Post-K&C – First Report

Brazilian Forest Map: Qualification of Tropical Forest Remnants to Sustainable Development Goals

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Brazilian Forest Service

Post-KC Science Team meeting #1
Tokyo, Japan, January 20-24, 2020

Introduction

SNIF database and NFI are the main reference to produce the Brazilian forest numbers by national or international reports.

SNIF

Sistema Nacional de Informações Florestais

Brasil ifn
Inventário Florestal Nacional

15 VIDA TERRESTRE

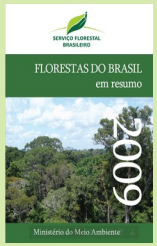
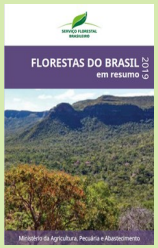
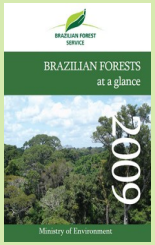
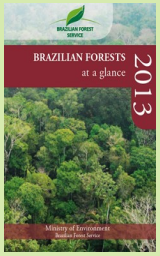
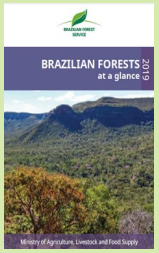
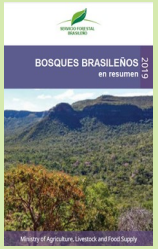
FRA 2020

System of Environmental Economic Accounting

United Nations FORUM ON FORESTS

Introduction

Brazilian Forests: at glance 2019 was presented on IUFRO 2019 four components: resources, economy, management and education.

2010	2011	2013	2019	
				Portuguese
				English
				Spanish

snif.florestal.gov.br

Total area of forest

498 Million ha

Natural Forest 488

Planted 9,8

Public 309,2

Community 157,4

Tree Forest Species ~8.000

Volume & Biomass

Stock

117,8 G m3 (billion)

Biomass

103,5 G ton (billion)

Forest Account

~2-4% of PIB

Introduction

Sustainable Forest Goals (SDGs) and Forest Resources Assessment (FRA):

For world's largest countries there are no doubts of the importance of remote sensing as indispensable contributor for Forest characteristics estimation.

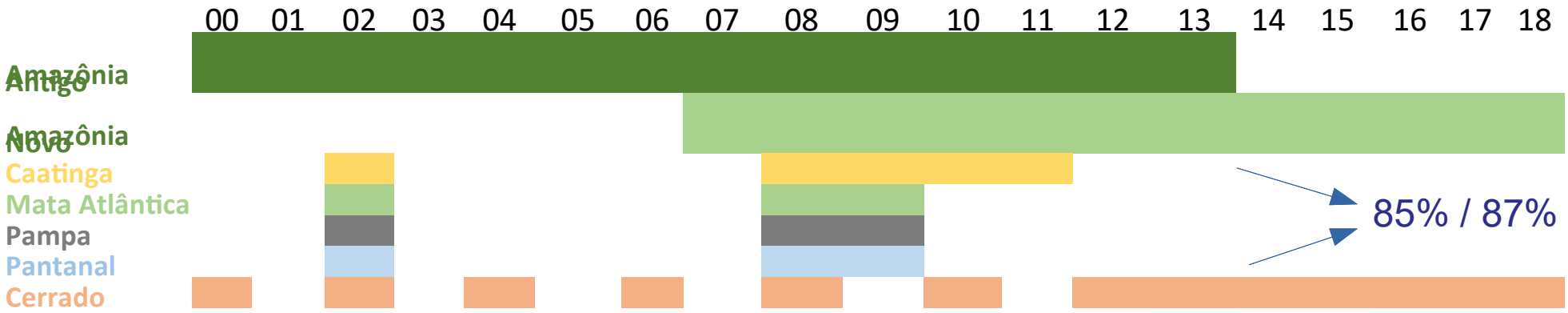
Main characteristics that may involve remote sensing data: extension, changes, planted and natural, reforestation, mangrove, primary, temporally unstocked, biomass and carbon, and disturbances.

Few of them consider to use SAR data for forest estimation!

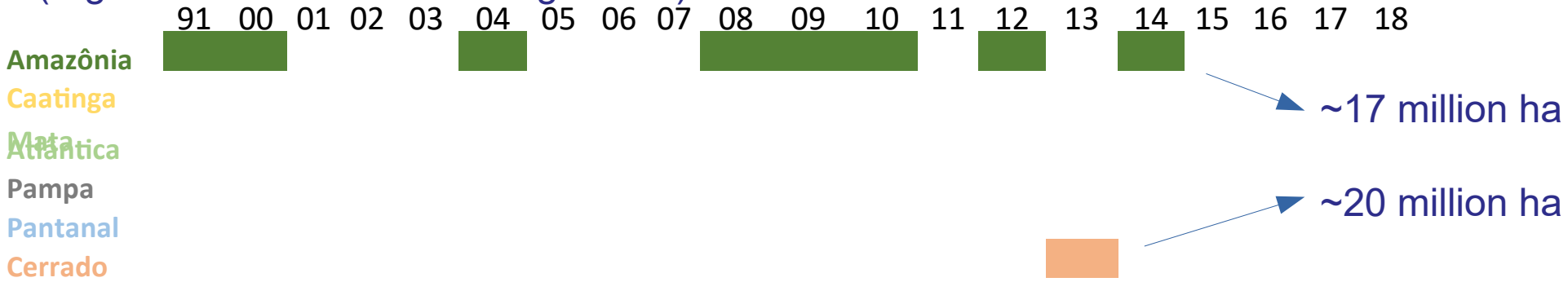
Introduction

Vegetation Monitoring:

PRODES and IBAMA Deforestation products (clear cutting of natural vegetation)



Terra Class from INPE, Embrapa and IBAMA Landcover Classification after cutting (regrowth areas of natural vegetation)

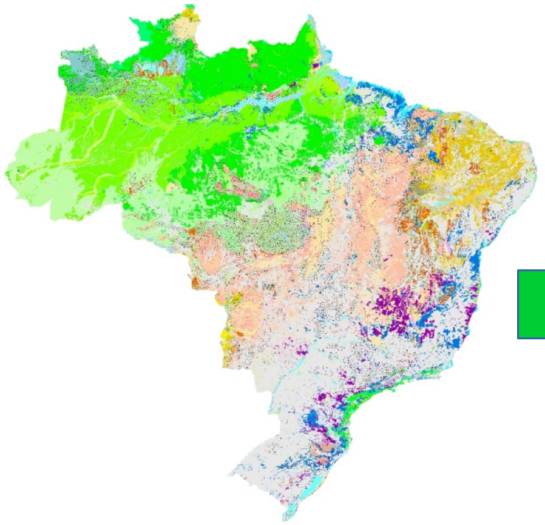


In course: deforestation 2000 – 2020 for all over Brazil and Terra Class for 2018 only for Amazonian region

Introduction

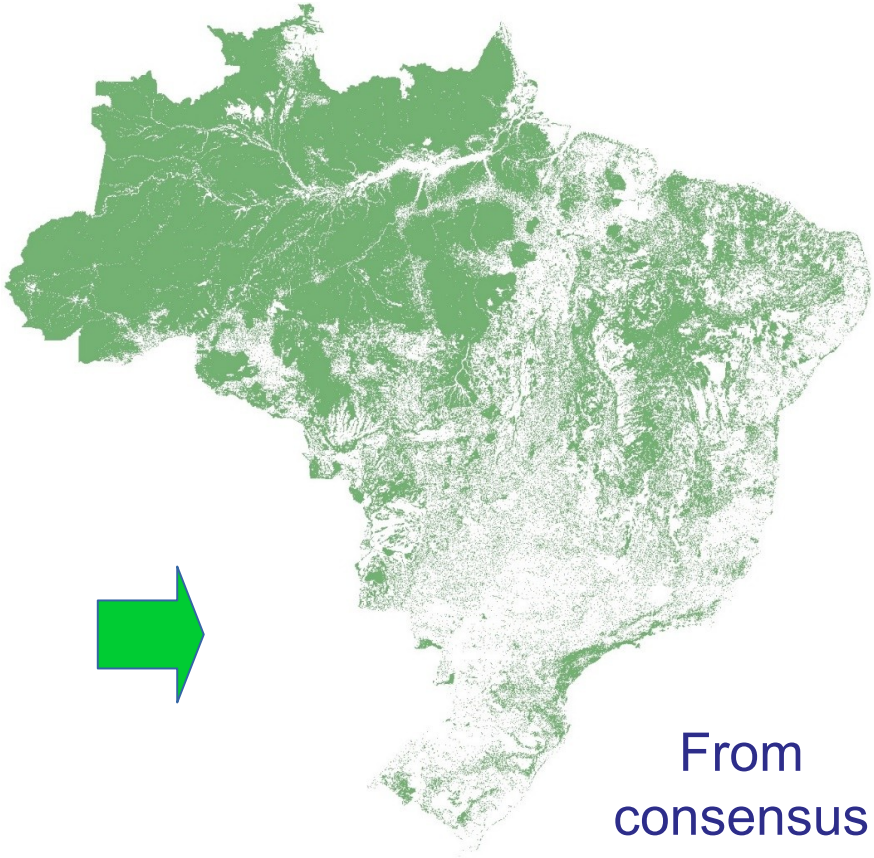
Based on binary information from deforestation and regrowth and vegetation map the derive Forest Extension and Forest Changes are produced.

From Vegetation types



Original Forest

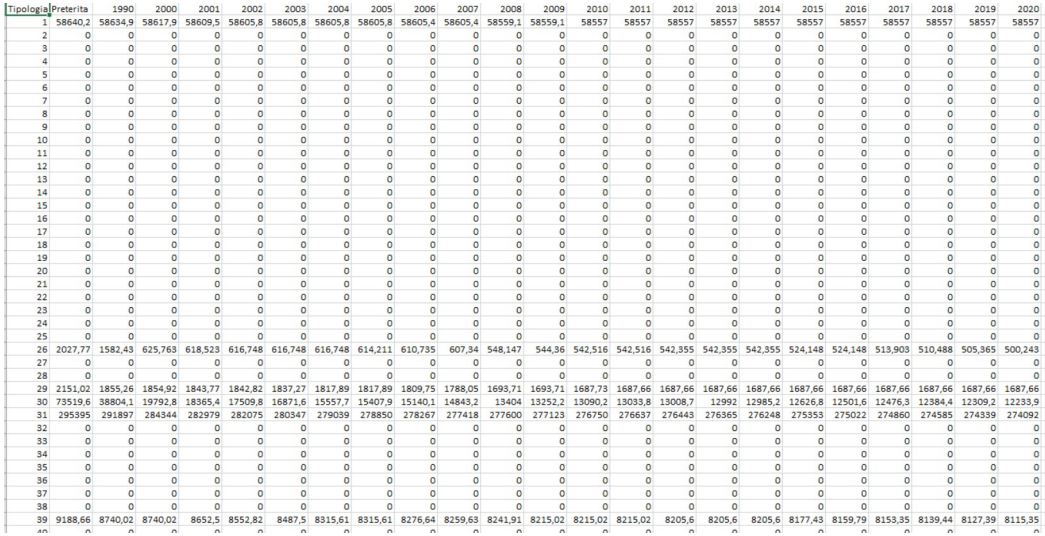
<1500



2018

From consensus of federal institutions

By interpolation the forest area for all types of vegetation were produced per year from 2000-2020 for FRA report.



Tipologia	Preterita	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
1	58640,2	58634,9	58617,9	58609,5	58605,8	58605,8	58605,8	58605,8	58605,4	58605,4	58559,1	58559,1	58557	58557	58557	58557	58557	58557	58557	58557	58557	58557	58557
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	2027,77	1582,43	625,763	618,523	616,748	616,748	616,748	614,211	610,735	607,34	548,147	544,36	542,516	542,516	542,355	542,355	542,355	524,148	524,148	513,903	510,488	505,365	500,243
27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29	2151,02	1855,26	1854,92	1843,77	1842,82	1837,27	1817,89	1817,89	1809,75	1788,05	1693,71	1693,71	1687,73	1687,66	1687,66	1687,66	1687,66	1687,66	1687,66	1687,66	1687,66	1687,66	1687,66
30	73519,6	38804,1	19792,8	18365,4	17509,8	16871,6	15557,7	15407,9	15140,1	14843,2	13404	13252,2	13090,2	13033,8	13008,7	12992	12985,2	12626,8	12501,6	12476,3	12384,4	12309,2	12233,9
31	295395	291897	284344	282979	282075	280347	279039	278850	278267	277418	277600	277123	276750	276637	276443	276365	276248	275353	275022	274860	274585	274339	274092
32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
39	9188,66	8740,02	8740,02	8652,5	8552,82	8487,5	8315,61	8315,61	8276,64	8259,63	8241,91	8215,02	8215,02	8215,02	8205,6	8205,6	8205,6	8177,43	8159,79	8153,35	8139,44	8127,39	8115,35

FRA categories	Area (1000 ha)								
	1990	2000	2010	2015	2016	2017	2018	2019	2020
Forest (a)	588 898.00	551 088.60	511 580.70	503 884.80	502 082.10	500 091.60	499 051.40	497 798.50	496 619.60
Other wooded land (b)	46 901.60	43 812.20	40 577.40	39 511.70	39 351.10	39 190.70	39 030.50	38 871.50	38 713.30
Other land (c-a-b)	200 014.40	240 913.20	283 655.90	292 417.50	294 380.80	296 531.70	297 732.10	299 144.00	300 481.10
Total land area (c)	835 814.00	835 814.00	835 814.00	835 814.00	835 814.00	835 814.00	835 814.00	835 814.00	835 814.00

Problem stock for FRA?

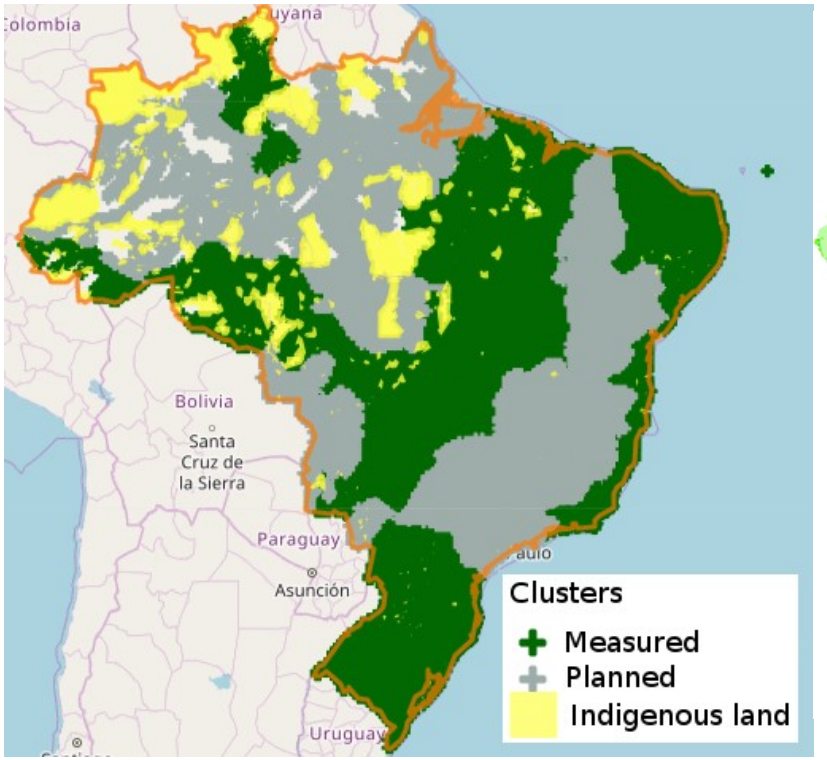
1. Old methodology based on a compilation of several bibliographic references

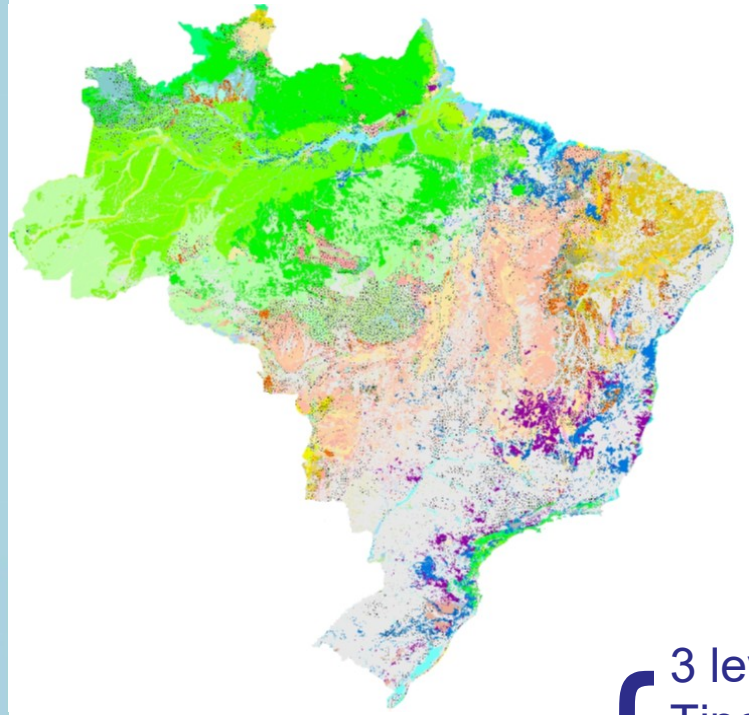
or

2. Conduct an analysis with the data we already have fro National Forest Inventory.

Decision: Version 1.0 of Brazilian Stock with the partial data.

For volume, biomass and carbon the inventory from **9435** points produce the growth factors to be multiplied by area for each forest type of vegetation, per year from 2000-2020 for FRA report.





For Pantanal biome there were no points collected.

120 types of vegetation { 3 levels: Tipolopgy, Physiognomy, Association

ALOS

K&C Initiative

An international science collaboration led by JAXA

120 Vegetation Types

11 Vegetation Types + BIOME

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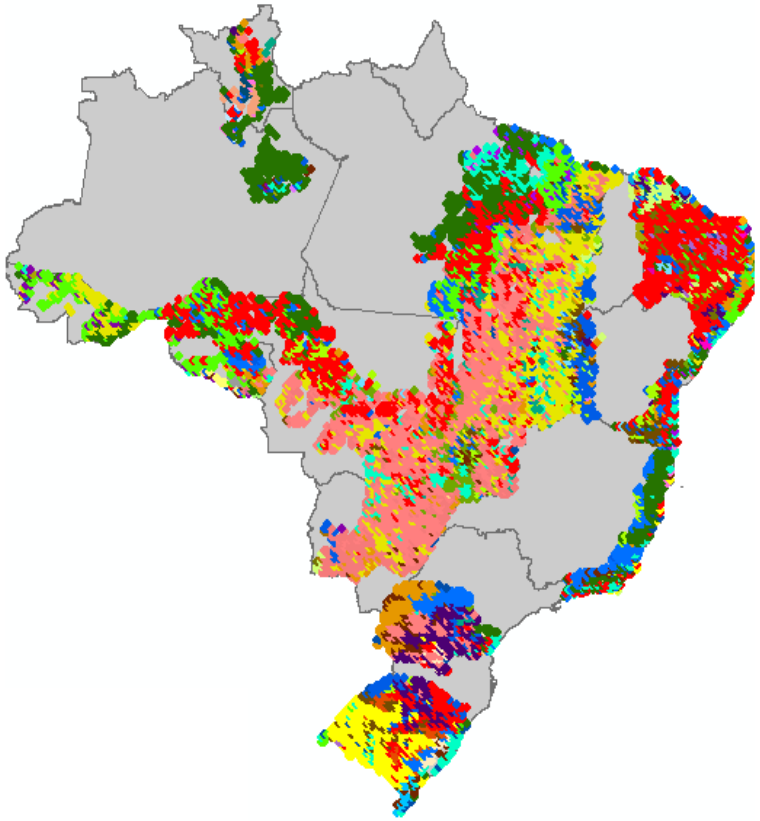

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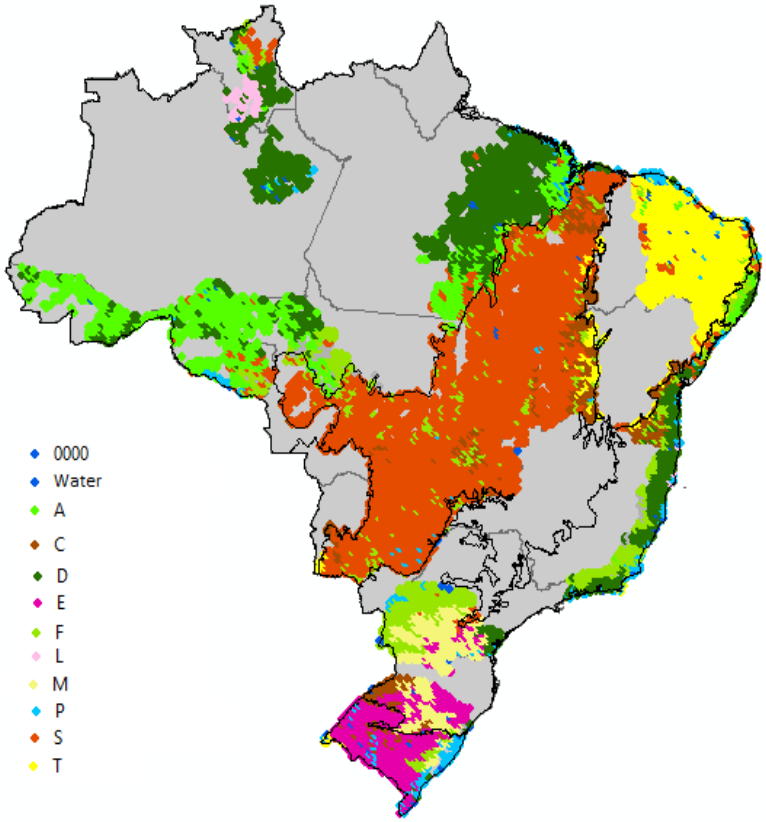


< number of samples

> number of samples

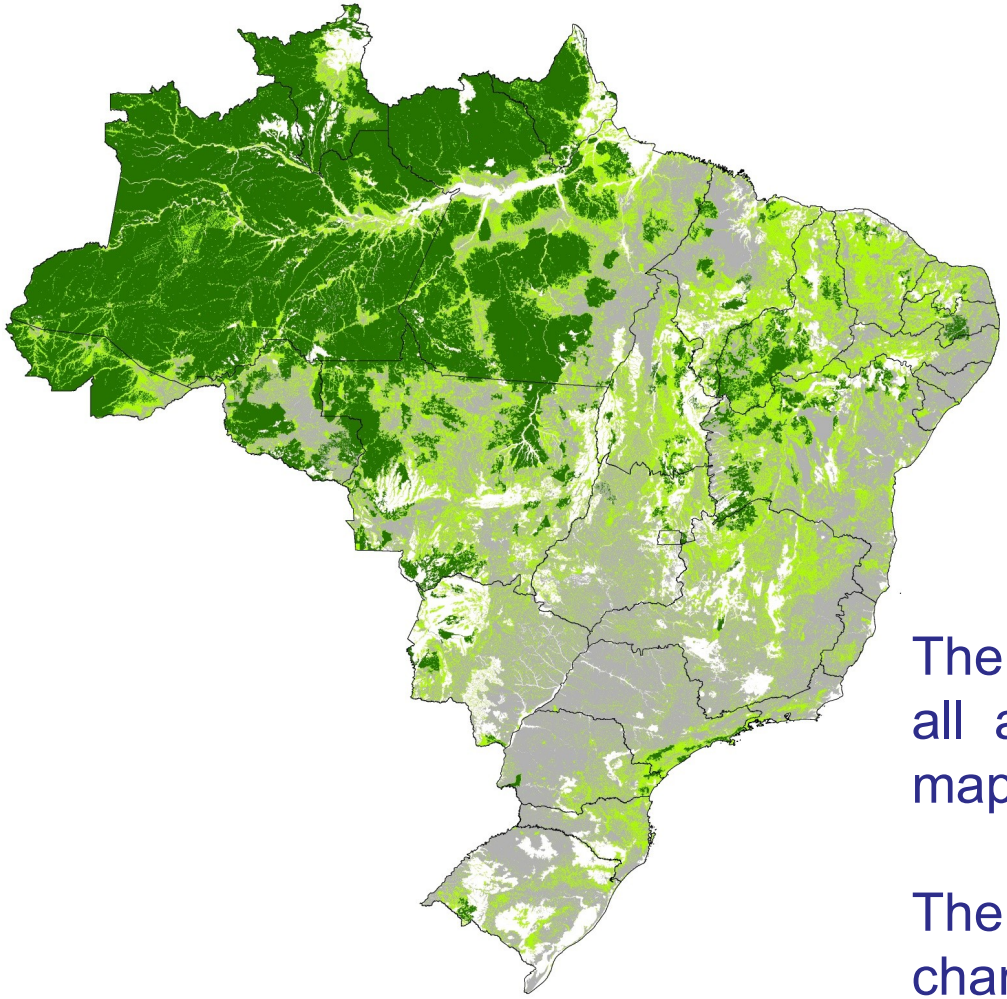
Per vegetation type

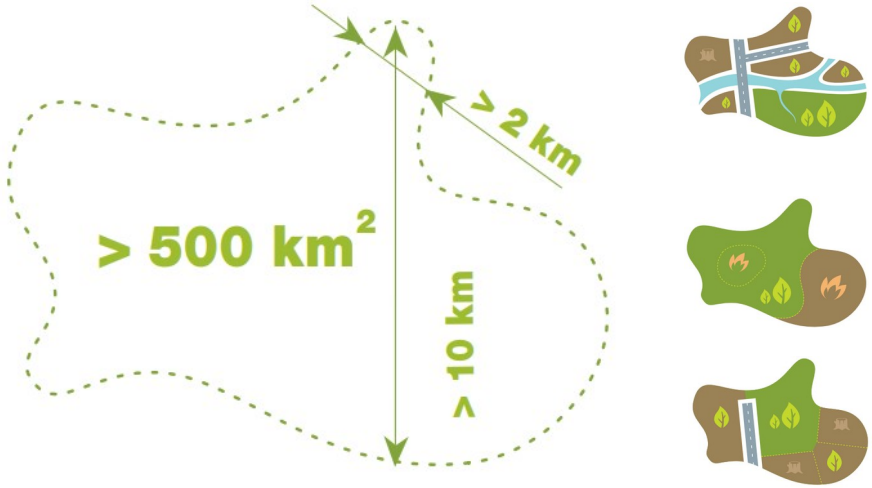
Estimation of Brazilian Forest Stocks (version 1.0)

Biome	Volume Million of m3	%	Biomas Million of tons	%	Carbon Million of tons	%
Amazon	109404	92,8	96046	92,8	47354	92,8
Cerrado	5023	4,3	4256	4,1	2076	4,1
Atlantic Forest	1529	1,3	1552	1,5	760	1,5
Caatinga	1097	0,9	965	0,9	473	0,9
Pantanal	563	0,5	551	0,5	269	0,5
Pampa	241	0,2	167	0,2	82	0,2
Total	**117856**	**100**	**103537**	**100**	**51014**	**100**

Measurement of DBG for AGB and Necromass, for BGB estimated by shoot-root ratio, for soil and Pantanal derived data from bibliographic references.

Primary Forest was estimated by geoprocessing algorithm using buffer zones to exclude forest close to deforestation, roads and urban areas and minimum size of to forest remnant fragment.

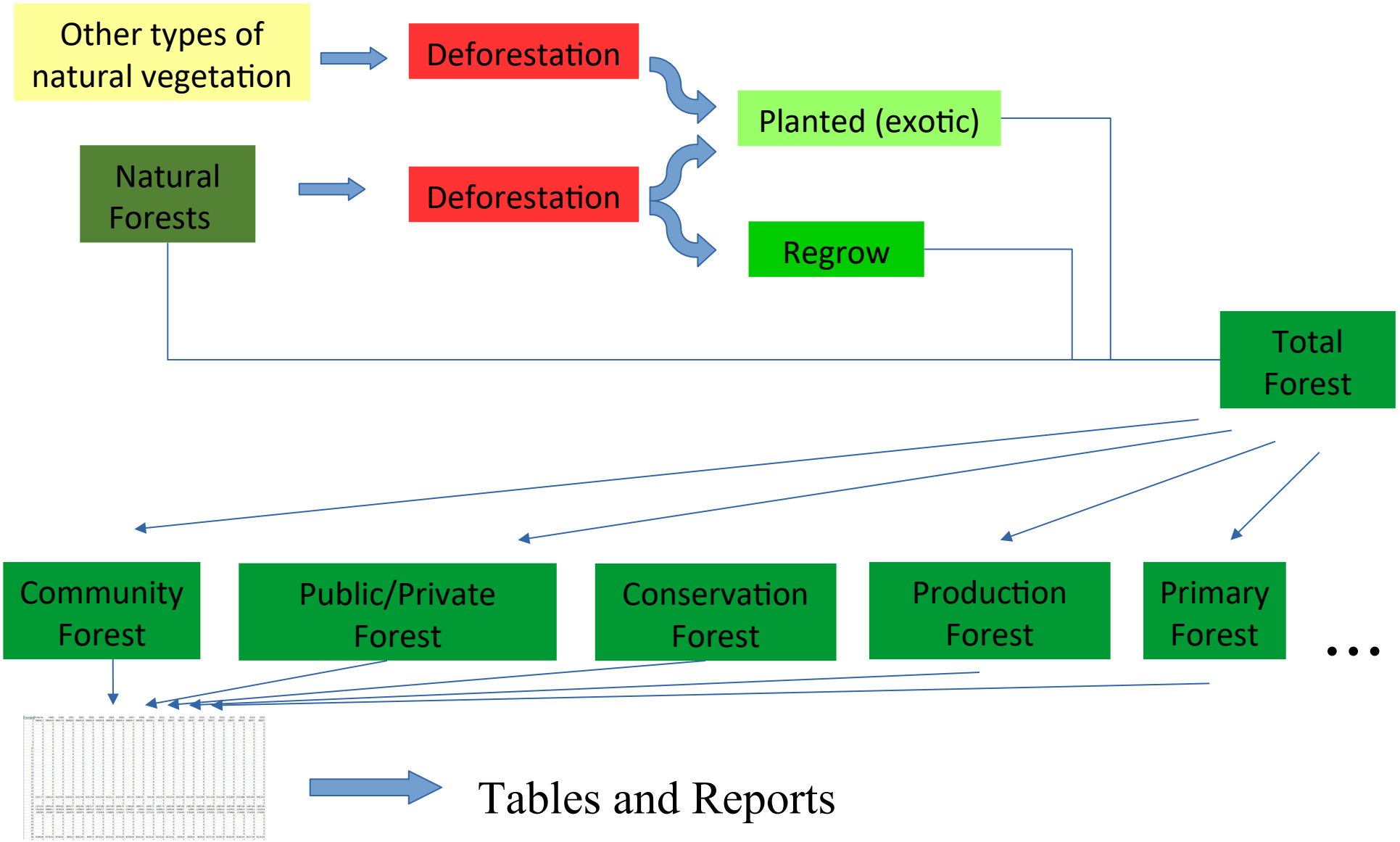


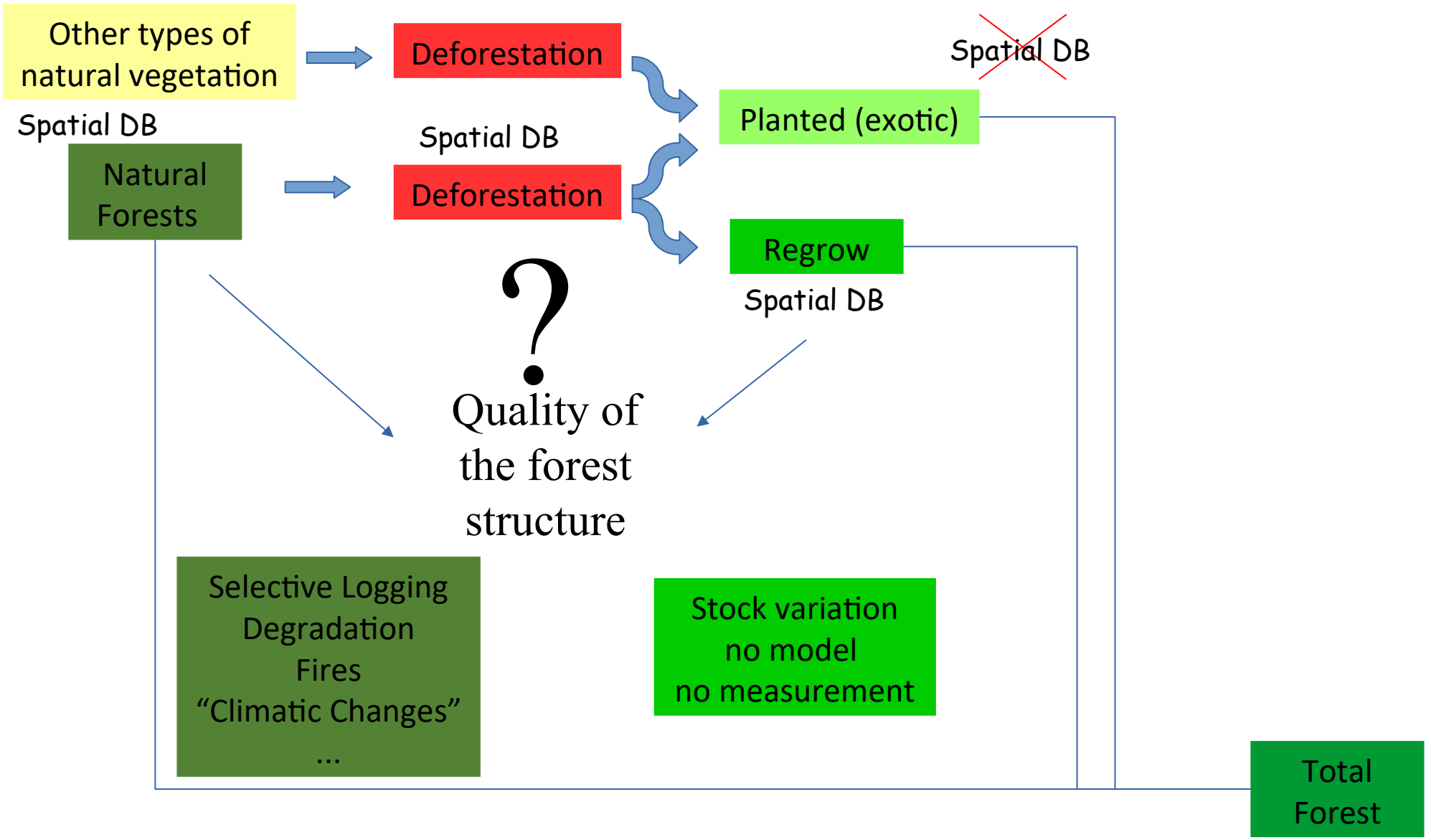


I Zhuravleva, S Turubanova, P Potapov, M Hansen, A Tyukavina, S Minnemeyer, N Laporte, S Goetz, F Verbelen and C Thies
Environmental Research Letters, Volume 8, Number 2 (2013)

There changes on forest concept but almost all approaches are based on optical forest map was a primary source.

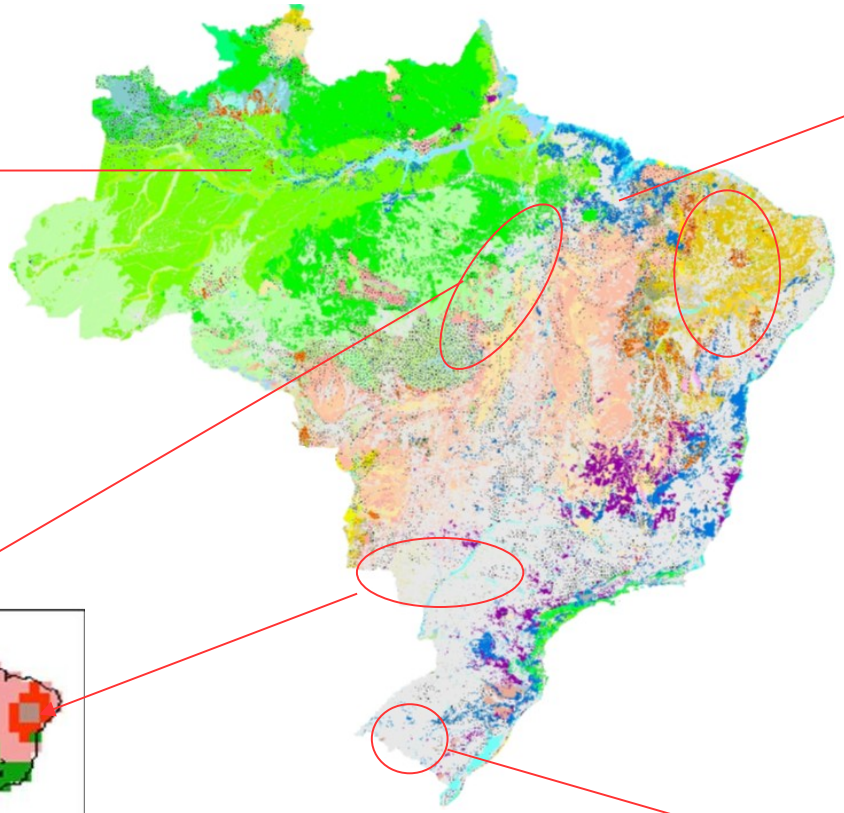
There were no consideration on intrinsic changes on forest structure.

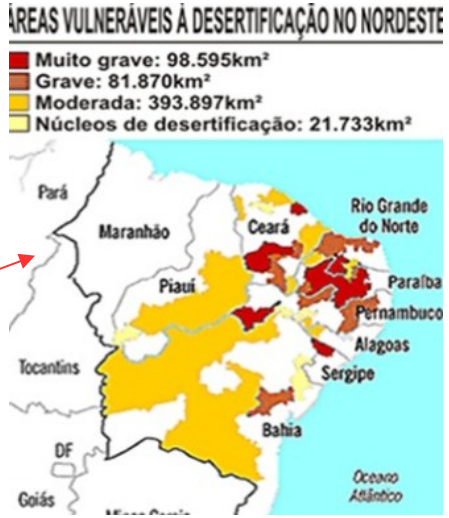

Other types of natural vegetation
Deforestation
Planted (exotic)
Natural Forests
Deforestation
Regrow
Total Forest
Community Forest
Public/Private Forest
Conservation Forest
Production Forest
Primary Forest
...
Tables and Reports


Other types of natural vegetation
Spatial DB
Natural Forests
Deforestation
Spatial DB
Deforestation
Spatial DB
Planted (exotic)
Regrow
Spatial DB
?
Quality of the forest structure
Selective Logging
Degradation
Fires
"Climatic Changes"
...
Stock variation
no model
no measurement
Total Forest

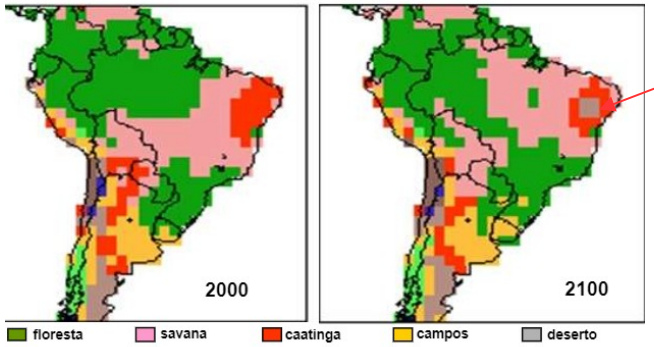
"Seminatural" changes: Desertification, Savannization and Afforestation

?



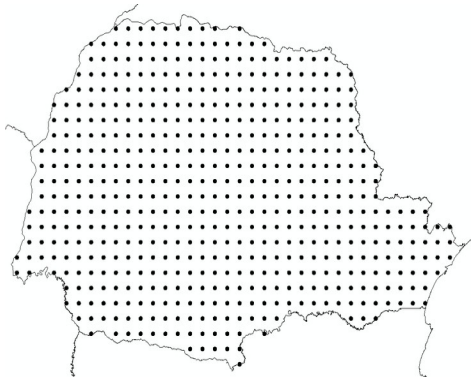


Futuro dos Biomas Amazônicos?

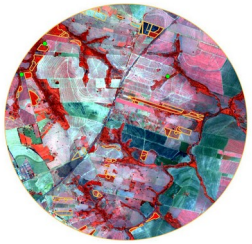


Savanização da Amazônia: um estado de equilíbrio na relação bioma-clima? fonte: Oyama and Nobre, 2003

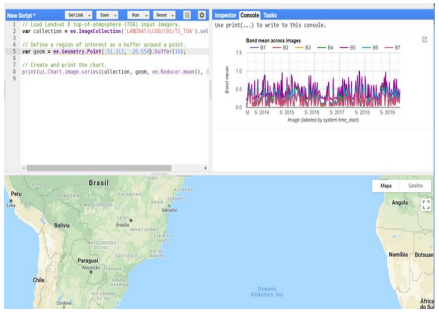
550 on sample plots Paraná State



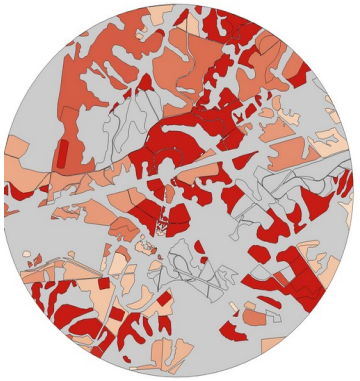
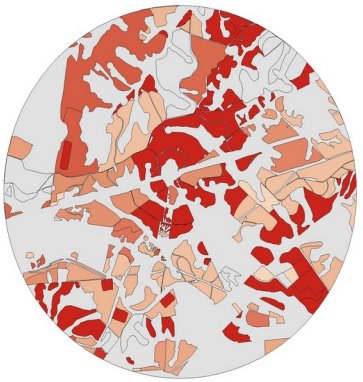
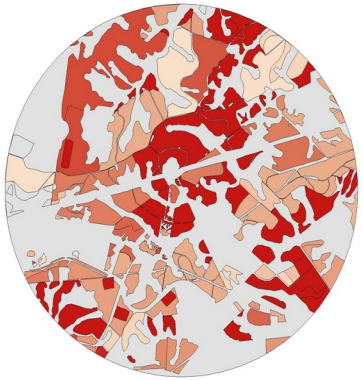
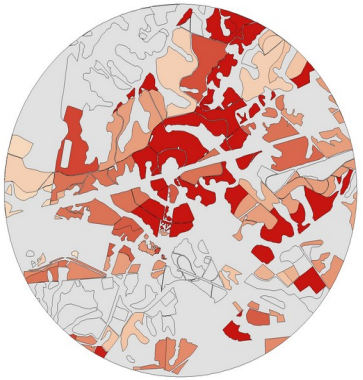
Rapid Eye
4 years



2,5km radius
Only planted forests.



Planted Forest – Collecting information to understand dynamics and stock variation.

	2011	2013	2015	2017
Type				
Age				

Introduction

In one hand:

Stock estimated using forest map based on deforestation changes.

On the other hand:

Degradation, Selective Logging and Regrowth usually are sub-estimated or not considered. The “semi-natural” changes of the vegetation are not considered.

Consideration:

Most of information are leaf physiology changes based optical data, there is a lack of information about forest structure and its spatial-temporal variation.

Project outline and objectives

Project objectives:

Recognize with Alos - PALSAR data the “reference” forest, “changed” forest and non-forest (misclassified as a forest) from the Brazilian Forest Map.

Project area(s):

Territory of Brazil

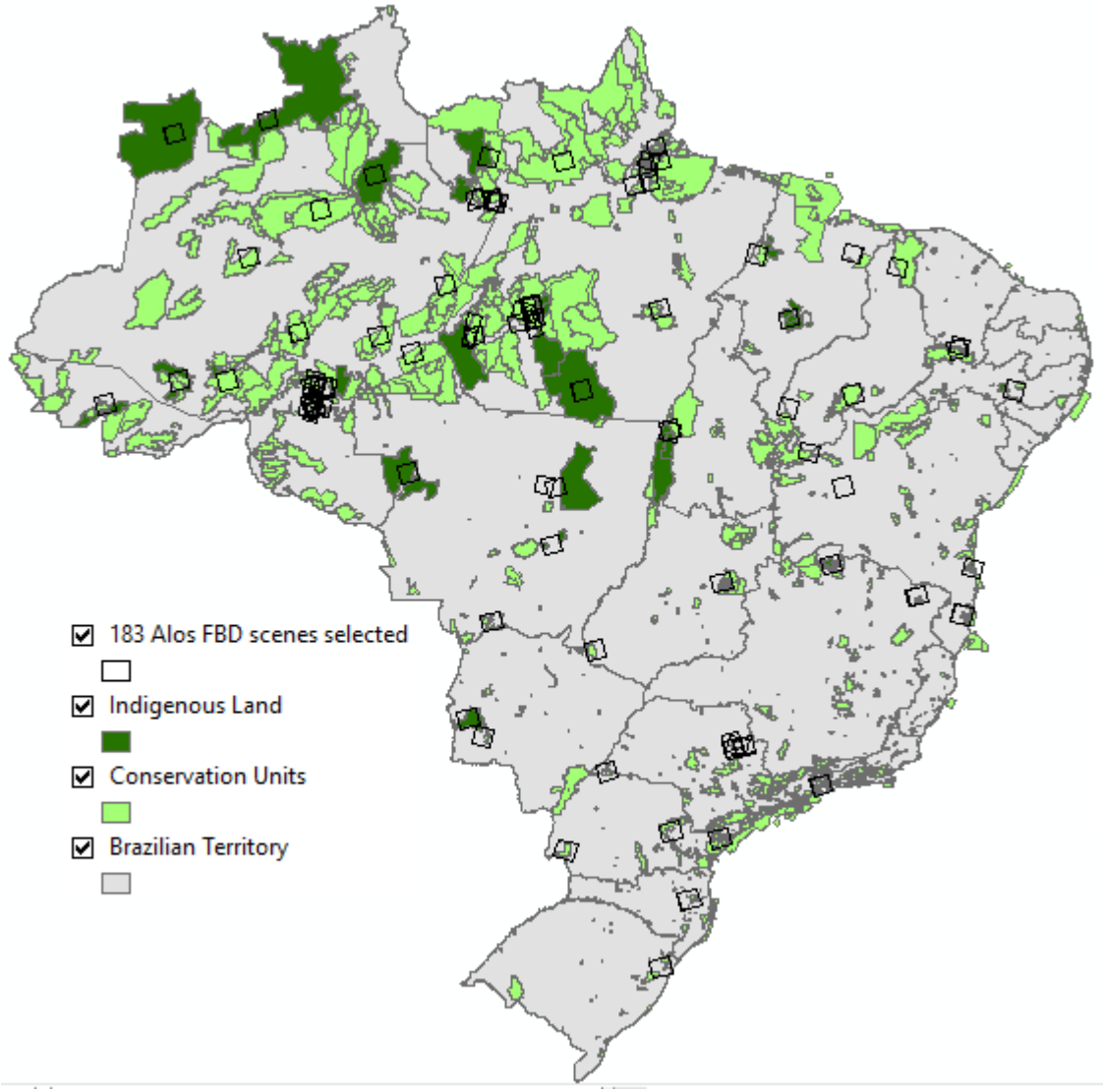
K&C thematic drivers:

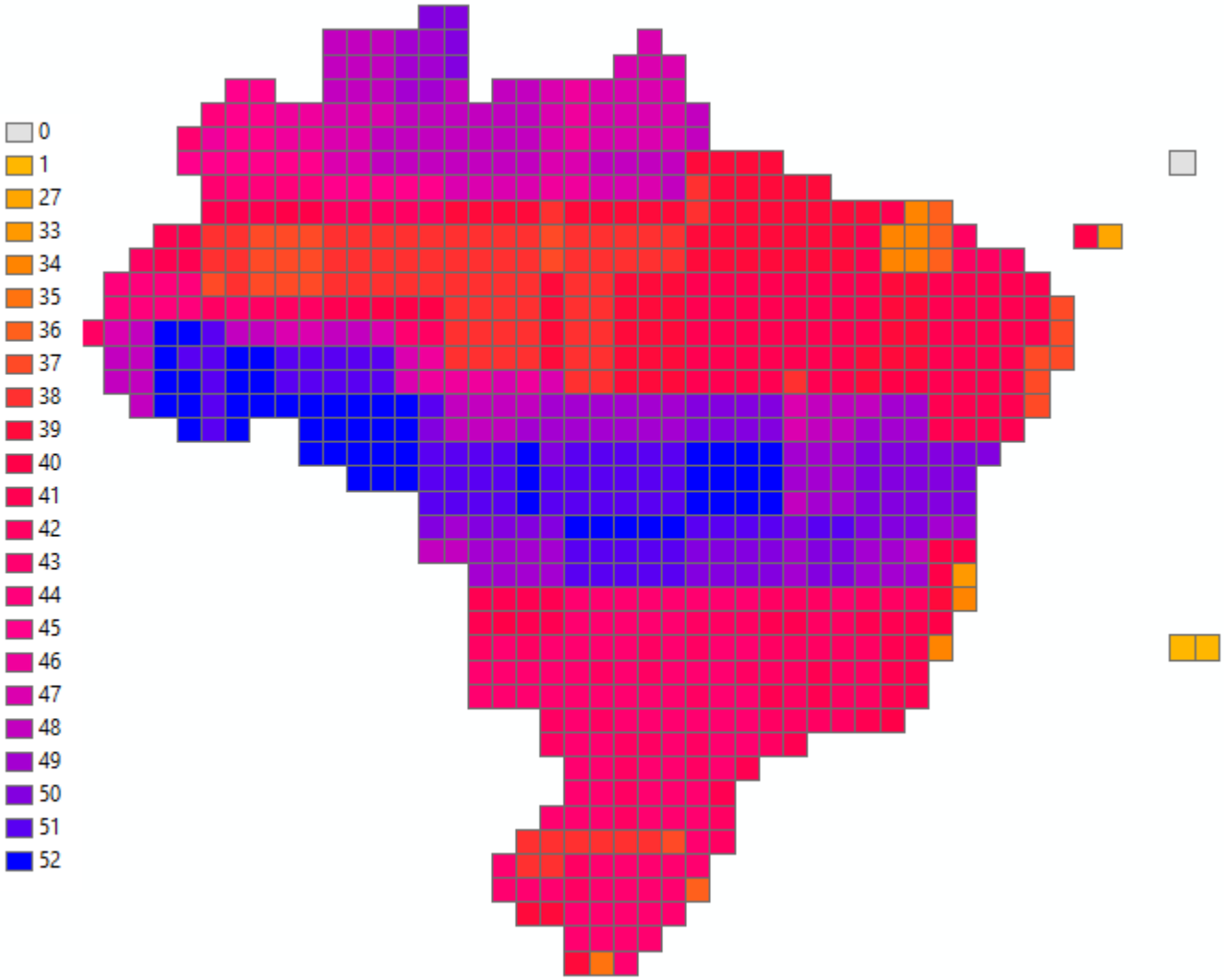
- **C**arbon cycle science (improve stock estimation)
- **C**limate Change (understand forest changes)
- International **C**onventions (Paris Agreement, Biodiversity...)
- Environmental **C**onservation (Reference sites will be on conservation units)

Results and significant findings expected – Data Pre-processing

Reference forest areas with almost all types of forest with FBD data for dry and wet season were selected.

Selection of polygons with remnants fragments of forest to be tested against reference forest.





ScanSAR tiles for temporal series

Until cycle 120 of alos-2 there were 52 cycles for the area of Brazil, in most of the country at least 30 cycles available

We start to develop in Python (gdal, scpy, numpy on Anaconda) scripts to process time series

Results and significant findings

Describe project outcomes and significant findings:

Improve of the Forest Mapping by the use of the struture infomation obtained by Alos-PALSAR images.

Comments and suggestions to JAXA:

Intesify the cooperation with the other members of the forest group, working with biomass estimatiom and forest non-forest mapping.

Deliverables and other output

Describe planned output of your project:

Project deliverables:

Implementation for operation use on the Forest Data Base

Peer-reviewed publications:

not planned yet

Non-peer-reviewed publications:

2 master dissertations

Other results – progress on Forest Estimation and Forest Mapping

PALSAR/PALSAR-2 data access

PALSAR/PALSAR-2 data:

FBD 14 scenes until now and ScanSAR

Have you had sufficient data to complete your research (according to your K&C agreement)?

Interruption of ScanSAR tiles production

If not, which key data sets are missing?

ScanSAR tiles for the cycles after 120.

ALOS

K&C Initiative
An international science collaboration led by JAXA

Collaboration with University of Brasília, Forest Science Program Two master students 1st year (in course)

Prof. Dr. Eraldo Aparecido Trondoli Matricardi

Name:
Adyne Cardoso da Costa

Title:
Area of potencial occurrence of Açaí (*Euterpe oleracea* Mart.) for sustainable management, Marajó-PA

Name:
Paula Lopes Germano de Oliveira

Title:
Biomass Estimation on Cerrado from PALSAR images, National Park of Brasília - DF

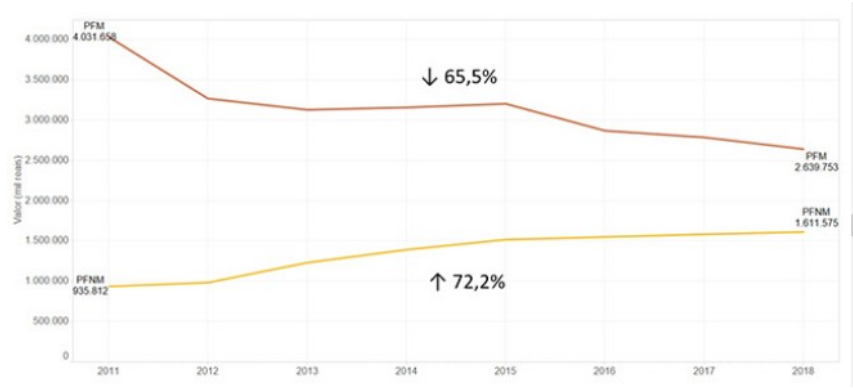
ALOS

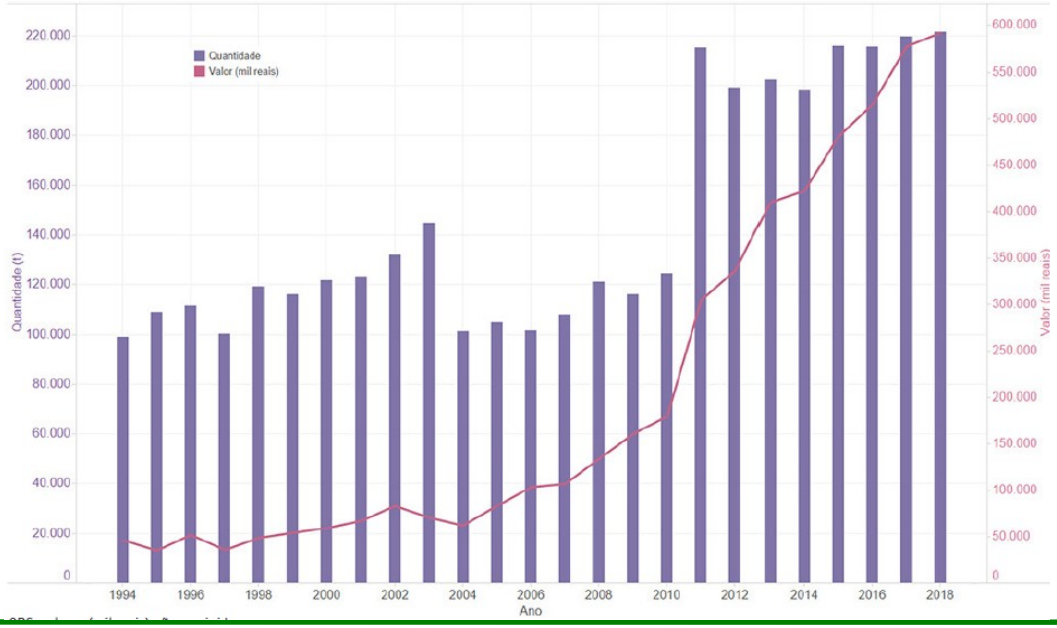
K&C Initiative
An international science collaboration led by JAXA

Area of potential occurrence of Açaí (*Euterpe oleracea* Mart.) for sustainable management, Marajó-PA

Forest Products:

Wood
X
Non Wood





Açaí is the most important non wood product from natural forest 0.6 billion from the total of 1.7 billion.

Source of resource and way to keep forest areas economically sustainable

ALOS

K&C Initiative
An international science collaboration led by JAXA

Area of potential occurrence of Açaí (*Euterpe oleracea* Mart.) for sustainable management, Marajó-PA

- Associated with forest
- Riverine communities
- Extraction from natural forest

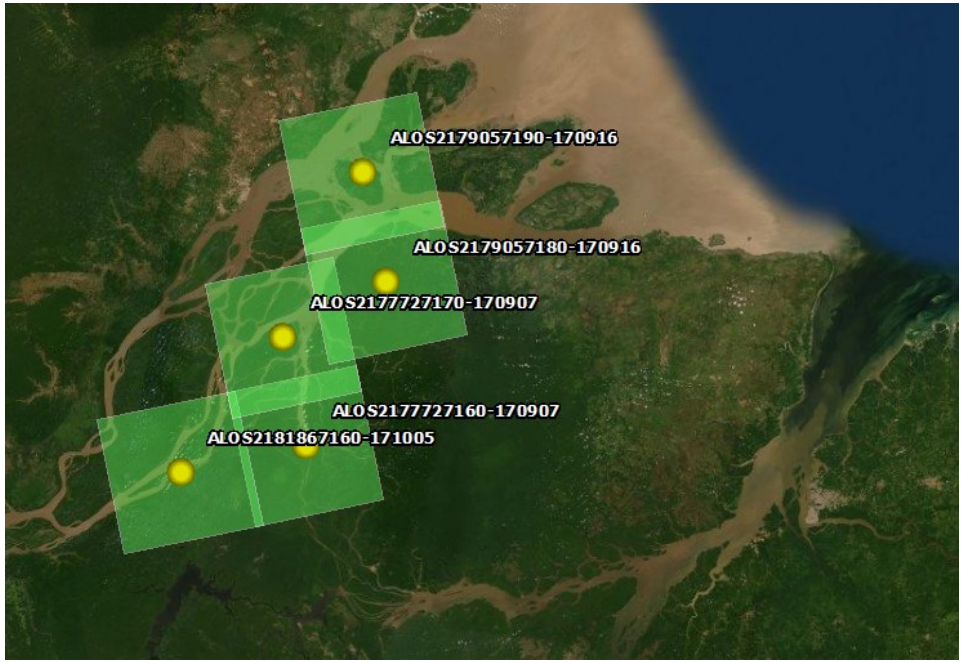
Adapted to live under the water but needs at least one period of dry to germinate.

Usually occur on low varzeas (inundated areas with forest).

Area of potencial occurrence of Açaí (Euterpe oleracea Mart.) for sustainable management, Marajó-PA

Around Marajo Island are most of the Açaí production.

Study area communities on public forest on Marajo Island



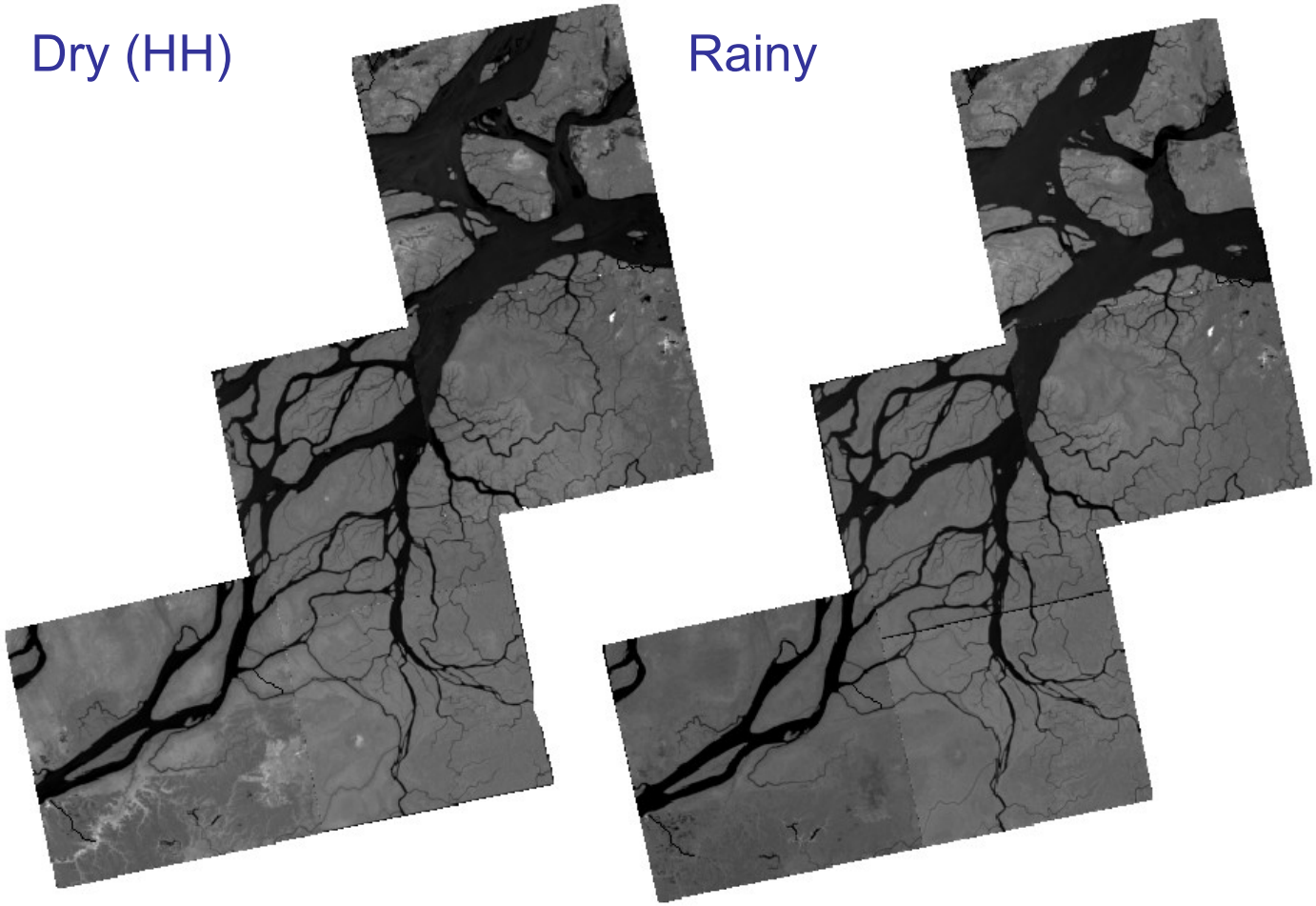
Area of potencial occurrence of Açaí (Euterpe oleracea Mart.) for sustainable management, Marajó-PA

Main goal is to estimate the area of occurrence of Açaí using ALOS PALSAR images.

Usually occur on low várzeas (inundated areas with forest).

Dry (HH)

Rainy



Biomass Estimation on Cerrado from PALSAR images, National Park of Brasília - DF

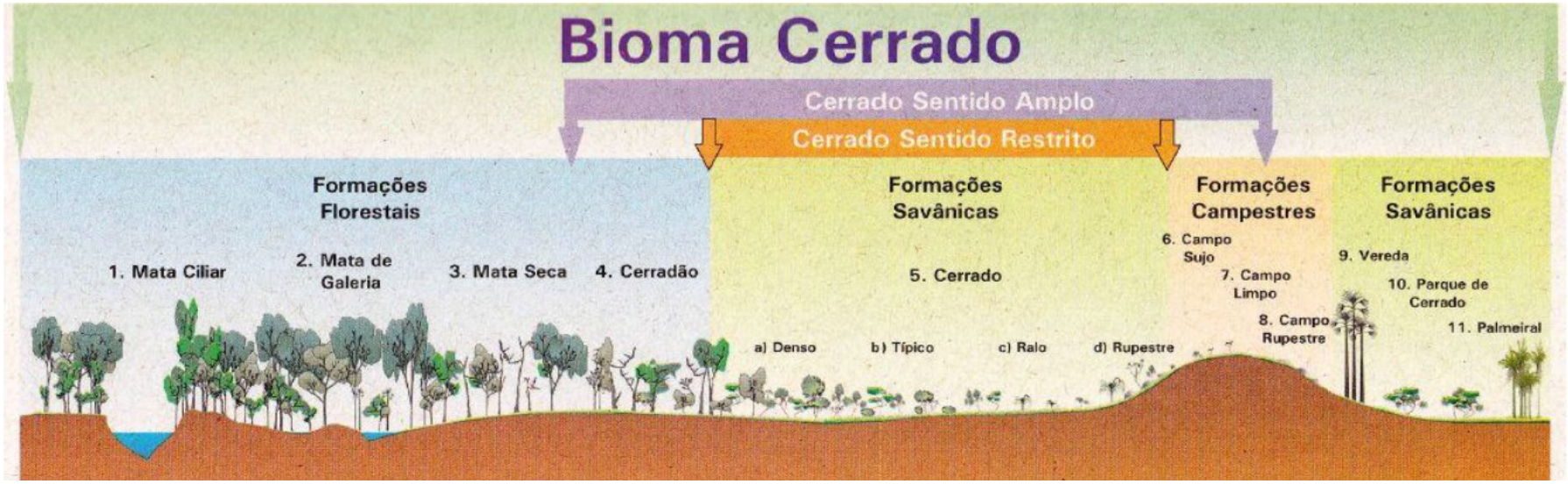
Main goal:

- To estimate aboveground biomass on each vegetation type of Cerrado with field data and ALOS PALSAR images.

- To evaluate to seasonal variation observed by PALSAR and the vegetation types for biomass.

Biomass Estimation on Cerrado from PALSAR images, National Park of Brasília - DF

Cerrado vegetation has a variation on the biomass and each physiognomy has a different response to seasonal variation.

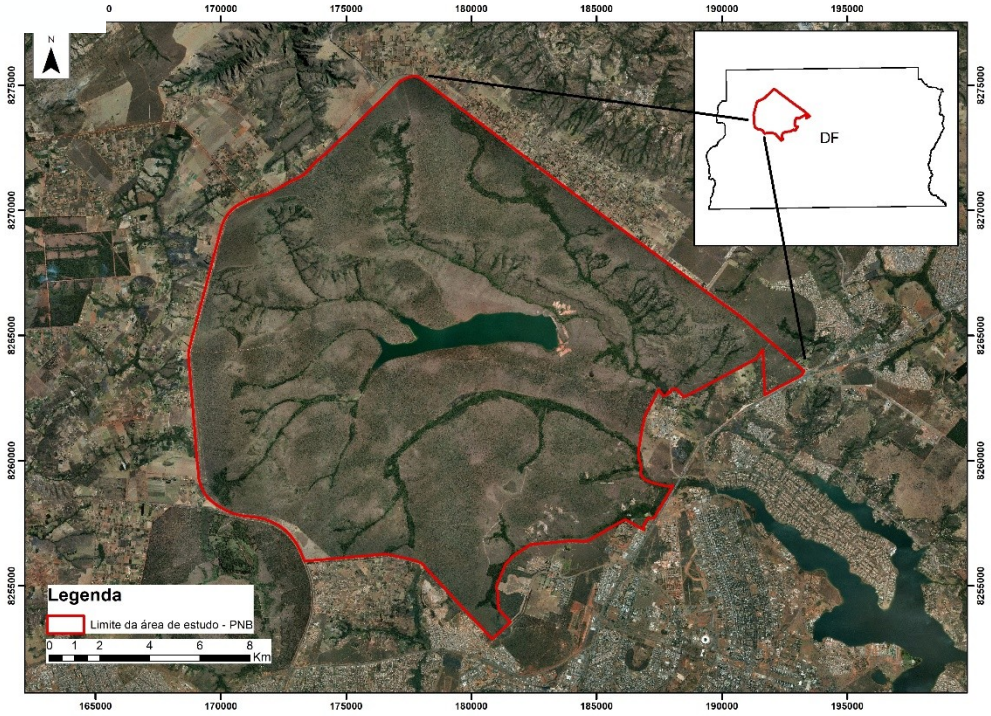


ALOS

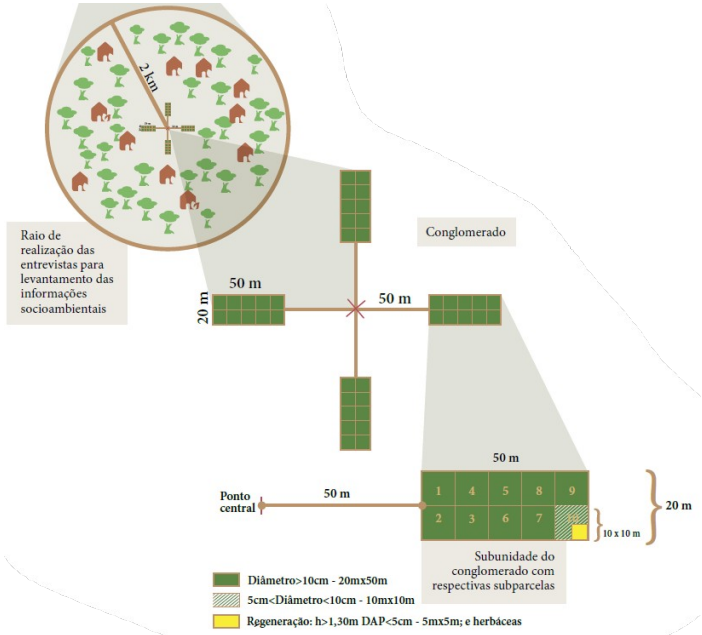
K&C Initiative
An international science collaboration led by JAXA

Biomass Estimation on Cerrado from PALSAR images, National Park of Brasília - DF

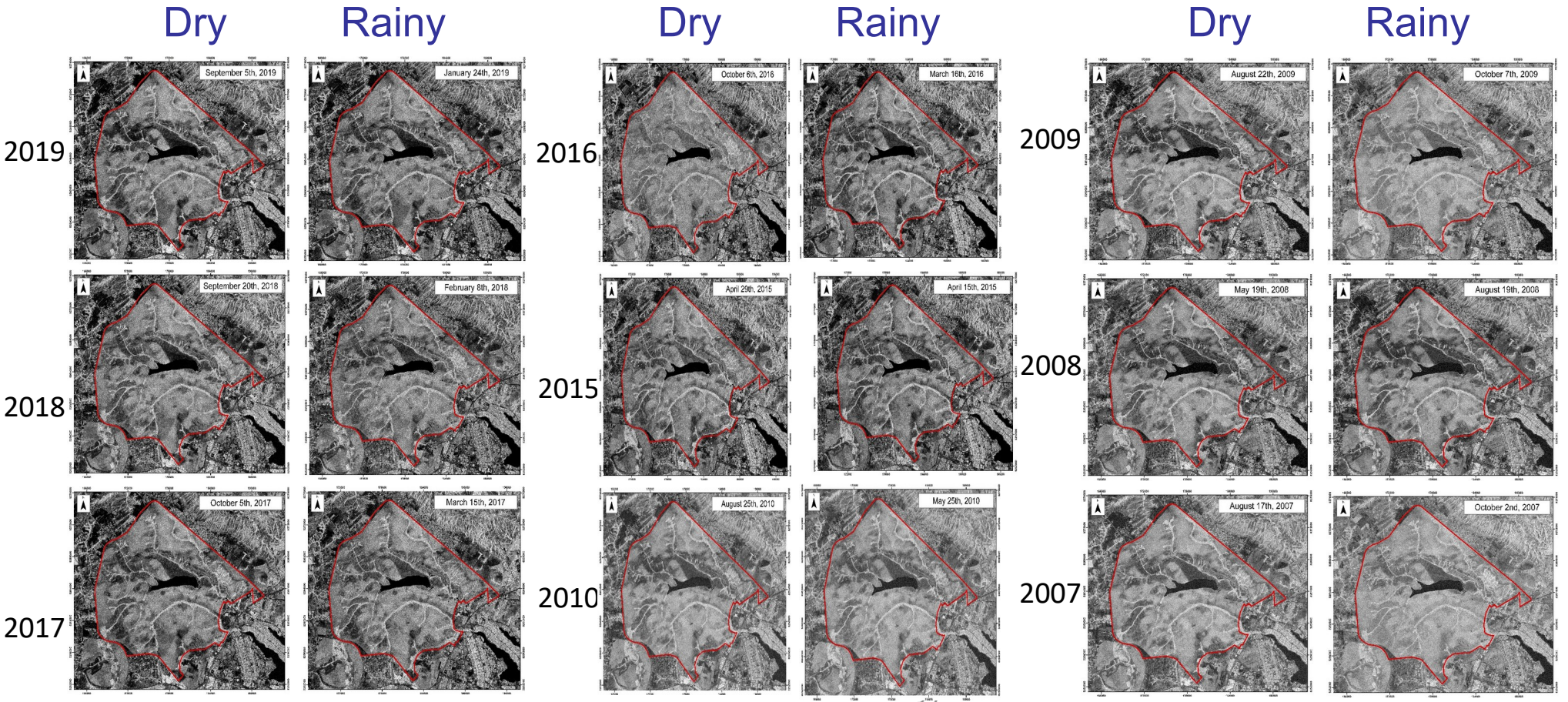
National Park of Brasília



Same methodology of National Forest Inventory but with sampling intensification on the study area



Biomass Estimation on Cerrado from PALSAR images, National Park of Brasília - DF

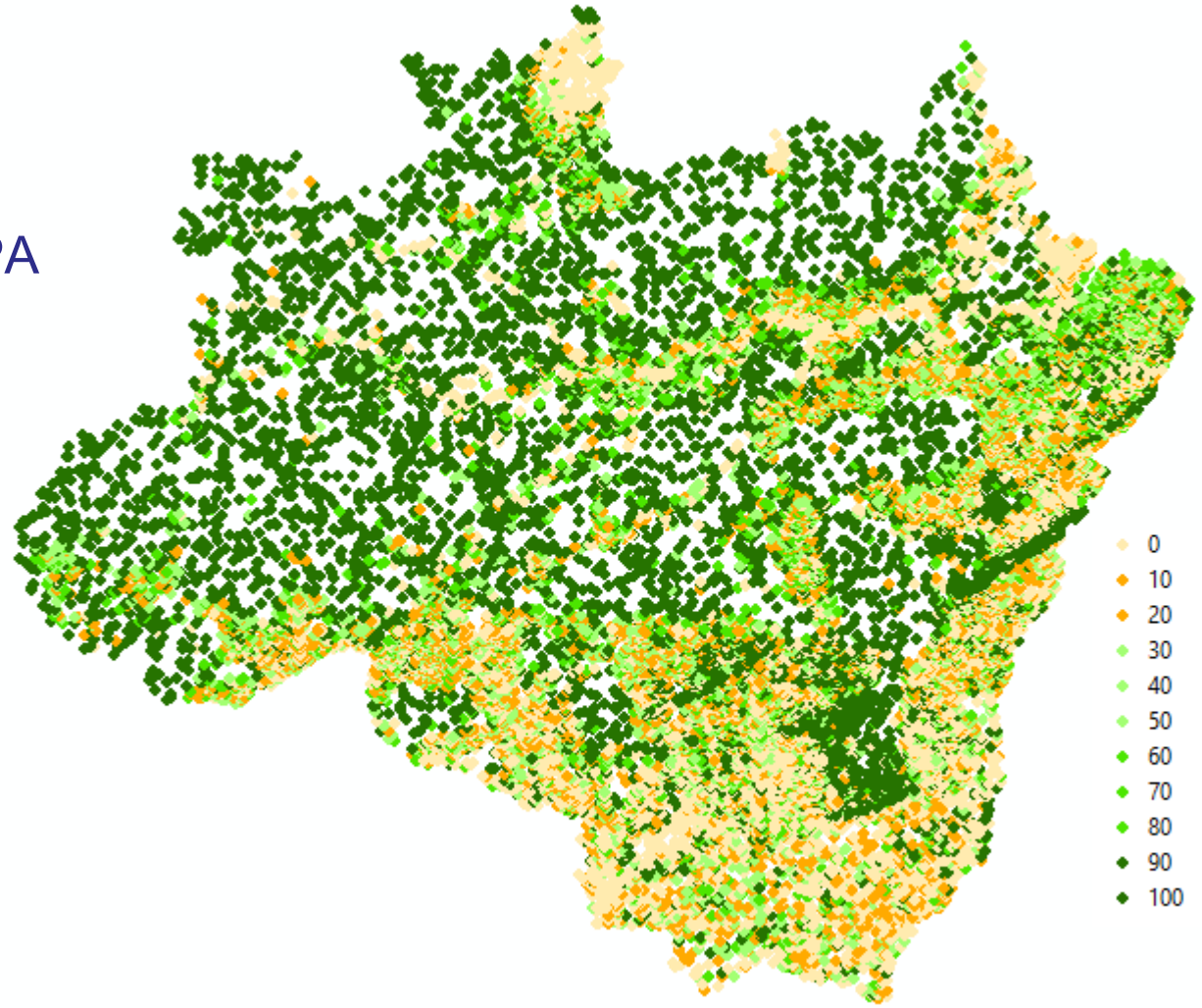


F.Y.I.

FRA2020 Remote Sensing Survey

1st workshop in Belem-PA
40 people 10.000 points
And after 3 months finished all
29.462 for 9 states of Amazonian region

March 2nd workshop
another half of Brazil
about 50.000 points



ありがとう！

Thank you!

Acknowledgments:

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(61)2028-7248
(61)98107-1011

Filiation:
National System of Forest Information – NFIS
Forest Information Management
Brazilian Forest Service – SFB
Ministry of Agriculture, Livestock and Supply - MAPA