.53	0.62	0.22	0.33	1.11
AU-Cpr	0.15	-0.10	-0.08	0.42	0.73	0.79	0.59	0.40	0.87	0.35	0.59	0.18
AU-DaP	0.76	0.76	0.74	0.86	1.26	1.06	1.23	0.93	1.00	0.86	0.55	1.23
AU-DaS	0.74	0.78	0.66	0.74	1.36	0.74	1.01	1.26	0.49	0.47	0.27	1.05
AU-Dry	0.63	0.41	0.52	0.54	1.04	0.81	1.10	1.74	0.43	0.59	0.31	3.09
AU-Stp	0.69	0.65	0.47	0.68	0.89	0.51	0.71	0.84	1.04	0.95	0.81	1.16
AU-Tum	0.64	0.39	0.55	0.49	1.44	1.61	1.52	1.51	-1.49	-0.68	-0.55	-1.21
AU-Wom	0.72	0.48	0.49	0.67	1.10	1.41	1.19	0.95	0.25	0.68	0.53	-0.42
BE-Bra	0.93	0.88	0.90	0.79	0.90	1.89	1.38	1.00	0.94	2.28	1.25	0.65
BE-Lon	0.63	0.68	0.61	0.55	2.12	2.34	2.21	2.23	1.57	2.34	1.45	0.82
BE-Vie	0.96	0.87	0.91	0.80	0.88	1.96	1.26	1.24	0.80	2.02	0.91	0.21
BR-Ji1	0.80	0.51	0.34	0.76	1.53	1.92	2.09	1.47	1.14	1.92	-0.32	2.49
BR-Ji2	0.84	0.83	-0.03	0.82	0.82	0.79	1.57	1.34	-1.20	-0.40	-1.98	-0.08
BR-Ma2	0.67	0.64	-0.50	-0.19	0.83	0.86	1.71	1.48	-2.39	0.69	-1.48	1.76
BR-Sp1	0.94	0.95	0.87	0.94	1.04	0.72	1.31	0.75	0.54	-0.47	0.36	-0.20
CA-Oas	0.96	0.90	0.85	0.81	0.77	1.07	1.29	1.25	0.70	0.49	0.51	0.19
CA-Obs	0.95	0.90	0.90	0.86	1.25	1.46	1.41	1.15	0.84	0.88	0.79	0.47
CA-Qcu	0.74	0.38	0.51	0.54	1.52	1.95	2.19	1.73	0.70	1.09	0.91	0.55
CA-Qfo	0.97	0.88	0.90	0.91	1.10	1.39	1.69	1.23	1.01	1.17	1.21	0.86
CH-Cha	0.77	0.78	0.84	0.88	1.68	2.13	1.86	1.30	-0.32	0.73	0.20	-0.38
CH-Dav	0.85	0.91	0.92	0.95	1.55	1.22	1.42	0.91	0.74	0.97	0.57	0.36
CH-Fru	0.88	0.87	0.91	0.89	1.29	1.77	1.48	1.17	0.40	1.28	0.81	0.47
CH-Lae	0.95	0.86	0.91	0.90	1.15	2.02	1.74	1.26	0.48	1.65	0.92	0.54
CH-Oe2	0.36	0.70	0.69	0.65	2.62	2.43	2.24	1.82	1.38	2.13	1.68	1.23
CZ-BK1	0.91	0.88	0.91	0.87	1.23	2.00	1.40	1.28	0.46	1.30	0.61	0.34
CZ-BK2	0.92	0.85	0.82	0.81	1.42	2.15	1.77	1.53	1.59	2.22	1.60	1.32
DE-Geb	0.66	0.77	0.75	0.72	1.88	2.08	1.68	1.45	1.59	2.21	1.48	1.13
DE-Lkb	0.90	0.69	0.73	0.74	1.90	2.66	2.27	1.79	2.42	3.16	2.42	2.19
DE-Lnf	0.97	0.78	0.78	0.75	0.63	2.04	1.63	1.56	0.76	1.36	0.56	0.11
DE-Obe	0.95	0.85	0.89	0.87	0.86	1.82	1.25	1.10	0.54	1.08	0.46	0.25
DE-Seh	0.62	0.67	0.64	0.67	2.09	2.43	2.11	1.73	0.91	1.84	1.55	1.04
DE-Spw	0.83	0.73	0.81	0.74	1.31	1.94	1.40	1.45	0.36	0.44	0.26	-0.63
DE-Tha	0.95	0.86	0.91	0.92	0.86	1.74	1.15	0.87	0.19	0.78	0.08	-0.23
ES-LgS	0.57	0.31	-0.02	-0.26	0.64	0.50	0.72	0.71	1.32	0.19	0.74	0.23
FI-Hyy	0.97	0.89	0.91	0.91	0.58	1.52	1.41	1.21	0.32	1.22	0.89	0.71
FI-Lom	0.96	0.79	0.78	0.76	0.62	1.53	1.52	1.28	0.77	1.24	0.89	0.74
IT-Col	0.81	0.60	0.62	0.45	1.26	1.96	2.02	1.96	1.14	1.66	2.54	0.32
IT-Lav	0.91	0.85	0.87	0.84	1.21	1.64	1.65	1.36	0.49	0.16	-0.02	0.19
IT-MBo	0.92	0.88	0.90	0.88	0.93	1.09	1.32	1.10	0.57	0.77	0.84	0.51
IT-Ren	0.90	0.89	0.89	0.91	1.15	1.22	1.59	1.05	0.44	0.80	0.72	0.33
RU-Tks	0.76	0.62	0.65	0.45	0.55	0.93	0.71	0.61	0.44	0.25	0.05	-0.04
SD-Dem	0.67	0.45	0.41	0.77	0.74	1.01	0.69	0.55	0.17	-1.04	-0.16	-0.42
SN-Dhr	0.27	0.23	0.21	0.21	2.48	2.57	2.26	2.30	-0.92	-2.69	-1.65	-3.42
US-AR1	0.71	0.68	0.53	0.43	1.09	0.93	0.88	0.77	1.04	0.79	0.80	-0.05
US-AR2	0.70	0.80	0.48	0.68	1.16	0.84	0.88	0.48	1.27	1.00	1.03	0.16
US-ARM	0.57	0.71	0.57	0.60	1.68	1.19	1.16	0.94	2.09	1.34	0.98	0.61
US-GLE	0.84	0.73	0.76	0.45	0.53	0.75	0.80	0.76	0.24	0.11	0.44	-0.30
US-Ha1	0.94	0.84	0.87	0.79	1.11	2.36	2.08	2.17	1.35	1.79	1.87	1.59
US-KFS	0.79	0.68	0.54	0.39	1.94	2.75	2.69	3.17	-1.75	-1.80	-2.78	-2.04
US-Kon	0.71	0.70	0.48	0.67	3.26	3.17	4.03	3.63	-3.75	-4.89	-4.93	-5.22

US-Me2	0.87	0.91	0.94	0.65	0.71	0.53	0.60	1.02	-0.69	-0.08	-0.23	-1.22
US-Me3	0.83	0.87	0.89	0.75	0.83	0.66	1.24	0.48	0.58	0.95	0.98	-0.13
US-Me6	0.65	0.74	0.80	0.69	0.85	0.77	1.11	0.63	0.35	0.58	0.86	-0.37
US-MMS	0.92	0.93	0.89	0.71	1.16	1.68	1.21	2.06	1.53	1.32	1.06	1.14
US-Ne1	0.77	0.89	0.70	0.53	2.35	1.68	2.45	3.03	0.87	0.29	-0.04	-0.41
US-Ne2	0.75	0.80	0.67	0.50	2.27	2.15	2.27	2.82	1.06	0.65	0.20	-0.05
US-Ne3	0.72	0.80	0.56	0.49	2.11	2.07	2.20	2.61	1.56	0.82	0.57	0.15
US-NR1	0.86	0.88	0.87	0.77	0.60	0.60	0.84	0.75	-0.02	0.41	0.72	-0.23
US-Seg	0.50	0.65	0.43	0.56	0.72	0.62	0.77	0.80	-0.16	-0.48	-0.30	-0.96
US-Ses	0.66	0.76	0.42	0.58	0.49	0.40	0.62	0.60	0.40	0.03	0.15	-0.51
US-SRG	0.71	0.87	0.52	0.59	0.77	0.38	0.59	0.59	0.69	0.50	0.23	-0.07
US-SRM	0.61	0.81	0.47	0.48	0.89	0.43	0.45	0.51	0.88	0.68	0.40	0.09
US-Sta	0.74	0.61	0.88	0.90	0.79	0.69	0.87	0.22	0.66	0.61	0.66	-0.16
US-Ton	0.47	0.72	0.68	0.88	1.40	1.00	1.17	0.43	1.44	2.30	1.70	0.40
US-Twt	0.49	0.07	0.28	-0.11	2.14	2.55	2.35	2.64	1.33	0.90	0.53	0.55
US-Var	0.27	0.32	0.30	0.69	1.56	1.58	1.71	0.82	1.08	2.38	1.78	0.78
US-Whs	0.69	0.79	0.63	0.52	0.97	0.60	0.29	0.36	1.07	0.91	0.59	0.29
US-Wkg	0.55	0.72	0.67	0.46	0.72	0.39	0.36	0.41	0.77	0.54	0.48	-0.03
ZA-Kru	0.65	0.66	0.37	0.70	1.51	1.62	1.63	1.68	1.30	2.31	1.82	2.92
ZM-Mon	0.62	0.35	0.74	0.63	1.51	1.50	1.03	1.46	1.59	1.33	1.70	1.38
Average	0.75	0.71	0.64	0.66	1.24	1.42	1.42	1.29	0.57	0.77	0.50	0.26

Table S5: Statistics of LE retrievals from WECANN, an ANN retrieval with NDVI instead of SIF as input, and an ANN retrieval with EVI instead of SIF as input compared to eddy covariance measurements.

Site ID	Correlation Coefficient			RMSE [W m ⁻²]			Bias [W m ⁻²]		
	WECANN	WECANN NDVI	WECANN EVI	WECANN	WECANN NDVI	WECANN EVI	WECANN	WECANN NDVI	WECANN EVI
AT-Neu	0.92	0.90	0.93	15.91	17.27	18.09	-4.00	-3.45	-10.95
AU-ASM	0.81	0.80	0.80	18.97	20.17	21.08	-5.84	-5.10	-13.32
AU-Cpr	0.55	0.59	0.61	14.04	12.00	11.15	2.24	1.86	-6.43
AU-DaP	0.80	0.80	0.79	29.50	29.76	30.99	-1.69	4.27	-14.19
AU-DaS	0.90	0.90	0.89	16.16	14.56	14.82	-21.37	-14.98	-33.39
AU-Dry	0.65	0.66	0.64	31.41	30.18	30.72	-23.62	-17.43	-35.93
AU-Stp	0.86	0.84	0.81	20.41	21.91	24.67	-1.95	-0.70	-12.39
AU-Tum	0.89	0.92	0.85	21.39	19.78	24.28	-20.45	-16.98	-28.84
AU-Wom	0.88	0.87	0.82	15.63	16.21	18.96	-24.39	-23.43	-33.87
BE-Bra	0.95	0.96	0.96	9.04	8.28	8.03	10.66	10.24	3.71
BE-Lon	0.87	0.88	0.89	16.03	15.58	15.05	6.61	4.55	-2.50
BE-Vie	0.94	0.94	0.94	10.22	10.30	10.90	10.76	9.77	1.84
BR-Ji1	0.13	0.36	0.49	16.67	15.41	16.38	27.83	25.81	8.91
BR-Ji2	0.77	0.79	0.49	4.16	3.79	13.98	4.85	5.84	-13.03
BR-Ma2	-0.26	-0.03	-0.55	13.33	10.83	14.63	7.71	15.23	-6.87
BR-Spl	0.84	0.88	0.86	14.74	12.88	14.08	7.63	6.52	-11.08
CA-Qcu	0.97	0.97	0.98	8.00	7.96	9.43	1.48	2.41	-3.06
CA-Qfo	0.98	0.98	0.98	6.97	8.20	5.12	8.52	9.24	3.90
CH-Cha	0.91	0.92	0.93	20.68	20.31	21.27	-15.29	-14.96	-22.76
CH-Dav	0.95	0.95	0.95	16.43	15.60	18.34	-21.63	-22.60	-26.88
CH-Fru	0.93	0.94	0.95	16.66	16.21	17.74	-9.05	-8.72	-16.62
DE-Geb	0.89	0.90	0.92	14.85	14.04	13.02	10.81	9.62	2.42
DE-Lkb	0.90	0.90	0.92	14.49	13.89	10.18	11.71	11.68	3.57
DE-Lnf	0.96	0.97	0.98	9.51	8.75	10.31	8.92	7.11	0.16
DE-Obe	0.94	0.95	0.95	10.84	10.00	10.63	5.28	4.70	-2.07
DE-Seh	0.78	0.79	0.81	20.13	19.43	17.39	3.42	3.00	-4.93
DE-Tha	0.96	0.96	0.97	9.13	8.57	7.24	5.29	4.73	-2.29
ES-LgS	0.74	0.49	0.35	14.80	19.34	20.95	-1.94	-9.84	-17.56
FI-Hyy	0.97	0.97	0.98	6.48	7.87	6.57	1.09	3.59	-4.06
FI-Lom	0.89	0.88	0.90	11.44	12.65	9.96	8.52	8.11	3.02
FR-Pue	0.84	0.82	0.86	16.57	18.26	15.51	8.55	11.90	0.91
IT-Col	0.87	0.90	0.80	24.05	21.45	28.94	4.27	4.82	-6.86
IT-Lav	0.94	0.95	0.95	13.73	11.92	8.62	4.07	-0.09	-8.07
IT-MBo	0.95	0.96	0.95	15.01	14.18	17.17	-2.82	-2.20	-7.29
IT-Ren	0.94	0.94	0.95	11.18	11.07	11.49	1.80	2.48	-2.67
RU-Tks	0.51	0.52	0.51	19.22	19.62	17.88	0.12	0.48	-2.21
SD-Dem	0.73	0.79	0.76	20.60	21.68	21.11	-17.40	-23.36	-25.32
SN-Dhr	0.36	0.38	0.40	47.17	44.84	42.68	-21.13	-24.59	-32.48
US-AR1	0.82	0.79	0.78	17.42	18.19	18.85	-3.09	-4.95	-12.27
US-AR2	0.52	0.51	0.52	23.49	21.00	19.42	3.14	1.29	-6.03
US-ARM	0.76	0.76	0.78	22.47	21.91	20.04	3.29	-0.58	-9.76
US-Bar	0.92	0.92	0.94	13.80	14.24	12.28	20.47	19.60	15.01
US-Bkg	0.89	0.89	0.89	22.72	23.14	24.92	-11.84	-13.80	-19.55
US-Fwf	0.85	0.79	0.67	15.38	15.38	17.29	-9.24	-7.72	-13.88
US-GLE	0.79	0.78	0.73	13.55	13.40	14.29	-17.33	-17.29	-22.24
US-Ha2	0.78	0.78	0.79	22.60	23.22	21.23	26.32	24.97	19.24
US-IB1	0.92	0.92	0.94	16.80	16.51	15.23	0.24	-1.89	-8.39
US-ICb	0.93	0.94	0.94	8.36	7.26	8.22	-3.09	-0.52	-2.82
US-ICs	0.94	0.95	0.94	8.58	8.19	10.14	-4.25	-2.15	-4.73
US-ICt	0.92	0.93	0.92	9.08	8.61	9.63	-0.36	1.08	-3.23
US-KFS	0.93	0.94	0.95	15.35	14.22	11.65	11.46	8.76	0.05

US-Kon	0.87	0.88	0.88	22.64	21.86	22.75	4.18	2.08	-7.30
US-Me2	0.89	0.83	0.84	13.89	16.26	18.01	-8.50	-9.66	-18.77
US-MMS	0.95	0.96	0.95	15.58	15.22	18.37	11.41	8.33	1.05
US-MOz	0.90	0.91	0.93	17.49	16.76	15.01	16.49	14.32	5.71
US-Mpj	0.85	0.87	0.88	9.14	9.08	9.52	-5.43	-7.96	-12.50
US-NC2	0.95	0.96	0.96	10.88	11.74	9.69	-23.05	-10.87	-26.03
US-Ne1	0.84	0.84	0.83	36.45	37.45	40.61	-26.85	-29.25	-36.54
US-Ne2	0.80	0.80	0.79	38.38	39.40	41.50	-22.08	-24.48	-31.77
US-Ne3	0.86	0.85	0.85	25.89	26.47	27.58	-6.30	-8.70	-16.00
US-NR1	0.89	0.91	0.82	13.65	12.59	17.84	-24.68	-22.42	-29.11
US-Ro1	0.93	0.93	0.95	15.12	14.15	11.97	5.68	4.14	-2.59
US-Seg	0.85	0.80	0.81	8.55	10.00	10.26	4.05	1.12	-3.63
US-Ses	0.85	0.81	0.81	8.05	9.00	9.20	5.38	2.44	-2.30
US-Slt	0.86	0.90	0.88	22.42	18.37	21.28	-3.62	5.14	-6.64
US-Snd	0.76	0.76	0.40	17.72	16.60	24.46	-16.66	-22.51	-43.17
US-SP1	0.69	0.71	0.68	24.29	23.34	22.99	20.10	25.04	4.80
US-SP3	0.68	0.66	0.69	31.33	32.06	31.27	8.62	13.05	-7.17
US-SRG	0.90	0.92	0.92	13.87	13.81	15.54	-7.06	-7.98	-15.63
US-SRM	0.87	0.90	0.89	12.30	11.30	12.72	-0.77	-1.50	-9.33
US-Ton	0.55	0.46	0.79	23.84	27.14	17.43	11.77	11.77	-4.35
US-Twt	0.77	0.71	-0.12	51.52	55.13	73.98	-42.74	-48.23	-67.53
US-Var	0.16	0.04	0.56	36.06	39.91	27.14	17.89	17.91	1.67
US-Vcm	0.83	0.84	0.78	15.70	16.58	18.98	-16.43	-17.76	-23.92
US-Whs	0.84	0.89	0.88	11.61	9.75	10.75	6.09	5.19	-2.55
US-Wjs	0.89	0.90	0.89	9.72	10.97	12.03	-4.64	-7.26	-12.57
US-Wkg	0.81	0.87	0.88	14.69	13.54	14.34	1.16	-0.53	-7.10
US-Wrc	0.69	0.73	0.60	17.22	19.23	17.79	23.54	24.04	12.64
ZA-Kru	0.50	0.52	0.54	39.37	37.85	36.58	-2.94	2.86	-14.41
ZM-Mon	0.54	0.53	0.51	33.85	33.51	33.54	6.63	9.08	-9.68
Average	0.80	0.80	0.78	17.95	17.86	18.45	-1.04	-1.08	-10.41

Table S6: Similar to Table S4 but for H instead of LE

Site ID	Correlation Coefficient			RMSE [W m ⁻²]			Bias [W m ⁻²]		
	WECANN	WECANN NDVI	WECANN EVI	WECANN	WECANN NDVI	WECANN EVI	WECANN	WECANN NDVI	WECANN EVI
AT-Neu	0.86	0.88	0.89	6.92	6.51	7.78	17.37	19.30	18.99
AU-ASM	0.74	0.74	0.69	18.09	18.12	19.49	-38.40	-38.14	-37.12
AU-Cpr	0.73	0.75	0.77	29.02	28.32	27.20	-12.33	-11.47	-8.33
AU-DaP	0.65	0.61	0.52	25.55	26.75	28.72	-4.27	-6.54	7.08
AU-DaS	0.75	0.78	0.72	13.90	11.49	12.01	5.06	2.44	16.22
AU-Dry	0.58	0.62	0.57	22.32	21.30	22.43	-4.62	-7.06	6.47
AU-Stp	0.66	0.62	0.37	14.86	15.47	18.75	-6.56	-5.67	2.00
AU-Tum	0.73	0.75	0.69	18.31	17.51	21.13	2.35	2.55	8.60
AU-Wom	0.87	0.88	0.85	21.72	21.21	21.20	3.67	3.83	10.15
BE-Bra	0.86	0.88	0.86	17.89	17.41	17.27	-9.11	-8.80	-6.20
BE-Lon	0.77	0.77	0.76	13.83	13.70	13.99	5.29	7.52	9.21
BE-Vie	0.87	0.88	0.85	17.89	16.33	16.22	-13.92	-12.27	-11.02
BR-Ji1	0.29	0.30	0.35	9.27	10.06	13.23	-4.88	-3.80	9.21
BR-Ji2	0.83	0.83	0.78	4.79	4.09	8.17	7.00	5.57	19.88
BR-Ma2	0.84	0.76	0.92	3.18	4.17	2.98	1.76	-4.85	14.33
BR-Spl	0.92	0.85	0.83	5.31	5.81	6.42	4.05	6.30	18.08
CA-Qcu	0.89	0.90	0.90	9.22	8.75	9.49	9.54	10.78	13.16
CA-Qfo	0.83	0.85	0.75	23.35	23.48	24.90	-17.06	-15.87	-14.00
CH-Cha	0.81	0.81	0.80	7.26	7.91	9.36	6.73	8.93	9.08
CH-Dav	0.75	0.76	0.70	19.43	19.44	19.79	-0.55	0.44	1.07
CH-Fru	0.87	0.88	0.88	8.11	7.63	7.56	8.39	10.71	10.91
DE-Geb	0.86	0.85	0.84	10.80	10.58	10.49	1.80	3.61	5.22
DE-Lkb	0.82	0.85	0.84	14.89	13.62	12.98	-7.72	-6.45	-4.84
DE-Lnf	0.25	0.22	0.24	36.73	37.34	37.47	15.32	17.13	18.88
DE-Obe	0.82	0.86	0.81	16.05	14.53	14.89	-8.54	-7.20	-5.53
DE-Seh	0.53	0.55	0.56	13.26	13.96	15.26	13.70	15.52	16.57
DE-Tha	0.92	0.94	0.91	20.92	19.38	18.20	-11.99	-10.56	-8.78
ES-LgS	0.87	0.87	0.89	26.47	25.56	23.76	1.26	6.27	11.03
FI-Hyy	0.83	0.88	0.83	16.67	15.81	16.01	-0.45	-0.26	2.87
FI-Lom	0.85	0.88	0.86	10.74	8.85	9.97	8.73	12.44	13.92
FR-Pue	0.93	0.94	0.93	21.70	21.43	19.66	-5.64	-7.15	0.52
IT-Col	0.77	0.81	0.73	20.89	19.56	22.48	-15.20	-16.30	-9.18
IT-Lav	0.95	0.95	0.93	27.07	25.45	23.00	-23.03	-21.03	-16.37
IT-MBo	0.84	0.85	0.86	15.47	15.47	13.91	16.23	16.11	17.57
IT-Ren	0.91	0.91	0.90	20.17	20.27	18.57	-24.96	-25.04	-23.61
RU-Tks	0.63	0.59	0.57	17.46	18.79	20.80	14.20	9.25	9.09
SD-Dem	0.64	0.43	0.30	10.84	12.33	12.88	4.21	10.02	9.93
SN-Dhr	0.60	0.57	0.58	18.18	16.62	14.17	30.43	35.74	38.38
US-AR1	0.86	0.86	0.82	12.74	13.35	16.01	12.19	13.18	18.55
US-AR2	0.63	0.65	0.66	20.51	20.73	21.68	3.21	4.20	9.57
US-ARM	0.78	0.78	0.82	22.93	22.50	20.31	-3.73	-0.06	6.60
US-Bar	0.81	0.83	0.80	22.65	21.79	21.33	-12.33	-12.92	-10.79
US-Bkg	0.68	0.60	0.54	14.78	16.29	19.28	1.35	2.79	7.12
US-Fwf	0.83	0.82	0.85	22.22	23.10	20.86	24.42	22.86	23.87
US-GLE	0.83	0.84	0.83	23.81	23.66	22.50	-5.50	-5.53	-2.93
US-Ha2	0.86	0.86	0.85	14.03	14.19	13.23	-5.76	-5.63	-1.82
US-IB1	0.87	0.83	0.80	9.50	10.88	13.37	7.23	7.80	12.12
US-ICb	0.87	0.87	0.88	12.02	11.18	10.13	23.78	19.49	18.26
US-ICs	0.83	0.86	0.88	13.11	11.67	10.32	25.86	21.42	20.04

US-ICt	0.87	0.89	0.91	11.60	10.82	9.16	10.12	8.23	10.80
US-KFS	0.88	0.91	0.88	6.17	5.75	9.16	1.65	3.59	10.37
US-Kon	0.53	0.51	0.41	13.74	14.53	18.41	-0.79	0.97	7.82
US-Me2	0.92	0.93	0.90	21.65	20.97	19.53	-9.08	-8.53	-1.53
US-MMS	0.66	0.60	0.49	16.17	17.03	19.75	-13.32	-12.26	-7.30
US-MOz	0.69	0.67	0.63	14.12	14.23	15.41	-9.96	-8.08	-2.10
US-Mpj	0.95	0.94	0.95	17.52	16.99	16.67	-29.72	-28.46	-27.96
US-NC2	0.73	0.76	0.73	17.66	16.49	21.35	17.41	15.36	25.88
US-Ne1	0.51	0.38	0.31	19.90	22.49	25.61	3.22	4.21	9.26
US-Ne2	0.58	0.46	0.39	18.15	20.65	23.66	2.87	3.86	8.92
US-Ne3	0.69	0.60	0.54	17.55	19.57	21.78	-4.41	-3.43	1.63
US-NR1	0.68	0.70	0.66	23.92	22.83	25.24	-9.26	-11.15	-5.38
US-Ro1	0.84	0.82	0.78	9.35	9.59	11.92	8.12	9.46	14.37
US-Seg	0.87	0.85	0.88	12.32	13.64	12.35	-10.82	-8.86	-8.36
US-Ses	0.92	0.89	0.90	9.32	11.84	10.80	-13.86	-11.90	-11.40
US-Slt	0.67	0.68	0.66	20.49	21.20	22.52	-6.13	-6.78	-1.29
US-Snd	0.51	0.51	0.51	24.99	27.32	31.86	11.37	15.18	23.94
US-SP1	0.59	0.58	0.59	14.85	15.04	14.92	4.99	0.58	16.13
US-SP3	0.60	0.58	0.58	20.46	20.77	20.34	-16.77	-20.85	-5.46
US-SRG	0.88	0.88	0.84	13.80	13.70	15.42	6.06	7.49	9.96
US-SRM	0.90	0.91	0.88	16.12	15.15	16.87	-15.69	-14.40	-11.75
US-Ton	0.96	0.95	0.96	21.37	22.67	16.35	-24.53	-24.45	-13.50
US-Twt	-0.38	-0.40	-0.41	51.06	53.27	57.75	34.92	38.31	46.99
US-Var	0.91	0.90	0.92	26.79	27.67	22.22	-15.70	-15.63	-4.64
US-Vcm	0.84	0.83	0.85	15.40	15.97	15.42	-19.02	-17.75	-15.35
US-Whs	0.88	0.88	0.85	15.11	14.44	15.96	-16.79	-15.37	-12.89
US-Wjs	0.89	0.86	0.86	14.04	15.03	15.06	-17.76	-16.19	-15.41
US-Wkg	0.90	0.90	0.90	12.95	12.37	12.57	-3.36	-2.19	-0.94
US-Wrc	0.90	0.89	0.86	21.60	22.59	21.24	-2.98	-3.79	3.80
ZA-Kru	0.59	0.62	0.58	13.25	12.58	13.57	-13.57	-17.98	-6.22
ZM-Mon	0.26	0.24	0.22	23.10	23.29	23.93	-15.84	-17.00	-3.82
Average	0.75	0.74	0.72	17.14	17.19	17.73	-1.63	-1.18	3.86

Table S7: Similar to Table S4 but for GPP instead of LE

Site ID	Correlation Coefficient			RMSE [W m ⁻²]			Bias [W m ⁻²]		
	WECANN	WECANN NDVI	WECANN EVI	WECANN	WECANN NDVI	WECANN EVI	WECANN	WECANN NDVI	WECANN EVI
AT-Neu	0.81	0.79	0.71	1.55	1.61	1.95	-0.66	-0.68	-2.22
AU-ASM	0.68	0.76	0.82	0.47	0.32	0.36	0.62	0.51	-0.09
AU-Cpr	0.15	0.18	0.21	0.73	0.47	0.36	0.87	0.63	-0.07
AU-DaP	0.76	0.76	0.78	1.26	1.15	1.35	1.00	1.10	-0.54
AU-DaS	0.74	0.79	0.82	1.36	0.87	0.52	0.49	0.63	-0.97
AU-Dry	0.63	0.70	0.66	1.04	0.75	0.55	0.43	0.78	-0.62
AU-Stp	0.69	0.73	0.75	0.89	0.46	0.47	1.04	0.87	0.04
AU-Tum	0.64	0.70	0.68	1.44	1.30	1.51	-1.49	-1.00	-3.33
AU-Wom	0.72	0.68	0.65	1.10	0.93	0.73	0.25	0.33	-1.45
BE-Bra	0.93	0.93	0.92	0.90	0.88	0.65	0.94	0.80	-0.61
BE-Lon	0.63	0.61	0.63	2.12	2.09	1.95	1.57	1.20	-0.31
BE-Vie	0.96	0.95	0.95	0.88	0.81	0.61	0.80	0.75	-0.87
BR-Ji1	0.80	0.90	0.83	1.53	1.14	1.53	1.14	0.20	-3.06
BR-Ji2	0.84	0.70	0.88	0.82	0.97	0.70	-1.20	-1.12	-5.36
BR-Ma2	0.67	-0.42	0.42	0.83	1.12	0.96	-2.39	0.00	-5.07
BR-Sp1	0.94	0.91	0.92	1.04	1.10	1.42	0.54	-0.15	-2.78
CA-Oas	0.96	0.97	0.93	0.77	0.81	1.28	0.70	0.70	-0.59
CA-Obs	0.95	0.95	0.94	1.25	1.35	0.50	0.84	0.83	-0.41
CA-Qcu	0.74	0.78	0.71	1.52	1.83	0.52	0.70	0.99	-0.48
CA-Qfo	0.97	0.96	0.98	1.10	1.47	0.29	1.01	1.30	-0.17
CH-Cha	0.77	0.79	0.78	1.68	1.49	1.17	-0.32	-0.22	-1.83
CH-Dav	0.85	0.80	0.79	1.55	1.45	0.66	0.74	0.39	-0.73
CH-Fru	0.88	0.91	0.89	1.29	1.02	1.11	0.40	0.50	-1.11
CH-Lae	0.95	0.96	0.96	1.15	0.93	0.52	0.48	0.58	-1.03
CH-Oe2	0.36	0.35	0.34	2.62	2.53	1.94	1.38	1.43	-0.19
CZ-BK1	0.91	0.88	0.81	1.23	1.35	1.02	0.46	0.48	-1.27
CZ-BK2	0.92	0.90	0.88	1.42	1.49	0.68	1.59	1.57	-0.18
DE-Geb	0.66	0.72	0.76	1.88	1.61	1.21	1.59	1.34	-0.12
DE-Lkb	0.90	0.93	0.90	1.90	1.81	0.66	2.42	2.32	0.54
DE-Lnf	0.97	0.98	0.94	0.63	0.54	1.25	0.76	0.46	-0.92
DE-Obe	0.95	0.94	0.89	0.86	0.87	0.94	0.54	0.31	-1.10
DE-Seh	0.62	0.63	0.61	2.09	1.96	1.66	0.91	0.84	-0.81
DE-Spw	0.83	0.84	0.83	1.31	1.22	1.55	0.36	0.06	-1.49
DE-Tha	0.95	0.93	0.88	0.86	0.89	1.00	0.19	-0.06	-1.49
ES-LgS	0.57	0.68	0.39	0.64	0.34	0.41	1.32	0.49	-0.16
FI-Hyy	0.97	0.96	0.94	0.58	0.98	1.00	0.32	0.66	-0.87
FI-Lom	0.96	0.94	0.95	0.62	1.03	0.51	0.77	0.87	-0.06
IT-Col	0.81	0.87	0.89	1.26	1.11	1.37	1.14	1.13	-0.39
IT-Lav	0.91	0.86	0.79	1.21	1.03	1.01	0.49	-0.36	-1.75
IT-MBo	0.92	0.92	0.92	0.93	0.96	1.15	0.57	0.56	-0.86
IT-Ren	0.90	0.88	0.88	1.15	1.25	0.79	0.44	0.43	-0.98
RU-Tks	0.76	0.83	0.80	0.55	0.51	0.31	0.44	0.04	-0.28
SD-Dem	0.67	0.70	0.75	0.74	0.44	0.47	0.17	-0.21	-0.41
SN-Dhr	0.27	0.29	0.32	2.48	2.26	2.20	-0.92	-1.34	-1.87
US-AR1	0.71	0.69	0.62	1.09	0.71	0.64	1.04	0.63	-0.08
US-AR2	0.70	0.72	0.69	1.16	0.65	0.44	1.27	0.86	0.16
US-ARM	0.57	0.51	0.35	1.68	1.38	1.26	2.09	1.08	-0.11
US-GLE	0.84	0.94	0.92	0.53	0.33	0.64	0.24	0.03	-0.47
US-Ha1	0.94	0.94	0.96	1.11	1.36	0.65	1.35	1.71	-0.16
US-KFS	0.79	0.80	0.77	1.94	1.89	2.32	-1.75	-2.40	-3.90
US-Kon	0.71	0.76	0.79	3.26	3.20	3.70	-3.75	-4.46	-5.84

US-Me2	0.87	0.85	0.87	0.71	0.76	1.11	-0.69	-0.74	-1.77
US-Me3	0.83	0.70	0.72	0.83	0.83	0.42	0.58	0.45	-0.53
US-Me6	0.65	0.60	0.64	0.85	0.89	0.67	0.35	0.34	-0.66
US-MMS	0.92	0.93	0.95	1.16	1.02	0.89	1.53	1.16	-0.33
US-Ne1	0.77	0.73	0.75	2.35	2.51	2.70	0.87	0.44	-0.69
US-Ne2	0.75	0.72	0.75	2.27	2.36	2.47	1.06	0.65	-0.44
US-Ne3	0.72	0.69	0.71	2.11	2.19	2.06	1.56	1.14	0.00
US-NR1	0.86	0.96	0.96	0.60	0.37	0.71	-0.02	0.26	-0.54
US-Seg	0.50	0.44	0.45	0.72	0.72	0.73	-0.16	-0.57	-0.89
US-Ses	0.66	0.68	0.73	0.49	0.44	0.46	0.40	-0.01	-0.34
US-SRG	0.71	0.80	0.82	0.77	0.42	0.46	0.69	0.45	-0.10
US-SRM	0.61	0.82	0.85	0.89	0.37	0.26	0.88	0.65	0.08
US-Sta	0.74	0.60	0.61	0.79	0.75	0.36	0.66	0.38	-0.12
US-Ton	0.47	0.36	0.41	1.40	1.42	0.82	1.44	1.42	-0.10
US-Twt	0.49	0.40	0.62	2.14	2.17	2.14	1.33	0.37	-0.91
US-Var	0.27	0.05	0.16	1.56	1.83	1.31	1.08	1.09	-0.17
US-Whs	0.69	0.84	0.85	0.97	0.44	0.18	1.07	0.87	0.28
US-Wkg	0.55	0.77	0.82	0.72	0.35	0.29	0.77	0.53	0.06
ZA-Kru	0.65	0.69	0.68	1.51	1.34	0.99	1.30	1.73	-0.30
ZM-Mon	0.62	0.57	0.50	1.51	1.23	1.15	1.59	1.42	-0.28
Average	0.75	0.74	0.75	1.24	1.16	1.02	0.57	0.43	-0.94

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