

Figure S1. Same as Figure 3 but diffuse PPFD fraction calculated using method from Spitters (1986).

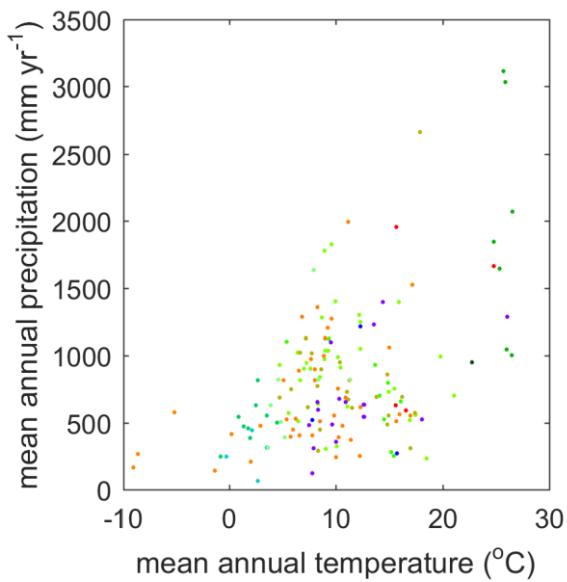


Figure S2. Mean annual climate of at the sites used in this study. The colors indicate different PFTs. Color codes are shown in Figure 4

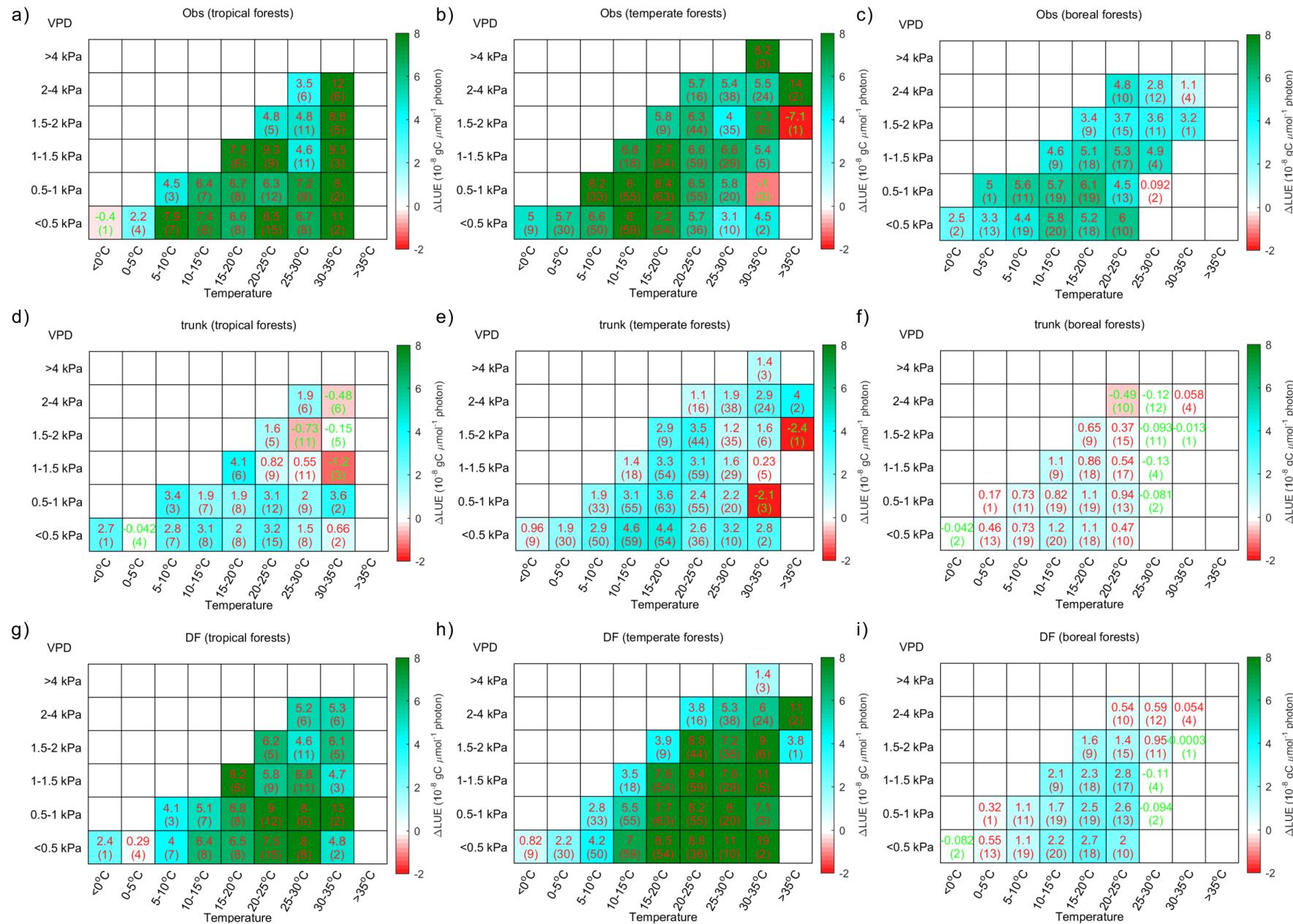


Figure S3. Same as Figure 10 but for tropical forests (a, d, g), temperate forests (b, e, h) and boreal forests (c, f, i) respectively.

Table S1. Plant functional types (PFT) in ORCHIDEE

PFT number	PFT abbreviation	PFT name
1		Bare soil
2	TrEBF	Tropical broad-leaved evergreen forests
3	TrDBF	Tropical broad-leaved raingreen forests
4	TeENF	Temperate needleleaf evergreen forests
5	TeEBF	Temperate broad-leaved evergreen forests
6	TeDBF	Temperate broad-leaved summergreen forests
7	BoENF	Boreal needleleaf evergreen forests
8	BoDBF	Boreal broad-leaved summergreen forests
9	BoDNF	Boreal needleleaf summergreen forests
10	C3Gra	C3 grasslands
11	C4Gra	C4 grasslands
12	C3Cro	C3 croplands
13	C4Cro	C4 croplands

Table S2. The information of the flux sites used in this study

Site name	Latitude	Longitude	PFT_ORCHIDEE	Time	Reference
AT-Neu	47.12	11.32	GraC3	2002-2006	(Wohlfahrt et al., 2008)
AU-Tum	-35.66	148.15	TeEBF	2001-2006	(Leuning et al., 2005)
AU-Wac	-37.43	145.19	TeEBF	2005-2007	(Kilinc et al., 2013)
BE-Bra	51.31	4.52	MF*	1997-2006	-
BE-Jal	50.56	6.07	MF	2006	-
BE-Lon	50.55	4.74	CroC3	2004-2006	(Moureaux et al., 2006)
BE-Vie	50.31	6	MF	1996-2006	(Aubinet et al., 2001)
BR-Ban	-9.82	-50.16	TrEBF	2003-2006	-
BR-Ji1	-10.76	-62.36	GraC4	1999	(von Randow et al., 2004)
BR-Ji2	-10.08	-61.93	TrEBF	2000-2002	(von Randow et al., 2004)
BR-Ma2	-2.61	-60.21	TrEBF	1999-2006	(Araujo et al., 2002)
BR-Sa2	-3.01	-54.54	CroC3	2001-2002	(Sakai et al., 2004)
BR-Sa3	-3.02	-54.97	TrEBF	2000-2003	(Saleska et al., 2003)
BR-Sp1	-21.62	-47.65	TrDBF	2001-2002	-
CA-Ca1	49.87	-125.33	TeENF	1997-2005	(Humphreys et al., 2003)
CA-Ca3	49.53	-124.9	TeENF	2001-2005	(Humphreys et al., 2006)
CA-Gro	48.22	-82.16	MF	2003-2005	(McCaughey et al., 2006)
CA-Oas	53.63	-106.2	BoDBF	1997-2005	(Black et al., 1996)
CA-Obs	53.99	-105.12	BoENF	1999-2005	(Bergeron et al., 2007)
CA-Ojp	53.92	-104.69	BoENF	1999-2005	(Howard et al., 2004)
CA-Qfo	49.69	-74.34	BoENF	2003-2006	(Bergeron et al., 2007)
CA-SF1	54.49	-105.82	BoENF	2003-2005	(Amiro et al., 2006)
CA-SJ3	53.88	-104.65	BoENF	2004-2005	(Gower et al., 1997)
CA-TP2	42.77	-80.46	TeENF	2003-2005	(Arain and Restrepo-Coupe, 2005)
CA-TP3	42.71	-80.35	TeENF	2003-2005	(Arain and Restrepo-Coupe, 2005)
CA-TP4	42.71	-80.36	TeENF	2003-2005	(Arain and Restrepo-Coupe, 2005)
CA-WP1	54.95	-112.47	MF	2003-2005	(Syed et al., 2006)
CA-WP2	55.54	-112.33	GraC3	2004	(Glenn et al., 2006)
CA-WP3	54.47	-113.32	GraC3	2004	(Glenn et al., 2006)
CH-Oe1	47.29	7.73	GraC3	2002-2006	(Ammann et al., 2009)
CH-Oe2	47.29	7.73	CroC3	2005	(Dietiker et al., 2010)
CN-Anh	33	117	TeDBF	2005-2006	-
CN-Bed	39.53	116.25	TeEBF	2005-2006	-
CN-Cha	42.4	128.1	MF	2003	(Guan et al., 2006)
CN-Do1	31.52	121.96	GraC4	2005	(Yan et al., 2008)
CN-Du1	42.05	116.67	CroC3	2005-2006	(Chen et al., 2009)
CN-Du2	42.05	116.28	GraC3	2006	(Chen et al., 2009)
CN-HaM	37.37	101.18	GraC3	2002-2004	(Kato et al., 2006)
CN-Xfs	44.13	116.33	GraC3	2004-2006	(Miao et al., 2009)
CN-Xi1	43.55	116.68	GraC3	2006	(Chen et al., 2009)
CN-Xi2	43.55	116.67	GraC3	2006	-
CZ-BK1	49.5	18.54	TeENF	2000-2006	(Acosta et al., 2013)
CZ-BK2	49.5	18.54	GraC3	2004-2006	-
CZ-wet	49.03	14.77	GraC3	2006	(Dušek et al., 2012)
DE-Bay	50.14	11.87	TeENF	1996-1999	(Valentini et al., 2000)
DE-Geb	51.1	10.91	CroC3	2004-2006	(Anthoni et al., 2004)
DE-Gri	50.95	13.51	GraC3	2005-2006	(Prescher et al., 2010)

DE-Hai	51.08	10.45	TeDBF	2000-2006	(Knöhl et al., 2003)
DE-Har	47.93	7.6	TeENF	2005-2006	(Bernhofer et al., 1996)
DE-Kli	50.89	13.52	CroC3	2004-2006	(Prescher et al., 2010)
DE-Tha	50.96	13.57	TeENF	1996-2006	(Grünwald and Bernhofer, 2007)
DE-Wet	50.45	11.46	TeENF	2002-2006	(Rebmann et al., 2010)
DK-Fou	56.48	9.59	CroC3	2005	-
DK-Lva	55.68	12.08	GraC3	2005-2006	-
DK-Ris	55.53	12.1	CroC3	2004-2005	-
DK-Sor	55.49	11.65	TeDBF	1996-2006	(Pilegaard et al., 2011)
ES-ES1	39.35	-0.32	TeENF	1999-2006	(Reichstein et al., 2005)
ES-ES2	39.28	-0.32	CroC3	2004-2006	-
ES-LMa	39.94	-5.77	TeDBF	2004-2006	-
ES-VDA	42.15	1.45	GraC3	2004-2006	-
FI-Hyy	61.85	24.29	BoENF	1996-2006	(Suni et al., 2003)
FI-Kaa	69.14	27.3	GraC3	2000-2006	-
FI-Sii	61.83	24.19	GraC3	2004-2005	-
FR-Aur	43.55	1.11	CroC3	2005	-
FR-Fon	48.48	2.78	TeDBF	2005-2006	(Delpierre et al., 2016)
FR-Hes	48.67	7.06	TeDBF	1997-2006	(Granier et al., 2000)
FR-Lam	43.49	1.24	CroC4	2005	(Béziat et al., 2009)
FR-Lq1	45.64	2.74	GraC3	2004-2006	-
FR-Lq2	45.64	2.74	GraC3	2004-2006	-
FR-Pue	43.74	3.6	TeEBF	2000-2006	(Rambal et al., 2004)
GF-Guy	5.28	-52.93	TrEBF	2004-2006	(Bonal et al., 2008)
HU-Bug	46.69	19.6	GraC3	2002-2006	(Nagy et al., 2007)
HU-Mat	47.85	19.73	GraC3	2004-2006	-
ID-Pag	2.35	114.04	TrEBF	2002-2003	-
IE-Ca1	52.86	-6.92	CroC3	2004-2006	-
IE-Dri	51.99	-8.75	GraC3	2003-2005	-
IL-Yat	31.35	35.05	TeENF	2001-2006	(Grünzweig et al., 2003)
IT-Amp	41.9	13.61	GraC3	2002-2006	(Papale et al., 2015)
IT-Be2	46	13.03	CroC4	2006	(Papale et al., 2015)
IT-Bon	39.48	16.53	TeENF	2006	(Papale et al., 2015)
IT-Col	41.85	13.59	TeDBF	1996-2006	(Valentini et al., 1996)
IT-Cpz	41.71	12.38	TeEBF	1997-2006	(Garbulsky et al., 2008)
IT-Lav	45.96	11.28	TeENF	2000-2006	(Marcolla et al., 2003)
IT-Lec	43.3	11.27	TeEBF	2005-2006	(Papale et al., 2015)
IT-LMa	45.58	7.15	TeDBF	2003-2006	(Papale et al., 2015)
IT-Mal	46.12	11.7	GraC3	2003-2006	(Papale et al., 2015)
IT-MBo	46.02	11.05	GraC3	2003-2006	(Marcolla et al., 2011)
IT-Noe	40.61	8.15	TeENF	2004-2006	(Papale et al., 2015)
IT-Pia	42.58	10.08	TeENF	2002-2005	(Papale et al., 2015)
IT-Ren	46.59	11.43	TeENF	1999-2006	(Montagnani et al. 2009)
IT-Ro2	42.39	11.92	TeDBF	2002-2006	(Tedeschi et al., 2006)
IT-SRo	43.73	10.28	TeENF	1999-2006	(Chiesi et al., 2005)
JP-Mas	36.05	140.03	CroC3	2002-2003	(Saito et al., 2005)
JP-Tak	36.15	137.42	TeDBF	1999-2004	(Yamamoto et al., 1999)
KR-Hnm	34.55	126.57	CroC3	2004-2006	(Lee et al., 2003)
NL-Ca1	51.97	4.93	GraC3	2003-2006	(Jacobs et al., 2007)

NL-Haa	52	4.81	GraC3	2003-2004	(Jacobs et al., 2007)
NL-Lan	51.95	4.9	CroC4	2005-2006	-
NL-Loo	52.17	5.74	TeENF	1996-2006	(Moors, 2002)
NL-Lut	53.4	6.36	CroC3	2006	-
NL-Mol	51.65	4.64	CroC3	2005-2006	-
PL-wet	52.76	16.31	GraC3	2004-2005	-
PT-Esp	38.64	-8.6	TeEBF	2002-2006	-
PT-Mi2	38.48	-8.02	GraC3	2004-2006	-
RU-Cok	70.62	147.88	BoDBF	2003-2005	(van der Molen et al., 2007)
SE-Abi	68.36	18.79	BoDBF	2005	-
SE-Deg	64.18	19.55	GraC3	2001-2005	-
SE-Fla	64.11	19.46	BoENF	1996-2002	-
SE-Nor	60.09	17.48	TeENF	1996-2005	(Lagergren et al., 2008)
SE-Sk2	60.13	17.84	TeENF	2004-2005	-
UK-AMo	55.79	-3.24	GraC3	2005	-
UK-EBu	55.87	-3.21	GraC3	2004-2006	-
UK-ESa	55.91	-2.86	CroC3	2003-2005	-
UK-Gri	56.61	-3.8	TeENF	1997-2006	-
UK-Ham	51.12	-0.86	TeDBF	2004-2005	(Wilkinson et al., 2012)
UK-PL3	51.45	-1.27	TeDBF	2005-2006	-
UK-Tad	51.21	-2.83	GraC3	2001	-
US-ARb	35.55	-98.04	GraC4	2005-2006	(Fischer et al., 2012)
US-ARc	35.54	-98.04	GraC4	2005-2006	(Fischer et al., 2012)
US-ARM	36.61	-97.49	CroC3	2003-2006	(Fischer et al., 2007)
US-Atq	70.47	-157.41	GraC3	1999-2006	(Kwon et al., 2005)
US-Bar	44.06	-71.29	TeDBF	2004-2005	(Richardson et al., 2007)
US-Blo	38.9	-120.63	TeENF	1997-2006	(Baker et al., 1999)
US-Bn1	63.92	-145.38	BoENF	2003	(Liu et al., 2005)
US-Bn2	63.92	-145.38	BoDBF	2003	(Liu et al., 2005)
US-Brw	71.32	-156.63	GraC3	1998-2002	(Kwon et al., 2005)
US-CaV	39.06	-79.42	GraC3	2004-2005	-
US-Dk1	35.97	-79.09	GraC3	2001-2005	(Katul et al., 2003)
US-FPe	48.31	-105.1	GraC3	2000-2006	-
US-Fuf	35.09	-111.76	TeENF	2005-2006	(Dore et al., 2008)
US-Fwf	35.45	-111.77	GraC3	2005-2006	(Dore et al., 2008)
US-Goo	34.25	-89.97	GraC3	2002-2006	(Benjamin et al., 2017)
US-Ho1	45.2	-68.74	TeENF	1996-2004	(Hollinger et al., 1999)
US-IB2	41.84	-88.24	GraC3	2004-2007	(Allison et al., 2005)
US-Ivo	68.49	-155.75	GraC3	2003-2006	(McEwing et al., 2015)
US-Los	46.08	-89.98	TeDBF	2001-2005	(David et al., 2003)
US-Me3	44.32	-121.61	TeENF	2004-2005	(Campbell and Law, 2005)
US-Me4	44.5	-121.62	TeENF	1996-2000	(Campbell and Law, 2005)
US-MMS	39.32	-86.41	TeDBF	1999-2005	(Schmid et al., 2000)
US-MOz	38.74	-92.2	TeDBF	2004-2006	(Gu et al., 2006)
US-NC2	35.8	-76.67	TeENF	2005-2006	(Noormets et al., 2010)
US-NR1	40.03	-105.55	BoENF	1999-2003	(Monson et al., 2002)
US-Oho	41.55	-83.84	TeDBF	2004-2005	(Noormets et al., 2008)
US-PFa	45.95	-90.27	MF	1996-2003	(Berger et al., 2001)
US-SO2	33.37	-116.62	TeDBF	1997-2006	(Lipson et al., 2005)

US-SO4	33.38	-116.64	TeDBF	2004-2006	(Luo et al., 2007)
US-SP1	29.74	-82.22	TeENF	2000-2005	(Powell et al., 2008)
US-SP3	29.75	-82.16	TeENF	1999-2004	(Powell et al., 2008)
US-Syv	46.24	-89.35	MF	2002-2006	(Desai et al., 2005)
US-Ton	38.43	-120.97	TeDBF	2001-2006	(Xu and Baldocchi, 2003)
US-UMB	45.56	-84.71	TeDBF	1999-2003	(Schmid, 2003)
US-Var	38.41	-120.95	GraC3	2001-2006	(Xu and Baldocchi, 2004)
US-WBW	35.96	-84.29	TeDBF	1995-1999	(Baldocchi and Vogel, 1996)
US-WCr	45.81	-90.08	TeDBF	1999-2006	(Desai et al., 2005)
US-Wi1	46.73	-91.23	TeDBF	2003	(Noormets et al., 2008)
US-Wi2	46.69	-91.15	TeENF	2003	(Noormets et al., 2008)
US-Wi4	46.74	-91.17	TeENF	2002-2005	(Noormets et al., 2008)
US-Wrc	45.82	-121.95	TeENF	1998-2006	(Paw et al., 2004)
VU-Coc	-15.44	167.19	TrEBF	2001-2004	(Roupsard et al., 2008)

* Mix forests, treated as 50% TeDBF and 50% TeENF

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