	Available measurement years	*Ta* annual (C)	*Ta* dry season (C)	*PAR* annual (μmol $m^{-2}s^{-1}$)	*PAR* dry season (μmol $m^{-2}s^{-1}$)	*Prec* measurement years (mm a^{-1})	*Prec* dry season measurement years (mm a^{-1})	Annual *Prec TRMM* measurement years (mm a^{-1})	Prec dry *TRMM* measurement years (mm a^{-1})	Annual *Prec TRMM* 1998-2011 (mm a^{-1})	Dry Annual *Prec TRMM* 1998-2011 (mm a^{-1})	Dry season length measureme nt years (months)	Dry season length 1998-2011 (months)
K34	2000-2006	25.8	26.5	NaN	NaN	1975	1069	2453	866	2506	829	2.4	2.2
K67	2002-2005	25.3	25.9	343	379	1220	513	1749	587	1993	586	6.0	5.1
K83	2000-2003	25.9	26.7	322	361	1296	551	1886	633	1982	607	5.6	5.0
CAX	1999-2003	25.9	26.7	360	392	1912	1154	2634	755	2815	692	3.8	3.1
K77	2000-2005	26.3	26.8	372	413	1063	459	2040	667	2100	606	5.0	4.8
JAV	2004-2006	26.3	27.1	484	501	1326	253	1990	304	1843	246	4.5	4.8
RJA	1999-2002	25.3	25.2	425	435	1666	436	2262	594	2092	436	4.0	4.1
FNS	1999-2002	24.9	24.6	366	367	1321	433	1903	555	1867	459	4.3	4.2
PDG	2004-2006	22.6	21.7	572	532	858	359	1494	473	1603	478	6.3	5.7

Differences in measurement years can change the length of the dry season and mean values even if sites are close by, e.g.: variations in K77, K83, and K67 dry-season air temperature.

Dry season length calculated as total number of months where prec <100 mm mo^{-1} divided by number of years (e.g. 1998-2008).

Supplement Table 1. Mean environmental drivers at Brasil flux sites. Precipitation (*Prec*) from Tropical Rainfall Measuring Mission (TRMM), for site-specific tower measurement years and a long-term climatological series (1998-2006), excluding recent 2007-2008 and 2010-2012 La Nina and 2009-2010 ENSO events

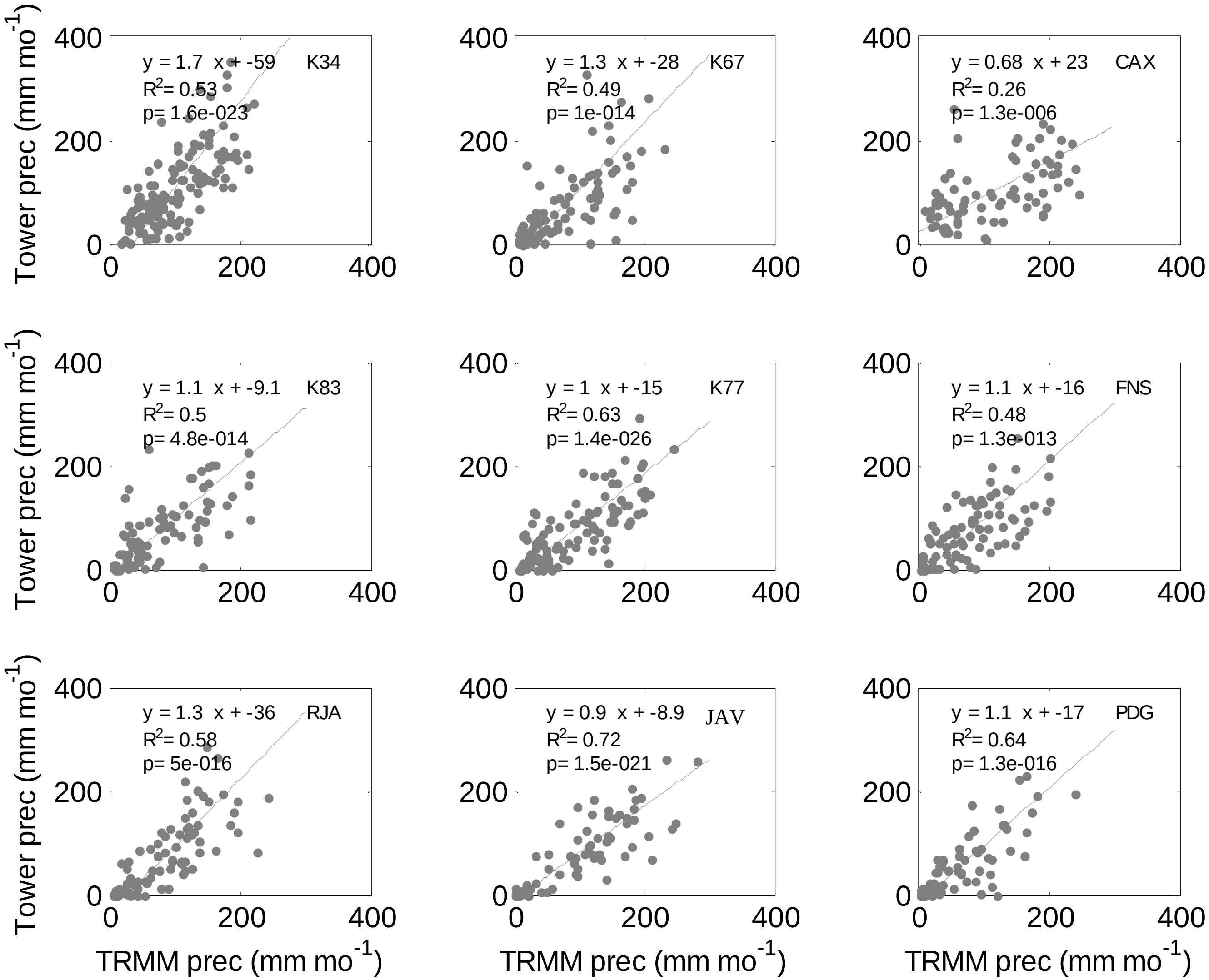
ID	System type**	IRGA	Sonic Anemometer	PAR sensor	Net Radiometer sensor	Air temperature sensor
K34	CP	LI-6262 (LI-COR, USA)	Solent 1012R2 (Gill Instrum., UK)	LI-190SZ (LICOR, USA)	CNR1 (Kipp & Zonen, ND)	PT100*
K67	CP	LI-6262 (LI-COR, USA)	CSTAT 3 (CampbellSci, USA)	LICOR 190-SA (LI-COR,USA)	Rebs Q7.1 with RV2 ventilation	MetOne 076B-4 assp. YSI 44032 thermistor
K83	CP	LI-6262 (LI-COR, USA)	CSTAT 3 (CampbellSci, USA)	LICOR 190-SA (LI-COR, USA)	CNR1 (Kipp & Zonen, ND)	MetOne 076B-4 assp. 107 Campbell Sci (CSI, USA)
CAX	CP	LI-6262 (LI-COR, USA)	Solent 1012R2 (Gill Instrum., UK)	Quantum SKP215 (Skye Inst, UK)	CNR1 (Kipp & Zonen, ND)	Shielded thermistors *
K77	CP	LI-6262 (LI-COR, USA)	CSTAT 3 (CampbellSci, USA)	Licor 190-SA (LI-COR,USA)	CNR1 (Kipp & Zonen, ND)	Vaisala Humitter CS500 (VaisalaOyj, Finland)
RJA	CP	LI-6262 (LI-COR, USA)	Solent 1012R2 (Gill Instrum., UK)	LI-190SZ (LI-COR,USA)	CNR1 (Kipp & Zonen, ND)	HMP35A Vaisalla, Campbell Sci (CSI, USA)*
FNS	CP	LI-6262 (LI-COR, USA)	Solent 1012R2 (Gill Instrum., UK)	LI-190SZ (LI-COR,USA)	CNR1 (Kipp & Zonen, ND)	HMP35A Vaisalla, Campbell Sci (CSI, USA)*
JAV	OP	LI-7500 (LI-COR, USA)	CSTAT 3 (CampbellSci, USA)	PAR LITE (Kipp & Zonen, ND)	Solent 1012R2 (Gill Instrum., UK)	HMP45C Vaisalla, Campbell Sci (CSI, USA)
PDG	OP	NOAA-ATDD (NOAA, USA)	SWS-211/3K (AppliedTechnologies)	LI 200x (LI-COR, USA)	REBS, model Q*7.1 (Campbell Sci, USA)	HMP45C Vaisalla, Campbell Sci (CSI, USA)

*: non aspirated T_{air} sensor.
OP: Open path gas analyzer
CP: Close path gas analyzer

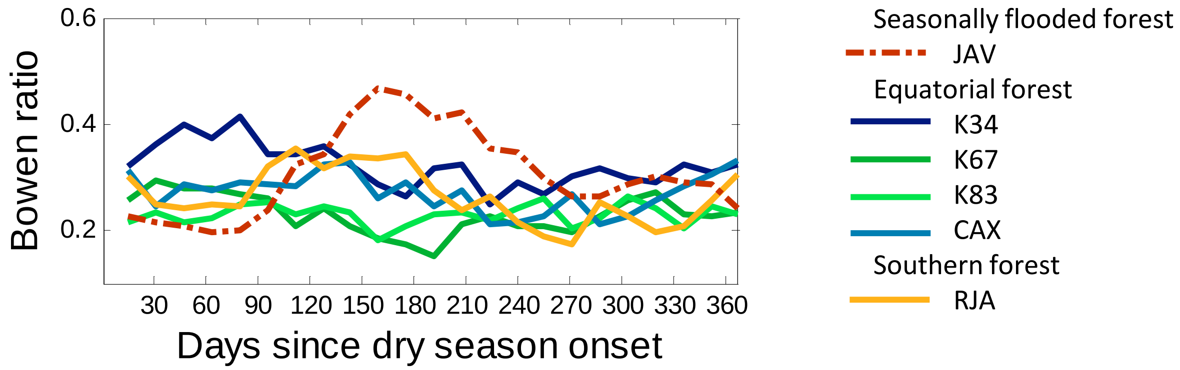
Supplement Table 2. Brasil flux sites instrumentation and measuring methods.

Supplement Table 3. Linear regressions obtained by a nonlinear mixed-effects regression model for leaf-flush (Equation **1**) versus combinations of 16-day average *PAR* (mmol m^{-2} d^{-1}, measured at each site separately) and soil volumetric water content, (m^3 m^{-3}, measured at K83), for Santarém forest sites (K67 and K83) and Manaus (K34)

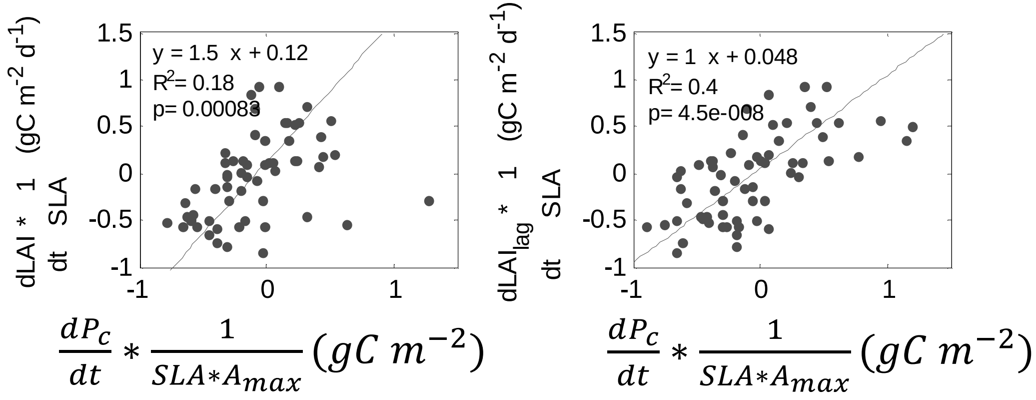
Leaf-flush	Independent variable	Coefficients		Coefficients Standar Error	AIC	Correlation coefficient (R^2)
K67	$m * \theta_{0-40cm} + b$	m	-10.77	2.08	66.48	0.41
		b	4.50	0.69		
	$p * PAR_{day} + b$	p	10.93	-2.581	119.21	0.37
		b	-1.76	0.76		
	$p * PAR_{day}$(lag 1-month) + b	p	12.40	2.00	112.02	0.42
		b	-3.09	0.68		
	$n * \theta_{0-40cm} * PAR_{day} + m * \theta_{0-40cm} + b$	n	32.27	5.3	45.45	0.71
		m	-19.08	0.46		
		b	3.58	2.07		
	$n * \theta_{0-40cm} * PAR_{day} + p * PAR_{day} + b$	n	-23.79	4.06	44.46	0.72
		p	17.77	0.58		
		b	-2.48	1.90		
	$n * \theta_{0-40cm} * PAR_{day} + b$	n	-3.60	5.90	82.76	0.01
		b	1.39	0.64		
	$m * \theta_{0-40cm} + p * PAR_{day} + b$	m	-8.10	1.66	44.57	0.72
		p	0.06	1.38		
		b	10.32	0.80		
	$n * \theta_{0-40cm} * PAR_{day} + m * \theta_{0-40cm} + p * PAR_{day} + b$	n	-11.29	41.77	48.50	0.72
		m	-4.28	14.23		
		p	13.85	13.17		
		b	-1.14	4.51		
K83	$m * \theta_{0-40cm} + b$	m	-9.43	1.83	91.78	0.33
		b	4.32	0.55		
	$p * PAR_{day} + b$	p	9.67	1.53	94.43	0.41
		b	-1.62	0.51		
	$p * PAR_{day}$(lag 1-month) + b	p	9.68	1.48	93.00	0.43
		b	-1.66	0.50		
	$n * \theta_{0-40cm} * PAR_{day} + m * \theta_{0-40cm} + b$	n	30.56	5.18	82.18	0.53
		m	-13.49	1.66		
		b	2.55	0.46		
	$n * \theta_{0-40cm} * PAR_{day} + p * PAR_{day} + b$	n	-13.77	5.22	81.67	0.54
		p	12.41	1.51		
		b	-1.25	0.52		
	$n * \theta_{0-40cm} * PAR_{day} + b$	n	2.24	6.38	108.56	0.01
		b	1.28	0.60		
	$m * \theta_{0-40cm} + p * PAR_{day} + b$	m	-3.40	1.71	80.92	0.54
		p	9.16	1.62		
		b	-0.51	0.90		
	$n * \theta_{0-40cm} * PAR_{day} + m * \theta_{0-40cm} + p * PAR_{day} + b$	n	-25.87	44.90	84.59	0.54
		m	5.05	14.85		
		p	16.56	13.00		
		b	-2.95	4.37		
K34	$m * \theta_{0-40cm} + b$	m	-15.11	3.22	129.28	0.31
		b	6.96	1.26		
	$p * PAR_{day} + b$	p	3.42	0.28	146.57	0.18
		b	-0.28	0.76		
	$p * PAR_{day}$(lag 1-month) + b	p	5.10	0.68	118.91	0.35
		b	-0.91	0.25		
	$n * \theta_{0-40cm} * PAR_{day} + m * \theta_{0-40cm} + b$	n	'4.96	3.90	64.62	0.35
		m	-13.25	3.18		
		b	5.50	1.49		
	$n * \theta_{0-40cm} * PAR_{day} + p * PAR_{day} + b$	n	-31.05	9.99	63.67	0.35
		p	13.90	3.22		
		b	0.37	0.56		
	$n * \theta_{0-40cm} * PAR_{day} + b$	n	8.96	4.40	75.48	0.11
		b	-0.26	0.64		
	$m * \theta_{0-40cm} + p * PAR_{day} + b$	m	1.88	1.52	64.89	0.35
		p	-11.28	3.83		
		b	4.76	1.88		
	$n * \theta_{0-40cm} * PAR_{day} + m * \theta_{0-40cm} + p * PAR_{day} + b$	n	-60.87	59.68	67.41	0.35
		m	11.42	22.54		
		p	25.46	23.03		
		b	-4.07	8.78		



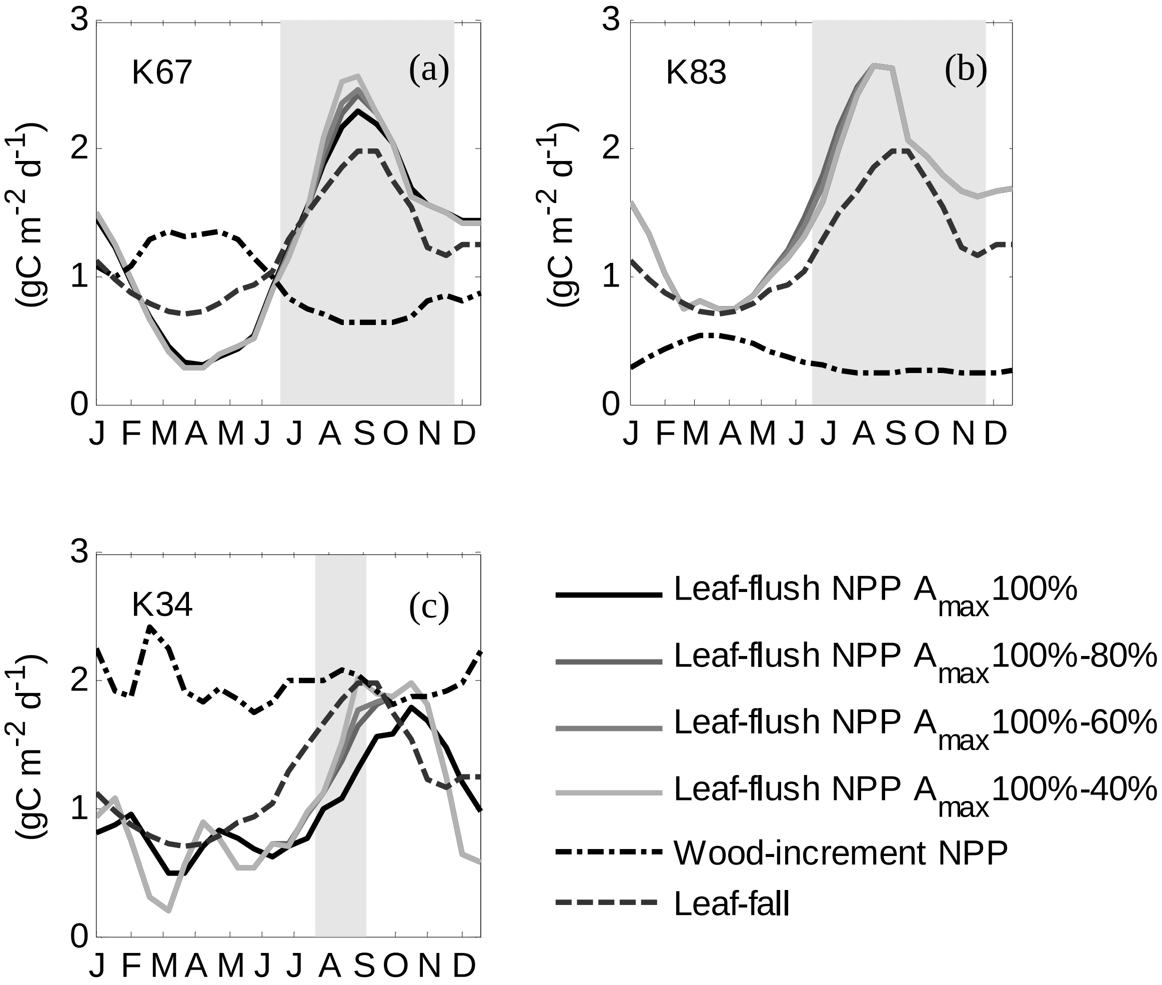
Supplement Figure 1. Linear regression 16-day average Tropical Rainfall Measuring Mission (TRMM) data product from 1998-2006 (TRMM prec) and site-specific measurements of rainfall (Tower Prec) in mm mo^{-1}. Brasil flux sites, Manaus, K34, Santarém forests K67 and K83, Caxiuana CAX, Santarem pasture K77, Southern Pasture FNS, Jarú forest RJA, Bananal (JAV) and Southern savanna PDG.



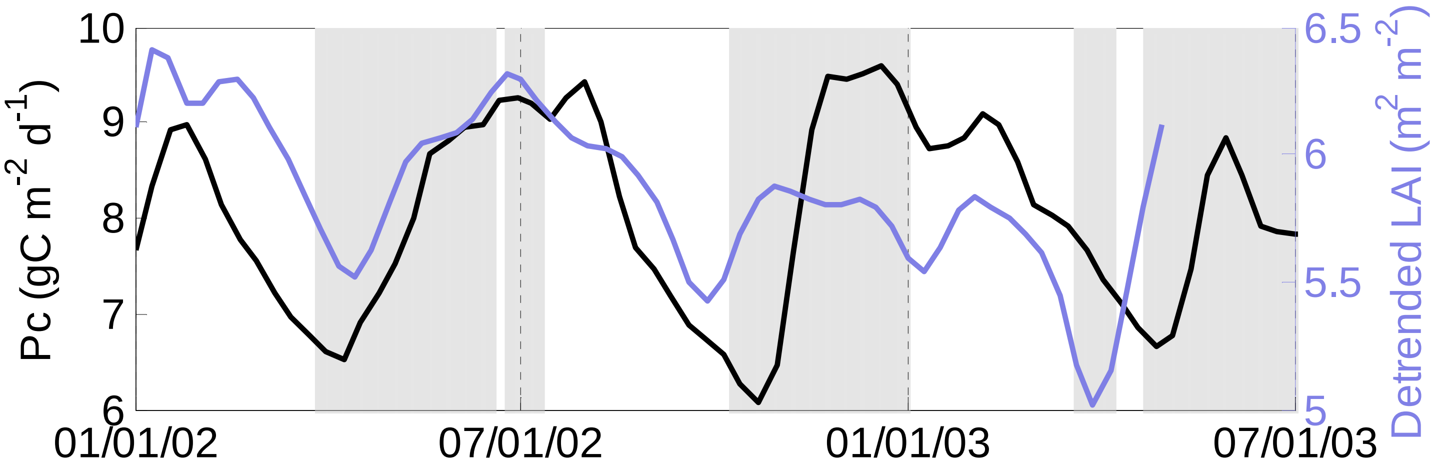
Supplement Figure 2. 16-day average forest Bowen ratio (ratio between sensible heat, H and latent heat, LE), with time series set to the start of the dry season at each tower site.



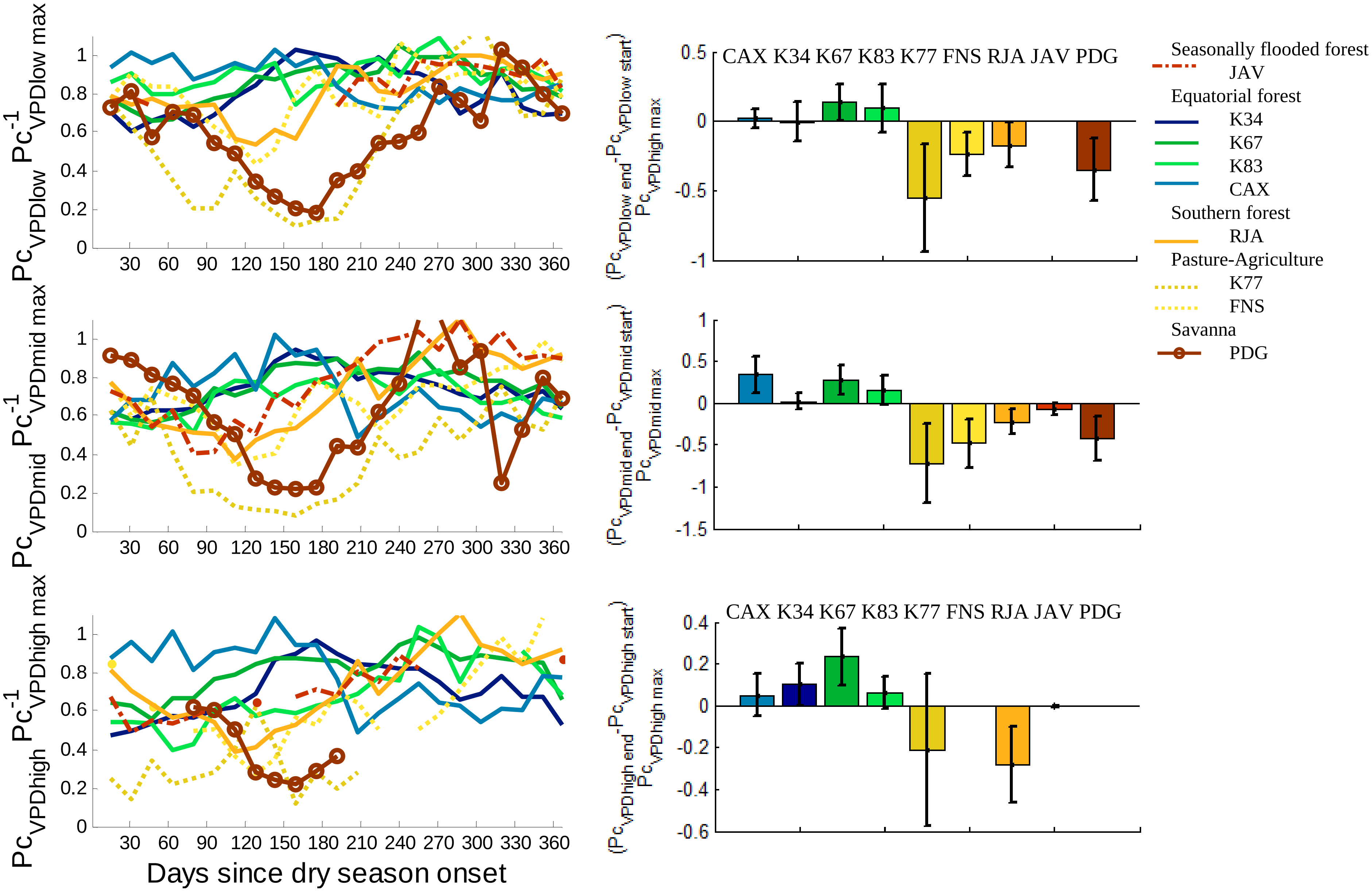
Supplement Figure 3. Comparison of the time-derivative component of the two leaf – flush models independent of leaf-fall term for K67 Santarem forest. (dLAI/dt * 1/SLA) (left panel) and lagged 1-month respect to (dPc/dt*1/(SLA*A_{max})) (right panel)



Supplement Figure 4. Central Amazon forests (Santarém (a and b) and Manaus (c) annual cycle of measurements of wood increment (gC m^{-2} d^{-1}) , leaf fall (gC m^{-2} d^{-1}) and modeled leaf-flush (gC m^{-2} d^{-1}). Leaf flush calculated using Equation 1, where A_{max} fix to a set to its maximum value (Leaf-flush NPP A_{max}100%), other model results include A_{max} varying accordingly to expected decrease in A_{max} as the leaf ages (leaf fall as proxy) for example Leaf-flush NPP A_{max}100%-40%, A_{max} will linearly decrease 2-months prior to peak in leaf-fall from 100% to 40% values. Areas in grey represent precipitation <100 mm $month^{-1}$ based on tower and Tropical Rainfall Measuring Mission (TRMM) data.



Supplement Figure 5. Eddy flux derived photosynthetic capacity (Pc) as in Section 2.3 (left axis) overlaid with detrended leaf area index (LAI) observations (right axis) (Brando et al., 2006). Pearson's correlation coefficient r = 0.47, $p<0.0005$. Areas in grey represent precipitation <100 mm month^{-1} based on tower and Tropical Rainfall Measuring Mission (TRMM) data.



Supplement Figure 6. Left panels 16-day average normalized Photosynthetic Capacity, *Pc* $Pcmax^{-1}$ defined for fixed *VPD* bins, (a) low (0-1 kPa), (b) medium (1-2 kPa) and (c) high (2-3 kPa). Right panels bar plots showing the beginning-to-end of dry season change relative to the start of the season, error bars indicate site-specific interannual variability for *Pc*, (d) low Pc_{VPDlow} (0-1 kPa), (e) medium Pc_{VPDmed} (1-2 kPa) and (f) high $Pc_{VPDhigh}$ (2-3 kPa) *VPD* levels. Bars follow line color code.