Supplementary materials of

Synergy between TROPOMI sun-induced chlorophyll fluorescence and MODIS spectral reflectance for understanding the dynamics of gross primary productivity at integrated carbon observatory system (ICOS) ecosystem flux sites

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Tab S1: Information on the sites used in this study from the ICOS release 2018 and 2021. The PFT represents the plant functional type corresponding to each site: MF (mixed forests), CRO (croplands), DBF (deciduous broadleaf forests), EBF (evergreen broadleaf forests), ENF (evergreen needleleaf forests), GRA (grasslands), OSH (open shrublands), and WET (wetlands). Years denote the year of data flux available for each site.

Site name	Latitude (°)	Longitude (°)	PFT	Years
BE-Bra	51.307617	4.519844	MF	2018
BE-Lcr	51.112184	3.850433	CRO	2019, 2020
BE-Lon	50.551586	4.7461305	CRO	2019, 2020
BE-Vie	50.305068	5.998052	ENF	2018
CH-Dav	46.815283	9.855009	ENF	2018, 2019, 2020
CZ-BK1	49.50213	18.53685	ENF	2018
CZ-Lnz	48.681611	16.946416	MF	2018
CZ-Wet	49.024657	14.7703419	WET	2018
DE-Geb	51.099714	10.914629	CRO	2018
DE-Gri	50.950046	13.512681	GRA	2018, 2019, 2020
DE-Hai	51.079189	10.452336	DBF	2018, 2019, 2020
DE_HoH	52.086484	11.222468	DBF	2018, 2019, 2020
DE-Hzd	50.963566	13.490172	DBF	2018
DE-Kli	50.892881	13.5225056	CRO	2018, 2019, 2020
DE-RuR	50.621914	6.3041256	GRA	2018
DE-RuS	50.865912	6.4471689	CRO	2018, 2019, 2020
DE-RuW	50.504907	6.33101886	ENF	2018
DE-Tha	50.962631	13.565225	ENF	2018

DK-Sor	55.485869	11.644644	DBF		2018
FI-Hyy	61.84741	24.29477	ENF	2018, 2020	
FI-Sii	61.832683	24.19278333	WET	2018, 2019, 2020	
FI-Var	67.7549	29.61	ENF	2018, 2019, 2020	
FR-Aur	43.54965	1.10615	CRO	2019, 2020	
FR-Bil	44.49389	-0.95592	ENF	2018, 2019, 2020	
FR-EM2	49.872108	3.02065	CRO	2018, 2019, 2020	
FR-Fon	48.476339	2.780136	DBF	2018, 2019, 2020	
FR-Hes	48.84415	1.951910019	DBF		2018
FR-LGt	48.67416	7.06461667	WET	2018, 2019, 2020	
FR-Mej	48.117707	-1.798283	CRO	2019, 2020	
GF-Guy	5.2787	-52.9248	EBF	2018, 2019, 2020	
IT-BCi	40.52375	14.957444	CRO		2018
IT-Cp2	41.704267	12.357293	EBF		2018
IT-Lsn	45.740481	12.750297	OSH	2018, 2019, 2020	
IT-SR2	43.73203	10.29095	ENF	2018, 2019, 2020	
IT-Tor	45.844444	7.578055556	GRA	2018, 2019, 2020	
NL-Loo	52.16648	5.74355	ENF		2018
SE-Deg	64.182	19.556694	WET	2018, 2020	
SE-Htm	56.09763	13.41897	ENF	2018, 2019, 2020	
SE-Nor	60.086441	17.479455	ENF	2018, 2019, 2020	
SE-Svb	64.256097	19.77451111	ENF	2018, 2019, 2020	

Tab S2: MODIS Terra and Aqua surface spectral reflectance bands.

Acronym	Full Name	Wavelengths (nm)	Spatial Resolution
B_1	Surface Reflectance for B_1	620-670	500 m
B_2	Surface Reflectance for B_2	841-876	
B_3	Surface Reflectance for B_3	459-479	
B_4	Surface Reflectance for B_4	545-565	

B_5	Surface Reflectance for B_5	1230-1250	
B_6	Surface Reflectance for B_6	1628-1652	
B_7	Surface Reflectance for B_7	2105-2155	
B_8	Surface Reflectance for B_8	405-420	1 km
B_9	Surface Reflectance for B_9	438-448	
B_{10}	Surface Reflectance for B_{10}	483-493	
B_{11}	Surface Reflectance for B_{11}	526-536	
B_{12}	Surface Reflectance for B_{12}	546-556	
B_{13}	Surface Reflectance for B_{13}	662-672	
B_{14}	Surface Reflectance for B_{14}	673-683	
B_{15}	Surface Reflectance for B_{15}	743-753	
B_{16}	Surface Reflectance for B_{16}	862-877	

Tab S3: Detailed results and statistics of the site-specific linear relationships between GPP and SIF_d. The sign ± denotes the confidence interval on the slope and on the intercept for each relationship. R^2 denotes for the coefficient of determination. The units are for the slope in (gC m^{-2} d^{-1}/(mW m^{-2} sr^{-1} nm^{-1})), intercept in (gC m^{-2} d^{-1}), and RMSE (Root Mean Squared Error) in (gC m^{-2} d^{-1}). PFT represents the plant functional type of each site: MF (mixed forests), CRO (croplands), DBF (deciduous broadleaf forests), EBF (evergreen broadleaf forests), ENF (evergreen needleleaf forests), GRA (grasslands), OSH (open shrublands), and WET (wetlands). All pairwise linear relationships between GPP and SIF_d were statistically significant with $p<0.0001$, except for IT-Cp2 site ($p = 0.604$).

Site name	R^2	Slope	Intercept	RMSE	N	PFT
BE-Bra	0.59	11.27±1.07	3.33±0.45	2.00	300	MF
BE-Lcr	0.20	9.02±1.39	4.06±0.66	4.06	630	CRO
BE-Lon	0.27	12.33±1.64	2.1±0.89	6.05	582	CRO
BE-Vie	0.20	4.75±1.24	4.84±0.60	2.44	228	ENF
CH-Dav	0.15	4.17±0.96	2.67±0.26	1.74	406	ENF
CZ-BK1	0.35	18±3.62	5.92±0.79	3.38	178	ENF
CZ-Lnz	0.42	9.98±1.25	4.76±0.60	3.18	346	MF
CZ-Wet	0.20	9.46±2.16	3.12±0.71	3.68	306	WET
DE-Geb	0.53	10.04±1.18	2.12±0.68	3.80	254	CRO

DE-Gri	0.28	8.58±0.94	2.89±0.38	3.26	842	GRA
DE-Hai	0.57	9.23±0.54	1.40±0.32	2.91	852	DBF
DE-HoH	0.35	9.29±0.79	3.04±0.41	4.14	1002	DBF
DE-Hzd	0.41	8.56±1.25	2.40±0.57	2.73	260	DBF
DE-Kli	0.31	9.05±0.89	1.18±0.40	3.85	886	CRO
DE-RuR	0.17	6.87±1.76	4.59±0.87	3.80	280	GRA
DE-RuS	0.29	17.04±1.97	1.81±0.80	6.22	708	CRO
DE-RuW	0.16	5.02±1.51	6.42±0.57	2.61	230	ENF
DE-Tha	0.56	6.43±0.68	3.54±0.31	1.61	280	ENF
DK-Sor	0.81	14.06±0.77	2.09±0.56	2.73	310	DBF
FI-Hyy	0.27	8.05±1.10	3.33±0.34	2.68	554	ENF
FI-Sii	0.32	4.01±0.40	1.06±0.12	1.10	850	WET
FI-Var	0.13	4.73±0.92	3.23±0.20	2.00	690	ENF
FR-Aur	0.23	7.98±0.97	1.08±0.41	3.65	908	CRO
FR-Bil	0.17	6.47±0.95	3.98±0.32	3.13	884	ENF
FR-EM2	0.11	5.10±1.02	2.99±0.59	4.85	780	CRO
FR-Fon	0.66	11.91±0.53	2.48±0.27	2.71	986	DBF
FR-Hes	0.50	12.12±1.28	2.55±0.66	3.78	352	DBF
FR-LGt	0.43	8.02±0.55	1.76±0.22	2.29	1114	WET
FR-Mej	0.04	4.72±1.65	4.40±0.84	5.22	672	CRO
GF-Guy	0.02	1.86±0.91	10.79±0.57	2.63	774	EBF
IT-BCi	0.16	13.43±3.5	5.10±1.39	6.11	306	CRO
IT-Cp2	0.001	0.36±1.37	9.37±0.54	2.01	190	EBF
IT-Lsn	0.54	8±0.36	2.17±0.17	2.10	1594	OSH
IT-SR2	0.21	6.78±0.94	5.78±0.36	2.95	774	ENF
IT-Tor	0.42	11.31±1.02	2.30±0.30	2.83	646	GRA
NL-Loo	0.24	5.36±1.22	5.96±0.48	2.19	242	ENF
SE-Deg	0.35	2.04±0.21	0.61±0.06	0.54	680	WET
SE-Htm	0.29	6.34±0.66	4.70±0.30	2.72	860	ENF
SE-Nor	0.51	8.35±0.62	3.53±0.25	2.14	684	ENF
SE-Svb	0.20	7.61±0.93	3.88±0.24	2.75	1056	ENF

Tab S4: The generalized linear model results statistics (GLM). The following equation was fitted to investigate the effects of the site, year, and PFT and their interactions on the seasonal and interannual variations of SIF_d and its relationship with GPP. SIF_d = 1 + Year + Site + PFT + GPP + Year ×GPP + Site×GPP + PFT×GPP. All pairwise linear relationships between GPP and SIFd were statistically significant with $p<0.001$, except for Site×GPP interaction ($p = 0.896$).

Parameters	Estimate	Std. Error	p-value
Intercept	-3.01E+01	5.79E+00	2.00E-07
Year	1.50E-02	2.87E-03	1.66E-07
Site	-1.06E-03	2.49E-04	2.13E-05
PFT	-1.31E-02	1.02E-03	< 2e-16
GPP	3.09E+00	7.60E-01	4.83E-05
Year×GPP	-1.52E-03	3.76E-04	5.70E-05
Site×GPP	-4.17E-06	3.19E-05	0.896
PFT×GPP	1.88E-03	1.59E-04	< 2e-16

Tab S5: Detailed results and statistics of the site-specific comparison between tower-based observed GPP against the RF predicted GPP. PFT denotes plant functional type of each site, including MF (mixed forests), CRO (croplands), DBF (deciduous broadleaf forests), EBF (evergreen broadleaf forests), ENF (evergreen needleleaf forests), GRA (grasslands), OSH (open shrublands), and WET (wetlands). R2 denotes for the coefficient of determination. The units are for the slope in (gC m^{-2} d^{-1}/(mW m^{-2} sr^{-1} nm^{-1})), intercept in (gC m^{-2} d^{-1}), and RMSE (Root Mean Squared Error) in (gC m^{-2} d^{-1}). The sign ± denotes the confidence interval on the slope and on the intercept for each linear relationship. RF-R model includes only surface spectral reflectance as explanatory variables, RF-SIF-R uses SIF_d and spectral bands inputs to predict GPP, RF-SIF-VI explores SIF_d and VIs as inputs, and RF-SIF-PFT establishes based on SIF_d, spectral bands and vegetation type as categorial variable to estimate GPP.

			RF-R				**RF-SIF-R**			
Site name	PFT	N	R^2	Slope	Intercept	RMSE	R^2	Slope	Intercept	RMSE
BE-Bra	MF	55	0.63	0.84±0.18	1.29±1.43	1.70	0.71	0.98±0.17	0.15±1.37	1.49
BE-Lcr	CRO	124	0.92	1.03±0.05	-0.14±0.47	1.26	0.90	1.06±0.06	-0.39±0.54	1.40
BE-Lon	CRO	111	0.91	1.03±0.06	-0.24±0.55	1.93	0.89	1.09±0.07	-0.45±0.65	2.22
BE-Vie	ENF	41	0.82	1.02±0.16	-0.07±1.04	1.08	0.70	1 .00±0.21	-0.20±1.43	1.37
CH-Dav	ENF	95	0.84	0.95±0.09	-0.01±0.34	0.79	0.76	0.87±0.10	0.04±0.43	0.98
CZ-BK1	ENF	23	0.65	0.96±0.32	0.86±3.03	2.28	0.71	1.31±0.37	-1.22±3.16	2.04
CZ-Lnz	MF	62	0.93	1.13±0.08	-0.81±0.78	1.12	0.87	1.15±0.12	-0.67±1.08	1.53
CZ-Wet	WET	54	0.88	0.98±0.10	-0.02±0.74	1.48	0.79	1.09±0.16	-0.52±1.09	1.97
DE-Geb	CRO	48	0.83	1.06±0.14	-0.14±1.11	2.23	0.87	1.05±0.12	0.11±0.93	1.95
DE-Gri	GRA	169	0.81	1.09±0.08	-0.49±0.52	1.58	0.77	1.12±0.09	-0.61±0.60	1.74
DE-Hai	DBF	161	0.90	1.01±0.05	-0.26±0.38	1.46	0.87	1.01±0.06	-0.57±0.46	1.66
DE-HoH	DBF	183	0.94	1.00±0.04	-0.06±0.33	1.28	0.9	1.04±0.05	-0.29±0.43	1.61
DE-Hzd	DBF	61	0.84	1.03±0.12	0.02±0.74	1.43	0.84	1.14±0.13	-0.83±0.83	1.44
DE-Kli	CRO	177	0.88	1.02±0.06	-0.58±0.35	1.59	0.83	1.08±0.07	-1.12±0.47	1.93
DE-RuR	GRA	61	0.75	0.95±0.14	0.66±1.14	1.82	0.59	1.05±0.23	0.19±1.71	2.33
DE-RuS	CRO	148	0.79	0.98±0.08	0.68±0.77	3.13	0.74	0.98±0.09	0.82±0.87	3.50
DE-RuW	ENF	46	0.82	0.96±0.14	0.38±1.13	1.14	0.55	0.94±0.26	0.78±2.03	1.78
DE-Tha	ENF	52	0.78	0.93±0.14	0.61±0.90	1.14	0.68	0.85±0.17	0.85±1.10	1.38
DK-Sor	DBF	59	0.94	1.05±0.07	0.15±0.88	1.56	0.93	1.04±0.08	0.39±0.96	1.73
FI-Hyy	ENF	104	0.92	1.02±0.06	-0.15±0.37	0.91	0.81	1.05±0.10	-0.23±0.61	1.41
FI-Sii	WET	163	0.86	0.91±0.06	0.01±0.15	0.49	0.69	0.68±0.08	0.30±0.21	0.72
FI-Var	ENF	139	0.79	0.97±0.08	0.13±0.38	1.05	0.74	0.96±0.10	0.12±0.43	1.16
FR-Aur	CRO	205	0.86	1.00±0.06	-0.14±0.28	1.45	0.83	1 .00±0.06	-0.10±0.32	1.61
FR-Bil	ENF	168	0.89	1.05±0.06	-0.13±0.35	1.15	0.82	1.09±0.08	-0.35±0.48	1.48
FR-EM2	CRO	169	0.63	0.94±0.11	0.62±0.75	2.97	0.6	0.86±0.11	1.03±0.74	3.08
FR-Fon	DBF	210	0.95	1.01±0.03	-0.20±0.25	0.97	0.95	1.02±0.03	-0.34±0.28	1.06
FR-Hes	DBF	74	0.84	1.00±0.10	-0.70±0.98	2.07	0.81	1.08±0.12	-1.43±1.14	2.24
FR-LGt	WET	239	0.93	1.03±0.04	-0.34±0.19	0.82	0.86	1.01±0.05	-0.45±0.28	1.15
FR-Mej	CRO	120	0.82	0.98±0.09	0.21±0.74	2.44	0.74	1.09±0.12	-0.34±0.95	2.89
GF-Guy	EBF	146	0.80	0.99±0.53	0.21±0.96	1.18	0.72	1.00±0.10	0.35±1.20	1.42
IT-BCi	CRO	69	0.22	1.16±0.53	0.94±5.08	5.98	0.22	0.61±0.28	5.31±3.23	5.98
IT-Cp2	EBF	42	0.38	0.65±0.27	3.89±2.51	1.25	0.27	0.58±0.31	4.85±2.73	1.36
IT-Lsn	OSH	317	0.91	1.02±0.04	-0.09±0.22	0.99	0.88	1.01±0.04	0.01±0.24	1.10
IT-SR2	ENF	160	0.60	0.96±0.12	0.55±1.02	2.04	0.56	1.08±0.15	-0.08±1.18	2.12

IT-Tor	GRA	134	0.79	0.97±0.09	0.19±0.43	1.60	0.75	1.00±0.10	0.13±0.49	1.74
NL-Loo	ENF	47	0.77	1.11±0.18	-0.46±1.32	1.30	0.66	1.19±0.25	-0.55±1.73	1.58
SE-Deg	WET	143	0.38	0.37±0.08	0.56±0.13	0.53	0.41	0.34±0.07	0.49±0.14	0.52
SE-Htm	ENF	167	0.78	1.02±0.08	-0.03±0.63	1.52	0.70	1.04±0.10	-0.17±0.78	1.77
SE-Nor	ENF	144	0.87	0.97±0.06	0.15±0.41	1.05	0.79	0.99±0.09	0.16±0.55	1.33
SE-Svb	ENF	199	0.92	1.01±0.04	0.00±0.02	0.91	0.86	1.05±0.06	-0.21±0.34	1.15

			RF-SIF-VI				**RF-SIF-R-PFT**			
Site name	PFT	N	R^2	Slope	Intercept	RMSE	R^2	Slope	Intercept	RMSE
BE-Bra	MF	55	0.60	0.85±0.19	1.18±1.53	1.76	0.72	0.97±0.16	0.14±1.34	1.47
BE-Lcr	CRO	124	0.85	1.08±0.08	-0.13±0.68	1.77	0.91	1.05±0.06	-0.33±0.53	1.39
BE-Lon	CRO	111	0.83	1.12±0.10	-0.54±0.82	2.72	0.89	1.08±0.07	-0.36±0.65	2.22
BE-Vie	ENF	41	0.68	0.95±0.21	0.13±1.45	1.42	0.76	1.05±0.19	-0.61±1.32	1.23
CH-Dav	ENF	95	0.72	0.85±0.11	0.16±0.46	1.05	0.77	0.88±0.10	0.02±0.42	0.96
CZ-BK1	ENF	23	0.42	1.04±0.55	1.68±4.24	2.90	0.68	1.30±0.40	-1.21±3.40	2.15
CZ-Lnz	MF	62	0.75	1.11±0.16	-0.34±1.54	2.11	0.87	1.16±0.12	-0.90±1.12	1.55
CZ-Wet	WET	54	0.69	1.13±0.21	-0.59±1.42	2.42	0.83	1.11±0.14	-0.34±0.96	1.81
DE-Geb	CRO	48	0.81	0.99±0.14	0.31±1.15	2.40	0.88	1.05±0.12	0.15±0.92	1.92
DE-Gri	GRA	169	0.65	1.03±0.12	-0.37±0.77	2.16	0.79	1.13±0.09	-0.84±0.59	1.69
DE-Hai	DBF	161	0.83	0.99±0.07	-0.72±0.54	1.91	0.88	1.02±0.06	-0.48±0.43	1.58
DE-HoH	DBF	183	0.87	1.09±0.06	-0.52±0.52	1.88	0.90	1.03±0.05	-0.17±0.43	1.61
DE-Hzd	DBF	61	0.75	1.07±0.16	-0.67±1.06	1.81	0.86	1.09±0.11	-0.34±0.71	1.34
DE-Kli	CRO	177	0.71	1.03±0.10	-1.15±0.63	2.49	0.84	1.07±0.07	-1.07±0.44	1.84
DE-RuR	GRA	61	0.58	0.97±0.22	-0.01±1.81	2.37	0.61	1.07±0.22	0.02±1.69	2.28
DE-RuS	CRO	148	0.72	1.05±0.11	0.77±0.91	3.62	0.75	0.98±0.09	0.84±0.85	3.45
DE-RuW	ENF	46	0.36	0.74±0.30	2.53±2.24	2.12	0.57	0.97±0.26	0.54±2.00	1.74
DE-Tha	ENF	52	0.55	0.74±0.19	1.32±1.31	1.63	0.69	0.93±0.18	0.34±1.16	1.35
DK-Sor	DBF	59	0.91	1.06±0.09	0.58±1.10	1.98	0.93	1.04±0.08	0.34±0.95	1.71
FI-Hyy	ENF	104	0.74	1.06±0.12	-0.17±0.73	1.65	0.81	1.06±0.10	-0.35±0.62	1.41
FI-Sii	WET	163	0.68	0.64±0.07	0.27±0.21	0.73	0.79	0.89±0.07	0.10±0.18	0.60
FI-Var	ENF	139	0.67	0.90±0.11	0.28±0.50	1.32	0.73	0.94±0.10	0.14±0.44	1.18
FR-Aur	CRO	205	0.79	0.99±0.07	-0.18±0.36	1.80	0.83	0.99±0.06	-0.06±0.32	1.62
FR-Bil	ENF	168	0.71	1.05±0.10	-0.05±0.62	1.87	0.82	1.10±0.08	-0.57±0.49	1.47
FR-EM2	CRO	169	0.55	0.85±0.12	1.09±0.80	3.25	0.60	0.86±0.11	1.05±0.74	3.07
FR-Fon	DBF	210	0.87	1.00±0.05	-0.22±0.44	1.63	0.95	1.02±0.03	-0.29±0.27	1.03
FR-Hes	DBF	74	0.61	1.01±0.19	-0.87±1.72	3.18	0.81	1.07±0.12	-1.24±1.12	2.22
FR-LGt	WET	239	0.74	0.90±0.07	-0.38±0.40	1.53	0.88	1.06±0.05	-0.39±0.25	1.05
FR-Mej	CRO	120	0.68	1.07±0.13	-0.37±1.09	3.20	0.75	1.08±0.11	-0.28±0.92	2.81
GF-Guy	EBF	146	0.54	0.89±0.14	2.07±1.51	1.81	0.75	1.05±0.10	-0.36±1.17	1.33
IT-BCi	CRO	69	0.22	0.63±0.29	5.16±3.33	6.00	0.21	0.60±0.28	5.46±3.24	6.02
IT-Cp2	EBF	42	0.12	0.35±0.29	7.13±2.42	1.49	0.32	0.65±0.31	3.95±2.84	1.31
IT-Lsn	OSH	317	0.83	0.98±0.05	0.21±0.29	1.33	0.89	1.02±0.04	-0.06±0.24	1.08
IT-SR2	ENF	160	0.38	1.02±0.20	0.80±1.51	2.52	0.59	1.11±0.15	-0.34±1.16	2.07
IT-Tor	GRA	134	0.71	0.98±0.11	0.19±0.53	1.88	0.76	0.99±0.10	0.08±0.49	1.74
NL-Loo	ENF	47	0.48	1.05±0.33	0.61±2.14	1.96	0.69	1.22±0.24	-0.98±1.70	1.51
SE-Deg	WET	143	0.38	0.22±0.05	0.54±0.14	0.53	0.55	0.50±0.07	0.34±0.13	0.45
SE-Htm	ENF	167	0.56	0.98±0.13	0.27±0.99	2.15	0.72	1.08±0.10	-0.44±0.77	1.71
SE-Nor	ENF	144	0.70	0.94±0.10	0.61±0.63	1.57	0.82	1.02±0.08	-0.14±0.52	1.24
SE-Svb	ENF	199	0.68	0.99±0.09	0.16±0.55	1.76	0.87	1.04±0.06	-0.26±0.35	1.15

Figure S1: Correlation matrix between explanatory variables and target variable. B_1 to B_{16} denote the spectral reflectance of MODIS bands, SIF_d is the daily TROPOMI sun-induced chlorophyll fluorescence, GPP is the tower-based daily gross primary production, NDVI (normalized difference vegetation index), NIRv (near infrared reflectance of vegetation index), and PRI (photochemical reflectance index). The correlation matrix shows strong relations between variables. Based on these observations B_{10}, B_{12} and B_{14} were excluded from the explanatory variables for establishing the RF regression models. Furthermore, B_{15} and B_{16} were excluded from the analyses due to many missing values that they contained.

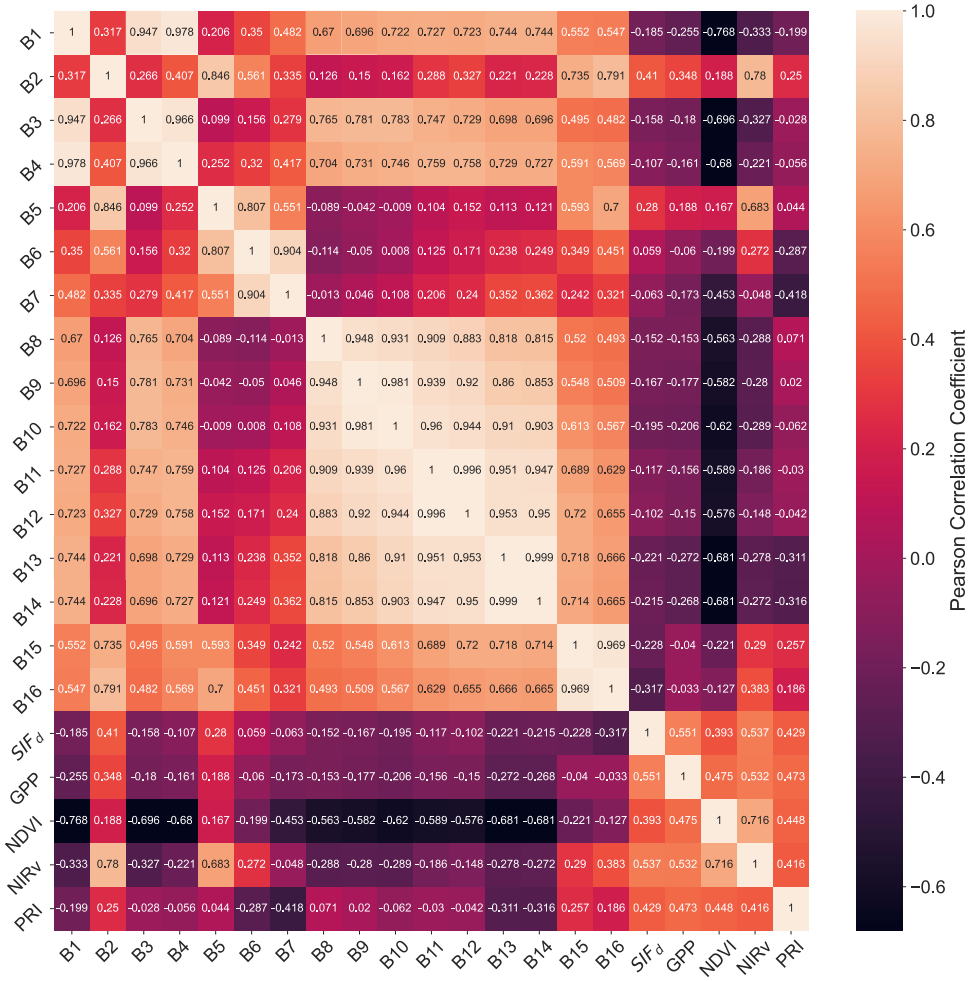

Figure S2: Comparison between RF models estimated GPP and observed tower-based GPP across all ICOS flux tower sites. Overall, our RF models show a high explanation of GPP variability across different vegetation types. However, the RF-SIF-VI shows some limits in some sites in predicting tower-based GPP as it overestimates (for instance at *SE-Deg*) and underestimates (for instance at *IT-Cp2*) tower-based GPP. The color code represents the different RF GPP predictions and the observed GPP: Red color stands for RF-SIF-R, green for RF-SIF-R-PFT, blue for RF-R, Cyan for RF-SIF-VI, and black for the observed tower-based GPP.

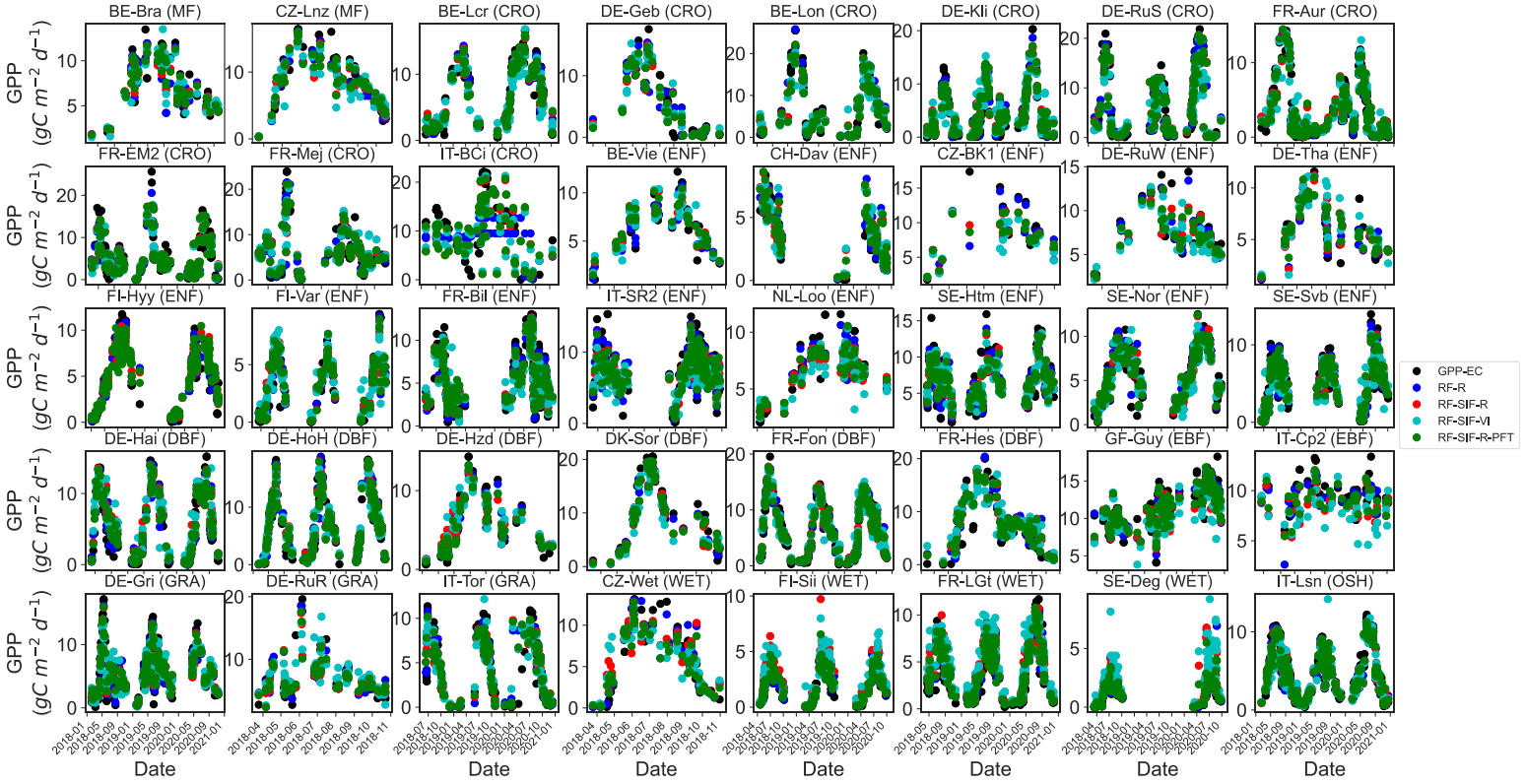

Figure S3-a RF-R: Scatterplots between tower-based GPP and RF-R predicted GPP of each site. The R^2 represents the coefficient of determination of the linear agreement between observed GPP and predicted GPP. The color code represents the eight different plant functional types encountered in the study sites: Red color stands for CRO (croplands), green for DBF (deciduous broadleaf forests), yellow for EBF (evergreen broadleaf forests), magenta for ENF (evergreen needleleaf forests), blue for GRA (grasslands), Cyan for MF (mixed forests), lime for OSH (open shrubland), and dimgrey for WET (wetland). The shaded area depicted in each line is the 95% confidence interval of the linear relationships between SIF_d and GPP.

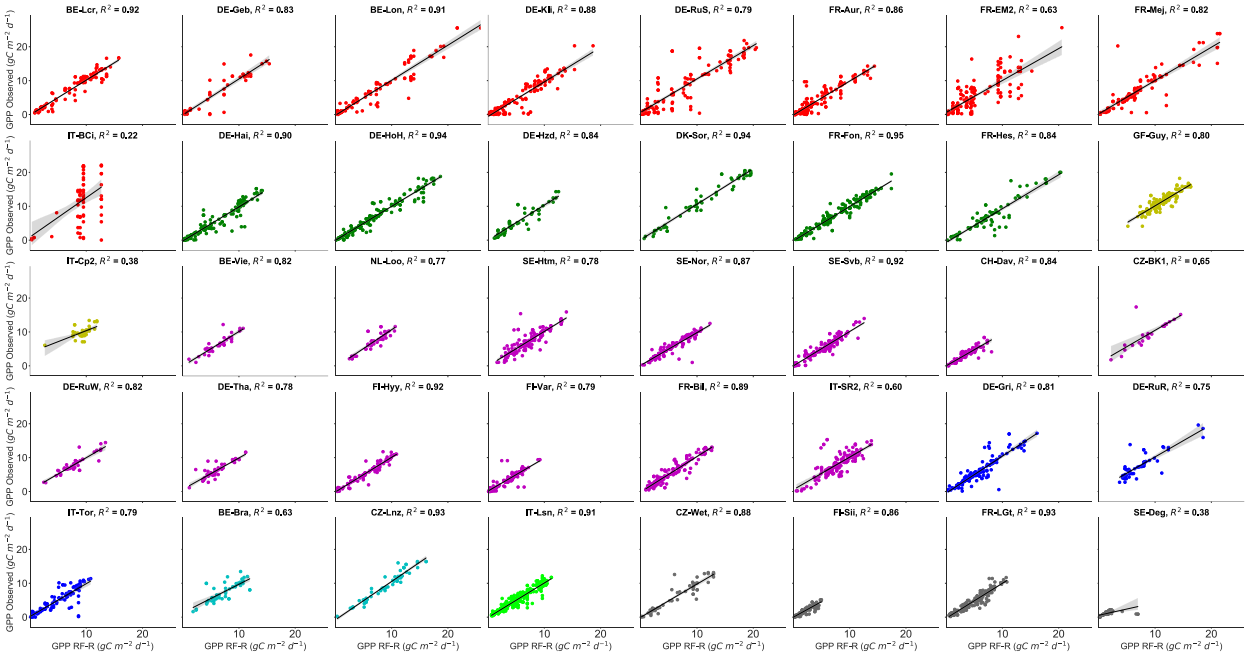

Figure S3-b RF-R: Scatterplots of the tower-based GPP against RF-R predicted GPP based on each PFT: mixed forests (MF), croplands (CRO), evergreen needleleaf forests (ENF), deciduous broadleaf forests (DBF), evergreen broadleaf forests (EBF), grasslands (GRA), open shrublands (OSH), and wetlands (WET) at daily timescale. The R^2 represents the coefficient of determination of the relationship between observed GPP and predicted GPP. p denotes the statistically significant level of the linear relationships. The shaded area depicted in each line is the 95% confidence interval of the linear relationships between GPP predicted and GPP observed.

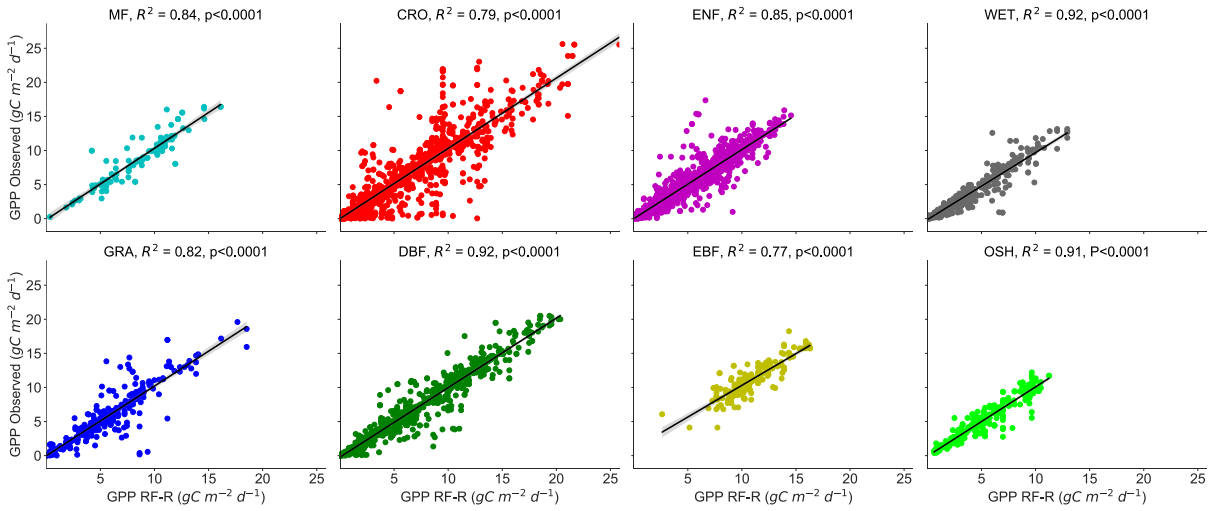

Figure S4-a RF-SIF-VI: Scatterplots between tower-based GPP and RF-SIF-VI predicted GPP for each site. The R^2 represents the coefficient of determination of the linear agreement between observed GPP and predicted GPP. The color code represents

the eight different vegetation types encountered in the study sites: Red color stands for CRO (croplands), green for DBF (deciduous broadleaf forests), yellow for EBF (evergreen broadleaf forests), magenta for ENF (evergreen needleleaf forests), blue for GRA (grasslands), Cyan for MF (mixed forests), lime for OSH (open shrubland), and dimgrey for WET (wetland). The shaded area depicted in each line is the 95% confidence interval of the linear relationships between SIF_d and GPP.

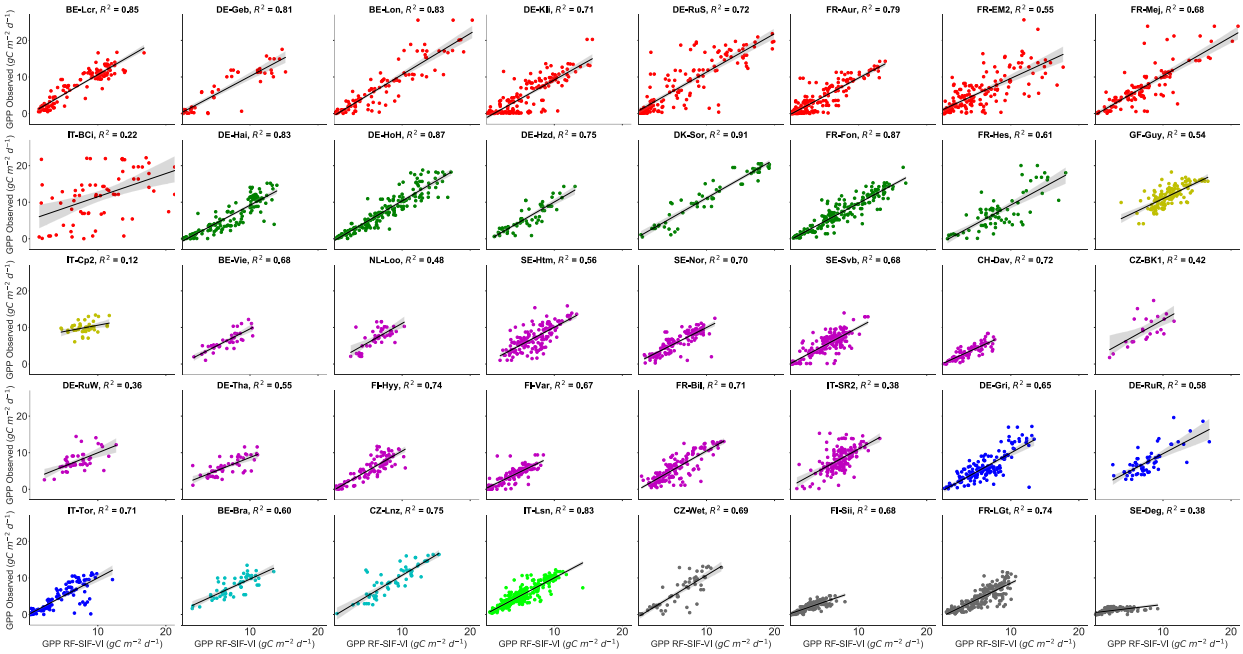

Figure S4-b RF-SIF-VI: Scatterplots of the tower-based GPP against RF-SIF-VI predicted GPP for each plant functional types: mixed forests (MF), croplands (CRO), evergreen needleleaf forests (ENF), deciduous broadleaf forests (DBF), evergreen broadleaf forests (EBF), grasslands (GRA), open shrublands (OSH), and wetlands (WET) at daily timescale. The R^2 represents the coefficient of determination of the relationship between observed GPP and predicted GPP. p denotes the statistically significant level of the linear relationships. The shaded area depicted in each line is the 95% confidence interval of the linear relationships between GPP predicted and GPP observed. The strongest correlations between observed and predicted GPP are observed in DBF and OSH vegetation types, while the lowest are recorded in EBF and ENF.

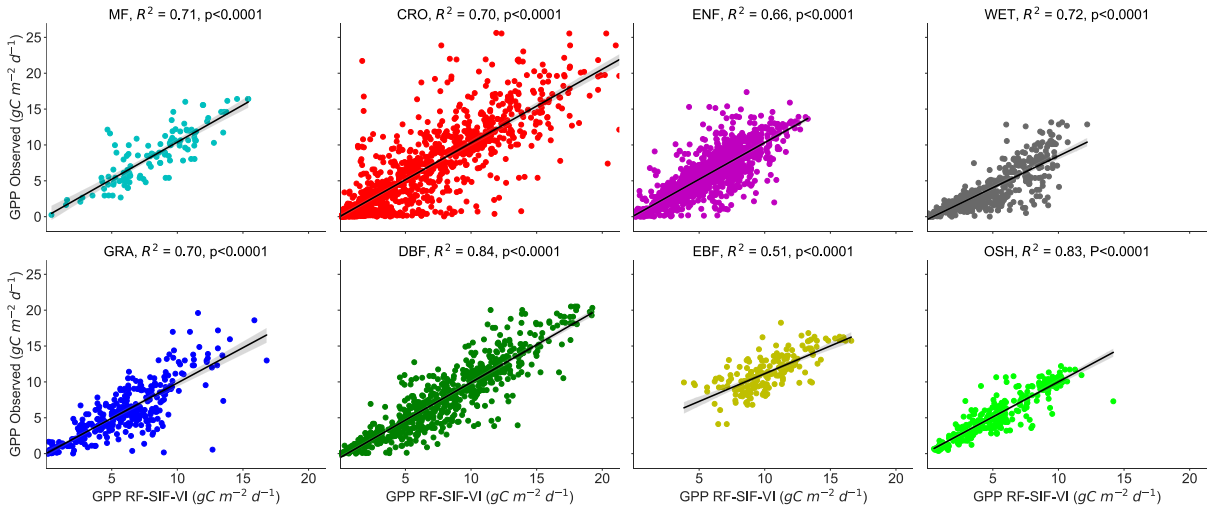

Figure S5-a RF-SIF-R-PFT: Scatterplots between tower-based GPP and RF-SIF-R-PFT predicted GPP for each site. The R^2 represents the coefficient of determination of the linear agreement between predicted GPP and observed GPP. The color code

represents the eight different vegetation types encountered in the study sites: Red color stands for CRO (croplands), green for DBF (deciduous broadleaf forests), yellow for EBF (evergreen broadleaf forests), magenta for ENF (evergreen needleleaf forests), blue for GRA (grasslands), Cyan for MF (mixed forests), lime for OSH (open shrubland), and dimgrey for WET (wetland). The shaded area depicted in each line is the 95% confidence interval of the linear relationships between SIF_d and GPP.

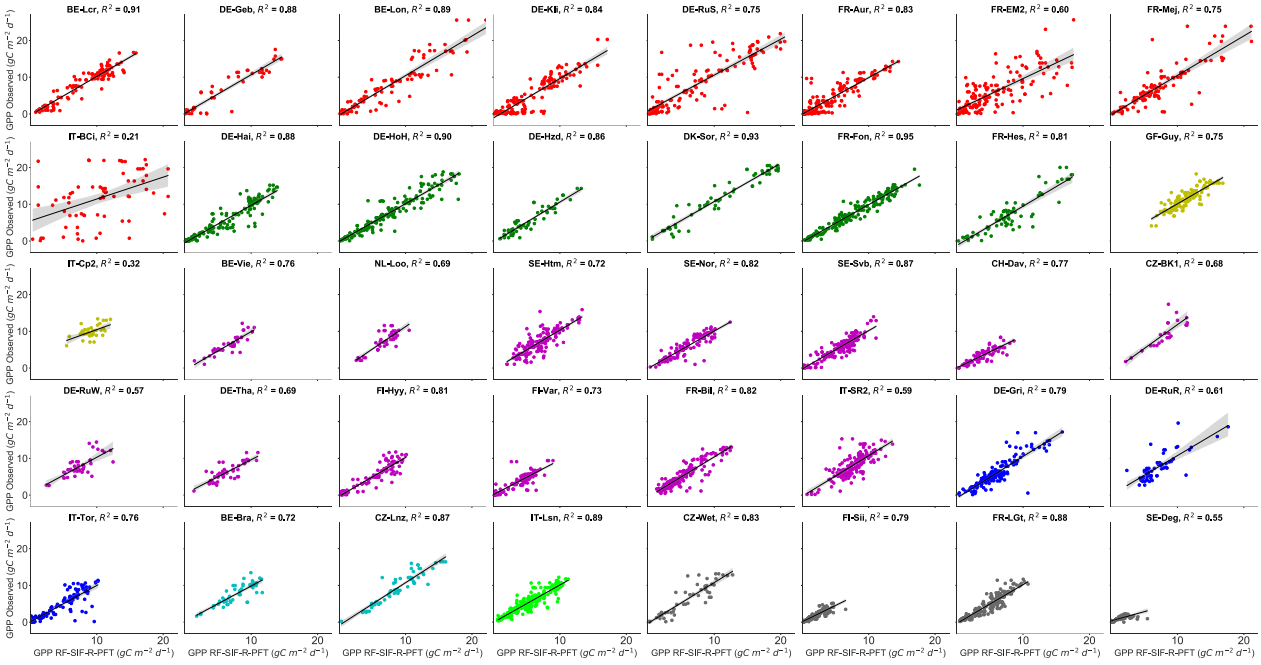

Figure S5-b RF-SIF-R-PFT: Scatterplots of the ICOS tower-based GPP against RF-SIF-R-PFT predicted GPP for each plant functional type: mixed forests (MF), croplands (CRO), evergreen needleleaf forests (ENF), deciduous broadleaf forests (DBF), evergreen broadleaf forests (EBF), grasslands (GRA), open shrublands (OSH), and wetlands (WET) at daily timescale. The R^2 represents the coefficient of determination of the relationship between observed GPP and predicted GPP. p denotes the statistically significant level of the linear relationships. The shaded area depicted in each line is the 95% confidence interval of the linear relationships between GPP predicted and GPP observed.