Post-doctorat cnes application

imCLASS

User-tailored machine learning IMage CLASSification for land surface mapping

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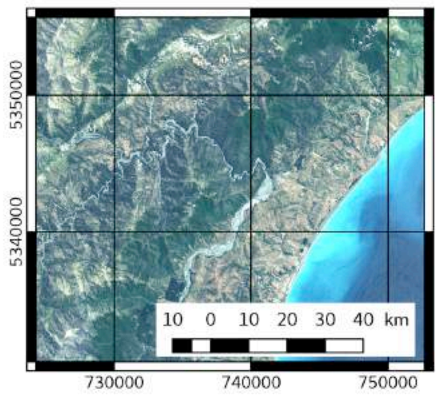
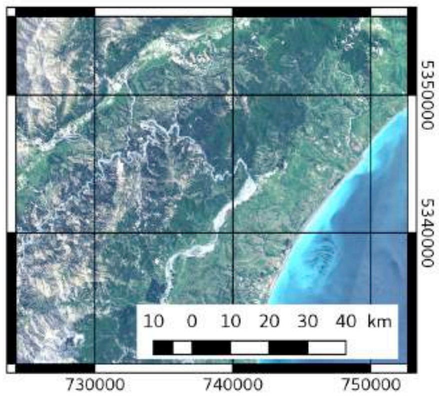
Context

Earthquakes and extreme rainfall (typhoons) can cause >1000s to 100,000s landslides.

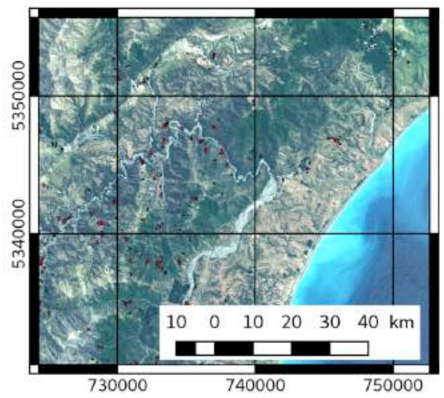
Optical imagery gives the opportunity to rapiddly and efficiently detect and map landslides in very short time



Pre-event image

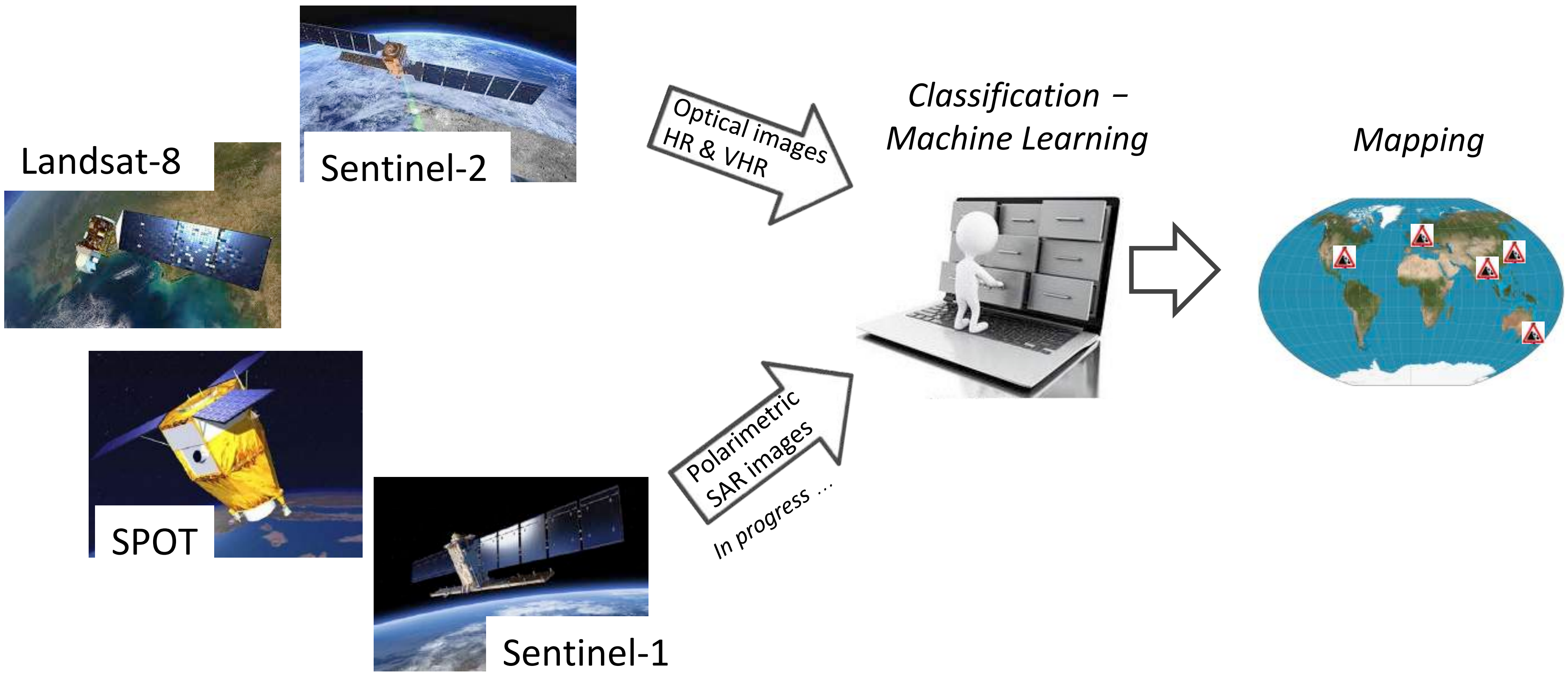


Post-event image



Landslide inventory

Context: input data



Workflow

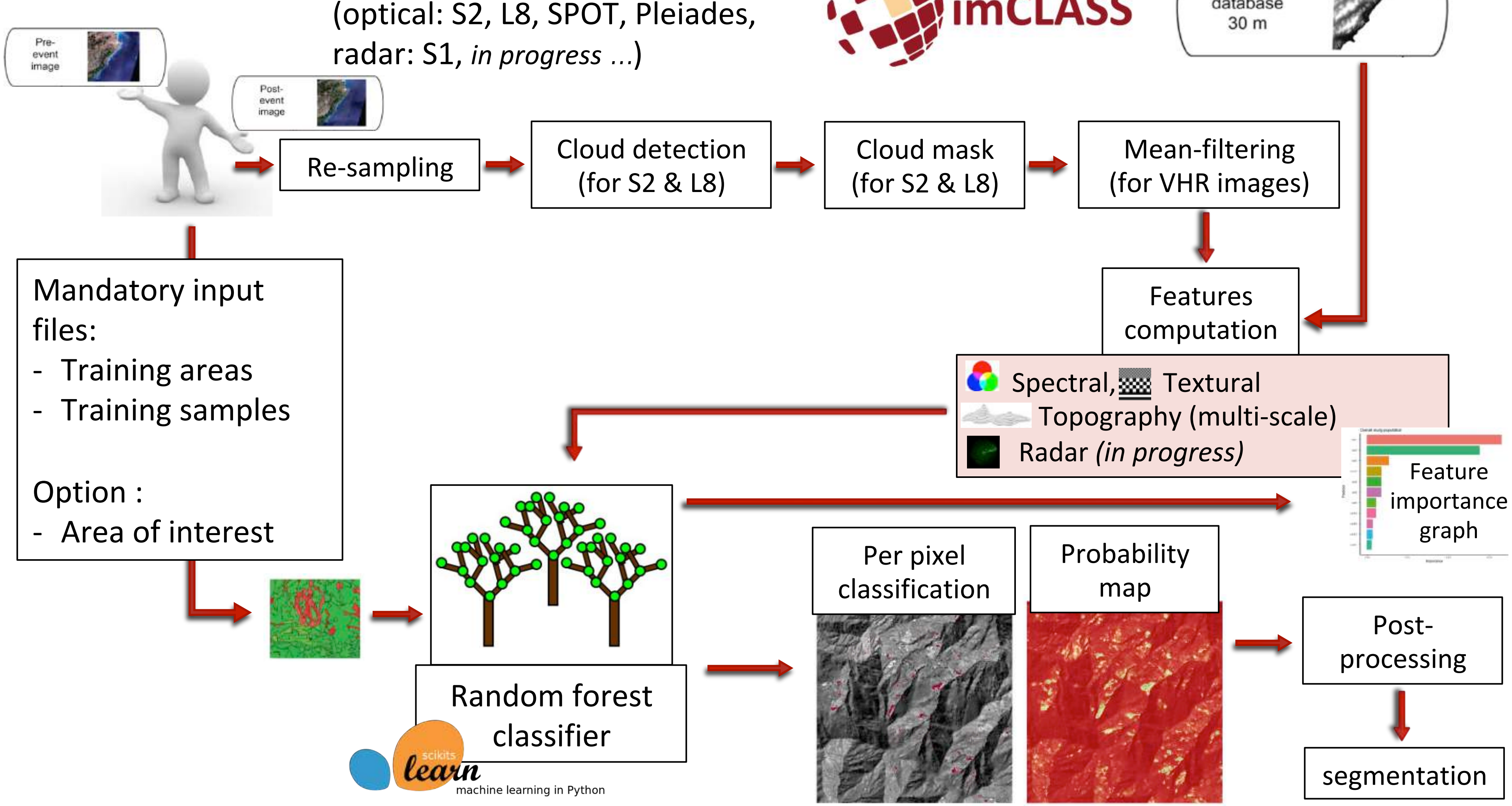
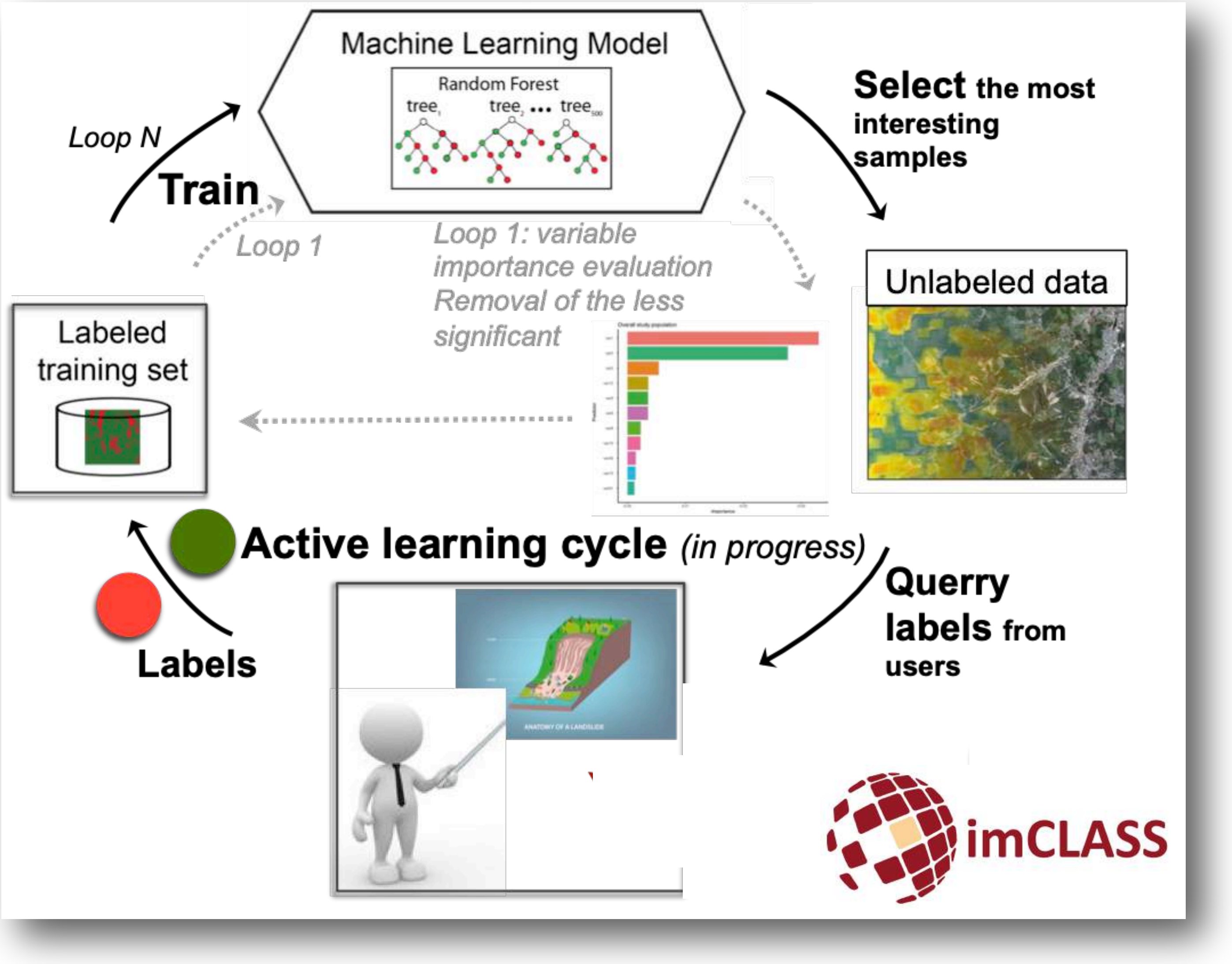


Image selection
(optical: S2, L8, SPOT, Pleiades,
radar: S1, *in progress* …)
imCLASS
SRTM
database
30 m
Pre-
event
image
Post-
event
image
Re-sampling
Cloud detection
(for S2 & L8)
Cloud mask
(for S2 & L8)
Mean-filtering
(for VHR images)
Features
computation
Spectral, Textural
Topography (multi-scale)
Radar *(in progress)*
Mandatory input
files:
- Training areas
- Training samples
Option :
- Area of interest
Feature
importance
graph
Random forest
classifier
scikits
learn
machine learning in Python
Per pixel
classification
Probability
map
Post-
processing
segmentation

Workflow

- Variables selection with respect to their relative importance
- Selection of the most reliable pixels to add in the training sample
- Active learning cycle



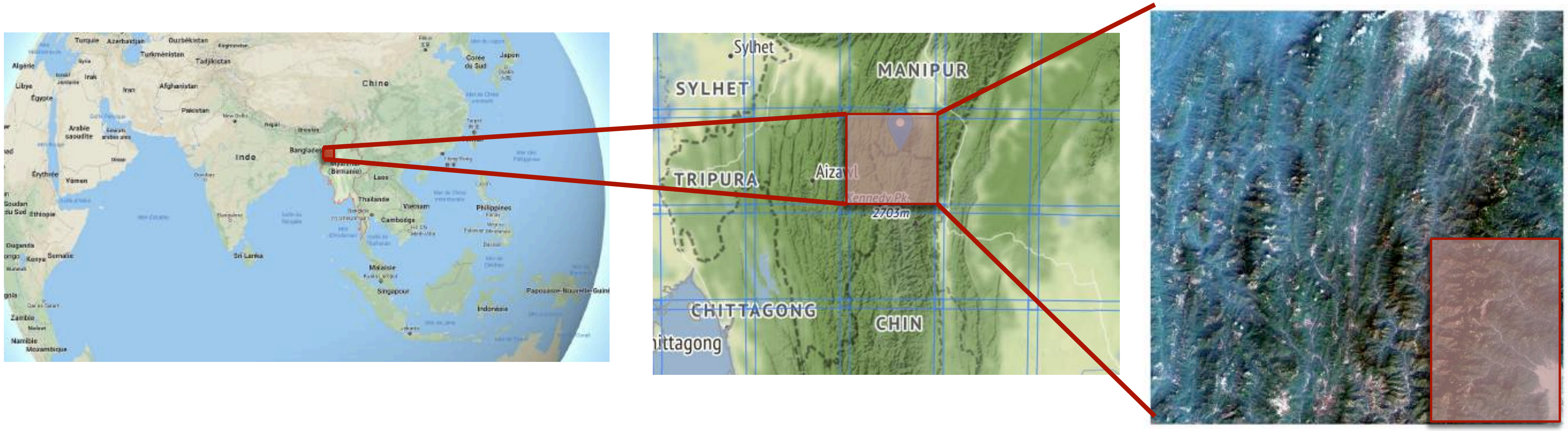
First Results

Mapping of landslides after heavy rains and cyclone Komen. Myanmar, 2015

Input data:

- Landsat 8 image pre-event (resolution : 15m for panchromatic band, 30m for the RGB + NIR bands)
- Sentinel 2 image post-event (resolution : 10m for RGB + NIR bands)

Location:



First Results: Mapping of landslides after heavy rains and cyclone Komen. Myanmar, 2015

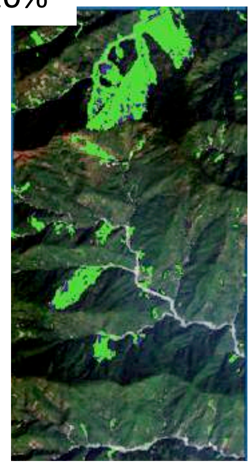
Training set size influence

Pixels to classify	50 048 209	52 257 598	53 831 443
Training pixels	5 361 685 (10%) (-:5 180 228, +:181 457)	3 152 296 (6%) (-: 3 030 935, +: 121 361)	1 578 451 (3%) (-: 1 540 660, +:37 791)

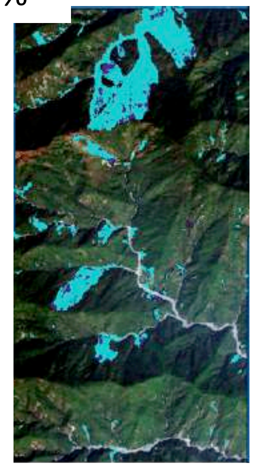
(x%) : ratio
(nb pixels in training set) / (nb total of pixels)
+ : landslide pixel
- : no-landslide pixel

Manual digitalisation

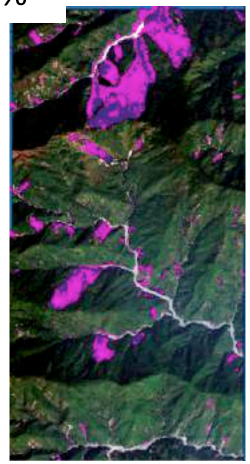
10%



6%



3%



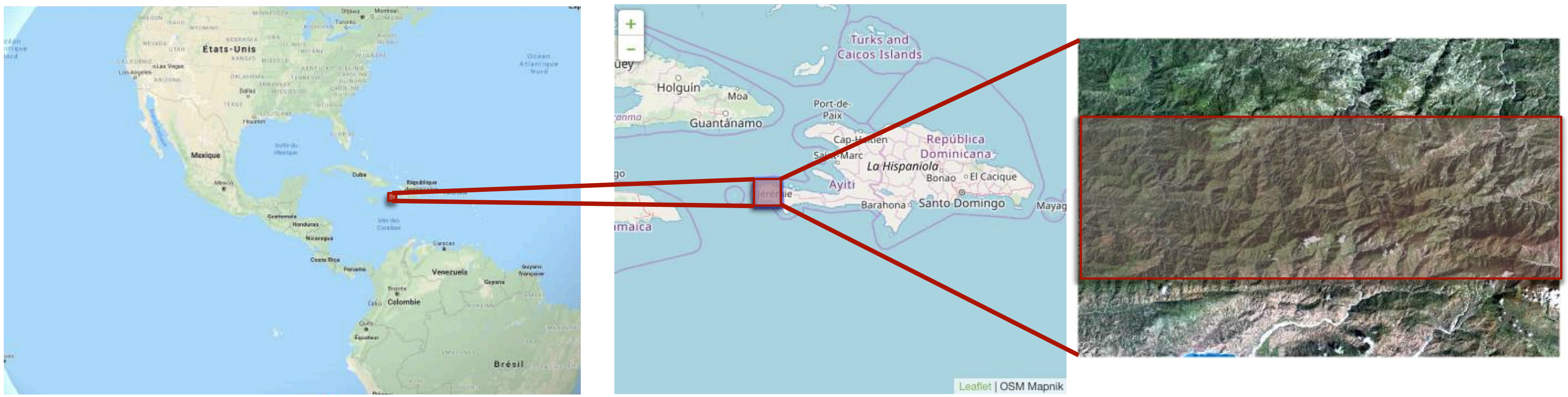
Per pixel classification

First Results: Mapping of landslides after Hurricane Matthew. Haïti, 2016

Input data:

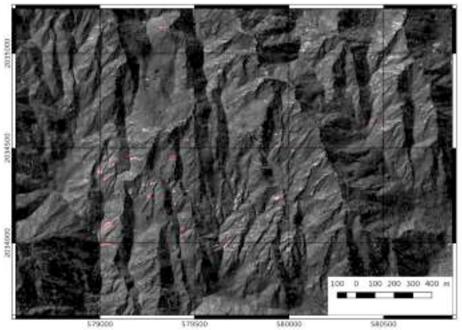
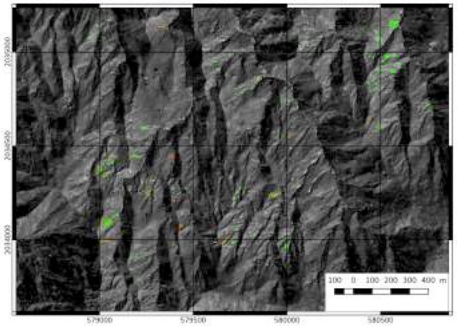
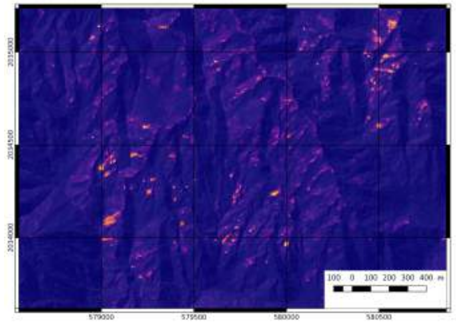
- SPOT6 images (resolution : 1.5m for panchromatic images, 6m for the RGB + NIR images)
- SPOT7 images (resolution : 1.5m for panchromatic images, 6m for the RGB + NIR images)

Location:



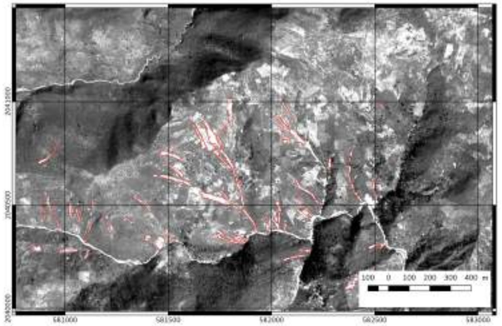
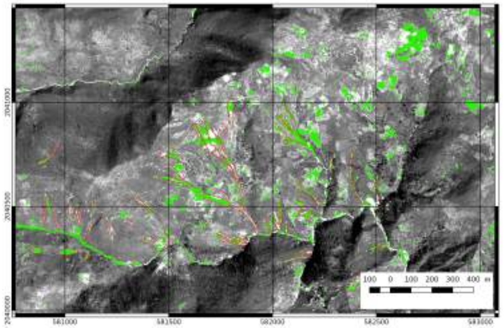
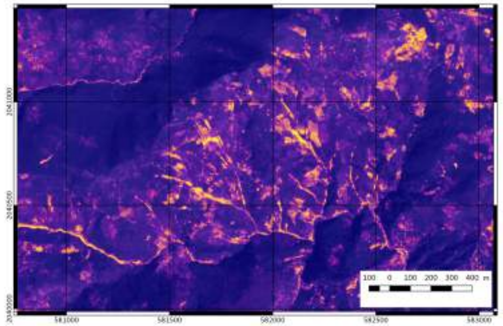
First Results: Mapping of landslides after Hurricane Matthew. Haïti, 2016

A lot of small landslides well identified

But some zones are more difficult to classified …

Rivers & agricultural plots erroneously mapped

Panchromatic image + manual digitalization

Pixels mapped as landslide

0 0.25 0.5 0.75 1

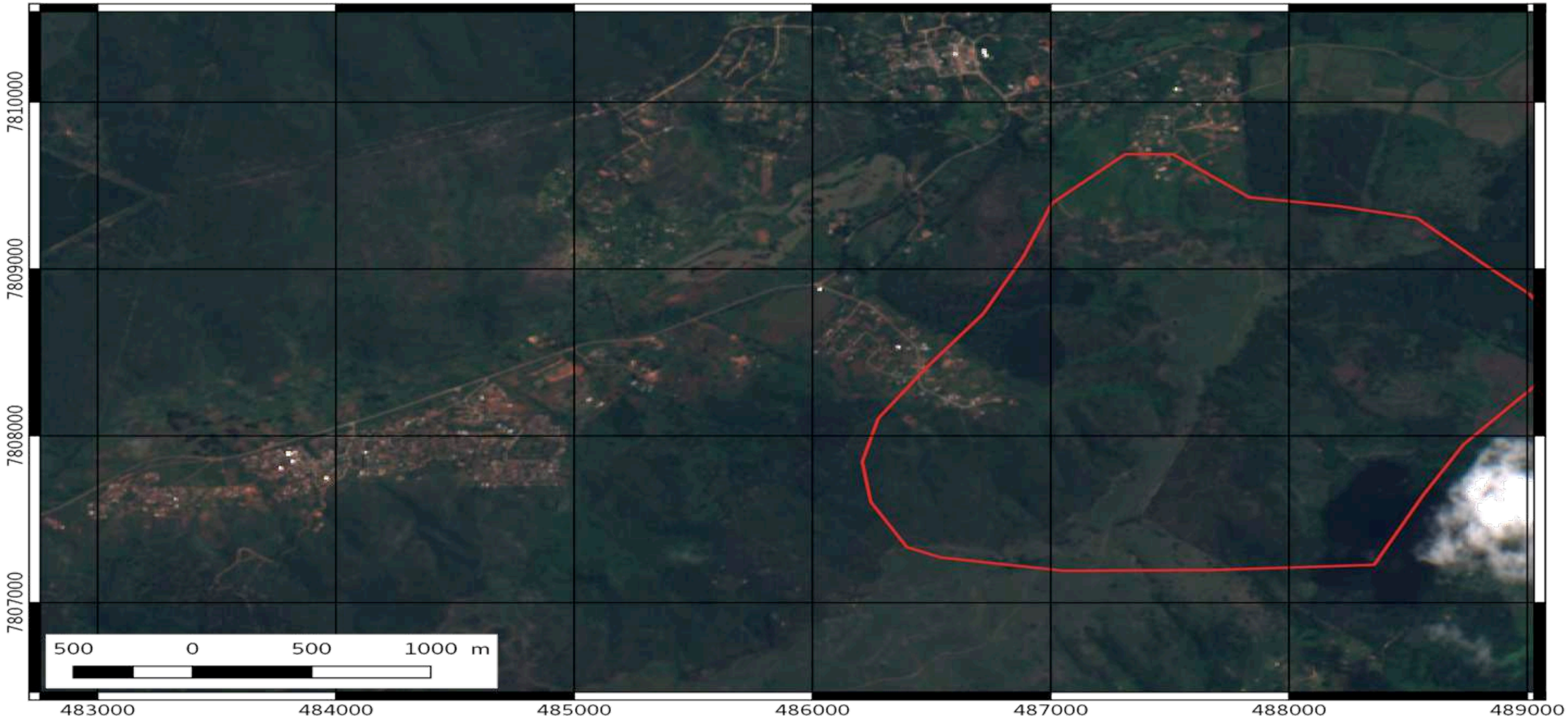
First Results: Mapping of landslides after cyclone Idai. Mozambique, 03/2019

Input data:

- Sentinel2 images (resolution : 10m- 60m)

First Results: Mapping of landslides after cyclone Idai. Mozambique, 03/2019

Sentinel 2 **pre-event**: 23 Feb. 2019
Zone 1



First Results: Mapping of landslides after cyclone Idai. Mozambique, 03/2019

Sentinel 2 **post-event**: 25 March 2019

Training area: 100 landslides interpreted for the training sample, eg. ca. 30 min of labour work

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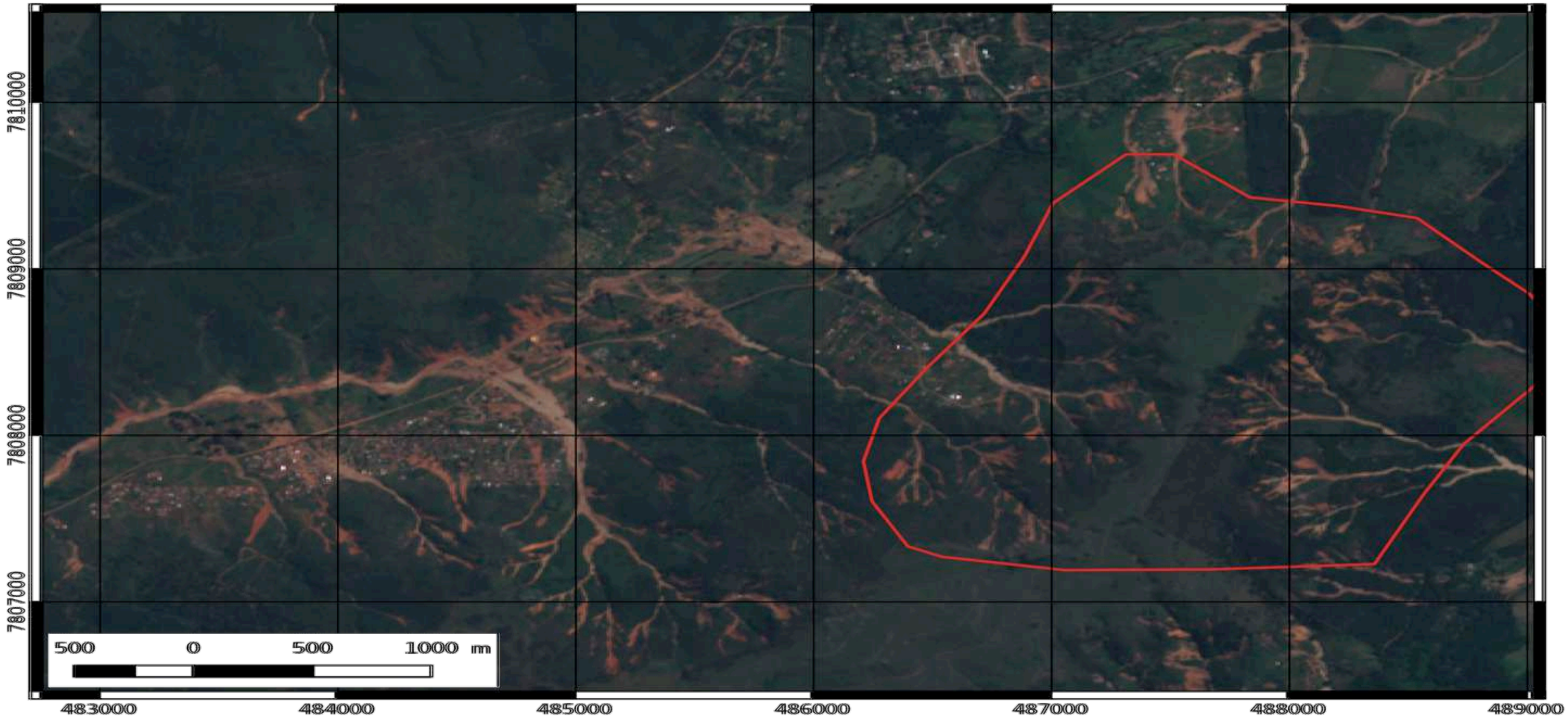

First Results: Mapping of landslides after cyclone Idai. Mozambique, 03/2019

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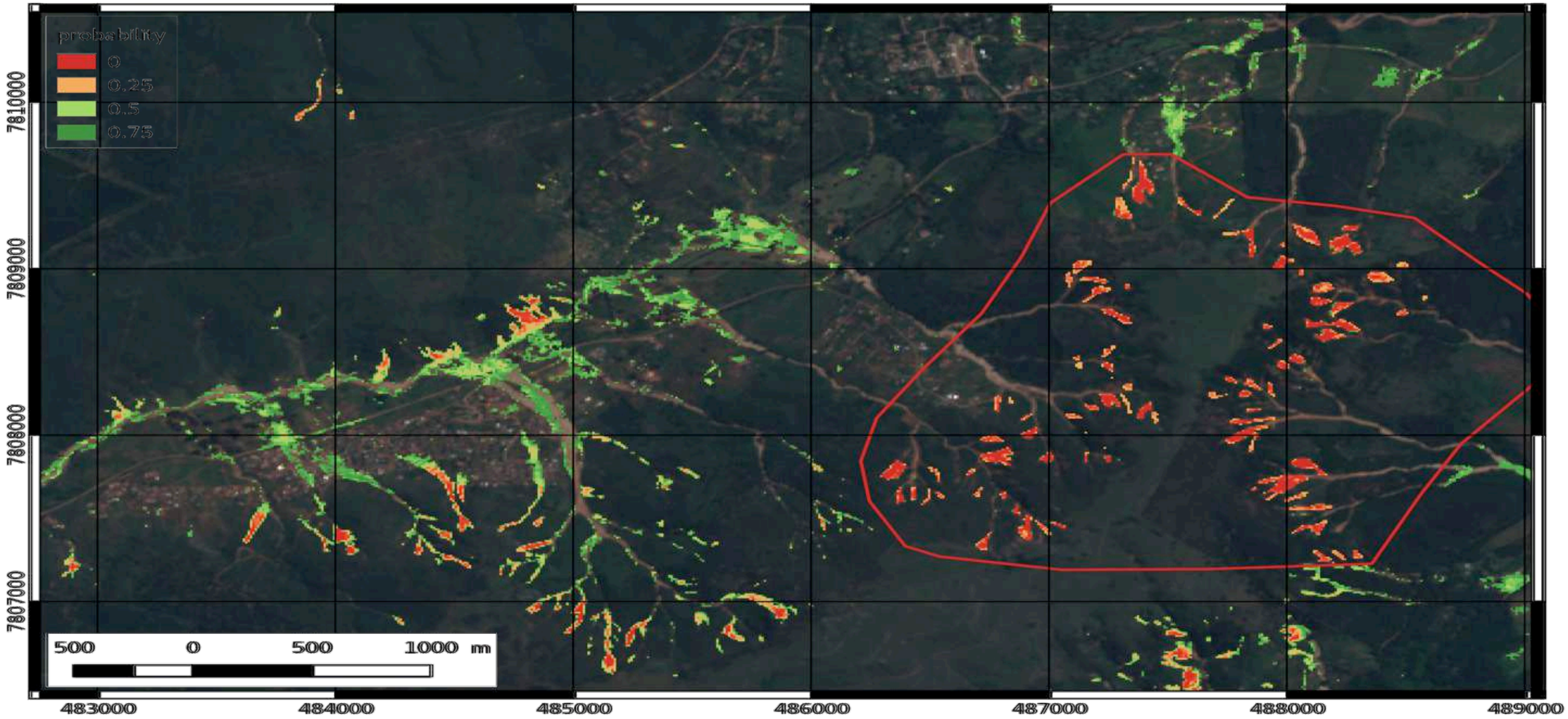
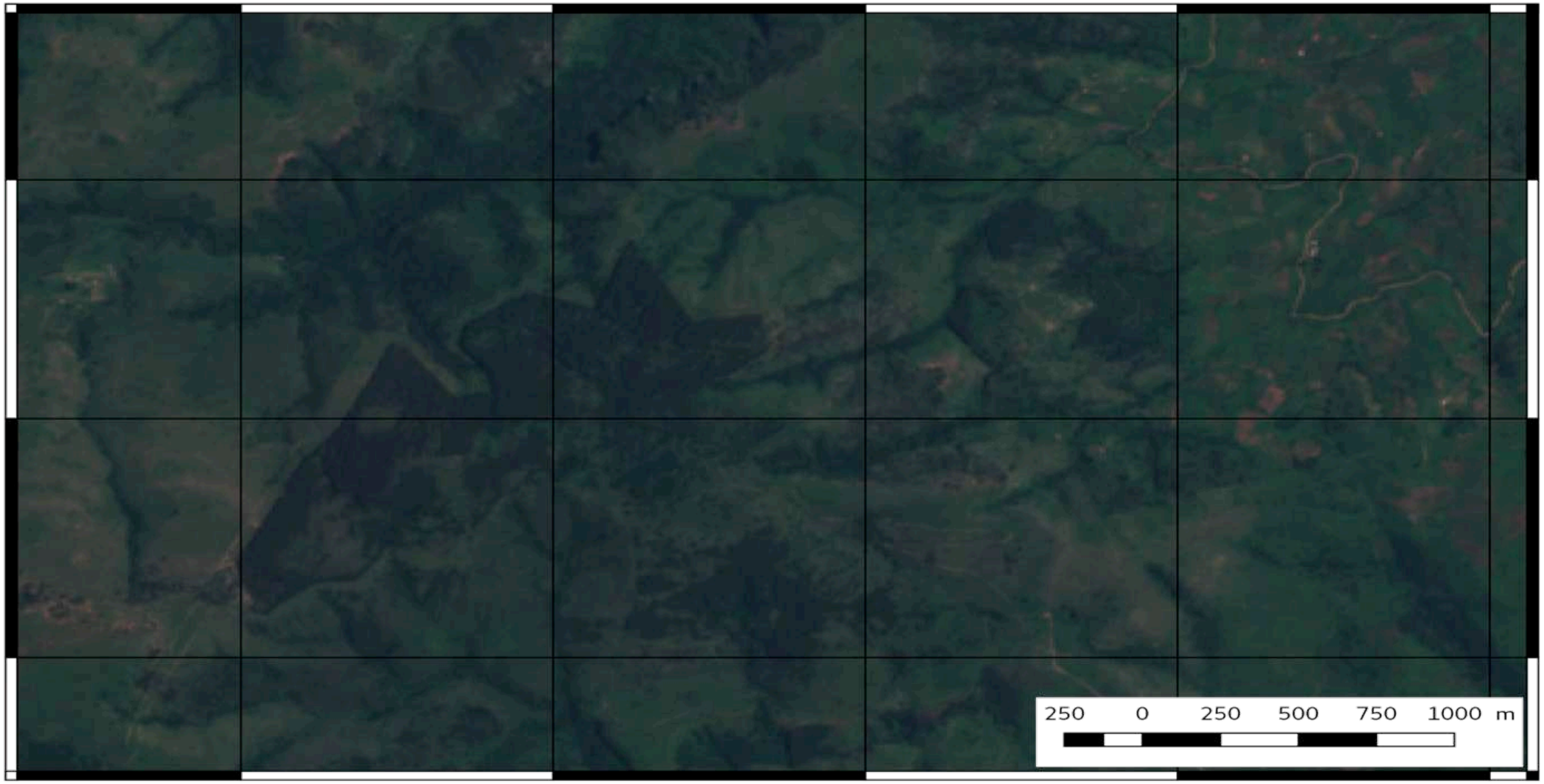


First Results: Mapping of landslides after cyclone Idai. Mozambique, 03/2019

Sentinel 2 **pre-event**: 23 Feb. 2019
Zone 2, with no reference inventory



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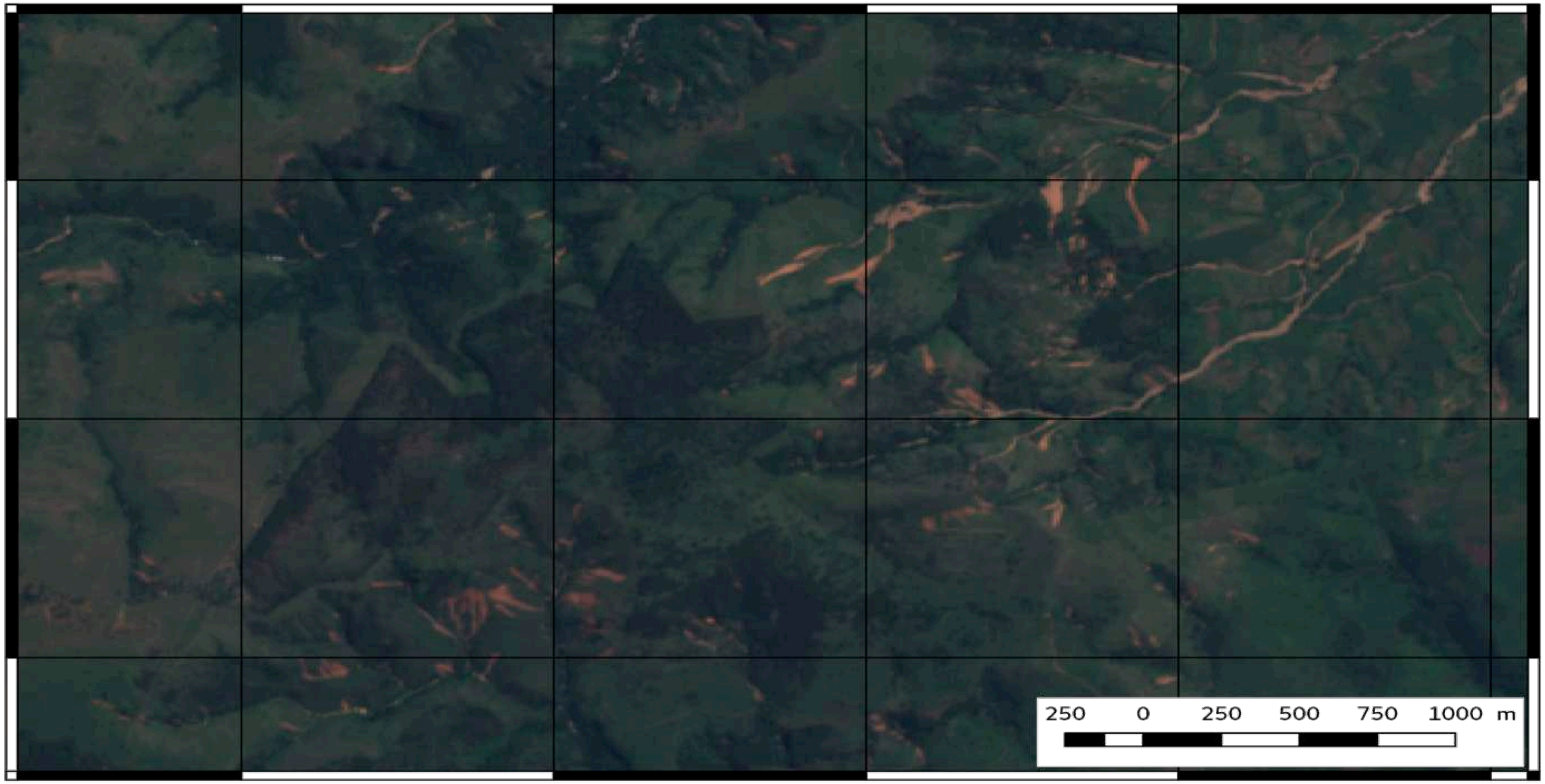
Zone 2, with no reference inventory



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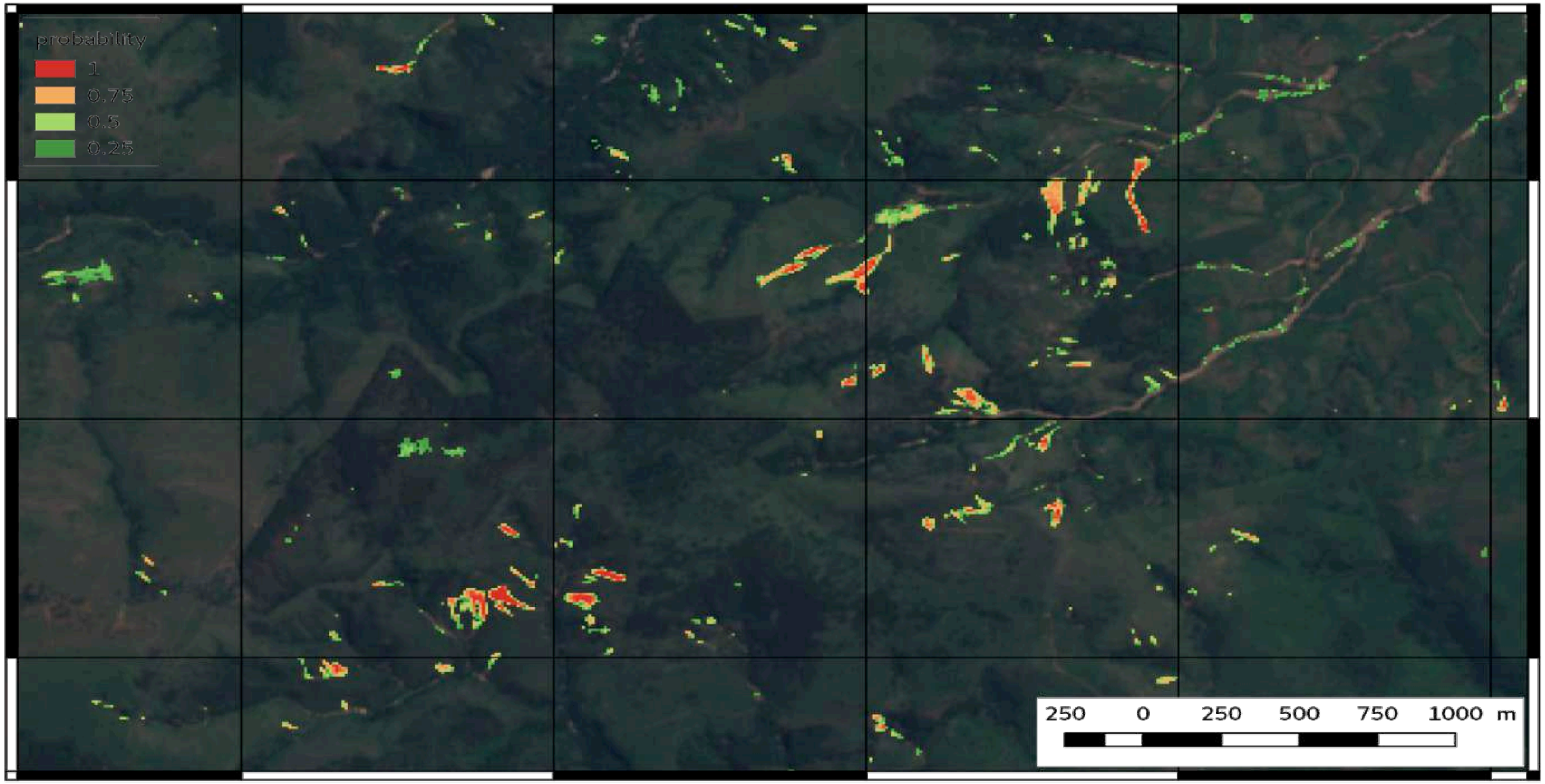
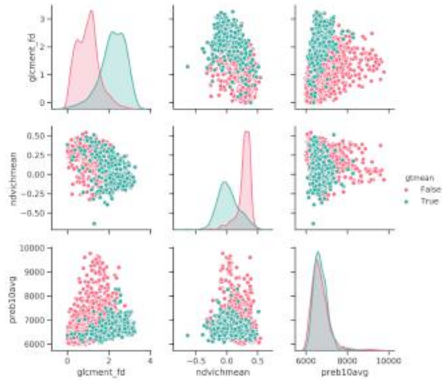
Zone 2, with no reference inventory



Optimizations & Perspectives:



- **Training set optimization:**
- Active learning implementation

- **Best selection of the attributes**
- Adding radar attributes (use of S1tiling (Koleck et al., CNES/Cesbio))
- Adding height information (from de DSM Pléiades, (S2P CNES))

- **Classifier generalisation**
- Algorithm able to classify any kind of objects, based on a reliable training sample

- **Upscaling**
- Porting the code on an high performance computer

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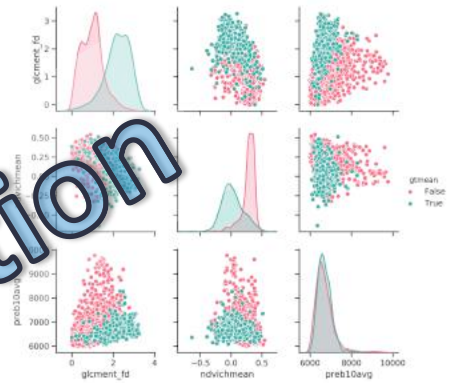

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Thanks for your attention