

Data Science for improved legality and transparency in the Amazon forestry sector: a case study and perspectives



INSTITUTO DE MANEJO E CERTIFICAÇÃO FLORESTAL E AGRÍCOLA

Marco W. Lentini e Robson Feichas Vieira

Rio de Janeiro, Summer School on Data Science, Feb 2nd, 2020

Outline

- *Presenting IMAFLORA*
- *Context of deforestation, forest degradation and illegal logging in the Brazilian Amazon*
- *Wood transactions official control datasets*
- *The 'timberflow' initiative: the Amazon wood reference platform*
- *Where to go now: perspectives and opportunities in terms of intelligence and data science*

IMAFLORA[®], the Agricultural and Forestry Management and Certification Institute, is a Brazilian civil society organization, founded in 1995.



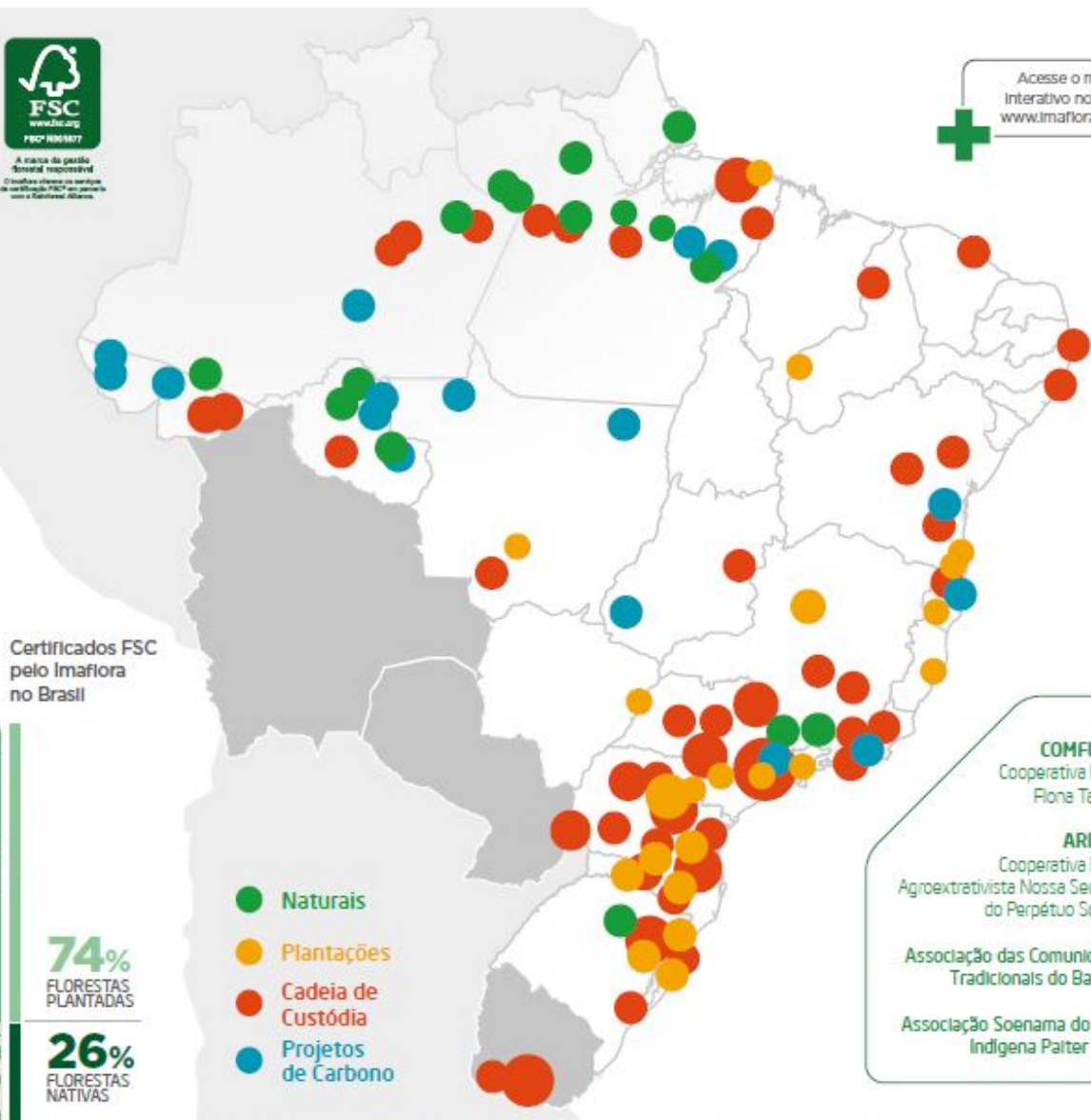
CERTIFICAÇÃO FLORESTAL



A marca da gestão florestal responsável
O trabalho oferece os serviços de certificação FSC em parceria com a National Alliance

Acesse o mapa interativo no site: www.imaflora.org

Certificados FSC pelo Imaflora no Brasil



- Naturais
- Plantações
- Cadeia de Custódia
- Projetos de Carbono

- COMFLONA**
Cooperativa Mista
Fiona Tapejos
- ARIMUM**
Cooperativa Mista
Agroextrativista Nossa Senhora do Perpétuo Socorro
- Associação das Comunidades Tradicionais do Bailique
- Associação Soenama do Povo Indígena Paiter Suruí



74% FLORESTAS PLANTADAS
26% FLORESTAS NATIVAS



2,4 milhões hectares

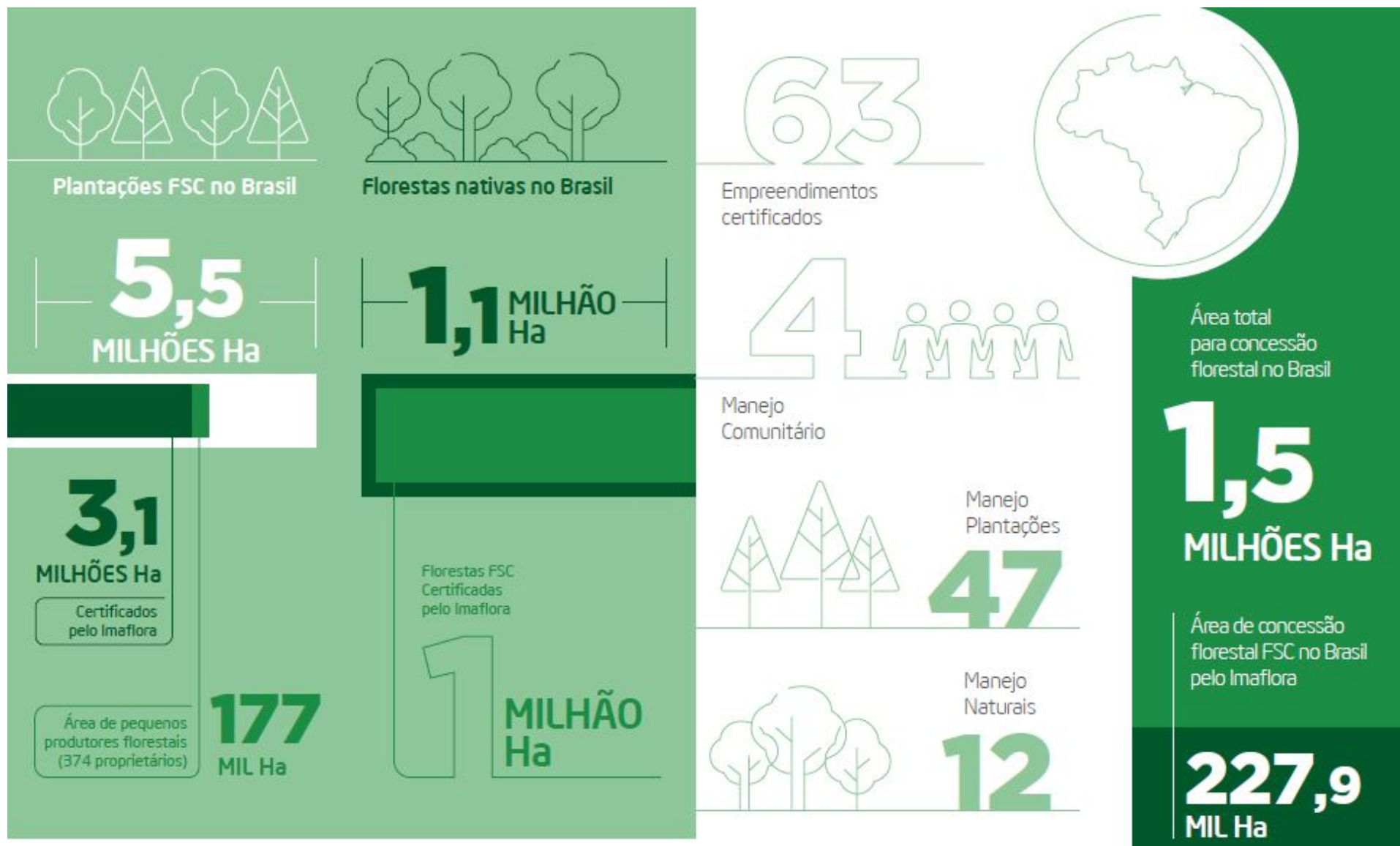
***Área natural conservada**
*Consideramos área natural conservada, todo o manejo de floresta natural acrescido da área destinada a conservação nas plantações florestais.



90.000

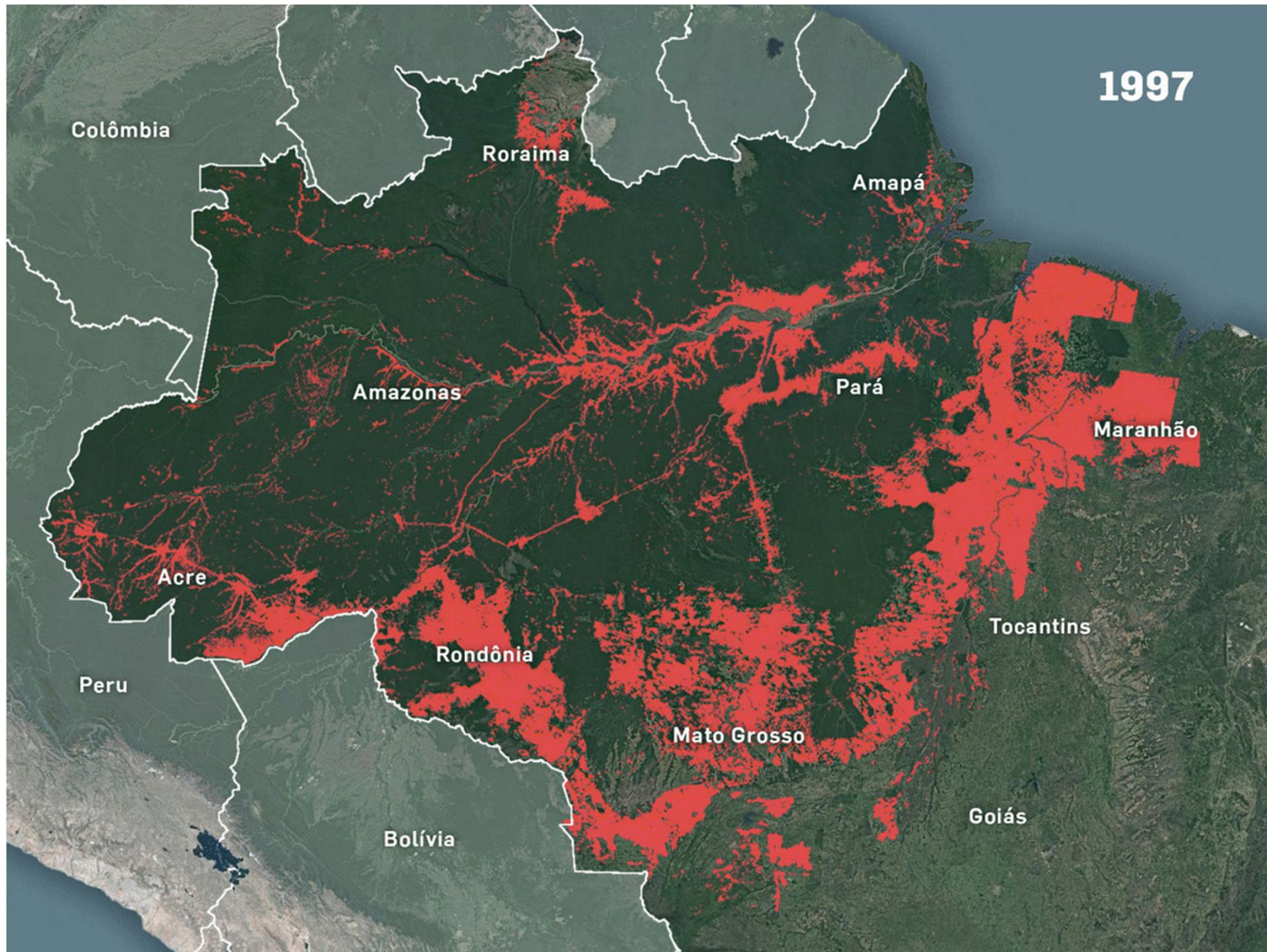
218 Cadeias de Custódia

4 Cooperativas e associações comunitárias Certificadas FSC

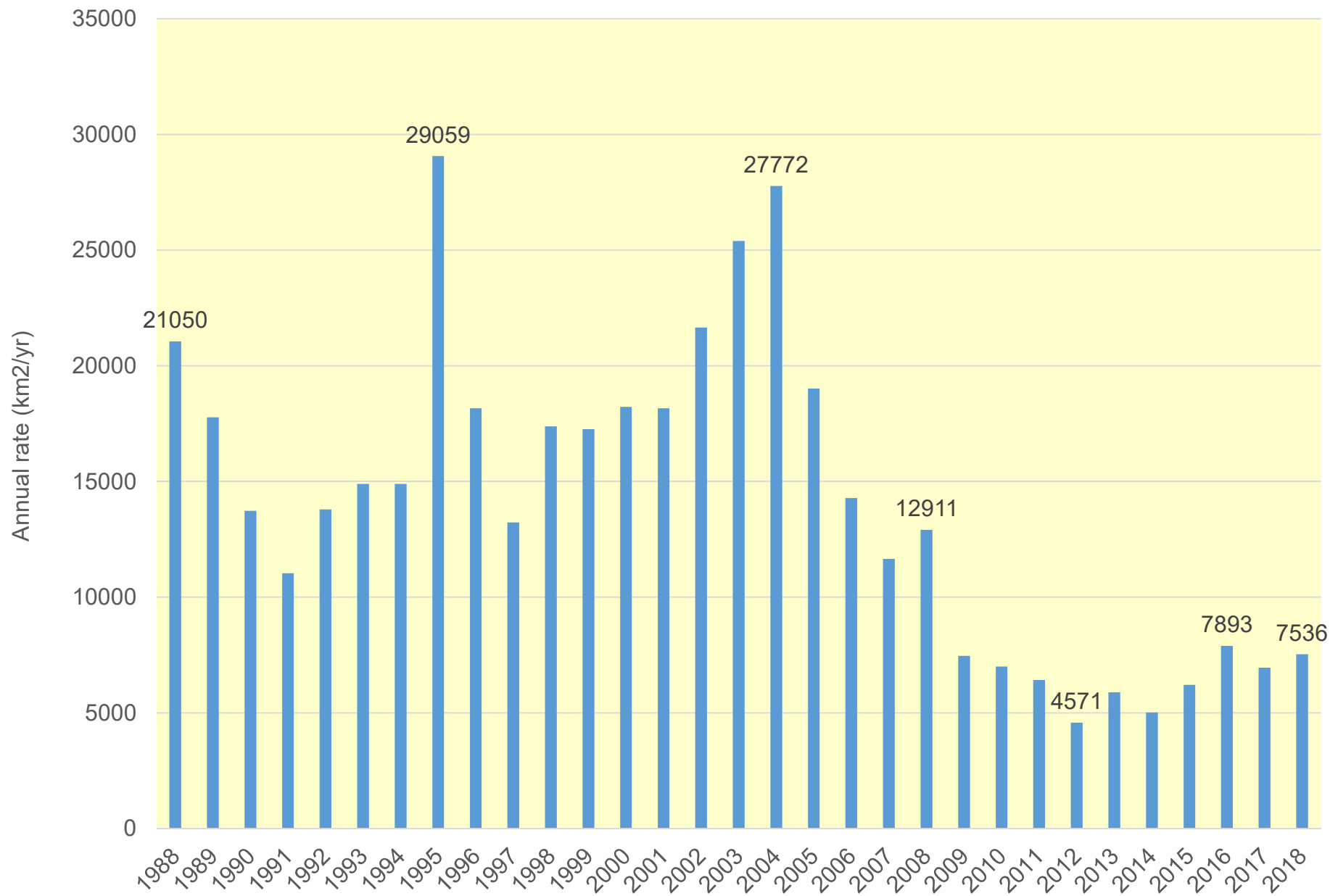


Balanco de 2017

*Context of deforestation, forest
degradation and illegal logging in the
Brazilian Amazon*



Source: Estadão

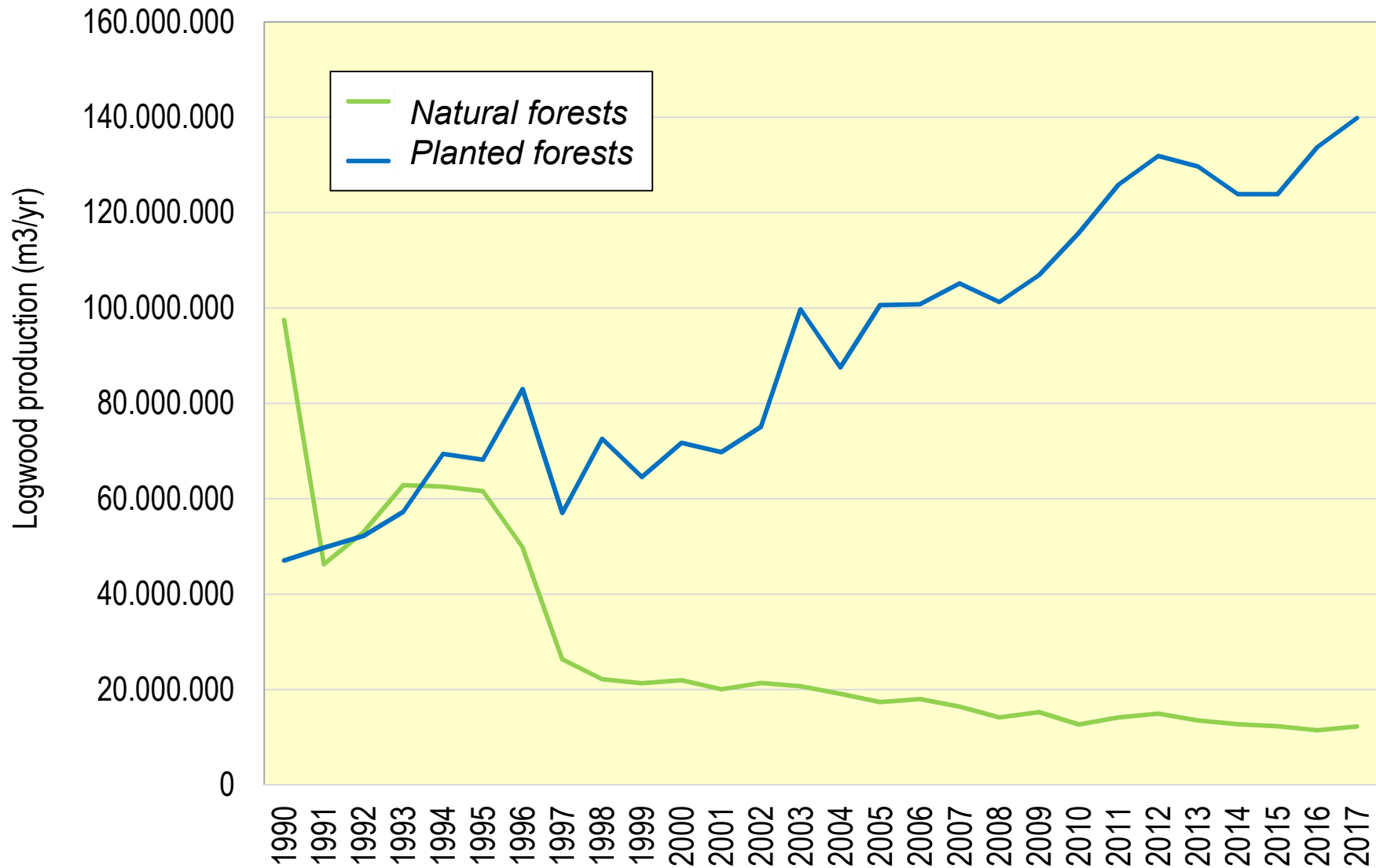


Source: Prodes



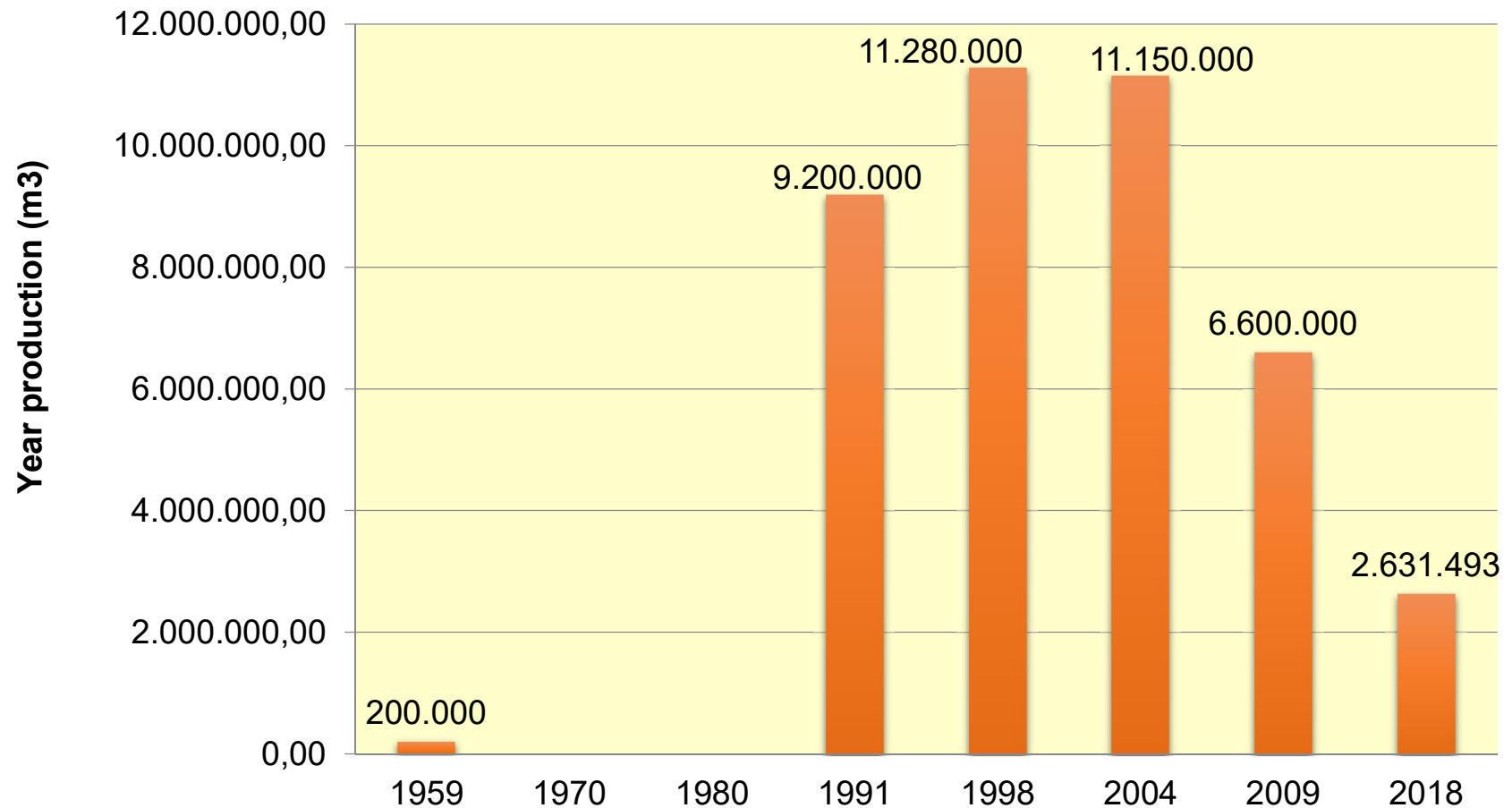
Source: GreenPeace

Evolution of roundwood production in Brazil



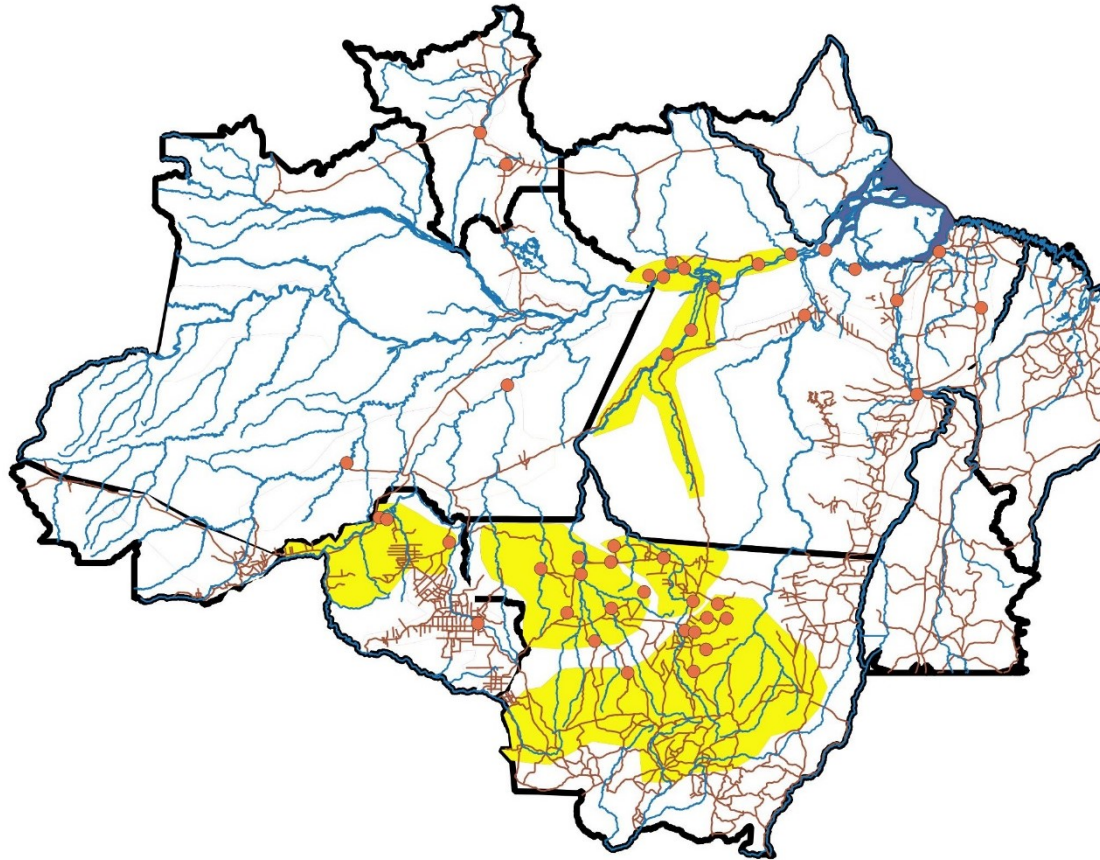
Source: SIDRA/IBGE (2018)

Evolution of logwood production from native forests in Pará state



Source of data: Knowles (1966), Uhl et al. (1997), Lentini et al (2003),
Lentini et al. (2005), SFB e IMAZON (2009), IMAFLORA (2019)

The Amazon logging sector in 2018



- Timber products from the Amazon subsidized the development of Brazilian civil construction
- The sector suffered a strong retraction, either for reasons of reputation or due to strong substitution by other materials
- The state of São Paulo has historically been the main consumer of wood from the Amazon
- The domestic market in the Amazon has developed and probably today has a fundamental role
- The growth of the region's middle class in the coming years will create even greater pressure for wood

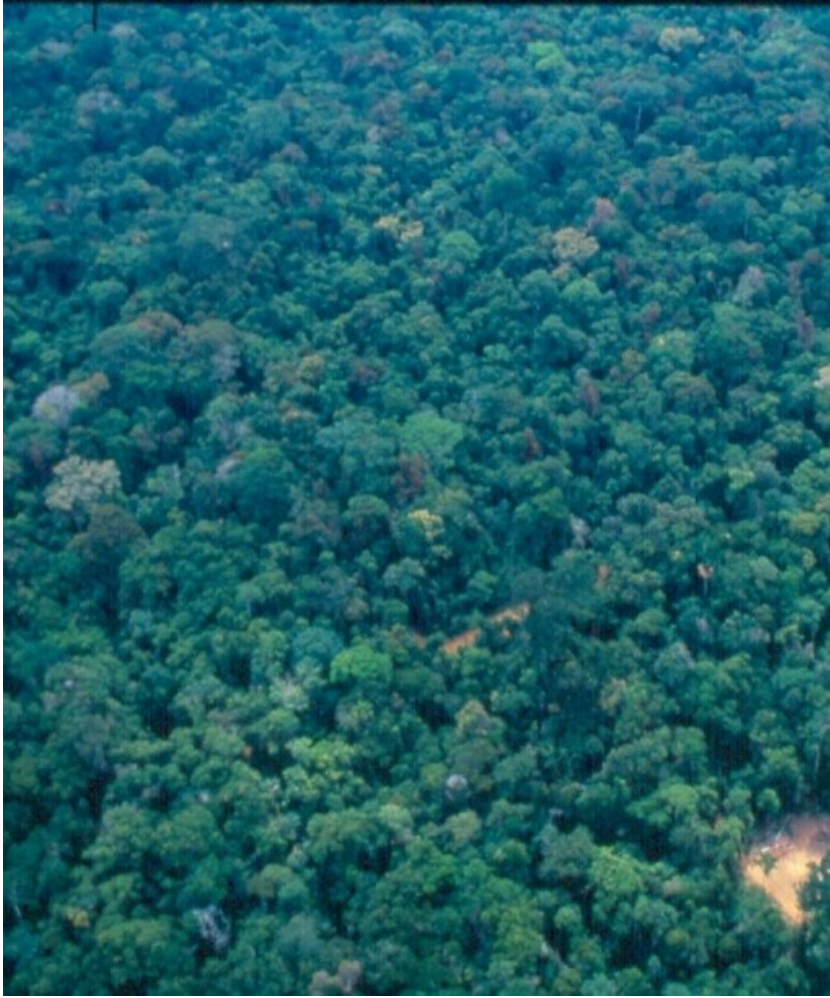
OUR HARDWOOD INDUSTRY IS DISINTEGRATING!



IT'S OK... WE'VE GOT A PLAN!



RWKE



CRÉDITO DAS FOTOS: IFT

Civil construction sector in Brazil: an opportunity for sustainable development

Brazilian housing deficit: 6 Mio units*
Estimate 20 Mio until 2024*
Investment needed: R\$ ~18-20 billion/yr.*



* Source: VALOR ECONOMICO – 13/10/2014

Lumber is the material with the lowest value of built-in energy

Sawnwood - 350 KWH/M³

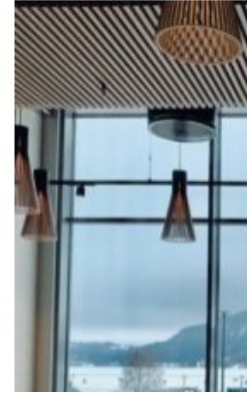


Cement – 1750 KWH/M³



LAROCA 2002

THE WORLD'S TALLEST WOODEN TOWER



Opened on 15 March, the Mjøstårnet, or the Mjøsa Tower in Brumunddal near Oslo, Norway, is with 85.4 metres currently the world's tallest wooden building.

While wood was one of the first building materials used by men, its use fell out of favour because of it being known as a fire hazard. However, with the downsides of building materials like **bricks, concrete** and **metal** becoming more evident, more and more people are turning back to wood. Not the type of wood that grows on trees, though, but engineered wood that is stronger and less flammable.

Designed by **Voll Arkitektur**, the 18-storey tower is made from lightweight, prefabricated materials, mainly glulam (glued laminated timber), **CLT** (cross-laminated timber) and **MetsäWood's** Kerto LVL (laminated veneer timber), produced in Finland. Kerto LVL is lightweight, strong, and uniform and has an "outstanding strength-to-weight" ratio.

floors, with offices and hotel facilities, are made of prefabricated wooden elements. The decks on the upper floors, however, where apartments are made of concrete. This is because the amount of swaying increases the higher you get in a building built of wood or concrete. The weight of the concrete makes the swaying slower and not as noticeable. The shafts for the elevators and staircases are made of CLT.

The tower, located next to the eponymous largest lake of Norway, was built according to strict fire safety regulations. Untreated solid wood creates its own fire-resistant surface because the outermost layer chars when exposed to fire, protecting against further fire damage. Massive wooden structures manufactured in large maintain therefore their load-bearing capacity in case of fire.

For more wooden buildings, click [here](#).

By Els Zijlstra



INSTITUTO DE MANEJO E CERTIFICAÇÃO FLORESTAL E AGRÍCOLA

*Wood transactions official control
datasets and the 'timberflow' initiative:
the Amazon wood reference platform*



SINAFLOR - National system for controlling the origin of forest products

- *The Brazilian Forest Code - Law 12651 (2012)*
- *Instrução Normativa 21 (2014)*
- *System availability starting from Dec 1st, 2017*
- *Mandatory implementation from May 2nd, 2018*
- *Integration with DOF system*



DOF – Forest origin document

- Created in IBAMA's Portaria 253 (2006)
- *"It constitutes a mandatory license for the transport and storage of forest products of native origin, including native charcoal, containing information on the origin of these products";*
- IBAMA maintains the DOF system available on the internet for issuing the document;
- States can issue the document through their own control systems (according to art. 6º, § 2º, Resolução Conama 379, October 2006). This is the case of Mato Grosso, Pará and Minas Gerais States;



INSTITUTO DE MANEJO E CERTIFICAÇÃO FLORESTAL E AGRÍCOLA



MINISTÉRIO DO MEIO AMBIENTE

INSTITUTO BRASILEIRO DO MEIO AMBIENTE E DOS RECURSOS NATURAIS RENOVÁVEIS

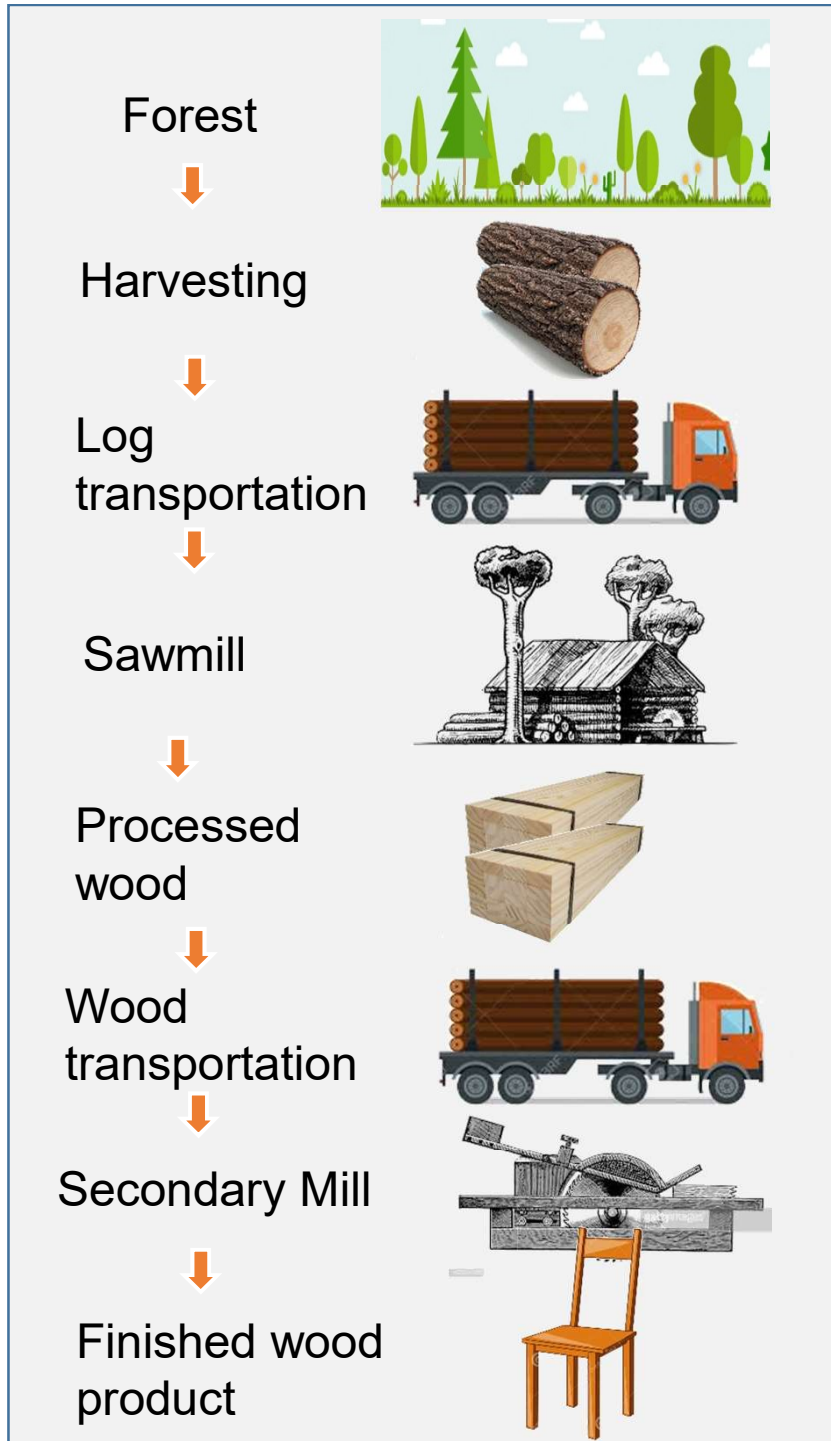
DOCUMENTO DE ORIGEM FLORESTAL - DOF

Nº 21757447

1 - Emissor	[REDACTED]			2 - Ibama/CTF
3 - Endereço	EST VICINAL CURUA S/N - UMF II - CONCESSÃO			6674975
4 - Bairro	FLONA DE ALTAMIRA	5 - Município	ITAITUBA/PA	
6 - Origem	- UMF II - FLONA DE ALTAMIRA			7 - Coordenadas
8 - Endereço	-----			55°10'11.4"W - 05°41'31.3"S
9 - Bairro	-----			10 - Município
11 - Roteiro de acesso				
ATRAVÉS DA RODOVIA BR-163, ACESSA-SE A ESTRADA VICINAL CURUÁ ATÉ A UMF II.				
12 - Autorização	1015.2.2018.01681	13 - Tipo	PLANO DE MANEJO	
14 - Produto / Espécie		15 - Qtd.	16 - Un.	17 - Valor
Tora / Apuleia leiocarpa - garapa		19,7598	M3	117,40
Tora / Tabebuia serratifolia - ipê-amarelo		12,2499	M3	117,40
Tora / Tabebuia impetiginosa - ipê-roxo		7,6984	M3	117,40
-----		-----	-----	-----
-----		-----	-----	-----
-----		-----	-----	-----
-----		-----	-----	-----
18 - Destinatário	[REDACTED]			19 - Ibama/CTF
20 - Endereço	ROD. TRANSGARIMPEIRA S/N - KM 03			7248607
21 - Bairro	MORAES ALMEIDA	22 - Município	ITAITUBA/PA	
23 - Destino	[REDACTED]			24 - Coordenadas
25 - Endereço	ROD. TRANSGARIMPEIRA S/N - KM 03			-----
26 - Bairro	MORAES ALMEIDA	27 - Município	ITAITUBA/PA	
28 - Roteiro de acesso				

29 - Meio de Transporte	30 - Placa/Registro	31 - Município Origem	32 - Município Destino	
Rodoviário	EKH1593,JZY1340	ALTAMIRA/PA	ITAITUBA/PA	

Wood production chain



Harvesting and origin control systems (forest management licensing)

Transportation, selling and processing control systems (DOF e SISFLORA)

Fiscal and tributary control systems

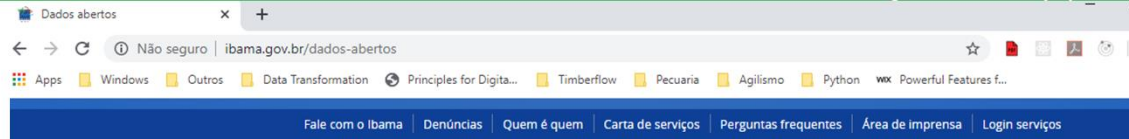


IBAMA's open data initiative

- Compliance with Law 12.527 (2011), also known as Access to Information Law (LAI);
- Both IBAMA's open data plan (PDA) for 2018-2019 and its revision for 2019-2021 are available at <http://www.ibama.gov.br/dados-abertos>;
- The data available includes DOFs for forestry products shipment issued since January 2007 in formats 4 different formats (html, csv, xml and json);
- Not all States have data covering whole period;



INSTITUTO DE MANEJO E CERTIFICAÇÃO FLORESTAL E AGRÍCOLA



PÁGINA INICIAL > DADOS ABERTOS

Dados abertos

Publicado: Quinta, 22 de Dezembro de 2016, 20h19 | Última atualização em Terça, 28 de Janeiro de 2020, 10h28



Cadastro Técnico Federal (CTF)
Wildfire 2019

SERVIÇOS

- Acesse o Portal de Dados Abertos do Ibama
- Acesse o Plano de Dados Abertos do Ibama (PDA) 2019-2021 (PDF - 2,1 MB)
- Acesse o Plano de Dados Abertos do Ibama (PDA) 2018-2019 (PDF - 2,1 MB)

BIODIVERSIDADE

EMISSÕES E RESÍDUOS

Twitter

Facebook

Licença

Outra (Domínio Público)

OPEN DATA



Ibama
Dados Abertos

Organizações / Dados Abertos / DOF - Transportes de ...

DOF - Transportes de Produtos Florestais

Seguidores: 1

Organização

Dados Abertos
O Instituto Brasileiro do Meio Ambiente e

DOF - Transpor

Relação de transportes efetuado transporte e armazenamento de em 2007 e estão separadas por ano de emissão ou UF e por unidade federativa (UF) o Devido à não utilização do sistema DOF ou falta de integração de sistemas estaduais, es transportes internos aos seguintes estados e períodos: Bahia, até novembro de 2007, Ce Rondônia, até maio de 2011; Mato Grosso, Minas Gerais e Pará, em todo o período de le contemplados nestes dados abertos todos os documentos de transporte emitidos de sist assim como os DOFs destinados aos mesmos estados.

ATENÇÃO! O Ibama disponibiliza dados completos sobre DOFs emitidos desde janeiro d arquivos em cada formato (html, csv, xml e json). Para simplificar a exibição, foram inclui com origem no estado do Acre no ano de 2007. É possível pesquisar outros períodos e U recurso (URL), exibido na barra superior do seu navegador, com os parâmetros desejad Exemplo: o endereço-padrão é [http://dadosabertos.ibama.gov.br/dados/DOF/SP/transporte/2018.html](http://dadosabertos.ibama.gov.br/dados/DOF/XX/transporte/UF e YYYY é o ano. Se deseja dados de São Paulo no ano de 2018, altere esse endereç http://dadosabertos.ibama.gov.br/dados/DOF/SP/transporte/2018.html)

Dados e recursos

DOF - Transportes de Produtos Florestais

- DOF - Transportes de Produtos Florestais**
DOFs emitidos em 2007 com origem no estado do Acre. Para acessar outros anos... [Explorar](#)
- DOF - Transportes de Produtos Florestais**
DOFs emitidos em 2007 com origem no estado do Acre. Para acessar outros anos... [Explorar](#)
- DOF - Transportes de Produtos Florestais**
DOFs emitidos em 2007 com origem no estado do Acre. Para acessar outros anos... [Explorar](#)

- Carvão Vegetal
- Comércio
- DOF
- Indústria
- Lenha
- Madeira
- Movimentações
- Produto Florestal
- Produto Não Madeireiro
- Transporte
- Venda

Informações Adicionais

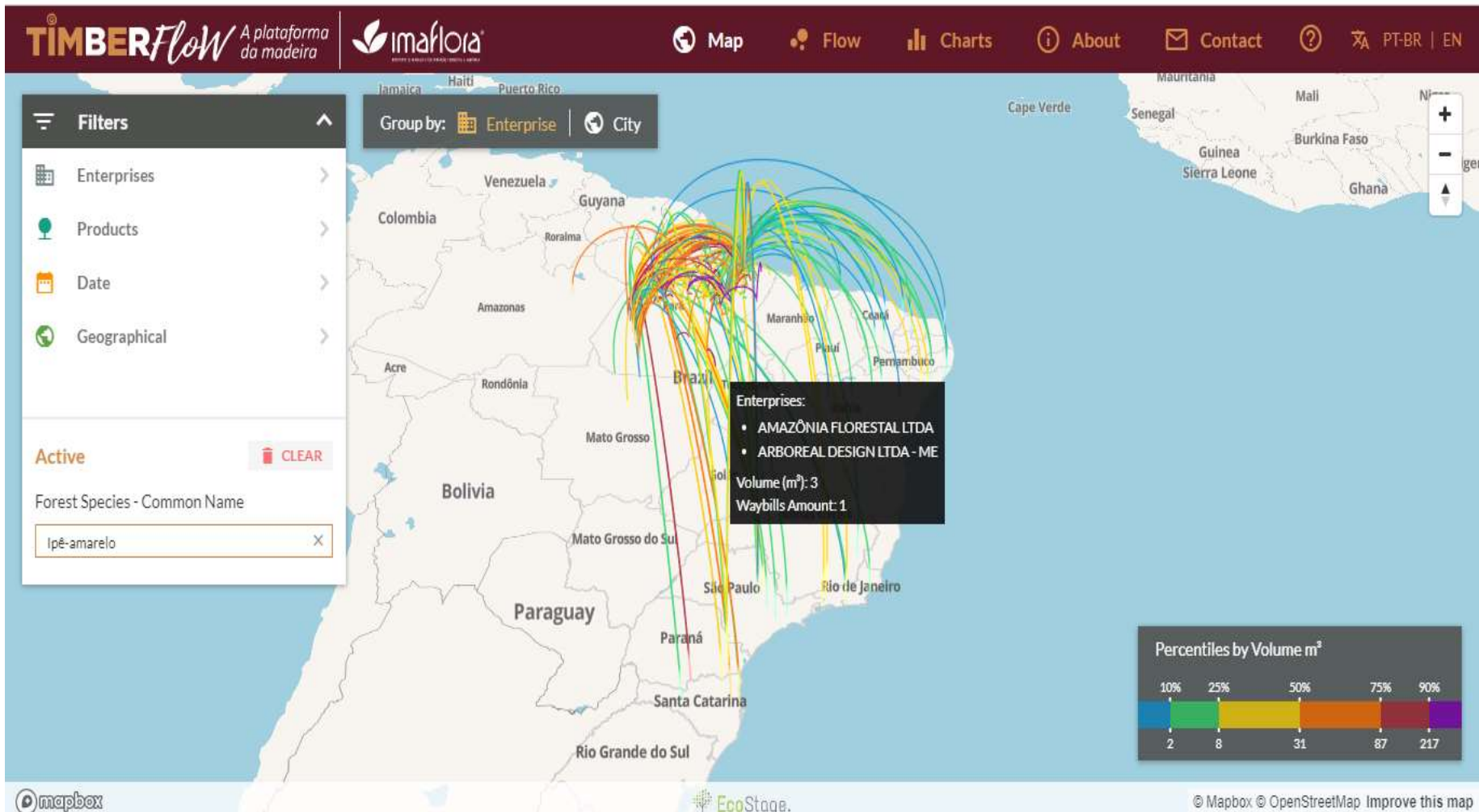
Campo	Valor
Fonte	http://dadosabertos.ibama.gov.br/
Autor	Ibama
Mantenedor	Diretoria de Uso Sustentável da Biodiversidade e Florestas
Última Atualização	4 de Novembro de 2019, 19:11 (UTC-03:00)
Criado	14 de Setembro de 2018, 19:05 (UTC-03:00)
Frequência de atualização dos dados	semanal

<http://www.ibama.gov.br/dados-abertos>

Timberflow – The timber platform

- Transparency initiative aimed at combating illegality in the forestry sector;
- Version 1.0 based on a 2017 dataset from the State of Pará;
- Provides map based visualization of forest products shipping orders (GFs);
- Displays transactions between every two companies and the user could filter data by company name and id, municipality, product, forest species or time period;

TIMBERFlow



Filtros

- Empreendimentos >
- Produtos >
- Temporais >
- Geográficos >

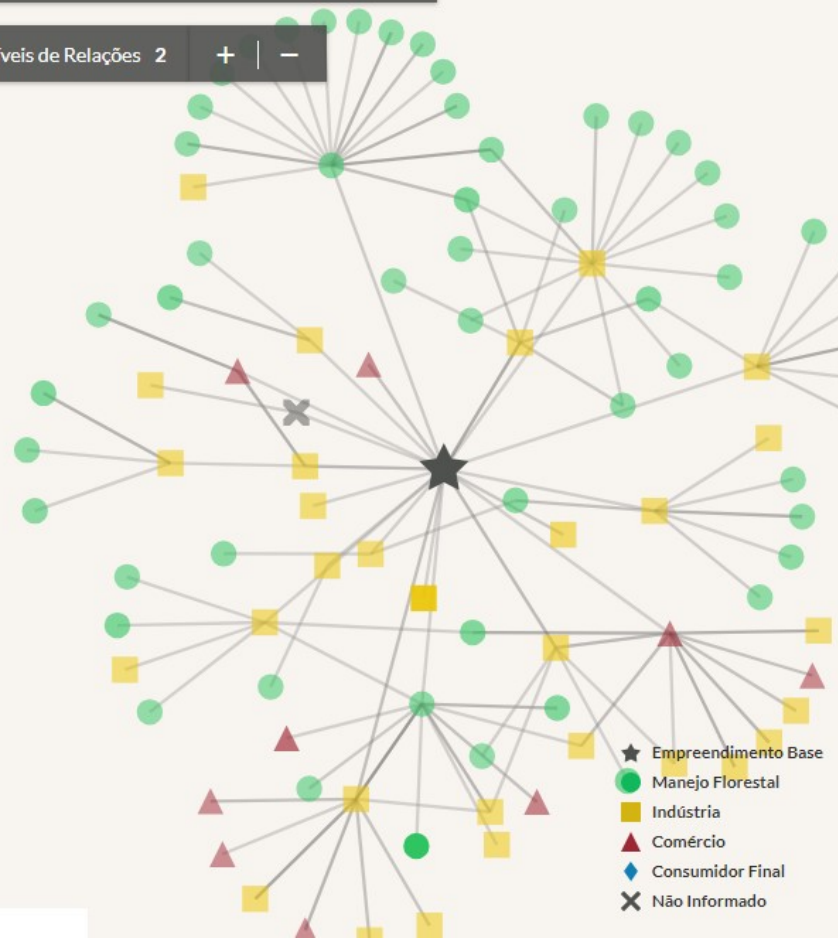
Ativos LIMPAR

CEPROF Destinatário

Espécie Florestal - Nome Comum

Agrupar por: Empreendimento | Município

Níveis de Relações 2 + | -



Ranking de Empreendimentos

#	Nome	Volume Total (m³)
1º	RONDOBEL IND E COM...	4.236,18
2º	EBATA PRODUTOS FLO...	3.427,96
3º	G. C MADEIRAS COM. I...	1.299,13
4º	LN GUERRA INDUSTRIA...	962,57
5º	ASSOCIAÇÃO DOS REM...	923,30
6º	ASSOCIAÇÃO DOS PRO...	892,16
7º	MADEIREIRA CANDEUA...	891,14
8º	LN GUERRA INDUSTRIA...	857,79
9º	RONDOBEL IND E COM...	791,60
10º	PONTE EMPRENDIME...	771,73

1 de 10



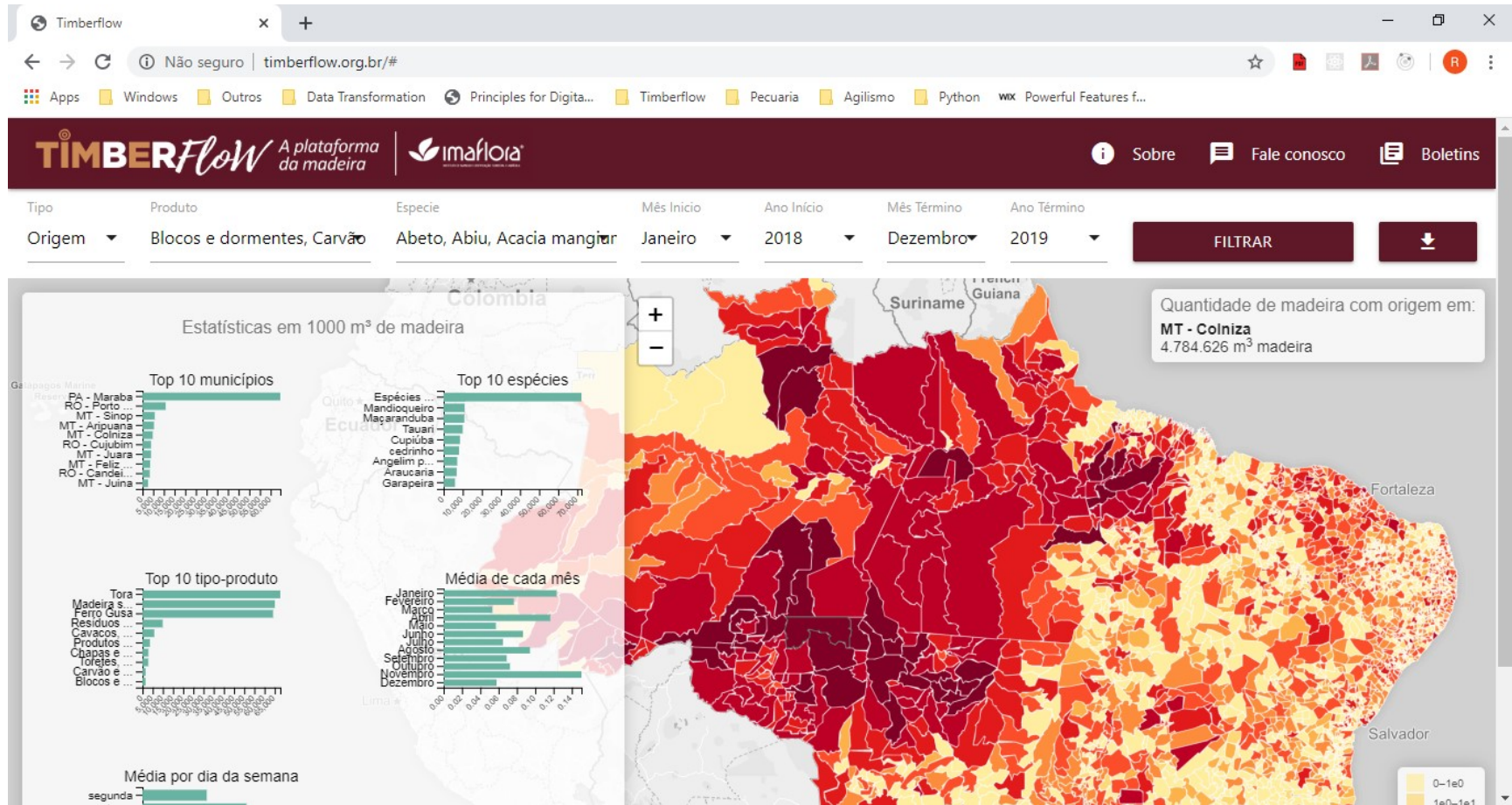
TimberFlow 1.0 limitations

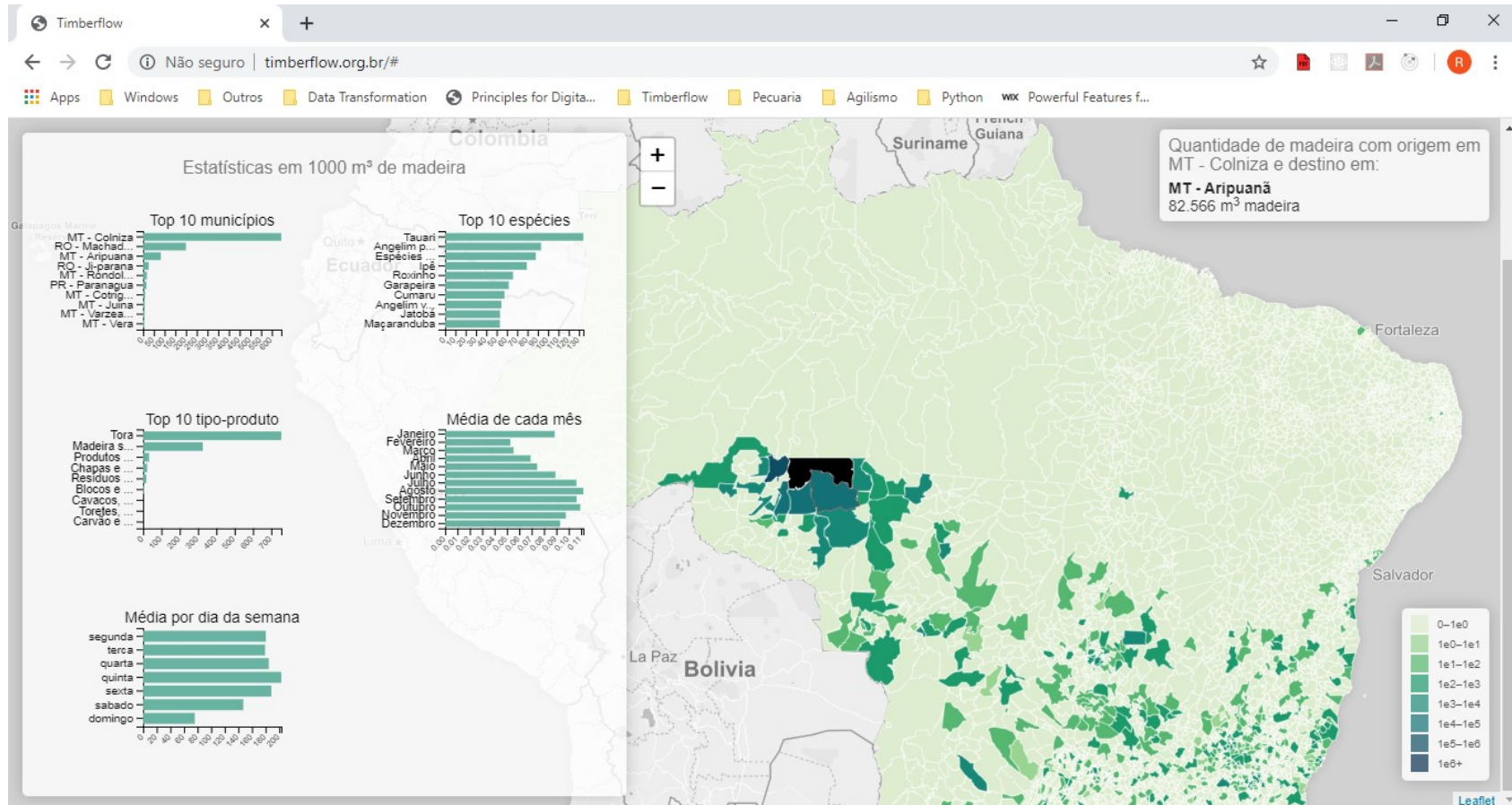
- Difficulties in upsizing the platform for data from all Brazilian States and other (different) datasets;
- Platform strongly linked to the State of Pará data model (SISFLORA / PA);
- User interface vastly compromised by dataset increase (grows from about 1million records to over 30 million);
- Network diagrams gets really confusing



Timberflow 2.0 Development

- Version 2.0 built in partnership with ICMC / USP São Carlos, with data from all over Brazil (DOF/IBAMA, SISFLORA/PA and SISFLORA/MT)
- Aggregation of data at the municipality level;
- Data sanitize: compatibilization of product names, forest species names, municipality names, volume conversions to cubic meters in all three datasets;
- The interface shows a heat map over the map of municipalities in Brazil, the user chooses between Source or Destination of products from/to municipalities;

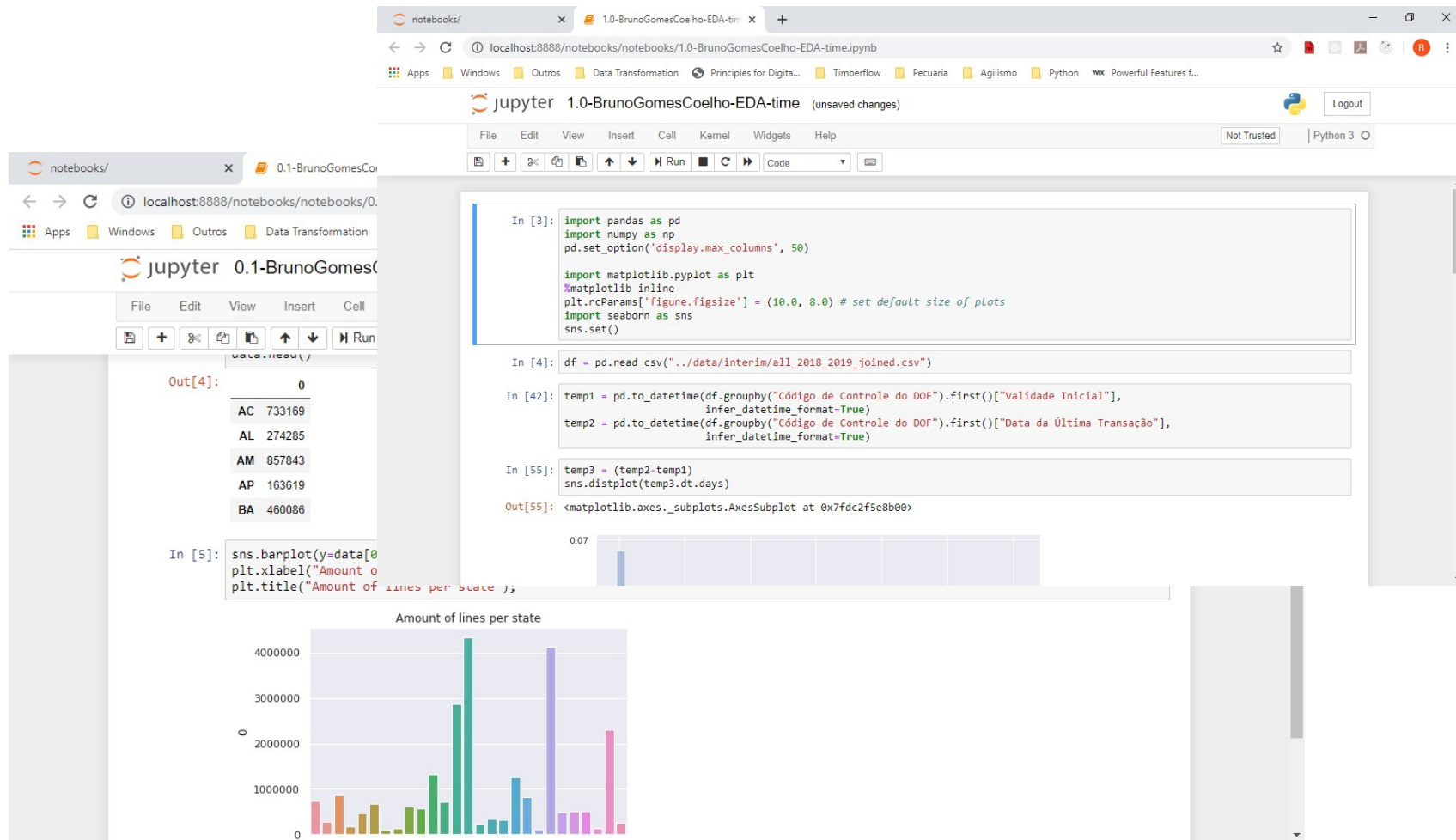






Other contributions of Timbflow v.2.0's Development

- IBAMA's data download and sanitization is now automated;
- EDA is very consistent;
- Improved application performance and robust Frontend / Backend architecture;
- Source code for the application and EDA is high quality and shared among partners;
- Strengthening of the partnership and collaboration between IMAFLORA and ICMC/USP São Carlos;



The screenshot displays a Jupyter Notebook environment with the following content:

Browser Tab: notebooks/ 1.0-BrunoGomesCoelho-EDA-time

URL: localhost:8888/notebooks/notebooks/1.0-BrunoGomesCoelho-EDA-time.ipynb

Page Title: Jupyter 1.0-BrunoGomesCoelho-EDA-time (unsaved changes)

Code Cells:

```
In [3]: import pandas as pd
import numpy as np
pd.set_option('display.max_columns', 50)

import matplotlib.pyplot as plt
%matplotlib inline
plt.rcParams['figure.figsize'] = (10.0, 8.0) # set default size of plots
import seaborn as sns
sns.set()

In [4]: df = pd.read_csv("../data/interim/all_2018_2019_joined.csv")

In [42]: temp1 = pd.to_datetime(df.groupby("Código de Controle do DOF").first()["Validade Inicial"],
infer_datetime_format=True)
temp2 = pd.to_datetime(df.groupby("Código de Controle do DOF").first()["Data da Última Transação"],
infer_datetime_format=True)

In [55]: temp3 = (temp2-temp1)
sns.distplot(temp3.dt.days)

Out[55]: <matplotlib.axes._subplots.AxesSubplot at 0x7fdc2f5e8b00>
```

Output [4]:

	0
AC	733169
AL	274285
AM	857843
AP	163619
BA	460086

Code Cell [5]:

```
sns.barplot(y=data[0],
plt.xlabel("Amount of lines per state"),
plt.title("Amount of lines per state"))
```

Figure: A bar chart titled "Amount of lines per state". The y-axis represents the number of lines, ranging from 0 to 4,000,000. The x-axis represents different states. The bars are colored in a gradient from red to purple. The highest bar is green, reaching approximately 4,000,000 lines.



INSTITUTO DE MANEJO E CERTIFICAÇÃO FLORESTAL E AGRÍCOLA



Where to go now: perspectives and opportunities in terms of intelligence and data science

New opportunities for the Amazon forest sector

- Agenda and political priorities in the states more focused on forest production and improved legality
- Scarcity of resources for enforcement activities, which means that more intelligence is necessary
- Growing trend of using timber in civil construction markets internationally and even in Brazil as a solution for the climate agenda
- Increasing area under forest management in the Amazon in forest concessions (perspective of 5 million hectares in the next 2-3 years)
- Increasing interest in legality from timber buyers (including reforms in the Chinese Forest Act)

Perspectives for improved intelligence regarding forestry and land use/land use change data

- Improved understanding of timber production chains
 - Variation of timber stocks in the mills over time
 - Mapping the connections between different companies supplying wood products in the production chain
 - Determining the mass balance variation in different portions of the supply chain
- Improved integration of forestry transaction datasets with georeferenced data on land use and land use change
 - Deforestation, forest degradation, land use and zoning, supply chains, etc.
- Improved integration of forestry transaction datasets with data on trade for other commodities
- Better prediction of the logging sector evolution over time

Timber stocks in the sawmills

Logwood



Sawnwood



Average efficiency = (y m3 sawn wood) / (x m3 logs)

2016



2016



2017



2017



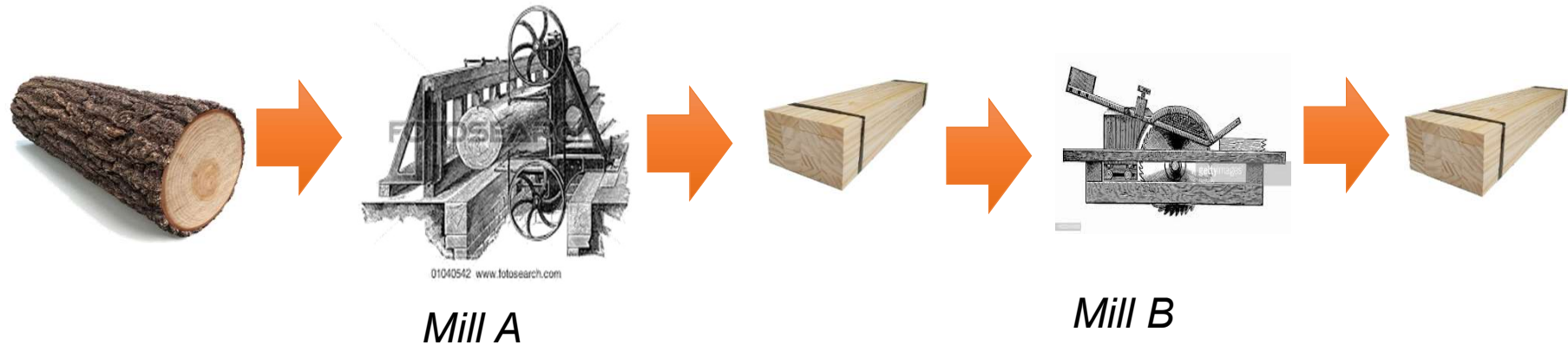
2018



2018



Mapping the connections between different companies supplying wood products in the production chain

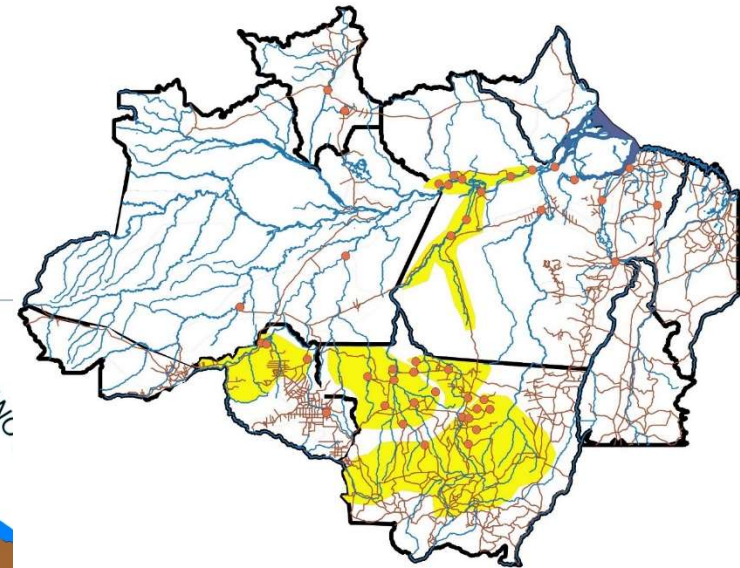
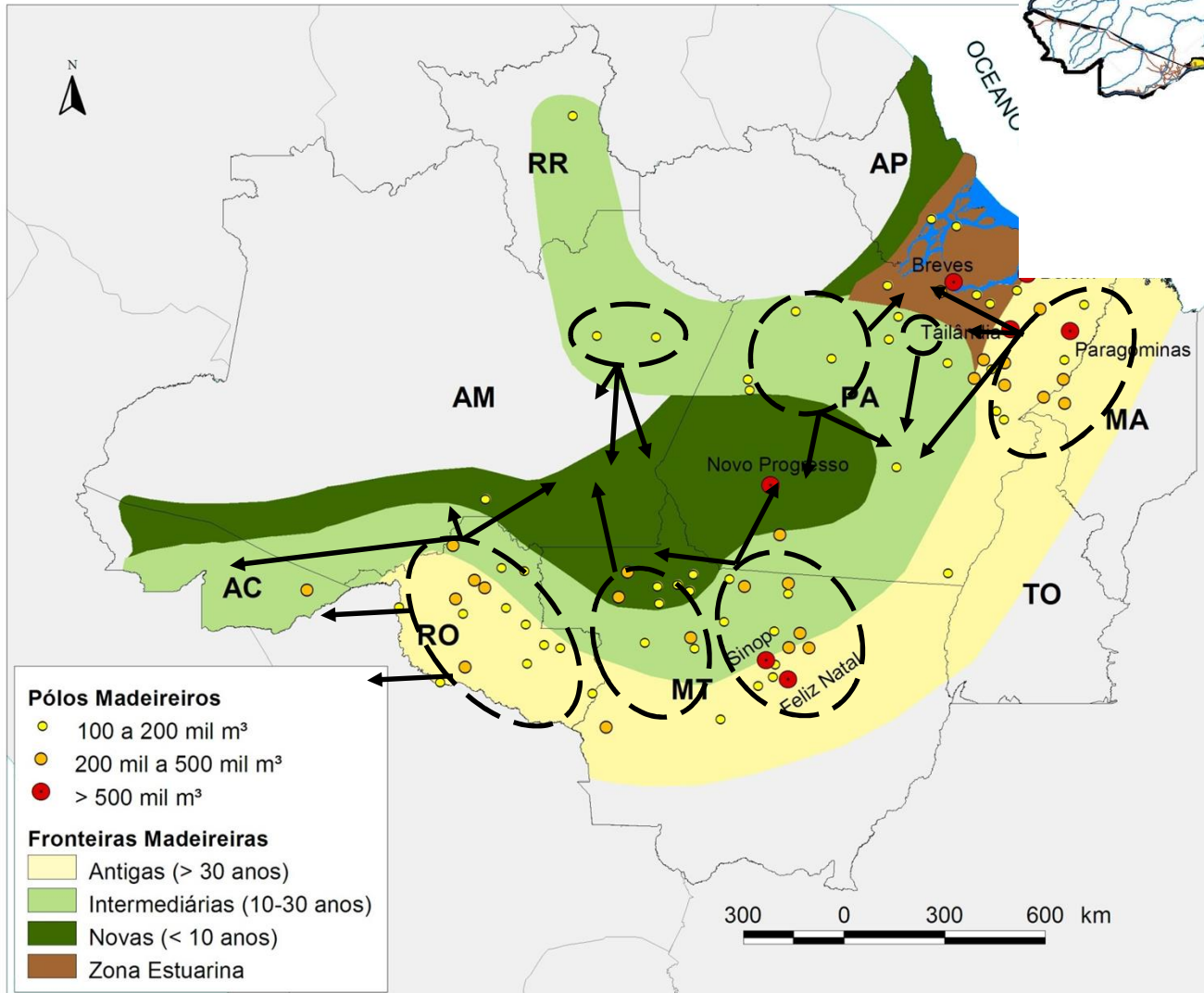


Determining the mass balance variation in different portions of the supply chain



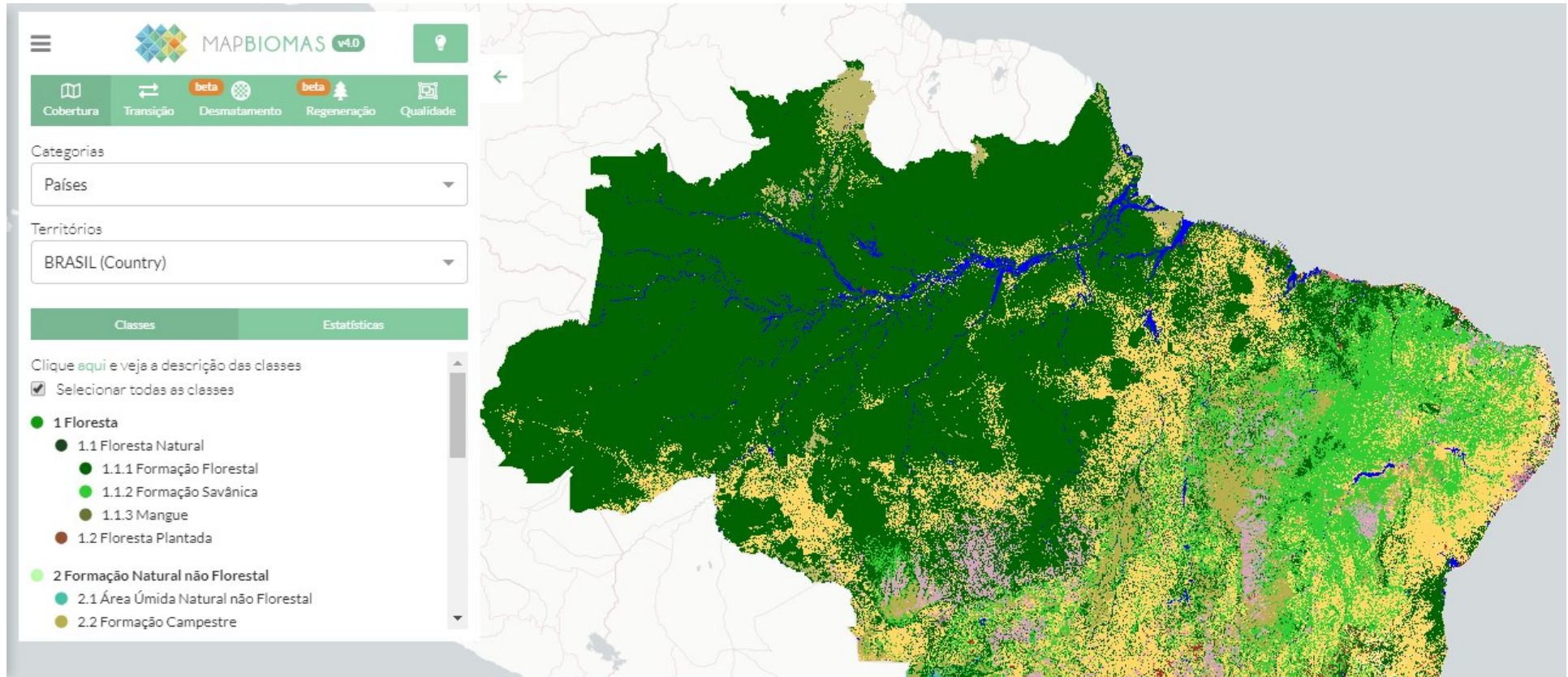
Better prediction of the logging sector evolution over time

Early 2000s



2019-20

Improved integration of forestry transaction datasets with georeferenced data on land use and land use change



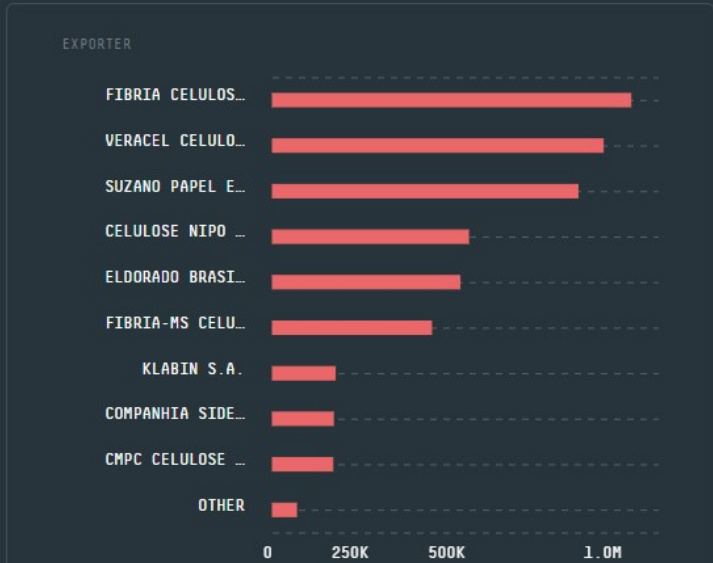
Other examples: Prodes, Simex (Imazon, ICV), public forest databases (protected areas and public forests)

Improved integration of forestry transaction datasets with data on trade for other commodities (e.g., Trase)

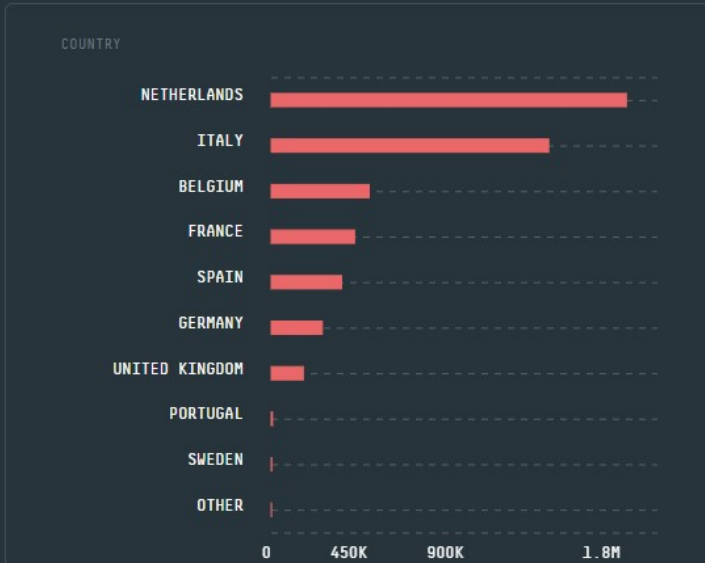
Your dashboard will include **wood pulp** produced in **Brazil** going into **European Union**

YEAR: 2017
UNITS: Trade volume

Top 10 exporters



Top 10 importing countries





“Soluções inovadoras para conservar o planeta e beneficiar pessoas que vivem do campo ou das florestas.”

www.imaflora.org

Tel. +55 19 3429.0800
Fax +55 19 3429.0809
imaflora@imaflora.org

SEDE:
Estrada Chico Mendes, 185
CEP- 13426-420
Piracicaba | SP | Brasil

ESCRITÓRIOS:
Travessa Antônio Nunes, 123
CEP 68380-000
São Félix do Xingu - PA

Lauro Sodré, 215
CEP 68109-000
Alter do Chão - Santarém - PA