3-4 FEBRUARY 2021

GEO-INPE WEBINARS

Learn about Brazil's monitoring system and the recent technological advances by Brazil's National Institute for Space Research (INPE)

Welcome
by the GEO Secretariat Director, Gilberto Câmara

Welcome
by the National Institute for Space Research in Brazil (INPE)

Moderator

Dr Luiz Aragão
Head of the Earth Observation and Geoinformatics Division, INPE

Luiz Aragão is the head of the Earth Observation and Geoinformatics Division at the National Institute for Space Research in Brazil. He also acts as president of Amazonia's Large-scale Biosphere-Atmosphere Program (LBA) scientific committee.

Dr Aragão is a senior scientist, authoring over 170 publications integrating remote sensing, modelling and field-based studies on tropical ecosystems' functioning, environmental sustainability and carbon accounting.

Housekeeping

- **Indicate your name and your affiliation** by going to the list of participants, clicking on your name and then on “rename”.

- **Post your questions in the chat box**. The moderator will pick them up and speakers will respond in the chat as well as during the Q&A session.

- **We are recording** this webinar and we will post it on the GEO website.

Structure of the GEO-INPE Webinar - Day 1

- **The PRODES system: history, operation, data dissemination and use -** Cláudio Almeida, Daniel Silva (20 min)
- Moderated Q&A and discussion (30 min)
- Short break (5 min)
- **The DETER system: history, operation, data dissemination and use -** Marcos Adami, Cláudio Almeida (20 min)
- Moderated Q&A and discussion (30 min)
- Wrap-up (5 min)

Dr Cláudio Almeida
Coordinator of Monitoring of Amazon e Other Biomes Program
INPE

Cláudio Almeida is a senior technologist at the National Institute for Space Research (INPE). Between 2009 and 2012, he was the head of Regional Center of Amazon, and since 2018 he coordinates the program of Monitoring Amazon and Other Brazilian Biomes. He works with monitoring changes in land use and land cover, and analyzes of anthropized landscapes.

He graduated in Agronomy from UFRRJ (1992), and holds a Masters in Remote Sensing from INPE (2008) and a PhD in Geomatics from the University of Montpellier, France (2016).

Dr Daniel E Silva
Technical Manager - Amazon PRODES Project
INPE

Daniel E Silva is the technical manager of Amazon PRODES Project at the National Institute For Space Research (INPE) since 2019, working on detection and quantification of annual deforestation in the Amazon Biome, based on Remote Sensing data and Geoprocessing techniques. He currently deals with different aspects of the Program like map production, methodology and research.

He has experience on Ecosystems Ecology, niche modeling and vegetation responses to environmental stress, and worked with forest inventory databases at large spatial scale and local ecological characterizations.

He holds a PhD in Biodiversity, Ecology and Forest Sciences.

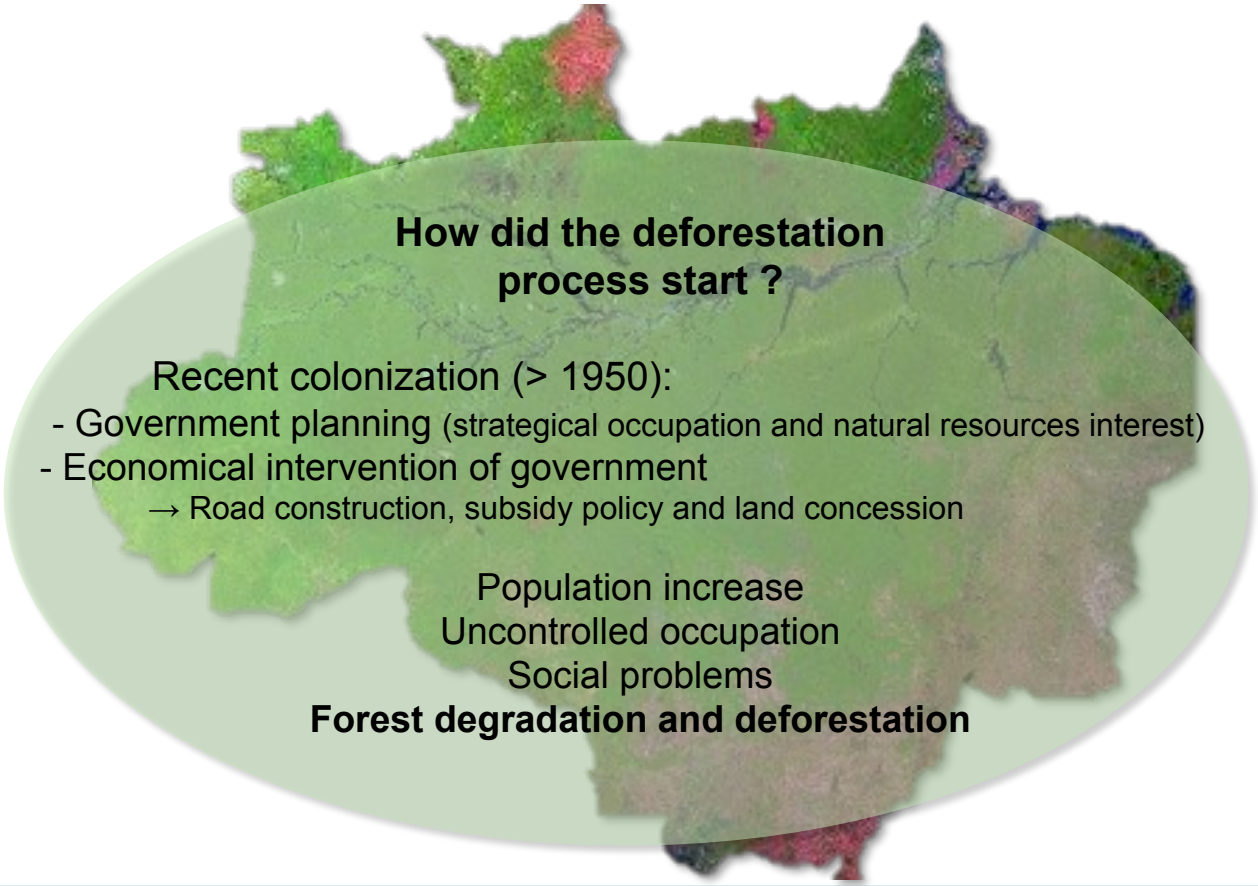
Monitoring Forest Project PRODES

History, operation, data dissemination and use

Cláudio Almeida – Amazon Program (INPE)

Daniel E Silva – Amazon Program (INPE)

The Amazon and deforestation



How did the deforestation process start ?

Recent colonization (> 1950):

- Government planning (strategical occupation and natural resources interest)
- Economical intervention of government

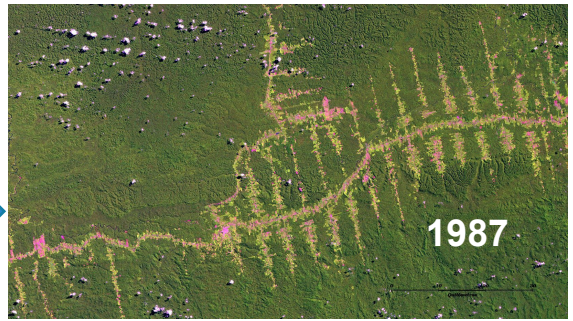
→ Road construction, subsidy policy and land concession

Population increase
Uncontrolled occupation
Social problems
Forest degradation and deforestation

Preparation to ECO-92

Brazil: first country to sign the UN Framework Convention on Climate Change, as a result of the UN Conference on Environment and Development (Rio, 1992)

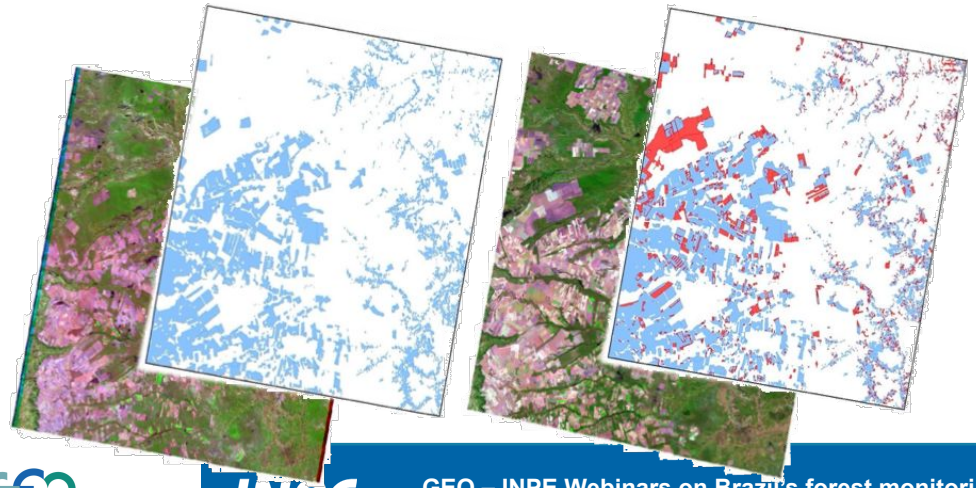
Impacts of road construction settlements



PRODES - Methodology

Almeida et al. 2021: http://urlib.net/rep/8JMKD3MGP3W34R/443H3RE

Incremental system
Annual increase of deforestation
Medium spatial resolution (~ 20-30 m)
Minimum Mapping Unit (MMU) = 6.25 ha (AMZ) 1 ha Other biomes
Visual Interpretation
Team with large experience
Accuracy >93% (Maurano *et al* 2019, Parente *et al* 2021)



Previous year

Mapping year

PRODES processes: implications on data quality

Aspects of **PRODES quality**:

I - Mapping processes requirements

II - External validation

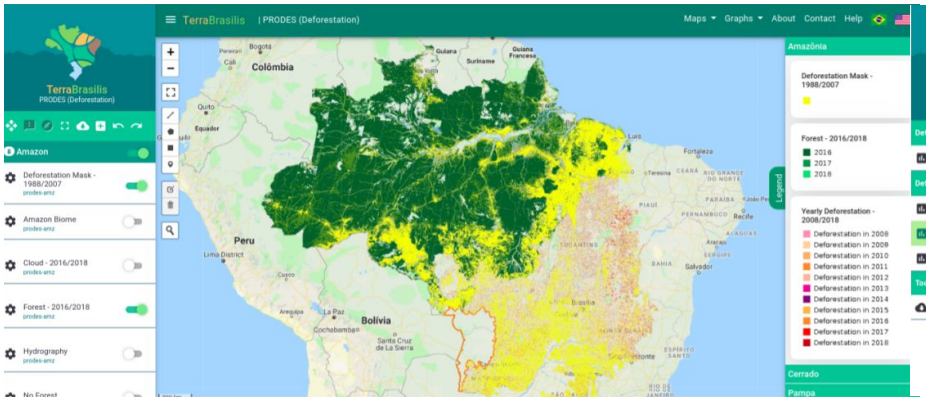
III - Transparency

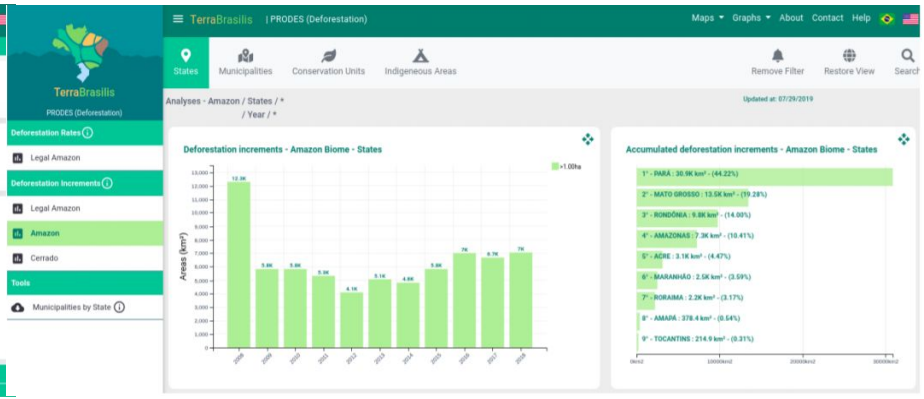
Image selection and processing	Best detection period Reduced cloud coverage
Visual interpretation	Multi-disciplinary and experiente team Legend and protocol standardization Ancillary data Information about regional or local specificity
Auditing	Systematic process (100% of territory) Visual inspection
Post-processing	Consistency and processing rules checking
Map validation	Stratified and random sampling External staff
Data Dissemination	Transparency (http://terrabrasilis.dpi.inpe.br/) Technical reports Scientific publications

Data dissemination

Terrabrasilis Platform
- Open data
- Map visualization and dashboards
- Spatial analysis tools
  http://terrabrasilis.dpi.inpe.br

Papers and scientific and technical reports
http://www.obt.inpe.br/

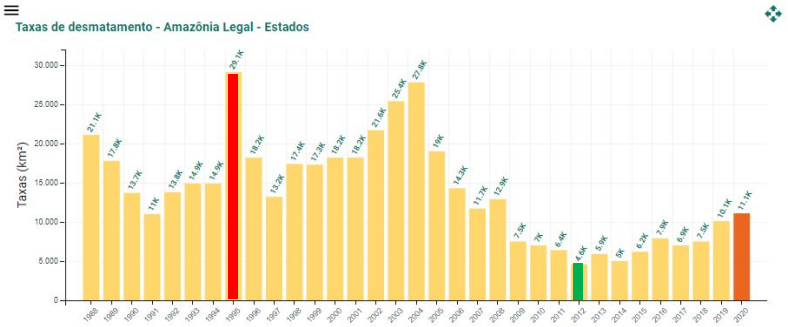


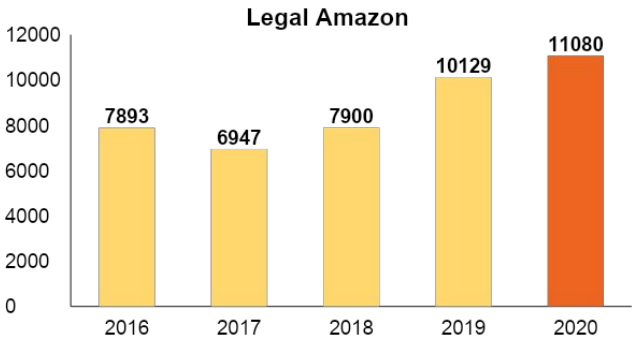


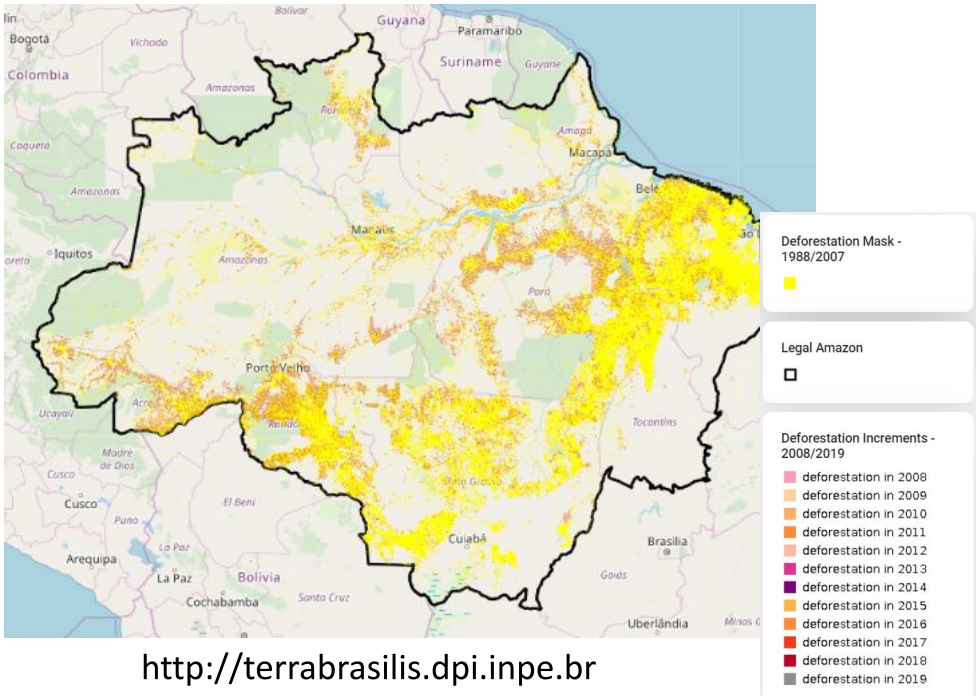
PRODES results (Amazon)

Clear cut deforestation at 2020 > 810.000 km^2
> 20% of original forest of Brazilian Legal Amazon

Compatible historical series



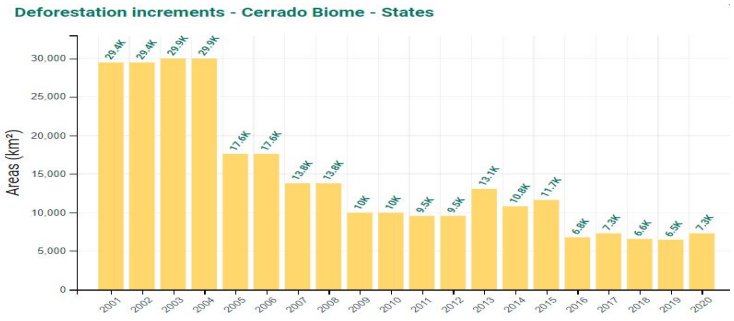


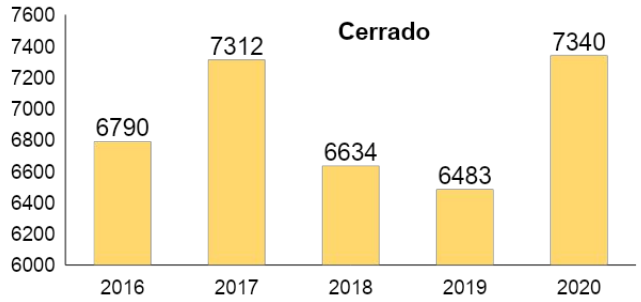


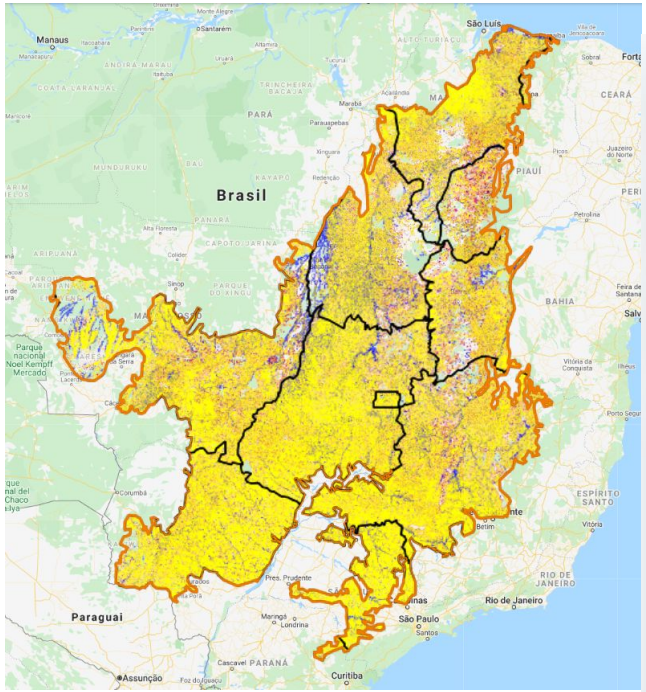
http://terrabrasilis.dpi.inpe.br

PRODES results (Cerrado)

Natural vegetation removal until 2020 > 1.000.000 km^2
> 50% of original vegetation of Cerrado biome







http://terrabrasilis.dpi.inpe.br

PRODES Other biomes

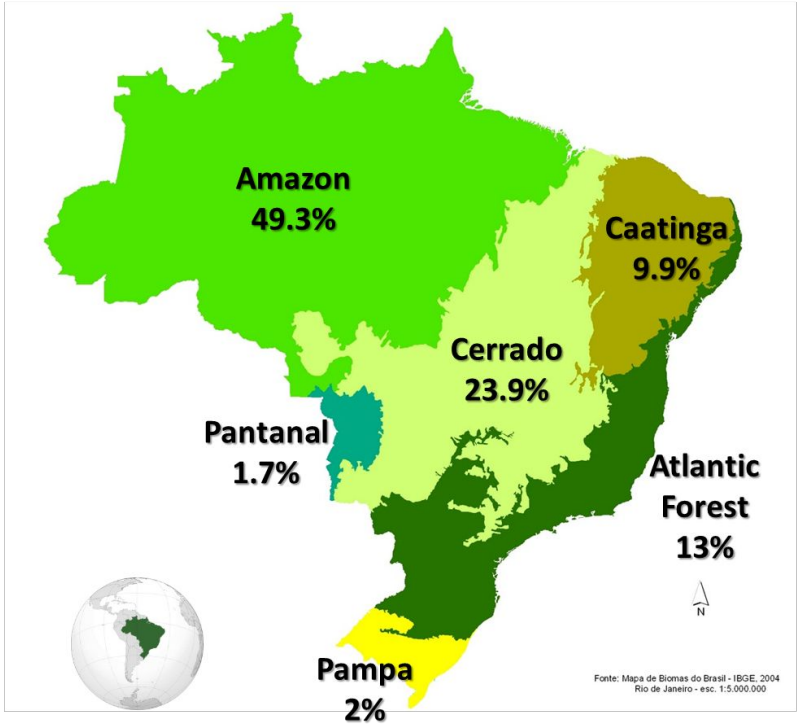
FUNDO AMAZÔNIA

Brazilian Biomes

Amazon

Pantanal

Pampa



Cerrado

Caatinga

Atlantic Forest

PRODES Other biomes
2004 – 2018 (FREL)
Annual > 2019

PRODES Challenges

Process automatization

Use of multi-sources data

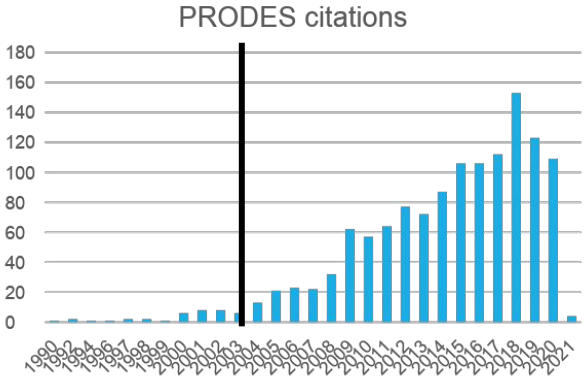
New techniques for vegetation change detection

X

Maintain the consistency of the historical series and the data quality

PRODES Data Users

Academic studies



Until 01/02/2021: 1.281 papers in 429 indexed journals

Compliance
Economic Channels

Public policies

National Adaptation Plan to Climate Change

General Strategy
VOLUME I

Reducing
Emissions from
Deforestation and forest
Degradation

conservation of forest carbon stocks
\+ sustainable management of forests
enhancement of forest carbon stocks

United Nations
Framework Convention on Climate Change

Thank you

Cláudio Almeida / claudio.almeida@inpe.br
Daniel E Silva/ daniel.silva@inpe.br

http://www.obt.inpe.br/OBT/assuntos/programas/amazonia/prodes

Q&A and discussion

30 minutes

Short break

5 minutes

Dr Marcos Adami
Researcher
INPE

Marcos Adami has been working on agriculture area and yield forecasting since graduating. In the last 8 years, his research at the National Institute For Space Research (INPE) has been focused on Brazilian Amazon land cover and land use changes and their drivers and impacts.

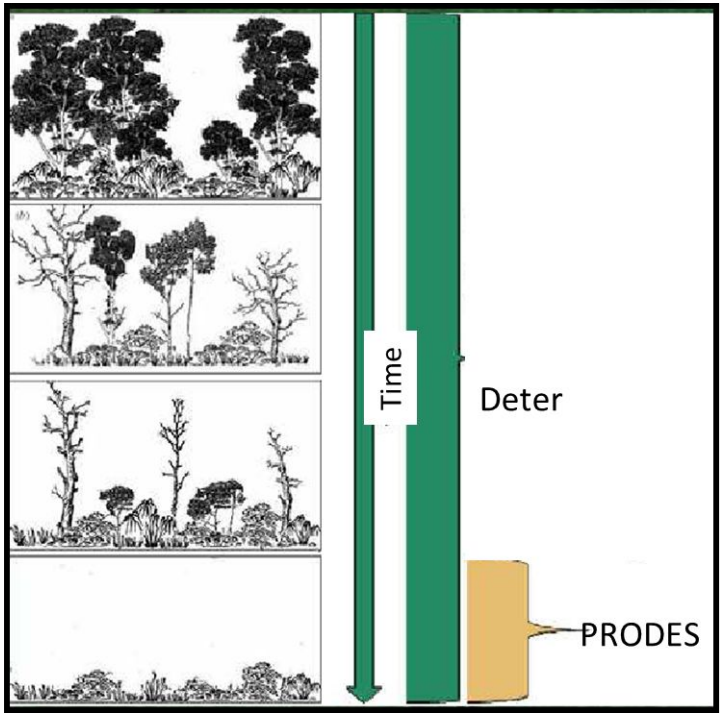
His research interests involve sampling, agricultural statistics, remote sensing time series, land cover and land use change.
He holds a B.S. degree in Economics, a M.Sc. and a Ph.D. in Remote Sensing.

Deter Project
Amazon Near Real-Time Deforestation Detection System

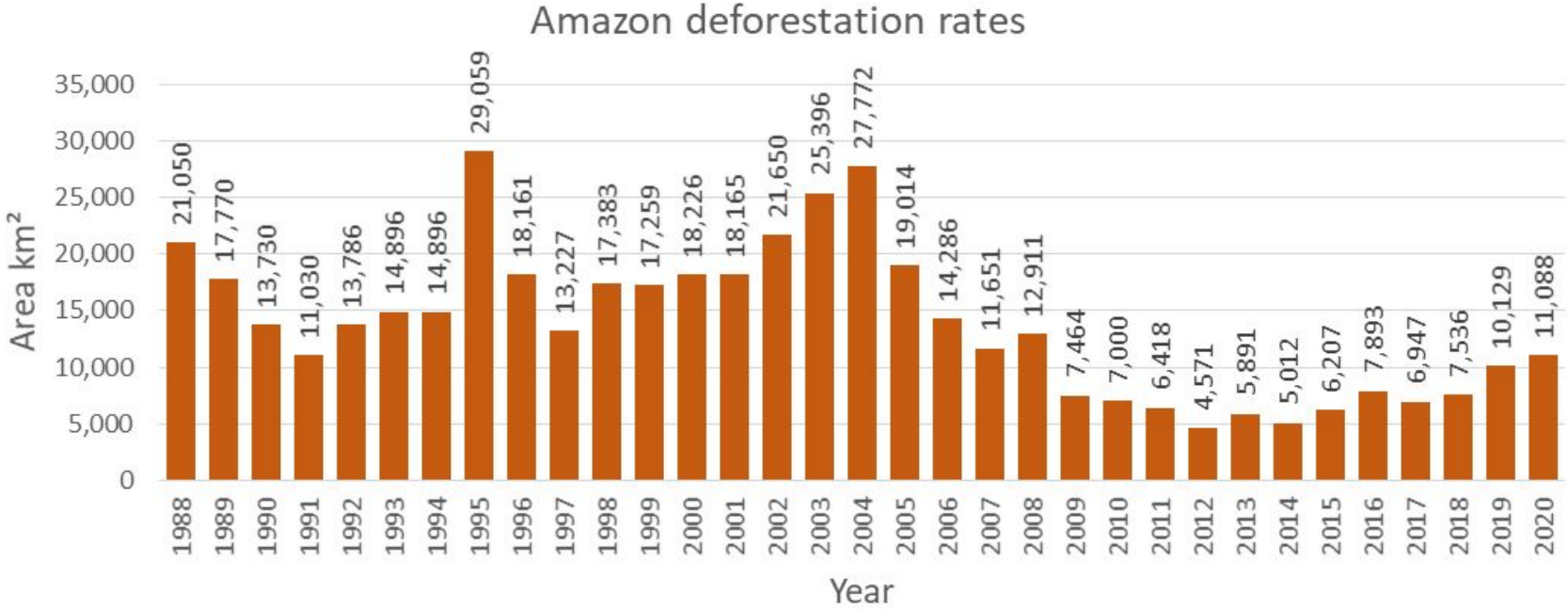
History, operation, data dissemination and use

DETER -> when forest degradation and deforestation can be detected?

- ❑ Intense logging
- ❑ Canopy loss >50%
- ❑ Canopy loss >90%
- ❑ Clear cut

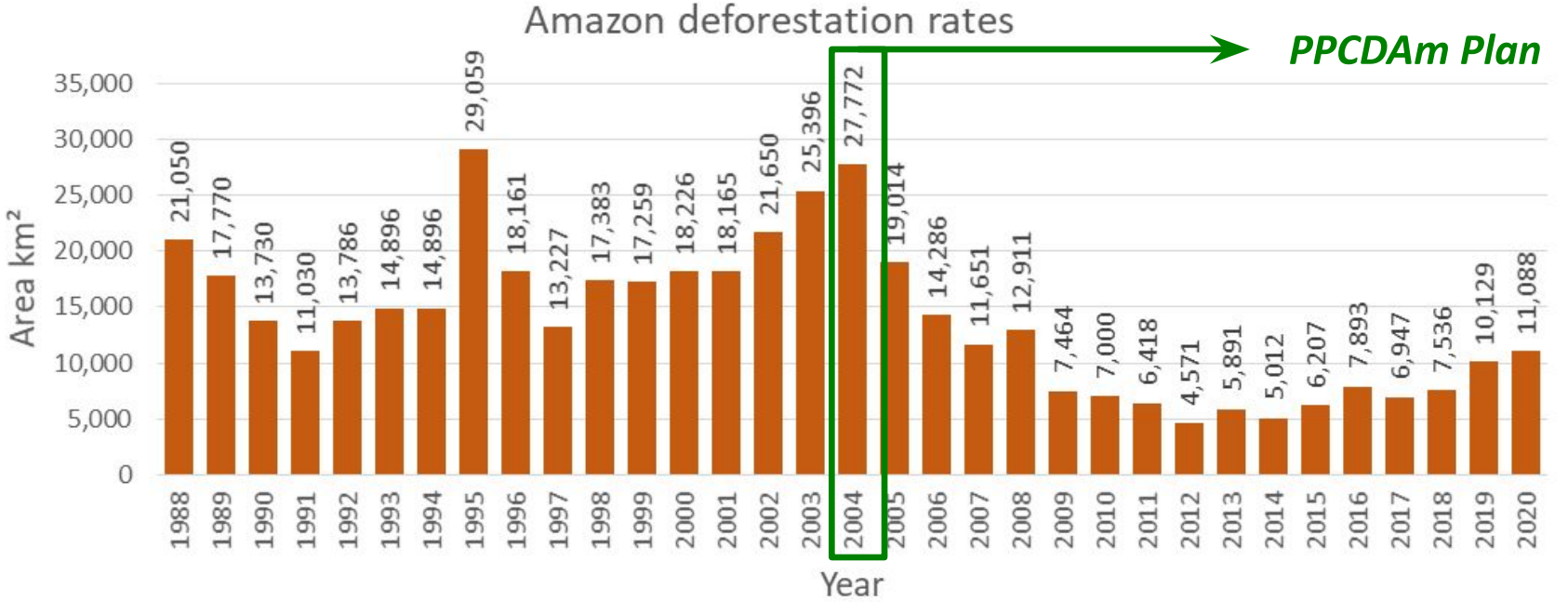


Deter history



Source: PRODES (2021)

Deter history



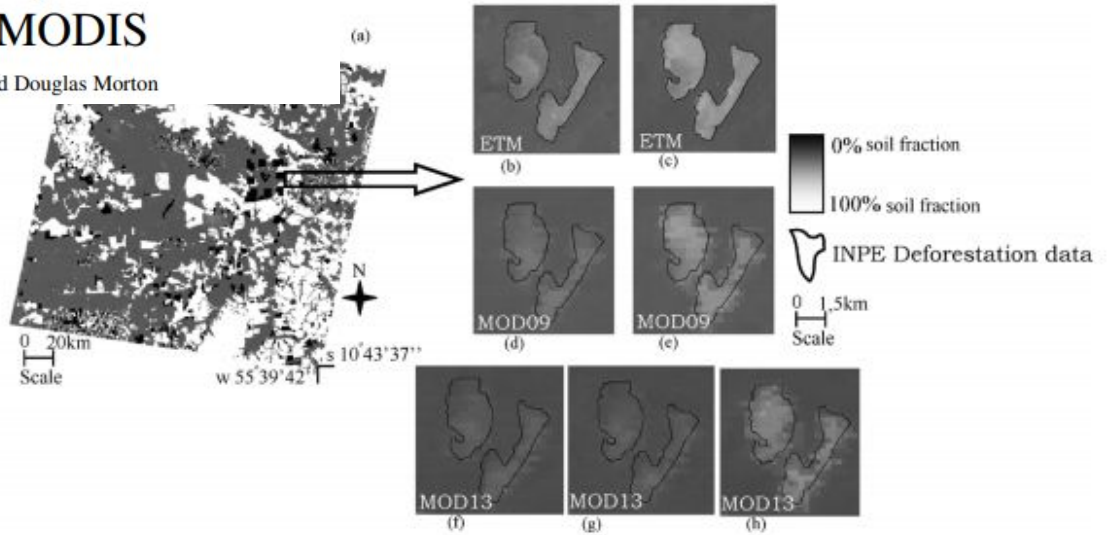
Source: PRODES (2021)

A tool to support environmental law enforcement

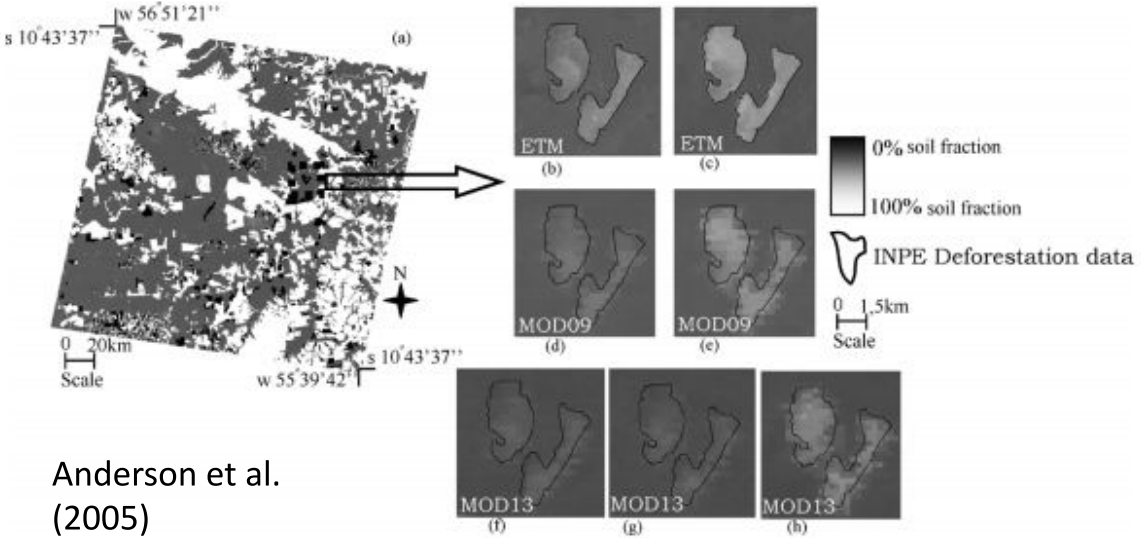
IEEE GEOSCIENCE AND REMOTE SENSING LETTERS, VOL. 2, NO. 3, JULY 2005 315

Assessment of Deforestation in Near Real Time Over the Brazilian Amazon Using Multitemporal Fraction Images Derived From Terra MODIS

Liana O. Anderson, Yosio E. Shimabukuro, Ruth S. Defries, and Douglas Morton



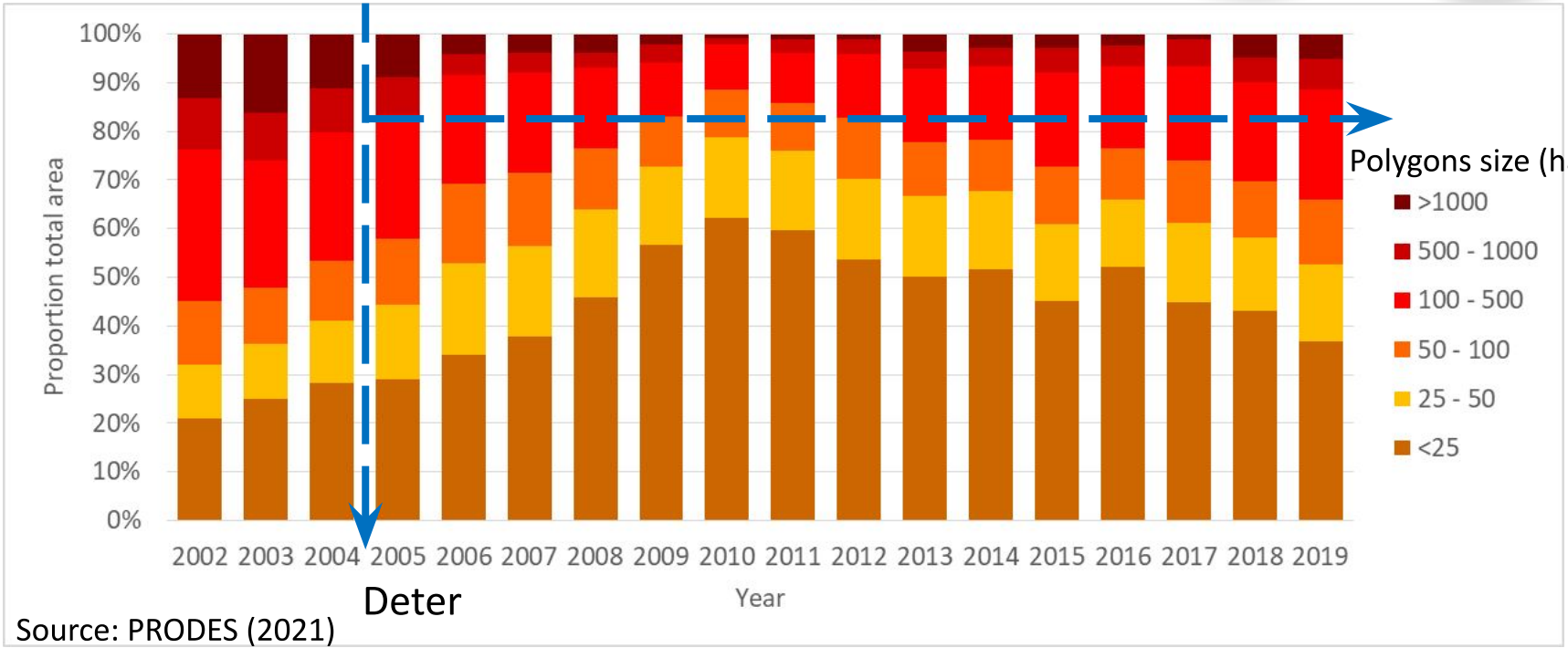
How it was operated (2004 – 2017)



Anderson et al. (2005)

- MOD09 daily images
- Linear mixture model
- Visual interpretation
- Only 1 Class -> Alert

Small polygons became important



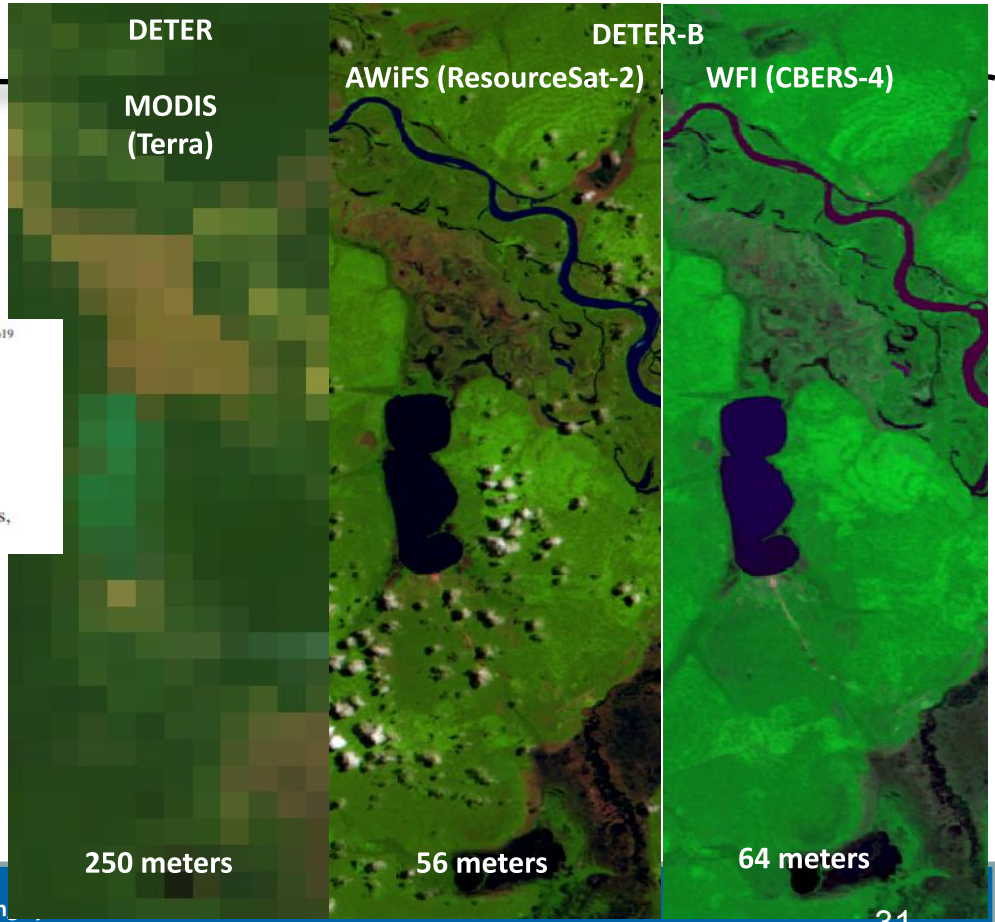
Source: PRODES (2021)

Deter improvements

IEEE JOURNAL OF SELECTED TOPICS IN APPLIED EARTH OBSERVATIONS AND REMOTE SENSING, VOL. 8, NO. 7, JULY 2015 3619

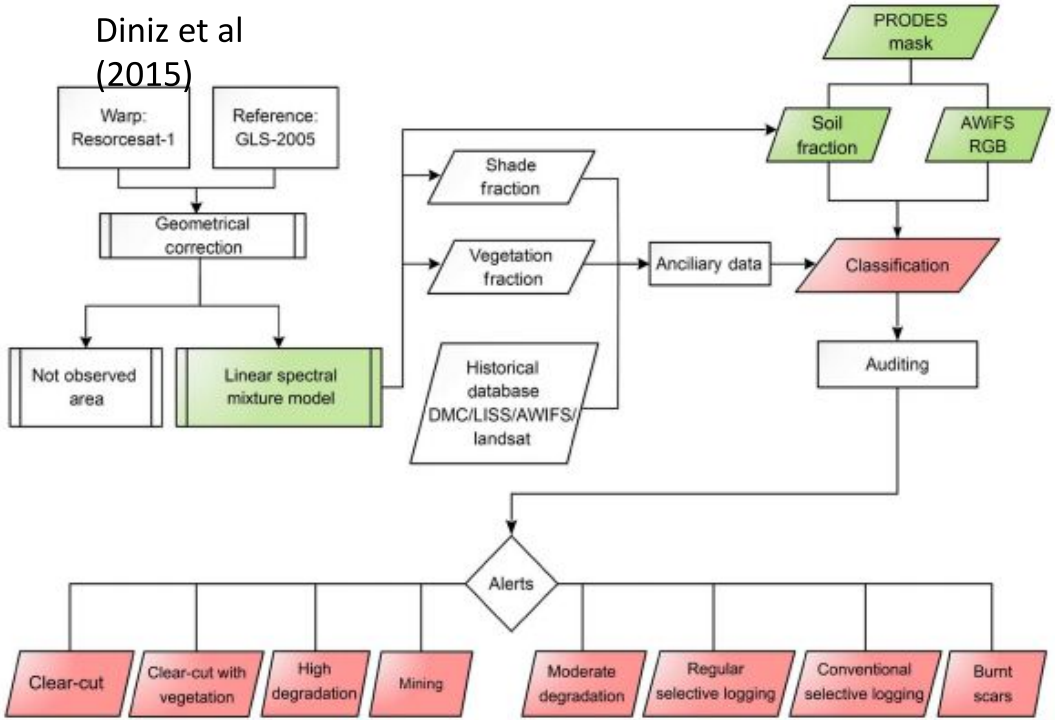
DETER-B: The New Amazon Near Real-Time Deforestation Detection System

Cesar Guerreiro Diniz, Arleson Antonio de Almeida Souza, Diogo Corrêa Santos, Mirian Correa Dias, Nelton Cavalcante da Luz, Douglas Rafael Vidal de Moraes, Janaina Sant'Ana Maia, Alessandra Rodrigues Gomes, Igor da Silva Narvaes, Dalton M. Valeriano, Luis Eduardo Pinheiro Maurano, and Marcos Adami



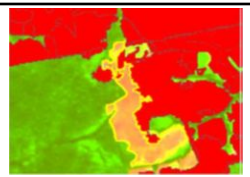
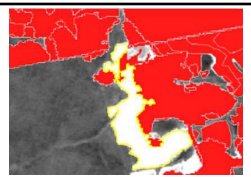
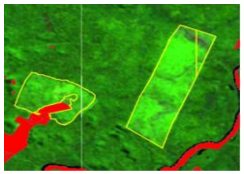
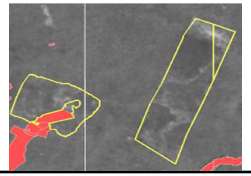
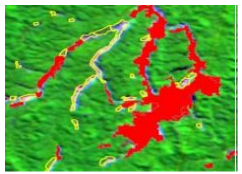
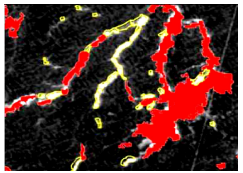
How it is operated (2005 –> …)

Diniz et al (2015)



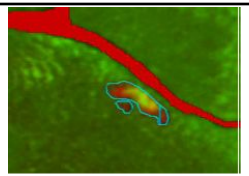
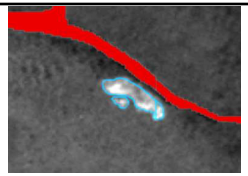
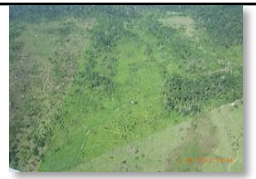
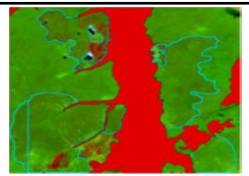
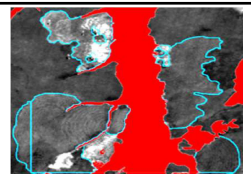
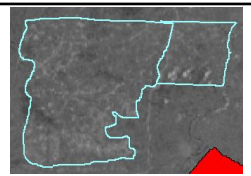
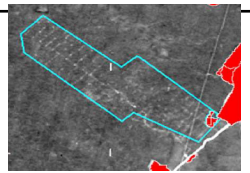
- WFI CBERS images
- Linear mixture model
- Visual interpretation
- 8 classes

DETER - Classes

Level 1	Level 2	Satellite	Soil Fraction	Field
Deforestation (ALERT)	Clear cut Deforestation			
	Deforestation With vegetation			
	Mining			

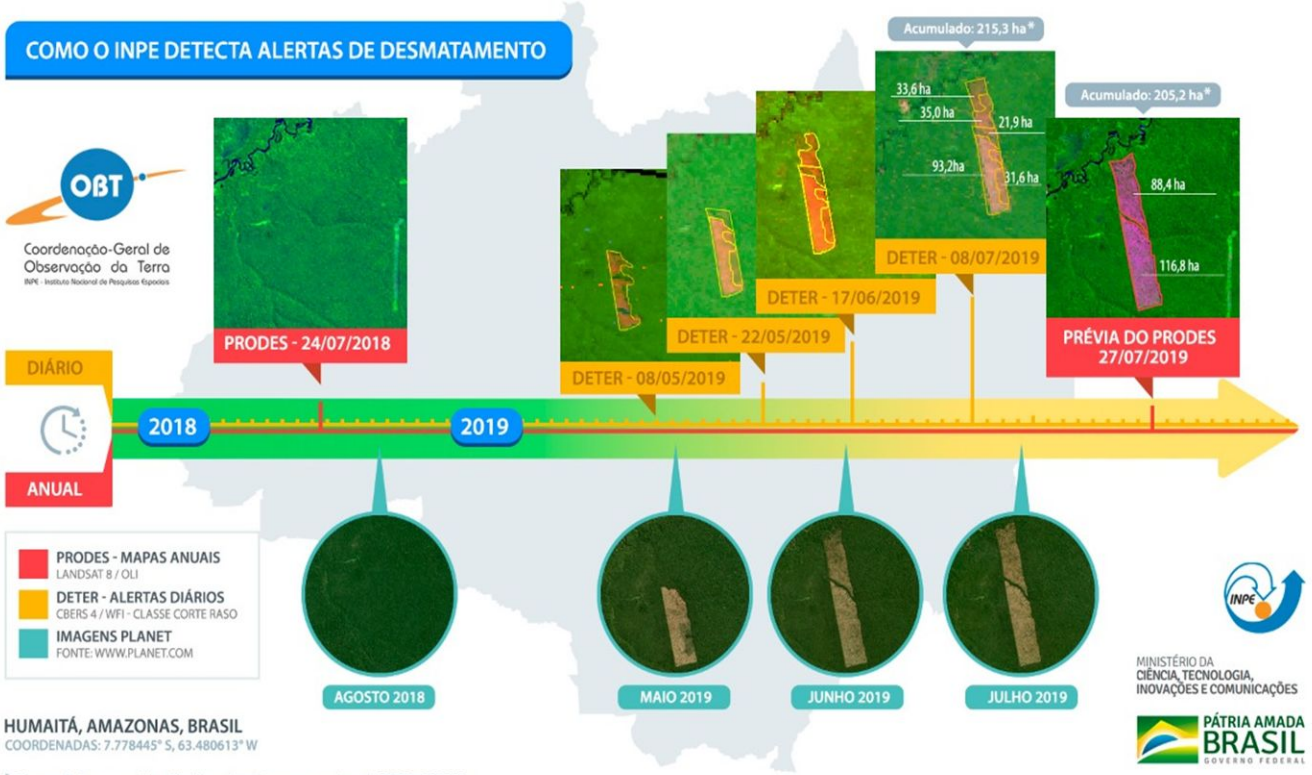
Diniz et al. (2015)

DETER - Classes

Level 1	Level 2	Satellite	Soil Fraction	Field
Degradation	Degradation			
	Burn Scar			
Selective logging	Selective Logging Type 1 (disordered)			
	Selective Logging Type 2 (ordered)			

Diniz et al. (2015)

How it works (2005 –> …)

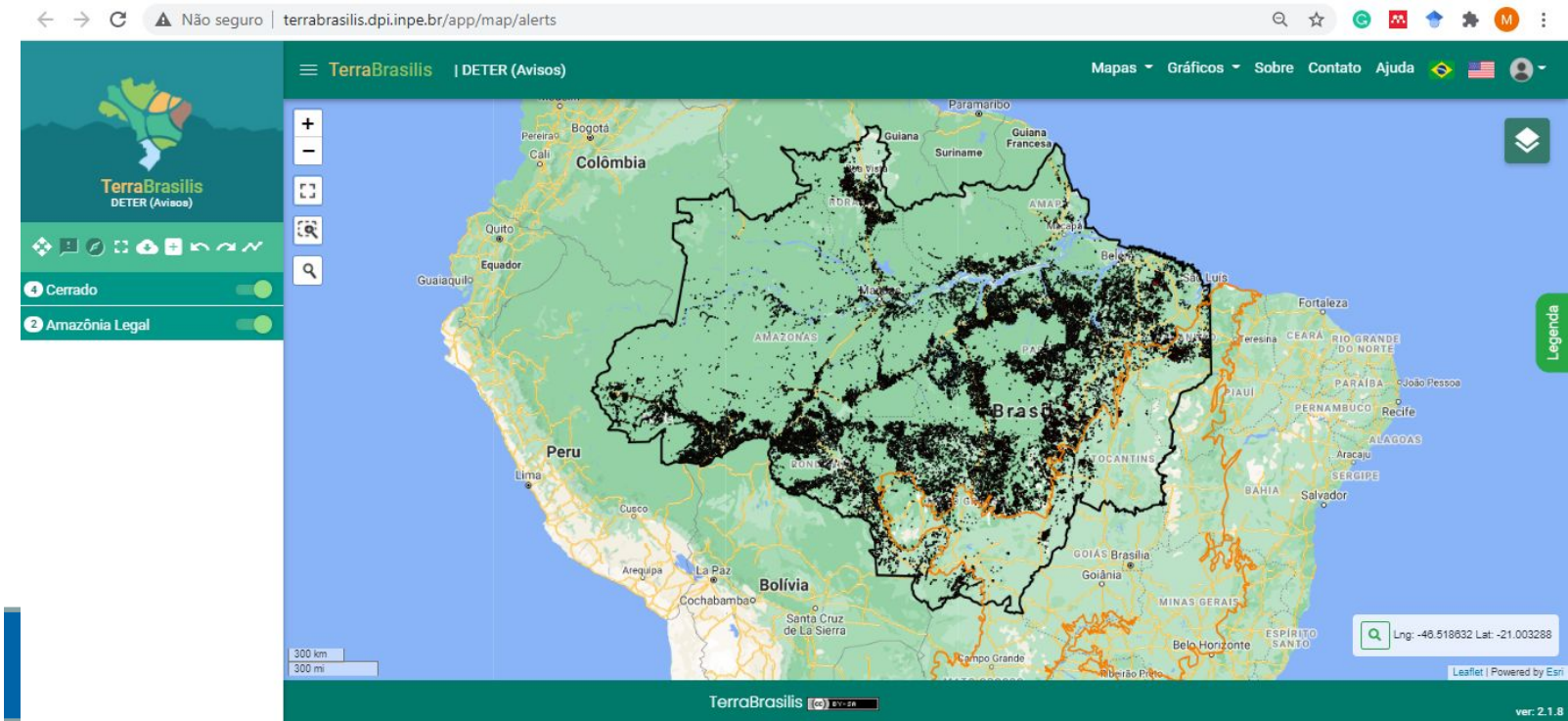


DETER- Sharing, analyzing, and reporting

Since 2014, all polygons greater than 3 ha have been sent to IBAMA

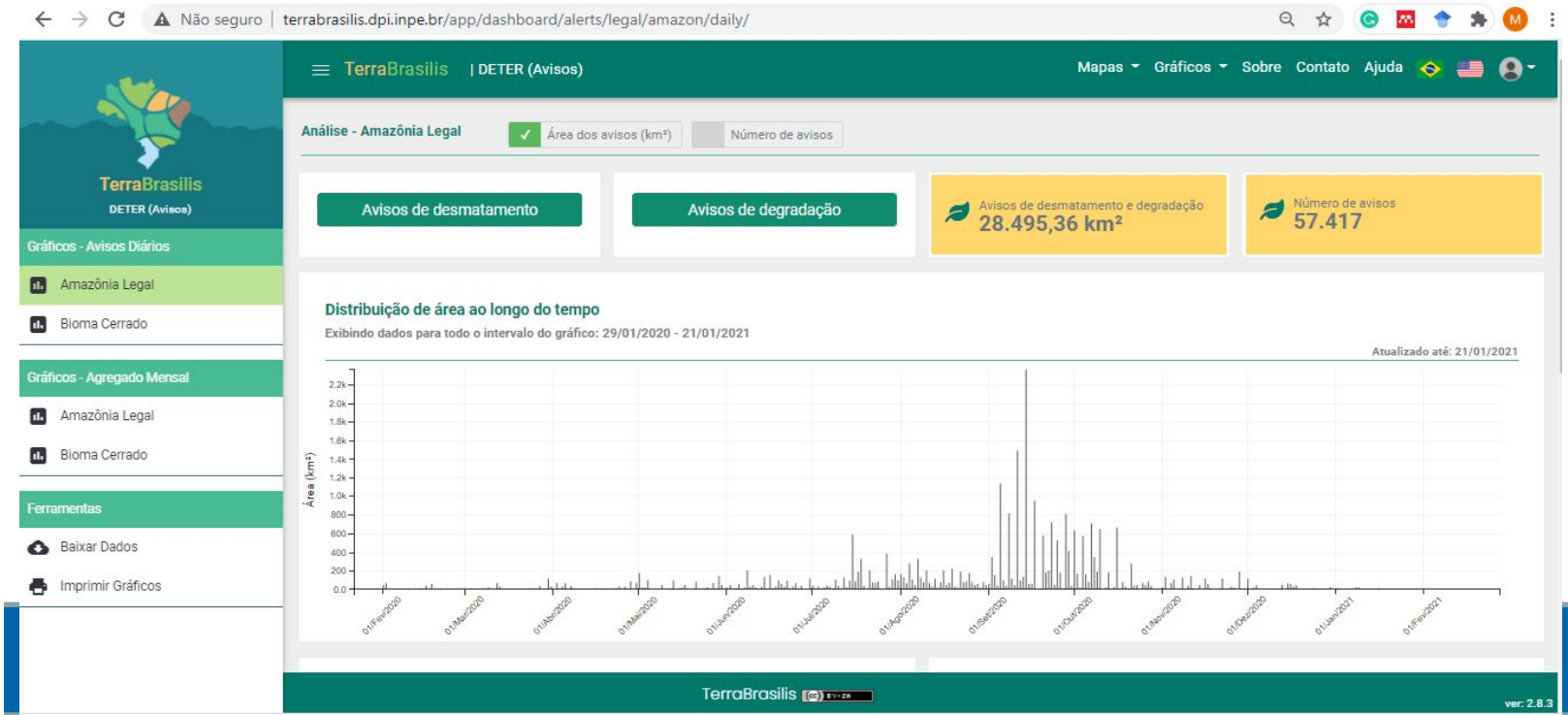
DETER- Sharing, analyzing, and reporting

http://terrabrasilis.dpi.inpe.br/



DETER- Sharing, analyzing, and reporting

http://terrabrasilis.dpi.inpe.br/



Deter evaluation

Alerts confirmed by Sentinel-2 (considering those zones with at least 3 ha of deforestation detected) in km.sq and (percentages)

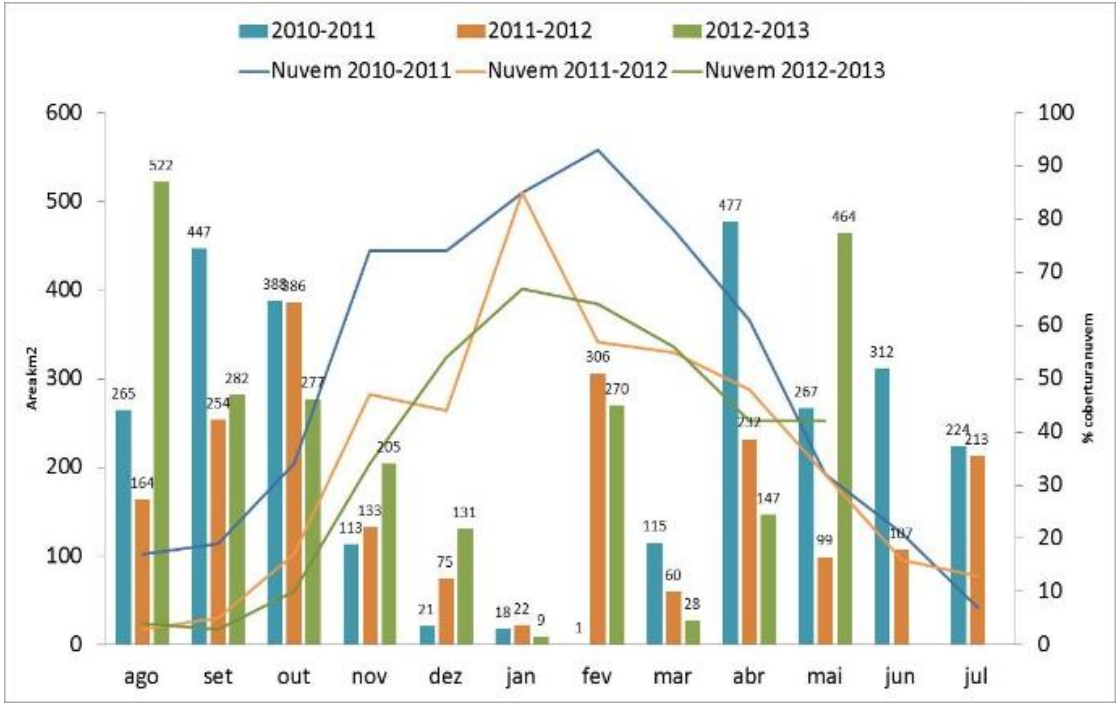
	May	June	July
2018	370.1 (78.3%)	367.7 (79.7%)	472.9 (73.7%)
2019	497.8 (76.0%)	721.2 (79.9%)	1794.9 (80.1%)

Alerts confirmed by Sentinel-2 (considering those zones with at least 1.5 ha of deforestation detected) in km.sq and (percentages)

	May	June	July
2018	396.1 (83.8%)	406.0 (88.0%)	520.0 (81.0%)
2019	544.0 (83.0%)	785.8 (87.1%)	1950.3 (87.0%)

https://geowiki.users.earthengine.app/view/brazildeforestation Fritz et al. (2019), Science

Some issues


2010-2011
2011-2012
2012-2013
Nuvem 2010-2011
Nuvem 2011-2012
Nuvem 2012-2013
Area km2
% cobertura nuvem
600
500
400
300
200
100
0
100
90
80
70
60
50
40
30
20
10
0
265
164
522
447
254
282
388
386
277
113
133
205
21
75
131
18
22
9
1
306
270
115
60
28
477
232
147
267
99
464
312
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213
ago
set
out
nov
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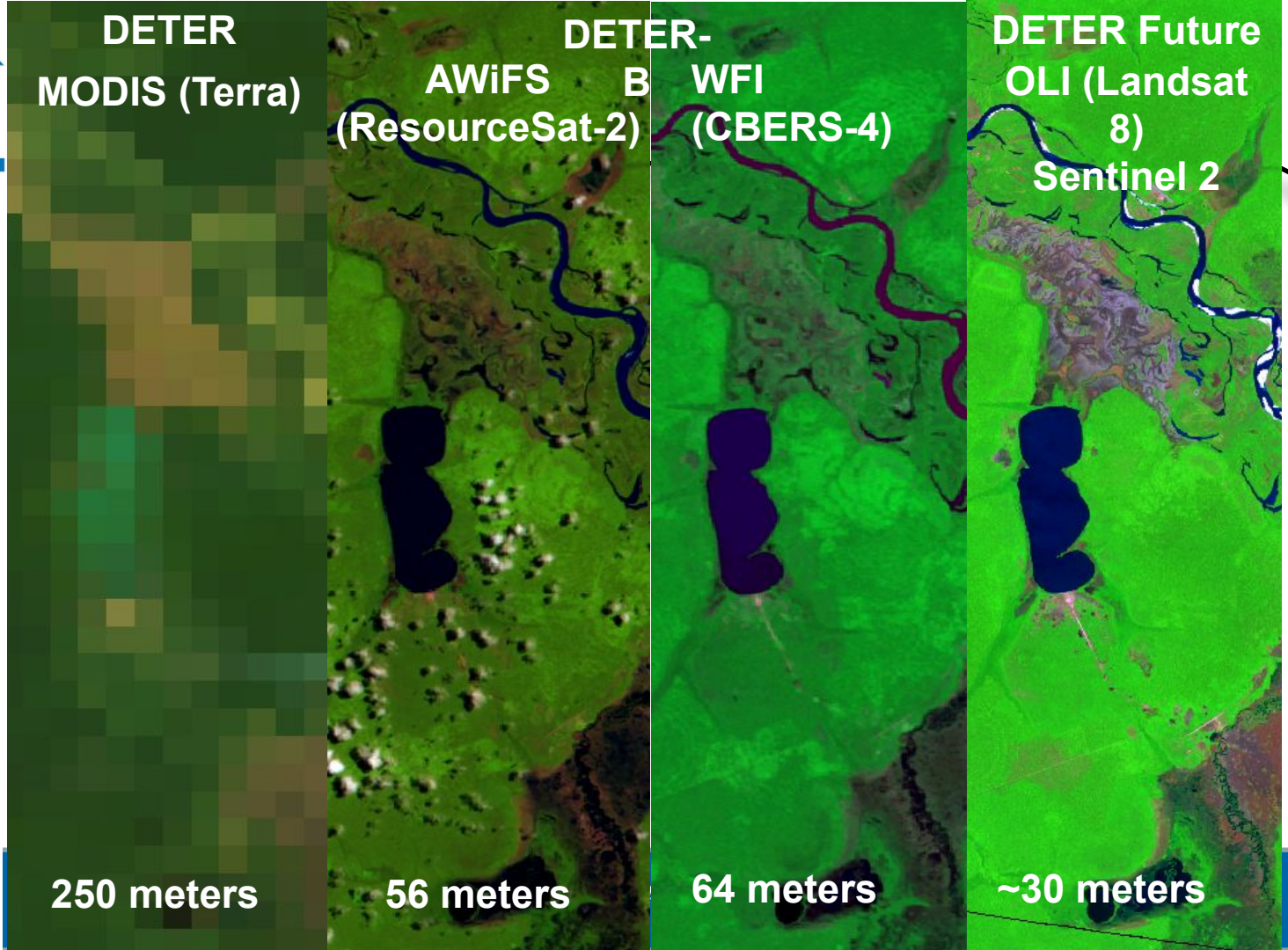
jan
fev
mar
abr
mai
jun
jul


DETER
MODIS (Terra)
250 meters
DETER-B
AWiFS
(ResourceSat-2)
56 meters
WFI
(CBERS-4)
64 meters
DETER Future
OLI (Landsat 8)
Sentinel 2
~30 meters

Thank you so much!

http://www.inpe.br/
http://www.obt.inpe.br/prodes
http://www.obt.inpe.br/deter
http://terrabrasilis.dpi.inpe.br/en/home-page/

marcos.adami@inpe.br

Q&A and discussion

30 minutes

Wrap-up!

5 minutes