

KC#27 Project Report

*Detection illegal Mining in Brazilian Amazon using SAR
Images and Machine Learning Approaches*

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IBAMA



Project area(s)

Brazilian Amazon Indigenous Lands: Yanomami, Mundukuru and Kayapó

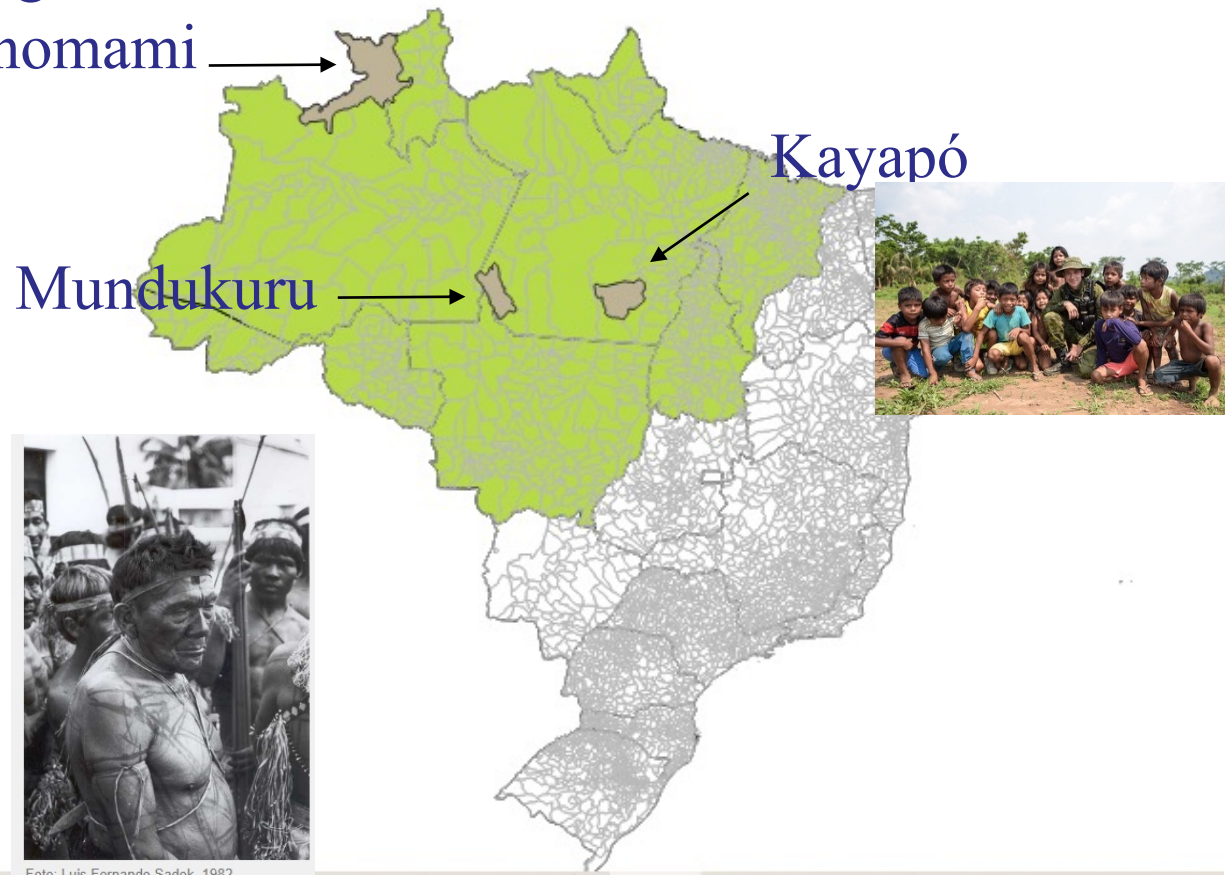
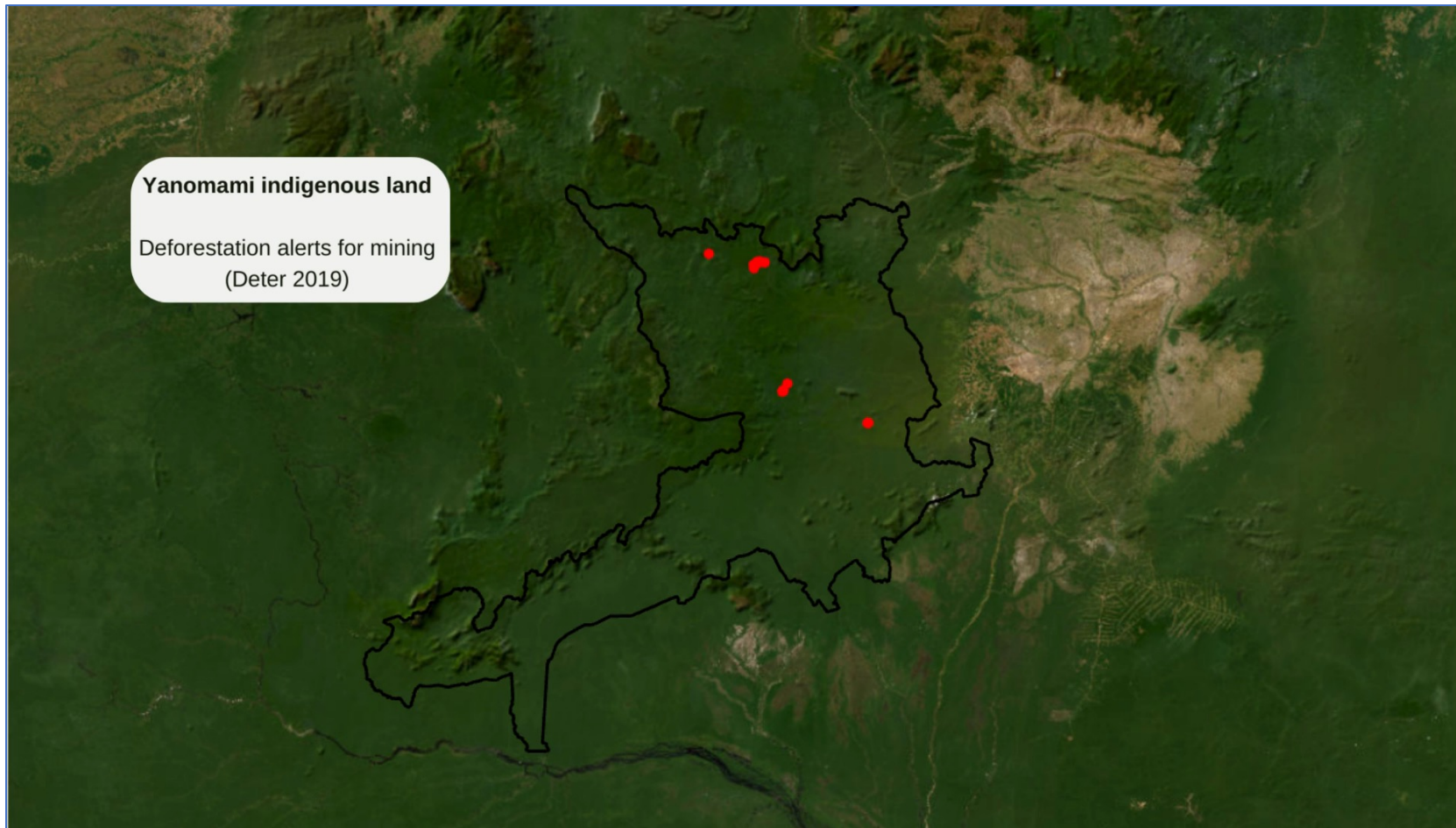


Foto: Luis Fernando Sadek, 1982

ALOS

K&C Initiative
An international science collaboration led by JAXA





Project outline and objectives

Project objectives

The goal of the project is checking the possibility of use the Machine learning and Deep learning approaches to detecting, by orbital images polygons of illegal mining mainly in indigenous land from Brazilian Amazon Forest.



Supporting command and control action planning for deforestation combat in Amazon, the project help to prevent new emissions from land use changes (Carbon cycle science, Climate Change, International Conventions).

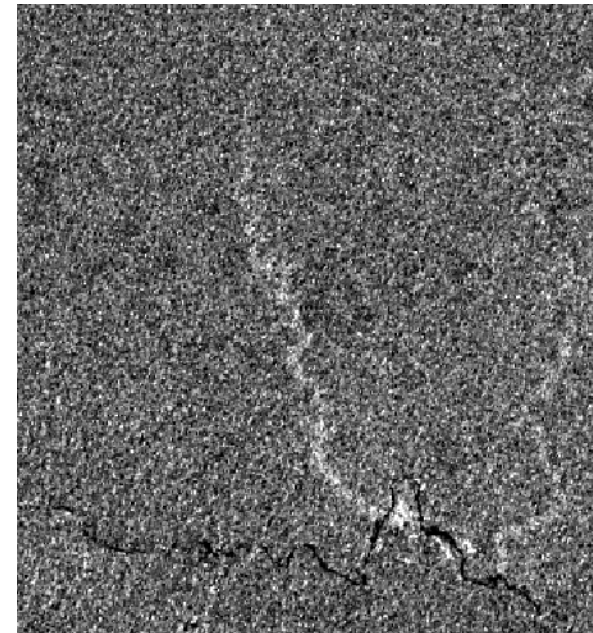
As the indigenous lands in the Brazilian Amazon are almost pristine natural areas, the project plays a role in preserving environmental conservation in the region (Environmental Conservation).

Results and significant findings

The used images were ALOS2
ScanSAR data for the period Jan
- July 2023 (cycles 220-235);

The backscattering values was
calculated as Shimada (2009):

$$\sigma = 10 * \log_{10}(\text{DN}^2) + (-83).$$



Results and significant findings

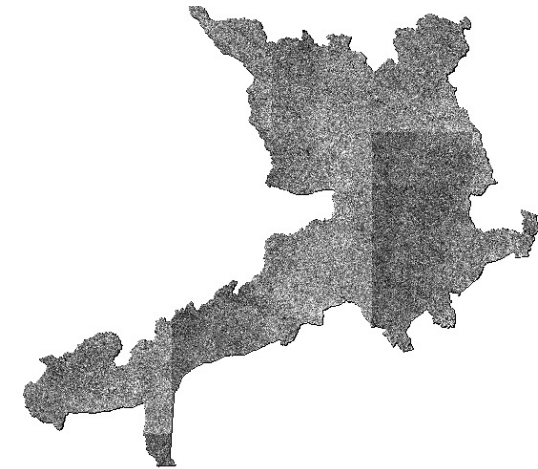


Revista Brasileira de Cartografia (2014) Nº 66/2: 209-221
Sociedade Brasileira de Cartografia, Geodésia, Fotogrametria e Sensoriamento Remoto
ISSN: 1808-0936

POTENCIAL DAS IMAGENS MULTIPOLARIZADAS DO SATÉLITE ALOS/PALSAR NA DISCRIMINAÇÃO DE COBERTURA VEGETAL DO BIOMA PANTANAL: ESTUDO DE CASO NA REGIÃO DO MÉDIO TAQUARI, MS

*Potential of Multipolarized ALOS/PALSAR Satellite Images to Discriminate
Vegetation Coverage in the Pantanal Biome: A Case Study in the Region of Medio
Taquari, MS*

Daniel Moraes de Freitas^{1,3}, Edson Eyji Sano^{1,2} & Rodrigo Antônio de Souza³



As Freitas, Sano and Souza (2018), we try to identify differences in backscattering values among Mining, Forest, Non-Forest, and Hydrography targets in the HH and HV polarizations of ALOS-2 ScanSAR images through discriminant analysis

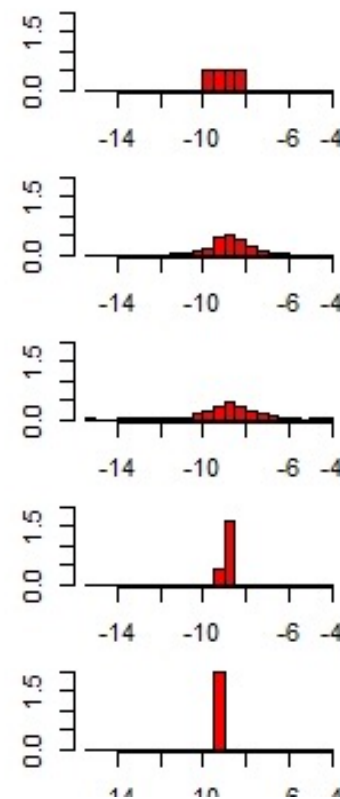
Results and significant findings

Although the HH polarization values explain the majority of the backscattering variation in the analyzed targets (Coefficients of linear discriminants: LD1 -0.8018882, LD2 0.9517229)

We did not find a conspicuous difference between the Mining and Forest classes.

Forest HH: -7.949972; HV: -11.30321

Mining HH -7.842958; HV -12.27008



Results and significant findings

Machine Learning to detect risk areas of new mining in Yanomami area

Ecological Modelling 387 (2018) 1–9



Improved spatial model for Amazonian deforestation: An empirical assessment and spatial bias analysis

Rodrigo Antônio de Souza^a, Paulo De Marco Junior^{b,*}



ENMTML: An R package for a straightforward construction of complex ecological niche models

André Felipe Alves de Andrade^a, Santiago José Elías Velazco^b,
Paulo De Marco Júnior^a

The algorithms those we have run was:

- MaxEnt
- Randon Forest

Variables

- ScanSAR HH (2021, 2022),
- ScanSAR HV (2021, 2022),
- Height Above the Nearest Drainage

Validation

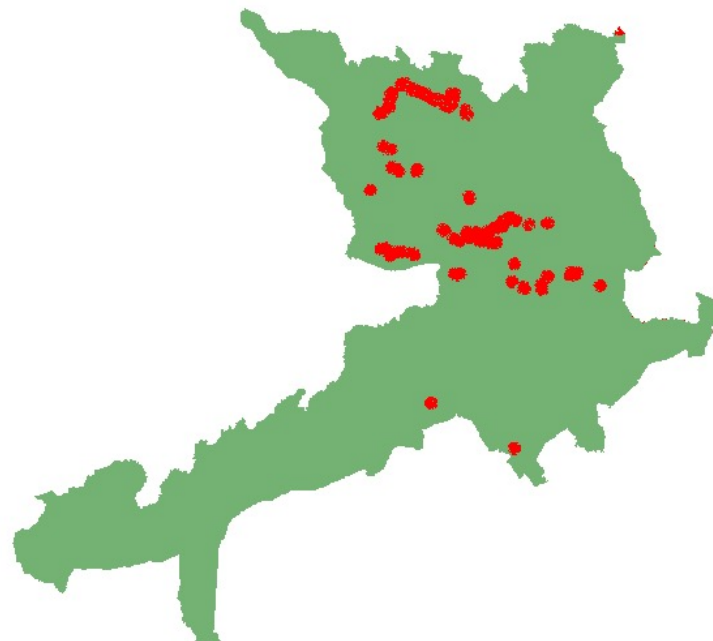
- Confusion Matrix with alerts of mining from Planet images

Results and significant findings

Machine Learning to detect risk areas of new mining in Yanomami area

Maxent yielded the best results, with 9 out of 10 recent mining alerts occurring within the predicted area (>90% of risk) in 2021 and 2033.

Random Forest, on the other hand, only had 3 out of 10 recent mining alerts occurring within the predicted area (>90% of risk) in 2021 and 2023."



Results and significant findings

Machine Learning to detect risk areas of new mining in Yanomami area

We will also explore using neural networks in the next steps to achieve the project's goal of identifying mining activities in indigenous lands using SAR images from the ALOS satellite.

```
from tensorflow.keras.datasets import mnist

def get_mnist_model():
    inputs = keras.Input(shape=(28 * 28,))
    features = layers.Dense(512, activation="relu")(inputs)
    features = layers.Dropout(0.5)(features)
    outputs = layers.Dense(10, activation="softmax")(features)
    model = keras.Model(inputs, outputs)
    return model
```



Deliverables and other output

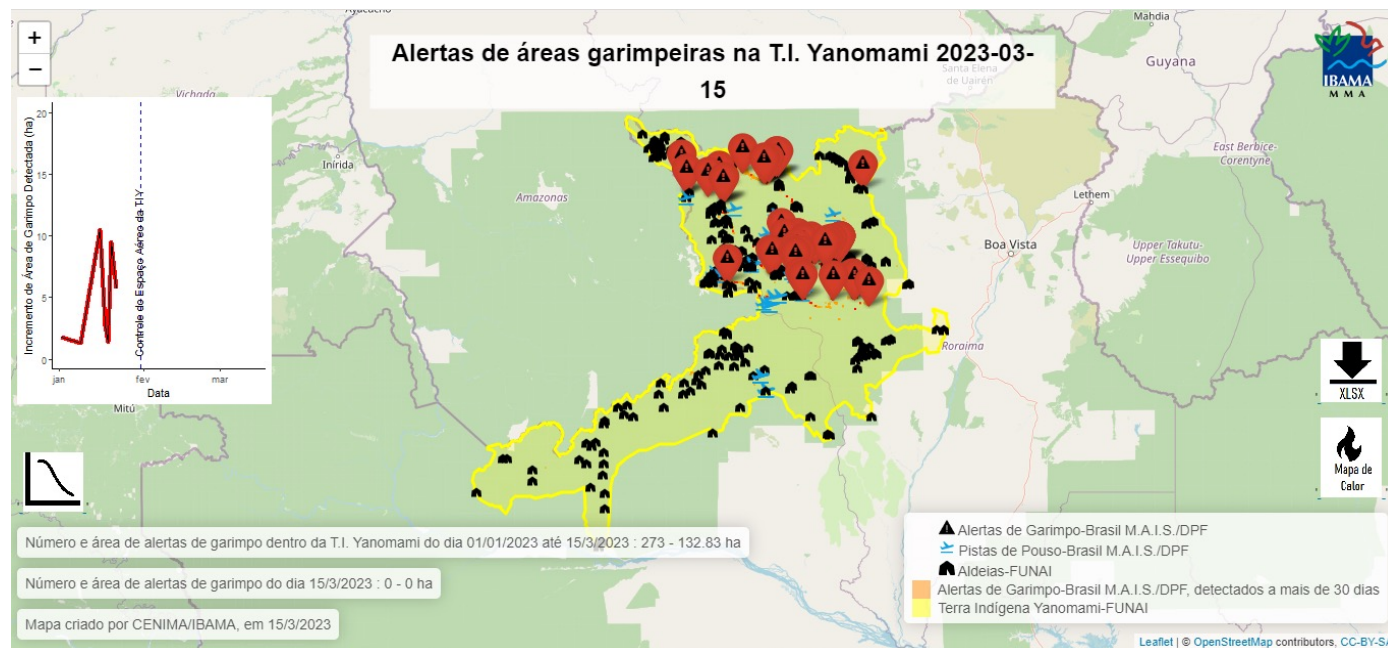
Describe planned output of your project.

- Non-peer-reviewed publications (conference papers, reports etc.)

Reports for support Brazillian government in combat of illegal mining in Amazon.

Deliverables and other output

- Other results:
 - Creation of a prototype of an open source dashboard for share polygons of the models.



PALSAR/PALSAR-2 data access

Please list the PALSAR/PALSAR-2 data you have obtained.

ALOS2479657180-230411(2)

ALOS2480250050-230415(2)

ALOS2480250060-230415(2)

ALOS2479657180-230411(2)

ALOS2479657190-230411(2)

ALOS2480250030-230415(2)

ALOS2480250040-230415(2)

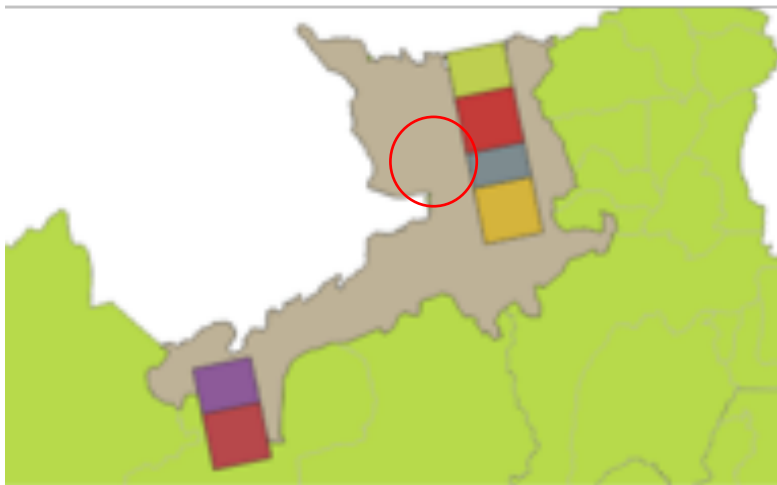
PALSAR/PALSAR-2 data access

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

Unfortunately, I didn't obtain the necessary data.

If not, which key data sets are missing?

The hotspot of minning exploration in Yanomami area and images from Munduruku and Kayapó Areas.



どうもありがとう
Thanks a lot
Muito Obrigado

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