Source: Wikimedia/Jonathan Wilkins

Source: Iness Larry

Source: Thomas Wagner

Source: Anja Hoffmann

Source: Ted Wood

Source: Casey Ryan

Wildfires in tropical dry ecosystems: Integrated fire management, emission abatement, and NDCs

Rosa Maria Roman-Cuesta, Anja Hoffmann, Jonas Franke, Geoff Lipsett-Moore, Natasha Ribeiro, Lara Steil, Roland Vernooij

rosa.roman@wur.nl

25TH November 2020

Background of this Webinar

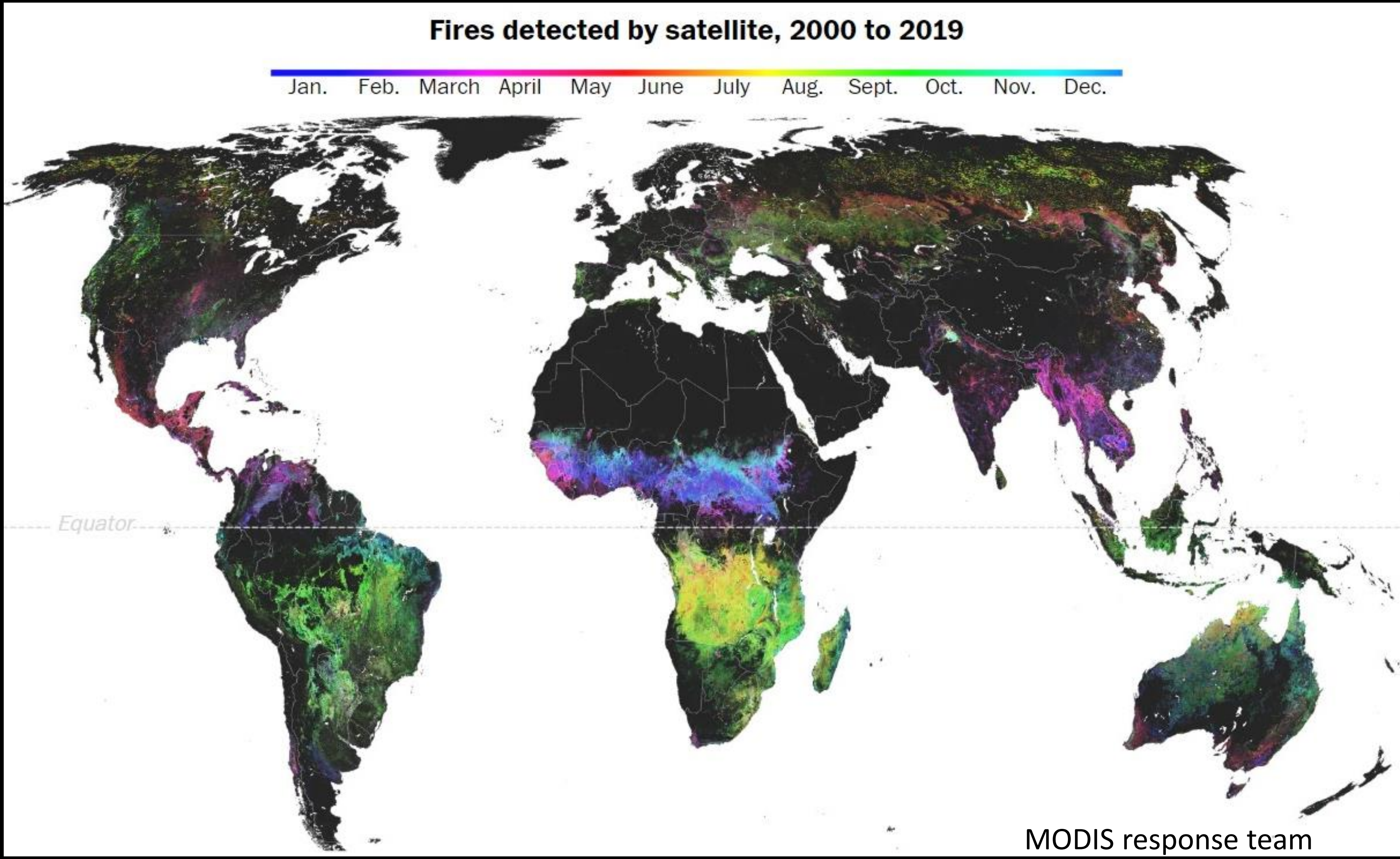
Three USAID-funded research proposals for CIFOR-ICRAF between 2018-2020

1. Forest Landscape Restoration
Beyond hectare-based targets: overcoming key barriers for effective implementation Dr. Manuel R. Guariguata m.guariguata@cgiar.org

2. Fire in the tropics: Understanding, foreseeing and acting on future fire danger in tropical landscapes Dr. Rosa Roman-Cuesta

3. Supporting fire management with a focus on the dry tropics: mainstreaming fire management into landscape decisions and NDCs Dr. Rosa Roman-Cuesta (r.roman-cuesta@cgiar.org; rosa.roman@wur.nl)

Monthly distribution of global fires as detected by satellite data 2000-2019



Fire is currently present in most ecosystems in the planet


Australian fires 2019



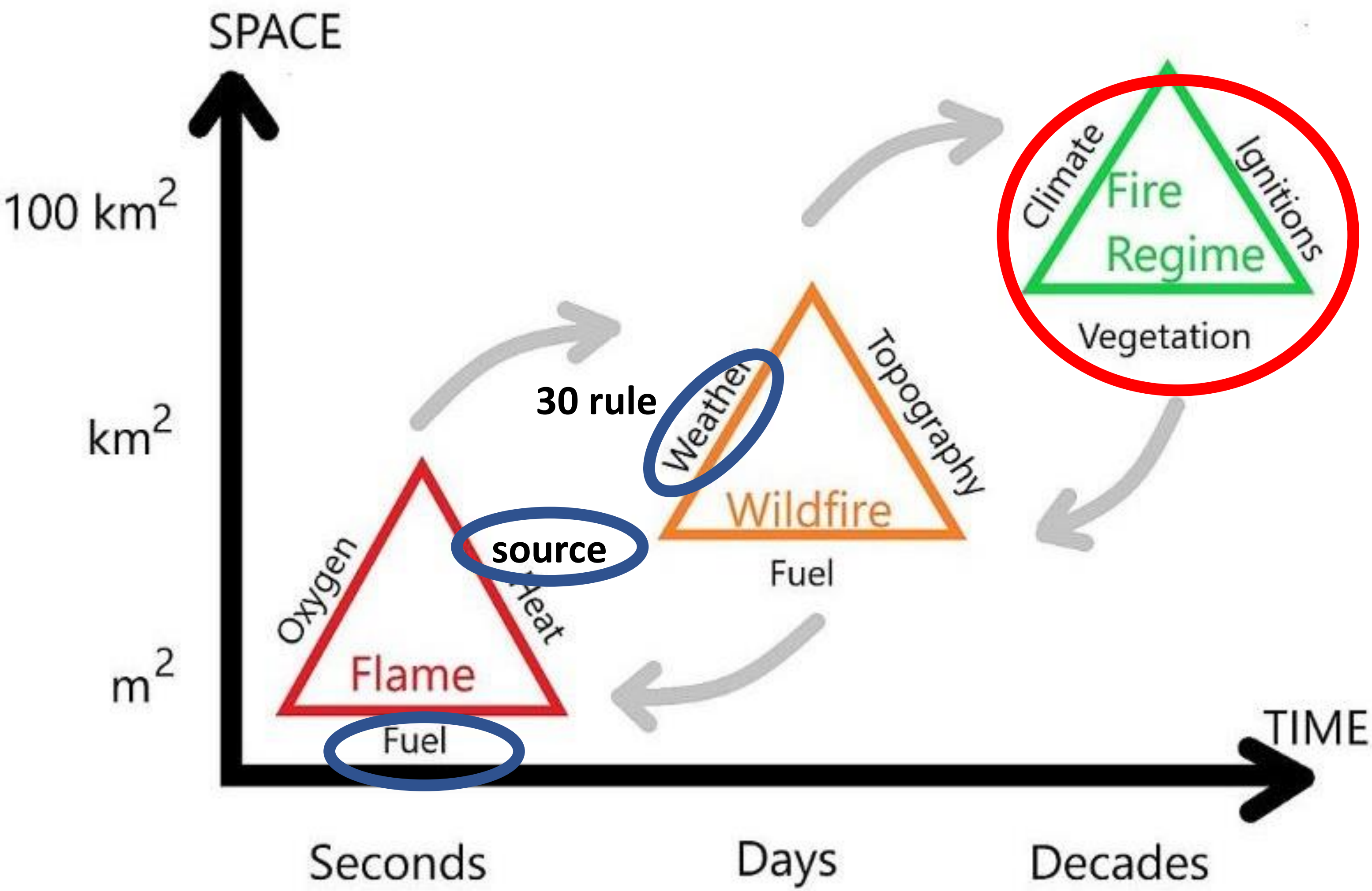


Alaska and Canada 2019

Brazil 2019

Are these fires 'normal' ? Fire regimes vs Fire trends

Fire disturbances: the importance of scale



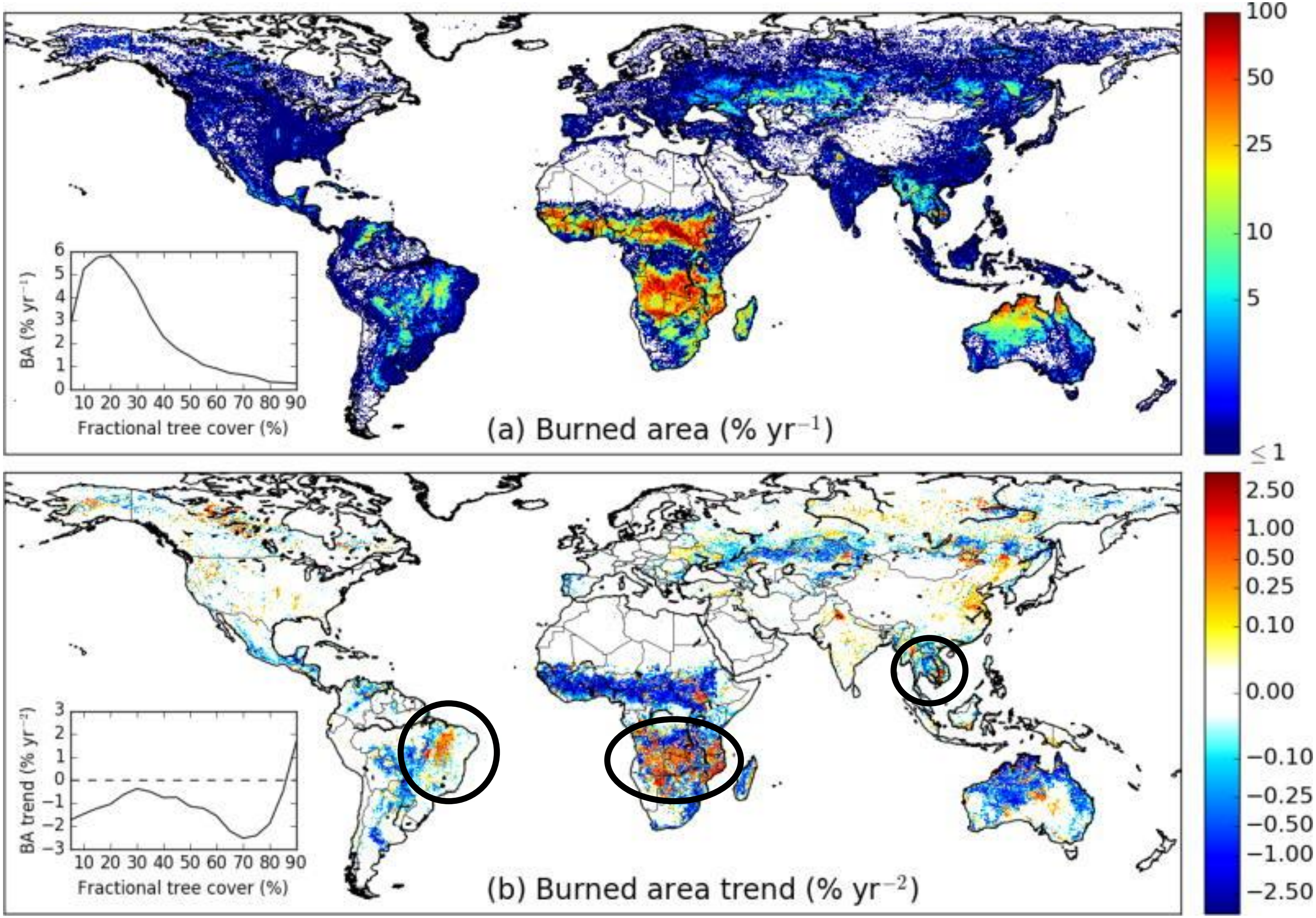
Fire risk =ignition

Fire danger = spread

Fire regimes

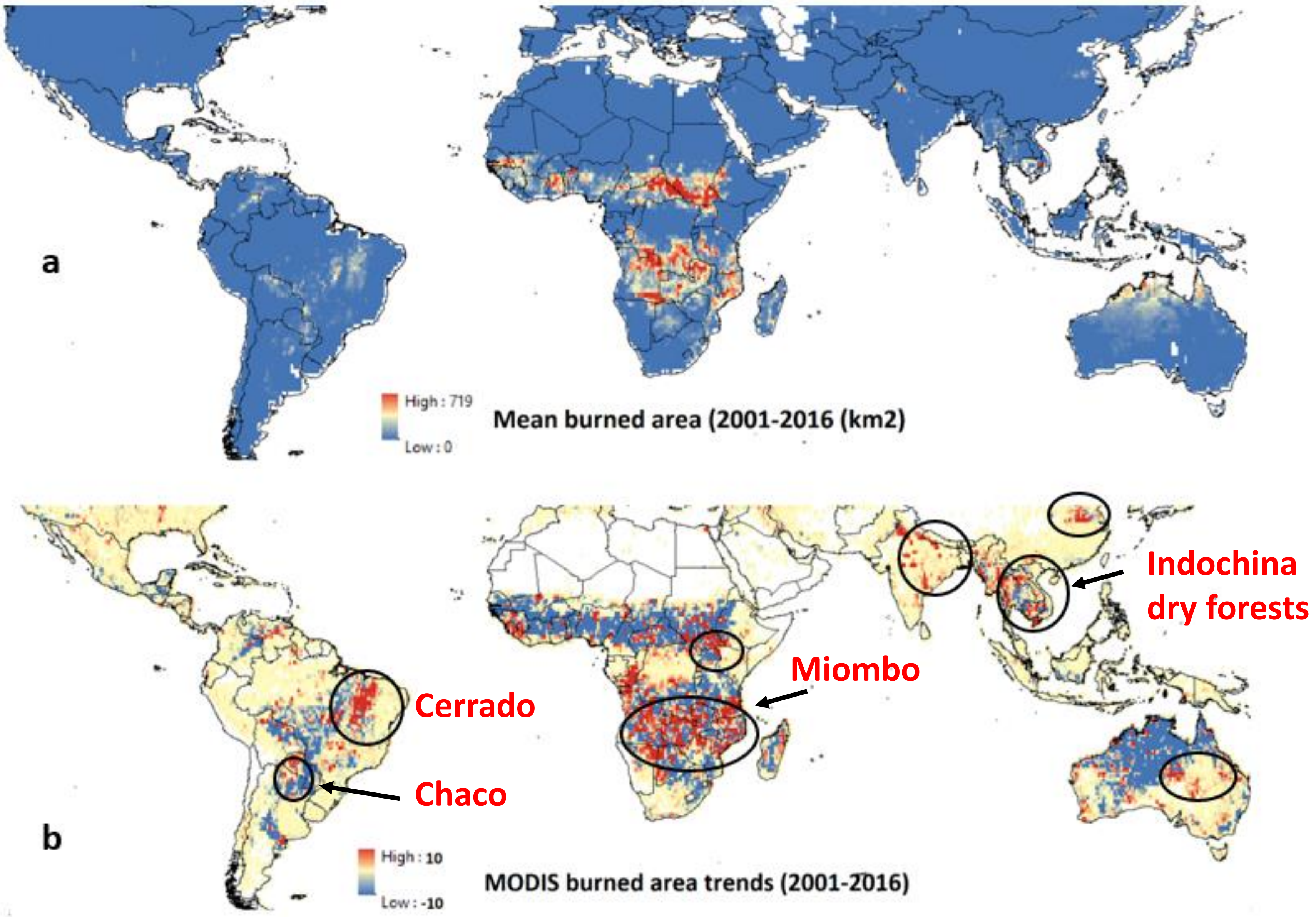
- ✓ Frequency
- ✓ Intensity
- ✓ Severity
- ✓ Size
- ✓ Season

Locating the hotspots of fire activity in the tropics: Fire density and increasing fire trends (1998-2015)



Andela et al. 2017 (Science)

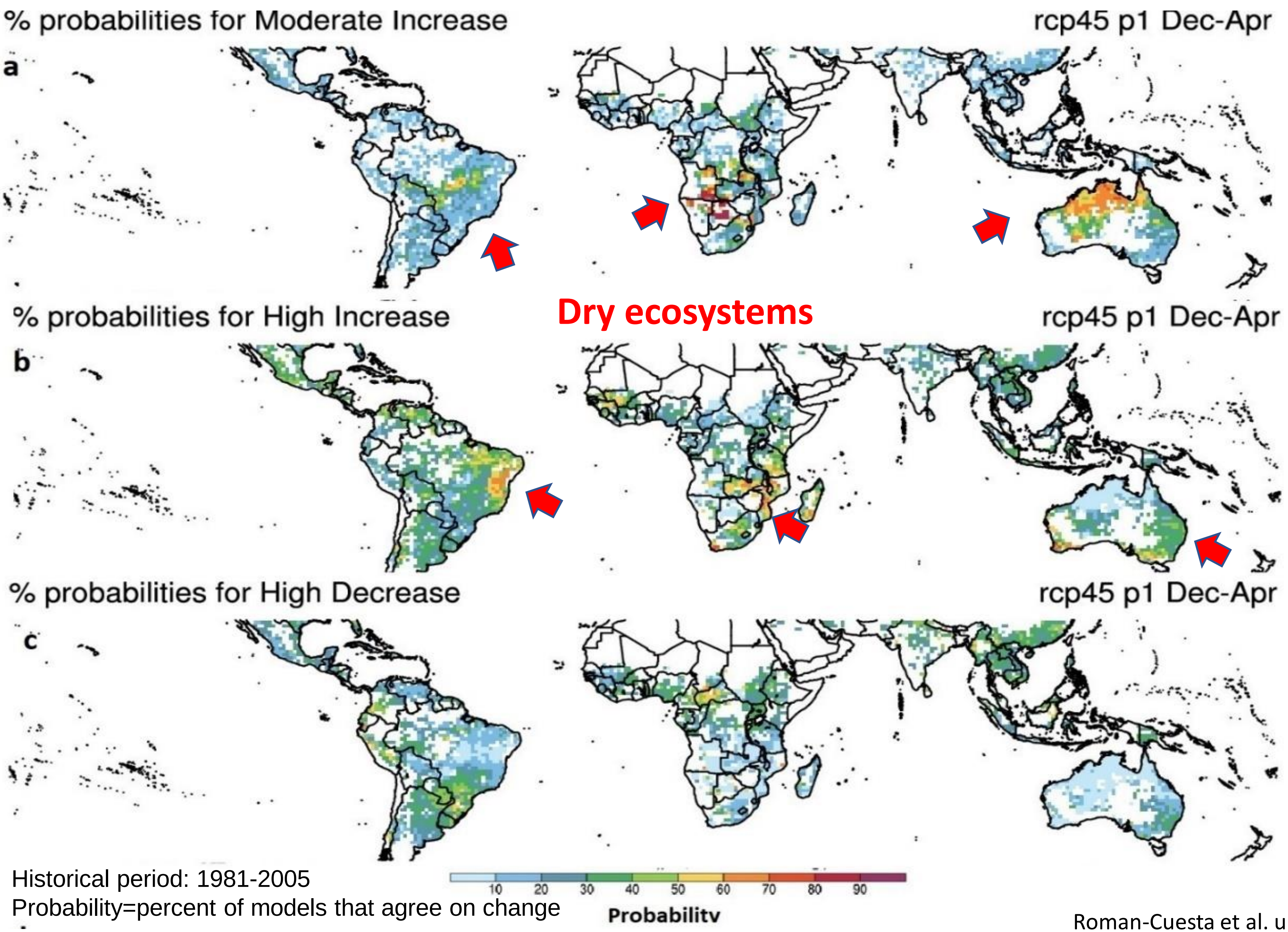
Locating the hotspots of fire activity in the tropics: Fire density and increasing fire trends (2001-2016)



Roman-Cuesta et al. unpublished

Average Burned Area Change Probability in 2021-2045

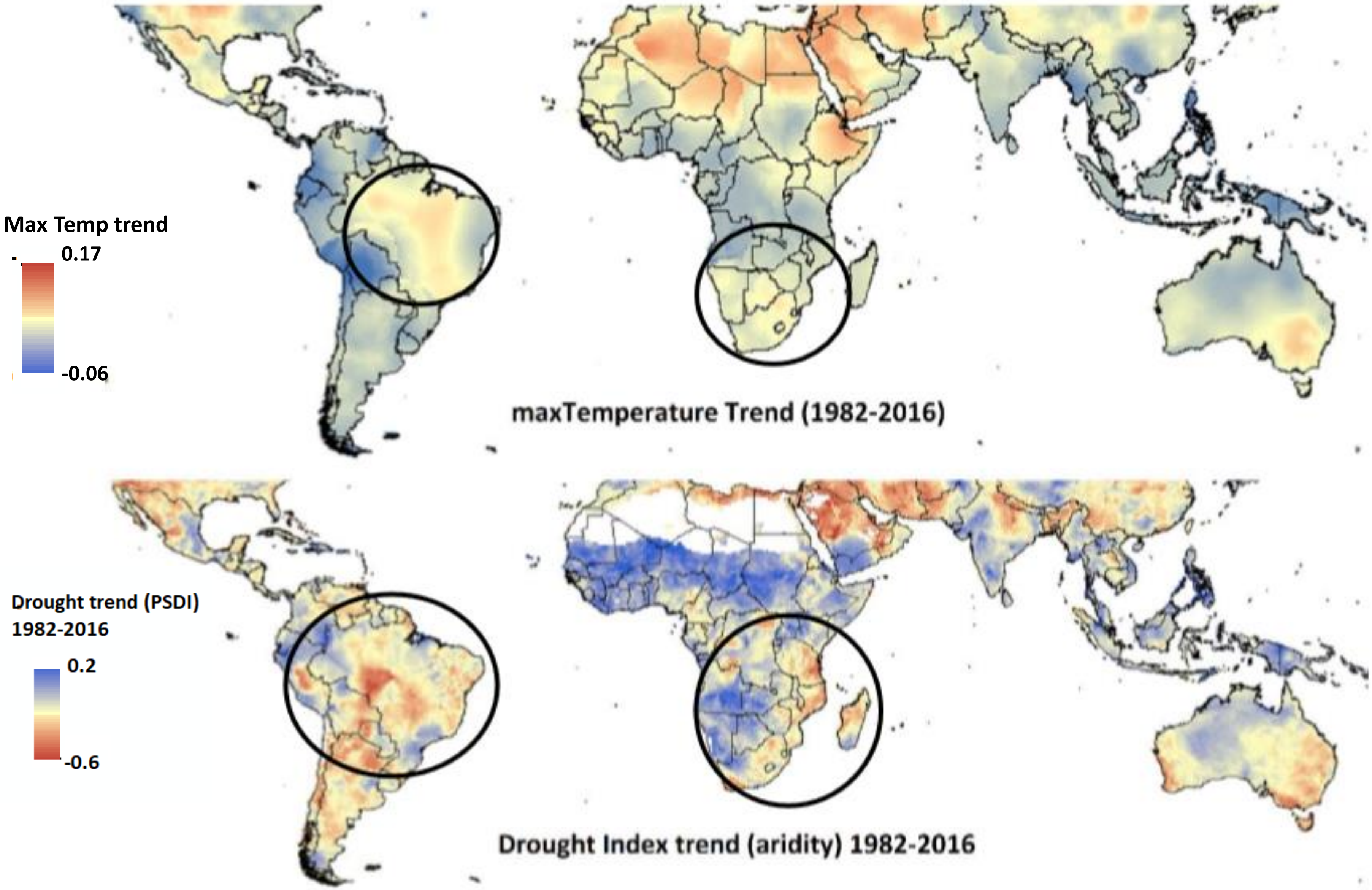
based on empirically estimated precipitation linear control (RCP4.5, CMIP5)



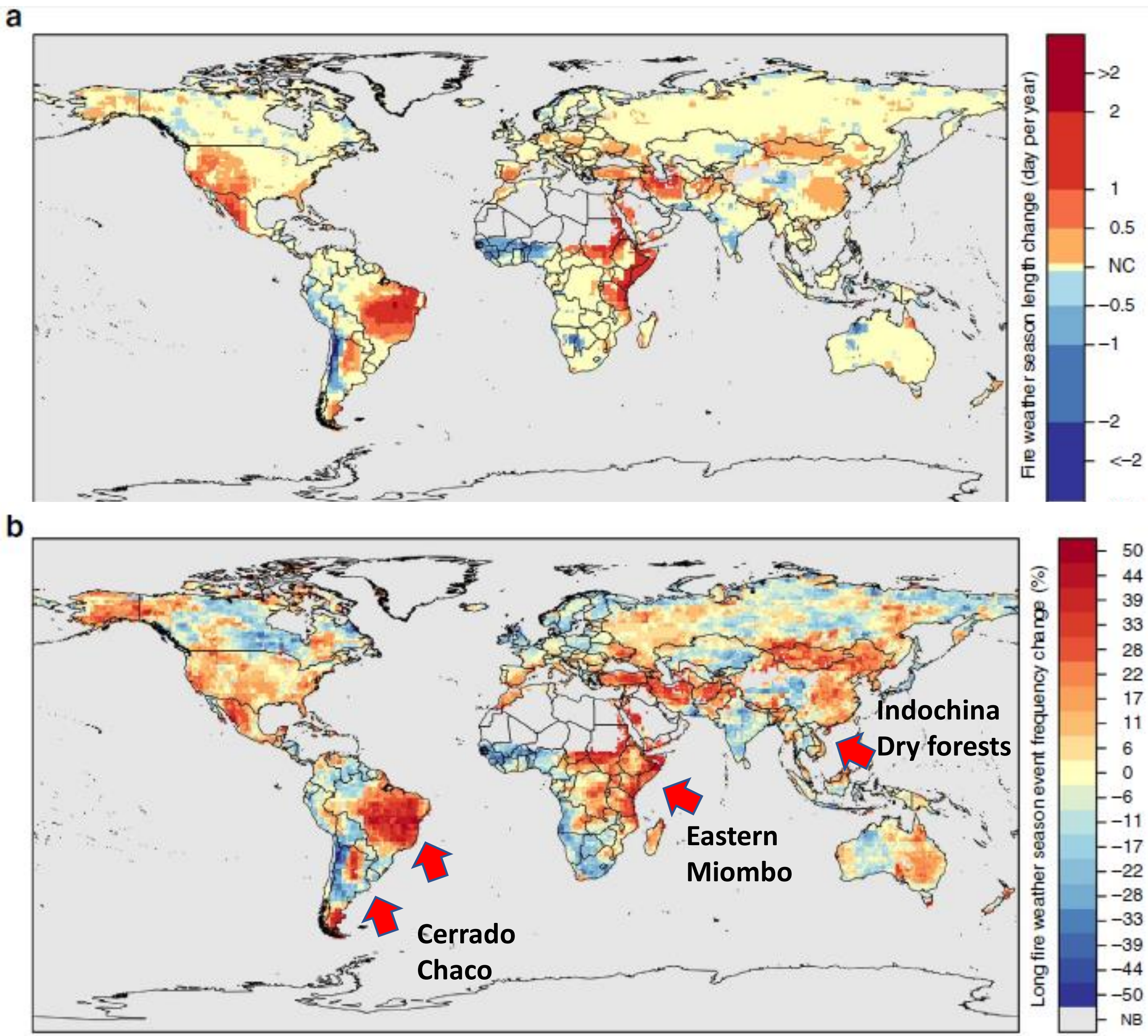
Historical period: 1981-2005
Probability=percent of models that agree on change

Roman-Cuesta et al. unpublished

Are increasing fire trends driven by climate?



Climate-induced increases in global wildfire danger (1979-2013)



Increased trend in number of days with burnable conditions

Increased frequency in the number of Fire seasons larger than normal

Jolly et al. 2015 (Nat. Commn)

World Africa Americas Asia Australia China Europe India Middle East United Kingdom

The Amazon burns. But another part of Brazil is being destroyed faster

By Amy Woodyatt, CNN

Updated 0420 GMT (1220 HKT) September 22, 2019

erbicide is sprayed on a soybean field in the Cerrado plains near Campo Verde, Mato Grosso stat
The neighboring Pantanal area, a sanctuary of biodiversity, is presently at risk because of the inten
culture of soybean and the deforestation, scientists said.

UK fast food 'linked to Brazilian forest fires'

By Jim Reed and Joseph Lee
Victoria Derbyshire programme

9 October 2019

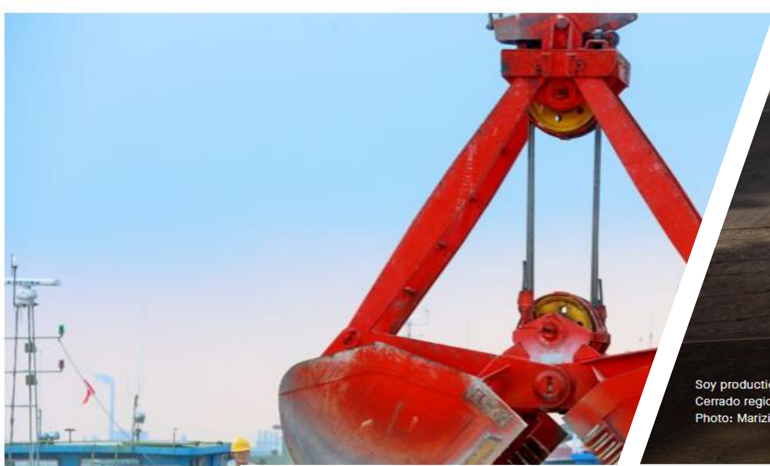
Amazon fires

Cerrado and soya for EU livestock

BBN News, Oct 2019

Human driven fires in the Cerrado: agro-commodity expansion

October 2019



Soy production has exploded in the Cerrado region in recent decades. Photo: Marizilda Cruppe/Greenpeace

Cerrado and Miombo ecosystems

Selected countries for mainstreaming fire management into landscape planning and NDCs

Cerrado, Chaco Chiquitania

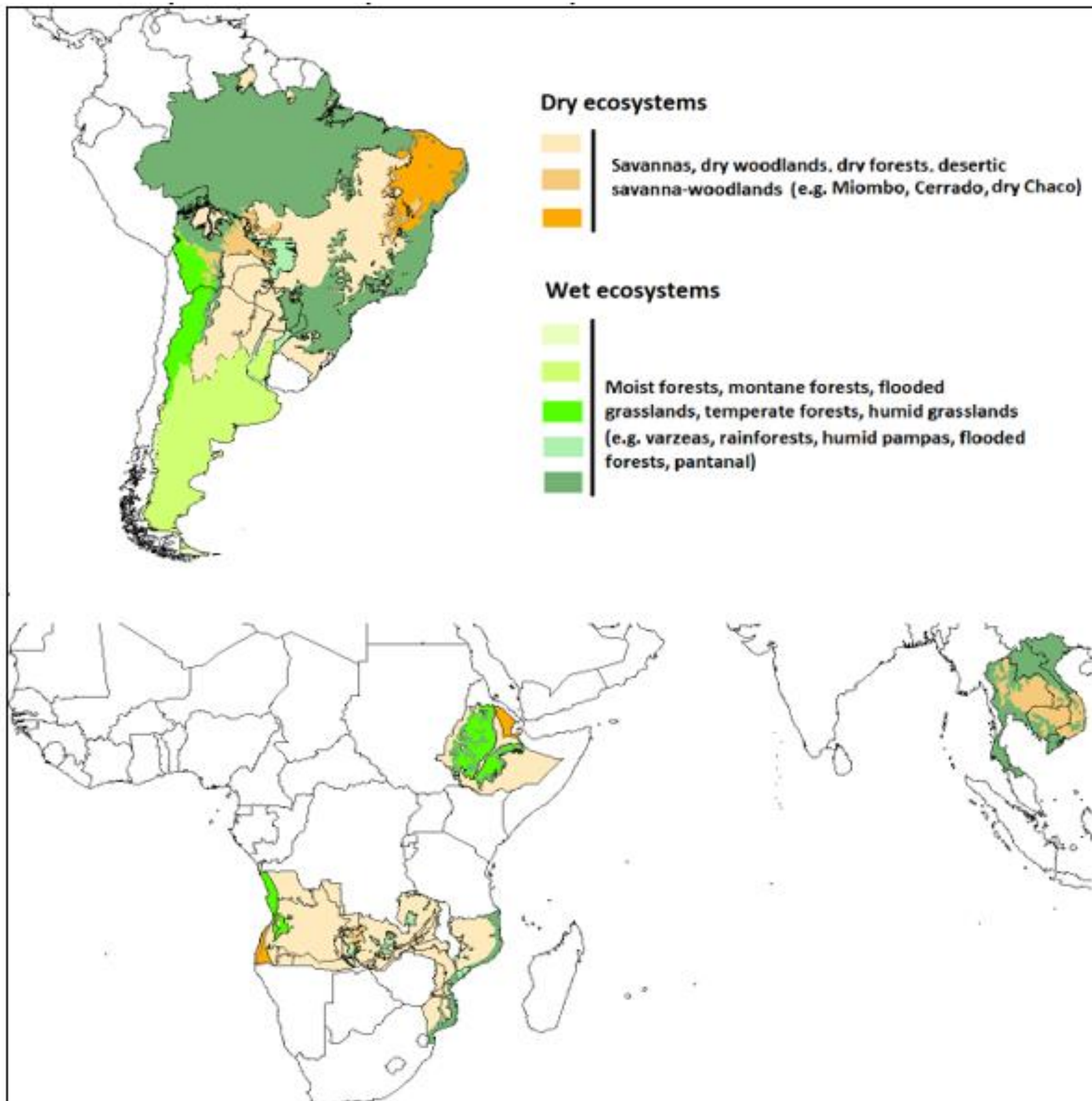
Brazil
Argentina
Bolivia
Paraguay

African Miombo

Angola
Zambia
Botswana
Mozambique

Indochina's dryforests

Cambodia
Laos
Viet Nam
Thailand



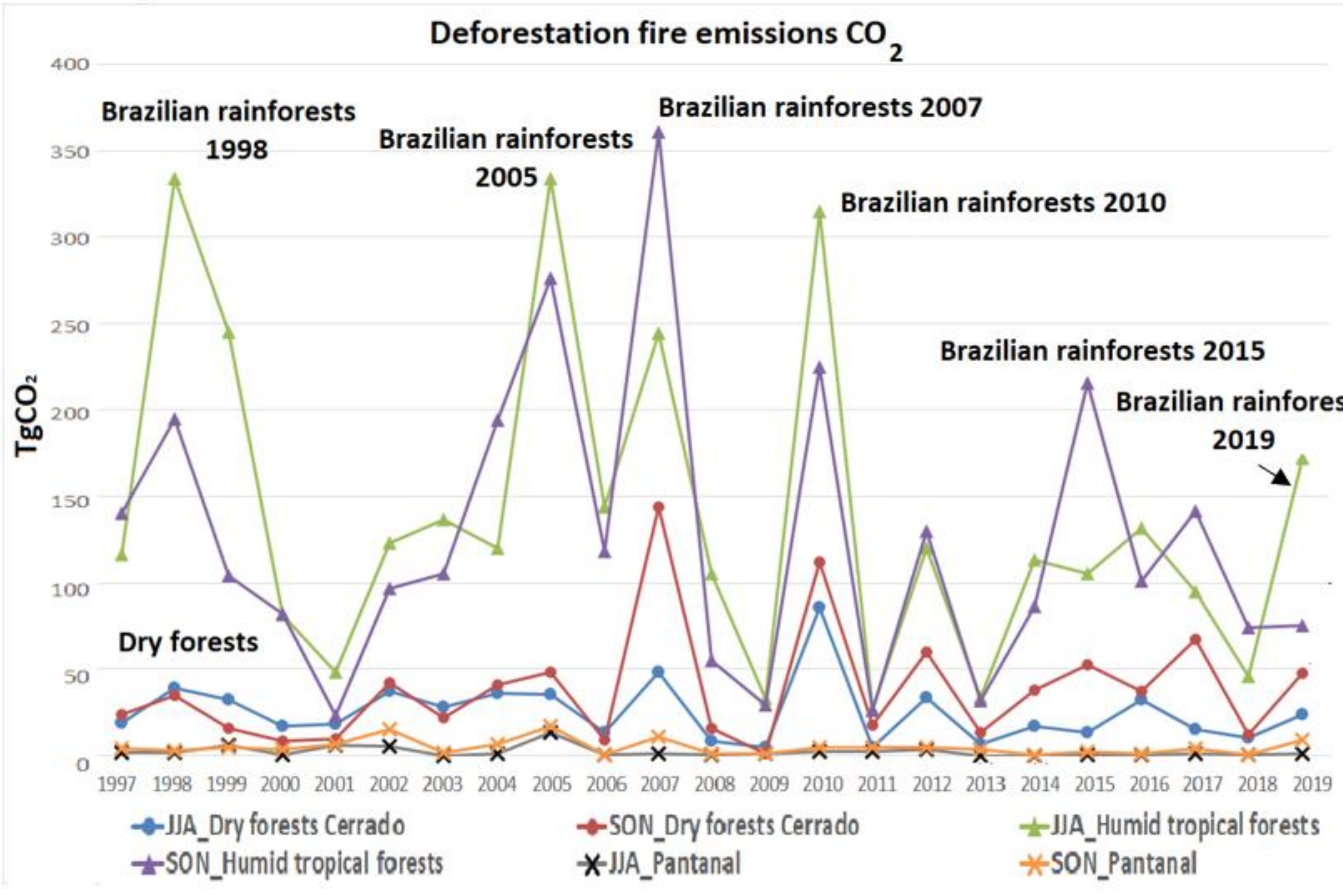
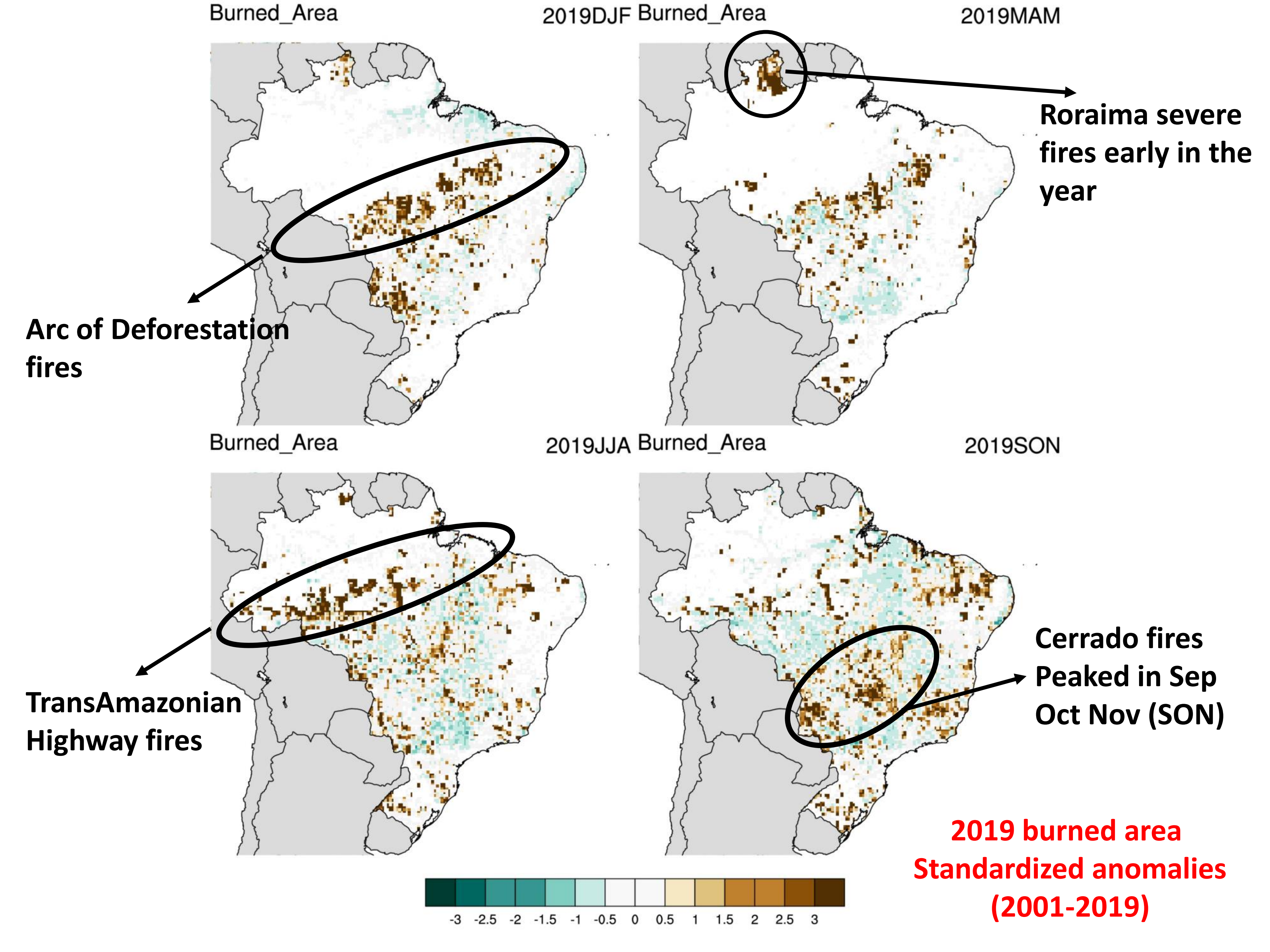
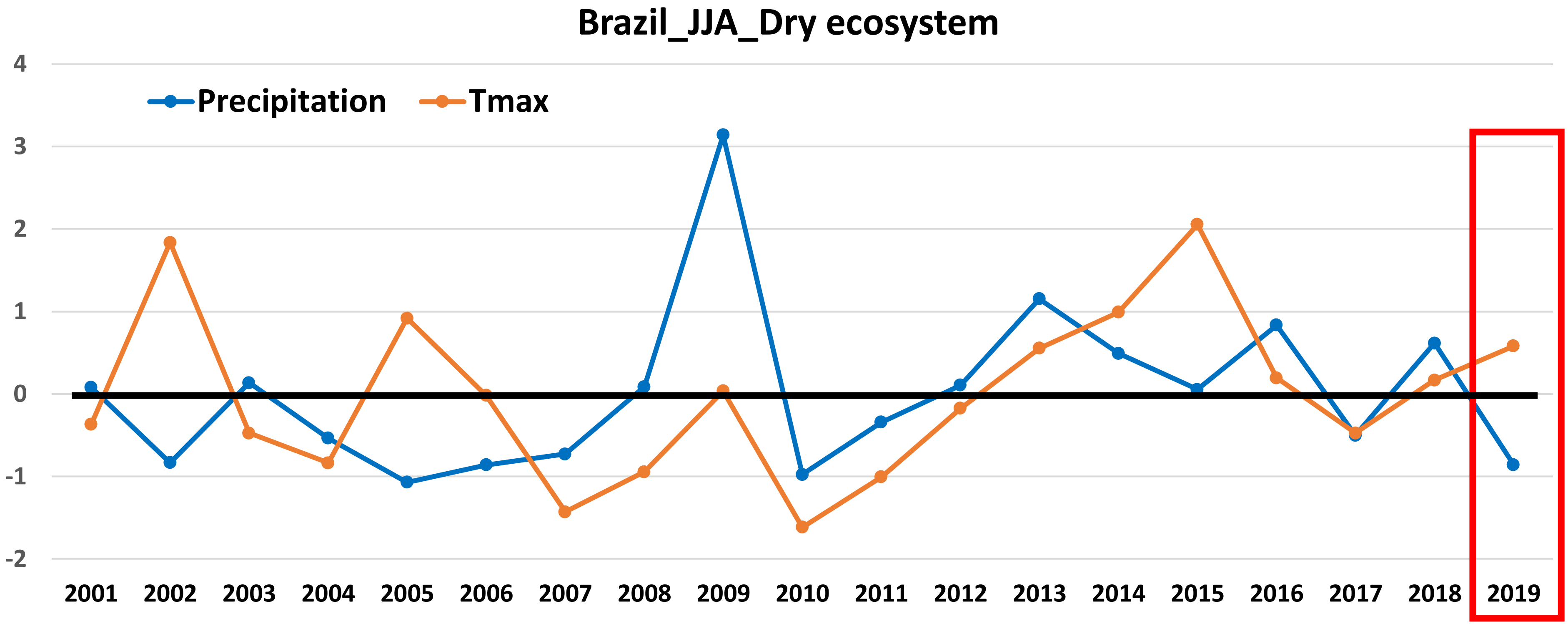
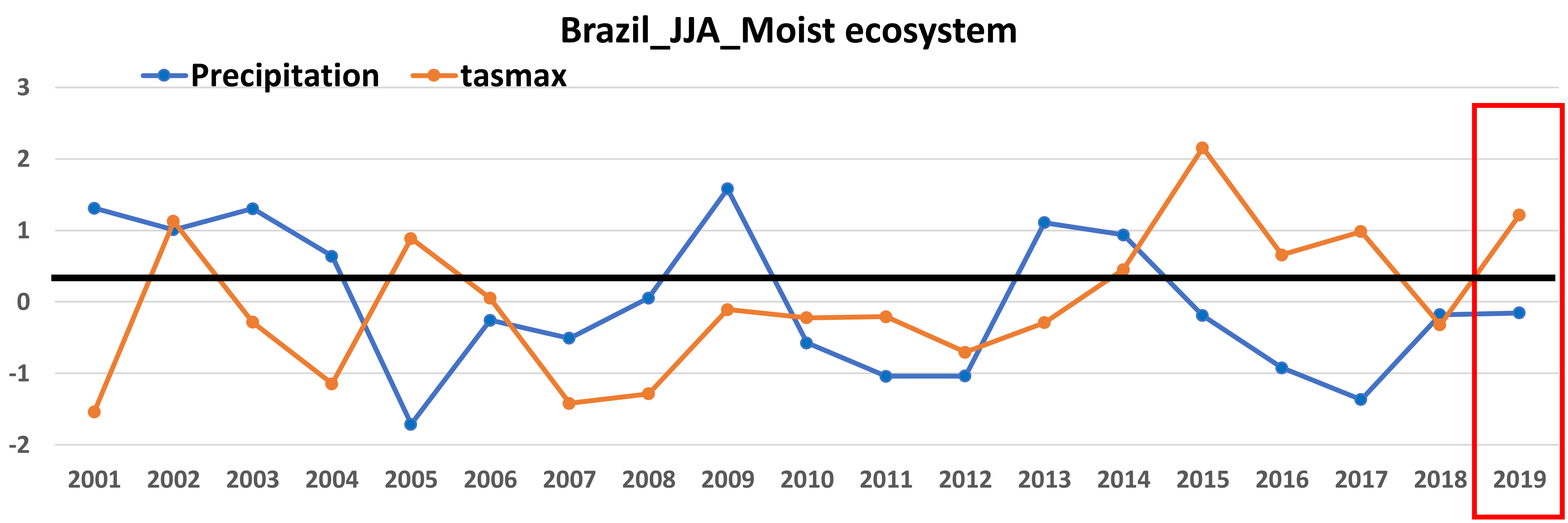
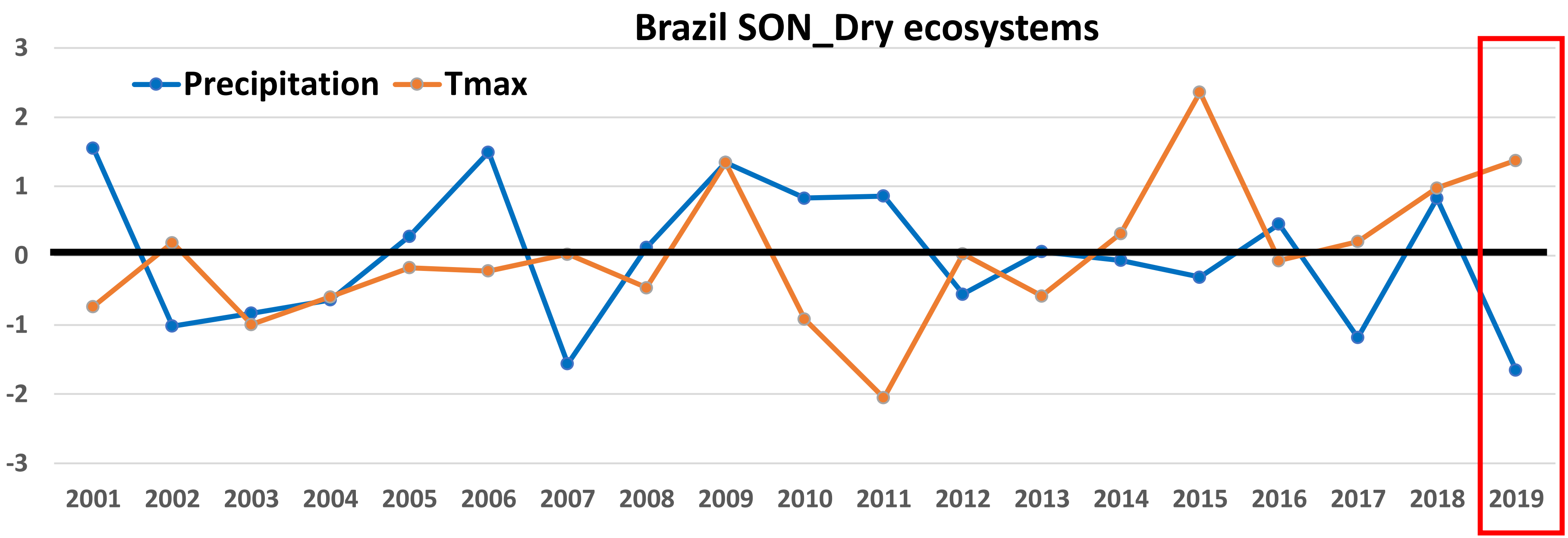


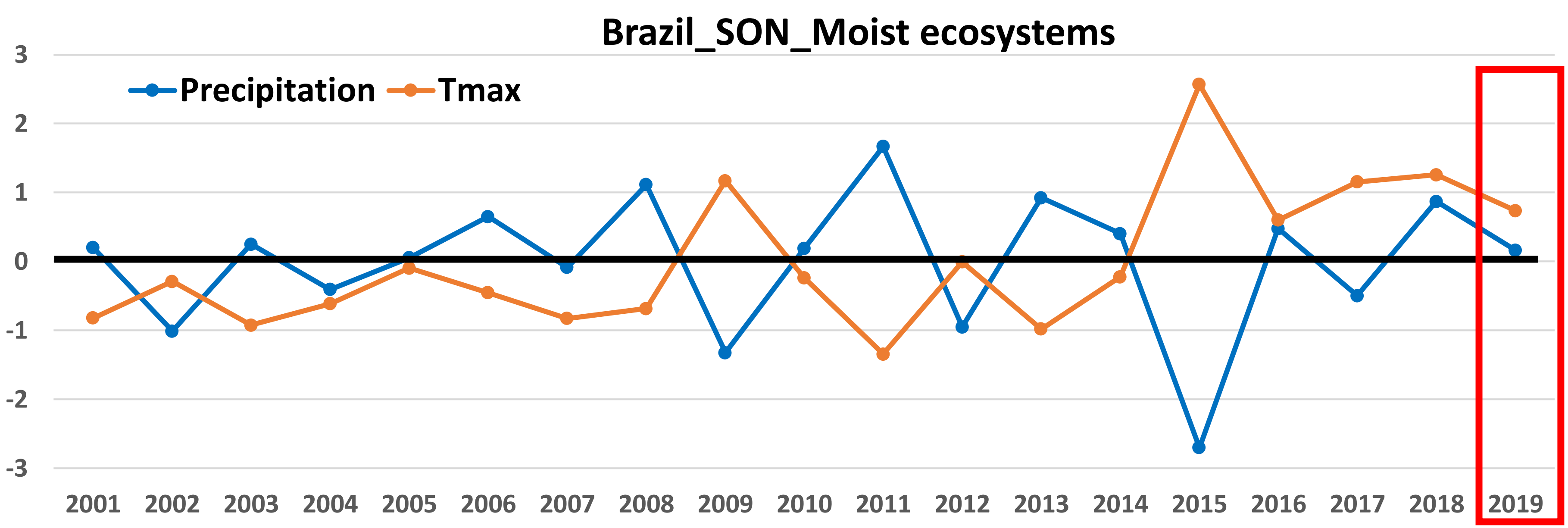
Figure 3: *Deforestation CO_2 fire emissions in wet (rainforests), dry (Cerrado) and fire-prone (Pantanal) ecosystems in Brazil for 1997-2019, for dry season fire quarters JJA (Jun-Jul-Aug), SON (Sep-Oct-Nov)*


Burned_Area
2019DJF
Burned_Area
2019MAM
Roraima severe fires early in the year
Arc of Deforestation fires
Burned_Area
2019JJA
Burned_Area
2019SON
TransAmazonian Highway fires
Cerrado fires Peaked in Sep Oct Nov (SON)
-3
-2.5
-2
-1.5
-1
-0.5
0
0.5
1
1.5
2
2.5
3
2019 burned area Standardized anomalies (2001-2019)

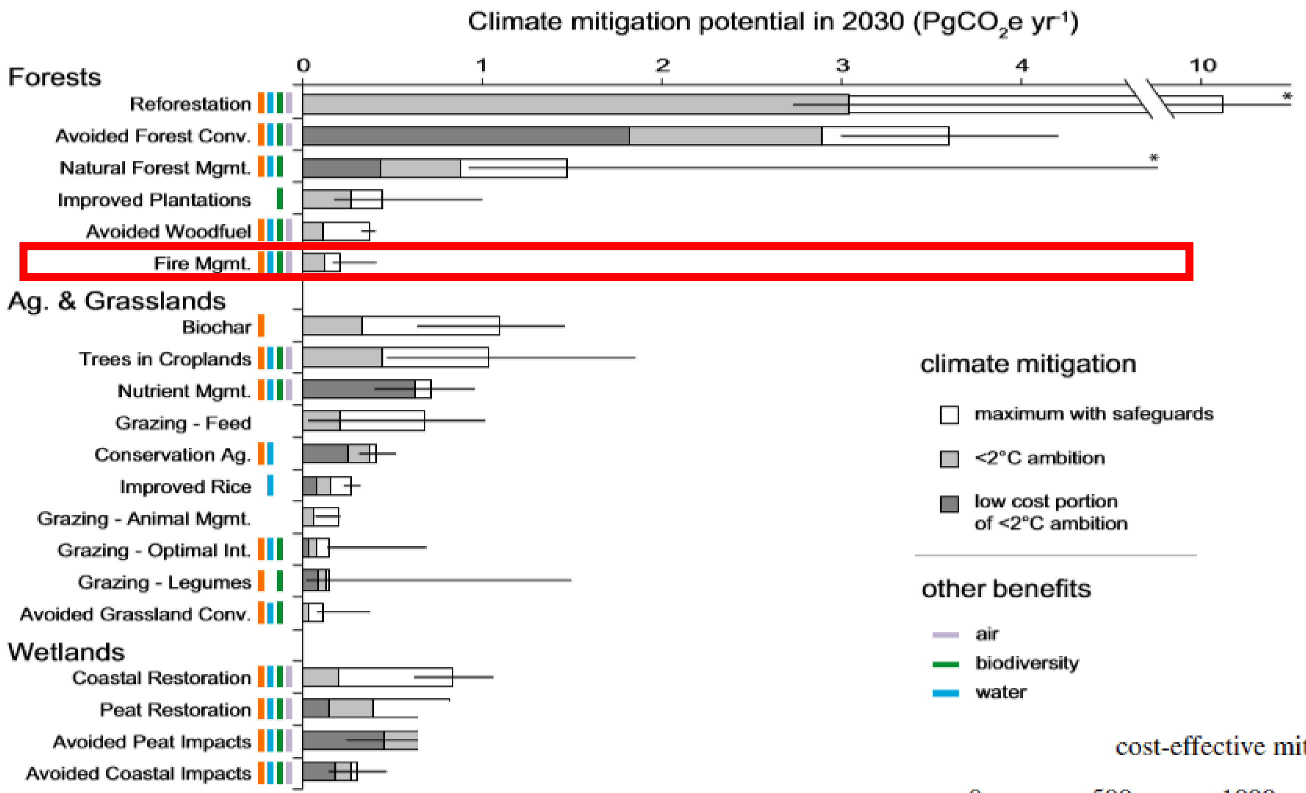

Brazil_JJA_Dry ecosystem
Precipitation
Tmax
4
3
2
1
0
-1
-2
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019


Brazil_JJA_Moist ecosystem
Precipitation
tasmax
3
2
1
0
-1
-2
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019


Brazil SON_Dry ecosystems
Precipitation
Tmax
3
2
1
0
-1
-2
-3
2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019


Brazil_SON_Moist ecosystems
Precipitation
Tmax
3
2
1
0
-1
-2
-3
2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019

Fire management as a Natural Climate Solution

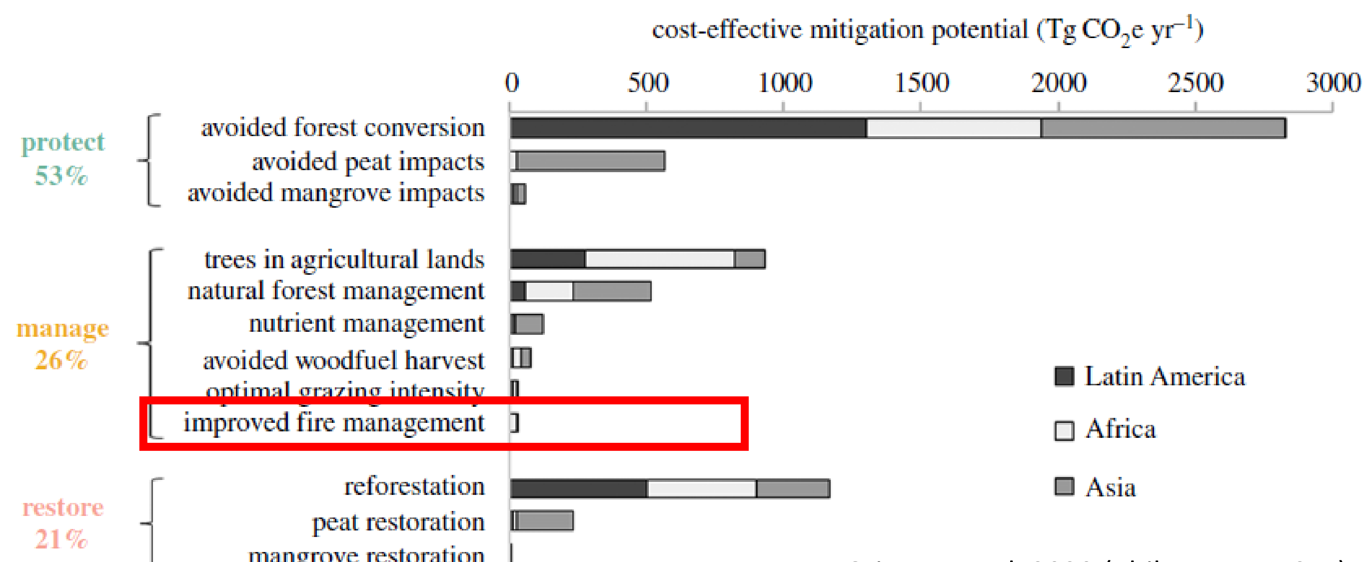


Griscom et al. 2017 (PNAS)

Mitigation potential with safeguards (2017-2030)

ca. 250 Tg CO_2e/year
ca. 70 Tg CO_2e/year in Africa only

ca. 89 Tg CO_2e/year for tropical Savannas (Lipsett-Moore et al. 2018)



Griscom et al. 2020 (Phil. Trans. R. Soc)

Estimating fire emissions: 2019 Refinement of the 2006 IPCC AFOLU Guidelines

https://www.ipcc-nggip.iges.or.jp/public/2019rf/pdf/4_Volume4/19R_V4_Ch02_Generic%20Methods.pdf

EQUATION 2.27
ESTIMATION OF GREENHOUSE GAS EMISSIONS FROM FIRE

$$L_{fire} = A \bullet M_B \bullet C_f \bullet G_{ef} \bullet 10^{-3}$$

L_{fire}= Fire emissions ($Mg.ha^{-1}.yr^{-1}$ CO_2eq)-------------------**GHG** (CO_2) + CH_4 +N_2O

Non-woody vegetation (savannas, woodlands with grassland-led fires)

- CO_2 carbon neutral (CO2 emitted is absorbed by postfire growth)
- CH_4, N_2O

A = Burnt Area (ha) **Only variable needed for Tier 1 reporting of GHG**

Mb = Fuel mass available for combustion ($Mg.ha^{-1}$) (biomass, -ground litter, dead wood-) (Default values, Tier 1)

Cf = Combustion Factor, dimensionless (Default values, Tier 1)

G_{ef} = Emission Factor ($g.kg^{-1}$) of dry matter burnt (Default values, Tier 1)

TABLE 2.4 (UPDATED) (CONTINUED)

FUEL (DEAD ORGANIC MATTER PLUS LIVE BIOMASS) BIOMASS CONSUMPTION VALUES (TONNES

FIRES IN A RANGE OF VEGETATION TYPES

(To be used in Equation 2.27, to estimate the product of quantities '$M_B \cdot C_f$', i.e., an a

Vegetation type	Subcategory	Mea	SE
Savanna woodlands (early dry season burns)*	Savanna woodland	2.5	-
	Savanna parkland	2.7	-
All savanna woodlands (early dry season burns)		**2.6**	**0.1**
Savanna woodlands (mid/late dry season burns)*	Savanna woodland	3.3	-
	Savanna parkland	4.0	1.1
	Tropical savanna	6	1.8
	Other savanna woodlands	5.3	1.7
All savanna woodlands (mid/late dry season burns)*		**4.6**	**1.5**
Savanna Grasslands/ Pastures (early dry season burns)*	Tropical/sub-tropical grassland	2.1	-
	Grassland	-	-
All savanna grasslands (early dry season burns)*		**2.1**	-
Savanna Grasslands/ Pastures (mid/late dry season burns)*	Tropical/sub-tropical grassland	5.2	1.7
	Grassland	4.1	3.1
	Tropical pasture~	23.7	11.8
	Savanna	7.0	2.7
All savanna grasslands (mid/late dry season burns)*		**10.0**	**10.1**
Other vegetation types	Peatland	41	1.4
	Tundra	10	-
Agricultural residues (post-harvest field burning)	$M_B = AGR_{(T)} \times Frac_{Burnt(T)}$		

* Surface layer combustion only

~ Derived from slashed tropical forest (includes unburned woody material)

[a] For sugarcane, data refer to burning before harvest of the crop.

[b] Expert assessment by authors.

TABLE 2.6 (UPDATED) (CONTINUED)

COMBUSTION FACTOR VALUES (PROPORTION OF PREFIRE FUEL BIOMASS CONSUMED) FOR FIRES IN A RANGE OF VEGETATION TYPES

(Values in column 'mean' are to be used for quantity C_f in Equation 2.27)

Vegetation type	Subcategory	Mean	SD	References
Shrublands	Shrubland (general)	0.95	-	44
	Calluna heath	0.71	0.30	26, 56, 39
	Fynbos	0.61	0.16	70, 44
All shrublands		**0.72**	**0.25**	
Savanna woodlands (early dry season burns)*	Savanna woodland	0.22	-	28
	Savanna parkland	0.73	-	57
	Other savanna woodlands	0.37	0.19	22, 29
All savanna woodlands (early dry season burns)		**0.40**	**0.22**	
Savanna woodlands (mid/late dry season burns)*	Savanna woodland	0.72	-	66, 57
	Savanna parkland	0.82	0.07	57, 6, 51
	Tropical savanna	0.73	0.04	52, 73, 66, 12
	Other savanna woodlands	0.68	0.19	22, 29, 44, 31, 57
All savanna woodlands (mid/late dry season burns)*		**0.74**	**0.14**	
Savanna Grasslands/ Pastures (early dry season burns)*	Tropical/sub-tropical grassland	0.74	-	28
	Grassland	-	-	48
All savanna grasslands (early dry season burns)*		**0.74**	-	
Savanna Grasslands/ Pastures (mid/late dry season burns)*	Tropical/sub-tropical grassland	0.92	0.11	44, 73, 66, 12, 57
	Tropical pasture~	0.35	0.21	4, 23, 38, 66
	Savanna	0.86	0.12	53, 5, 56, 42, 50, 6, 45, 13, 44, 65, 66
All savanna grasslands (mid/late dry season burns)*		**0.77**	**0.26**	
Other vegetation types	Peatland	0.50	-	20, 44
	Tropical Wetlands	0.70	-	44
Agricultural residues (Post-harvest field burning)	Wheat residues	0.90	-	see Note b
	Maize residues	0.80	-	see Note b
	Rice residues	0.80	-	see Note b
	Sugarcane a	0.80	-	see Note b
	Other Crops	0.85	-	see Note b

* Surface layer combustion only; ~ Derived from slashed tropical forest (includes unburned woody material); [a] For sugarcane, data refer to burning before harvest of the crop; [b] Expert assessment by authors.

Emission Abatement: IFM to reduce fire emissions

$$L_{fire} = A \bullet M_B \bullet C_f \bullet G_{ef} \bullet 10^{-3}$$

Reduce

- **Area burnt** (A)
- **Fuel loads** (Mb)
- **Fuel flammability**----Emission factors (G_{ef})

Fire prevention, post-fire restoration

- **Fire banning** (reduce ignition sources) (agriculture, forests, grasslands fire, etc)
- **Fuel management** (fuel reduction before fire season) (e.g. herbivory)
- **Changing landscape configuration** (managing fuel distribution and flammability)
- **Prescribed burning** (shifting ignition sources, altering fuel properties (loads, distribution, flammability) **towards EARLY DRY SEASON** from **LATE DRY SEASON fire**

Fire suppression

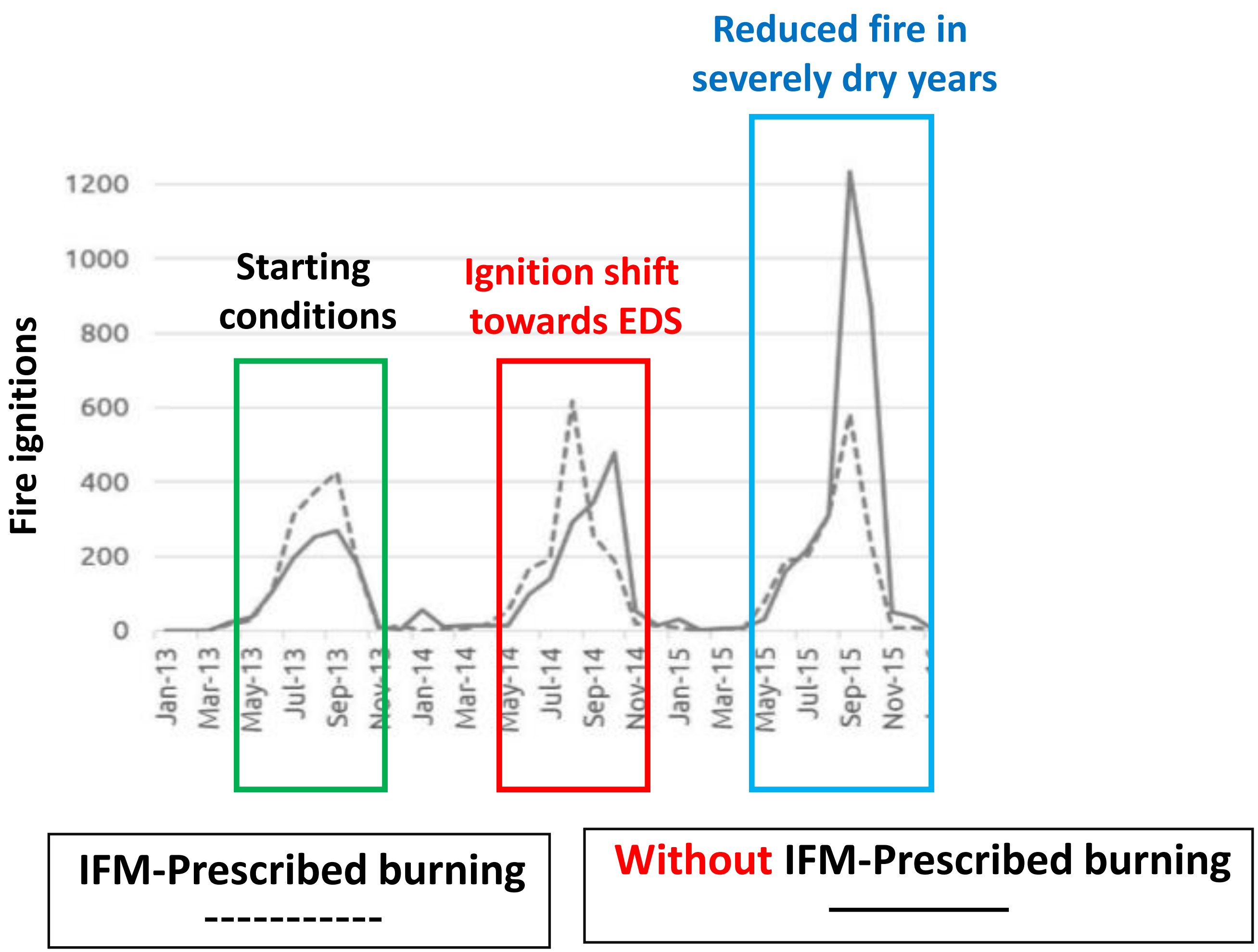
- **Fire suppression policies, fire fighting equipment** (e.g aerial support)
- **Fire fighting techniques** (e.g use of counter-fire)

Fire Emission Abatement: Prescribed burning

Shift from Late_Dry Season towards Early_Dry Season

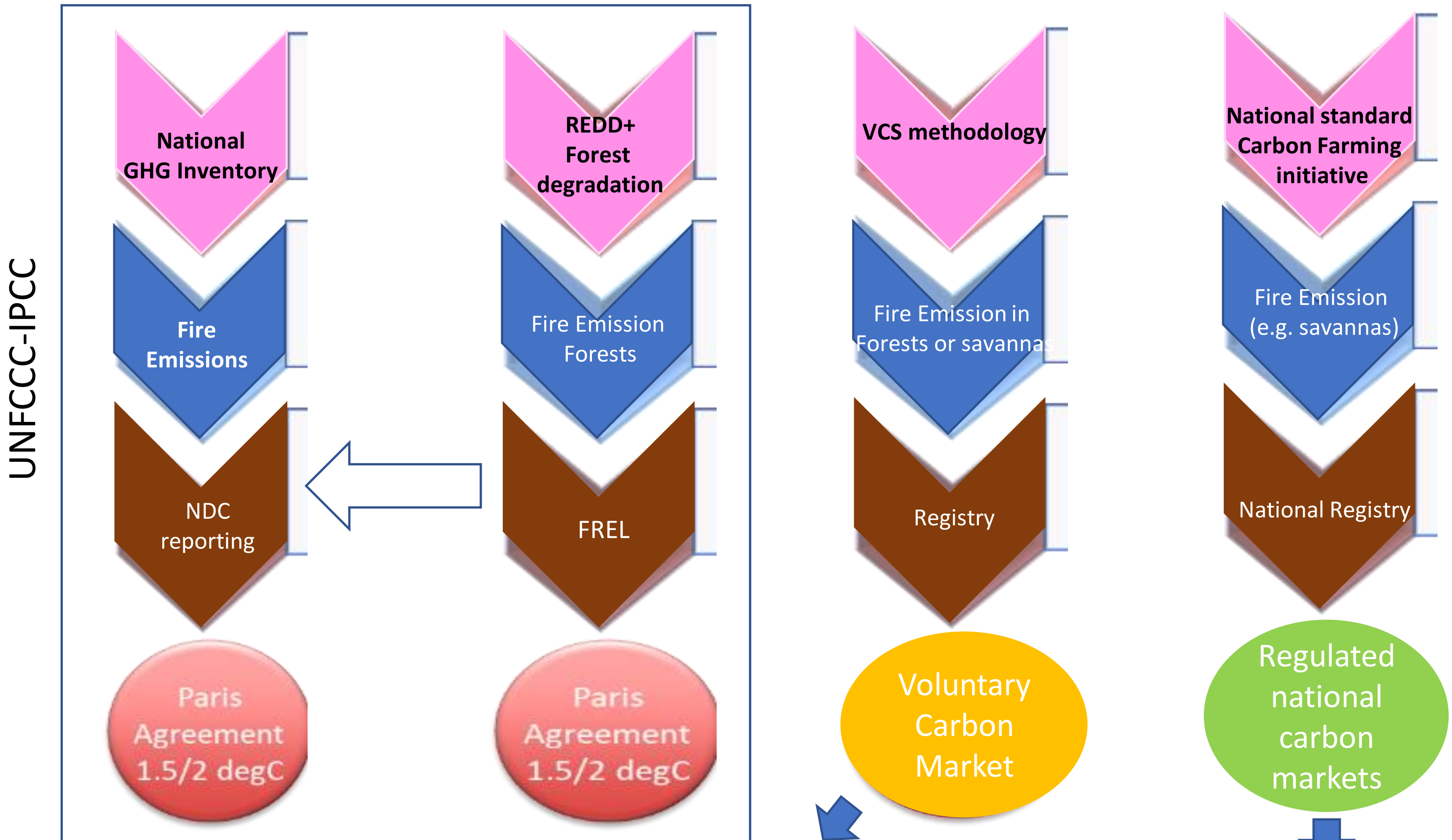
Change in A, M_b, G_{ef}

$$L_{fire} = A \bullet M_B \bullet C_f \bullet G_{ef} \bullet 10^{-3}$$



Source: Jonas Franke

Fire Emission Abatement: mitigation targets and carbon markets



VM0029: Methodology for Avoided Forest Degradation through Fire Management **(Eastern Miombo) (1)**

Australia's emissions trading scheme **(Savanna fire) (3,4)**

VM0032 Methodology for the Adoption of Sustainable Grasslands through Adjustment of Fire and Grazing, v1.0 **(grassland soil conservation) (2)**

(1,2) https://verra.org/methodologies/
(3)https://www.legislation.gov.au/Details/F2018L00560/Explanatory%20Statement/Text
(4)https://collections.unu.edu/eserv/UNU:5605/indigenous_fire_management.pdf

Rosa Maria Roman-Cuesta. CIFOR associate and Guest Researcher at the University of Wageningen

Anja A. Hoffmann. Integrated Fire Management Specialist.

Geoff Lipsett-Moore – formerly TNC Climate Specialist now Manager of Knowledge and Partnerships, Cape York Natural Resource Management, Australia.

Lara Steil. Brazilian National Center for prevention and fighting of wildfires.

Jonas Franke. Remote Sensing Solutions. Germany

Natasha S. Ribeiro. Universidade Eduardo Mondlane Mozambique

Roland Vernooij. Vrije Universiteit Amsterdam

Enabling factors for IFM and transferring lessons learnt to other parts of the world


Source: Wikimedia/Jonathan Wilkins
Source: Iness Larry
Source: Thomas Wagner
Source: Anja Hoffmann
Source: Ted Wood
Source: Casey Ryan