Remote Sensing of Amazon Deforestation & Forest Degradation

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24.09.18

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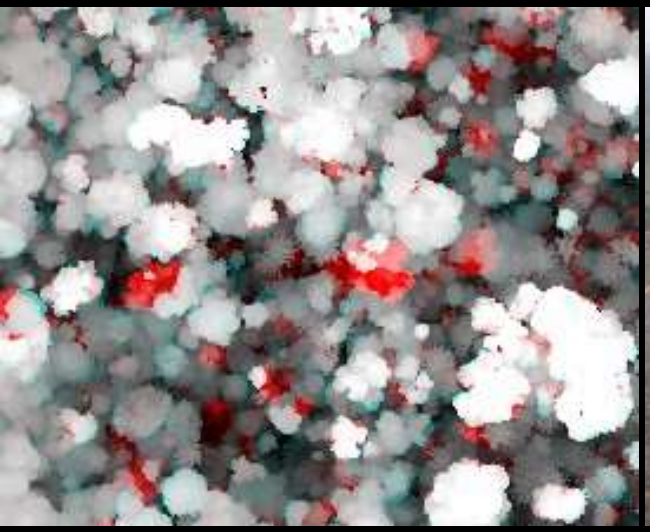
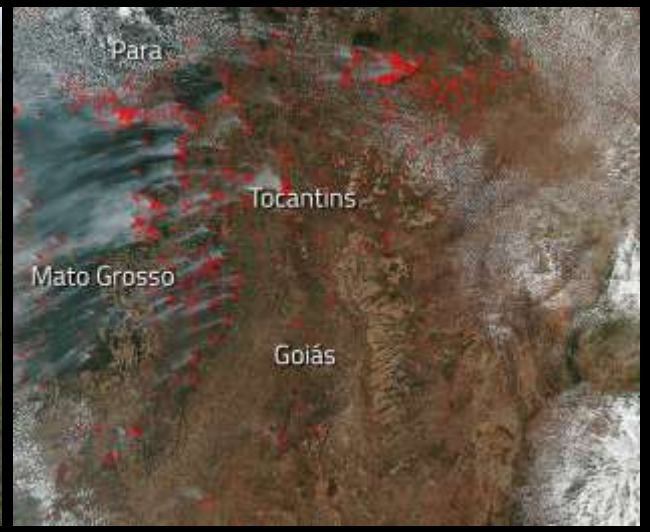
INPE

- Marcos Adami

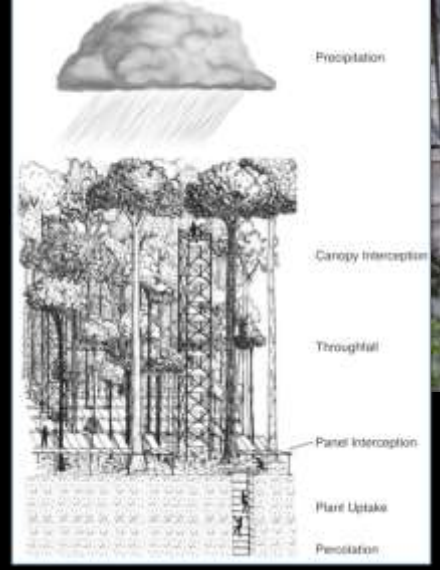




Outline:

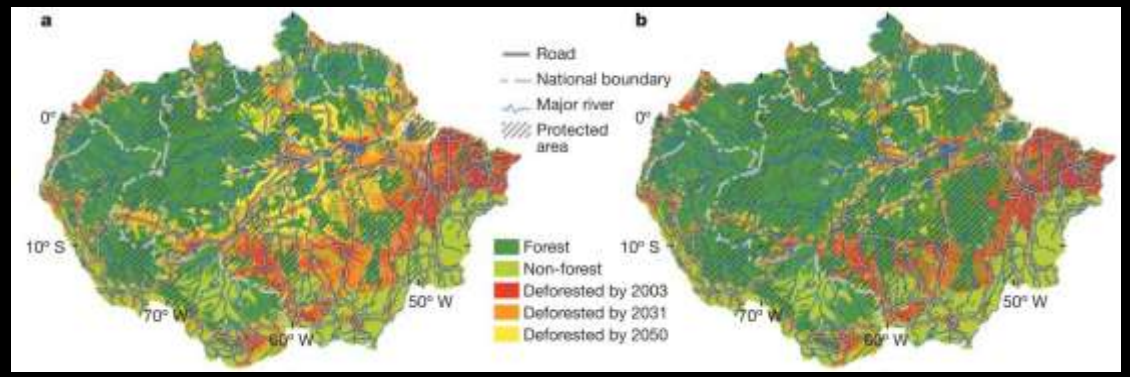
- NASA
- Deforestation
- Degradation
- Fire

Drought



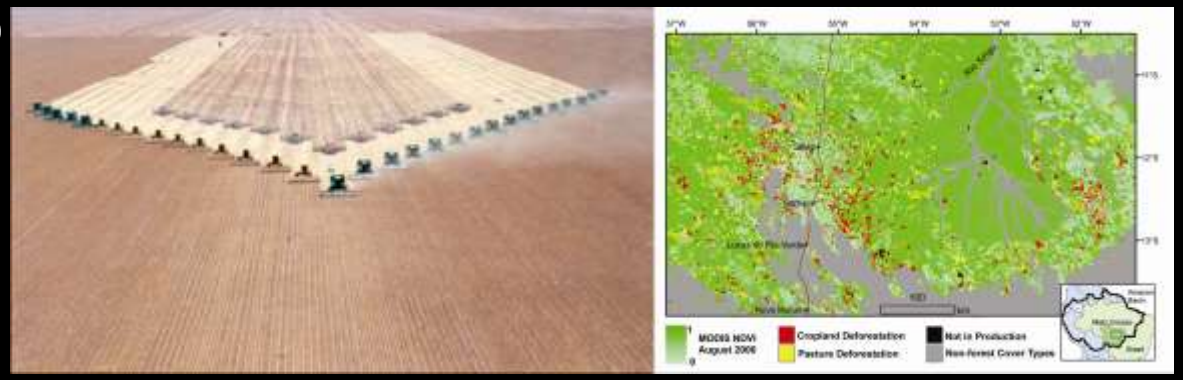
Nepstad *et al*., 2007

Deforestation



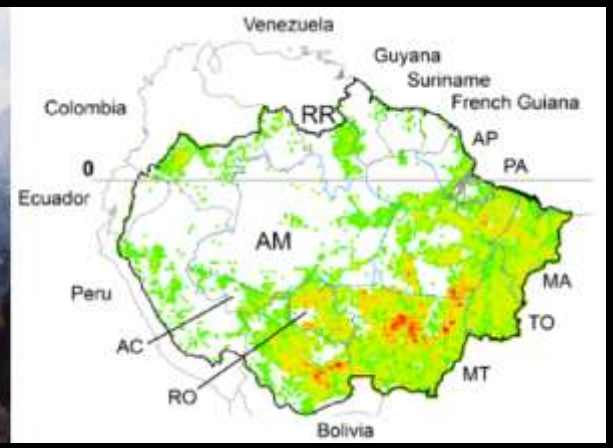
Soares-Filho *et al*., 2006

Land Use Change



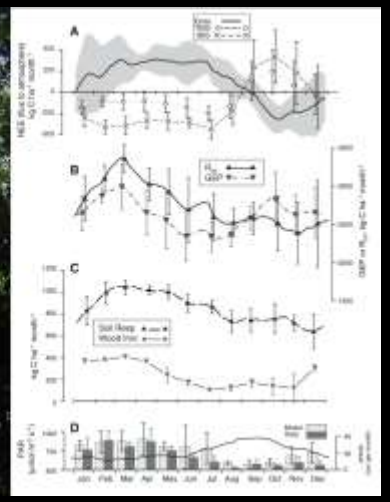
Morton *et al*., 2006

Fire



Morton *et al*., 2008

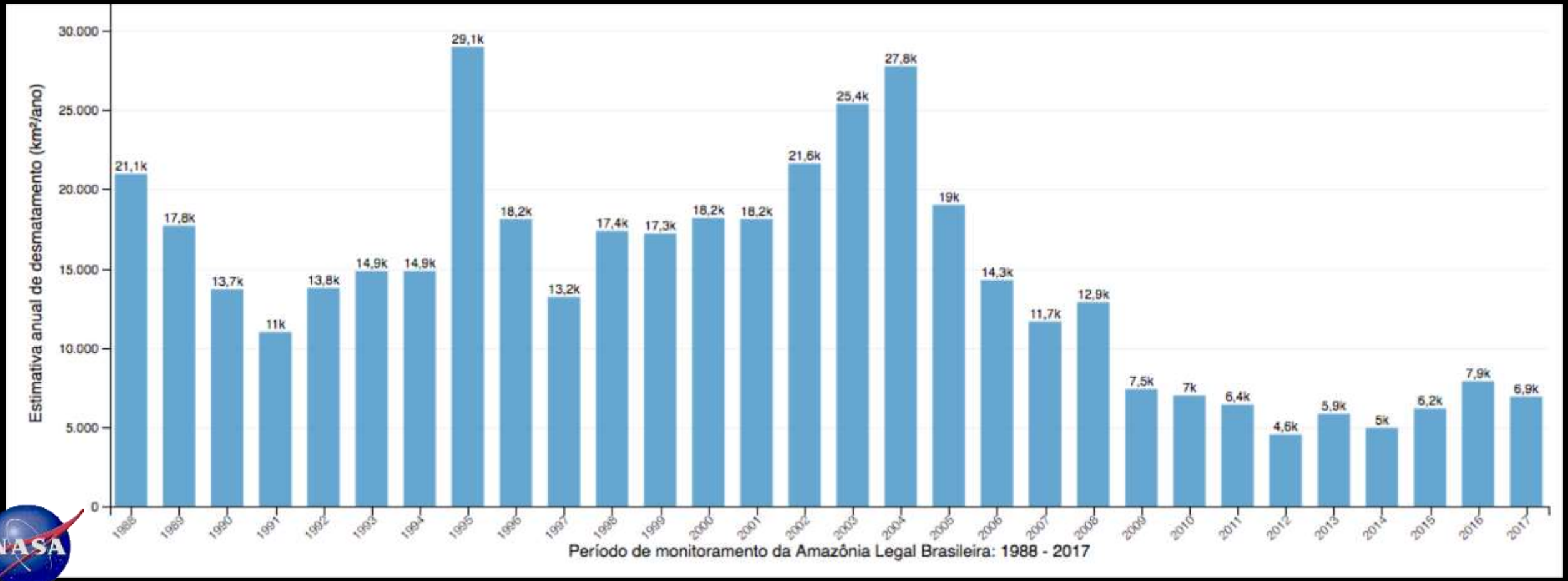
Carbon Dynamics



Saleska *et al*., 2003

Satellite Remote Sensing of Land Use & Land Cover Change		
Where?	Mapping	Higher Resolution (infrequent coverage)
When?	Monitoring	Frequent Coverage (lower resolution)
Why?	Analysis	Multi-sensor studies

INPE PRODES


Estimativa anual de desmatamento (km²/ano)
30.000
25.000
20.000
15.000
10.000
5.000
0
21,1k
17,8k
13,7k
11k
13,8k
14,9k
14,9k
29,1k
18,2k
13,2k
17,4k
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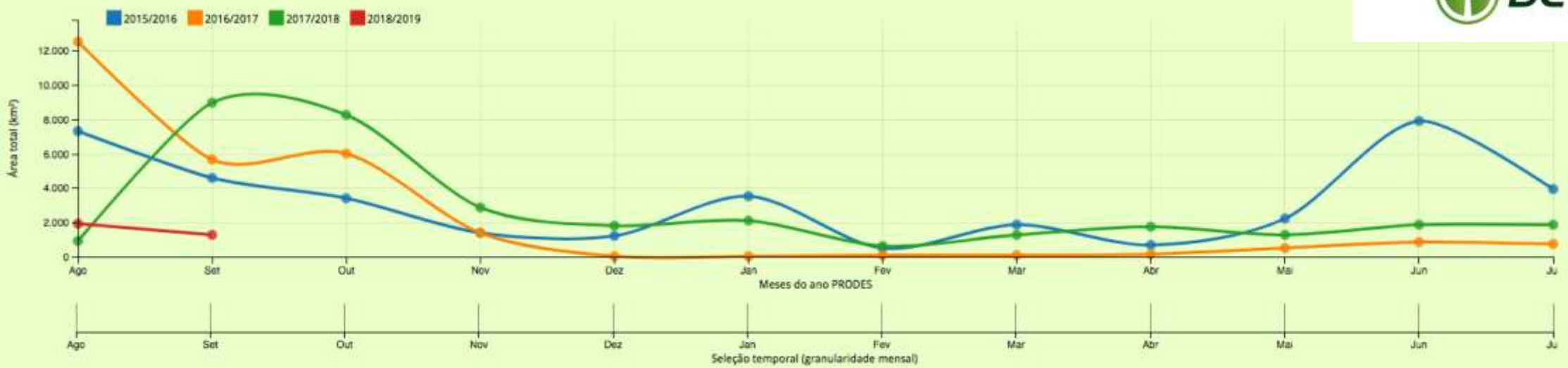
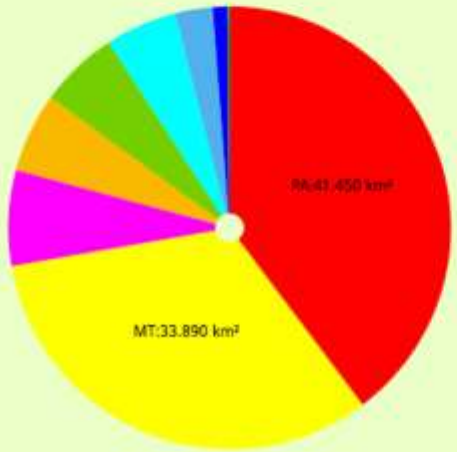
2017
Período de monitoramento da Amazônia Legal Brasileira: 1988 - 2017

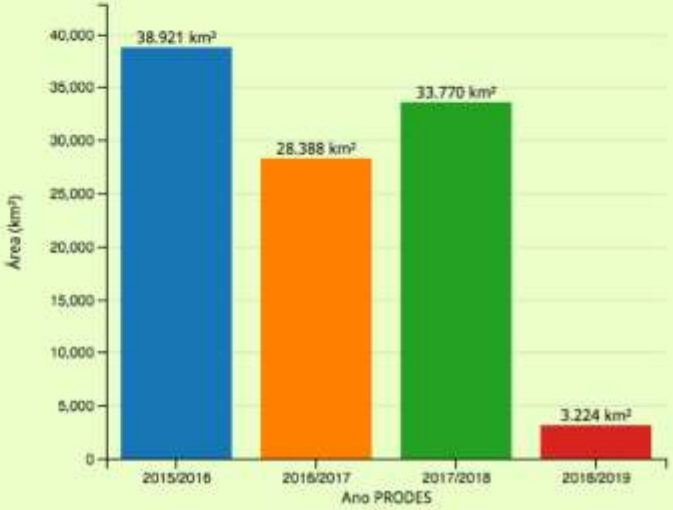
Painel DETER-B - mensal | Abrir o Painel Diário | Imprimir | Escurecer/clarear

Variação da detecção de área do projeto DETER-B, com granularidade mensal e sazonalidade ano PRODES (Agosto a Julho)



Filtros por Estados, Classes e ano PRODES (Agosto a Julho)





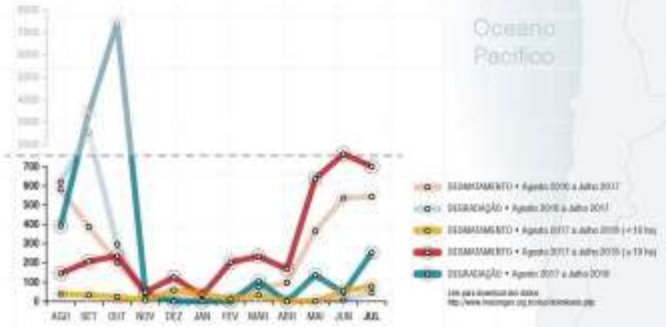
http://terrabrasilis.info/composer/DETER-B

SAD Sistema de Alerta de Desmatamento
Julho de 2018

Em julho de 2018, o SAD detectou **778** quilômetros quadrados de desmatamento na Amazônia Legal. Neste boletim, a fração de desmatamento entre 1 e 10 hectares foi de **11%** do total detectado (**89 quilômetros** quadrados). Considerando somente os alertas a partir de 10 hectares, houve aumento de **27%** em relação a julho de 2017, quando o desmatamento somou **544** quilômetros quadrados. Em julho de 2018, o desmatamento ocorreu no Pará (37%), Amazonas (21%), Rondônia (20%), Mato Grosso (17%), Acre (5%).
As florestas degradadas na Amazônia Legal somaram **356 quilômetros** quadrados em julho de 2018. Em julho de 2017, a degradação florestal detectada totalizou 46 quilômetros quadrados. Em julho de 2018 a degradação foi detectada nos estados do Pará (95%), Mato Grosso (3%), e Rondônia (2%).

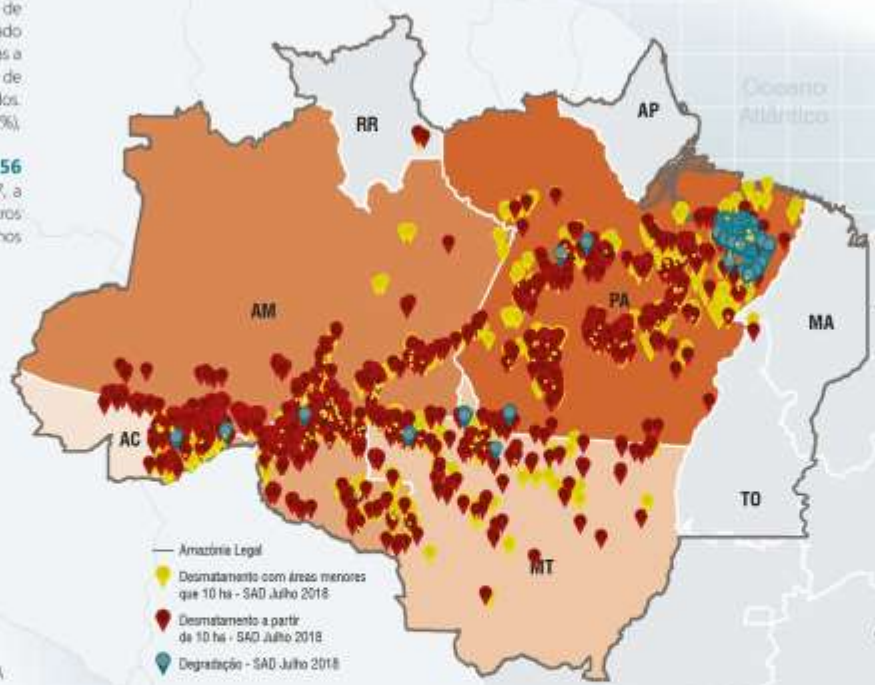
PROPORÇÃO DE DESMATAMENTO POR ESTADO

EVOLUÇÃO DO DESMATAMENTO E DEGRADAÇÃO NA AMAZÔNIA



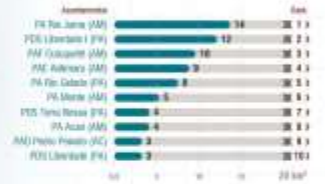
GEOGRAFIA DO DESMATAMENTO

Em julho de 2018, a maioria (**62%**) do desmatamento ocorreu em áreas privadas ou sob diversos estágios de posse. O restante do desmatamento foi registrado nos Assentamentos de Reforma Agrária (**19%**), Unidades de Conservação (**15%**) e Terras Indígenas (**4%**).



MUNICÍPIOS CRÍTICOS

ASSENTAMENTOS



UNIDADES DE CONSERVAÇÃO

TERRAS INDÍGENAS

DEGRADAÇÃO

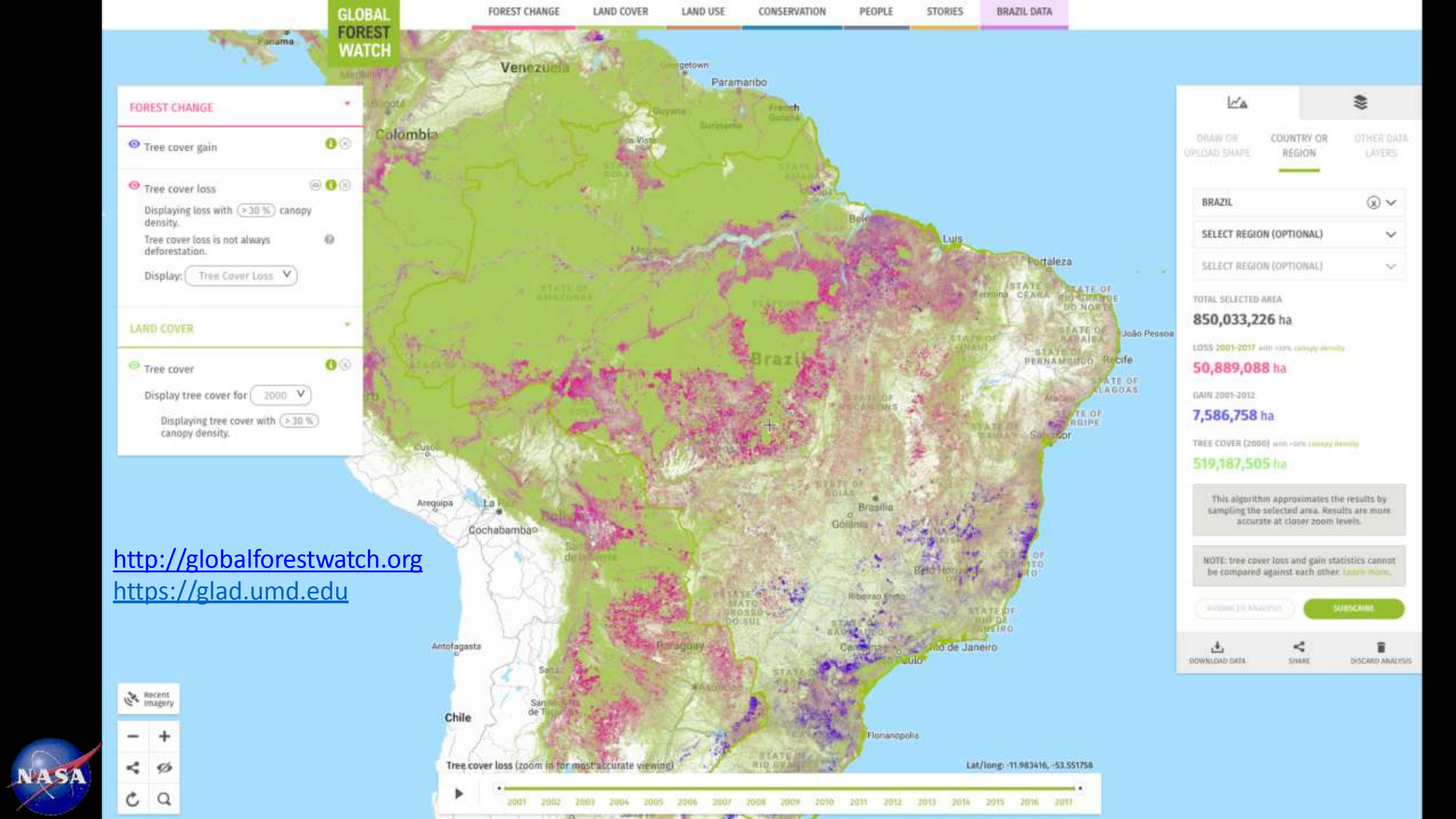
Estado	Ago 2016 a Jul 2017 (km²)	Ago 2017 a Jul 2018 (km²)	Variação (%)
Acre	68	3	-96
Amazonas	134	25	-81
Mato Grosso	3084	3220	69
Pará	276	3013	2008
Rondônia	58	84	30
Roraima	39	97	149
Tocantins	29	722	2398
Amapá	-	-	-
TOTAL	3680	11954	224

DESMATAMENTO

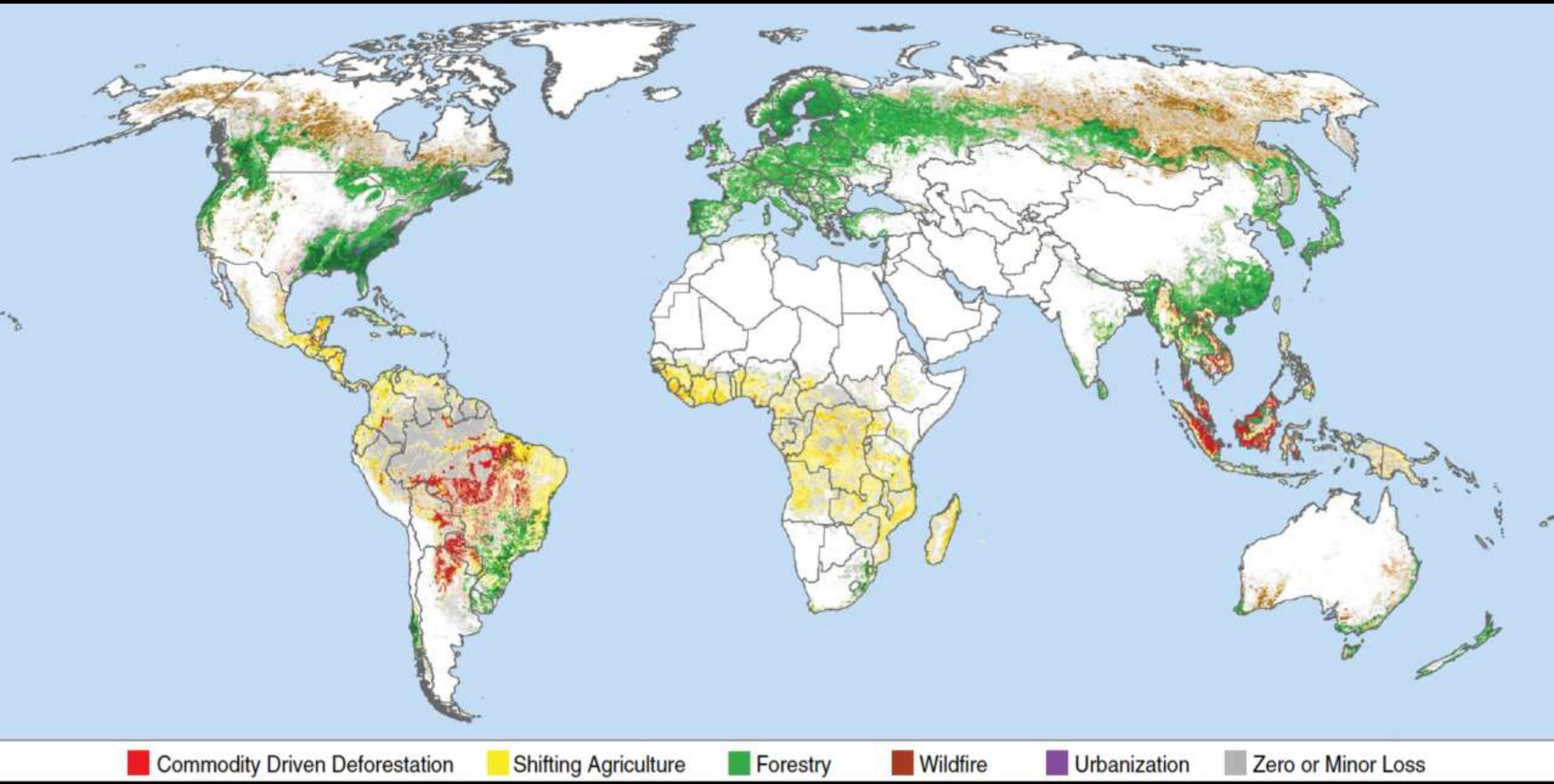
Estado	Alertas a partir de 10 ha			Alertas menores que 10 ha		
	Ago 2016 a Jul 2017 (km²)	Ago 2017 a Jul 2018 (km²)	Variação (%)	Ago 2016 a Jul 2017 (km²)	Ago 2017 a Jul 2018 (km²)	Variação (%)
Acre	28	70	168	-	34	-
Amazonas	601	767	17	-	39	-
Mato Grosso	810	1108	36	-	57	-
Pará	714	1257	82	-	105	-
Rondônia	543	589	4	-	78	-
Roraima	43	117	161	-	44	-
Tocantins	15	2	-86	-	2	-
Amapá	-	1	-	-	1	-
TOTAL	2834	3949	39	-	438	-

Imazon

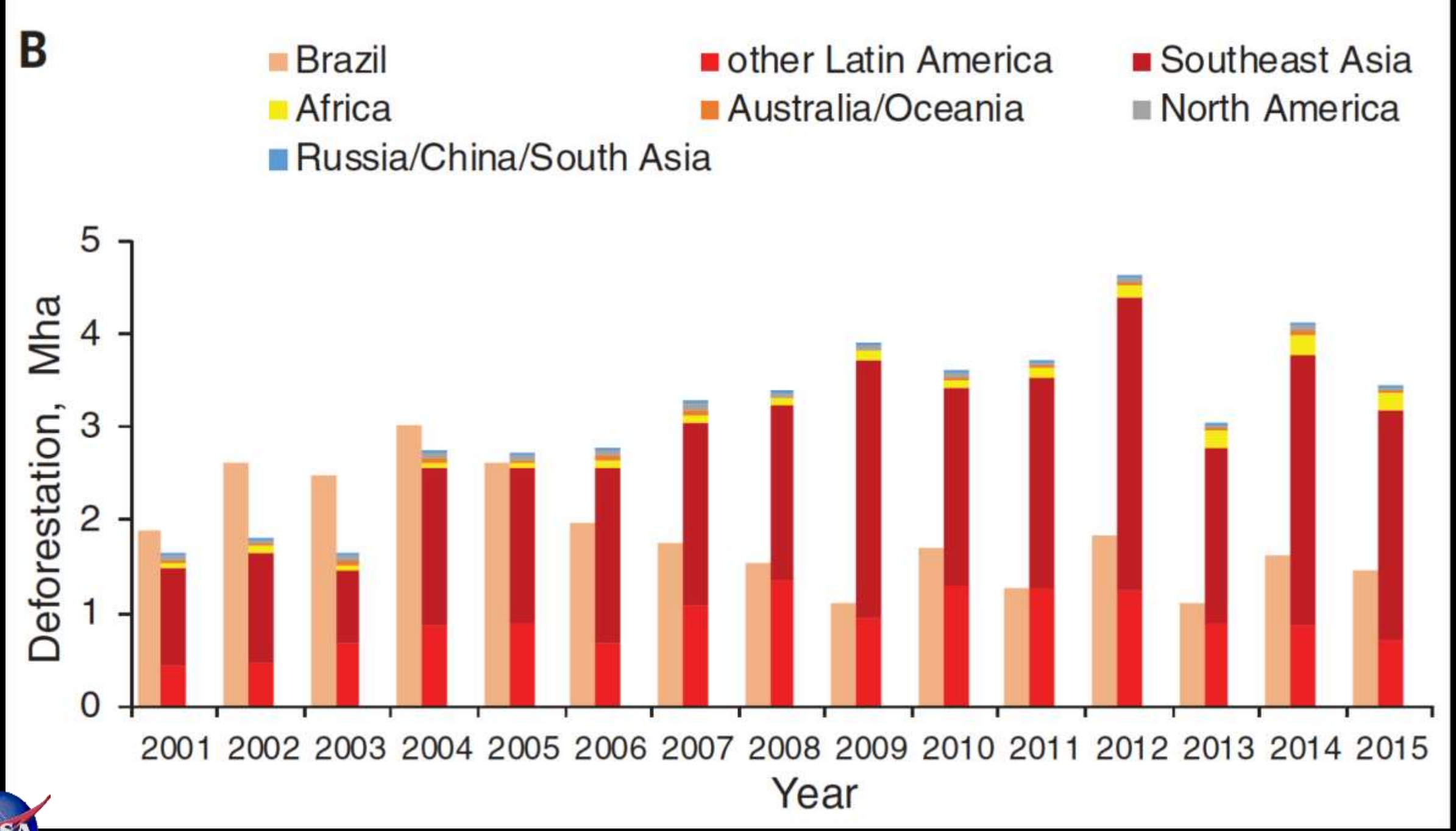
http://www.imazon.org.br



http://globalforestwatch.org
https://glad.umd.edu

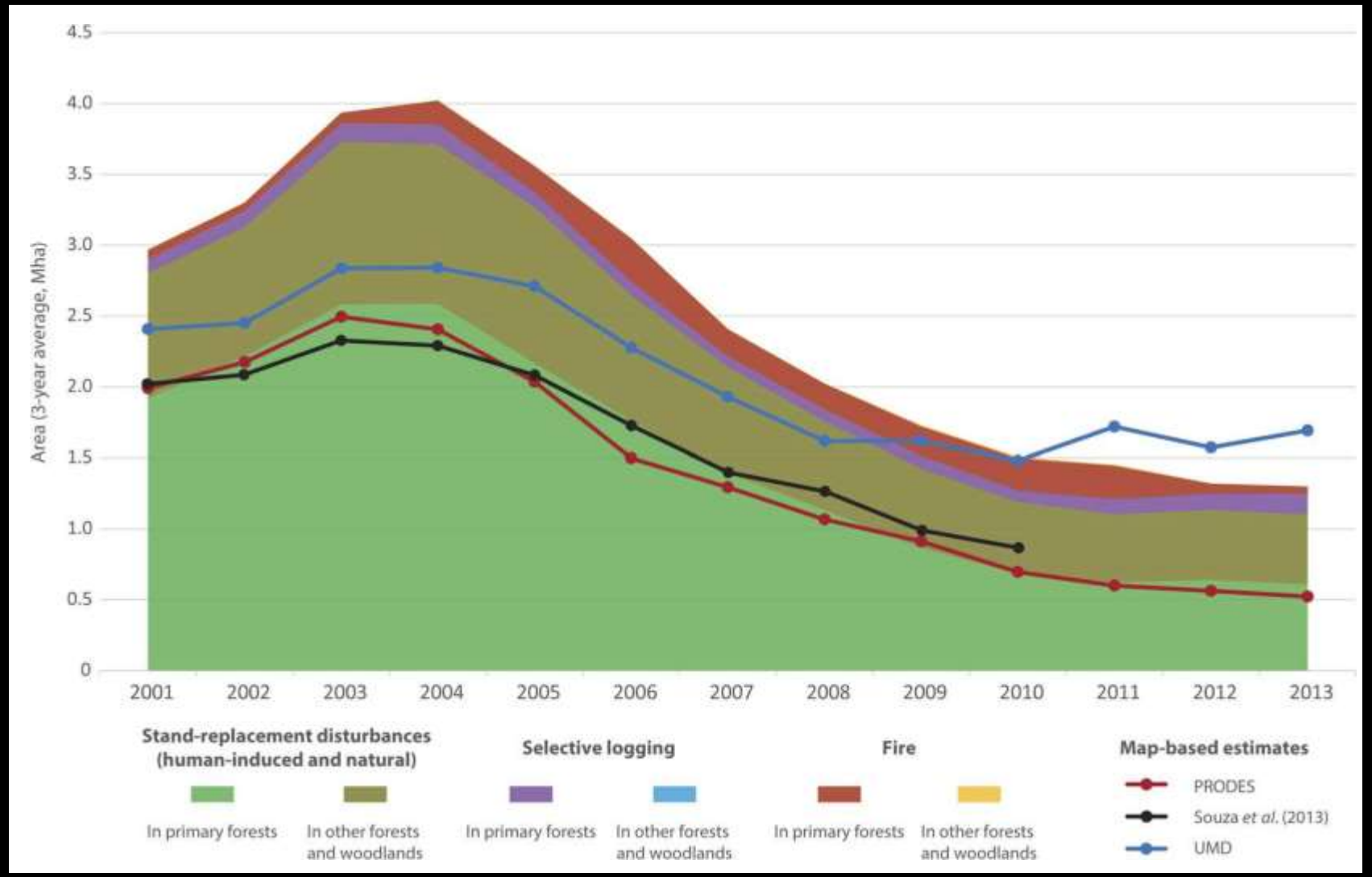


Curtis et al., 2018



Curtis et al., 2018

Land Use: Deforestation & Degradation

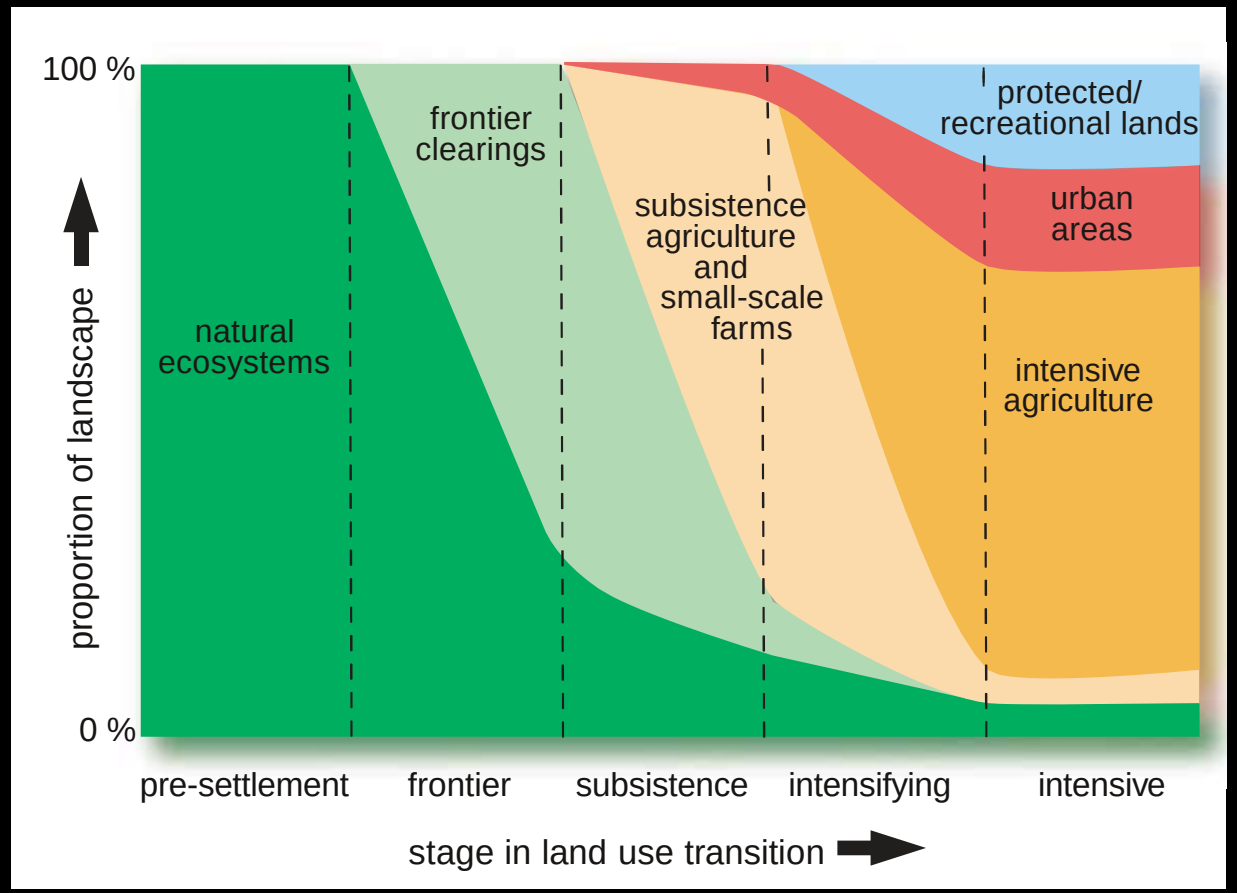


Tyukavina et al., 2017

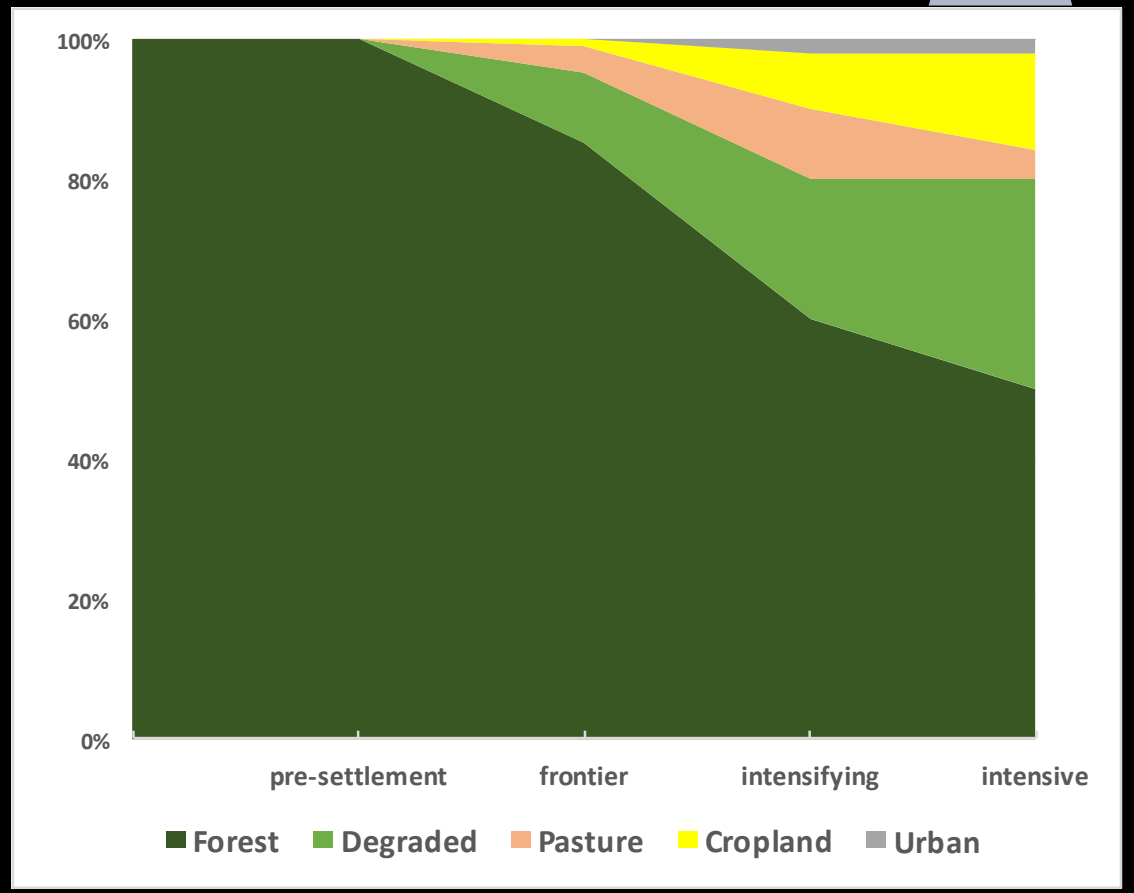
Deforestation Monitoring in 2018:

1)Broad use of freely-available satellite data has spurred innovation and changed the discourse at national and international levels.
   1)PRODES, DETER, CAR, Soy Moratorium, etc.
   2)REDD+
2) Estimates from different systems still disagree.
   1)Main difference is the treatment of forest degradation.
   2)Righting past wrongs in estimates of deforestation will help to understand patterns of land use and climate sensitivity.
3) Putting the Amazon in context.
   1) Replicating Amazon systems in the Cerrado and Mata Atlantica.
   2) Forecasting, managing human-dominated landscapes in the Amazon.

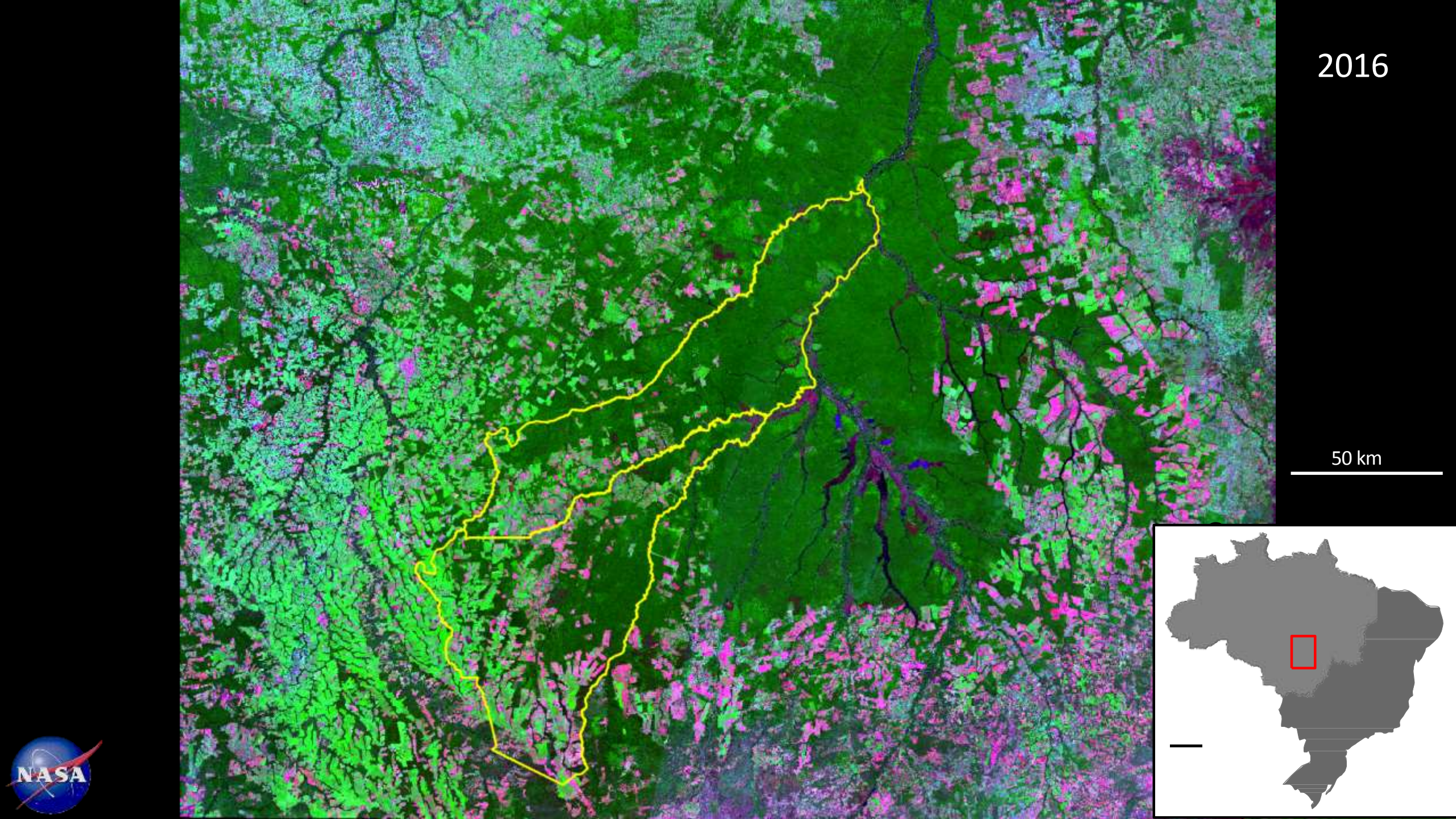
Airborne lidar

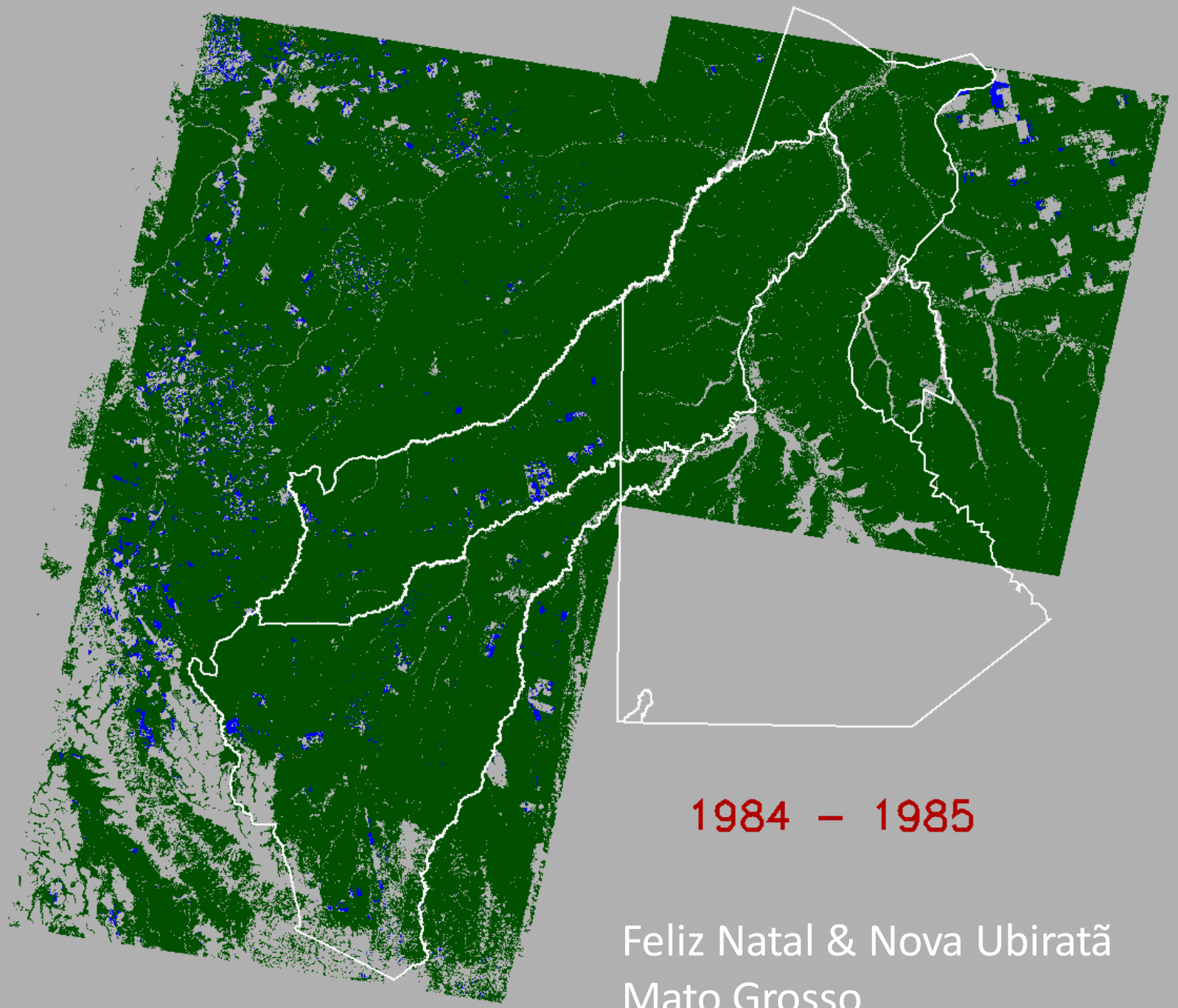


Foley et al., 2005



Landsat transitions 1984-2017 →

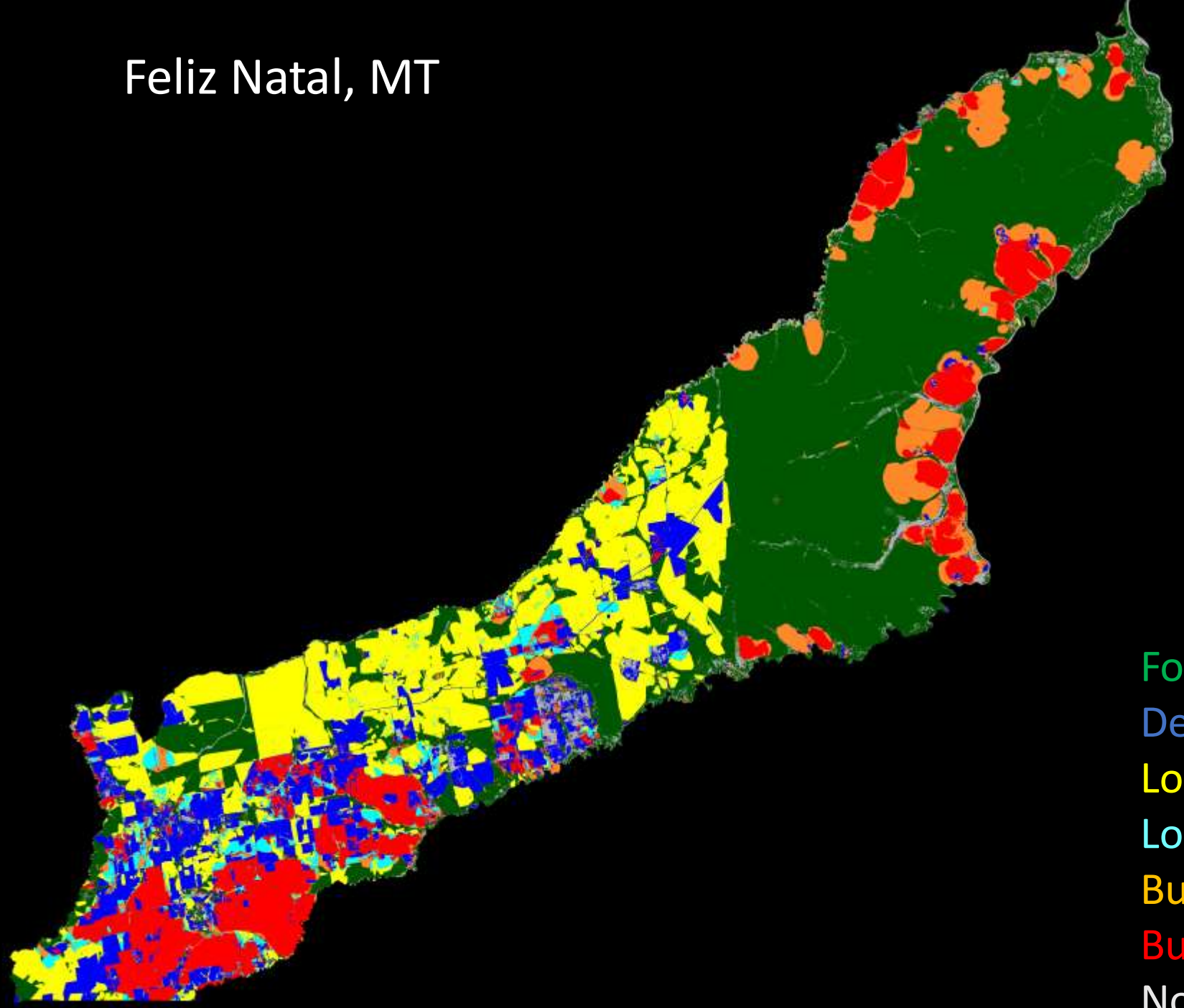

2016
50 km



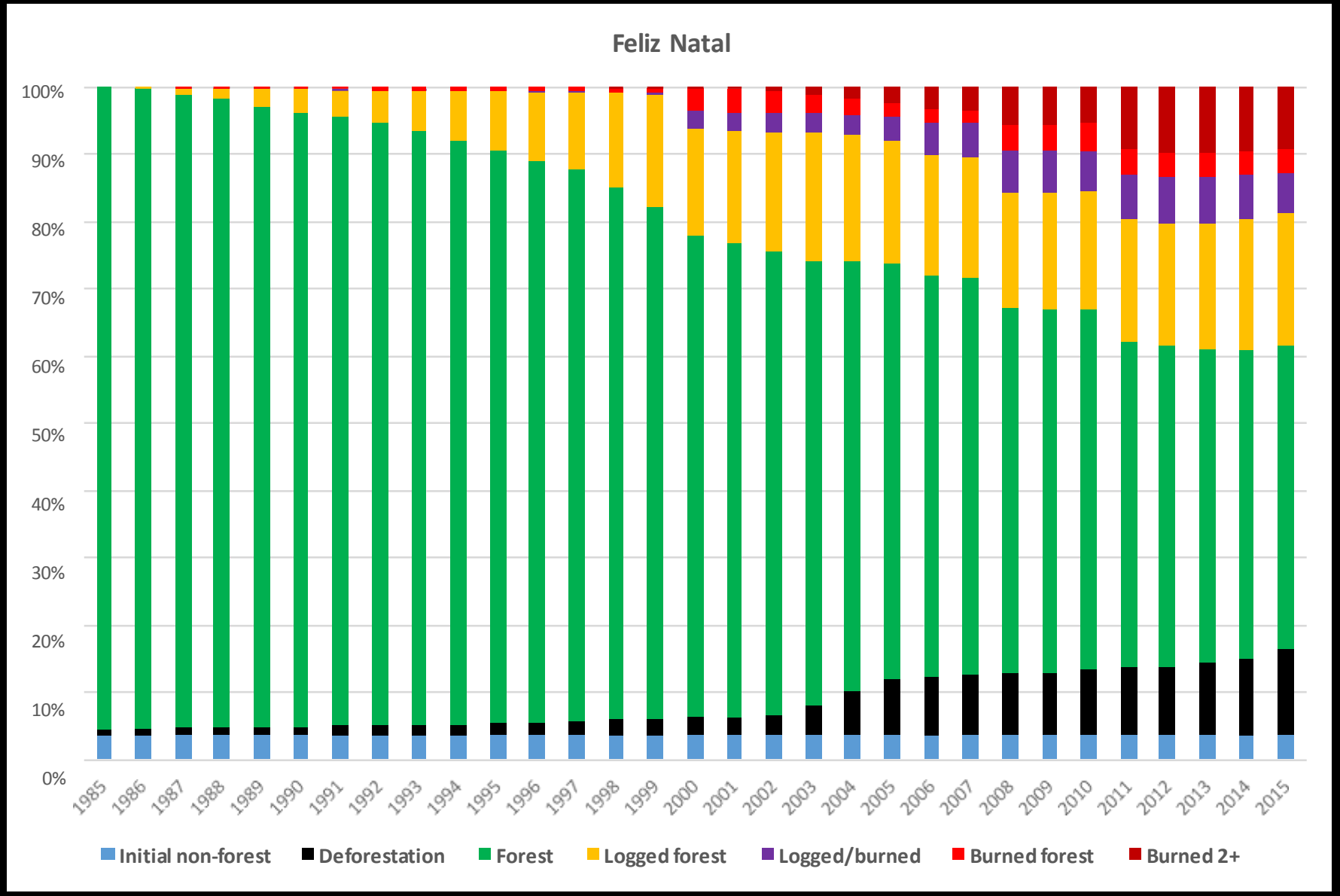
Forest
Deforestation
Logged
Logged & Burned
Burned
Burned 2+
Non-forest

Feliz Natal, MT

1984-2015

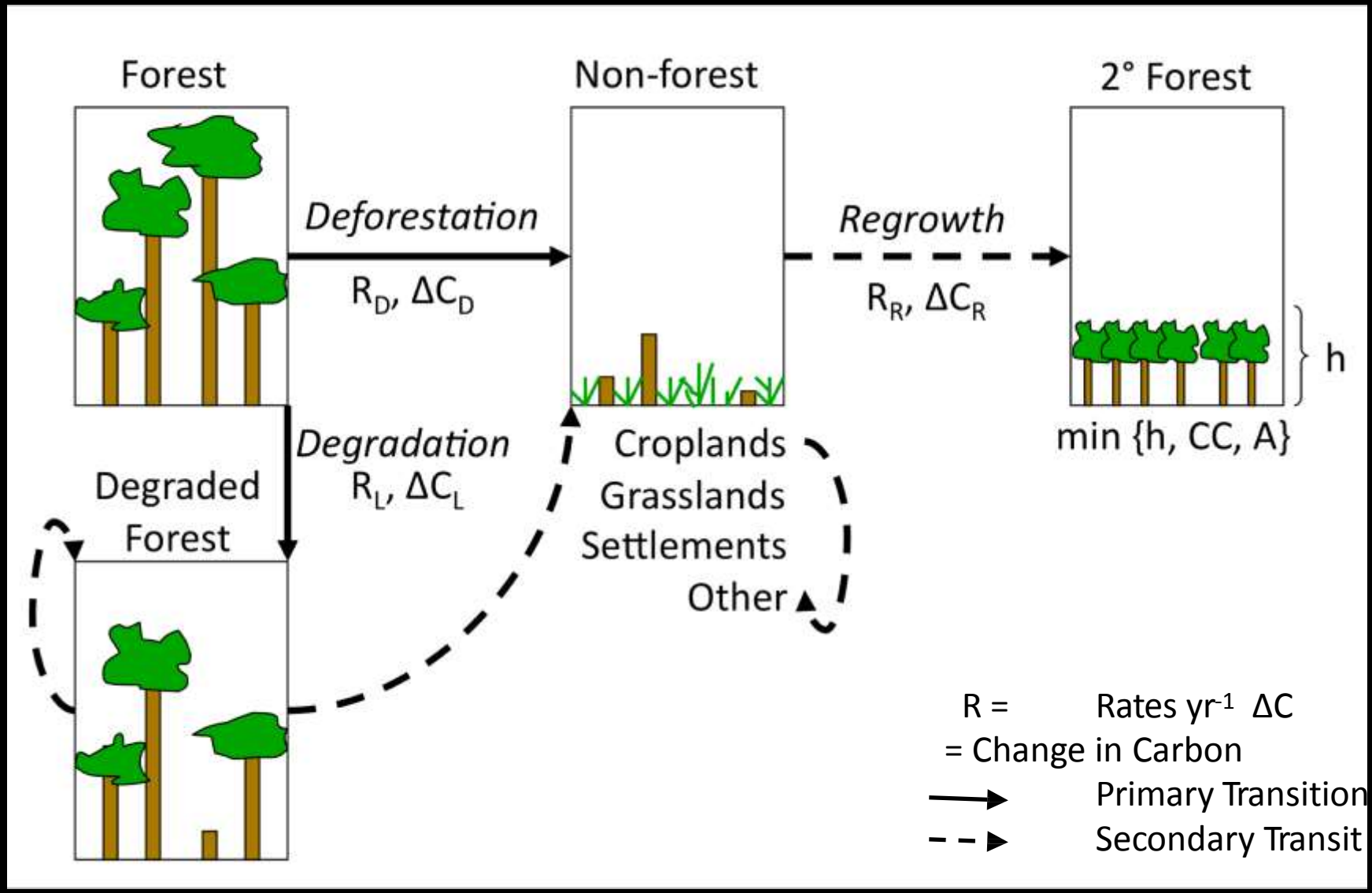


Forest
Deforestation
Logged
Logged & Burned
Burned
Burned 2+
Non-forest



Morton et al., in prep.

Full Carbon Accounting For REDD+

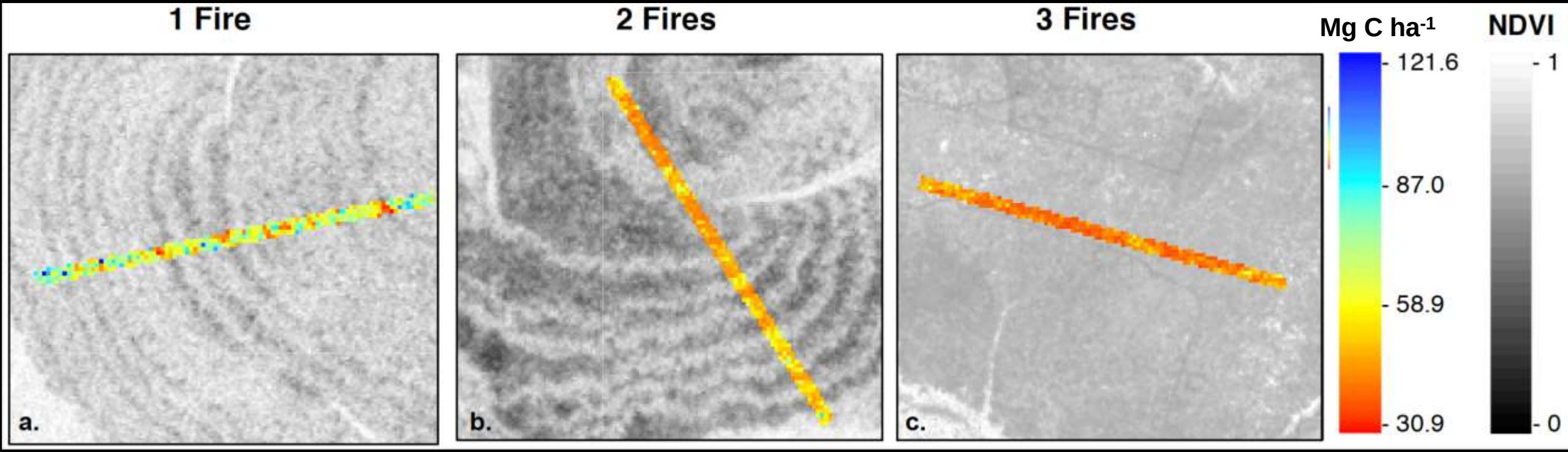


Morton et al., 2011, Bustamante et al., 2015

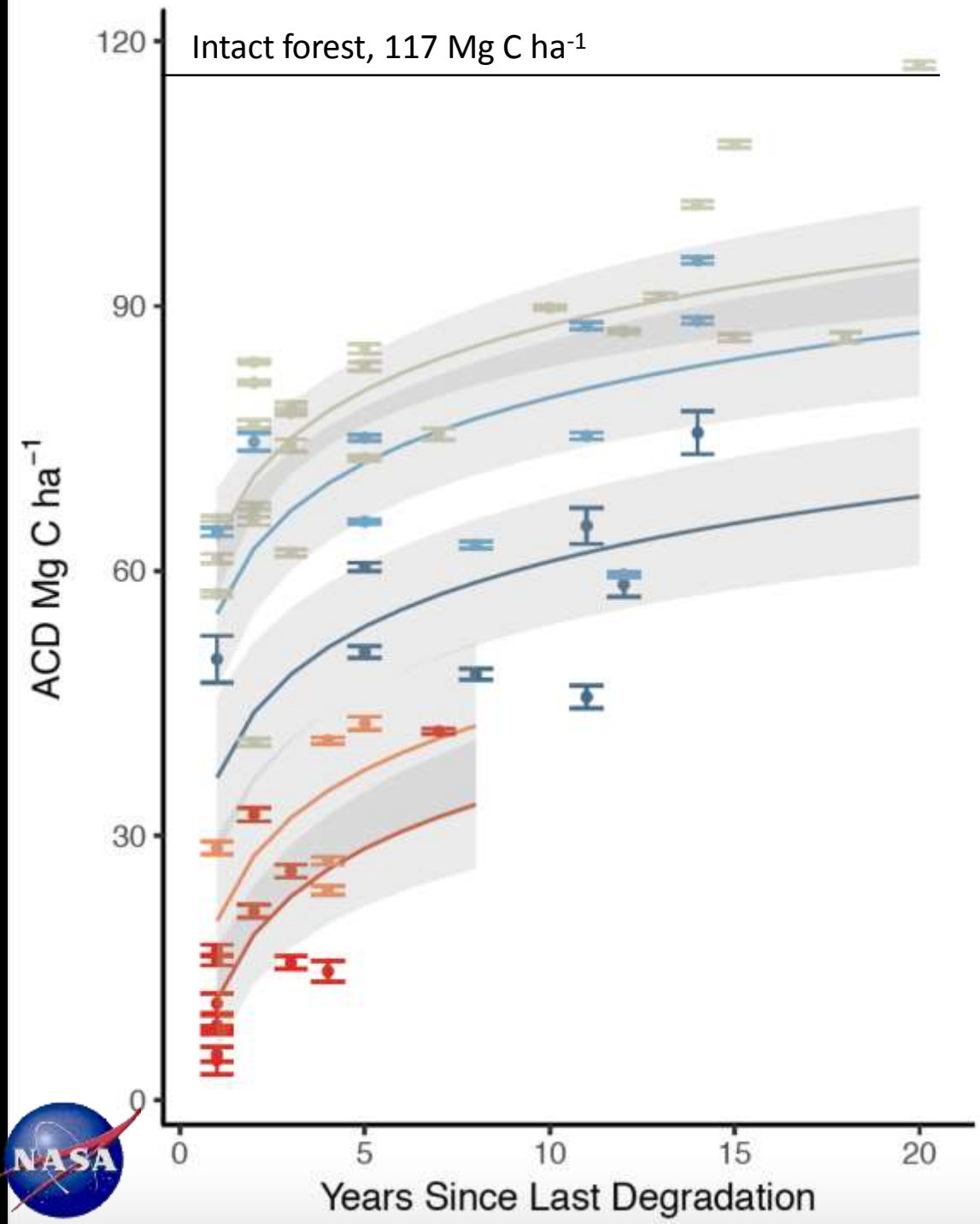
Lidar and Plot Data Online:

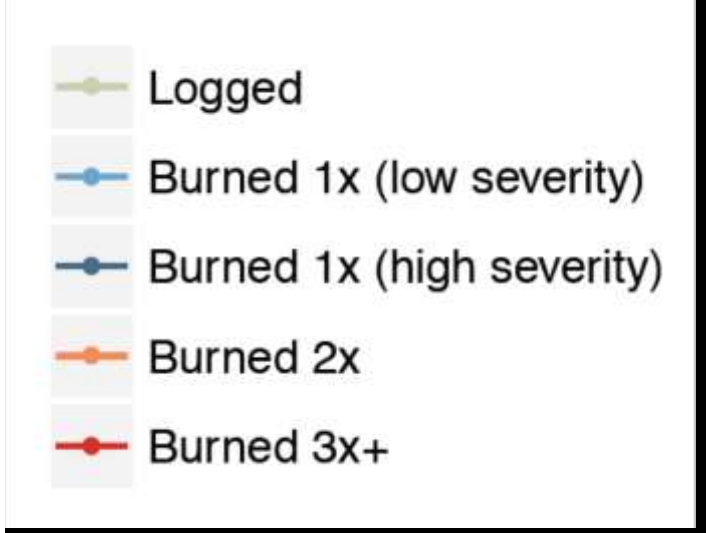
https://www.paisagenslidar.cnptia.embrapa.br/webgis/

Estimated aboveground carbon stocks from airborne lidar (5000 m x 200 m)



Rappaport et al., 2018

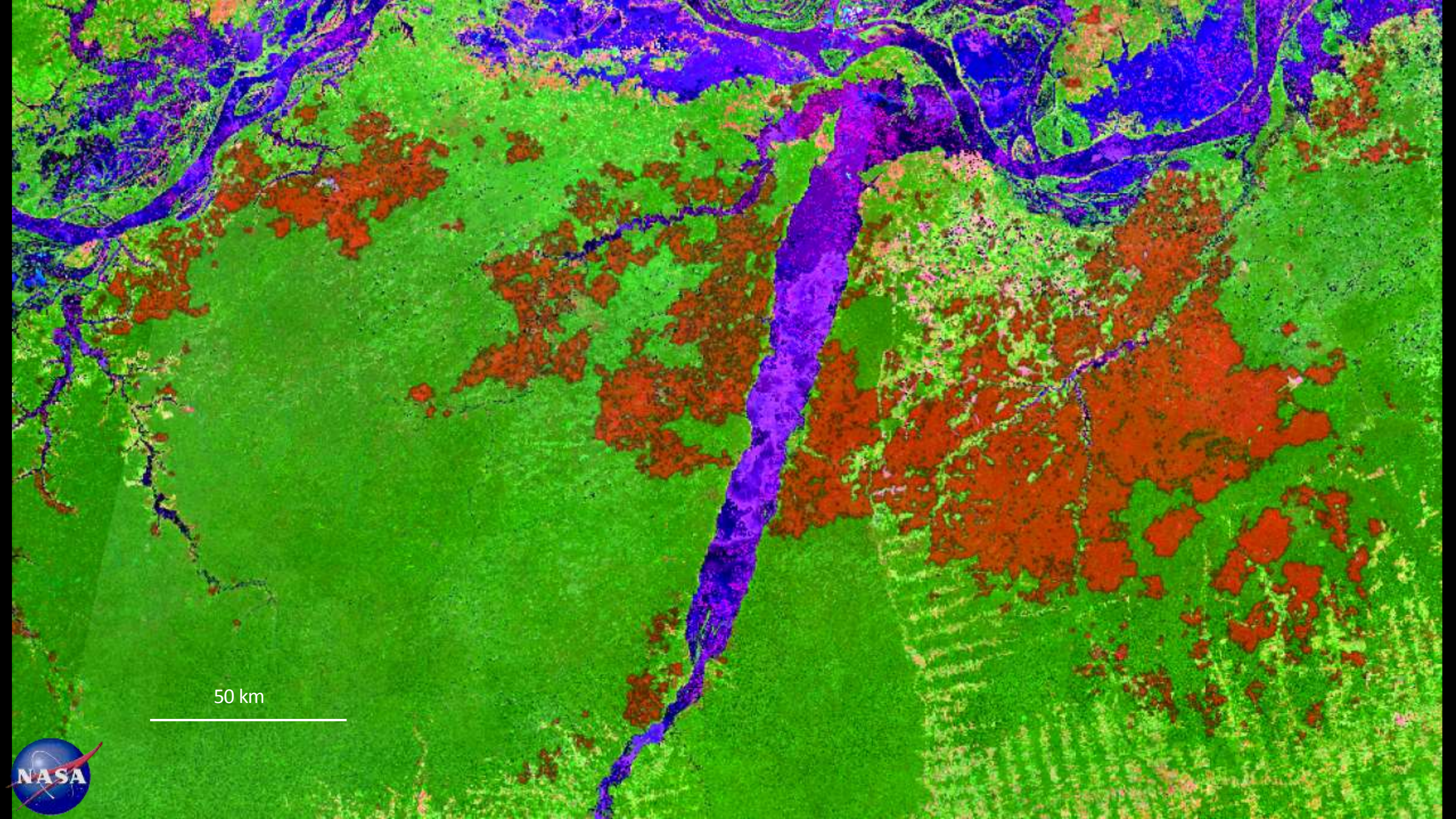




Biomass Recovery Following Degradation

	1 year	5 year	10 year	15 year
Logging	55%	71%	78%	82%
Burn 1x Low	49%	64%	70%	74%
Burn 1x High	32%	47%	54%	58%
Burn 2x	18%	34%		
Burn 3x	10%	26%		

Rappaport et al., 2018


50 km

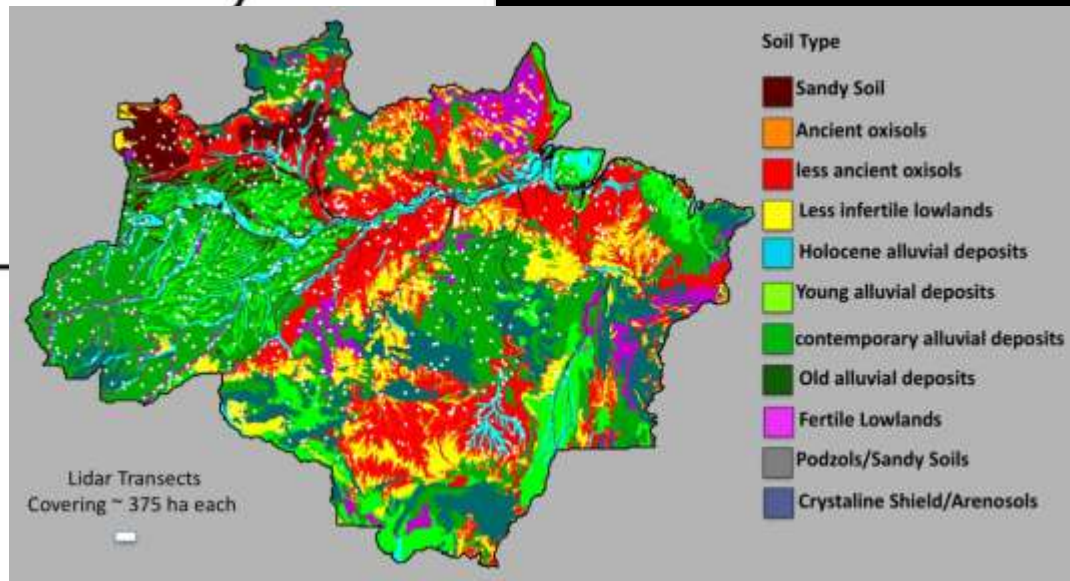
Preliminary estimate of fire-induced carbon losses 2015-2016:

Region	Understory Fire (km^2)	Committed C Emissions Tg (Low, 10 yr)	Committed C Emissions Tg (High, 1 yr)
Southern Amazon	31,400	130.8	233.2
Northern Amazon	9,500	39.6	70.5
Total	**40,900**	**170.4**	**303.7**
2016 Deforestation	**7,989**		**109.5****

*2015 and 2016 Fires, Combined
** INPE-EM

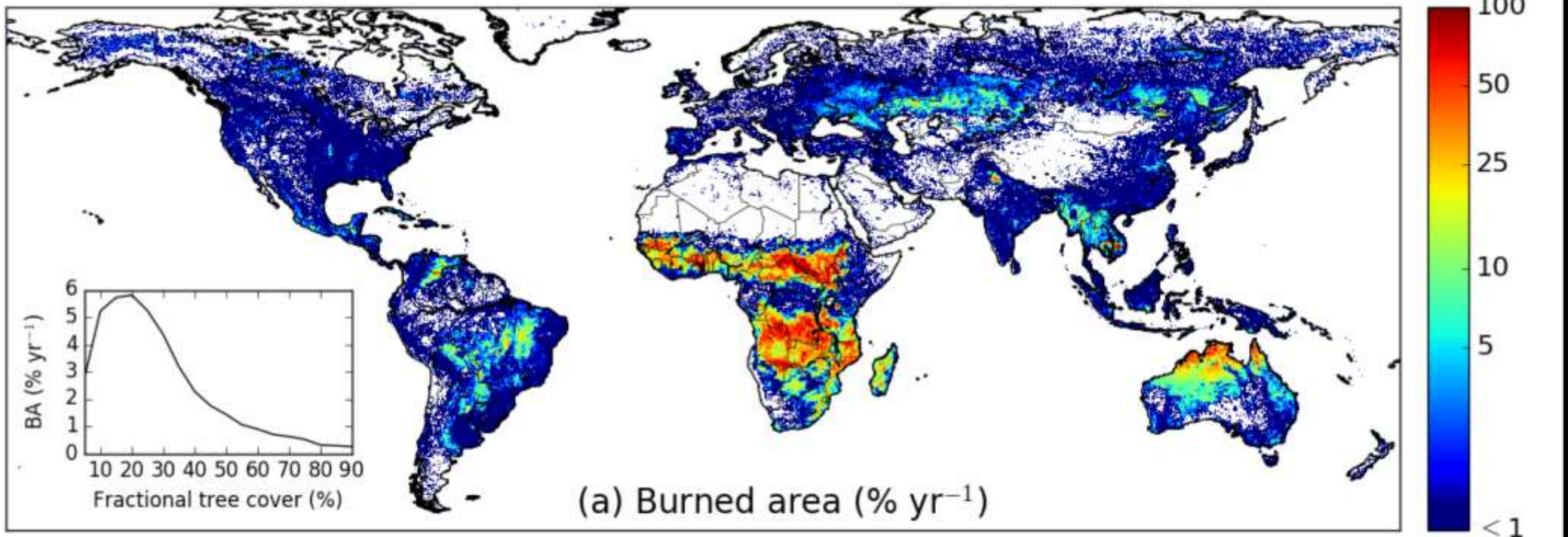
INPE Lidar 2016-2017

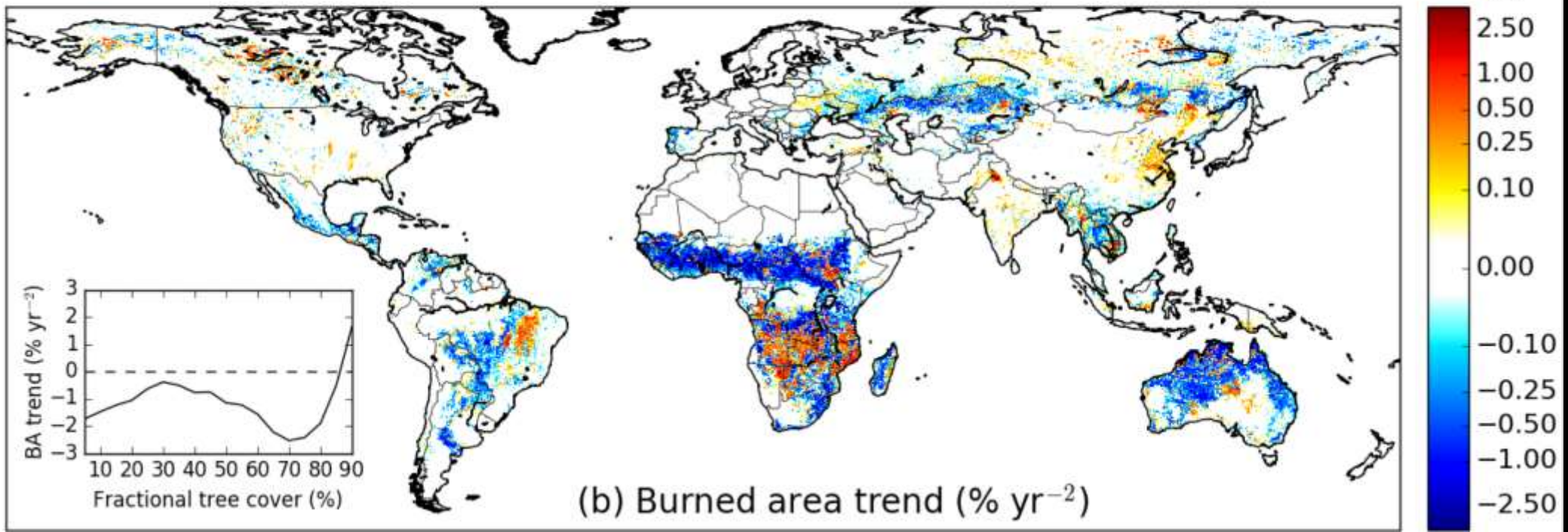
Sample
Repeat
Cal/val



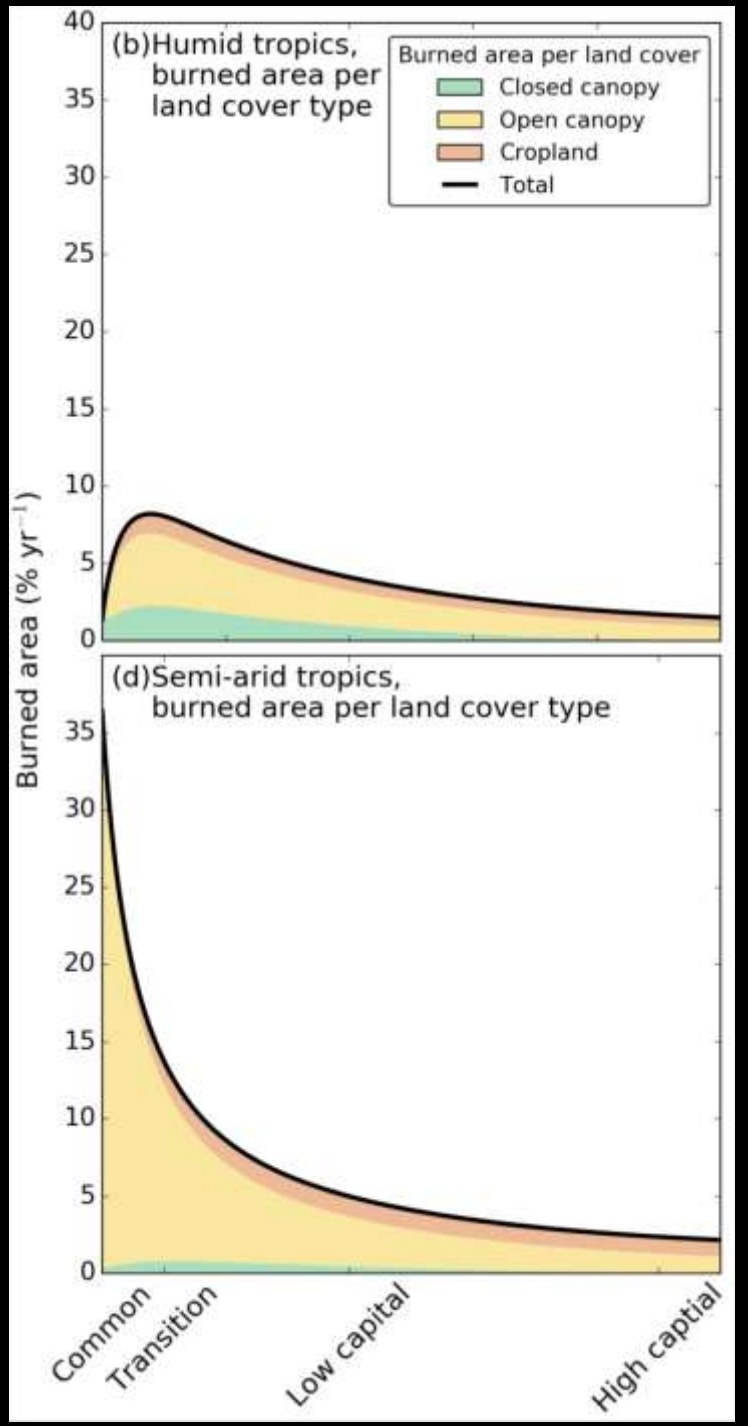
Forest Degradation:

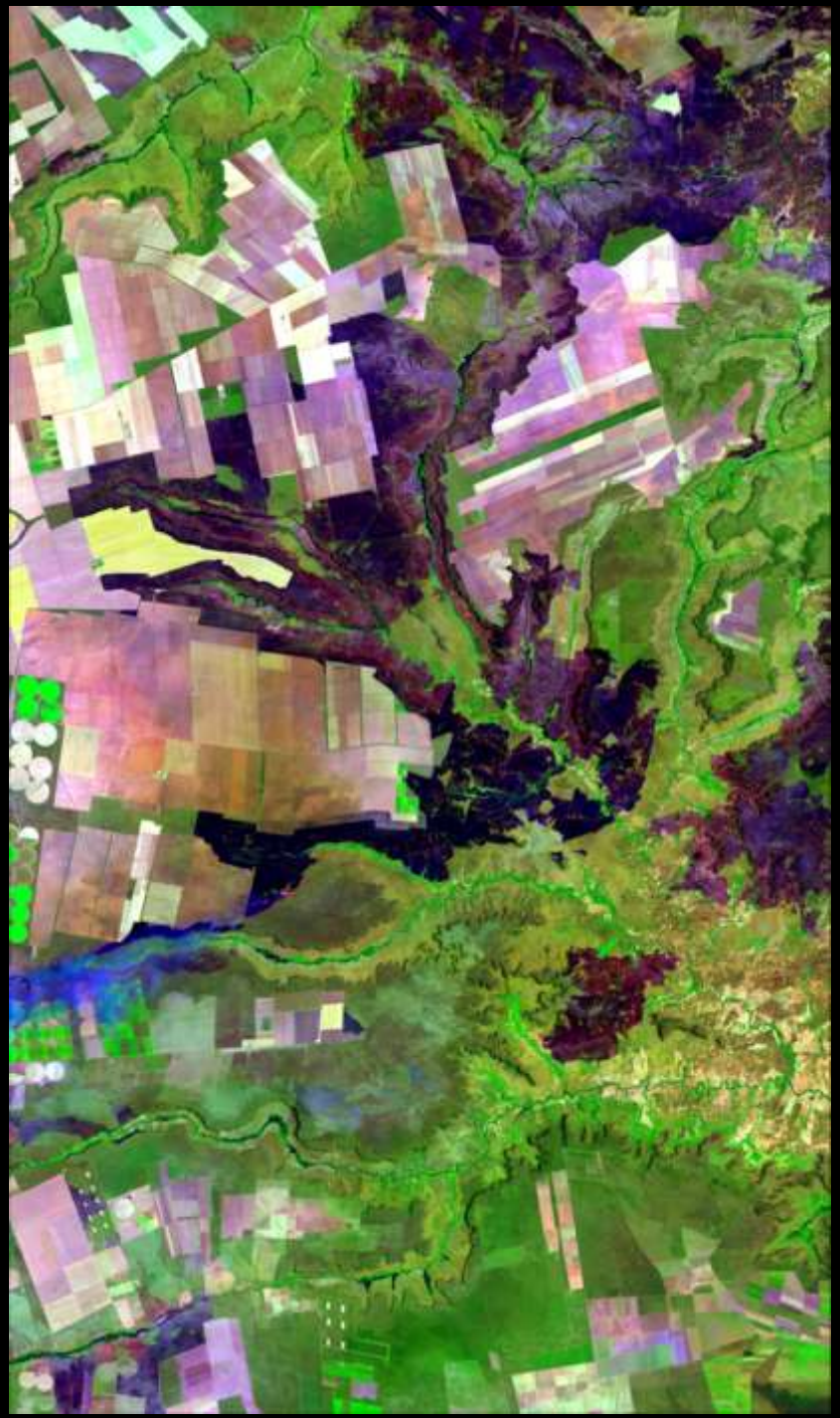
- The combination of Landsat and lidar provides a powerful tool to characterize the spatial and temporal patterns of frontier development.
- Degraded forests cover a large (and growing) proportion of frontier regions.
- Frontier forests have lower carbon stocks, following decades of logging, fire, and fragmentation, even after 5+ years of recovery.
- Burned forests have lower carbon stocks than logged forests, and recover more slowly following forest degradation.
- Airborne lidar data capture fine-scale heterogeneity in forest carbon stocks over spatial scales needed for REDD+ monitoring, reporting, and verification.



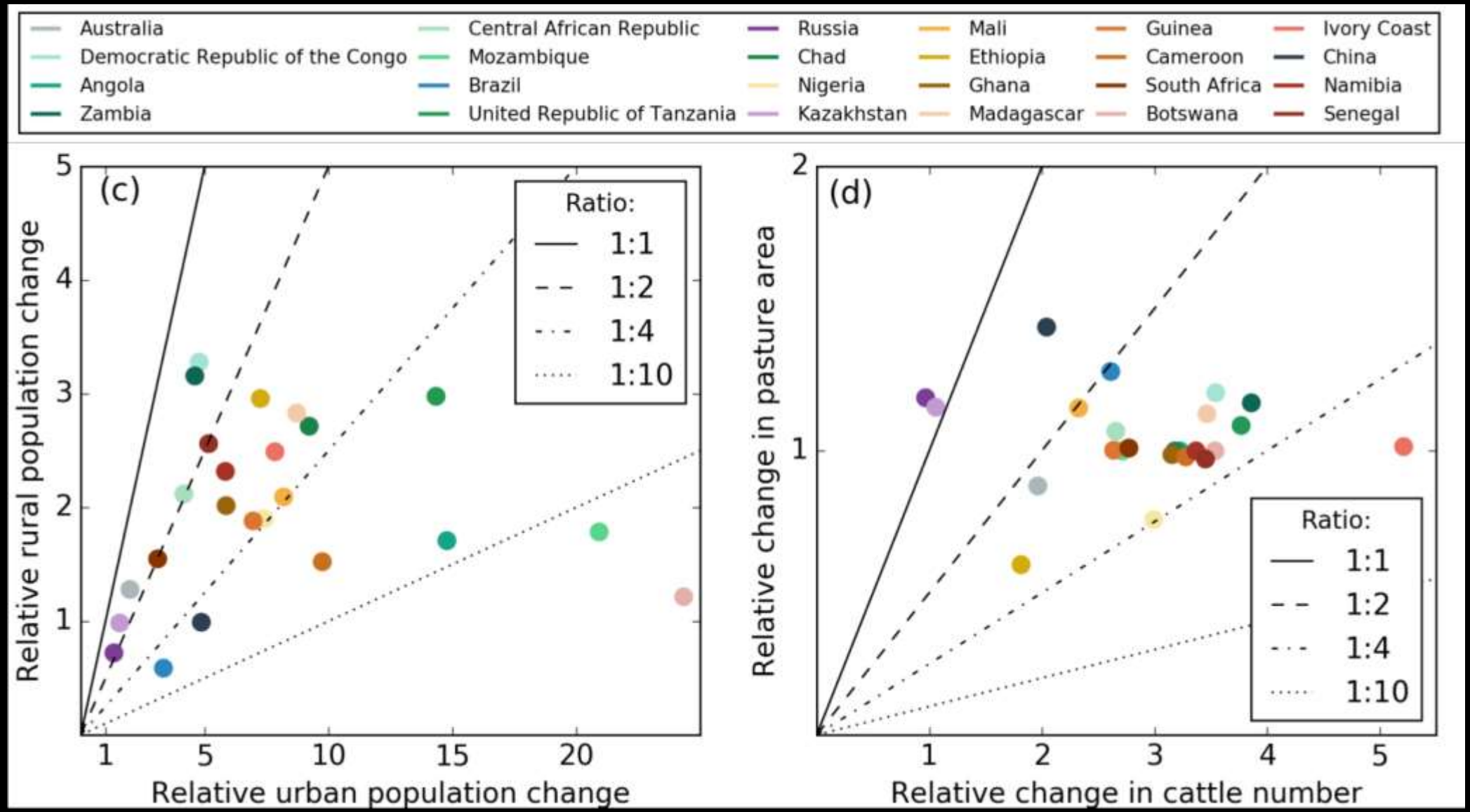


Andela et al., 2017



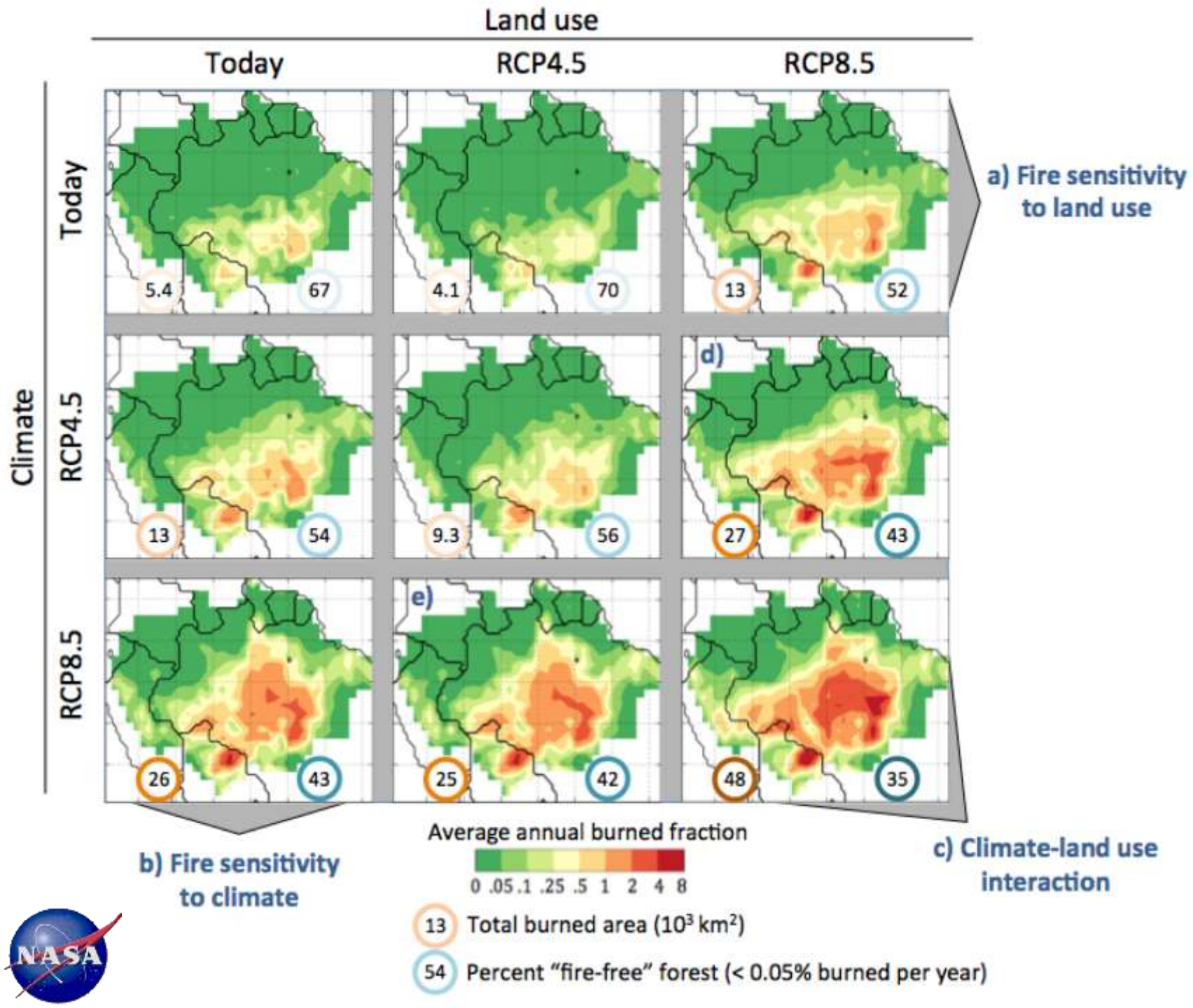


Andela et al., 2017 *Science*



Population & cattle rose exponentially between 1970-2015 in the 24 countries with most burned area, driven by urbanization and increasing stocking density.

Andela et al., 2017



Alone, restricting further deforestation will not protect Amazon forests from greater fire risk in coming decades.

Le Page et al., 2017

Fires

- Worldwide decline in burning, including across the Amazon arc of deforestation.
- Fewer fires presents some difficult tradeoffs for conservation, land management.
- Satellite remote sensing provides a means to track risk, real-time changes, to facilitate more active management.
- Can Brazil's Forest Code serve as a vehicle to incentivize less burning in the Amazon and more burning in human-dominated landscapes across the Cerrado?

Questions?

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https://www.paisagenslidar.cnptia.embrapa.br/webgis/

http://www.globalfiredata.org