Supplementary document

Supplementary information for the article: What determines peat swamp vegetation type in the central Congo Basin?

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Additional figures

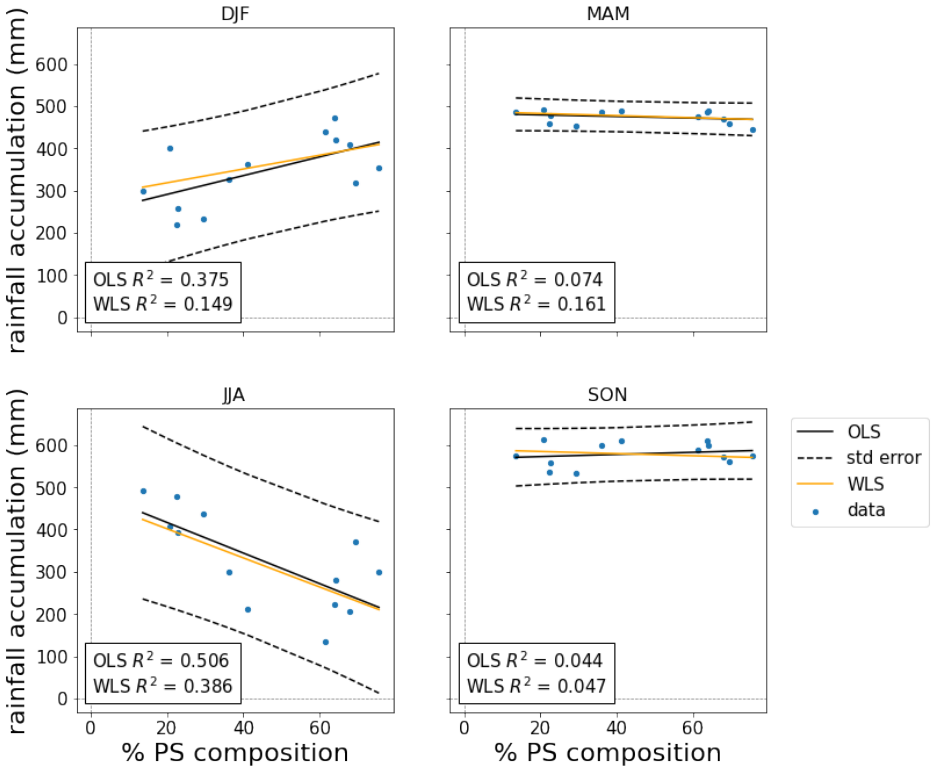

Figure S.1. Ordinary and weighted least squares regression plots for the correspondence between average seasonal rainfall totals across each sub-basin and overall palm swamp composition within each sub-basin.

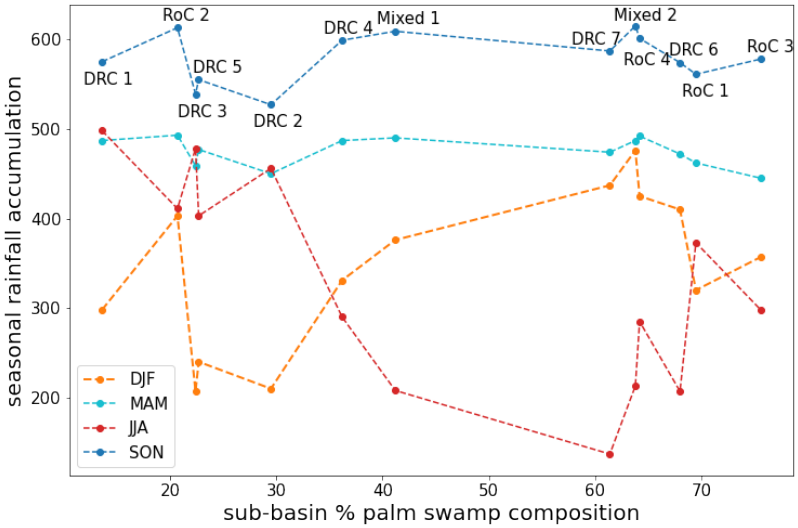

Figure S.2. Variability of sub-basin palm swamp composition with seasonal rainfall climatology accumulations. The sub-basin names are annotated only on the September, October, November (SON) season sub-basin points.

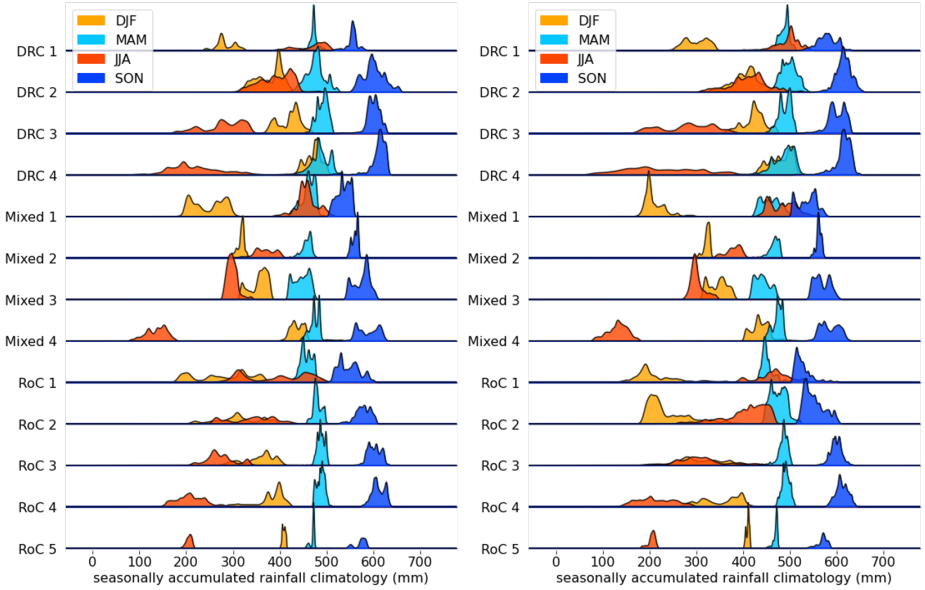

Figure S.3. Seasonal rainfall climatology density plots for (a) palm swamp, and (b) hardwood swamp pixels within each sub-basin. These show the

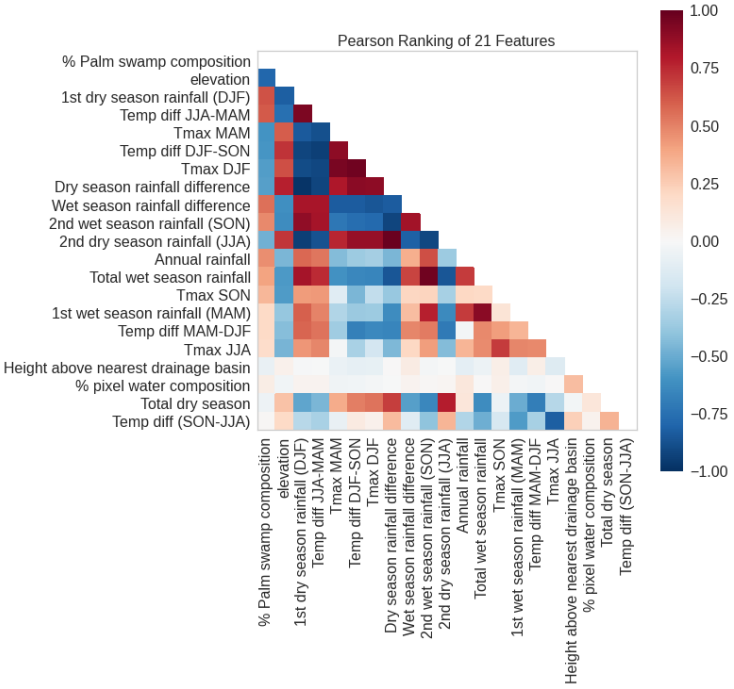

Figure S.4. Pearson correlation plot between all variables, calculated over all pixels containing at least 70% swamp.

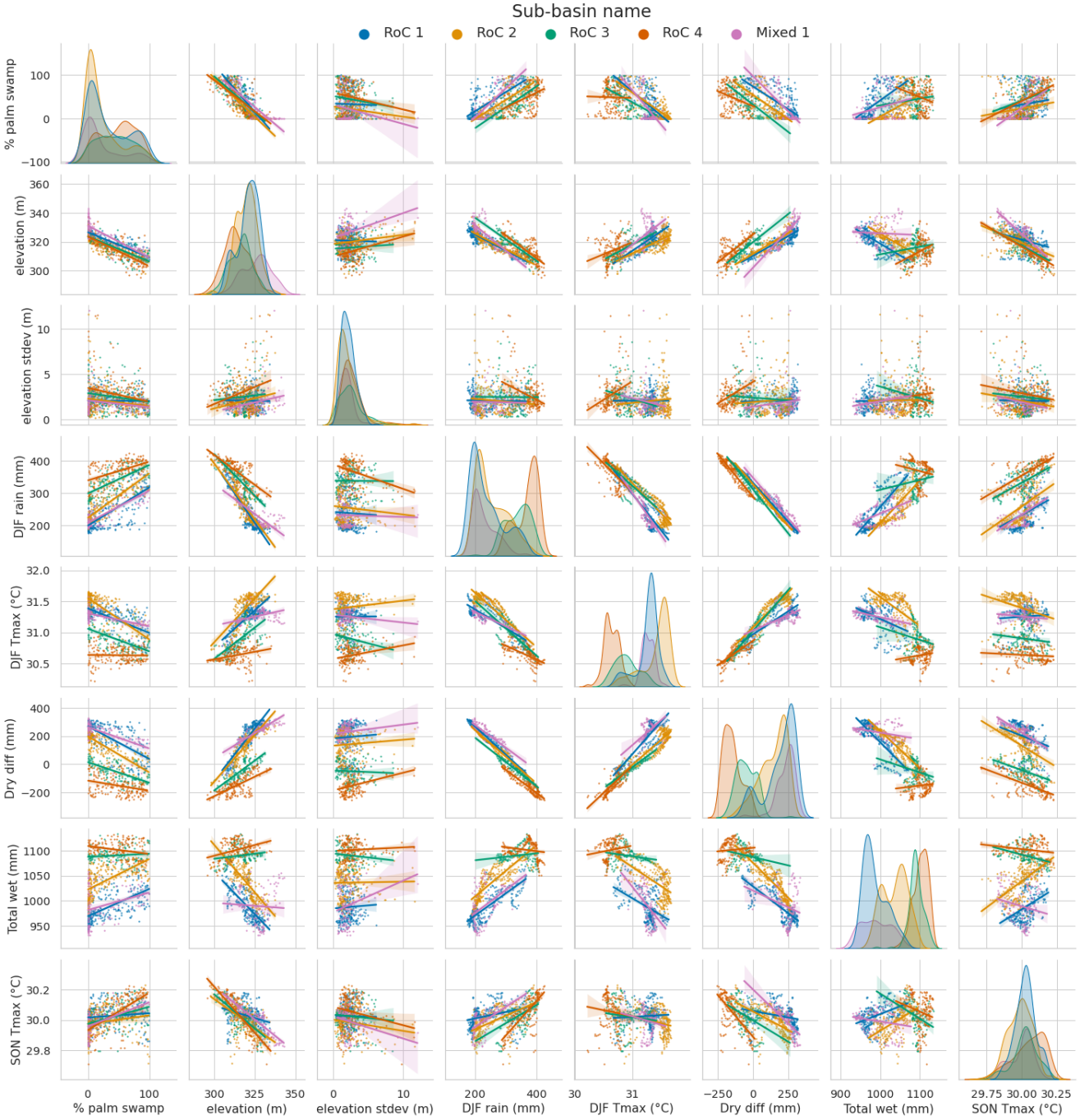

Figure S.5. A pairplot showing the co-variation between each of the seven variables included in the regression analysis, for each sub-basin including more than 10 of the 0.05° x 0.1° sub-pixels. The corresponding histograms for each set of paired parameters and for each sub-basin are plotted on the diagonal.

Additional tables

Table S.1. Land-type composition by sub-basin. Land-type column header abbreviations: TF = Terra firme (non-peat forming forest), PS = Palm swamp (peat-forming), HWS = Hardwood swamp, TS = total swamp (PS+HWS). Approximate areas were calculated using a conversion of 1° = 111 km at the equator.

Sub-basin	Approx. area (km^2)	Overall land-type composition (%)					Swamp type composition (%)		
		water	savannah	TF	PS	HWS	Total swamp (TS)	PS:TS	HWS:TS
RoC 1	60,940	1.8	8.4	51.5	11.3	27.0	38.3	29.5	70.5
RoC 2	29,850	1.3	7.8	24.3	15.1	51.5	66.6	22.7	77.3
RoC 3	23,060	1.5	1.0	52.8	16.2	28.5	44.7	36.2	63.8
RoC 4	47,420	0.4	15.8	52.5	12.9	18.4	31.3	41.2	58.8
RoC 5	850	5.2	21.1	30.5	29.3	13.8	43.1	68.0	32.0
Mixed 1	106,000	2.7	7.2	79.4	2.4	8.3	10.7	22.4	77.6
Mixed 2	1,170	18.2	4.4	15.8	42.8	18.8	61.6	69.5	30.5
Mixed 3	1,660	20.8	7.9	20.9	38.2	12.3	50.5	75.6	24.4
Mixed 4	27,260	3.4	48.2	34.5	8.6	5.4	14.0	61.4	38.6
DRC 1	82,630	0.5	0.6	86.4	1.7	10.8	12.5	13.6	86.4
DRC 2	189,060	0.5	1.1	81.6	3.5	13.4	16.9	20.7	79.3
DRC 3	13,990	11.2	7.9	33.2	30.7	17.1	47.8	64.2	35.8
DRC 4	230,910	1.8	21.1	63.0	9.0	5.1	14.1	63.8	36.2

Table S.2. Elevation min, max and range within each sub-basin

Sub-basin	Min elevation (m)	Max elevation (m)	Range (m)
RoC 1	296	429	134
RoC 2	295	385	91
RoC 3	295	407	112
RoC 4	289	444	155
RoC 5	289	334	45
Mixed 1	296	433	137
Mixed 2	295	352	57
Mixed 3	295	360	65
Mixed 4	287	436	149
DRC 1	295	417	122
DRC 2	305	412	107
DRC 3	290	380	91
DRC 4	290	464	174

Table S.3. Pearson correlation between palm swamp composition and feature variables for 0.05° latitudinal x 0.1° longitudinal pixels that contain (a) any amount of swamp, and (b) >70% swamp composition (hardwood + palm), in descending order of correlation.

Feature	All swamp pixels	>70% swamp pixels
elevation	-0.68	-0.80
1st dry season rainfall (DJF)	0.52	0.65
Temp diff (JJA-MAM)	0.57	0.63
Temp diff (DJF-SON)	-0.44	-0.60
Tmax (MAM)	-0.26	-0.59
Dry season rainfall difference	-0.41	-0.56
Tmax (DJF)	-0.27	-0.56
Wet season rainfall difference	0.29	0.53
2nd dry season rainfall (JJA)	-0.33	-0.49
2nd wet season rainfall (SON)	0.27	0.46
Annual rainfall	0.34	0.45
Tmax (SON)	0.40	0.40
Total wet season rainfall	0.23	0.38
Tmax (JJA)	0.36	0.23
Temp diff (MAM-DJF)	0.17	0.22
1st wet season rainfall (MAM)	0.13	0.19
Height above nearest drainage basin	-0.33	-0.12
% pixel water composition	0.14	0.09
Total dry season rainfall	0.04	-0.05
Temp diff (SON-JJA)	-0.19	0.01

Table S.4. Test of the model stability. Z-score beta coefficients for the mean (μ) model using 10 different random-seed numbers within the Scikit-learn algorithm which divides the data into 80% training and 20% test data sets. We initialised the random-seed value to 0 within our final model.

	Z-score beta coefficients corresponding with random seed:											
Feature	**0**	12	17	36	42	78	112	247	571	1000	**Mean**	**Std dev**
Intercept	**-2.83**	-2.86	-3.03	-3.11	-2.74	-2.81	-2.80	-2.82	-2.88	-2.79	-2.87	0.11
elevation	**-4.64**	-4.72	-4.89	-4.83	-4.68	-4.78	-4.56	-4.68	-4.67	-4.92	-4.74	0.11
elevation std dev	**-0.30**	-0.24	-0.34	-0.46	-0.15	-0.13	-0.37	-0.27	-0.29	-0.01	-0.26	0.13
Dry rainfall diff	**3.23**	2.95	3.21	3.17	3.21	3.16	3.18	3.21	3.24	3.10	3.17	0.09
DJF rainfall	**0.67**	0.53	0.51	0.48	0.63	0.59	0.77	0.66	0.54	0.56	0.59	0.09
DJF Tmax	**-1.28**	-1.20	-1.36	-1.35	-1.29	-1.25	-1.21	-1.36	-1.38	-1.24	-1.29	0.07
Total wet season	**0.73**	0.63	0.72	0.73	0.69	0.66	0.67	0.65	0.73	0.66	0.69	0.04
SON Tmax	**-0.35**	-0.45	-0.40	-0.40	-0.30	-0.34	-0.35	-0.41	-0.32	-0.38	-0.37	0.04
	Statistics											
R^2	**0.75**	0.74	0.74	0.75	0.74	0.74	0.73	0.74	0.73	0.75	0.74	0.01
log-likelihood	**939.5**	921.6	920.6	924.6	935.4	924.9	880.9	920.7	916.7	938.9	922.4	16.7

Table S.5. RoC sub-basin linear regression statistics.

Sub-basin	Variable	Equation	R^2	p-value
RoC 1	elevation	y = -0.17332x + 326.51	0.745	0.0000
	elevation stdev	y = -0.00058x + 2.11	0.000	0.7572
	DJF rain	y = 1.18161x + 199.21	0.527	0.0000
	JJA-DJF rain	y = -2.31471x + 269.18	0.485	0.0000
	Total wet season rain	y = 0.54518x + 969.25	0.359	0.0000
	DJF max temp	y = -0.00394x + 31.39	0.441	0.0000
	SON max temp	y = 0.00027x + 30.02	0.016	0.0419
RoC 2	elevation	y = -0.17816x + 323.79	0.636	0.0000
	elevation stdev	y = -0.00833x + 2.31	0.019	0.0276
	DJF rain	y = 1.37739x + 223.41	0.613	0.0000
	JJA-DJF rain	y = -2.5639x + 198.31	0.572	0.0000
	Total wet season rain	y = 0.60812x + 1022.58	0.308	0.0000
	DJF max temp	y = -0.00664x + 31.55	0.606	0.0000
	SON max temp	y = 0.00056x + 29.97	0.034	0.0036
RoC 3	elevation	y = -0.17363x + 323.68	0.570	0.0000
	elevation stdev	y = -0.00976x + 2.92	0.029	0.0484
	DJF rain	y = 0.87969x + 298.82	0.428	0.0000
	JJA-DJF rain	y = -1.45885x + 14.79	0.368	0.0000
	Total wet season rain	y = 0.06361x + 1087.51	0.010	0.2500
	DJF max temp	y = -0.00363x + 31.06	0.262	0.0000
	SON max temp	y = 0.00113x + 29.97	0.140	0.0000
RoC 4	elevation	y = -0.20541x + 323.61	0.589	0.0000
	elevation stdev	y = -0.01527x + 3.49	0.060	0.0010
	DJF rain	y = 0.57866x + 339.22	0.202	0.0000
	JJA-DJF rain	y = -0.71359x + -116.13	0.099	0.0000
	Total wet season rain	y = -0.15909x + 1109.23	0.060	0.0009
	DJF max temp	y = -9e-05x + 30.64	0.000	0.7821
	SON max temp	y = 0.00246x + 29.93	0.402	0.0000
RoC 5	elevation	y = -0.27218x + 323.09	0.870	0.0007
	elevation stdev	y = 0.00059x + 1.65	0.002	0.9110
	DJF rain	y = 2.21122x + 236.02	0.917	0.0002
	JJA-DJF rain	y = -5.29896x + 199.08	0.953	0.0000
	Total wet season rain	y = 0.77052x + 1002.28	0.789	0.0032
	DJF max temp	y = -0.01106x + 31.44	0.941	0.0001
	SON max temp	y = 0.00149x + 30.07	0.712	0.0084

Table S.6. Mixed sub-basin linear regreassion statistics.

Sub-basin	Variable	Equation	R^2	p-value
Mixed 1	elevation	y = -0.21926x + 331.03	0.692	0.0000
	elevation stdev	y = -0.00738x + 2.12	0.033	0.0491
	DJF rain	y = 0.98866x + 208.49	0.668	0.0000
	JJA-DJF rain	y = -1.52686x + 264.58	0.493	0.0000
	Total wet season rain	y = 0.34745x + 981.64	0.090	0.0009
	DJF max temp	y = -0.00209x + 31.31	0.333	0.0000
	SON max temp	y = 0.00158x + 29.96	0.367	0.0000
Mixed 2	elevation	y = -0.25047x + 327.53	0.906	0.0010
	elevation stdev	y = 0.01827x + 2.2	0.402	0.1265
	DJF rain	y = 1.58092x + 228.1	0.620	0.0356
	JJA-DJF rain	y = -3.00934x + 218.5	0.651	0.0283
	Total wet season rain	y = 0.69082x + 988.53	0.326	0.1808
	DJF max temp	y = -0.00468x + 31.36	0.448	0.1001
	SON max temp	y = 0.00183x + 30.01	0.686	0.0214
Mixed 3	elevation	y = -0.20688x + 323.91	0.888	0.0000
	elevation stdev	y = 0.0039x + 2.16	0.024	0.6292
	DJF rain	y = 1.07907x + 280.37	0.405	0.0261
	JJA-DJF rain	y = -2.29697x + 116.7	0.482	0.0122
	Total wet season rain	y = 0.24195x + 1031.12	0.088	0.3504
	DJF max temp	y = -0.00347x + 31.1	0.218	0.1257
	SON max temp	y = 0.00146x + 29.97	0.213	0.1307
Mixed 4	elevation	y = -0.26532x + 322.26	0.700	0.0025
	elevation stdev	y = 0.00154x + 2.45	0.004	0.8581
	DJF rain	y = 1.89882x + 283.65	0.597	0.0088
	JJA-DJF rain	y = -4.58776x + 72.58	0.528	0.0172
	Total wet season rain	y = 0.59183x + 1020.02	0.504	0.0215
	DJF max temp	y = -0.00687x + 31.07	0.266	0.1275
	SON max temp	y = 0.00286x + 30.0	0.345	0.0741

Table S.7. DRC sub-basin linear regreassion statistics.

Sub-basin	Variable	Equation	R^2	p-value
DRC 1	elevation	y = -0.17173x + 327.78	0.668	0.0000
	elevation stdev	y = -0.00339x + 2.31	0.006	0.4416
	DJF rain	y = -0.012x + 291.75	0.000	0.8798
	JJA-DJF rain	y = -0.75626x + 205.37	0.146	0.0000
	Total wet season rain	y = -0.47027x + 1055.92	0.266	0.0000
	DJF max temp	y = 0.00021x + 31.12	0.006	0.4223
	SON max temp	y = 0.00063x + 30.03	0.166	0.0000
DRC 2	elevation	y = -0.21002x + 328.87	0.658	0.0000
	elevation stdev	y = -0.02775x + 4.8	0.173	0.0000
	DJF rain	y = -0.54347x + 411.99	0.198	0.0000
	JJA-DJF rain	y = 0.07958x + 7.44	0.003	0.3817
	Total wet season rain	y = -0.75183x + 1122.94	0.304	0.0000
	DJF max temp	y = 0.00325x + 30.65	0.295	0.0000
	SON max temp	y = 0.00101x + 30.02	0.103	0.0000
DRC 3	elevation	y = -0.24322x + 329.11	0.377	0.0000
	elevation stdev	y = -0.05783x + 9.4	0.140	0.0035
	DJF rain	y = -0.60192x + 470.41	0.127	0.0057
	JJA-DJF rain	y = 1.41669x + -260.48	0.111	0.0100
	Total wet season rain	y = -0.007x + 1093.21	0.000	0.9633
	DJF max temp	y = 0.00184x + 30.45	0.082	0.0282
	SON max temp	y = -0.00065x + 30.11	0.006	0.5630
DRC 4	elevation	y = -0.24012x + 327.5	0.684	0.0000
	elevation stdev	y = -0.04574x + 7.39	0.292	0.0000
	DJF rain	y = -0.09959x + 482.0	0.014	0.0274
	JJA-DJF rain	y = -0.50045x + -196.01	0.031	0.0010
	Total wet season rain	y = -0.20332x + 1127.49	0.048	0.0000
	DJF max temp	y = 0.00097x + 30.44	0.041	0.0001
	SON max temp	y = 0.00072x + 30.12	0.016	0.0192

Table S.8. Pearson correlation between the model anomalies and terrain and climatological weather variables were assessed to determine if any of the anomalous predictions could be explained by some variation in the parameters used within the final regression analysis or the additional parameters that were not included. The small correlation values (all ≤ 0.10) show that the anomalies cannot be better accounted for using some other combination of input climatological variables.

Variable	Correlations with the modelled anomaly
HAND	0.10
elevation std dev	0.07
MAM rain	0.07
JJA mean Tmax	0.06
% water composition	-0.05
Wet season rain diff	-0.05
Annual rainfall	0.04
% combined swamps	-0.04
MAM mean Tmax	0.03
Total wet season rain	0.03
elevation	0.02
DJF mean Tmax	0.01
SON mean Tmax	-0.01
Total dry season rain	0.00
DJF rain	0.00
SON rain	0.00
Dry season rain diff	0.00
JJA rain	0.00

Table S.9. Annual correlations between palm swamp pixel composition and rainfall variables.

	JJA - DJF	DJF	JJA	SON	MAM	Annual	Total dry season	Total wet season
1981	-0.41	0.41	-0.37	0.35	-0.35	-0.28	-0.23	-0.12
1982	-0.46	0.57	-0.35	0.42	-0.02	0.41	0.07	0.43
1983	-0.44	0.62	-0.32	-0.36	0.12	-0.12	-0.07	-0.16
1984	-0.45	0.49	-0.32	0.52	-0.13	0.20	0.08	0.29
1985	-0.58	0.60	-0.48	0.24	-0.19	0.16	0.06	0.15
1986	-0.43	0.53	-0.26	-0.07	0.23	0.30	0.36	0.10
1987	-0.50	0.56	-0.43	0.45	0.07	0.15	-0.26	0.42
1988	-0.49	0.50	-0.45	0.14	-0.09	0.08	0.14	0.04
1989	-0.45	0.57	-0.39	0.26	-0.21	-0.25	-0.28	0.06
1990	-0.43	0.49	-0.34	0.03	0.22	0.43	0.50	0.18
1991	-0.48	0.56	-0.38	-0.32	0.22	-0.06	0.11	-0.21
1992	-0.50	0.62	-0.43	0.11	0.03	-0.29	-0.27	0.08
1993	-0.42	0.45	-0.39	0.09	-0.40	-0.35	-0.25	-0.10
1994	-0.46	0.51	-0.41	0.30	0.35	0.25	-0.26	0.35
1995	-0.45	0.49	-0.39	0.37	0.18	0.37	0.28	0.30
1996	-0.48	0.50	-0.45	0.34	0.32	0.32	-0.19	0.36
1997	-0.49	0.58	-0.42	0.32	0.10	0.18	-0.17	0.24
1998	-0.43	0.49	-0.36	0.29	-0.02	0.32	0.06	0.24
1999	-0.49	0.56	-0.39	0.10	0.25	0.29	0.36	0.17
2000	-0.44	0.50	-0.37	-0.04	0.08	0.04	0.08	0.00
2001	-0.45	0.48	-0.41	0.10	-0.22	-0.25	-0.21	-0.15
2002	-0.49	0.54	-0.42	0.14	-0.08	0.04	-0.07	0.09
2003	-0.48	0.57	-0.38	-0.06	0.36	0.25	0.20	0.16
2004	-0.47	0.54	-0.41	0.22	-0.03	0.04	-0.02	0.09
2005	-0.45	0.50	-0.42	0.17	0.20	-0.00	-0.27	0.22
2006	-0.46	0.52	-0.42	0.40	-0.41	-0.14	-0.28	0.15
2007	-0.44	0.55	-0.37	0.23	0.02	-0.04	-0.15	0.13
2008	-0.46	0.56	-0.37	0.31	-0.31	-0.06	-0.09	0.04
2009	-0.46	0.57	-0.36	0.13	0.10	0.28	0.06	0.24

Table S.10. Annual correlations between palm swamp pixel composition and temperature variables.

	SON Tmax	MAM Tmax	DJF Tmax	JJA Tmax
1983	0.51	-0.37	-0.36	0.28
1984	0.50	-0.27	-0.35	0.15
1985	0.25	-0.33	-0.29	0.19
1986	0.38	-0.23	-0.32	0.42
1987	0.18	-0.29	-0.31	0.19
1988	0.45	-0.26	-0.28	0.25
1989	0.29	-0.30	-0.25	0.23
1990	0.44	-0.36	-0.33	0.16
1991	0.48	-0.28	-0.29	0.29
1992	0.44	-0.31	-0.36	0.31
1993	0.45	-0.34	-0.24	0.36
1994	0.41	-0.33	-0.31	0.28
1995	0.27	-0.31	-0.32	0.06
1996	0.31	-0.35	-0.32	0.38
1997	0.40	-0.31	-0.36	0.12
1998	0.35	-0.38	-0.34	0.34
1999	0.37	-0.29	-0.23	0.28
2000	0.06	-0.37	-0.34	0.17
2001	0.53	-0.30	-0.38	0.50
2002	0.25	-0.27	-0.32	0.37
2003	0.38	-0.34	-0.35	0.35
2004	0.47	-0.35	-0.33	0.34
2005	-0.09	-0.28	-0.33	0.45
2006	0.02	-0.22	-0.28	0.42
2007	0.08	-0.21	-0.31	0.18
2008	0.10	-0.24	-0.35	0.33
2009	0.34	-0.28	-0.32	-0.02