S1 4Science Amazonas

esa

Sentinel-1 for Science Amazonas

The detection of deforestation with Sentinel-1

A simple ‘data cube’ approach

gisat

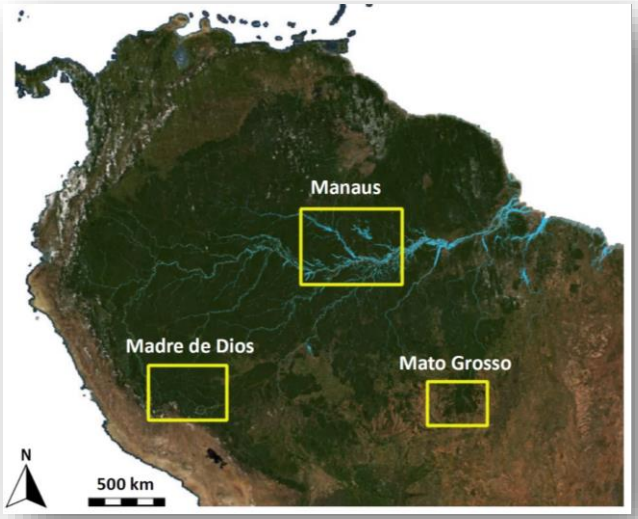
NMBU Norwegian University of Life Sciences

NLS FINNISH GEOSPATIAL RESEARCH INSTITUTE FGI

agresta

SPACE INTELLIGENCE

Objective: Forest area and carbon loss



Develop, test and validate an operational-level **Multi-temporal forest Change Detection** (MCD) algorithm using Sentinel-1 SLC IW time series.

Estimate **Carbon loss** from forest cover loss areas in the Amazonas based on the MCD outputs

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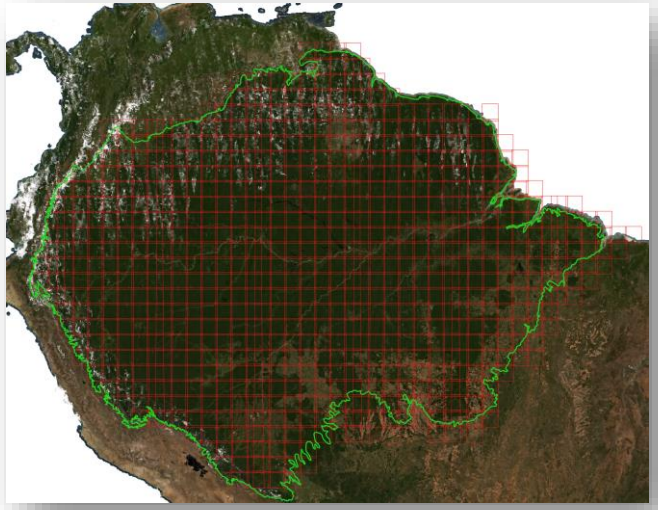

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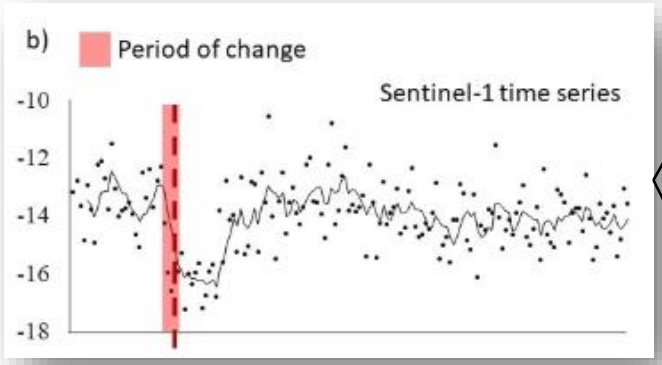
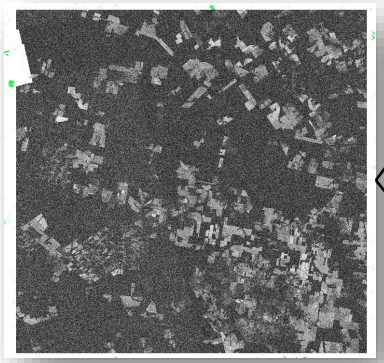
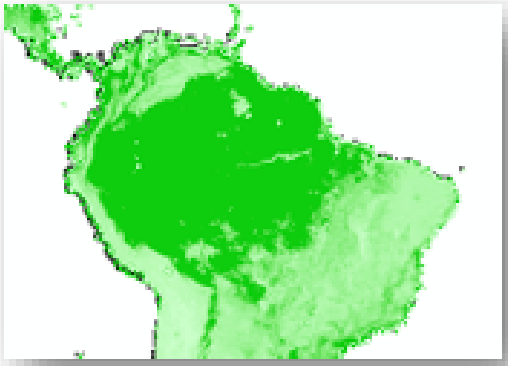
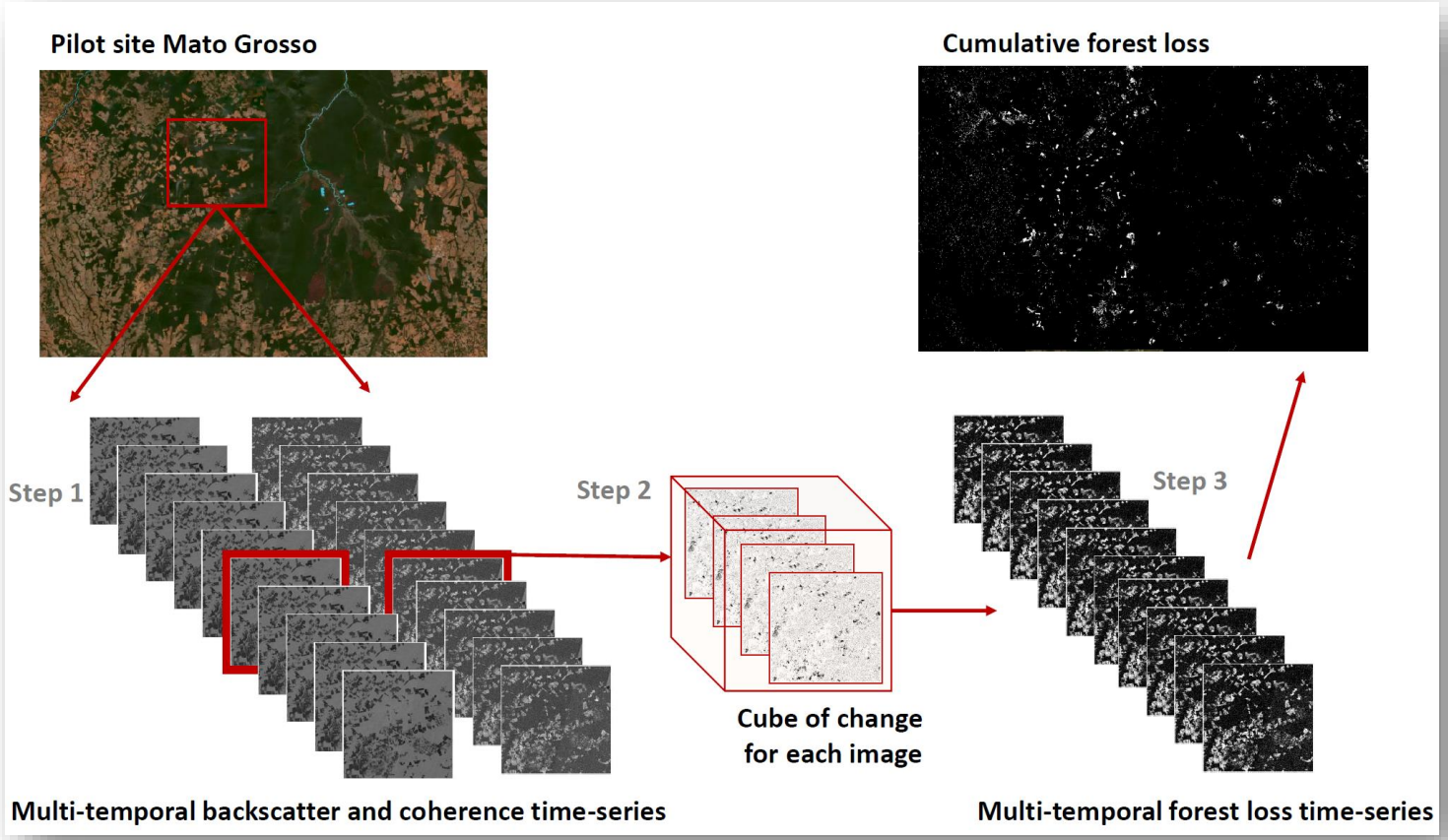






The MCD : Decision-Tree & Thresholds

Space-time data cube design : Statistical information relevant to identify changes is extracted at each point in the backscatter time-series



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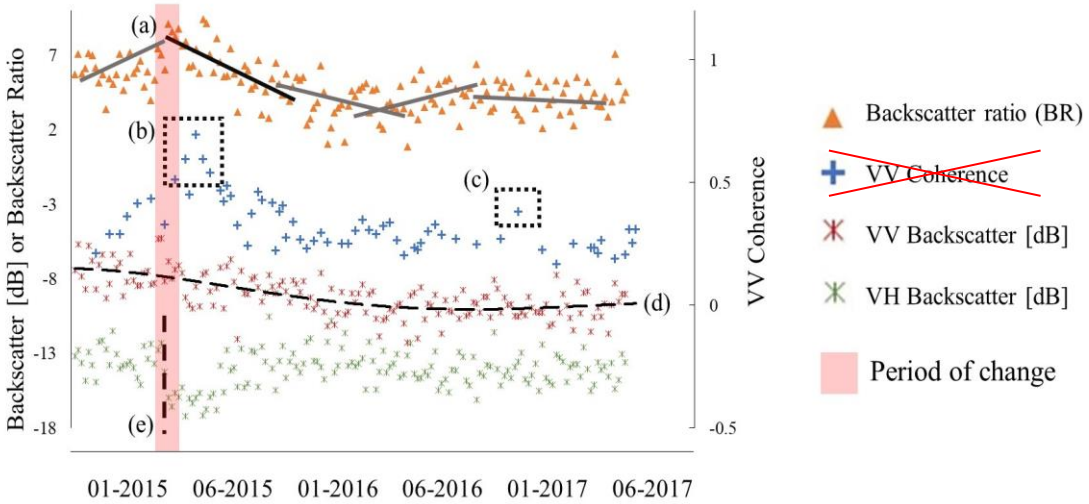

- Difference in VH/VV Backscatter between average of future and previous images
- Standard dev. of VH/VV Backscatter in future and previous x images
- T-statistic and P-value of VH/VV Backscatter between future and previous images
- Difference in VV-VH ratio between average of future and previous images
- R-squared value of linear trend fit on VV-VH ratio data in future and previous images
- Slope of the above linear trend fit
- Standard dev. of VV-VH ratio in future x images and previous images
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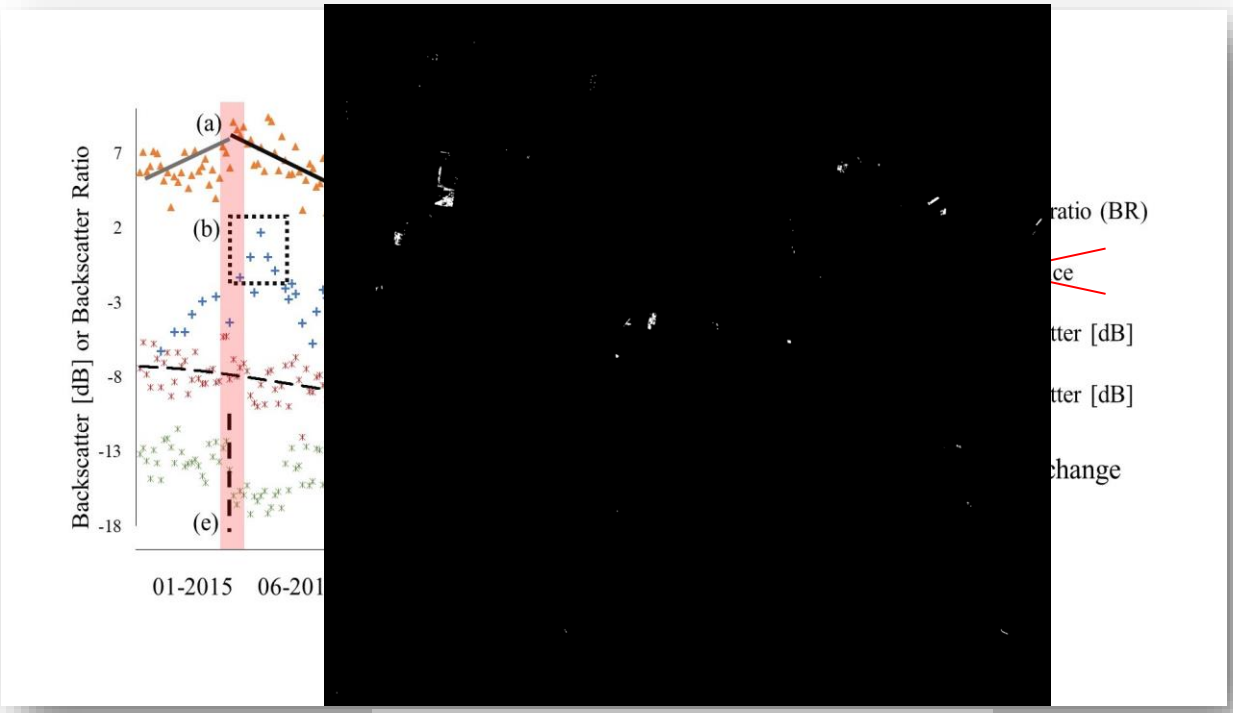

12-day time-series of forest loss

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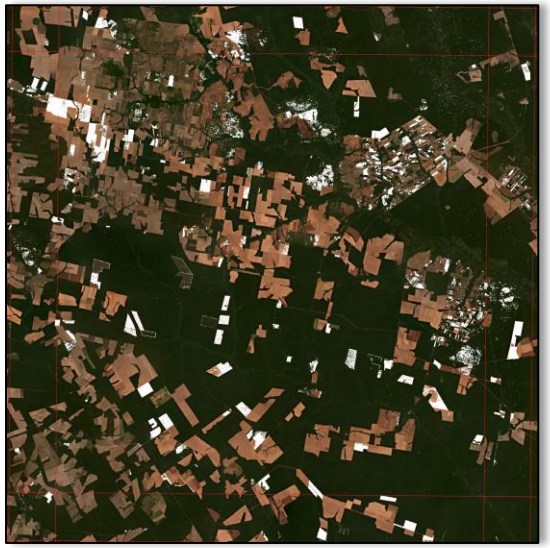
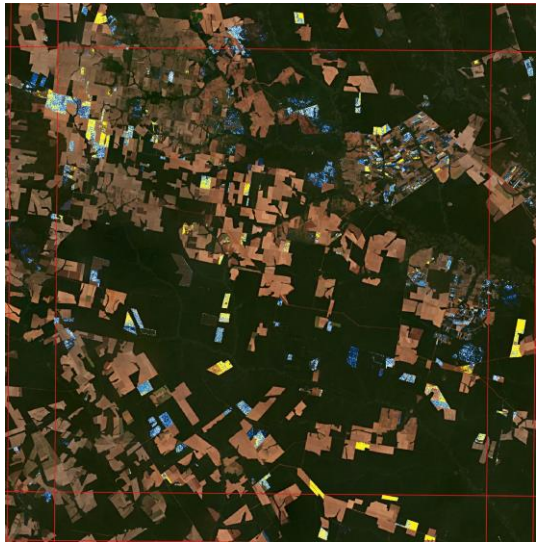
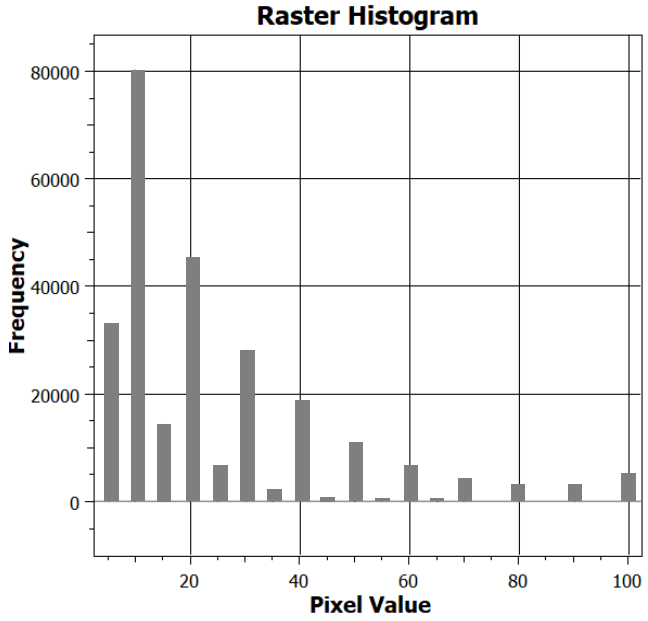
Cumulative forest loss (2017-2021)

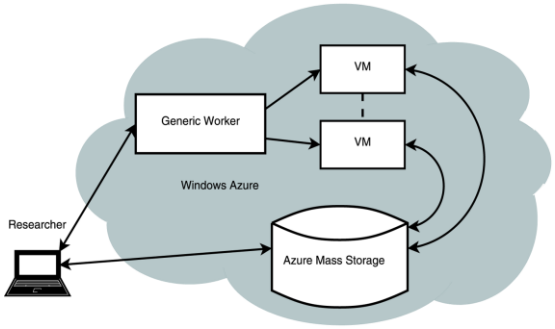


Confidence layer (%)





The MCD : Large-scale processing



CREODIAS powered by CloudFerro

A large amount of data needs to be processed. For example, the number of S1 GRD products

- Backscatter for one tile and one year 10 hours.
- Mosaics for one tile for all years 9 hours.
- 'StatCubes' for one tile for all the years: 24 - 40 hours
- Forest product: 3.5 - 7 hours

Year	Number of S1 GRD products		
	on-line	off-line	Total
2015	2420	0	2420
2016	4112	0	4112
2017	9277	0	9277
2018	9559	0	9559
2019	10383	0	10383
2020	11538	0	11538
2021	11488	0	11488
TOTAL	**58777**	**0**	**58777**

The MCD : Forest loss examples

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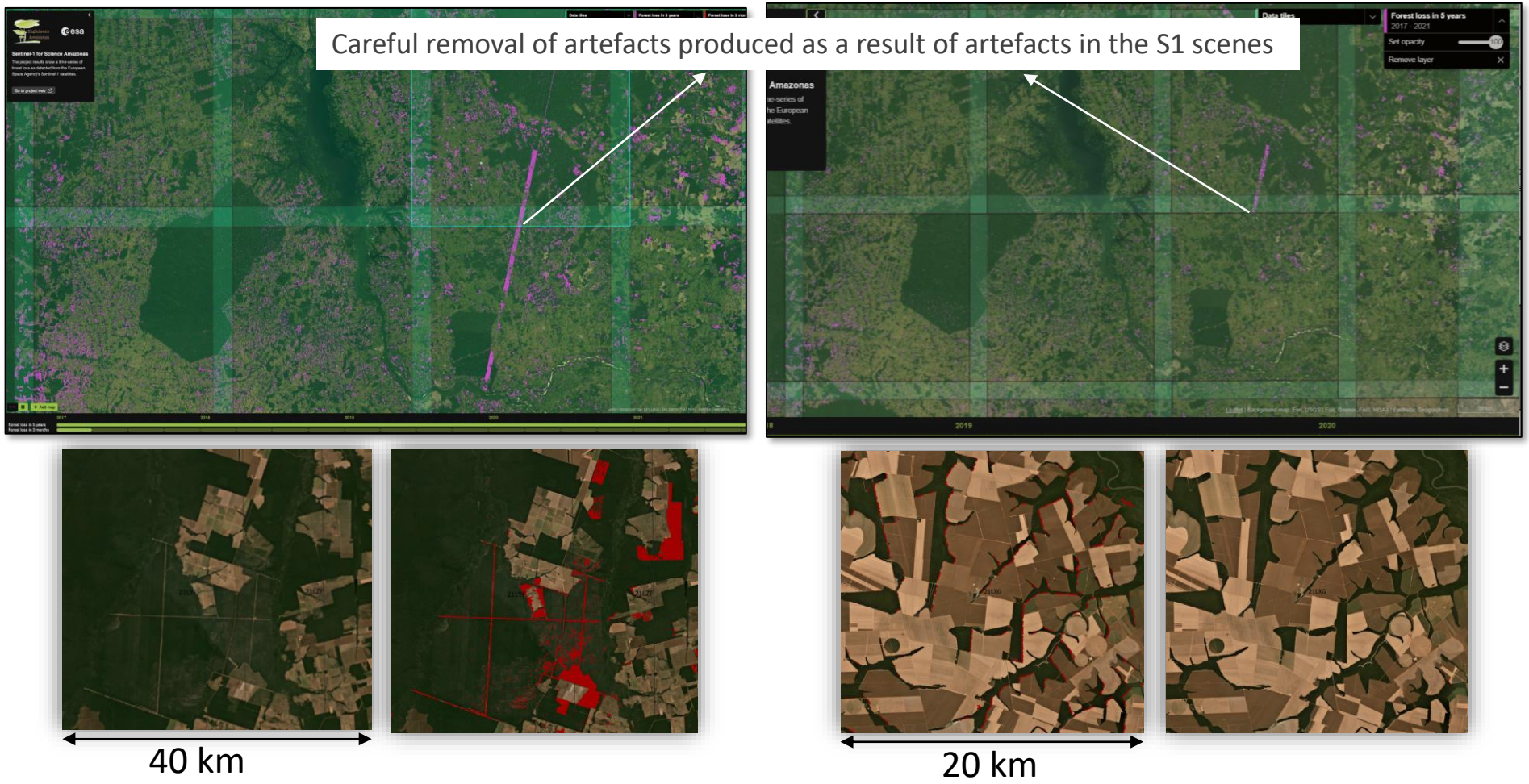

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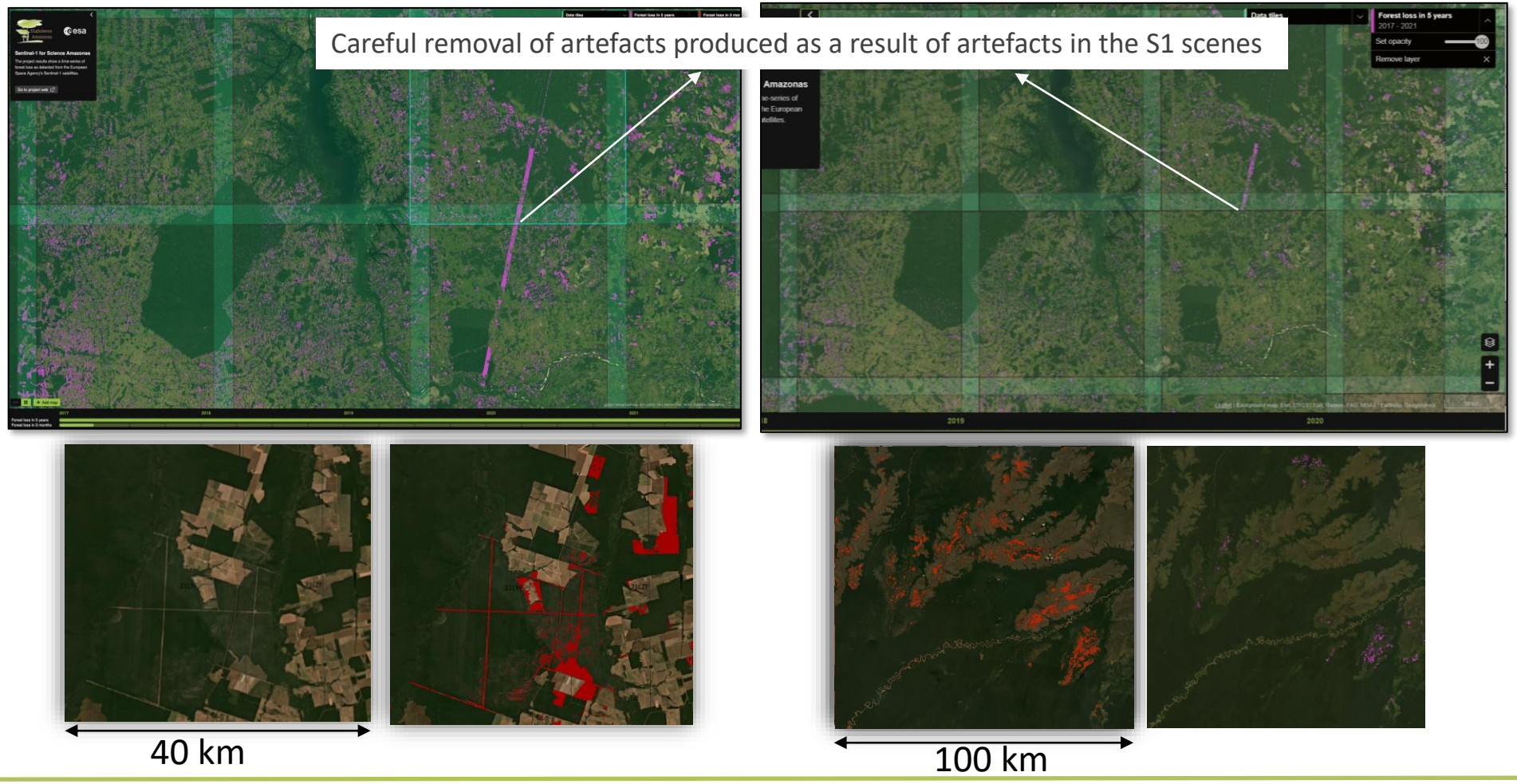

The MCD : Validation with Planet

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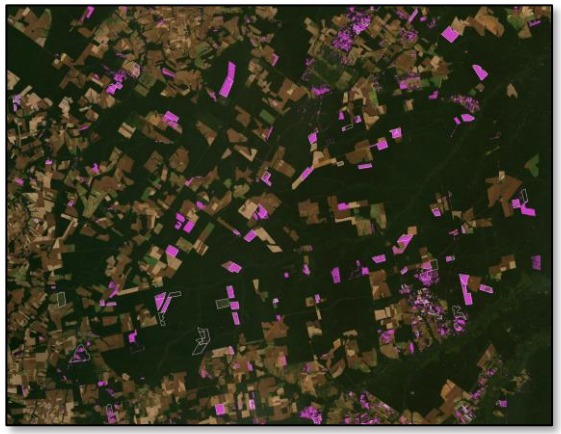

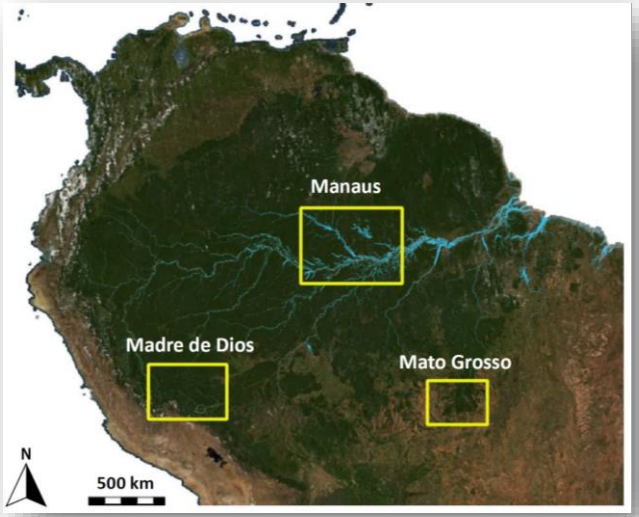

Study Site	Detection Rate %	False Alarm Rate %	Area covered with detections %	Temp. Acc. first (median) months	Temp. Acc. big. (median) months	Temp. Acc. first (average) months	Temp. acc. big. (average) months
Mato Grosso	89.3	0.21	48.3	-2	4	-4	7
Madre de Dios	91.6	0.26	66.9	-1	0	-4	1,5
Manaus	90.0	0.15	58.6	-1	0	-5	1

The MCD : Results on web-portal

(https://sen4ama.gisat.cz/)

The MCD : What's next

- Update and release of products and scripts (GitHub)
- Update of the validation across the whole study area
- Integration of external products – ALOS-2 L-band SAR
- Carbon loss analysis – awaiting release of CCI product

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Thank you!