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Biomass-burning smoke heights over the Amazon observed from space

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Table S1. Summary of main features for instruments and products used in the study.

Parameter	Instrument/ Product	Satellite[a] / Model	Level/ Version	Spatial Resolution Horizontal	Vertical	Temporal Res.	Main reference
Smoke Height	MISR	Terra	Level 1 & 2	275–500 m	1.1 km	variable	Diner et al., (1998)
Aerosol Extinction	CALIOP	CALIPSO	Level 2/v4	30–60 m	333 m	variable	Winker et al., (2013)
Active Fires	MOD14/MYD14	Terra & Aqua	v6	1 km x 1 km		daily	Giglio at al., (2003)
Land Cover	MOD12Q1	Terra & Aqua	v5.1	500 m x 500 m		annual	Friedl et al., (2010)
PBL	MERRA-2	GEOS-5 DAS	v5.12.4	0.625°x 0.5°	42	hourly	Bosilovich et al., (2015)
Atm. Stab.	MERRA-2	GEOS-5 DAS	v5.12.4	0.625°x 0.5°	42	6-hourly	Bosilovich et al., (2015)
drought (DSI)	MOD16/MOD13	Terra & Aqua		0.05°x 0.05°		8-day	Mu et al., (2013)

[a] Satellite swaths are 380 km (MISR), 2330 km (MODIS) and 70 m (CALIOP), with overpass times over the Amazon as 10–11 LT (AM/PM) (Terra), 1–2 LT (AM/PM) (Aqua) and 1:30 LT (AM/PM) (CALIPSO)

Table S2. Statistical summary for main smoke plume and plume rise controlling parameters[a].

	Tropical Forest				Savanna				Grassland			
	Dry Years[b]		Wet Years[b]		Dry Years		Wet Years		Dry Years		Wet Years	
	Early[c]	Late[c]	Early	Late	Early	Late	Early	Late	Early	Late	Early	Late
Smoke Height (m)	698 ± 407	898 ± 451	906 ± 418	1180 ± 693	795 ± 462	1110± 589	984±473	1250±653	881±508	1160±474	1280±971	1350±728
FRP (MW)	182 ± 408	245 ± 613	369 ± 813	369 ± 813	352 ± 744	503 ± 828	269 ± 456	330 ± 537	390 ± 480	567 ± 838	148 ± 152	529 ± 654
AOD (unitless)	0.53 ± 0.29	0.73 ± 0.37	0.21 ± 0.17	0.33 ± 0.21	0.37 ± 0.30	0.46 ± 0.32	0.14 ± 0.12	0.28 ± 0.18	0.29 ± 0.26	0.58 ± 0.35	0.1 ± 0.07	0.30 ± 0.15
Stability (K/km)	5.27 ± 3.64	4.28 ± 2.82	3.93 ± 2.17	3.11 ± 1.76	4.17 ± 3.72	2.92 ± 2.95	3.44 ± 3.24	2.47 ± 2.26	2.45 ± 3.07	2.32 ± 1.92	3.15 ± 3.65	2.07 ± 1.53
PBL Height (m)	1330 ± 535	1290 ± 551	1150 ± 487	1220 ± 486	1580 ± 509	1510 ± 482	1350 ± 522	1480 ± 543	1760 ± 525	1770 ± 534	1360 ± 443	1380 ± 316
Number	536	438	238	271	434	575	353	516	51	43	17	38

[a] Reported the average±SD for smoke plumes with valid values for all the parameters

[b] Dry years are 2005, 2007 and 2010 and wet years are 2006, 2008, 2009, 2011 and 2012

[c] Early season is defined as July–August and late season as September–November

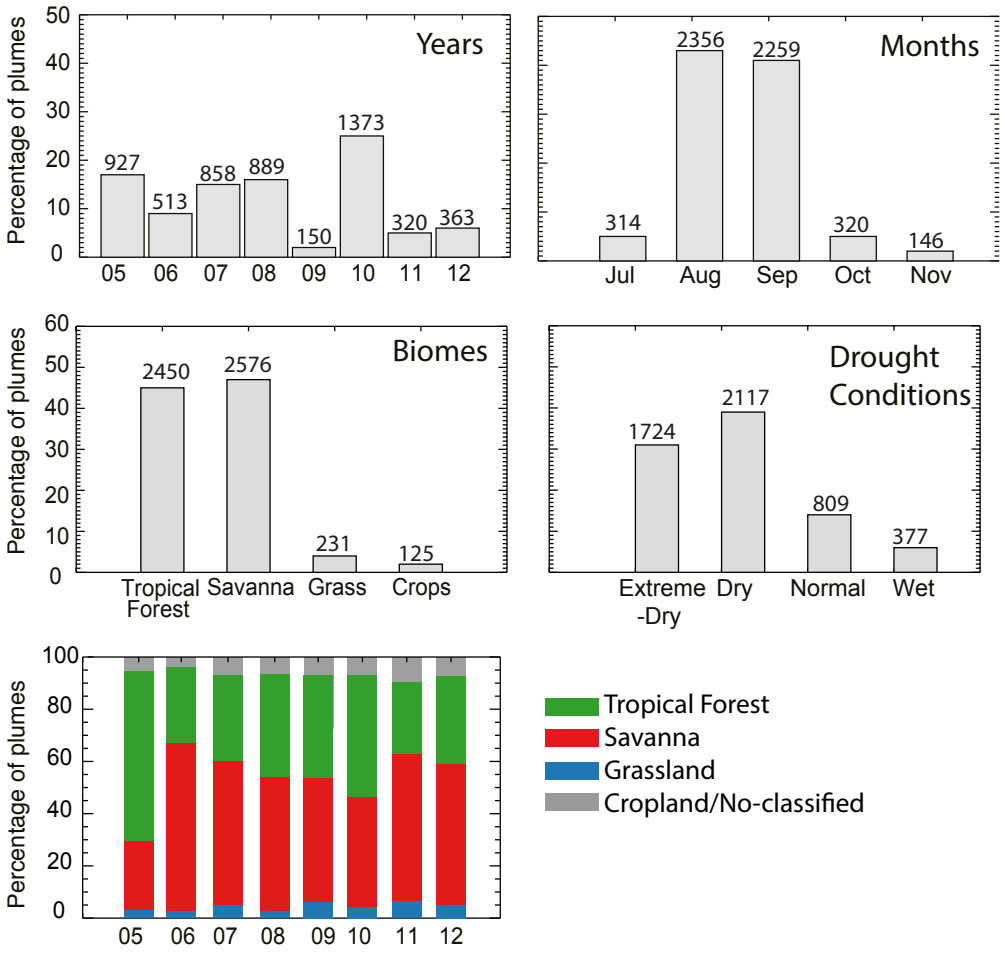

Figure S1. Percentage of MISR plumes in the climatology classified by year, month, biome and drought conditions. Absolute values in each distribution are included above the bars. Percentage of MISR plumes classified by biome and year are also shown, as tropical forest (green), savanna (red), grassland (blue), and cropland and not classified (grey).

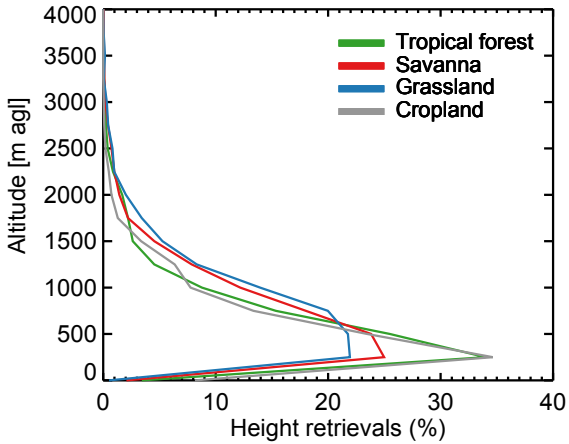

Figure S2. Vertical distribution of individual MISR stereo-height retrievals, averaged over all plumes in the eight-year of the study and stratified by biome.

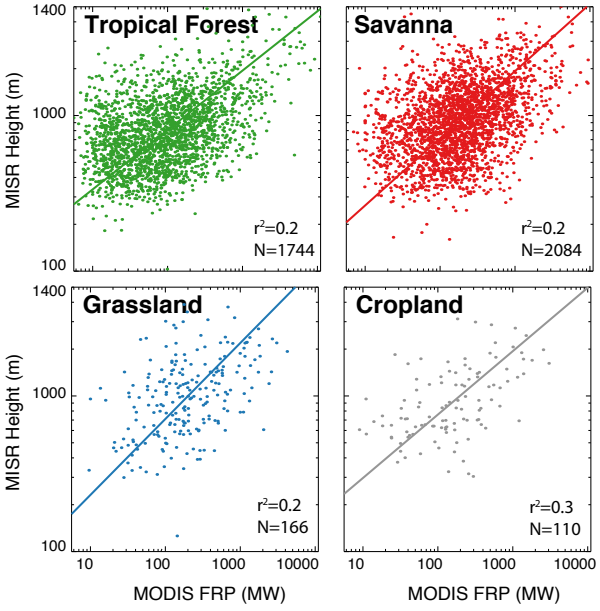

Figure S3. Relationship between MISR maximum plume heights and MODIS total fire radiative power (FRP) for the 8-year data set. Data are colour-coded per biome as tropical forest (green), savanna (red), grassland (blue), and cropland (grey). Total number of observations and r^2 are given in the annotation of each panel.

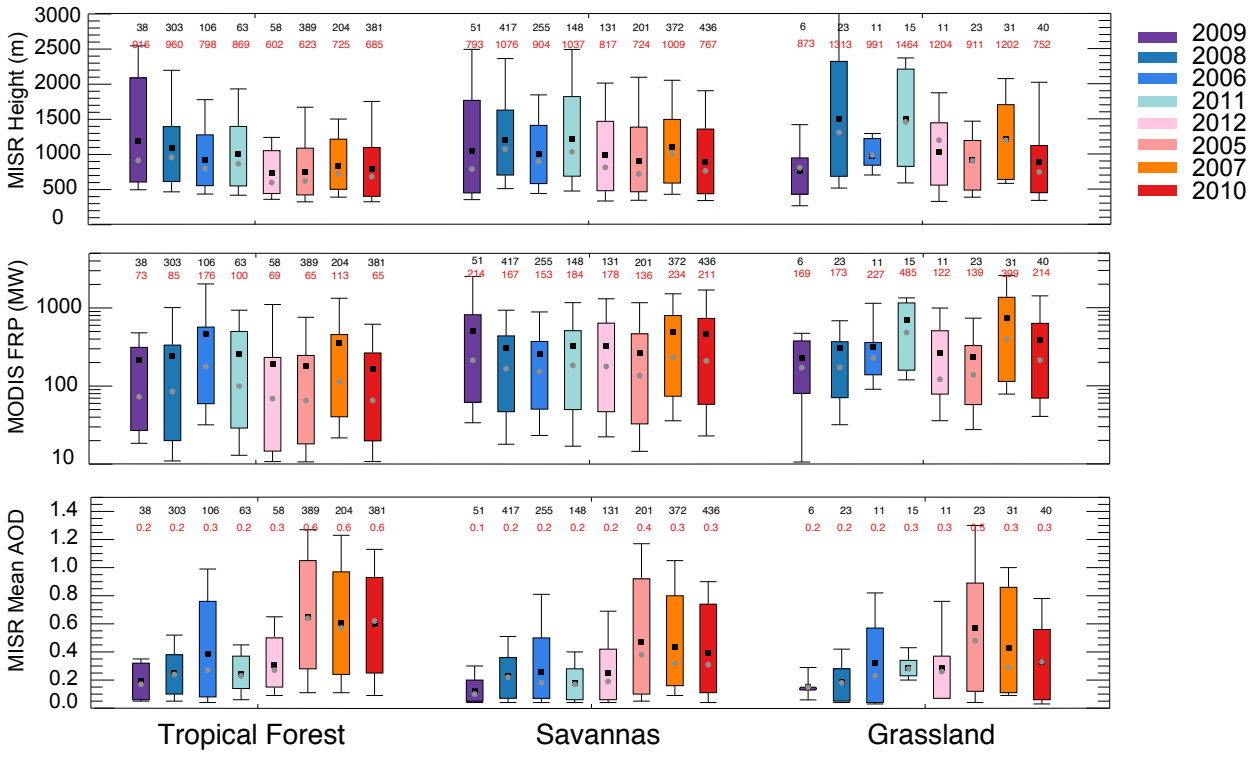

Figure S4. Interannual variability of MISR plume maximum heights above the terrain, MODIS FRP and MISR AOD by biome. Bar plots indicate the distribution of the data for each year. Bars in this figure are ordered based on DSI (Table 3) rather than chronologically, The medians (grey circles) and the means (black squares) are shown along with the central 67% (box) and the central 90% (thin black lines). Distributions are colour-coded based on drought conditions (Table 3). Note that, although no MODIS DSI data are available for year 2012, this year is plotted in the middle as it is defined as dry year by Erfanian et al., (2017). The number of observations (in black) and the median values (in red) included in each distribution are given at the top of the plot.

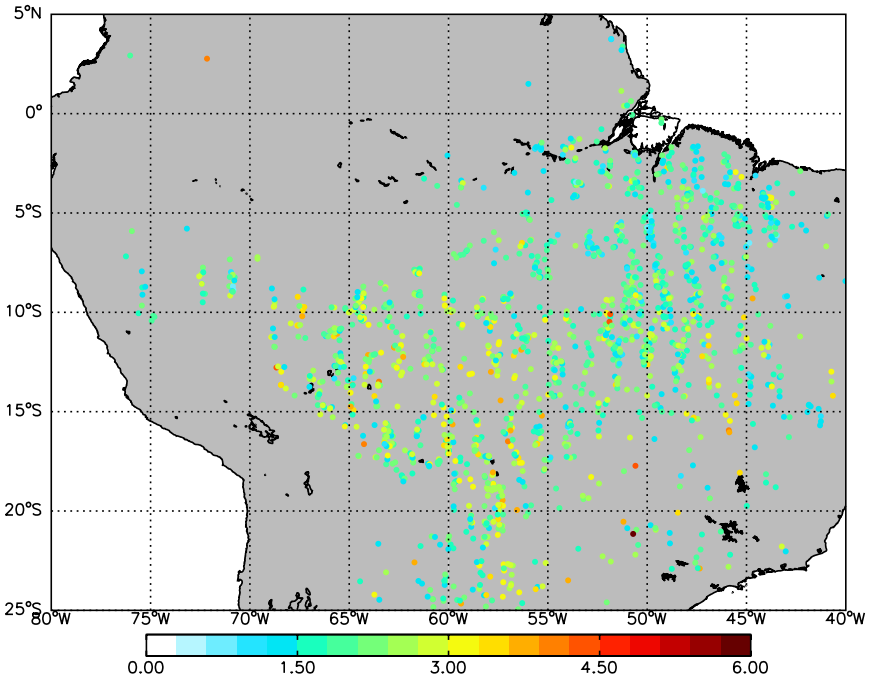

Figure S5. Location of the CALIOP plumes analysed with the median smoke plume height over the Amazon domain.

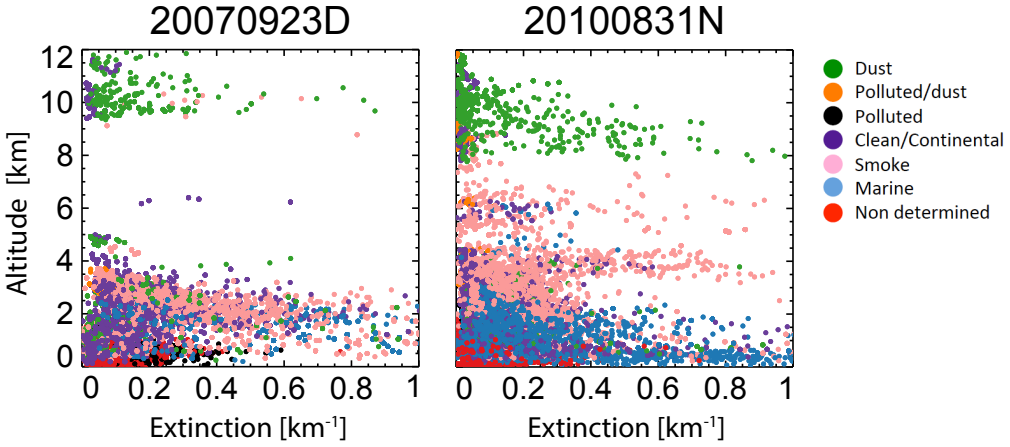

Figure S6. Examples of CALIOP vertical extinction profiles with smoke aerosols above 6 km. Values are coloured by classified aerosol types. Profile 20070923D represents a case where high altitude smoke is disconnected from low altitude smoke and profile 20100831N gives an example of smoke gradually distributed from low to high altitudes.