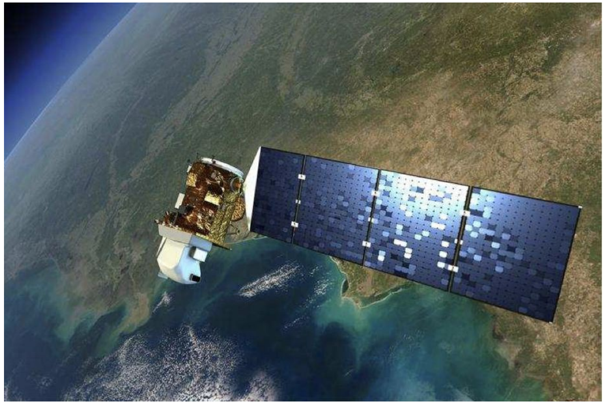
SITS: Satellite Image Time Series Analysis for Big Earth Observation Data

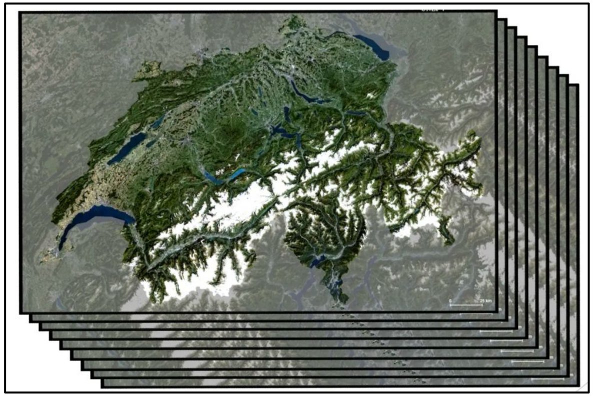
Equipe SITS
INPE (National Institute for Space Research, Brazil)

XXI SIMPÓSIO BRASILEIRO DE SENSORIAMENTO REMOTO

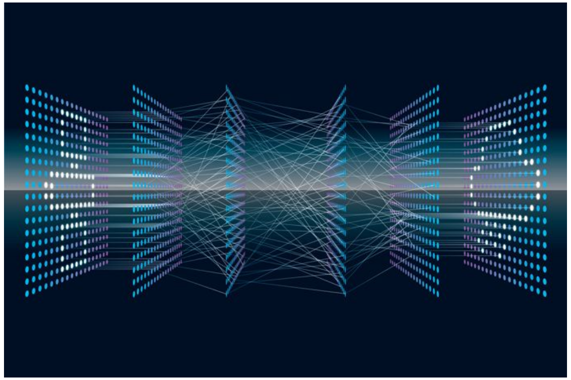
Grandes dados de observação da Terra



Dados de satélite



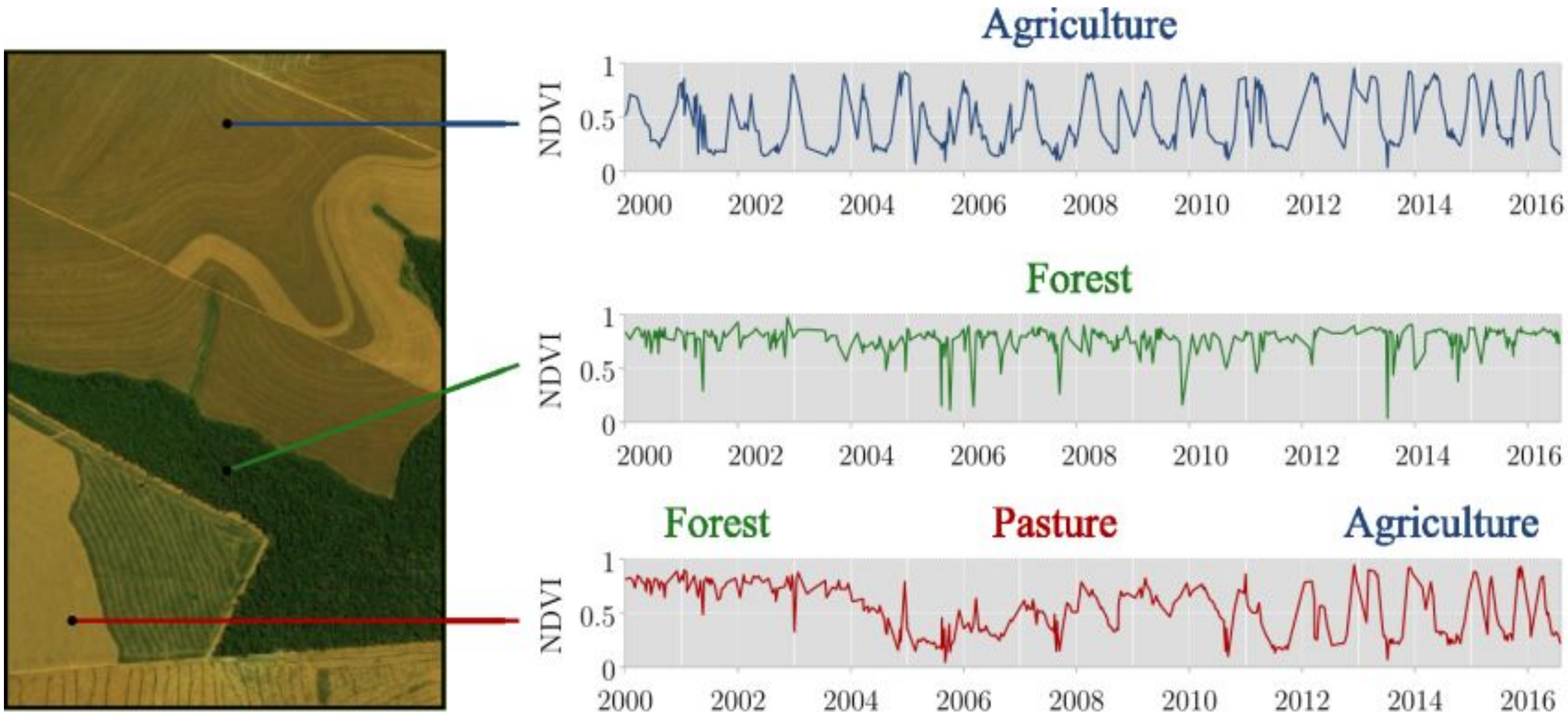
Cubo de dados



Machine learning

images: NASA, Swiss Data Cube, ECMWF

Séries Temporais de Imagem de Satélite



Como classificar a cobertura e o uso da terra usando séries temporais?

graphics: Maus, Victor

sits

R

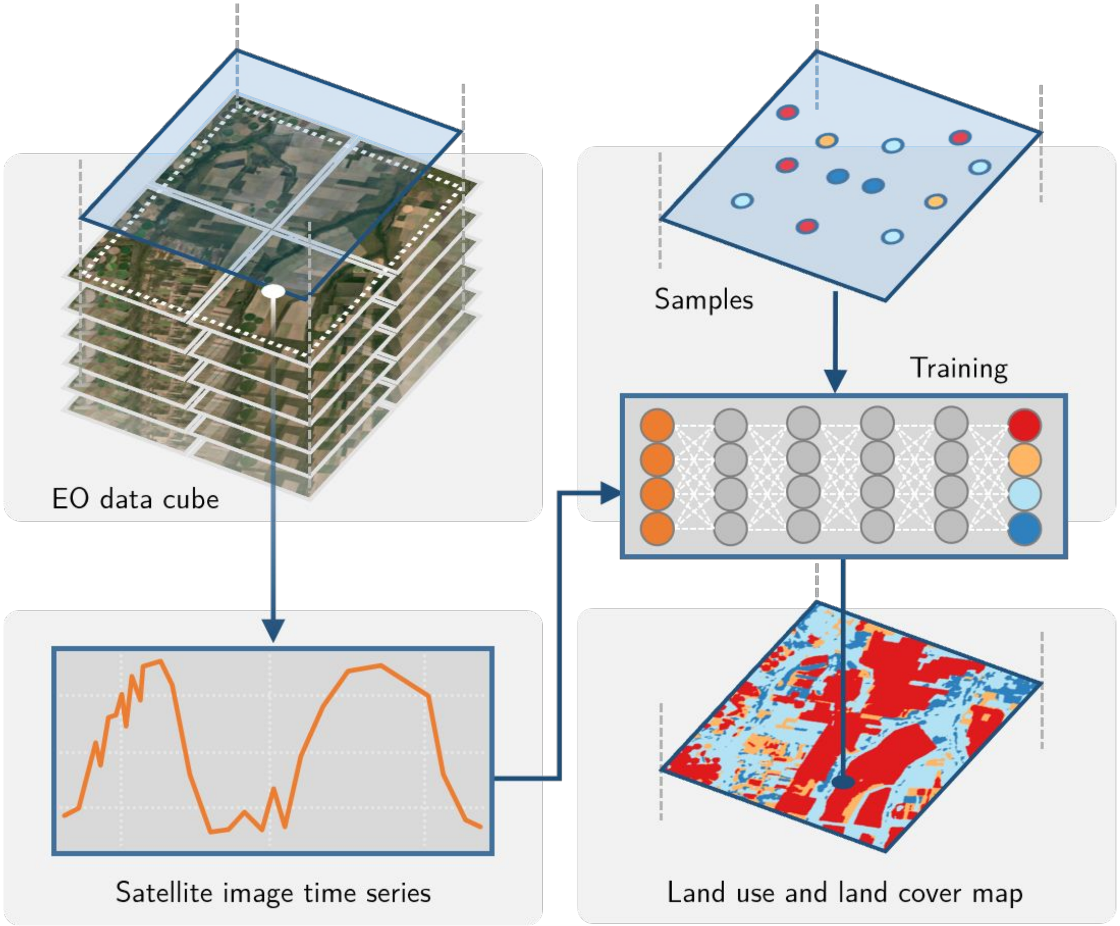
GitHub

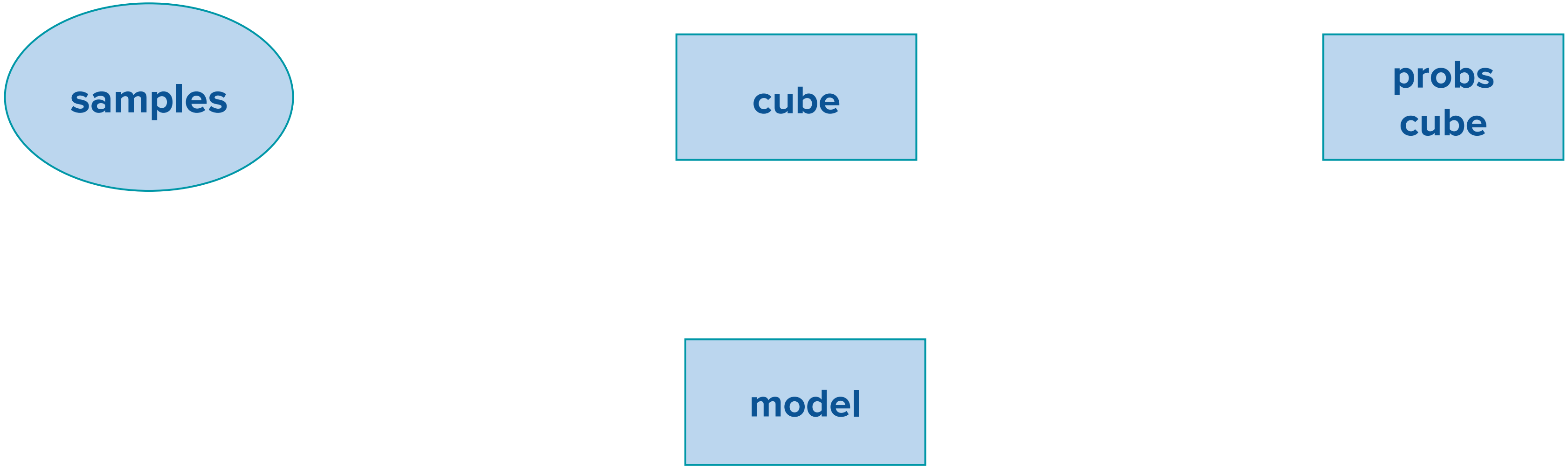
CRAN R
The Comprehensive R Archive Network

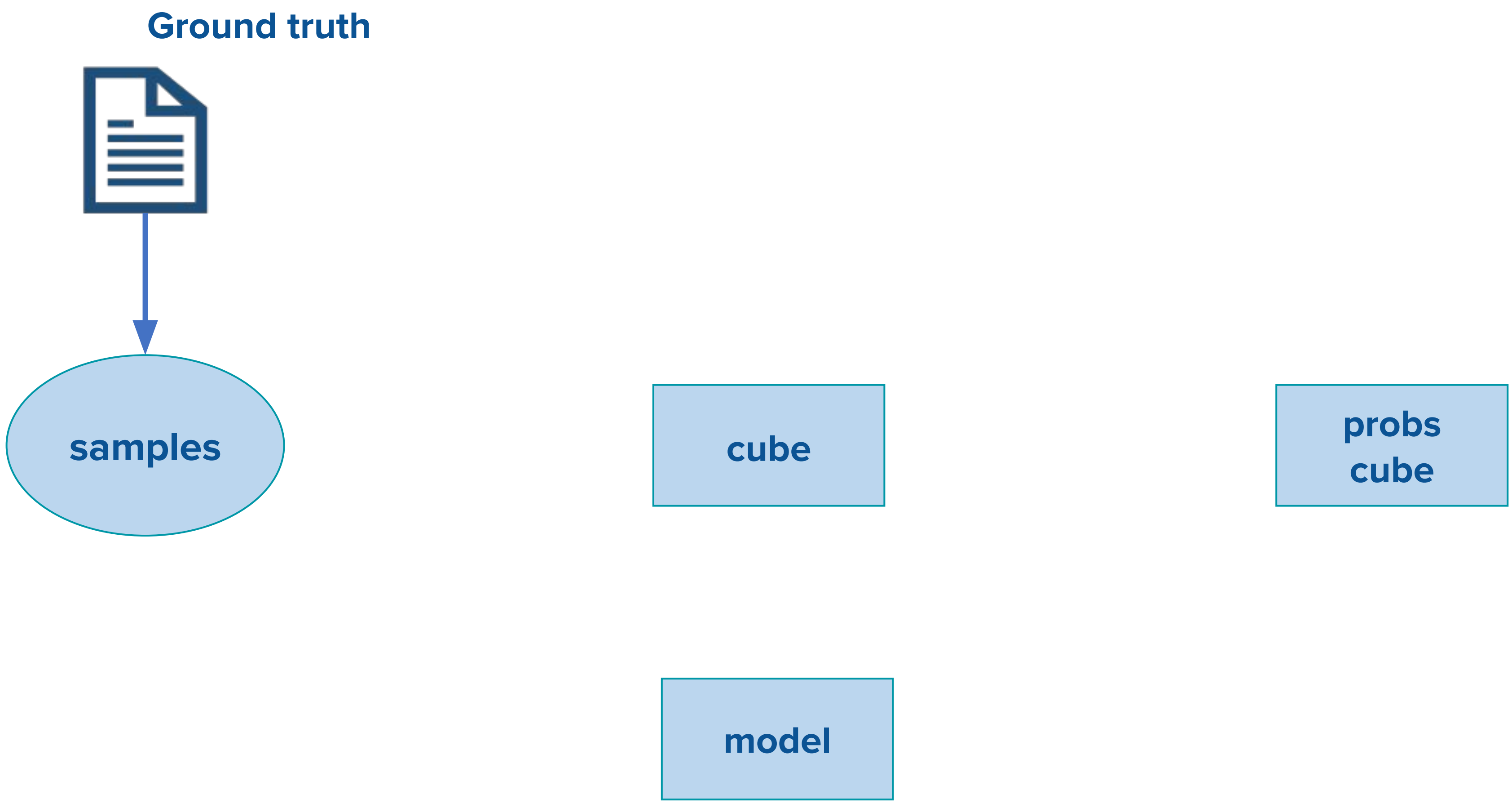
Codecov

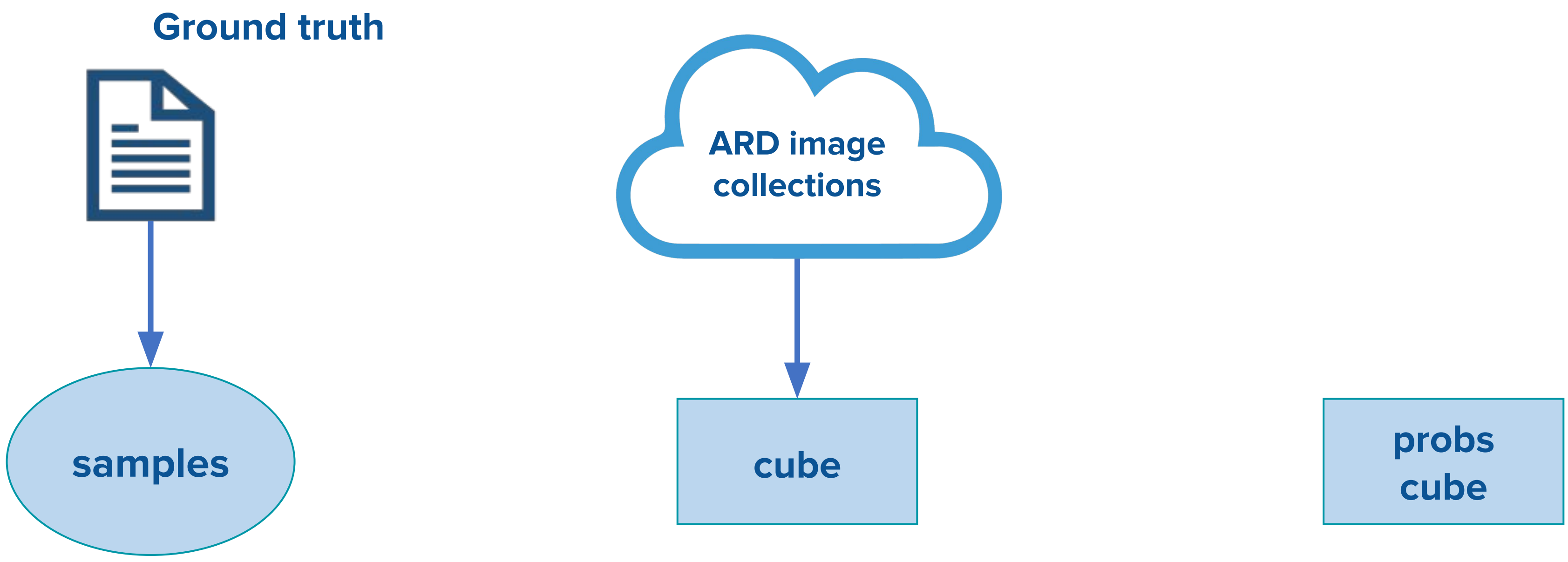
torch

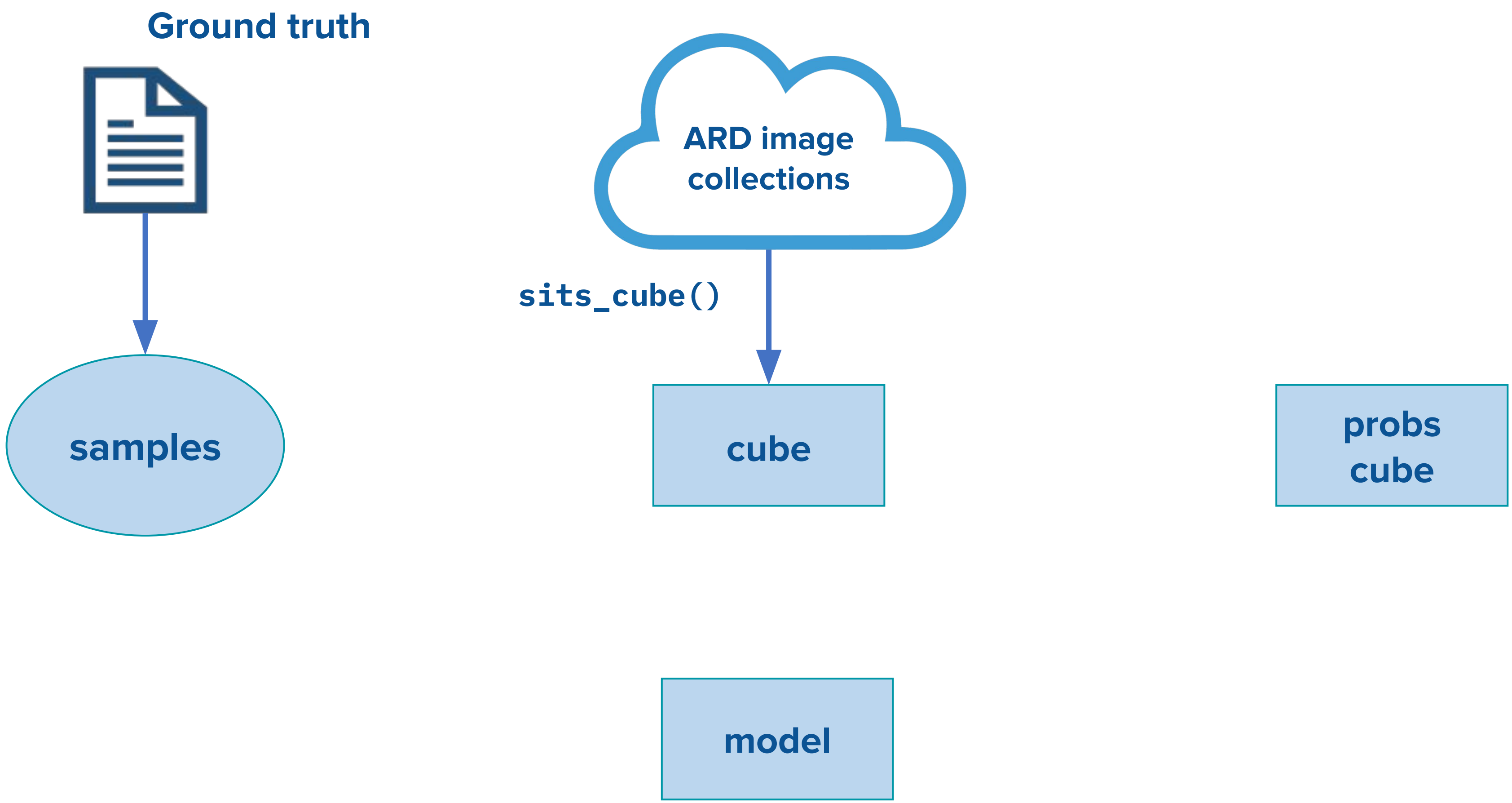
Classificação de cubo de dados usando sits

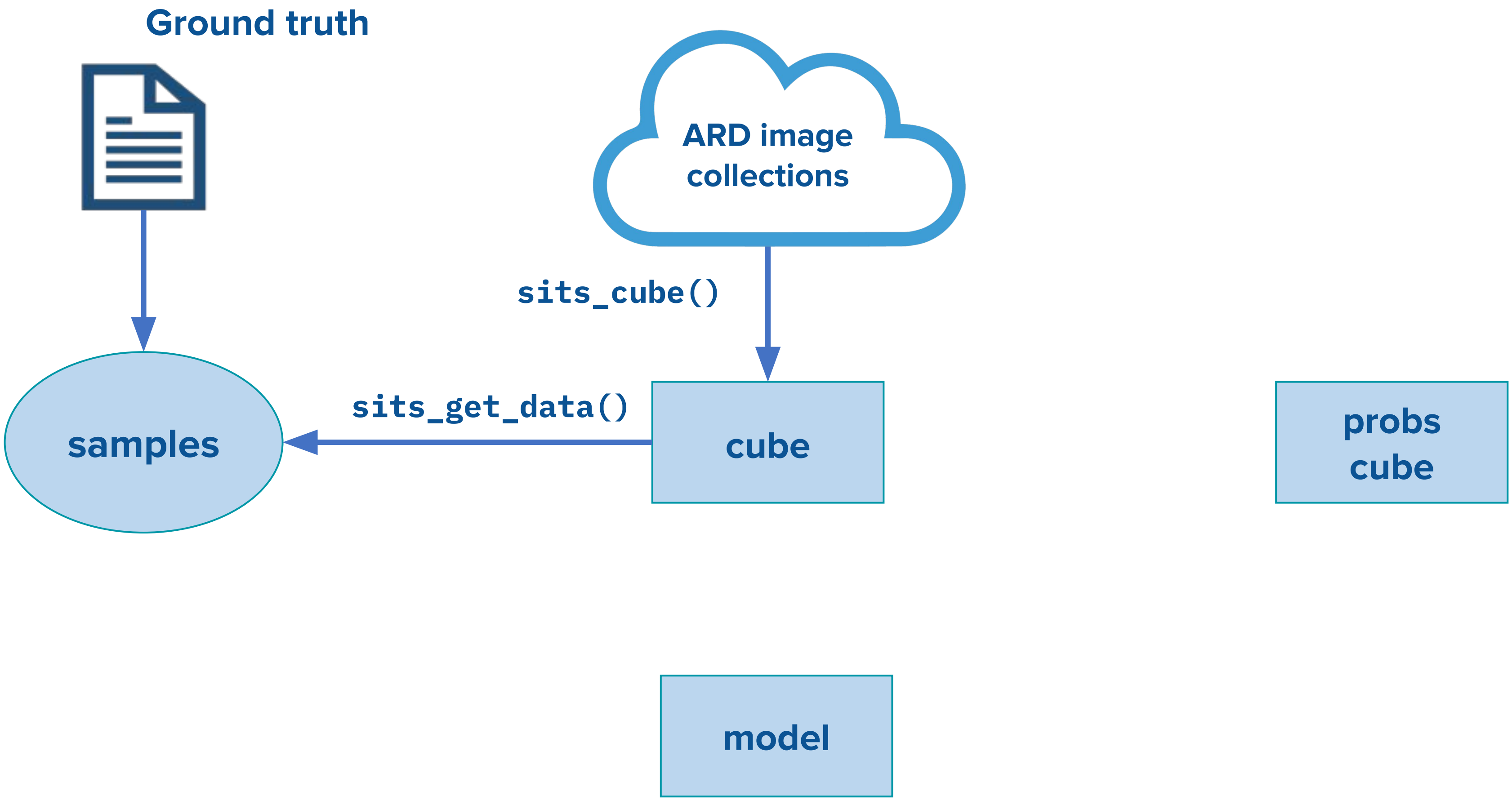


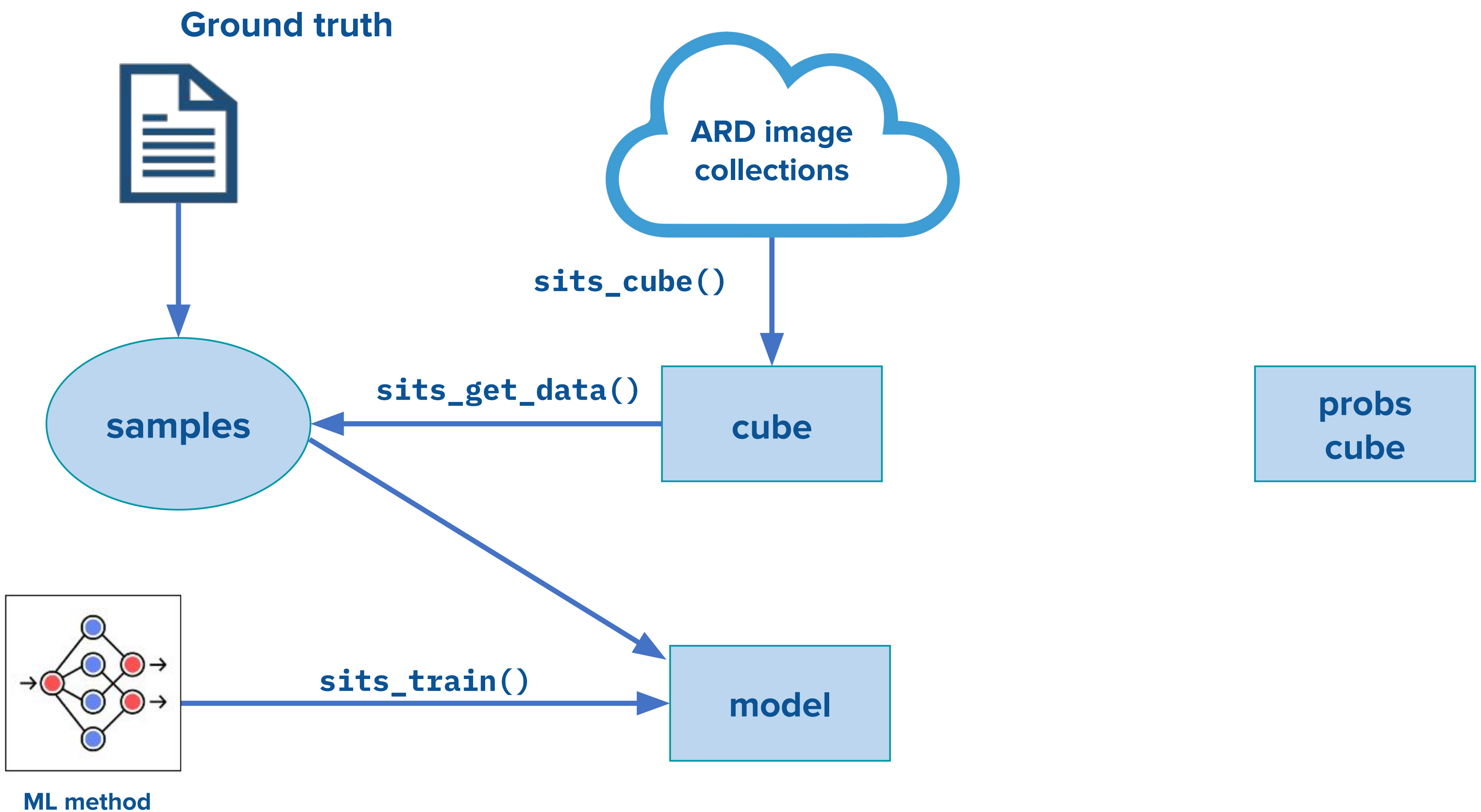

samples
cube
probs
cube
model

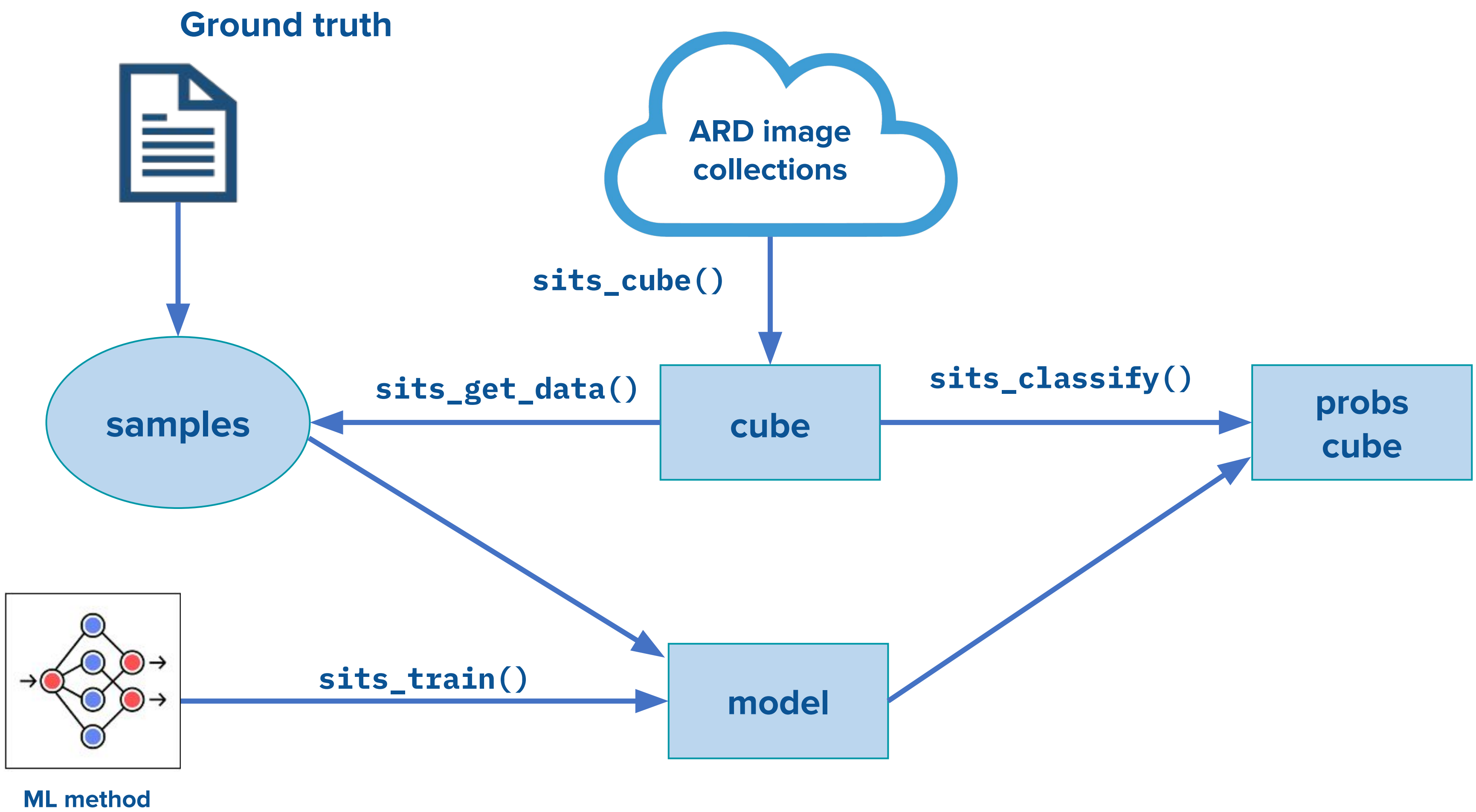

Ground truth
samples
cube
probs
cube
model

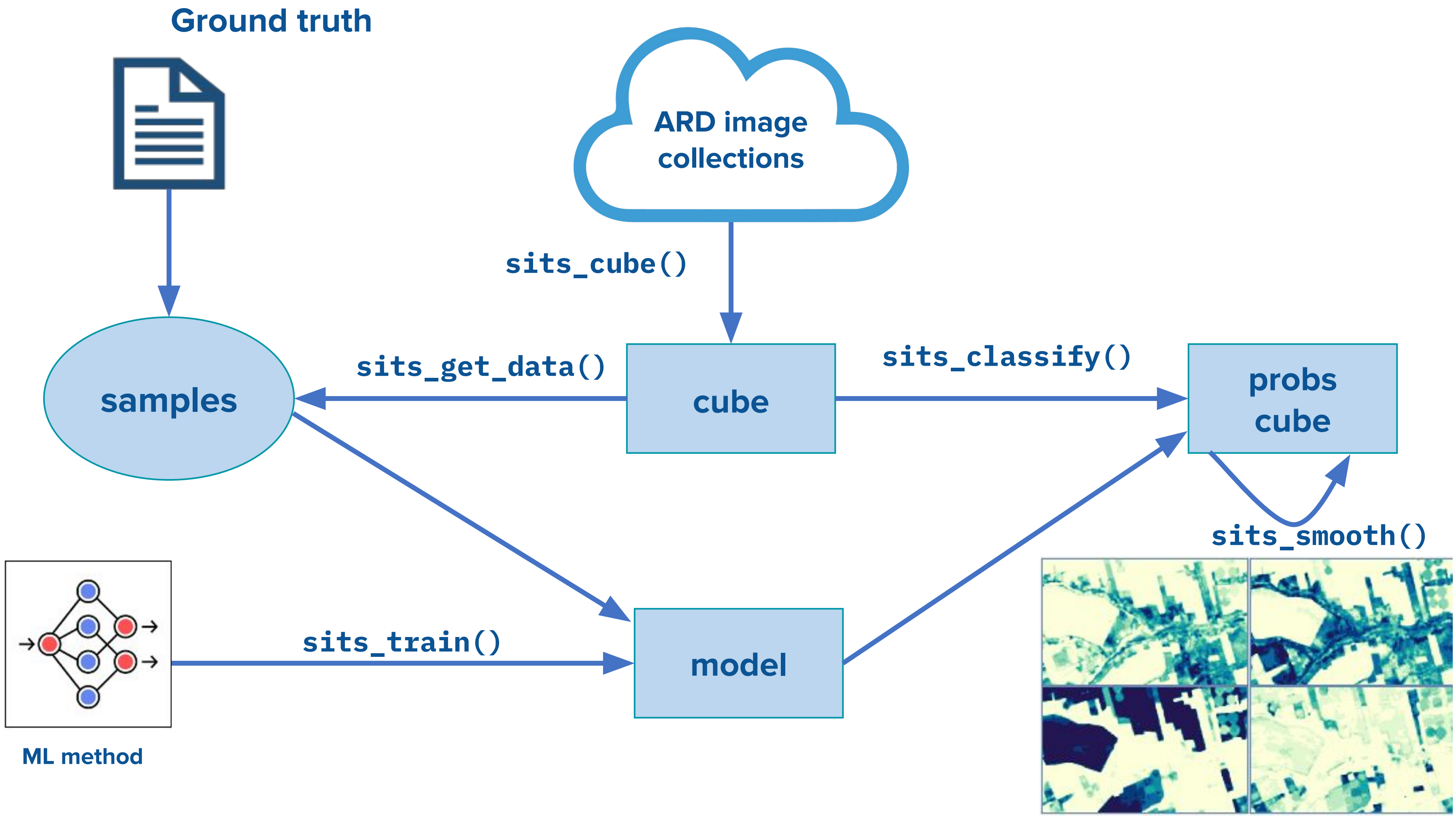

Ground truth
ARD image collections
samples
cube
probs cube
model

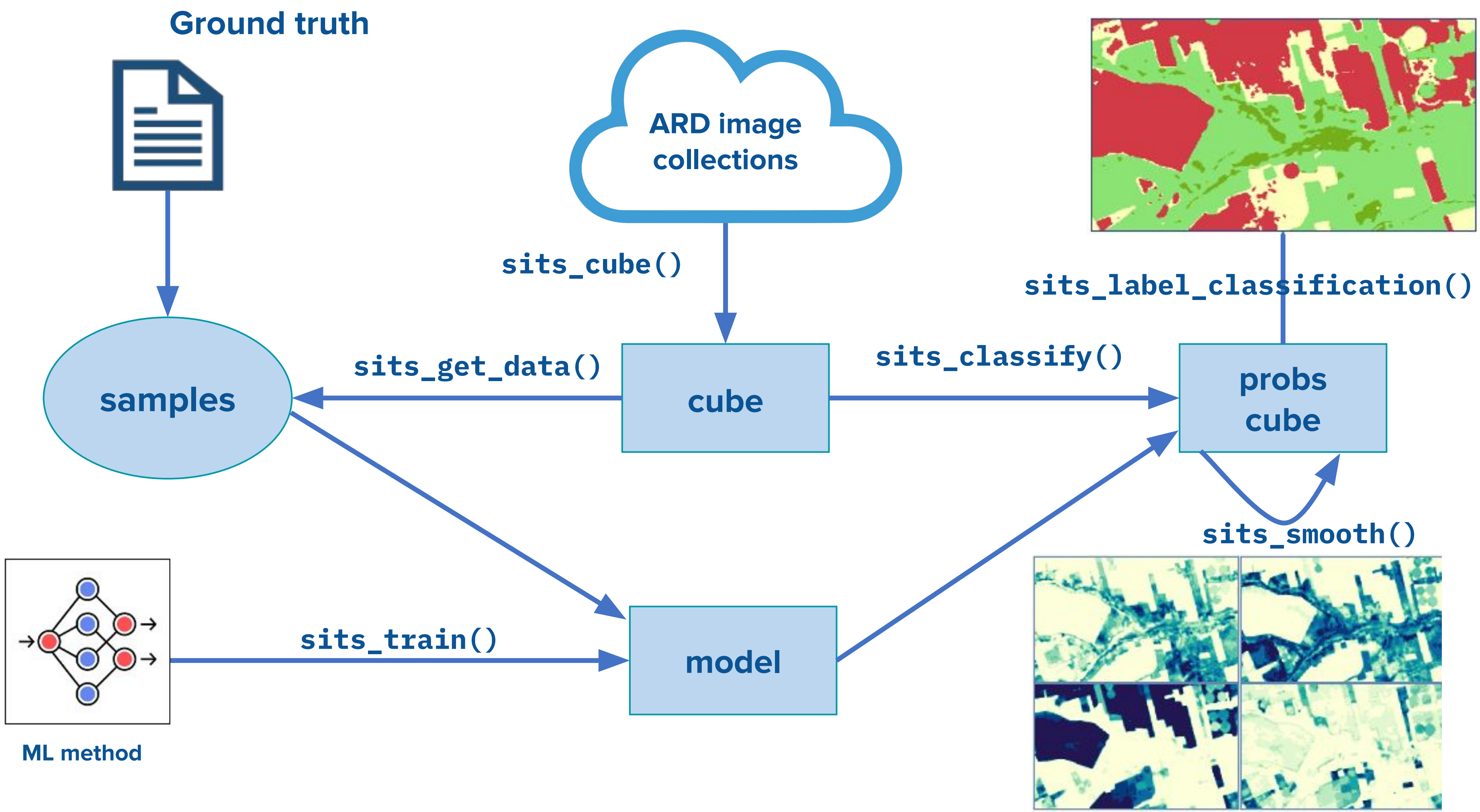

Ground truth
ARD image collections
sits_cube()
samples
cube
probs cube
model


Ground truth
ARD image
collections
sits_cube()
samples
sits_get_data()
cube
probs
cube
model

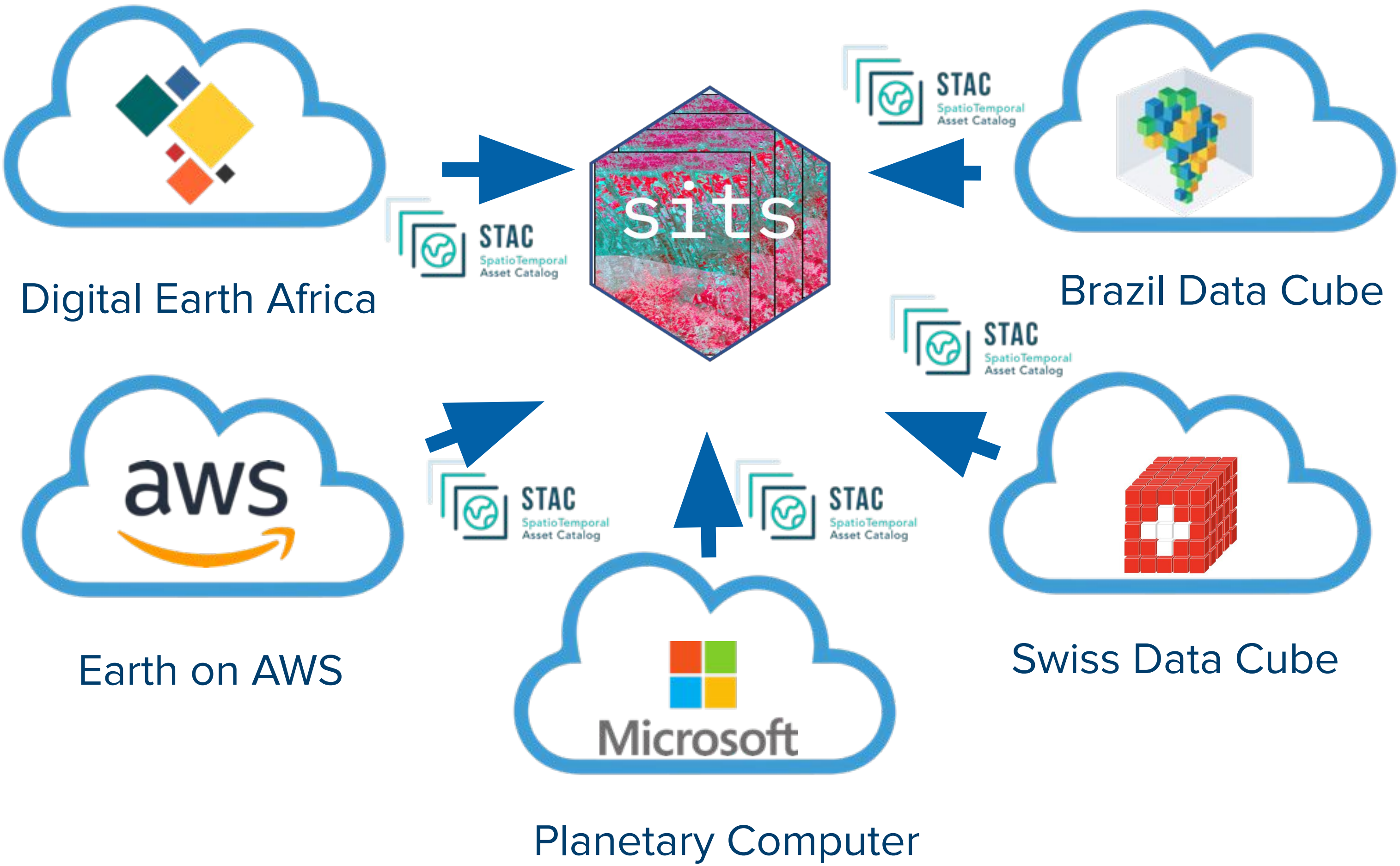

Ground truth
ARD image collections
sits_cube()
samples
sits_get_data()
cube
probs cube
sits_train()
model
ML method


Ground truth
ARD image collections
sits_cube()
samples
sits_get_data()
cube
sits_classify()
probs cube
sits_train()
model
ML method


Ground truth
ARD image
collections
sits_cube()
samples
sits_get_data()
cube
sits_classify()
probs
cube
sits_smooth()
sits_train()
model
ML method

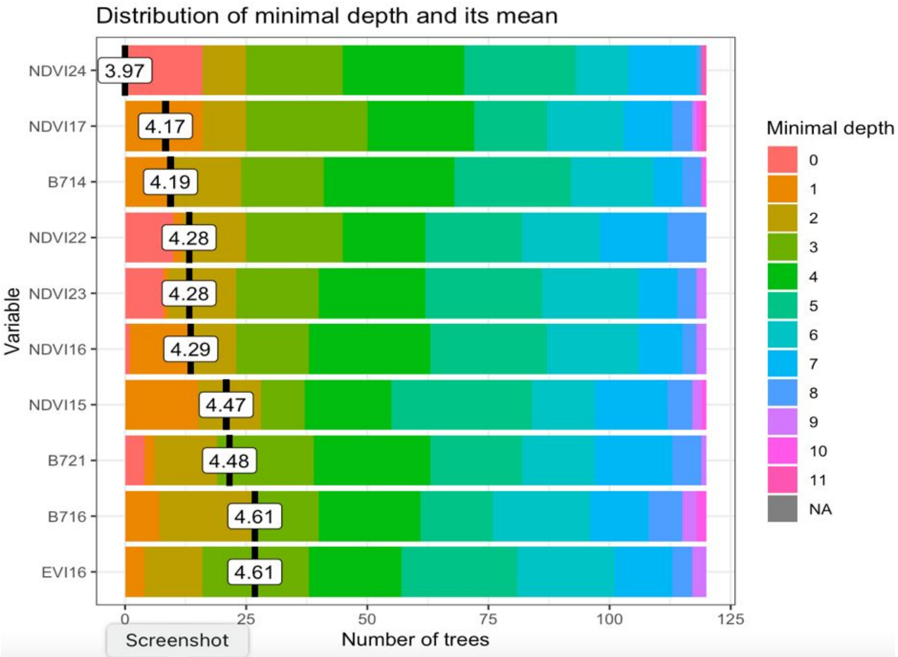

Ground truth
ARD image collections
sits_cube()
sits_label_classification()
sits_get_data()
sits_classify()
samples
cube
probs cube
sits_smooth()
sits_train()
model
ML method

Acesso a cubos de dados com STAC

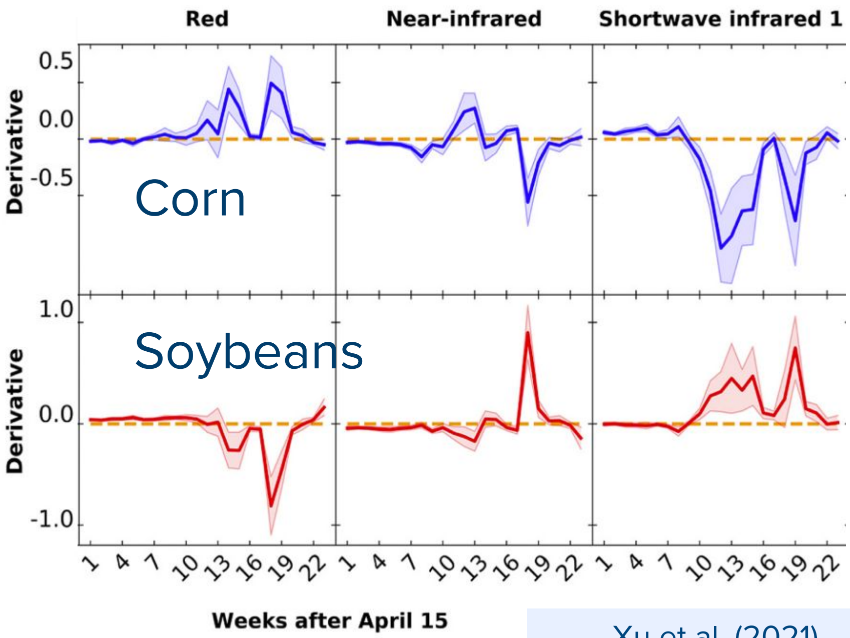


Dos métodos clássicos aos contemporâneos

Random forests (hierarchical model)



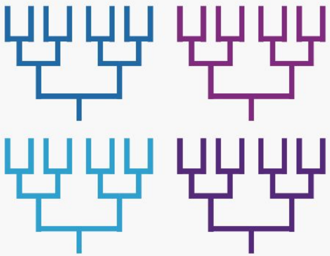
Transformers (relational model)



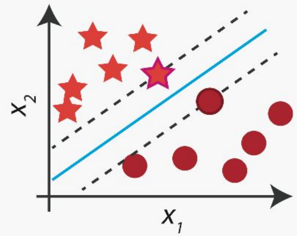
Xu et al. (2021)

Métodos de Aprendizagem de Máquina suportados pelo SITS

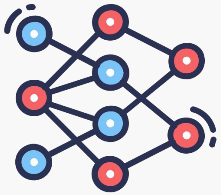
Random forests



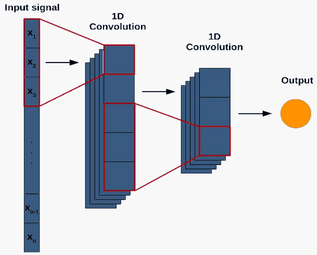
Support vector machines



Multilayer perceptrons



1D convolutional neural networks



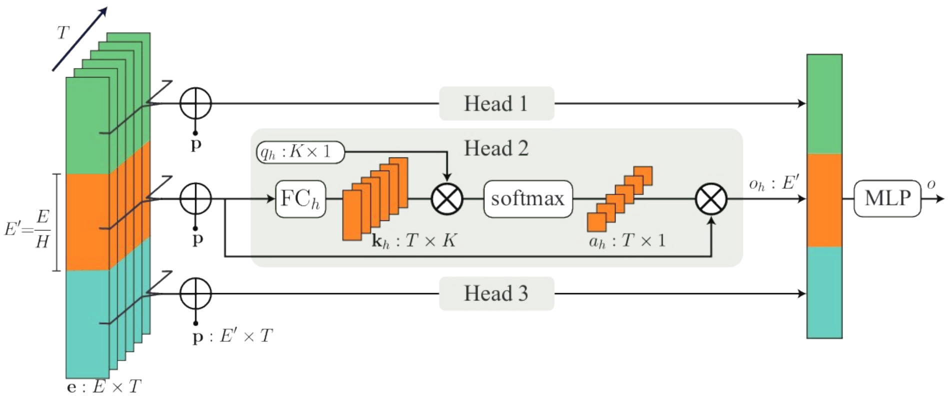
- **Extreme gradient boosting**
- **Deep Residual Networks**

- **Temporal attention encoders**
- **Lightweight temporal attention encoders**

graphics: Cambridge Coding Academy and Alex Shenfield

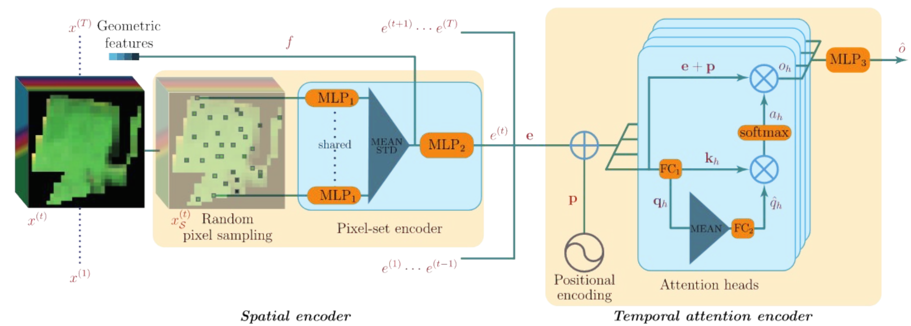
State-of-the-art time series classification

Lightweight Temporal Self-Attention Encoder



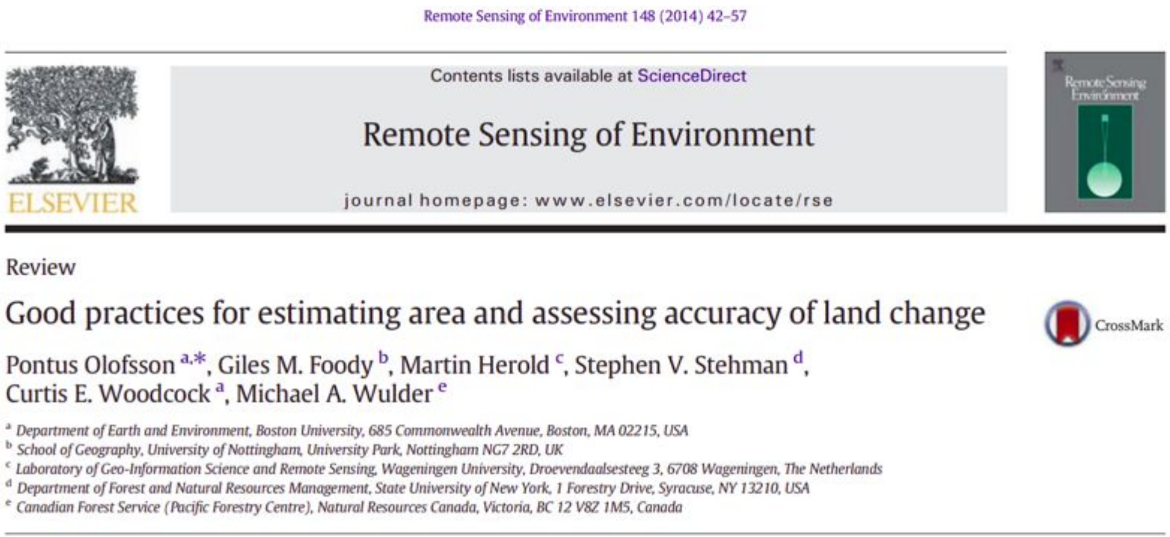
Garnot & Landrieu (2020)

Temporal Self-Attention Encoder



Garnot et al. (2020)

Estimativa de acurácia


Remote Sensing of Environment 148 (2014) 42–57

Contents lists available at ScienceDirect

Remote Sensing of Environment

journal homepage: www.elsevier.com/locate/rse

Review

Good practices for estimating area and assessing accuracy of land change

Pontus Olofsson [a,*], Giles M. Foody [b], Martin Herold [c], Stephen V. Stehman [d], Curtis E. Woodcock [a], Michael A. Wulder [e]

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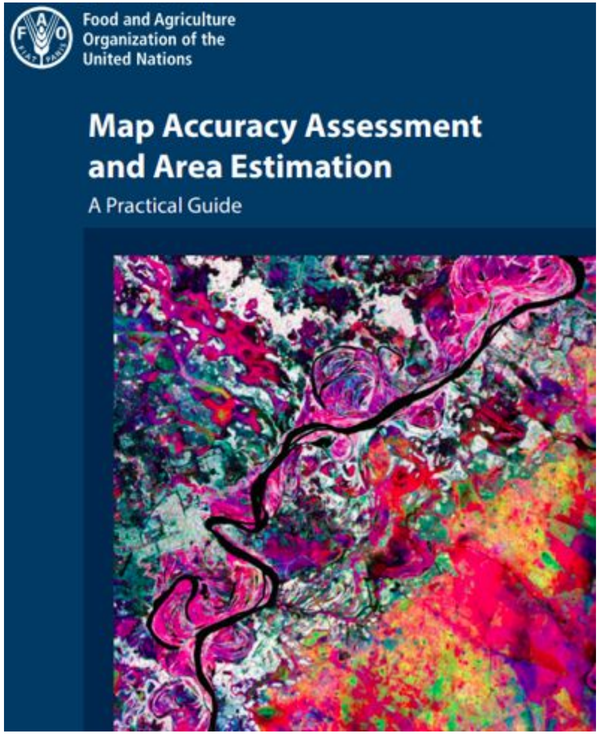
[b] School of Geography, University of Nottingham, University Park, Nottingham NG7 2RD, UK
[c] Laboratory of Geo-Information Science and Remote Sensing, Wageningen University, Droevendaalsesteeg 3, 6708 Wageningen, The Netherlands
[d] Department of Forest and Natural Resources Management, State University of New York, 1 Forestry Drive, Syracuse, NY 13210, USA
[e] Canadian Forest Service (Pacific Forestry Centre), Natural Resources Canada, Victoria, BC 12 V8Z 1M5, Canada



Mato Grosso classification from 2001 to 2017

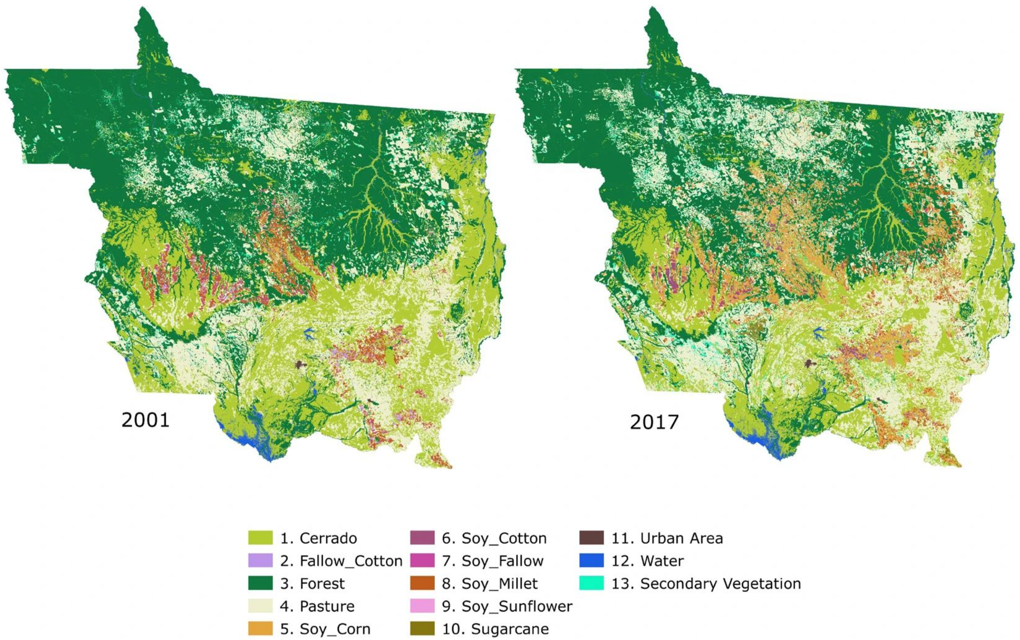
SCIENTIFIC DATA

Data Descriptor | Open Access | Published: 27 January 2020

Land use and cover maps for Mato Grosso State in Brazil from 2001 to 2017

Rolf Simoes, Michelle C. A. Picoli, Gilberto Camara, Adeline Maciel, Lorena Santos, Pedro R. Andrade, Alber Sánchez, Karine Ferreira & Alexandre Carvalho

Scientific Data **7**, Article number: 34 (2020) | Cite this article



Cerrado biome classification

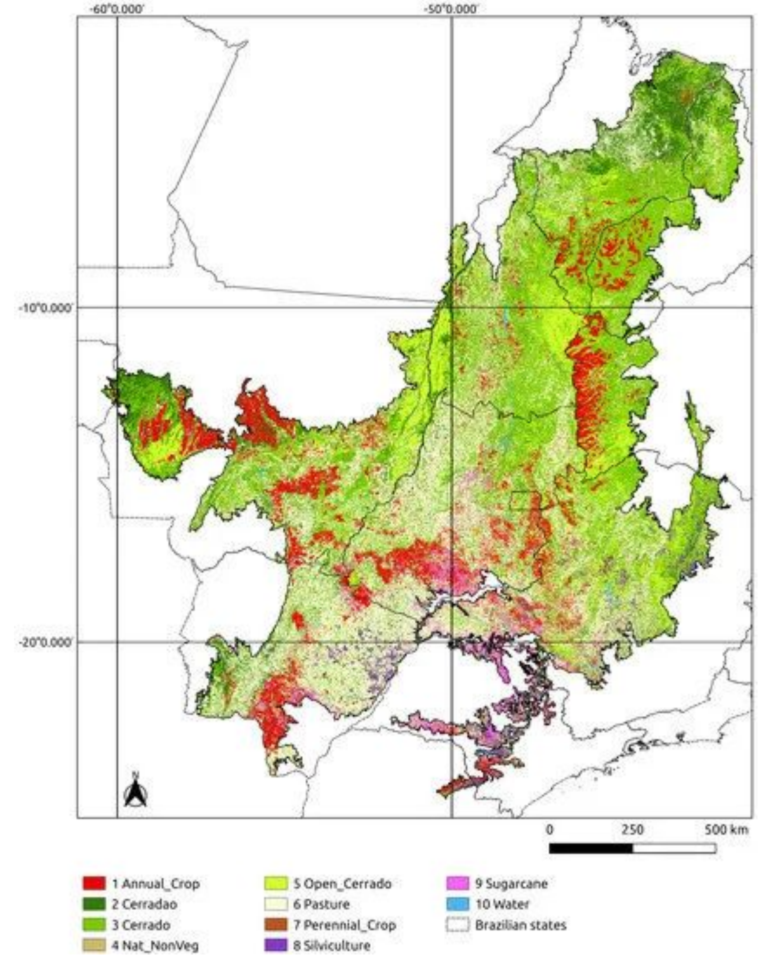
remote sensing

MDPI

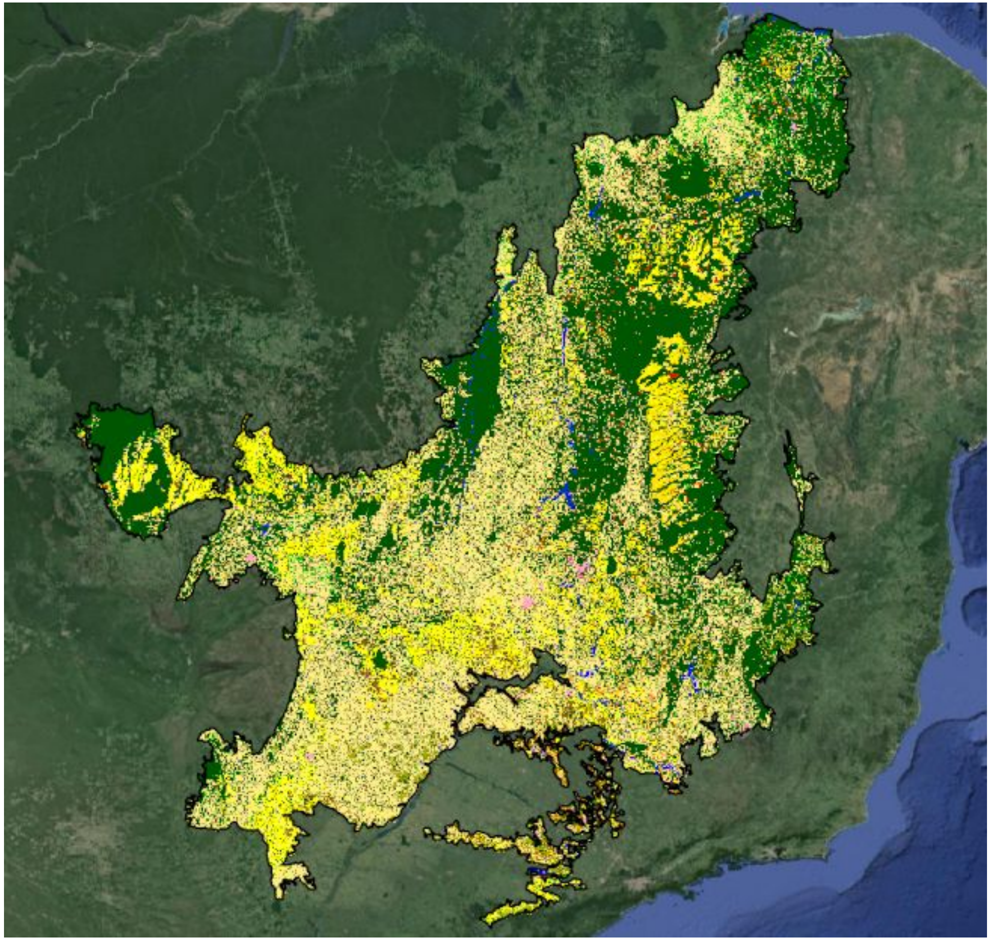
Article

Satellite Image Time Series Analysis for Big Earth Observation Data

Rolf Simoes [1,*], Gilberto Camara [1], Gilberto Queiroz [1], Felipe Souza [1], Pedro R. Andrade [1], Lorena Santos [1], Alexandre Carvalho [2] and Karine Ferreira [1]



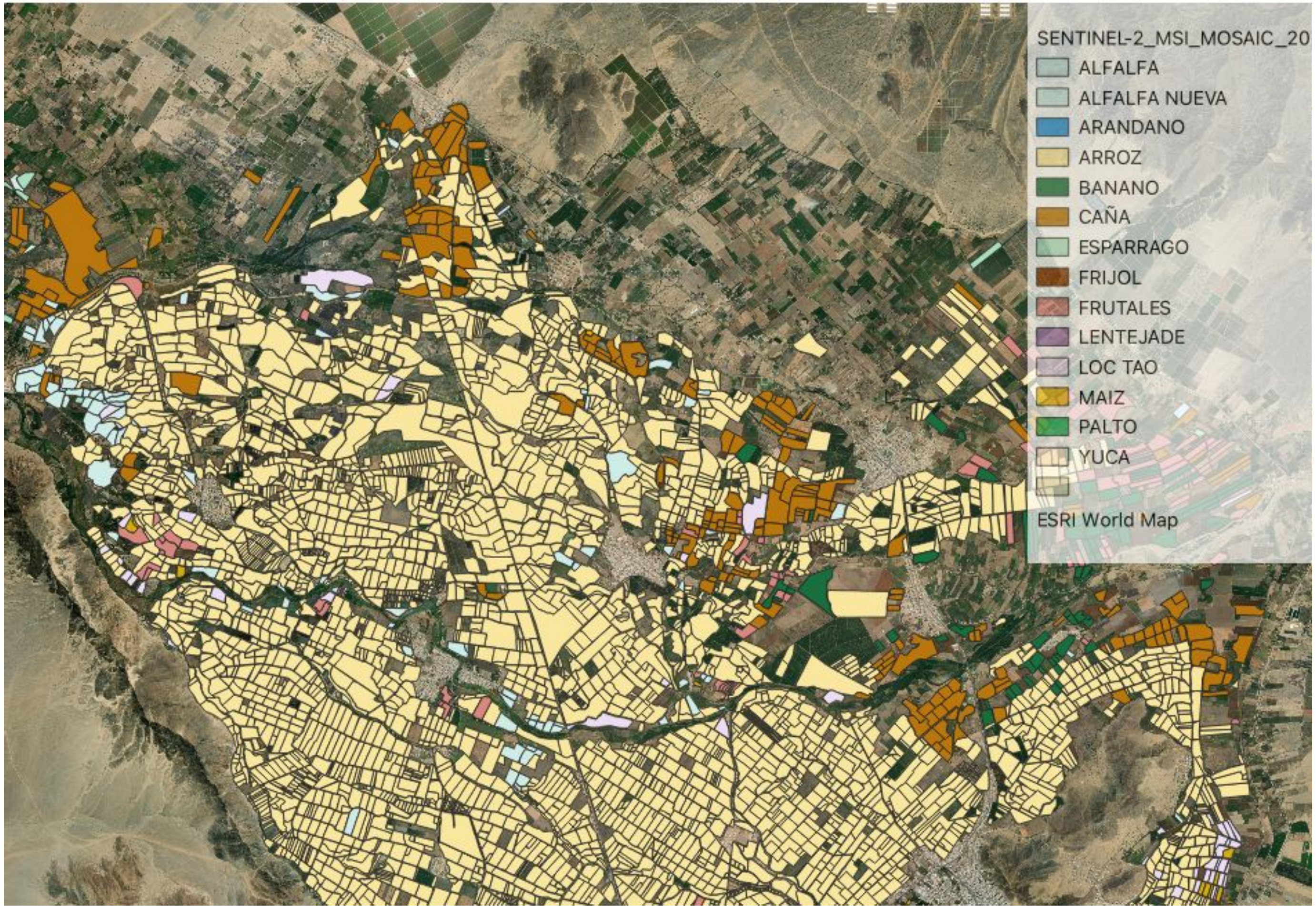
TerraClass Cerrado



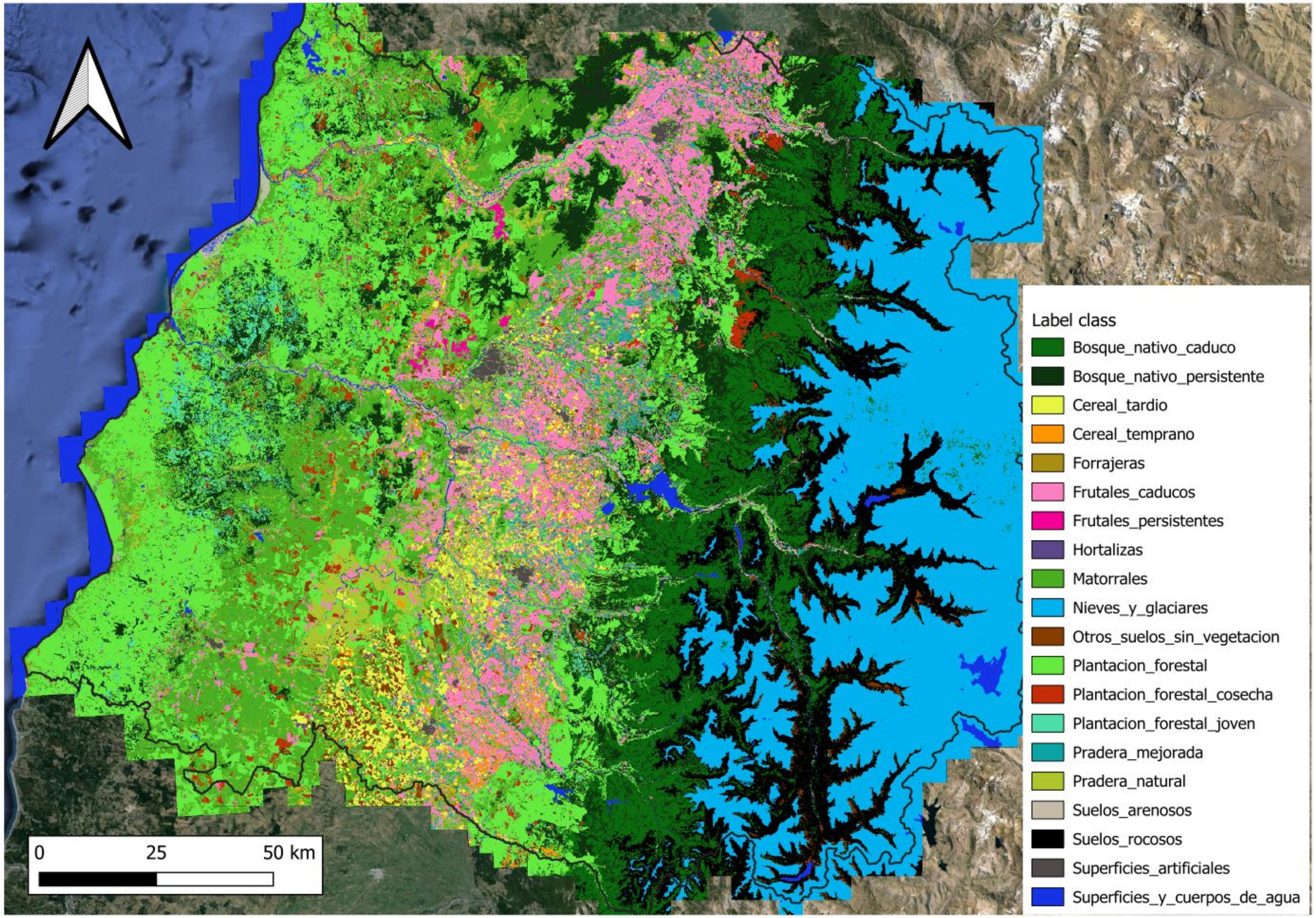
Mapeamento de LULC em Peru

PERÚ

MIDAGRI

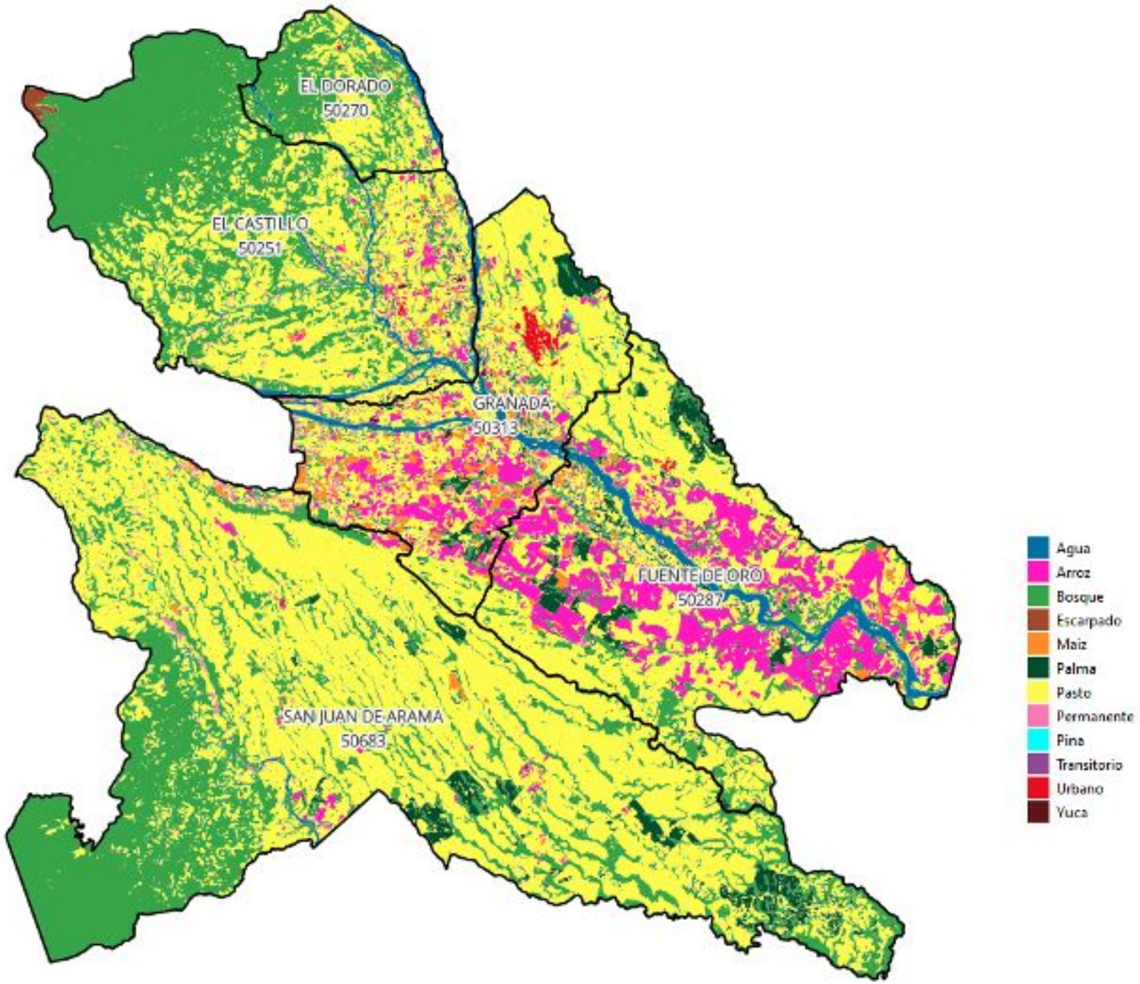


Mapeamento de LULC em Chile



Instituto Nacional de Estadísticas • Chile

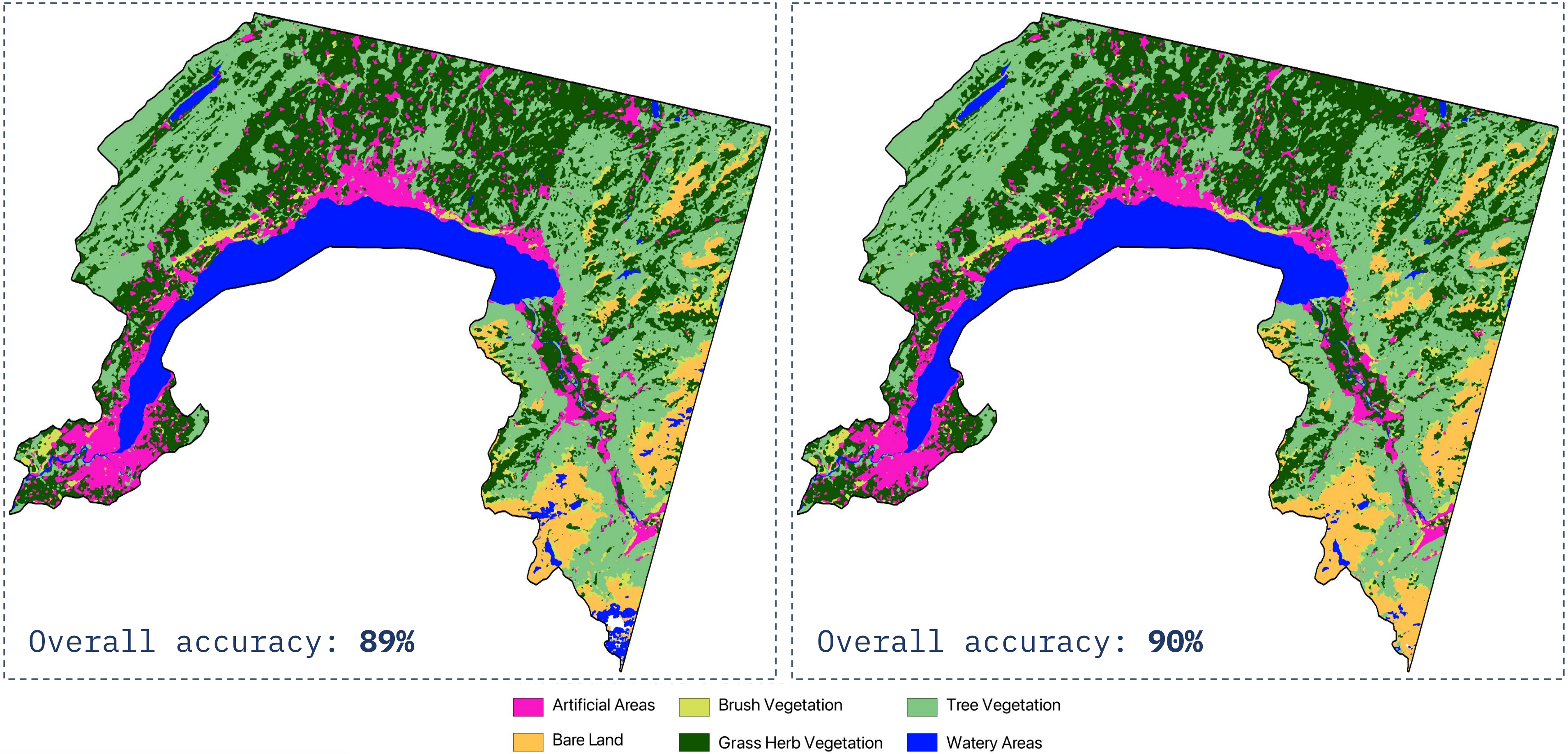
Mapeamento de LULC em Colombia



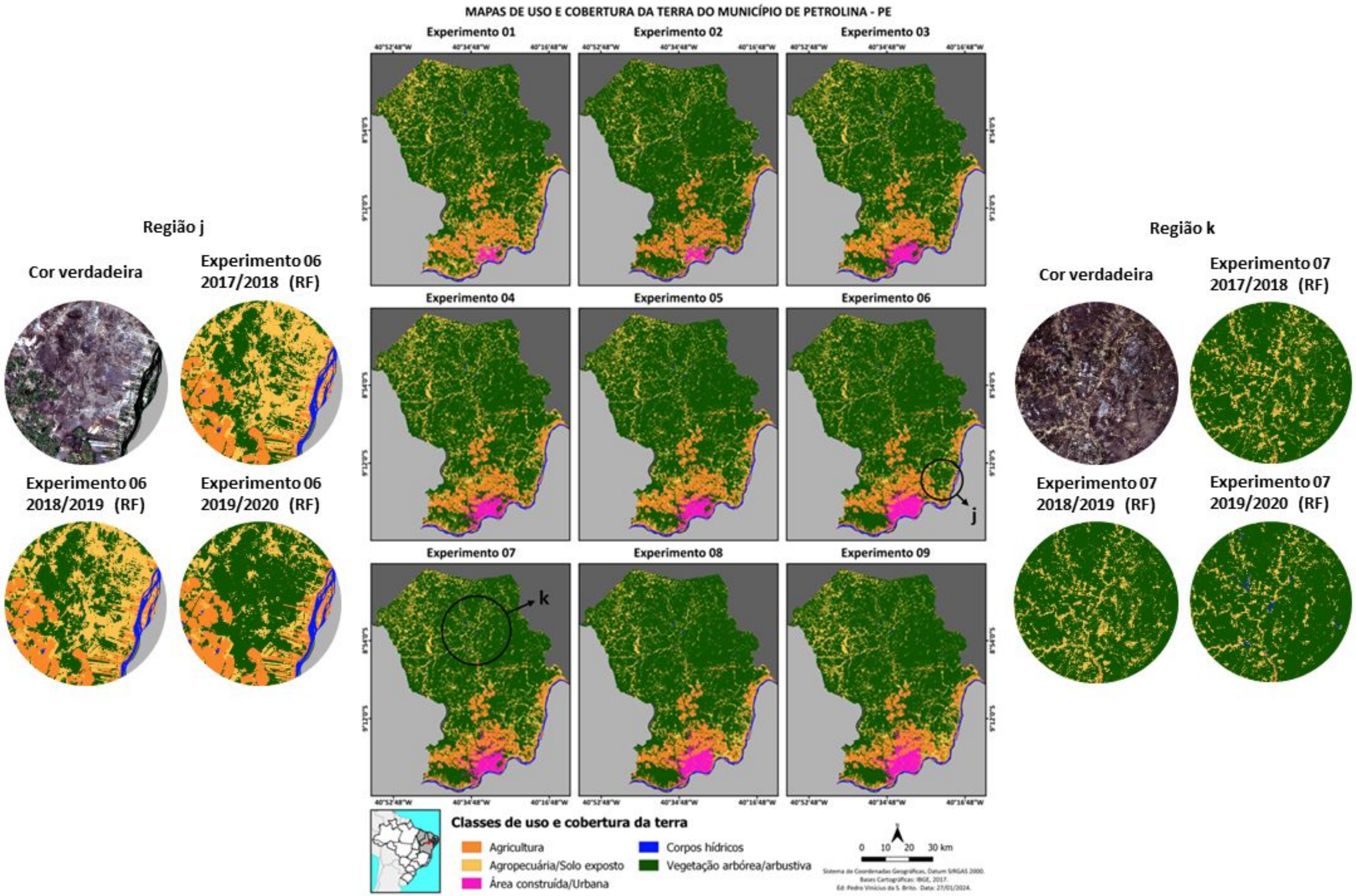
Mapeamento de LULC em Genebra

UNIVERSITÉ DE GENÈVE

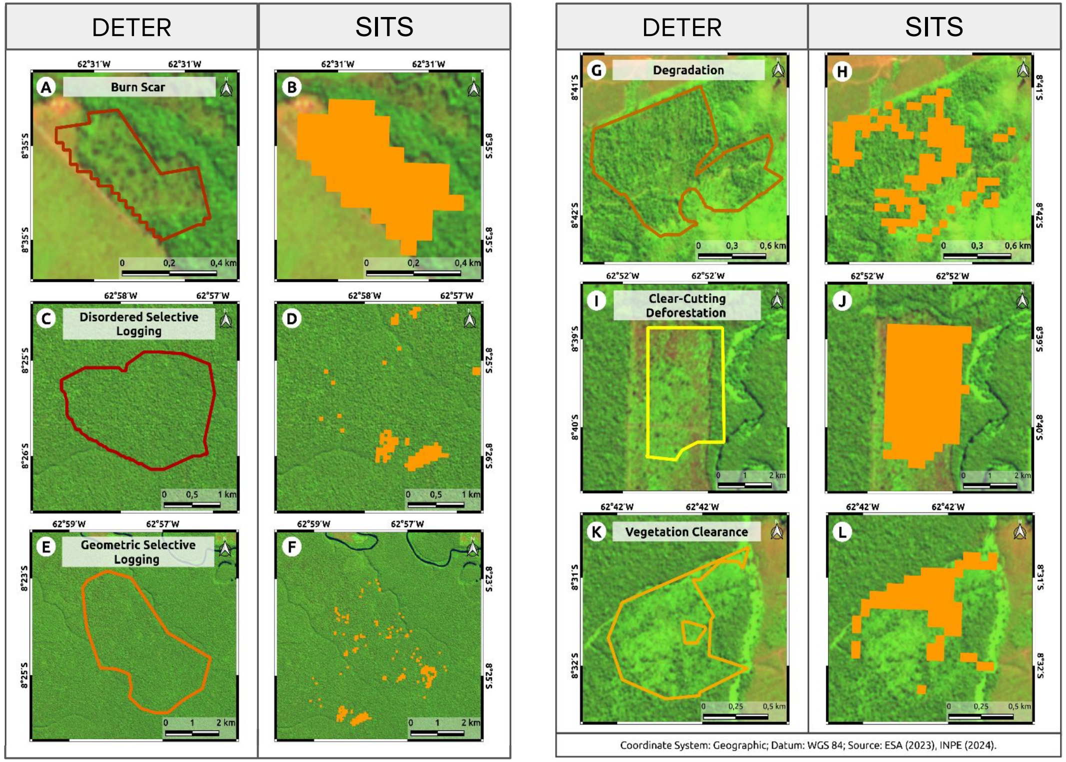
Reference: 2018 | **Target:** 2009



Combinação de dados meteorológicos e dados ópticos na Caatinga



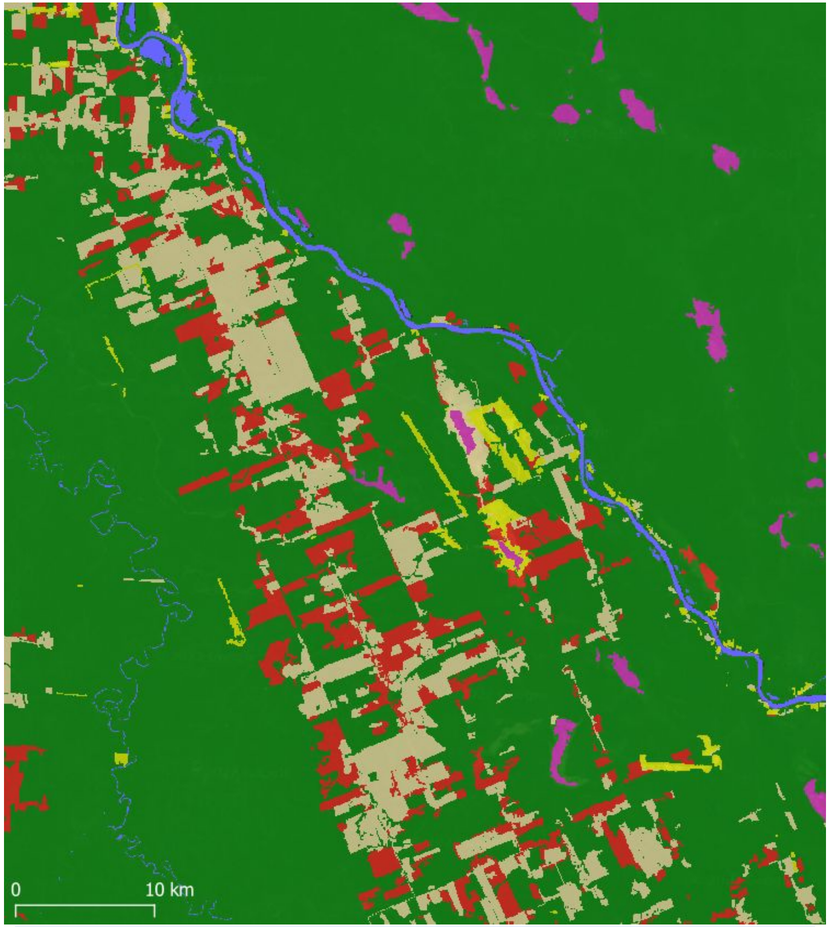
Combinação de dados SAR e ópticos para detecção de distúrbios florestais na Amazônia



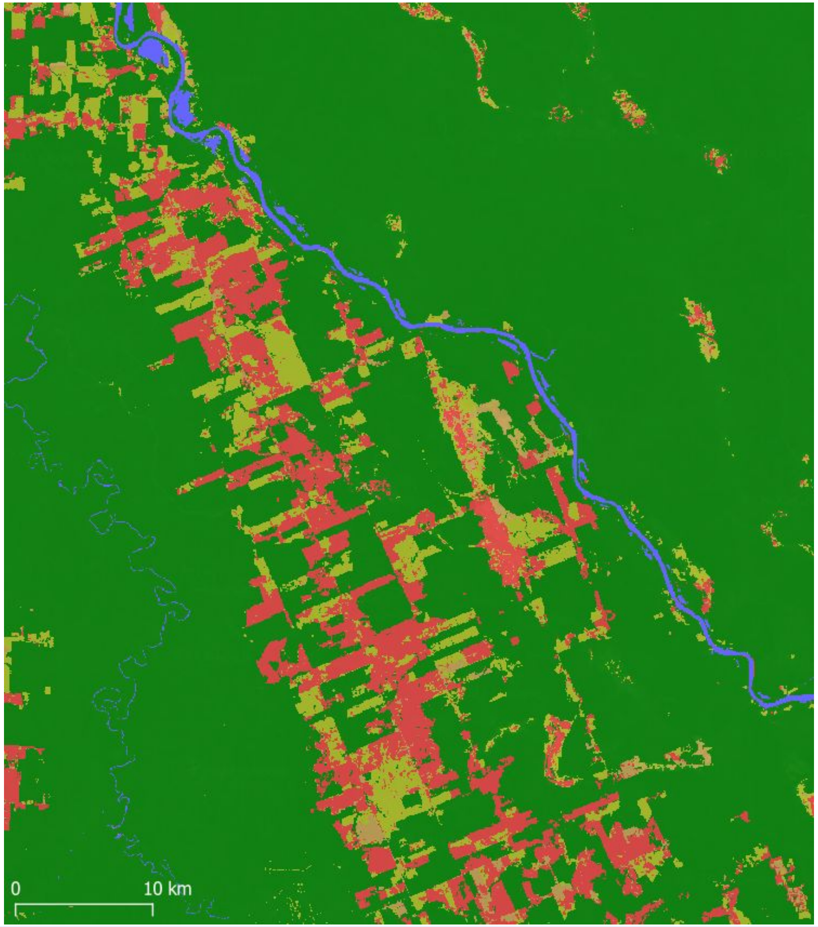
Combinação de dados SAR e ópticos para detecção de distúrbios florestais na Amazônia

DETER classification	Mean detection difference (in days ±)
Burn Scar	-87.8
Disordered Selective Logging	-183.
Geometric Selective Logging	-142.
Degradation	-89.4
Clear-Cutting Deforestation	-16.6
Vegetation Clearance	-61.1

Monitoramento de desmatamento em Rondônia



PRODES (reference)



400 samples, LTAE (97% agreement)

e-sensing.github.io/sitsbook/

Referências

1. Rolf Simoes, Gilberto Camara, et al. “Satellite Image Time Series Analysis for Big Earth Observation Data”. Remote Sensing, 13, p. 2428, 2021.
2. Lorena Santos, Karine Ferreira, et al., “Quality control and class noise reduction of satellite image time series”. ISPRS Journal of Photogrammetry and Remote Sensing, vol. 177, pp 75-88, 2021.
3. Gilberto Câmara, “On the semantics of big Earth observation data for land classification”, Journal of Spatial Information Science, 20, p. 21–34, 2020.
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3. Monarch, R., “Human-in-the-Loop Machine Learning: Active Learning and Annotation for Human-centered AI”. Manning Publications, 2021.
4. Garnot, Landrieu, et al., “Satellite Image Time Series Classification With Pixel-Set Encoders and Temporal Self-Attention”. IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR), 2020.
5. Garnot, Landrieu, et al., “Lightweight Temporal Self-attention for Classifying Satellite Images Time Series”. Arxiv:2007.00586., 2021.
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