Monitoring Brazilian Amazon, challenges and future perspectives

BiomasBR Program

CLÁUDIO ALMEIDA

COORDINATOR OF MONITORING PROGRAM FOR AMAZON AND OTHER BIOMES

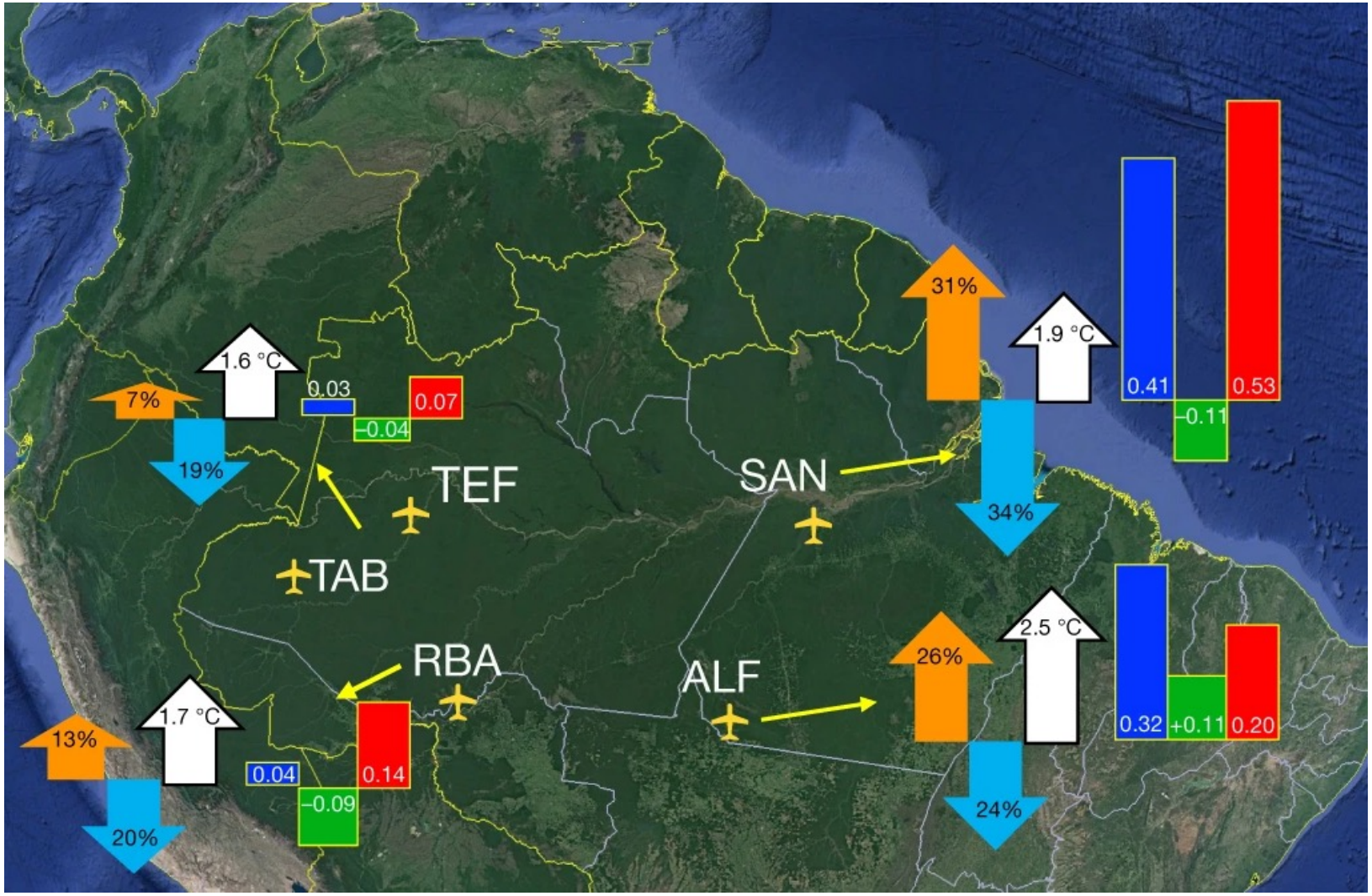
Amazon biome

Largest forest in the world

>> More than 3 Million km² of Forest

> More than 20% of the world's biodiversity

Effects of uncontrolled occupation



Deforestation

Precipitation ASO

Temperature ASO

Total C flux (g C m^{-2} d^{-1})

NBE C flux (g C m^{-2} d^{-1})

Fire C flux (g C m^{-2} d^{-1})

Gatti, L.V., Basso, L.S., Miller, J.B. *et al.* Amazonia as a carbon source linked to deforestation and climate change. *Nature* **595**, 388–393 (2021). https://doi.org/10.1038/s41586-021-03629-6

Regional Effects

Biogeosciences, 18, 2511–2525, 2021
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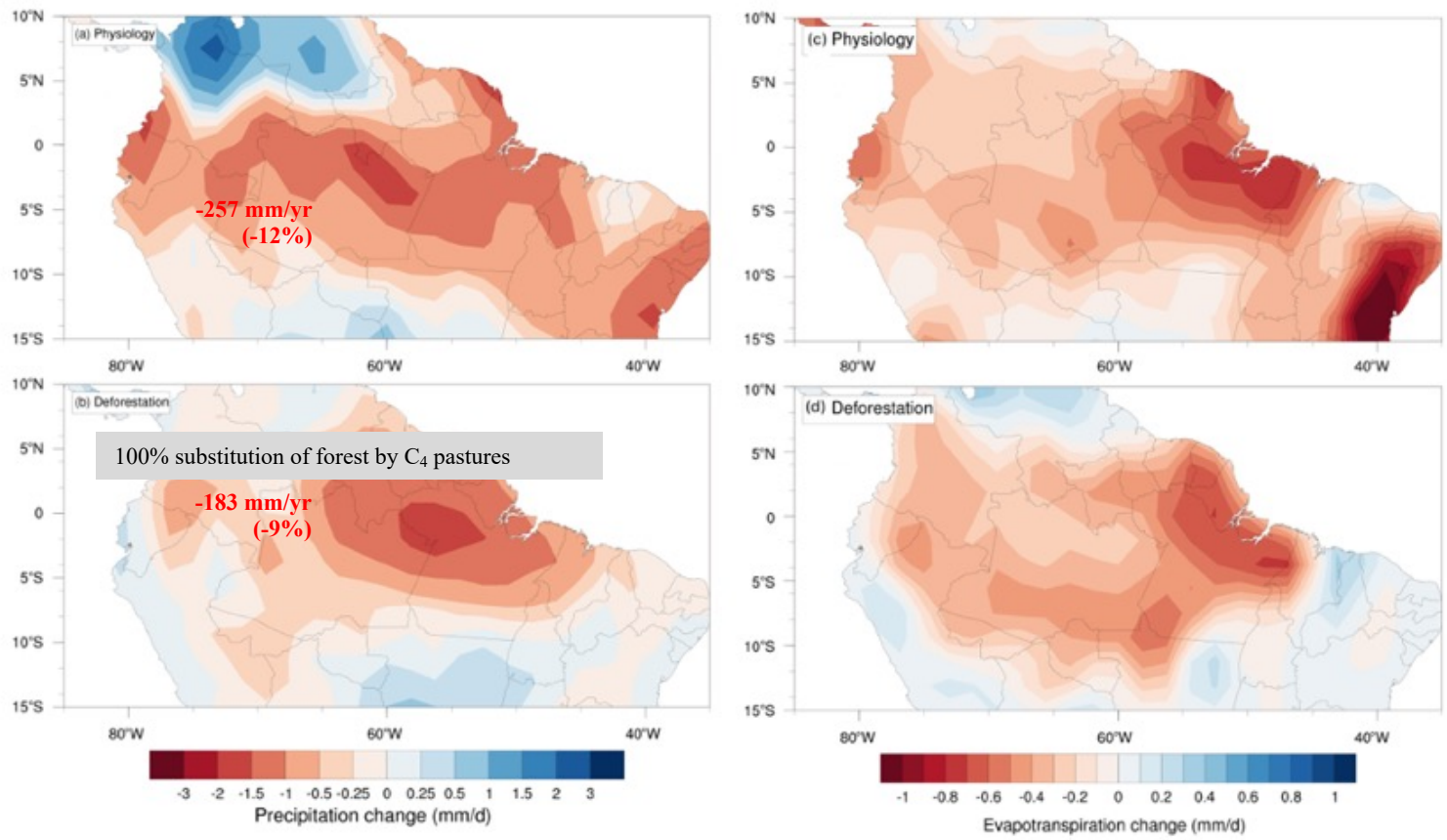
Biogeosciences Open Access EGU

The effect of CO_2 can cause as much rainfall decrease as large-scale deforestation in the Amazon

CO_2 physiological effect can cause rainfall decrease as strong as large-scale deforestation in the Amazon

Gilvan Sampaio[1], Marília H. Shimizu[1], Carlos A. Guimarães-Júnior[1], Felipe Alexandre[1], Marcelo Guatura[1], Manoel Cardoso[1], Tomas F. Domingues[2], Anja Rammig[3], Celso von Randow[1], Luiz F. C. Rezende[1], and David M. Lapola[4]

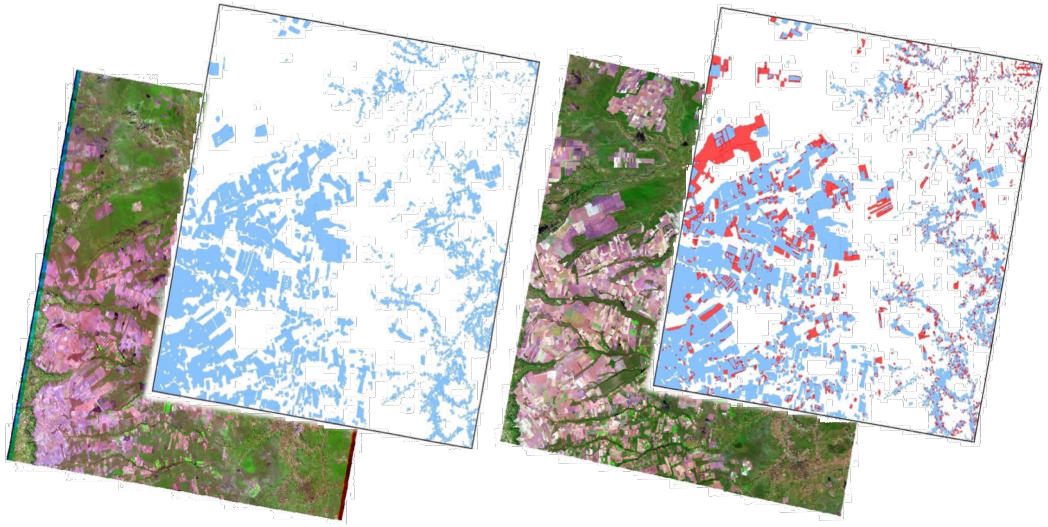


PRODES Methodology

Incremental System

Almeida *et al*. 2021: **Methodology for Forest Monitoring used in PRODES and DETER projects**

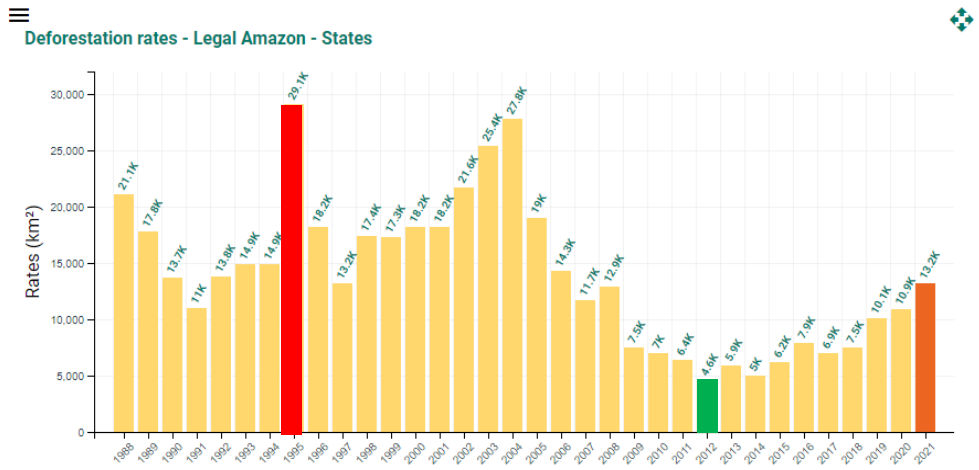
Incremental system
Annual increase of deforestation
Medium spatial resolution (20-30 m)
Minimum Mapping Unit = 6.25 ha (AMZ) 1ha (Other biomes)
Visual Interpretation
Experienced team
Accuracy >93% (Maurano *et al.* 2019, Parente *et al.* 2021)

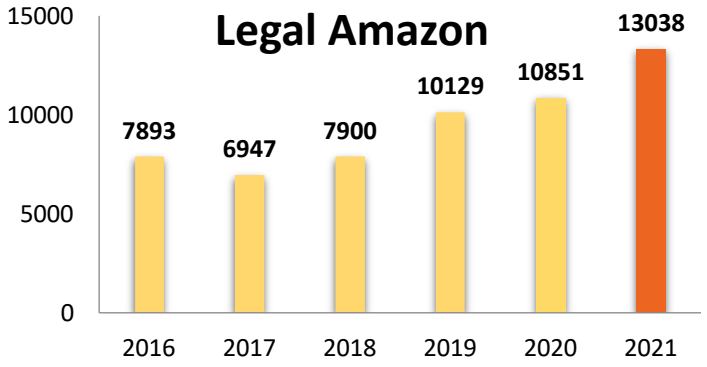


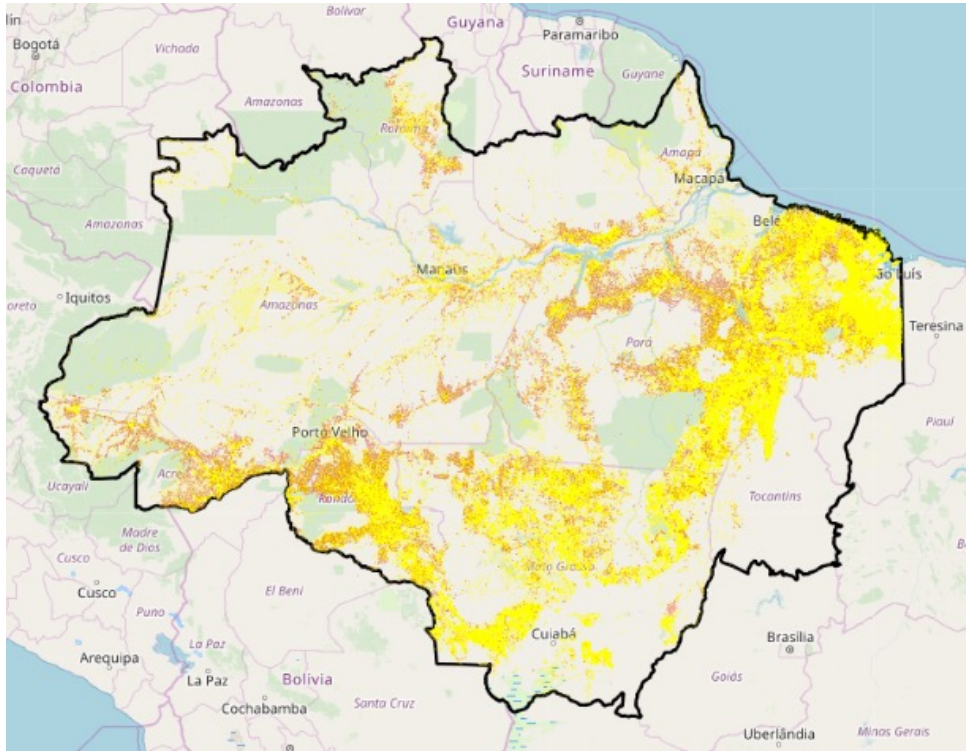
Previous year

Mapping year

Clear cut deforestation at 2021 > 820.000 km^2
> 20% of Original Forest of Legal Amazon





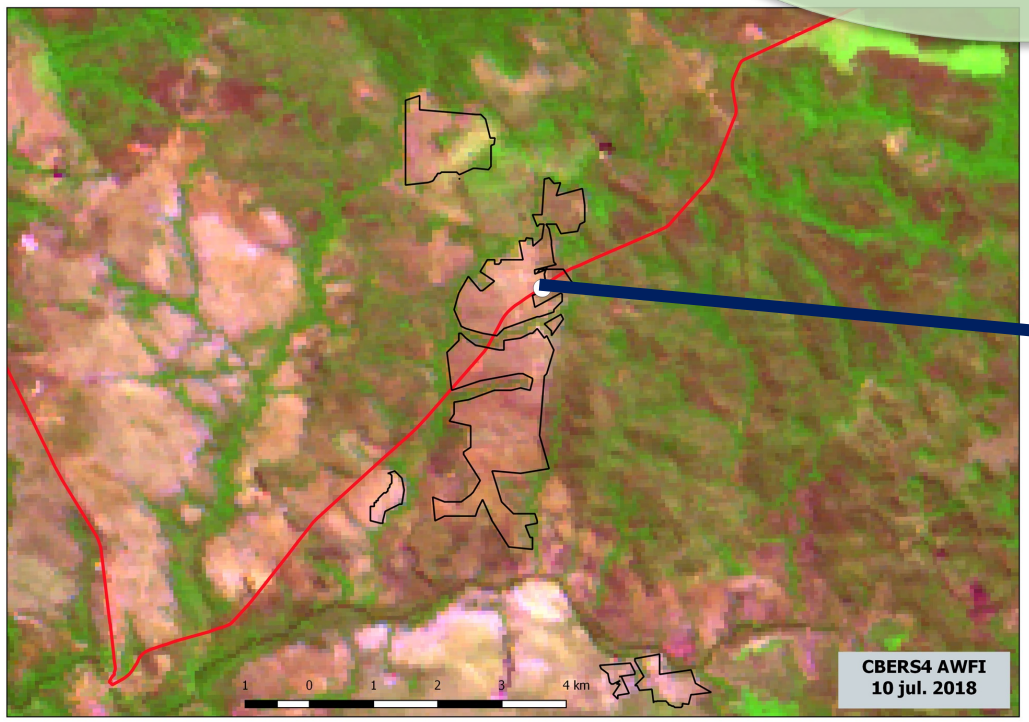


http://terrabrasilis.dpi.inpe.br

DETER: Daily monitoring

Incremental System

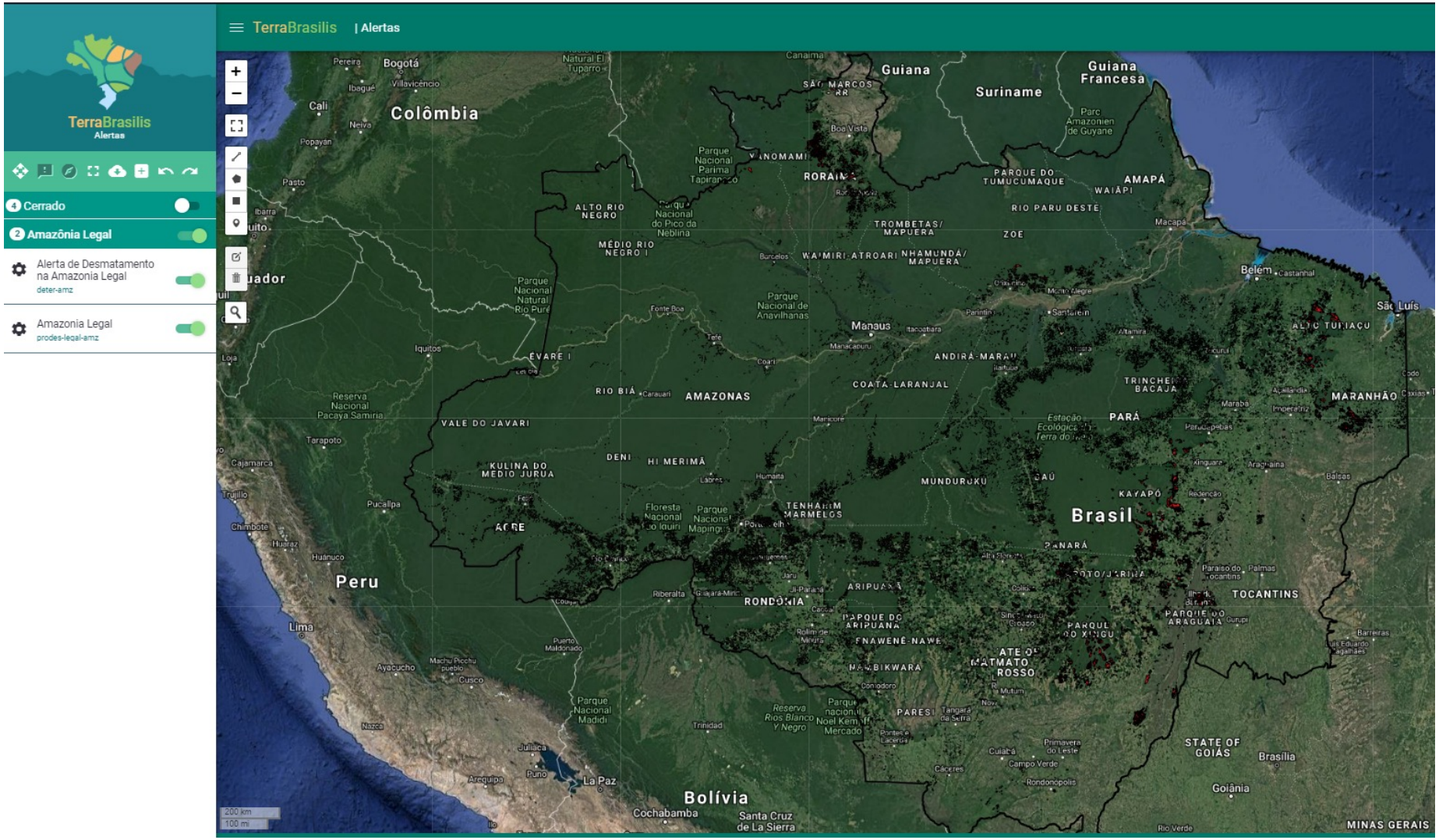
Daily increase of deforesation
moderate-resolution (WFI ~ 60 m)
Minimum Mapping Unit (MMU) 3 ha
Visual Interpretation
Team with very large expirience



WFI July 10, 2018

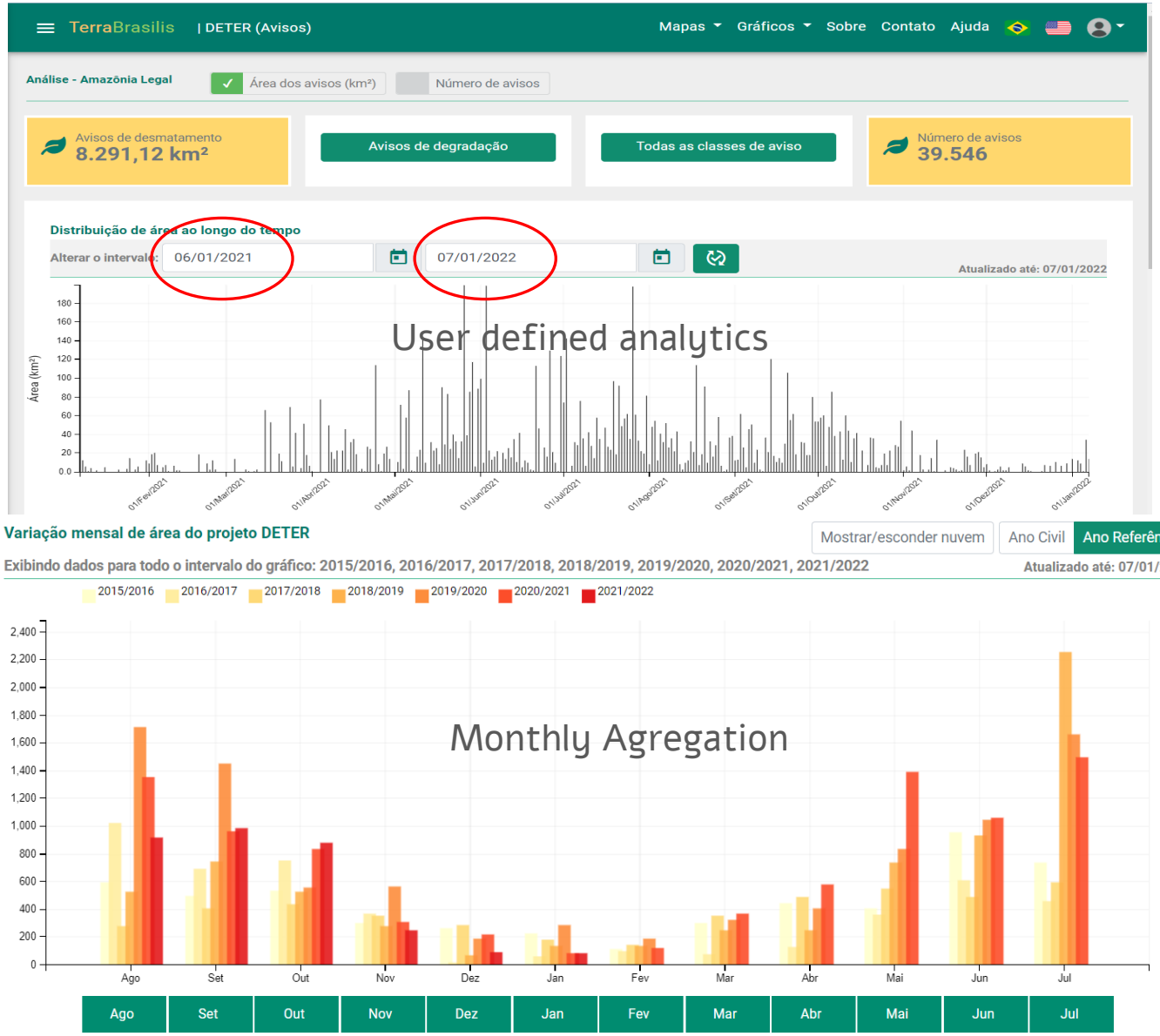
Field Mission: September 1, 2018

Explicit Spatial Information



http://terrabrasilis.dpi.inpe.br

DETER: Results



http://terrabrasilis.dpi.inpe.br

PRODES/DETER processes: implications on data quality

Aspects of **PRODES/DETER quality**:

I - Mapping processes requirements

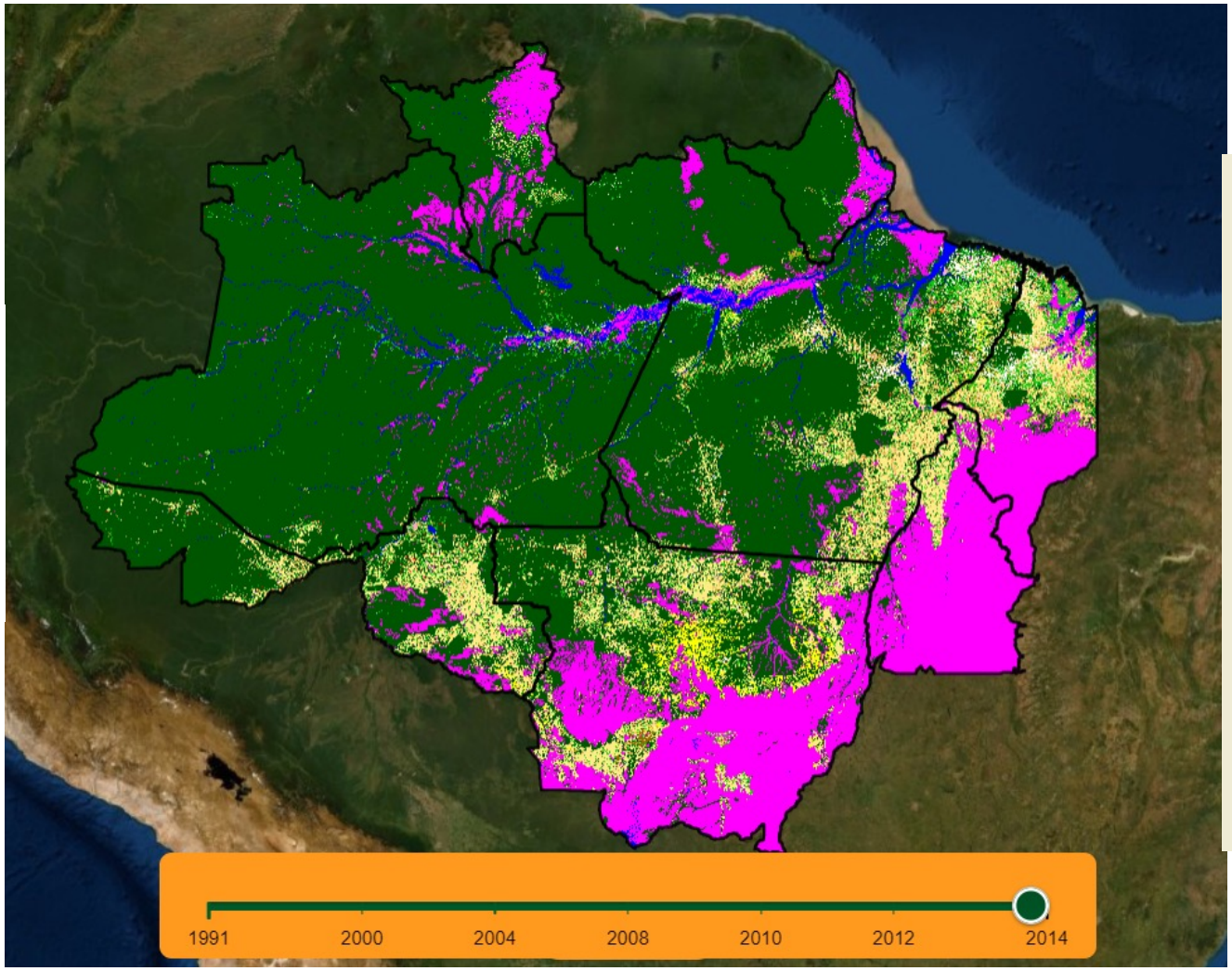
II - *Validation*

III - Transparency

Image selection and processing	Best detection period Reduced cloud coverage
Visual interpretation	Multi-disciplinar and experienced 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

TerraClass: Use of deforested areas

www.terraclass.gov.br

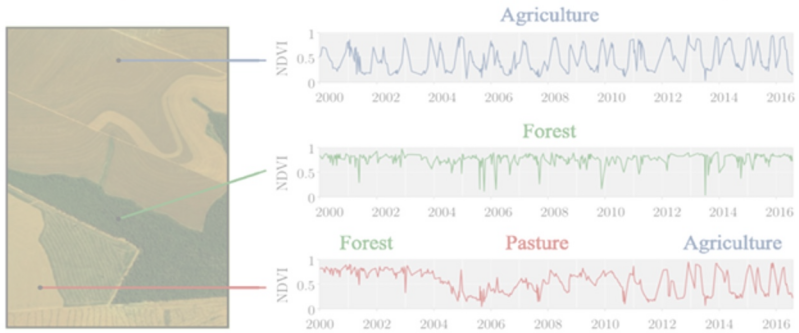


- Vegetação Natural Florestal Primária
- Vegetação Natural Florestal Secundária 24,0%
- Silvicultura 0,4%
- Pastagem Cultivada Arbustiva 13,7%
- Pastagem Cultivada Herbácea 49,6%
- Cultura Agrícola Perene 0,2%
- Cultura Agrícola Semiperene 0,3%
- Cultura Agrícola Temporária 5,6%
- Mineração 0,2%
- Urbanizada 0,7%
- Outros 0,9%
- Não Observado 3,9%
- Desflorestamento No Ano 0,6%
- Não Floresta
- Corpo D'água

TerraClass
Land Use Land Cover Mapping

Monitoring Challenges

Process automatization
Use of multi-sources data
New techniques for vegetation change detection



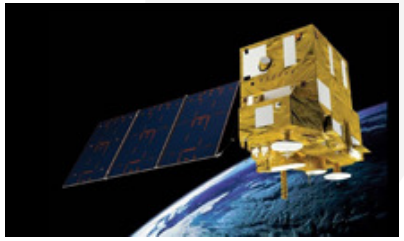
X

Maintain the consistency of the historical series

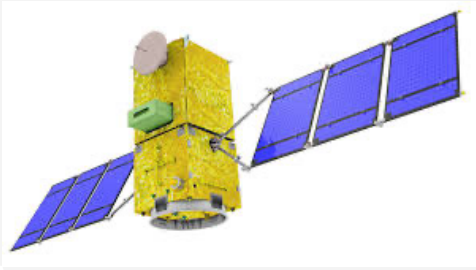
Evolution

Enlarging the Image Set			
Sensor	Spatial Resolution (m)	Temporal Resolution (days)	Images/month
WFI/CBERS 4	64	5	6
WFI/CBERS 4A	55	5	6
WFI/Amazônia-1	60	5	6
OLI/Landsat 8	30	16	1
MSI/Sentinel 2	10	5	6
SAR/Sentinel 1	10	12	2

+



CBERS-4



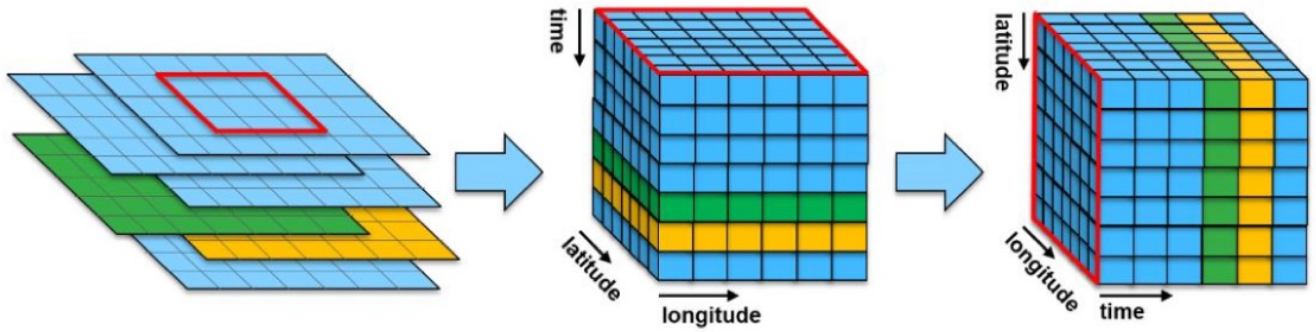
AMAZÔNIA-1

CBERS-4A

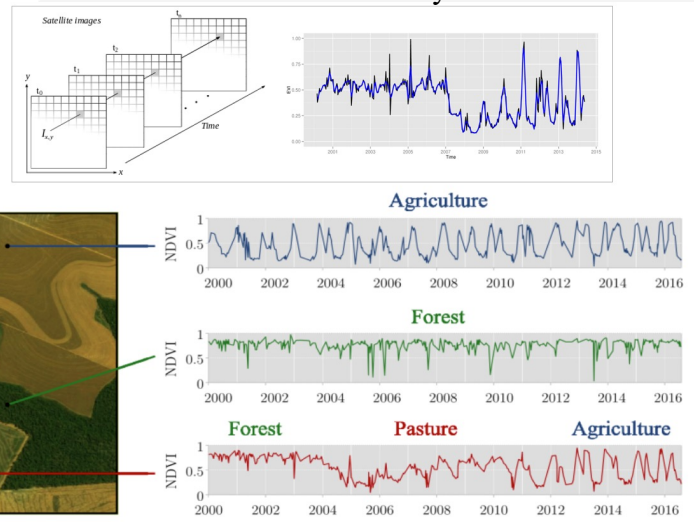
Only with 18 WFI monthly images

New technologies

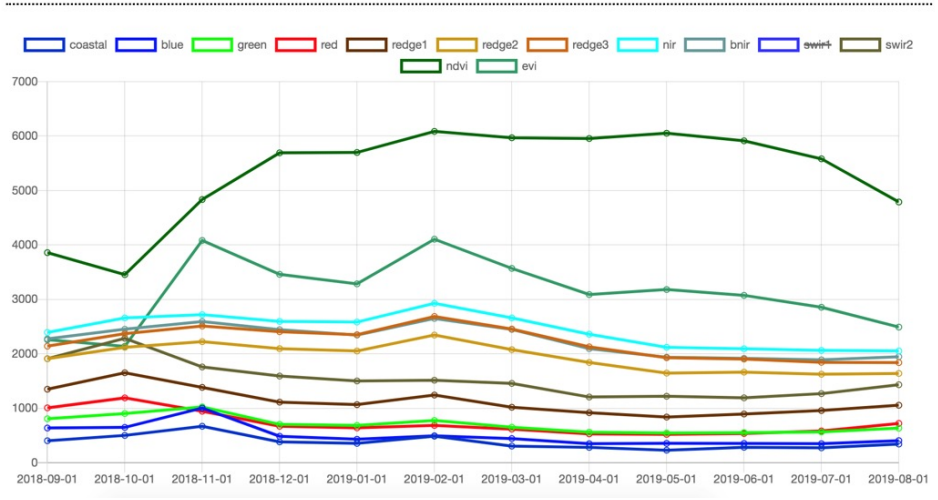
Brazilian Data Cube



Time series analysis



Big Data



Return for Society

Amazon and other biomes monitoring program

Thank you for your attention!

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