Electronic Supplementary Material for

Drought-induced Amazonian wildfires instigate a decadal-scale disruption of forest carbon dynamics

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Supplementary Material for Drought-induced Amazonian wildfires instigate a decadal-scale disruption of forest carbon dynamics (Silva et al., 2018)

Method S1: Description of methods applied for MCWD and Burned Area anomaly calculations in figure 1.

We used re-analysis data and satellite derived products of burned area to characterize the association between burned areas and drought affected regions over the Amazonia. To perform this analysis we calculated the Maximum Climatological Water Deficit (MCWD) anomalies for 2015 based on precipitation and evapotranspiration data from ERA-Interim reanalysis at 1º spatial resolution from 1979 to 2016 [1]. For calculation of burned area anomalies for 2015 we used data from MODIS (MCD64A1 product) at 500 m spatial resolution from 2001 to 2016 [2]. We calculated MCWD as indicated by [3]. Then we aggregated burned area at the MCWD 1º spatial resolution, so we assessed the total burned area for each grid-cell of MCWD. Both MCWD and burned area anomalies were then calculated for 2015 on a pixel-by-pixel basis, as the deviation from the long-term mean calculated from 1979 to 2016 (t) and 2001 to 2016 (t) respectively, normalized by the standard deviation (σ) as following:

$$\mathbf{X}\,\boldsymbol{Anomaly}\,(\mathbf{i},\mathbf{j}) = \frac{\mathbf{X(i,j)} - \mathbf{X(tx)}}{\boldsymbol{\sigma(tx)(i,j)}}$$

Along the time series we plotted the data extracted from plots location and observed coincident peak of BA on the falls of MCWD at all plots region (figure1).

Table S1: Description of permanent sample plots by region with respective brazilian federal state, number of plots in burned (BU) and un-burned (UB) area, period of measurements, number of repeated census, Years since last fire disturbance (YSLF), total number of census in each region, plot size in hectare.

Region	BU (N)	UB (N)	Census period	Census (N)	YSLF	Census Total	Plot size (ha)
East (PA)	4	6	2010-2016	3	16-31	30	0.25
Central (AM)	11	6	2015-2016	2	0.75 – 1.25	34	0.25
North (RR)	6	3	2015	1	12-17	9	0.25
Southeast (MT)	4	4	2009-2017	7	4-12	56	0.25
Southwest (AC)	10	10	2009-2016	3	0.75-11	60	0.25; 1
Total	35	29	2009-2017	16	0.75-31	189	_

Table S2: Summary of mean values of TAGB stock and dynamics parameters, mortality (M), wood productivity (Wp) and Net TAGB, with s.d. values between parentheses for burned and unburned plots.

Type	Plots	Region	Census period	Census (N)	YSLF	TAGB (Mg ha^{-1})	M ((Mg ha^{-1} y^{-1})	Wp (Mg ha^{-1} y^{-1})	Net TAGB (Mg ha^{-1} y^{-1})
Burned plots	AFL_2a	southeast	2009-2017	7	4-12	226.3 (3.7)	8.4(5.4)	10.3(1.6)	1.8(4.0)
	AFL_2b	southeast	2009-2017	7	4-12	198.0 (11.3)	4.1(5.9)	8.3(1.8)	4.1(6.4)
	AFL_2c	southeast	2009-2017	7	4-12	209.0 (7.5)	5.1(6.2)	7.6(1.5)	2.5(6.2)
	AFL_2d	southeast	2009-2017	7	4-12	161.2 (6.7)	8(6.3)	6.5(1.4)	-1.4(6.4)
	BOL_4	southwest	2011-2016	3	0.75-6	277.2(14.4)	9.4(11.7)	8.1(0.4)	-1.2(11.2)
	BOL_5	southwest	2011-2016	3	0.75-6	113.0(22.4)	12.9(9.8)	3.3(1.3)	-9.5(11.1)
	BOL_6	southwest	2011-2016	3	0.75-6	186.5(12.9)	8.7(9.8)	8.7(0.3)	-0.005(10.1)
	HUM_2a	southwest	2009-2016	4	4-11	217.4(10.8)	3.5(2.0)	8.4(1.3)	4.9(3.0)
	HUM_2b	southwest	2009-2016	4	4-11	203.1(5.7)	3.5(4.3)	7.1(2.0)	3.6(5.1)
	HUM_2c	southwest	2009-2016	4	4-11'	179.4(6.4)	9.7(11.4)	7.5(2.2)	-2.2(9.6)
	HUM_2d	southwest	2009-2016	4	4-11	190.1(19.7)	19.3(25.0)	8.4(1.9)	-10.8(23.5)
	MUC_10	north	2015	1	17	157.5			
	MUC_11	north	2015	1	17	203.1			
	MUC_13	north	2015	1	12	162			

Type	Plots	Region	Census period	Census (N)	YSLF	TAGB (Mg ha^{-1})	M ((Mg ha^{-1} y^{-1})	Wp (Mg ha^{-1} y^{-1})	Net TAGB (Mg ha^{-1} y^{-1})
	MUC_14	north	2015	1	12	143.6			
	MUC_6	north	2015	1	17	145.3			
	MUC_7	north	2015	1	17	55.4			
	NOC_4	central	2015-2016	2	0.75-1.25	242.9(13.7)	28.1	9.6	-18.4
	NOC_5	central	2015-2016	2	0.75-1.25	332.6(7.4)	22	12	-10
	NOC_6	central	2015-2016	2	0.75-1.25	235.8(17.9)	31.4	7.2	-24.1
	NOC_7	central	2015-2016	2	0.75-1.25	316.8(9.2)	22.2	9.8	-12.3
	NOC_8	central	2015-2016	2	0.75-1.25	316.4(11.8)	21.6	5.4	-16.1
	NOC_9	central	2015-2016	2	0.75-1.25	275.2(2.3)	12.7	10	-2.7
	RCM_4	southwest	2011-2016	3	0.75-6	198.5(14.7)	13.3(2.4)	9.8(0.8)	-3.5(3.2)
	RCM_5	southwest	2011-2016	3	0.75-6	215.9(3.7)	3.1(2.8)	7.9(5.1)	4.7(7.9)
	RCM_6	southwest	2011-2016	3	0.75-6	190(24.3)	16.6(7.7)	11.5(3.3)	-5.1(11.1)
	TIC_4	central	2015-2016	2	0.75-1.25	278.1(1.9)	8.8	11.7	2.9
	TIC_5	central	2015-2016	2	0.75-1.25	173.8(11.7)	27.1	11.5	-15.6
	TIC_6	central	2015-2016	2	0.75-1.25	185.9(41.9)	64.6	5.7	-58.8
	TIC_7	central	2015-2016	2	0.75-1.25	204.6(3.3)	12	7.6	-4.3
	TIC_8	central	2015-2016	2	0.75-1.25	190.2(20.3)	36.6	8.8	-27.8

Type	Plots	Region	Census period	Census (N)	YSLF	TAGB (Mg ha^{-1})	M ((Mg ha^{-1} y^{-1})	Wp (Mg ha^{-1} y^{-1})	Net TAGB (Mg ha^{-1} y^{-1})
	TPJ_10	east	2010-2014	2	12-16	469.9(36)	18.5	6.1	-12.3
	TPJ_7	east	2010-2014	2	25-29	307.9(49.5)	23.3	6.8	-16.4
	TPJ_8	east	2010-2016	3	25-31	219(3.8)	3.5(3.0)	5.1(2.2)	1.6(0.7)
	TPJ_9	east	2010-2016	3	25-31	161.3(13.1)	6.3(6.6)	4.9(0.8)	-1.4(5.9)
Unburned plots	AFL_1a	southeast	2009-2017	7		264.3(9)	3.9(1.5)	7(2.1)	3.1(1.8)
	AFL_1b	southeast	2009-2017	7		209.4(15.6)	6.3(8.3)	5.6(1.8)	-0.7(8.7)
	AFL_1c	southeast	2009-2017	7		292.5(4.7)	6.1(4)	5.9(1.7)	-0.2(4.6)
	AFL_1d	southeast	2009-2017	7		213.6(17.3)	6.8(8.2)	5.4(1.6)	-1.5(8.6)
	BOL_1	southwest	2011-2016	3		141.9(11.6)	1(0.1)	6(0.7)	4.9(0.5)
	BOL_2	southwest	2011-2016	3		236.1(12.8)	4.7(3.8)	9.4(0.9)	4.7(2.9)
	BOL_3	southwest	2011-2016	3		249.5(14.4)	1.5(1.2)	6.7(1.2)	5.2(2.5)
	HUM_1a	southwest	2009-2016	4		297.2(7.6)	4.2(5.5)	7.7(1.2)	3.5(6.8)
	HUM_1b	southwest	2009-2016	4		269.9(25.8)	1.4(1.7)	10.4(1.6)	9(2.4)
	HUM_1c	southwest	2009-2016	4		263.4(69.1)	15.2(17.8)	8(4.5)	-7.3(20.9)
	HUM_1d	southwest	2009-2016	4		258.5(14.5)	1.9(1)	6.9(2)	5(1)
	MUC_1	north	2015	1		332.8			

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Type	Plots	Region	Census period	Census (N)	YSLF	TAGB (Mg ha^{-1})	M ((Mg ha^{-1} y^{-1})	Wp (Mg ha^{-1} y^{-1})	Net TAGB (Mg ha^{-1} y^{-1})
	MUC_2	north	2015	1		195.3			
	MUC_3	north	2015	1		287.9			
	NOC_1	central	2015-2016	2		311.1(0.6)	8.7	10	1.2
	NOC_2	central	2015-2016	2		314.2(5.7)	1.5	9.8	8.3
	NOC_3	central	2015-2016	2		216.6(2.3)	6	9.4	3.4
	RCM_1	southwest	2011-2016	3		339.3(13.6)	2(2.7)	10.8(1.7)	8.7(4.4)
	RCM_2	southwest	2011-2016	3		104.7(7.7)	1.8(0.7)	4.7(0.1)	2.8(0.5)
	RCM_3	southwest	2011-2016	3		215.5(4.8)	1.1(0.8)	5(0.4)	3.8(1.3)
	TIC_1	central	2015-2016	2		213.4(3.6)	2.2	7.5	5.2
	TIC_2	central	2015-2016	2		165.1(3.3)	14.7	10.4	-4.3
	TIC_3	central	2015-2016	2		163.8(4.4)	12.6	6.5	-6.1
	TPJ_1	east	2010-2016	3		371.6(30.5)	15.9(9.5)	3.8(0.8)	-12.2(10.3)
	TPJ_2	east	2010	1		231.8			
	TPJ_3	east	2010-2016	3		204(10.2)	4.5(2)	8.2(2.8)	3.7(0.7)
	TPJ_4	east	2010-2016	3		313.1(10.6)	4.6(5)	5(1.2)	0.3(6.3)
	TPJ_5	east	2010-2016	3		333.7(15.1)	9.8(0.04)	4.9(0.4)	-5(0.3)
	TPJ_6	east	2010	1		518.4			

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Table S3. Mean difference (∆) in % (±s.e.) between each burned plot and unburned mean values of Increment and Recruitment. Positive values means higher values for burned plots than for unburned plots.

YSLF categories	Census year	TAGB Dynamics		
		Increment △%	Recruitment △%	N
(0.75 to 4)	2009; 2011; 2014; 2015; 2016	6.4(8.2)	37.9(36.0)	17
(5 to 8)	2010; 2011; 2012; 2013; 2016	25.2(8.1)	72.5(23.4)	26
(9 to 11)	2014; 2015; 2016	15(13.9)	41.4(16.4)	12
(12 to 31)	2010; 2014; 2016; 2017	6.3(9.5)	35.7(30.9)	10

Tables S4. Summary of LOESS model's parameters

LOESS model for TAGB ~ Years since last fire	
Number of Observations: 100	
Equivalent Number of Parameters: 4.73	
Residual Standard Error: 21.16	
Trace of smoother matrix: 5.17 (exact)	
Control settings:	
span : 0.75	
degree : 2	
family : gaussian	
surface : interpolate	cell = 0.2
normalize: TRUE	
parametric: FALSE	
drop.square: FALSE	

LOESS model for Mortality ~ Years since last fire	
Number of Observations: 65	
Equivalent Number of Parameters: 5.34	
Residual Standard Error: 452.6	
Trace of smoother matrix: 5.86 (exact)	

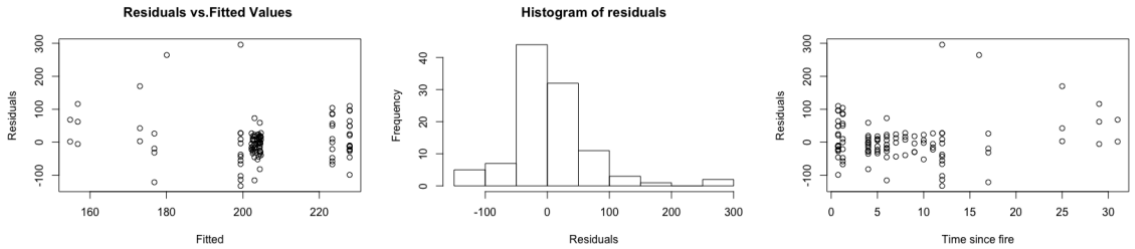
Control settings:	
span : 0.75	
degree : 2	
family : gaussian	
surface : interpolate	cell = 0.2
normalize: TRUE	
parametric: FALSE	
drop.square: FALSE	

LOESS model for Wood Productivity ~ Years since last fire	
Number of Observations: 65	
Equivalent Number of Parameters: 5.34	
Residual Standard Error: 34.34	
Trace of smoother matrix: 5.86 (exact)	
Control settings:	
span : 0.75	
degree : 2	
family : gaussian	
surface : interpolate	cell = 0.2
normalize: TRUE	
parametric: FALSE	
drop.square: FALSE	

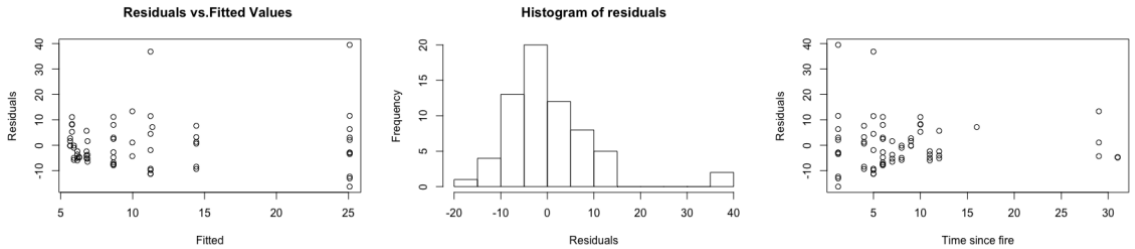
LOESS model for Net TAGB ~ Years since last fire	
Number of Observations: 65	
Equivalent Number of Parameters: 5.34	
Residual Standard Error: 953.2	
Trace of smoother matrix: 5.86 (exact)	
Control settings:	
span : 0.75	
degree : 2	
family : gaussian	
surface : interpolate	cell = 0.2
normalize: TRUE	
parametric: FALSE	
drop.square: FALSE	

Figure S1: The General Additive Mixed Model validation graphs for TAGB, mortality, Wp and Net TAGB: Residuals homogeneity, normality and independency.

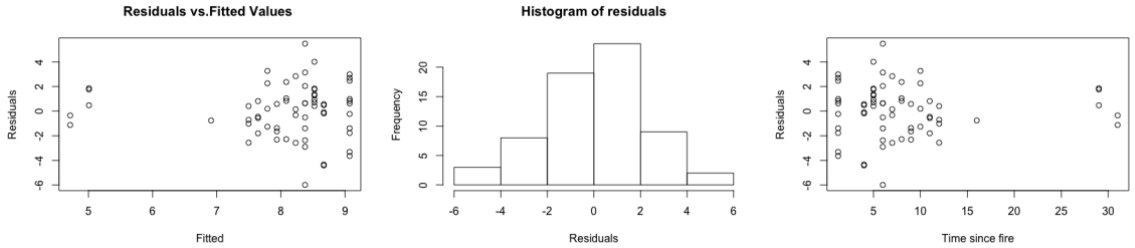
TAGB



Mortality



Wp


Residuals vs.Fitted Values
Residuals
Fitted
Histogram of residuals
Frequency
Residuals
Residuals
Time since fire

Net TAGB

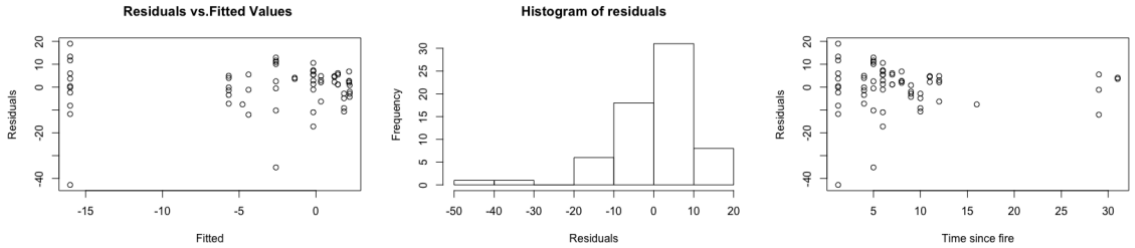

Residuals vs.Fitted Values
Residuals
Fitted
Histogram of residuals
Frequency
Residuals
Residuals
Time since fire

Figure S2: Probability density function of Stem Recruitment (% y^{-1}) by Wood Density classes (WD: 0.1-0.49; 0.5 -0.69; > 0.7 g cm^{-3}) in lines and years since last fire (YSLF) classes (0.75-4; 5-8; 9-11; 12-31 years) in columns. Dashed lines represent median, red colour for burned and blue for unburned forests. Significance of Wilcoxon text represented by: * p<0.05 and ** p<0.10.

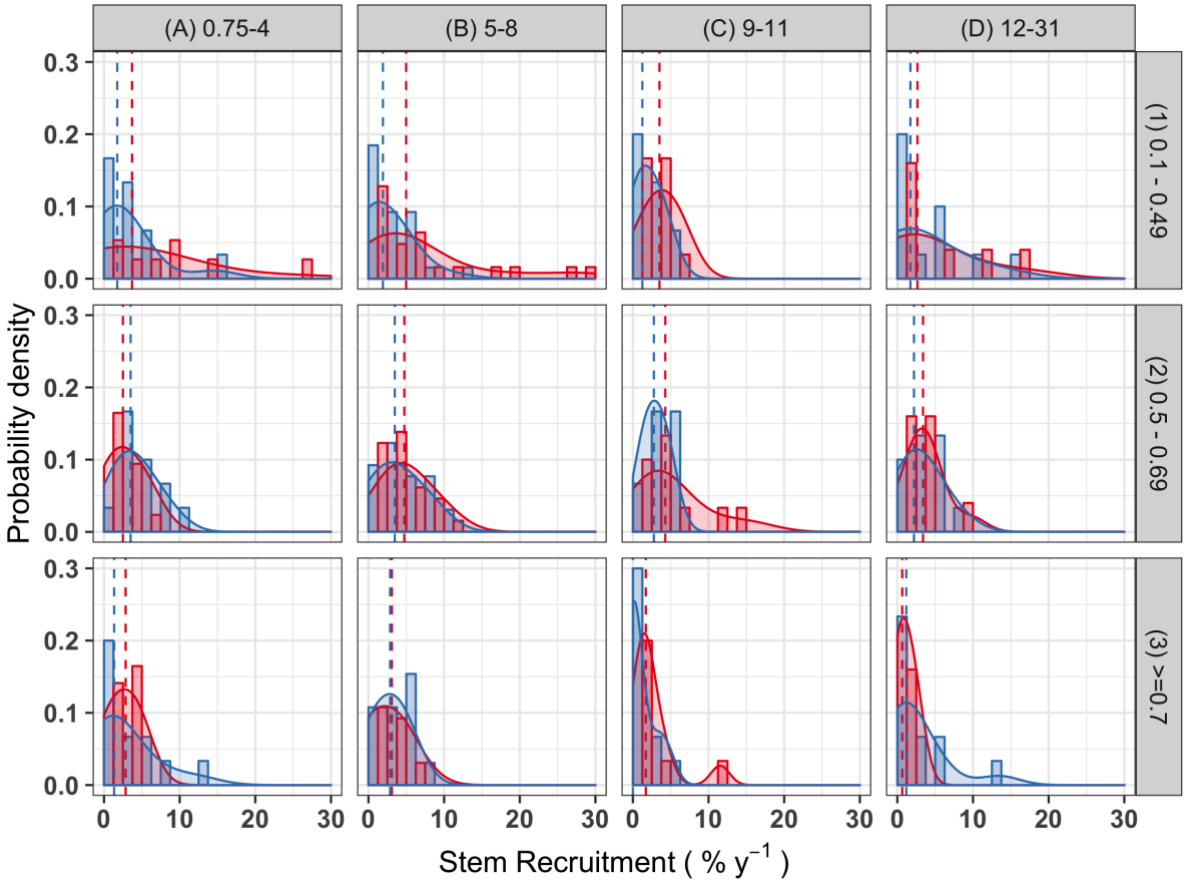
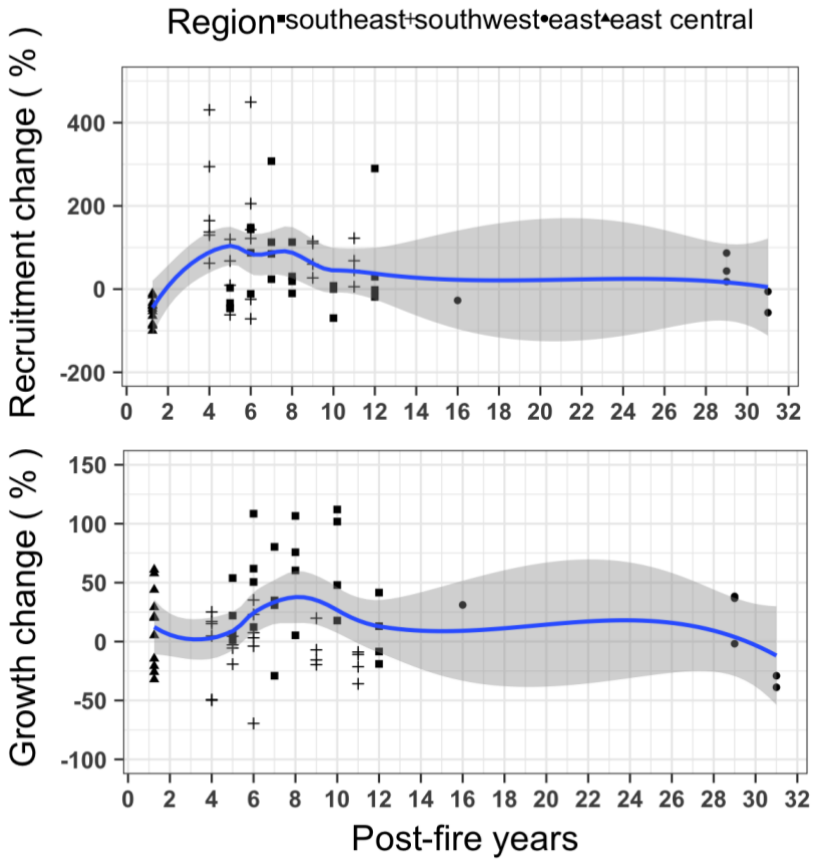


Figure S3: LOESS fit for percent difference of Recruitment and Growth in relation to unburned forest.



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