GOVERNMENT

Detecting Forest Loss with SAR:
A Pioneering Project in the Amazon

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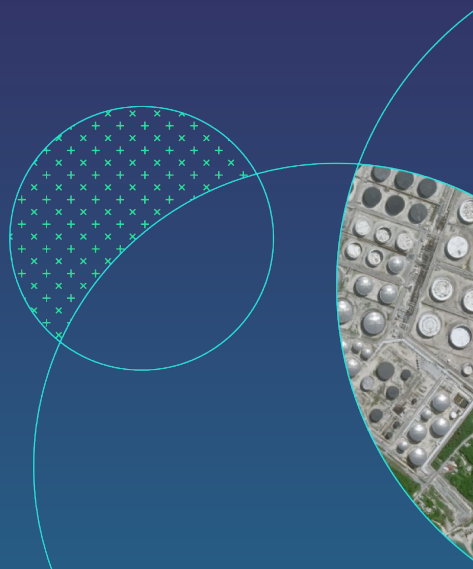

Global Connection

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ESA EO Open Science
Forests and Carbon Science

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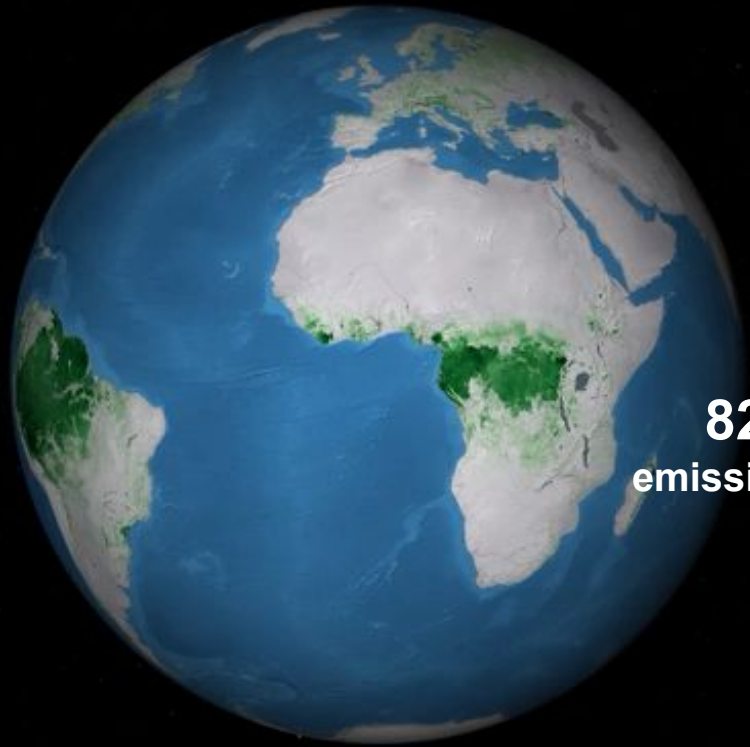
AFOLU represented 23% of total net anthropogenic GHG emissions during 2007-2016 (IPCC 2021)



13% of CO2,
44% of methane
82% of nitrous oxide
emissions from human activities

Above ground biomass maps, generated by ESA's Climate Change Initiative

Deforestation in the Amazon Basin

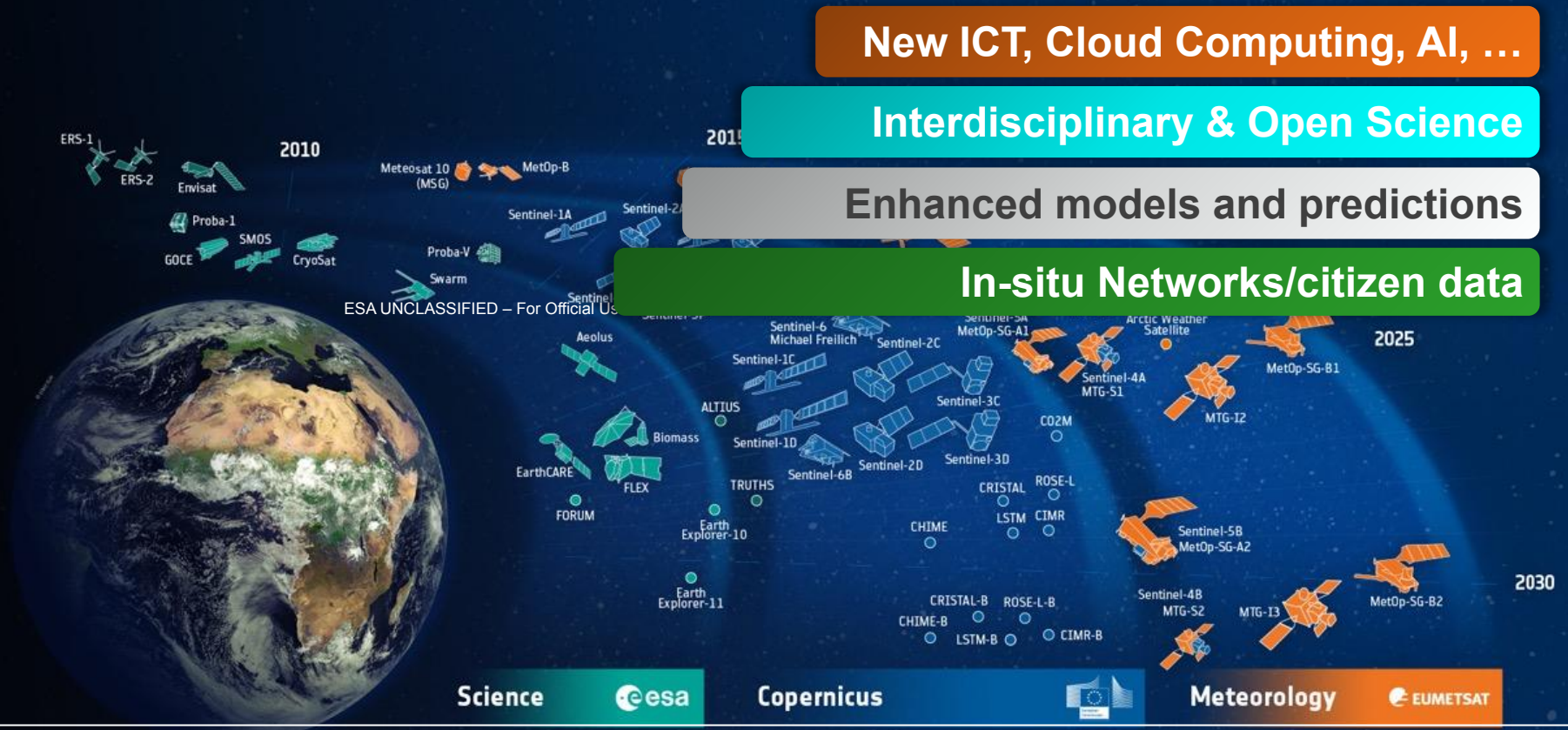
Continued Amazon deforestation, combined with a warming climate, raises the probability that this ecosystem will cross a tipping point into a dry state during the 21st century.

Both deforestation and drying are projected to increase by 2100, resulting in a worst-case scenario of up to a 50% loss in forest cover by 2050. (IPCC 2021)

University of Maryland forest loss data overlaid onto the 2018 above ground biomass dataset, generated by ESA CCI.

Cumulative forest loss from 2001 to 2020 in the Amazon basin

ESA EO Missions



ESA Carbon Science Cluster

- Mechanism to work with the scientific community
- Networking and collaborative research activities
- Expertise, Data and Resources from various projects
- Collaboration with the EC international partners

CARBON CYCLE SCIENCE

Final result may be bigger than the sum of the parts

Objectives

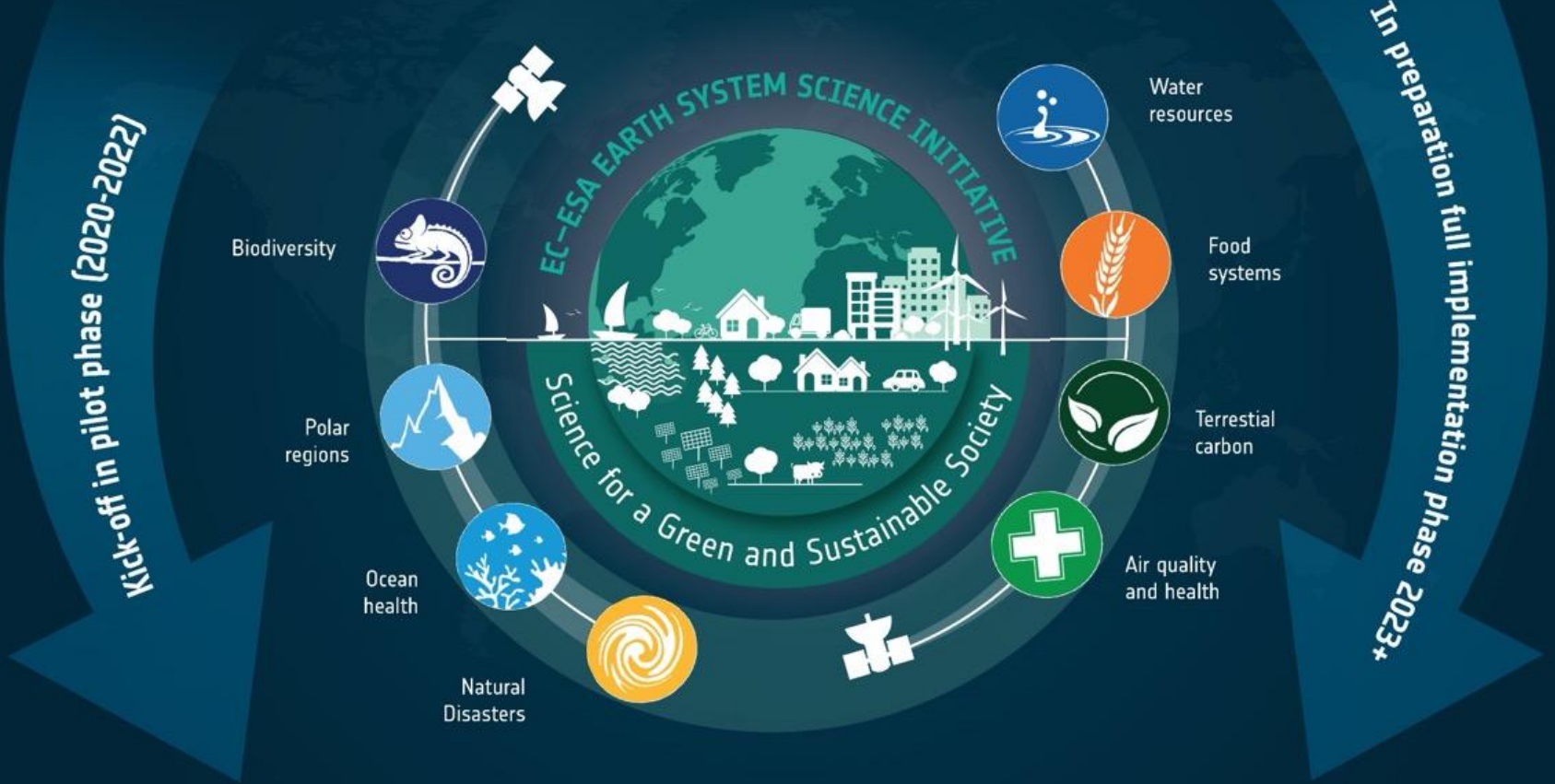
Develop the next generation of EO products maximising the European EO capacity (Sentinels, BIOMASS, FLEX, etc.)

Exploit EO capabilities to enhance the scientific understanding of the Carbon cycle and its interactions with society and ecosystems

Transfer new knowledge and results into actionable solutions for society, with special attention to the decarbonisation targets 2030

Joint EC-ESA Earth System Science Initiative

FLAGSHIPS ACTIONS



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Sentinel-1 for Science Amazonas

Forest loss detection in the Amazon rainforest

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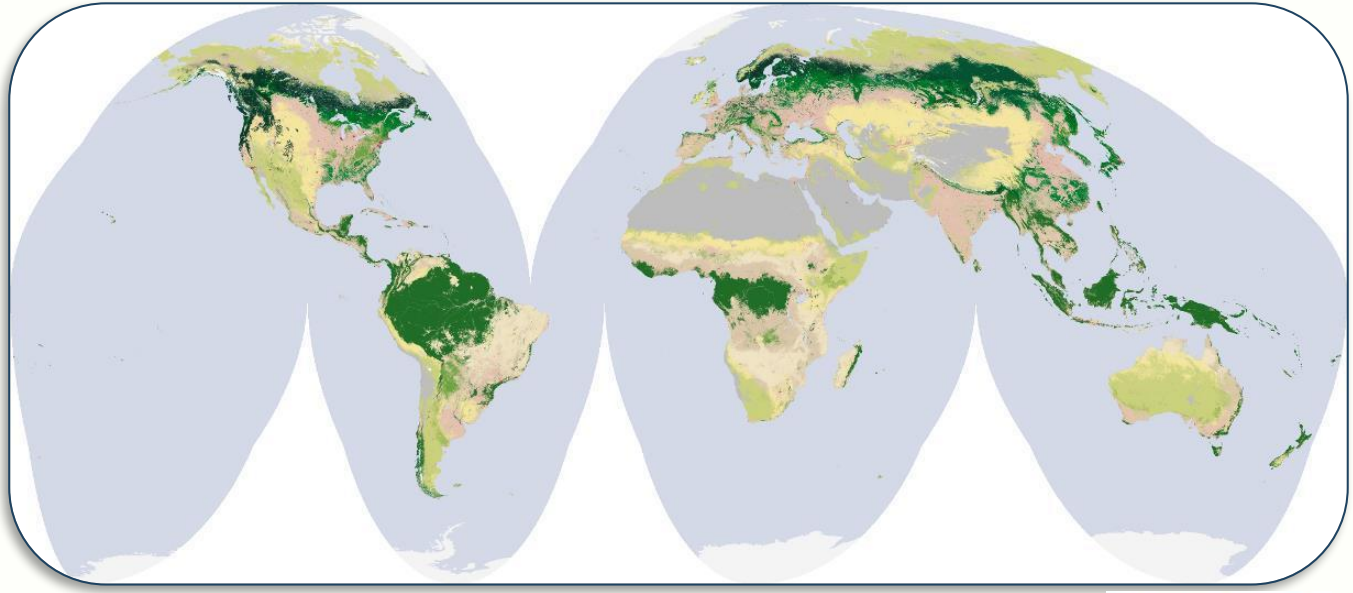
State of the world's forests



Credits: Map by Robert Simmon, based on data from the MODIS Land Cover Group, Boston University.

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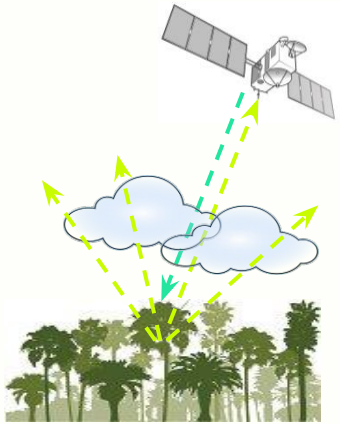
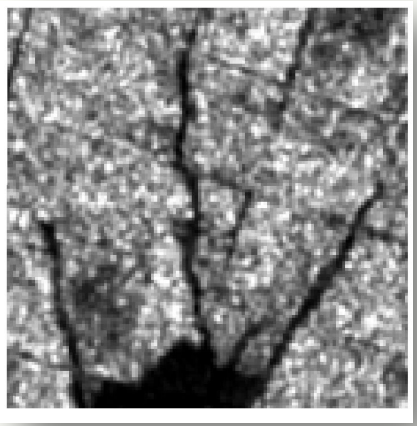
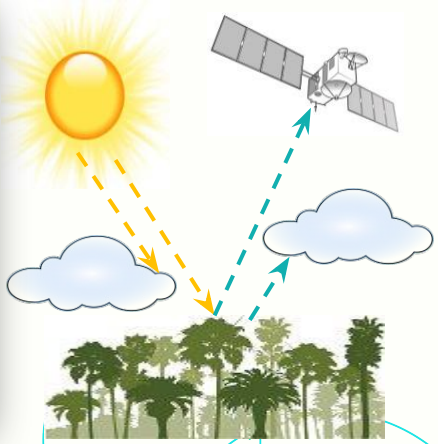
Watching forests from space

Synthetic aperture radar sensors
(e.g. Sentinel-1)





Optical sensors
(e.g. Landsat)



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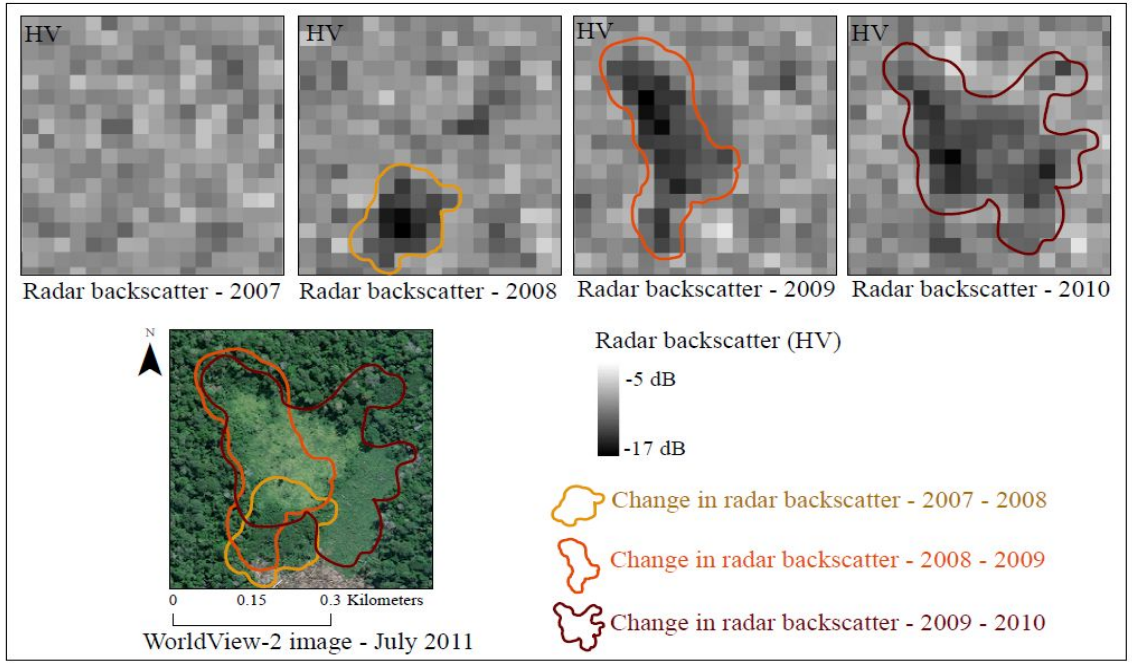
Watching forests from space



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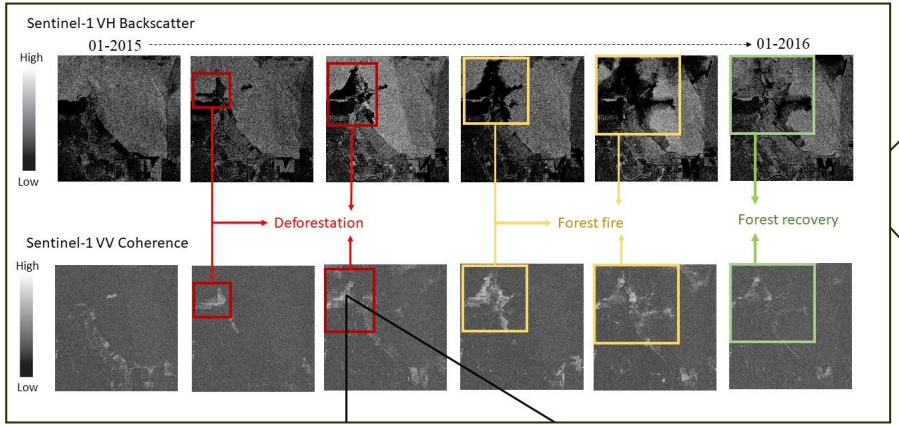
Reference: Joshi, N., Mitchard, E. T., Woo, N., Torres, J., Moll-Rocek, J., Ehammer, A., Collins, M., Jepsen, M. R. & Fensholt, R. (2015). Mapping dynamics of deforestation and forest degradation in tropical forests using radar satellite data. *Environmental Research Letters*, **10**(3): 034014.

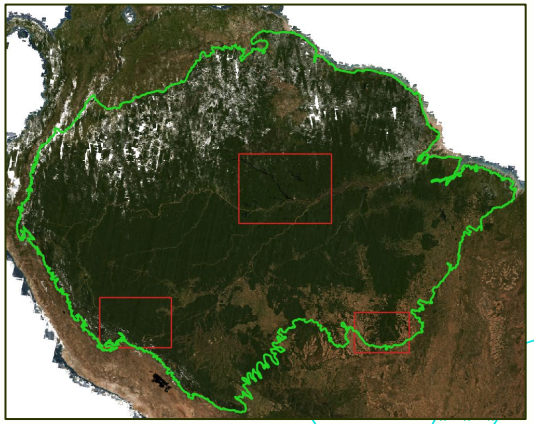
Global Connection

Project Objectives

Develop an operational-level Multi-temporal forest Change Detection (MCD) algorithm using Sentinel-1 time series.

Estimate Carbon loss from anthropogenic and natural land use changes (LUC) in the Amazonas based on the MCD





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Multi-temporal change detection

CREODIAS powered by CloudFerro

3-Stage cloud-processing

S1 IW SLC pre-processing chains

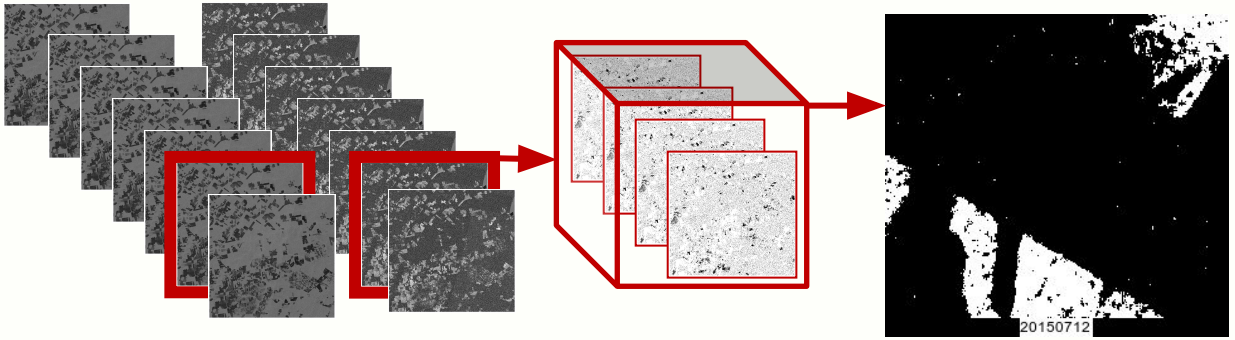
Extract descriptors for each date and each pixel

Apply descriptors to identify different types of forest changes

Backscatter & Coherence time-series

Stat-Cubes (spatio-temporal feature engineering)

Forest dynamics



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NICFI Monthly-Mosaics Validation Dataset

Polygons of change based on Planet optical satellite data

- **Detection rate** (%): at least one pixel of the validation polygon was detected
- **Temporal accuracy** (months): months between the first / the most extensive (most pixels detected) MCD detection and the validation polygon month
- **False positives** (%): MCD change detected within the false positives mask (pixel level) as FP. FP rate = FP/(FP+TN)

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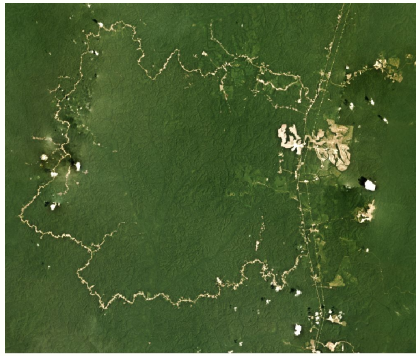
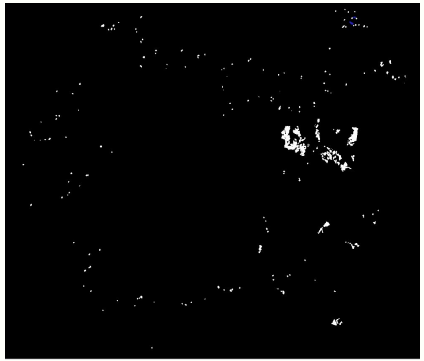
NICFI Monthly-Mosaics Validation Dataset

Planet monthly mosaic (2020)



MCD Forest-loss

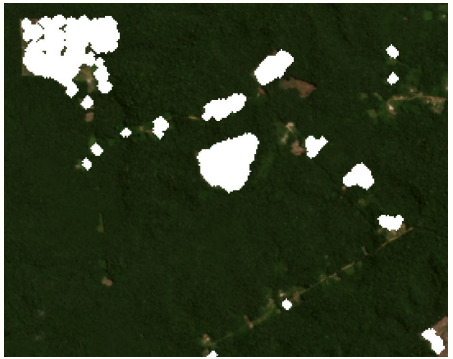


RING OF DEFORESTATION

approx. 35 km

Planet monthly mosaic (2020)

MCD Forest-loss



PLANTATIONS AND SMALL-SCALE DEFORESTATION

approx. 5 km

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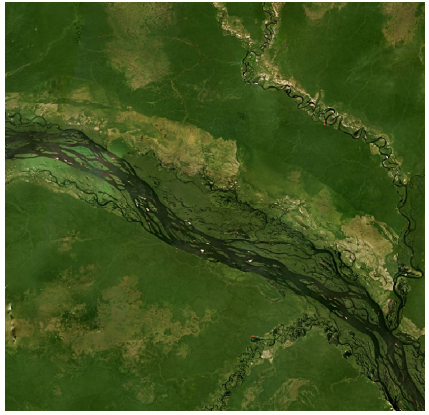
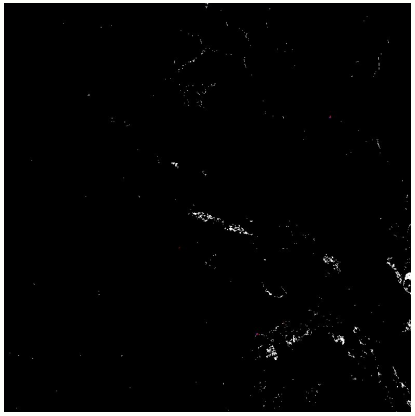
NICFI Monthly-Mosaics Validation Dataset

Planet monthly mosaic (2020)



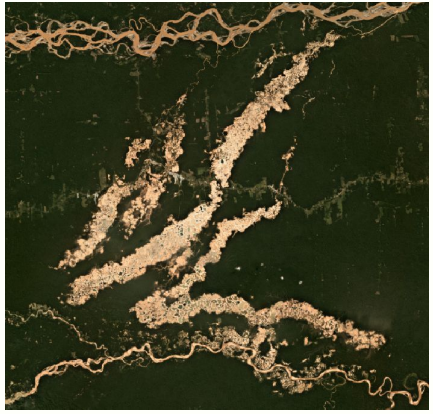
MCD Forest-loss



FLOOD PLAINS OF THE AMAZON RIVER

approx. 90 km

Planet monthly mosaic (2020)



MCD Forest-loss

ILLEGAL GOLD MINING

approx. 35 km

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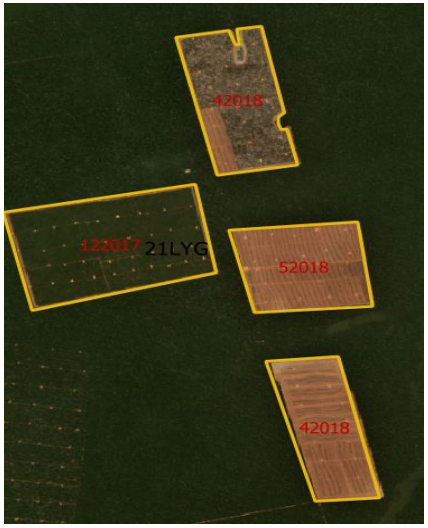
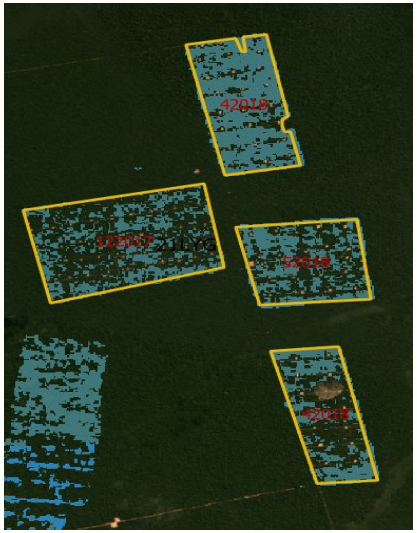
NICFI Monthly-Mosaics Validation Dataset

Planet monthly mosaic (2020)

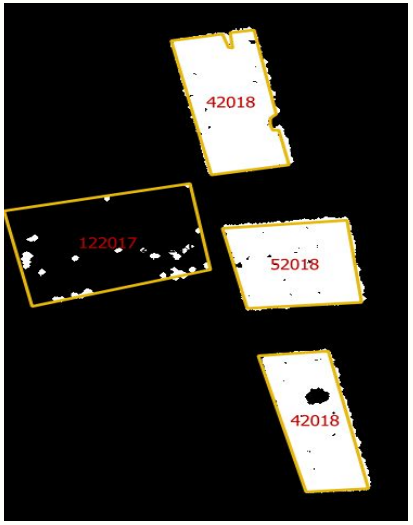


Global Forest Watch Forest-loss



PRODES Forest-loss

MCD Forest-loss



Example – PLANTATIONS AND LARGE-SCALE DEFORESTATION

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Conclusions

Unprecedented time-series of data for forest loss detection

Development and validation possible thanks to the Planet monthly-mosaics

Thank You!