Committee on Earth Observation Satellites

Recovery Observatory (RO)

Haiti Hurricane Matthew RO Status and Next Steps

Presentation to WGD #10
Napoli September 5th, 2018

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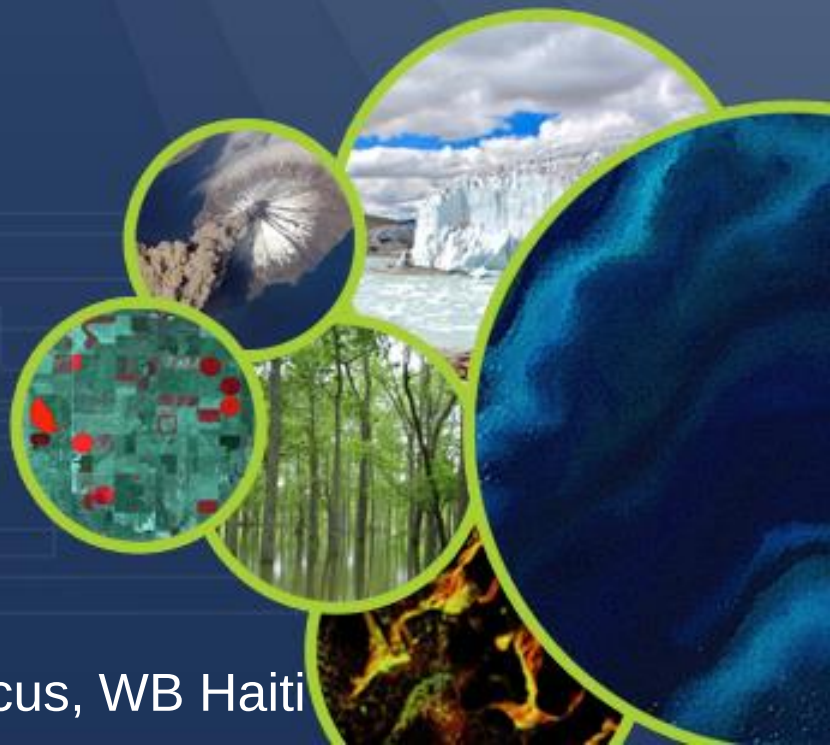
Anne Puissant, LIVE / UNISTRA
Giorgio Boni, CIMA
Andrew Eddy, RO Secretary
with contributions of NASA, NOAA, Copernicus, WB Haiti



Outline

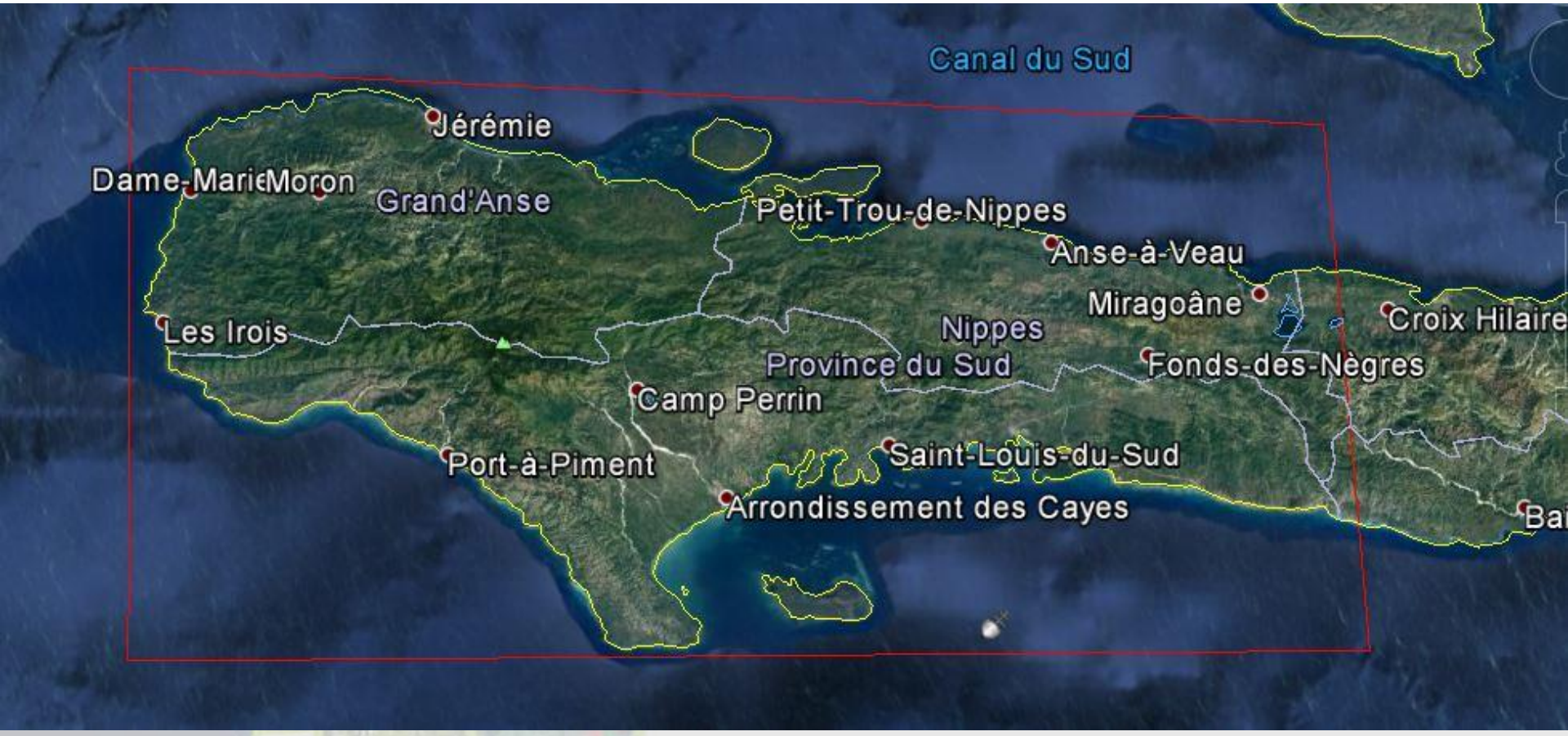
- **Haiti Recovery Observatory**
  - Key elements since WGD09
  - Mission : User Workshop #2
  - CNES activities with IRD / SERTIT
  - EOST Terrain Motion products, LIVE detect mineral extraction sites
  - DLR – TerraSAR-X contribution
  - ASI – Terrain motion products
  - Copernicus EMS R&R N50 & N51
  - Links with NASA, NOAA, WB Haiti
  - Next Steps

RO Haïti Status Overview

A Reminder of Haiti's diversity

- **Triggering of the RO by CEOS Chair - December 22, 2016**
- **Mission #1 to Haiti - end January 2017** Definition of activities in Haiti
- **Mission #2 to Haiti 29 May – 2 June 2017** 1st RO users workshop
- **Mission #3 to Haiti 5 Dec - 8 Dec 2017** technical review , link universities
- **Mission #4 to Haiti 8 – 11 Mai 2018** - 2nd User Workshop (PàP + Les Cayes)

Haiti RO covers three departments: Grand'Anse, Sud, and Nippes



Key elements since WGD mtg #9 -1

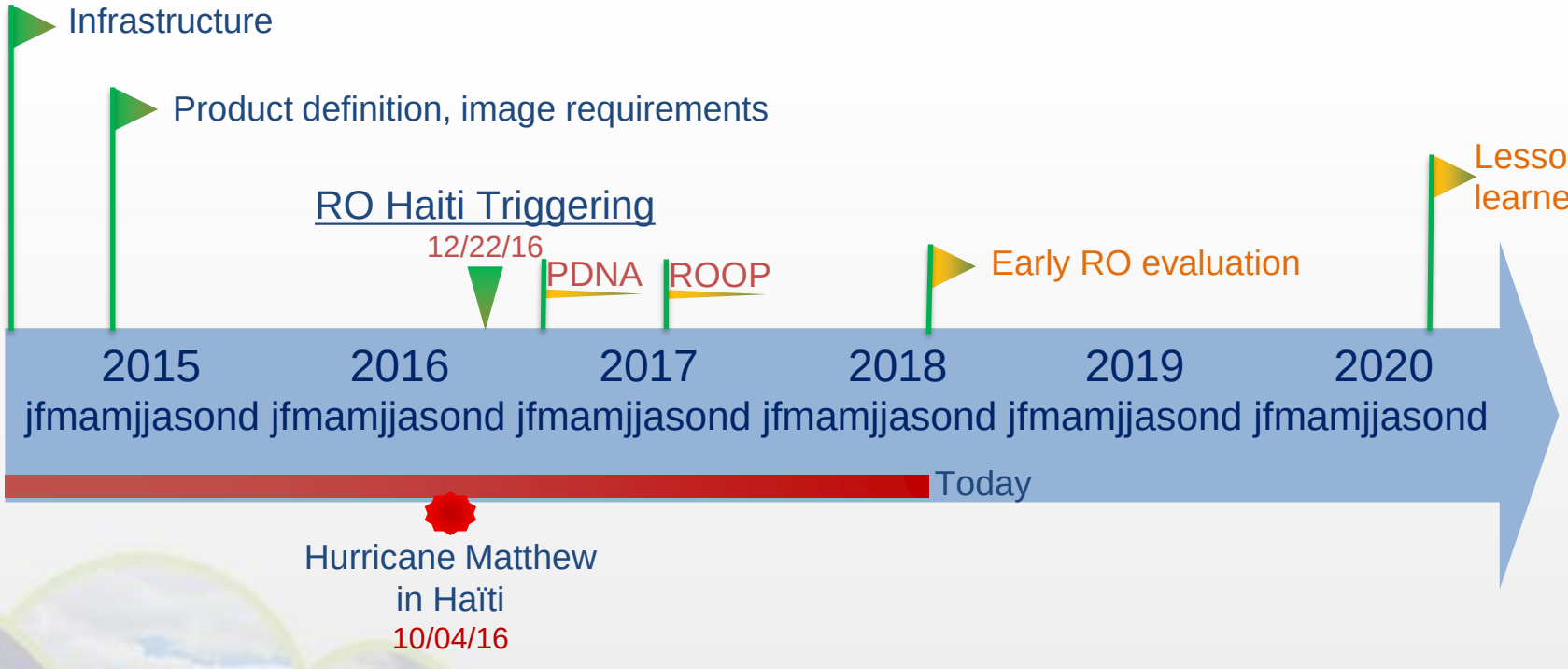
- Finalization of the **CNES / CNIGS MOU** (on going signatures)
- Continued **engagement of space agencies** (ASI, CNES, DLR, ESA, NASA, NOAA
- Activation of the **Copernicus Risk and Recovery** Service by the Delegation of the European Union to Haiti
- Drafting by Haitian partners of a **Capacity Development Plan**
- Writing the **Thematic Product Development Plan**
- A week of **mission in Haiti** with **two user workshops**: user feedback, new needs, cap building
- Holding the **CD # 3**
- Special session at **UR2018 Mexico**
- Coordination meetings with **UNOSAT, WG CapD**
- Proposal to **LPS2019**
- Working on a super site CEOS / GEO proposal in geophysical hazards / landslide

RO Thematic Products

Produit	Utilisateur-clef	Elaboration	Données satellites
Buildings	CIAT/ Planning Ministry	SERTIT, Copernicus EMS	Pléiades, WV
Land Use	ALL	CNIGS/CNES	Orthophotos, Sentinel-2
Forest	ONEV /Environnement Ministry	Copernicus EMS	S2, Spot6/7, Optique THR
Agriculture	Agriculture Ministry	Copernicus EMS	Sentinel-2, SPOT
Macaya Park Monitoring	ANAP / ONEV / Env. Min.	Copernicus EMS SERTIT	Optical THR, radar THR
Watershed / Flood	ONEV/ Agriculture Ministry	CIMA Foundation	MNT 1m/20cm and radar THR
Terrain Motion / Mining quarries	BME / Public Work Ministry	EOST, ASI	CSK, Pléiades, Spot6/7
Vector Borne Disease risk	Heath Minister/ OMS	NOAA	L8, Images NOAA + statistic needs
Air pollution	ONEV / Ministère Santé	NASA	S5P Tropomi Interest pronounced

+ some new precise needs
(more after on different thematics)

RO Timeline



Malawi, Nepal Demonstrators

Missions to Haiti (2 to 3 per year)

External Mission

Technical Review
5-8 Dec

1st
31 Jan – 3 Feb

1st User Workshop
29 May – 2 June

2nd User Workshop
8 – 11 May

Generic RO
WB + UNDP DC

Mission : User Workshop #2

First Workshop « local users » Les Cayes – 8 mai 2018

- About Thirty participants, including :
  - The Major of Jérémie
  - Les Cayes councils
  - American University of les Cayes
  - MARNDR (Agriculture ministry)
  - MDE/ONEV (Environment ministry)
  - PADF (Pan American Devlpt Found.)
  - ONU-Habitat
  - ONG Global

The Mayor of Jérémie during the workshop

- First analysis of products
- Awareness of project objectives
- Clear involvement of local actors in support of the project
- Identification of training needs and capacity development

Mission : User Workshop #2

Second Workshop at Port au Prince – 10-11 mai 2018

- About Thirty participants, including :
  - Minister of Planning : Fleurant AVIOL
  - CIAT, CNIGS, BME, ….
  - MDE/ONEV
  - UNDP, UNEP, UE, BID, …
  - National Scientific Committee on Risks
  - …..
- Reaffirmation of project support:
  Min Planning, PNUD and CIAT directors
- 1ère analyse de produits
- Update on all topics
- Identification of training needs and capacity development
- Confirmation of priority areas
- Identification of new product tracks – vector borne diseases risk, coral reefs, air pollution, anthropogenic impact on Macaya, non aedificandi areas monitoring
  - **3rd Steering Committee** held after the workshop

Introduction by the Minister of Planning

Side Event UR2018 – May, 15

Speakers :

- Haitian Civil Protection (Charte application announcement)
- World Bank
- UNDP
- European Commission (Copernicus Emergency)
- CNES
- CNIGS
- CIMA (ASI)

- **Forty listeners**
- **Strong audience interest (RO replicability issues)**
- **Reinforced links with WB, GFDRR teams working on Haiti**
- **RO contribution to two other side events (WGD, WB / Insurance)**
- **Generic RO Working meeting with WB / GDRR :**
  decision of G-RO White Paper CNES-WB-UN-EU, with WB peer review

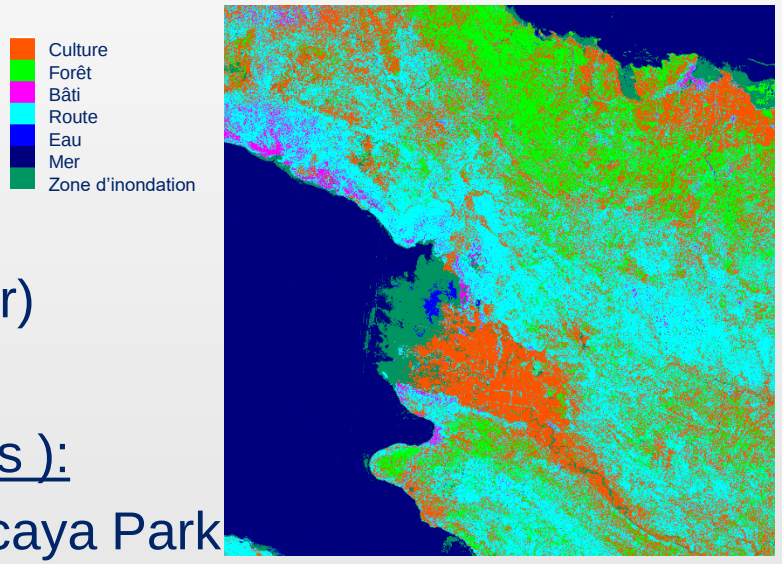
CNES Activities with IRD, SERTIT

- Internship CNES (April-September 2018)
  Adaptation of IOTA2 chain on Haiti for land use with S2

  Context : No land use map since 98 … 2014 in progress

  Data preparation procedure under development; will be exchanged with CNIGS. The goal is to go as far as possible with the limited data available.

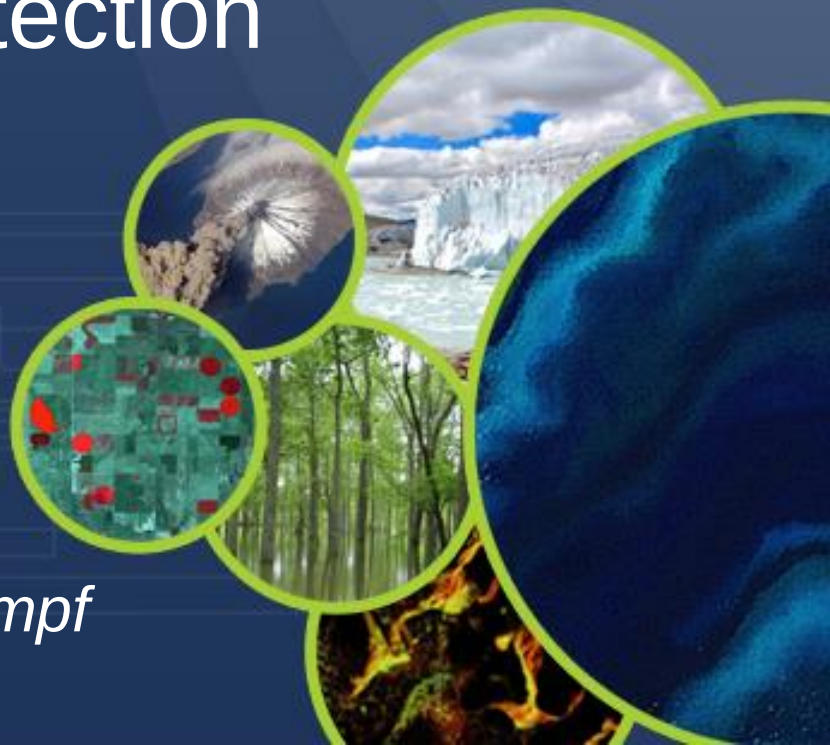
- Internship CNES/IRD
  Update of the Territorial Diagnosis of the RO Area.
  By an Haitian academic at IRD (Montpellier)



- SERTIT activities on going (Feasibility tests):
  - Monitoring Anthropogenic impact : Macaya Park
  - Non-aedificandi areas Monitoring Port Salut (non housing area)
  - Monitoring UNEP protected areas

Recovery bservatory Haïti

Automatic Landslide Detection and Mapping from VHRO images

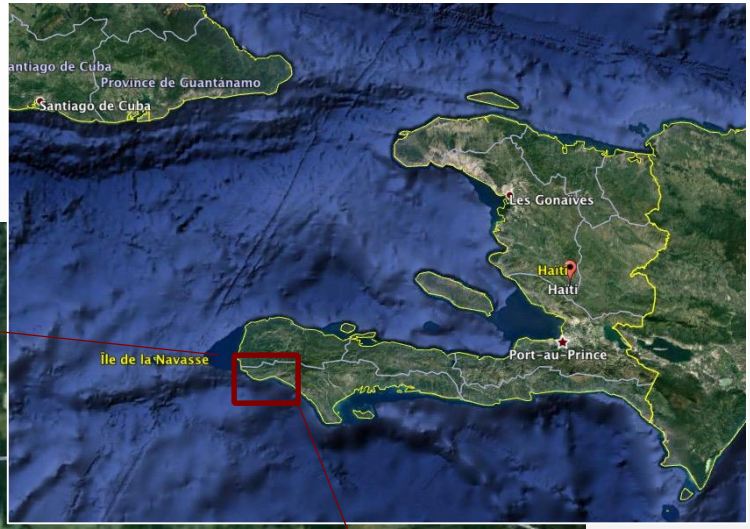


CNRS-EOST

E. Stell, J.-P. Malet, O. Marc, A. Stumpf

Post-hurricane landslide detection and mapping: Haiti

Haiti – Les Anglais Cordillera



Post-hurricane landslide detection and mapping: Haiti

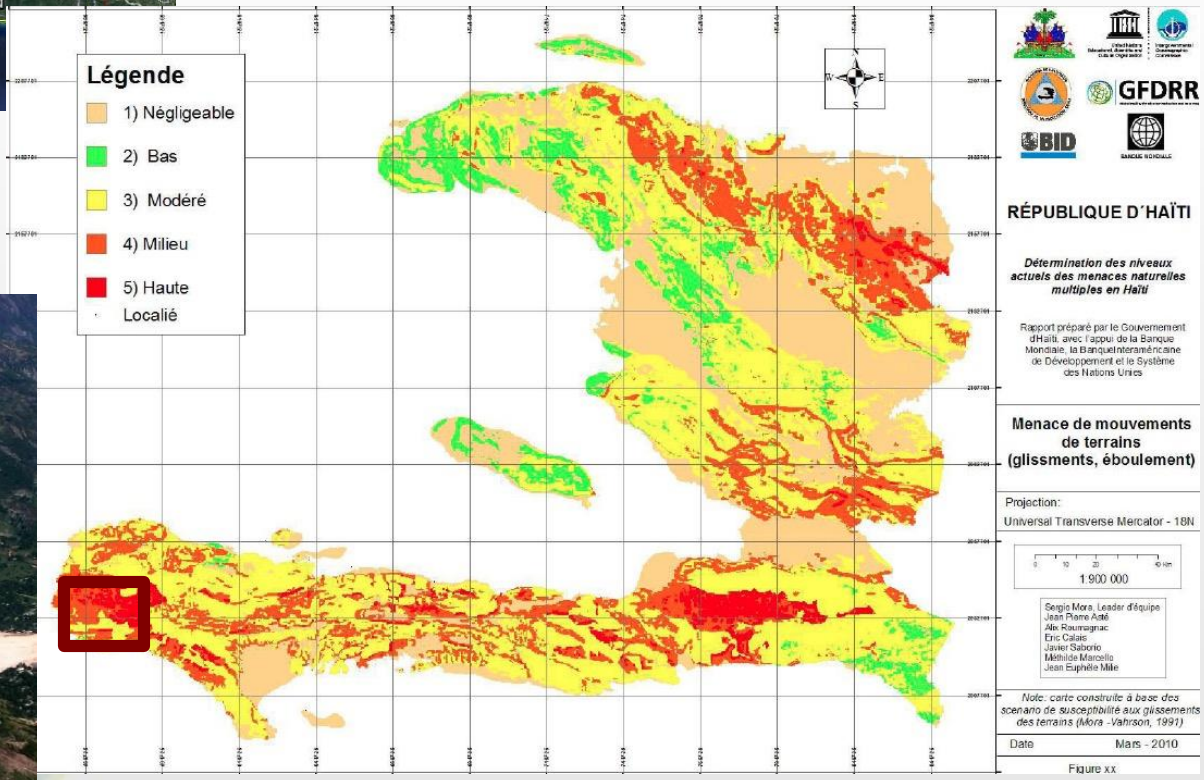
First landslide susceptibility map for the country

Topogragy = first driver of landsliding

Map created without landslide information

Landscape after Matthews

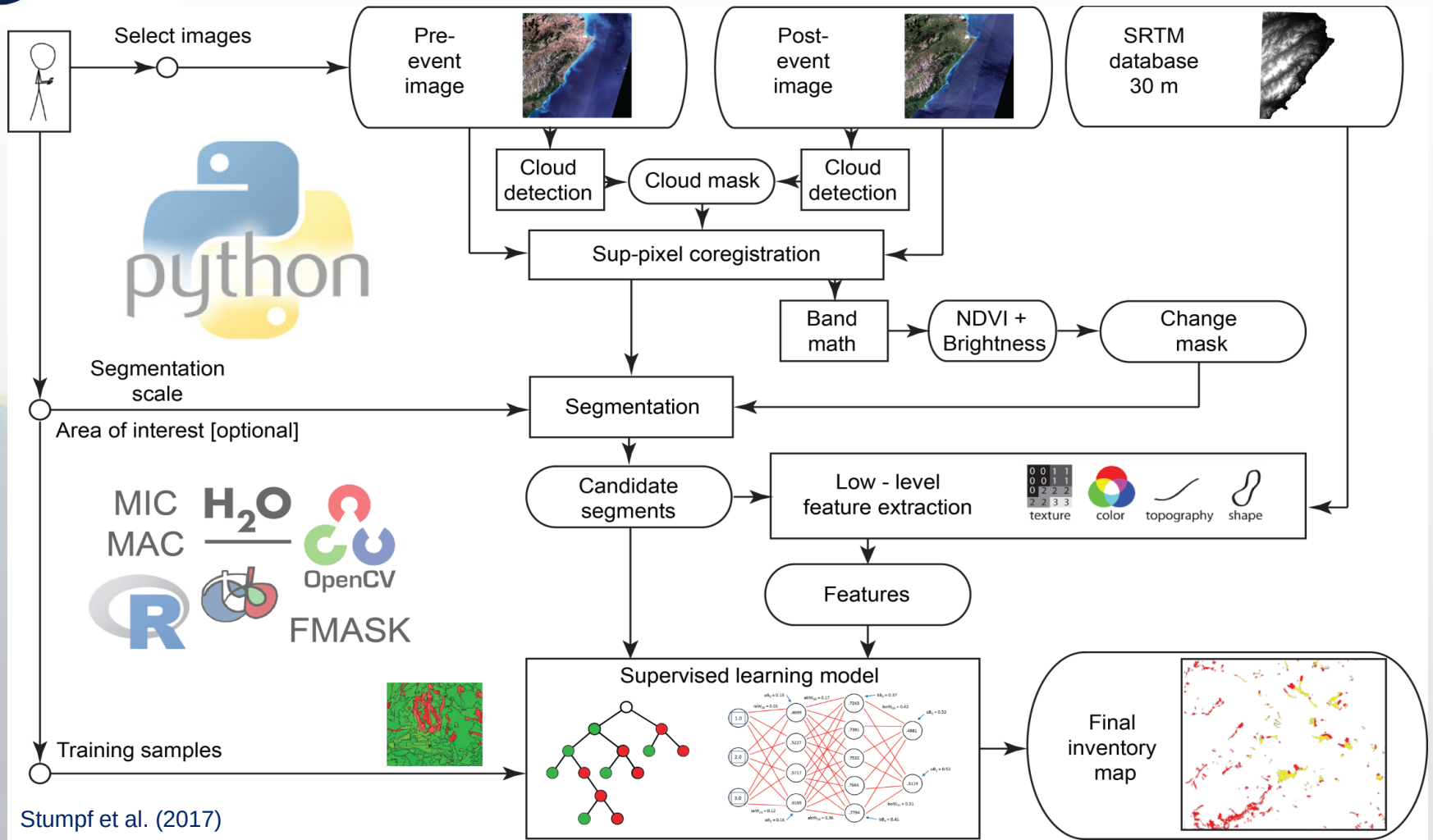
Major rain events



Landslide mapping using medium-resolution Sentinel-2 Optical Data

ALADIM: Automated Landslide Detection and Inventory Mapping

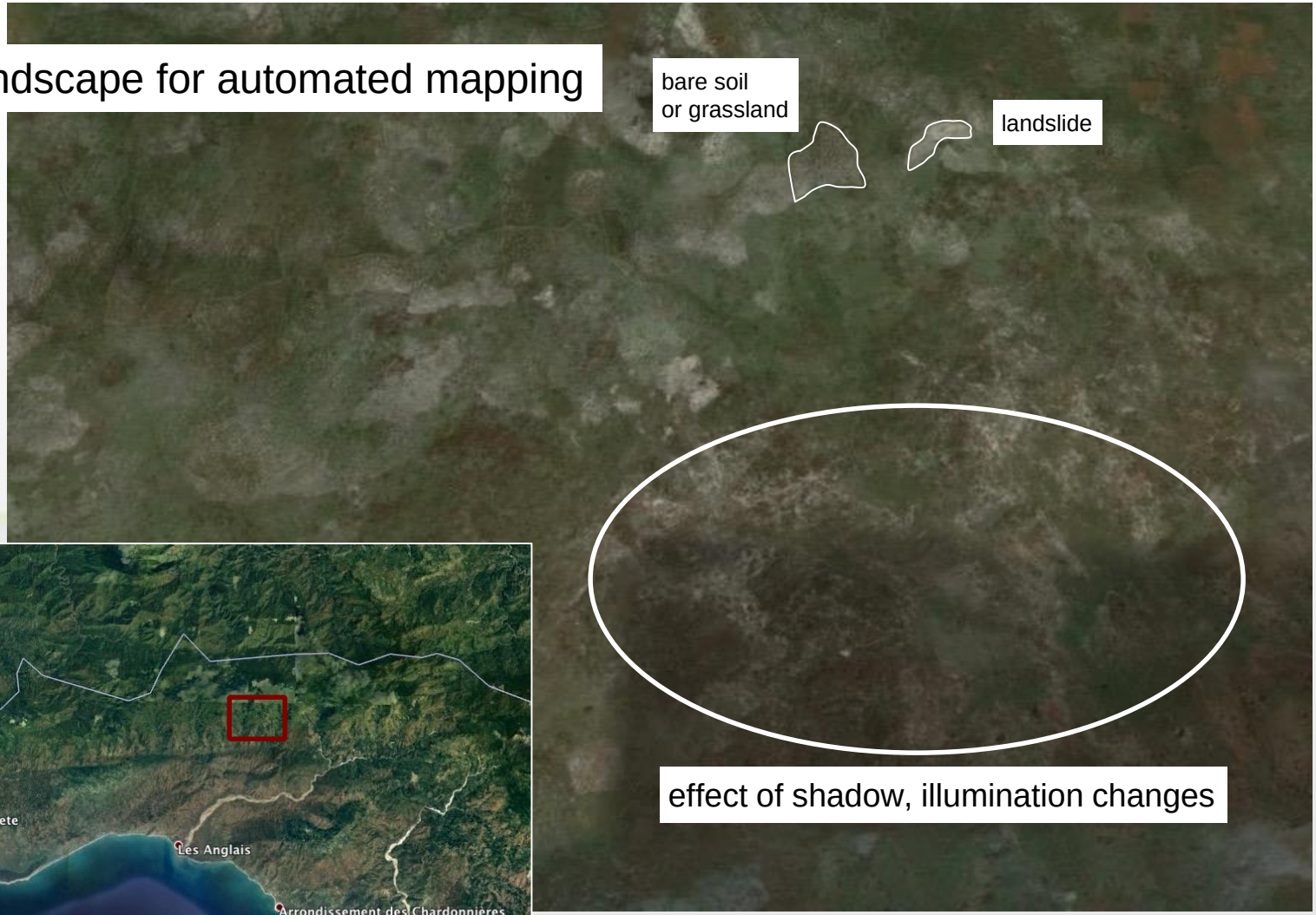
Image sources: S2 + VHRO ortho-images
Supervised method - Selection of image features – Random Forest classifier
HPC + cloud-based implementation (through dockerisation)



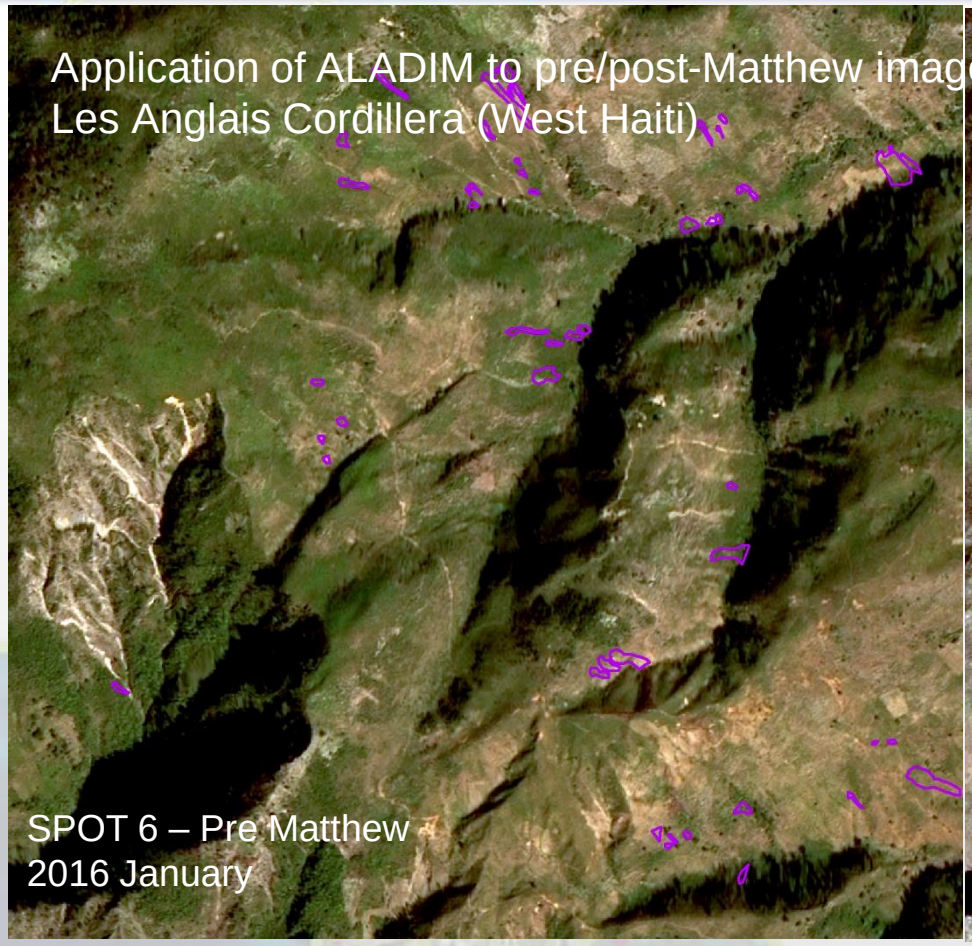
Stumpf et al. (2017)

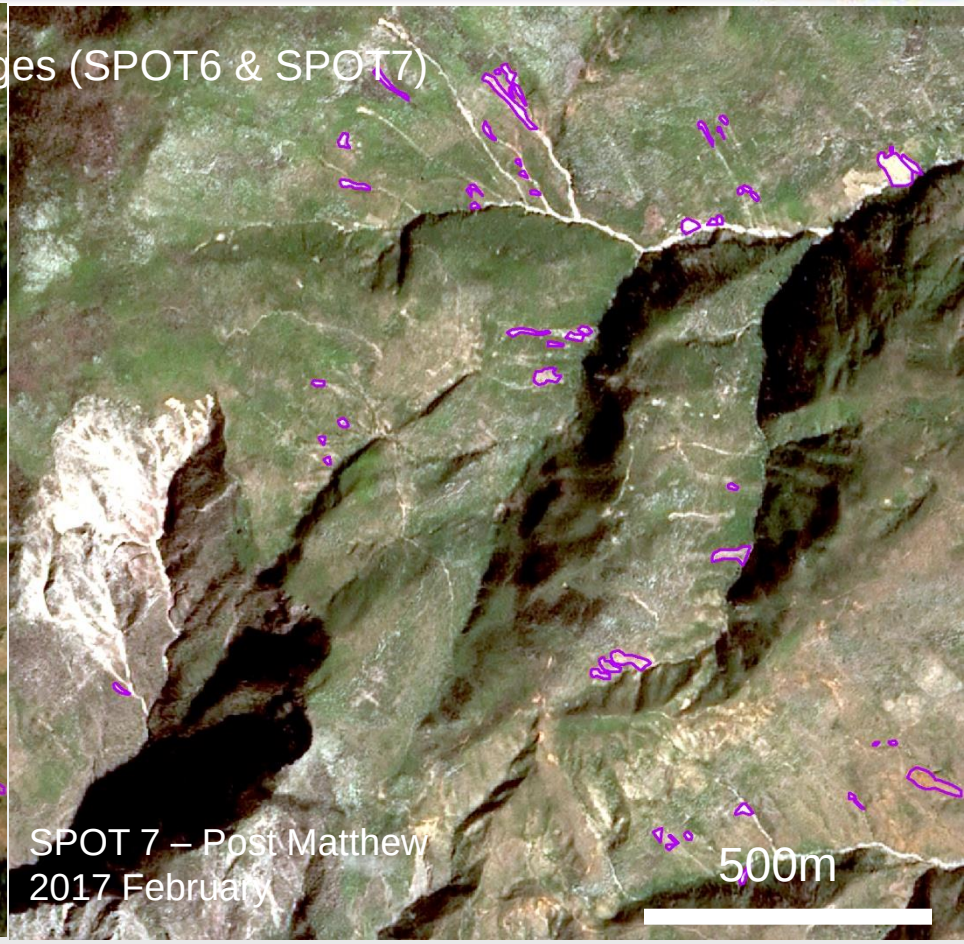
Post-hurricane landslide detection and mapping: Haiti

Complex landscape for automated mapping



Post-hurricane landslide detection and mapping: Haiti



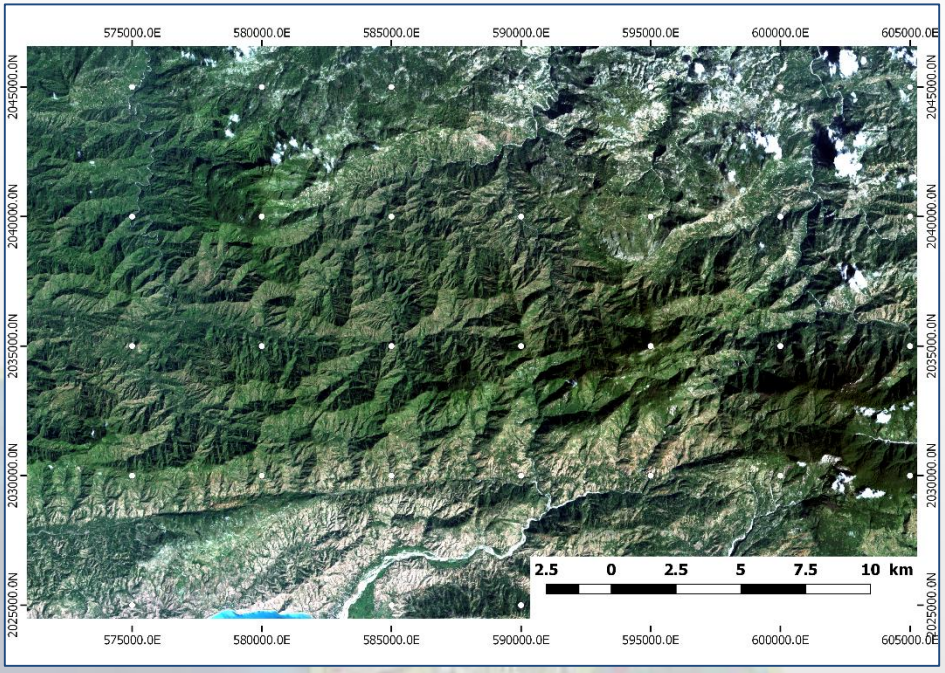


Channel deposits are difficult to map (they may add ~30% of affected areas)
Shadows on West and North slopes may cause underestimation of the total landsliding
Many bare soils …. Difficult for automated mapping

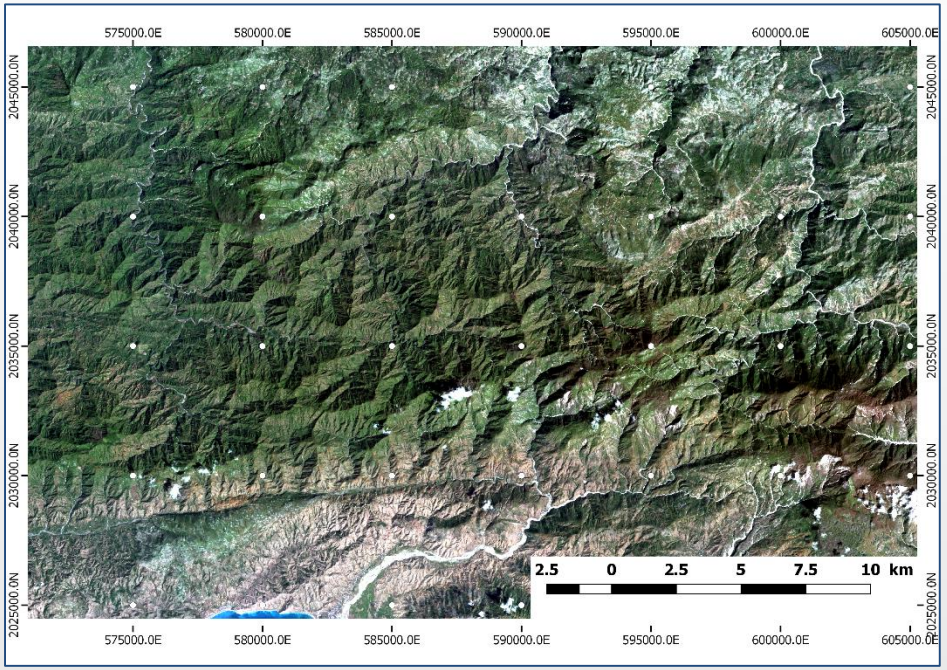
Marc et al. (2017)

Post-hurricane landslide detection and mapping: Haiti

Spot 6 pre-event 2016/04/14 (1.5m)



Spot 7 post-event 2017/04/04 (1.5m)



Post-hurricane landslide detection and mapping: Haiti

Experiments on different parameters were run in order to obtain the 'best' results

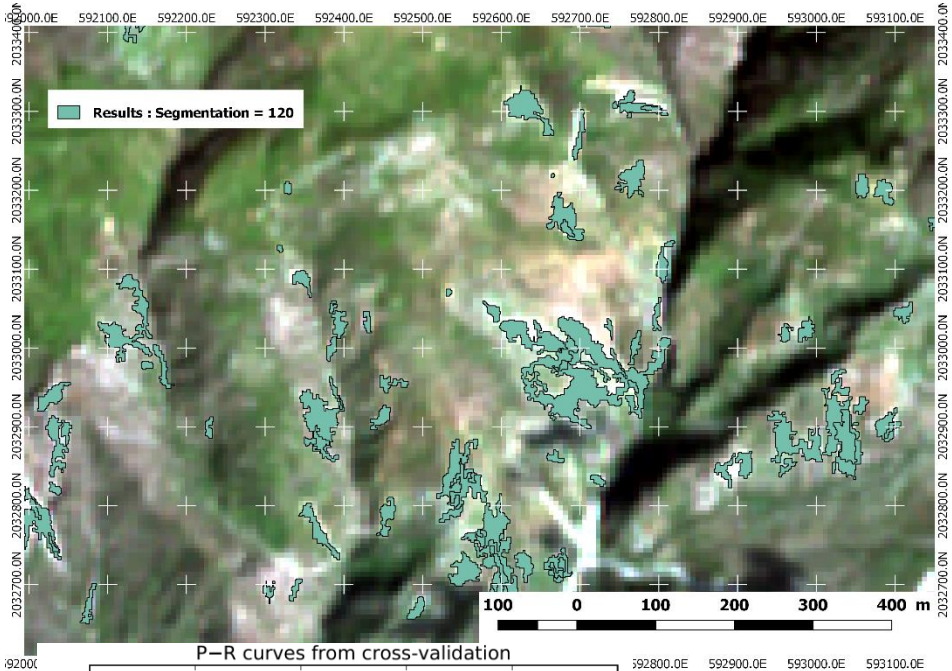
- **Segmentation** : The segmentation scale factor. Larger values will result in fewer larger segments and faster processing. Smaller values will result in more small segments which will increase the processing time but also typically the accuracy of the classification. The value depends a lot on the value range of the input imagery and the landscape characteristics. Settings tested : 20 / 60 / 120 / 200.

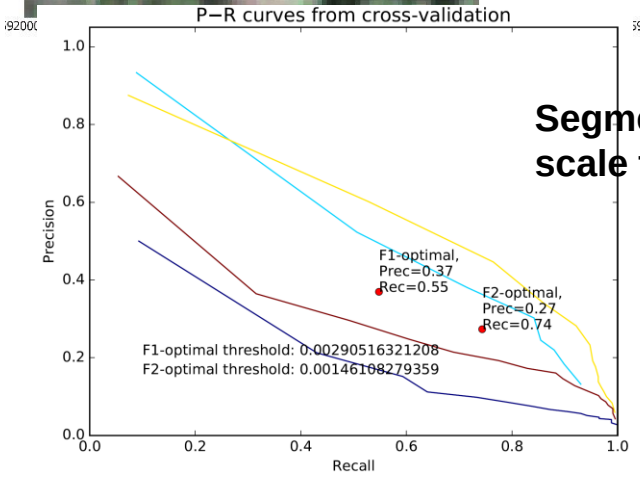
- **Training areas** : Area(s) mapped by the user, containing the training samples. Improve the diversity of the mapped landslides to improve landslide detection. Question: is it necessary to map a lot of landslides before running ALADIM ?
  Settings tested: 20 / 10 / 5 / 1 areas.

- **Positive Threshold** : A value between 0 and 1. If the fraction of positive area (i.e. landslide as mapped in the training samples) within a segment exceeds this value it is considered as a positive example. Different settings : 0.25 / 0.50 / 0.75.

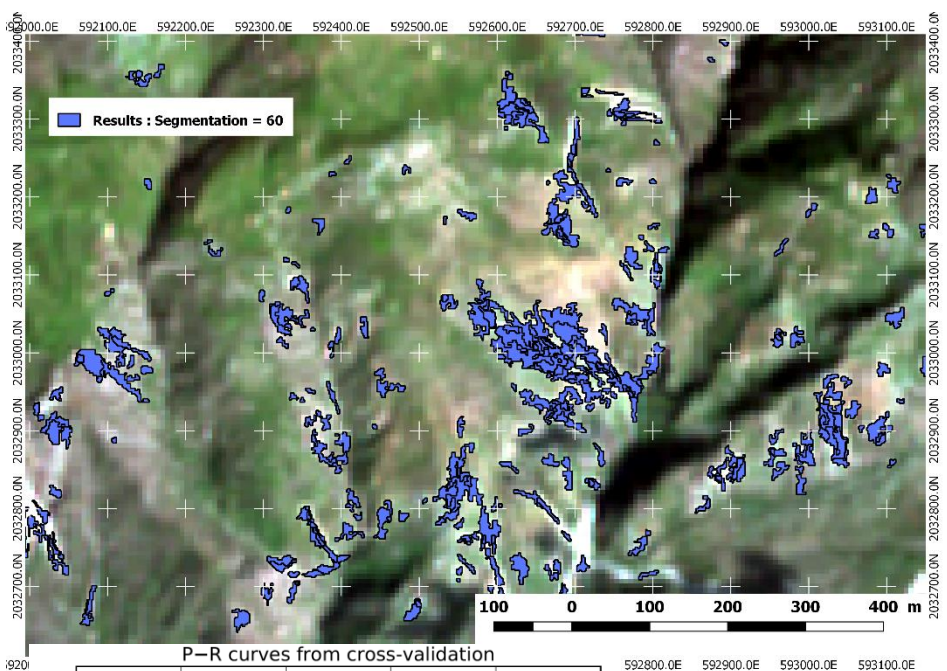
Post-hurricane landslide detection and mapping: Haiti

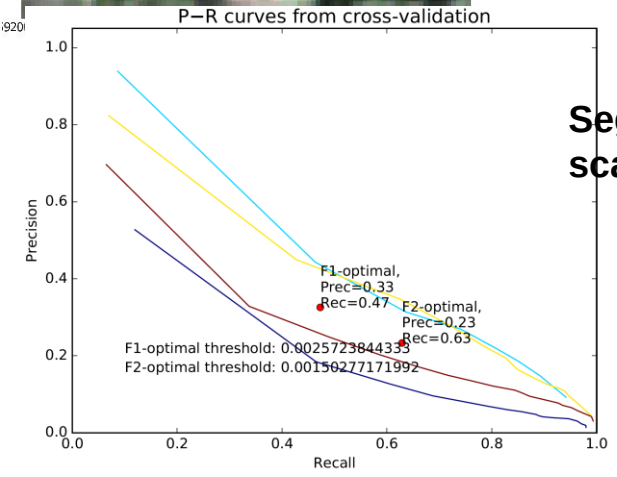
Effect of segmentation: → better results for a coarse segmentation





Segmentation: scale factor 120

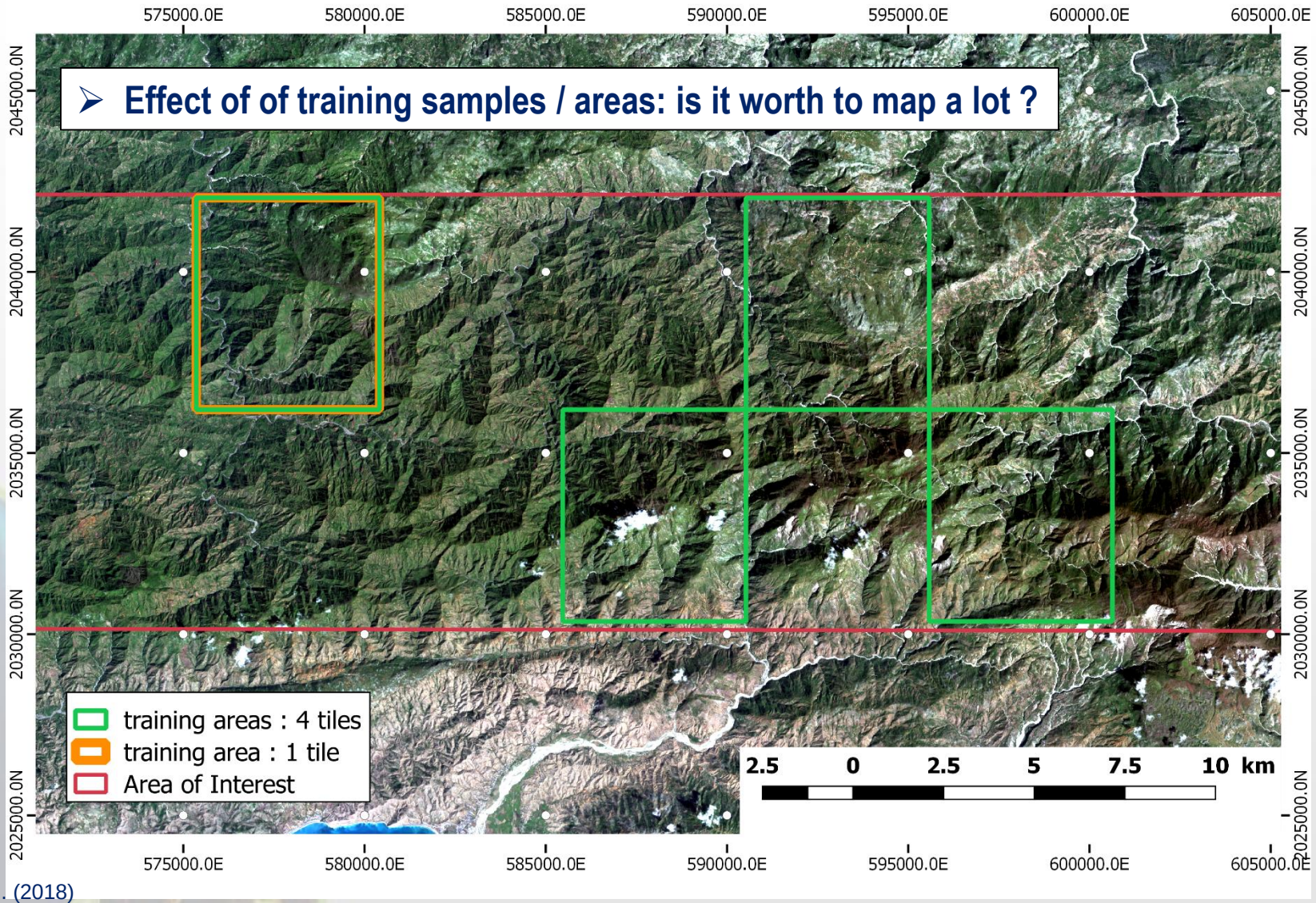




Segmentation: scale factor 60

Stell et al. (2018)

Post-hurricane landslide detection and mapping: Haiti



Stell et al. (2018)

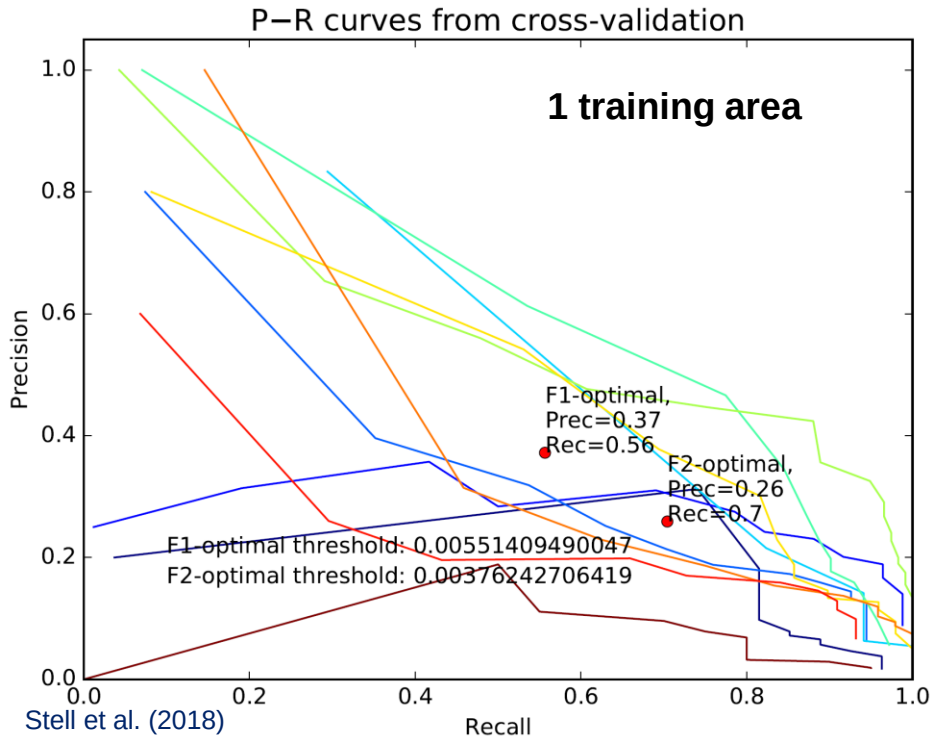
Post-hurricane landslide detection and mapping: Haiti

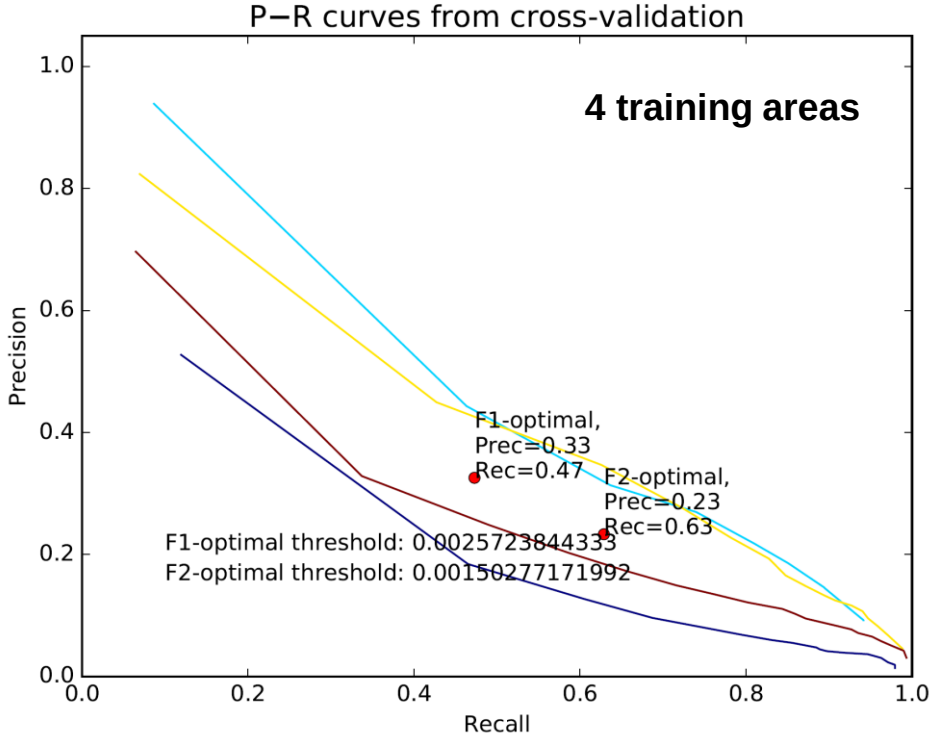
- **Effect of of training samples / areas: is it worth to map a lot ?**

Many landslides need to be mappes and integrated in the training sample because

- of the complexity of the landscape (many anthropogenic activities, mining + agricultural fields)
- of the small size of the landslides (shallow and small)
- of the specificities of the images with a ot of shadows

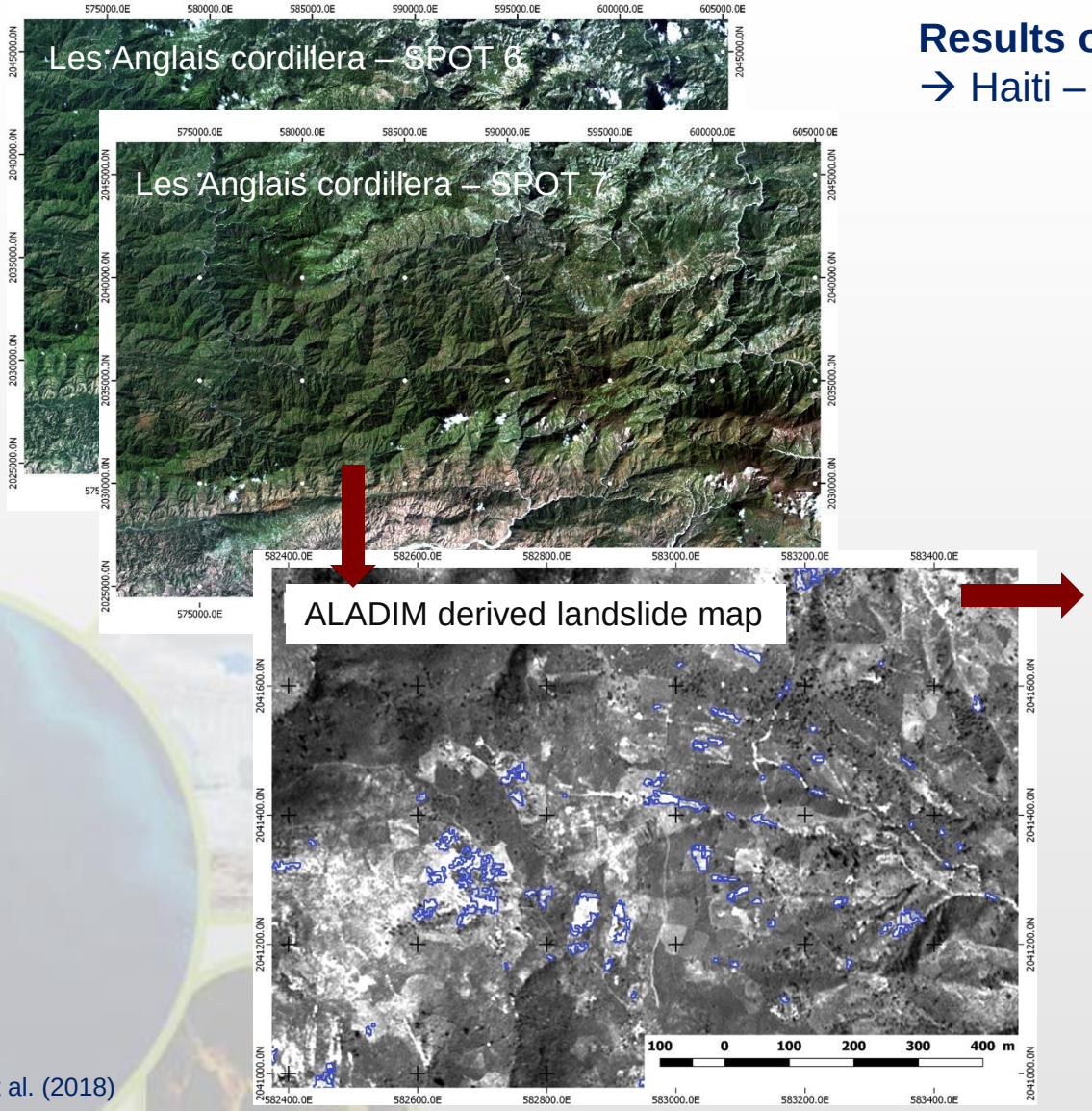
→ better results with 4 training areas and better results if hgh resolution topography is integrated





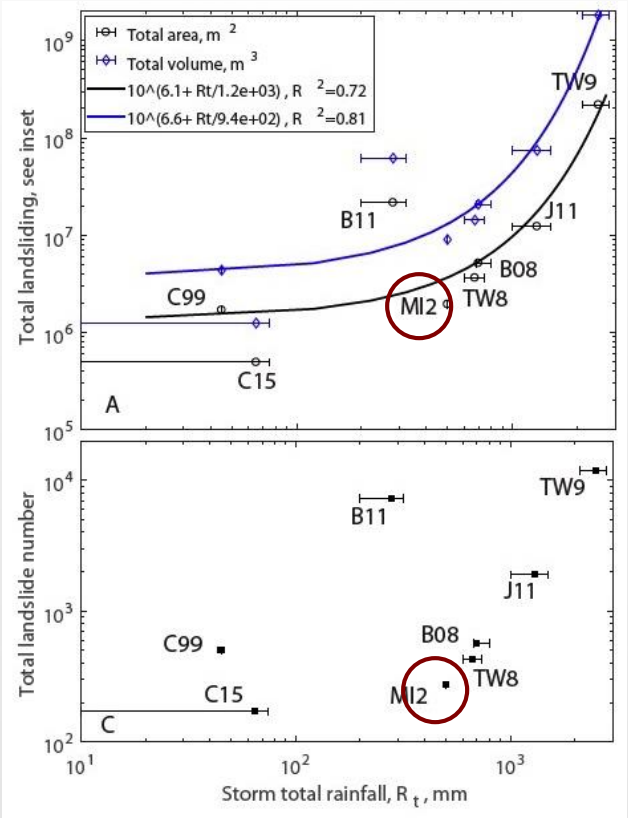
Stell et al. (2018)

Post-hurricane landslide detection and mapping: Haiti



Results of ALADIM-Caribbean:
→ Haiti – post-Matthews landslides

Landslide statistics and relation to triggers for several recent Hurricanes/Cyclons



Stell et al. (2018)

Further work

1. Develop Active Learning (AL) strategies for optimizing the creation of the training sample

→ projet IM-CLASS (post-doc appli) funded by CNES (*A. Deprez*)

2. Mask non-possible landslide areas before the classification

→ geological and topographic filtering

→ landcover filtering

3. Generalize the approach to the complete RO area

→ projet IDEX (post-doc) funded by Univ. Strasbourg (*S. Nakostian*)

4. Possibly test on new images after new landsliding events → EO-based landslide observatory over Haiti (links with GeoHazard Lab, with Landslide Pilot, etc)

Potentialities of Pléiades imagery to detect mineral extraction sites (quarrying, mining) in tropical environments

Anne Puissant

with the contribution of L. Schwaab

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Department of Geography
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Committee on Earth Observation Satellites

ROI: area with intense & non-regulated mineral extraction sites

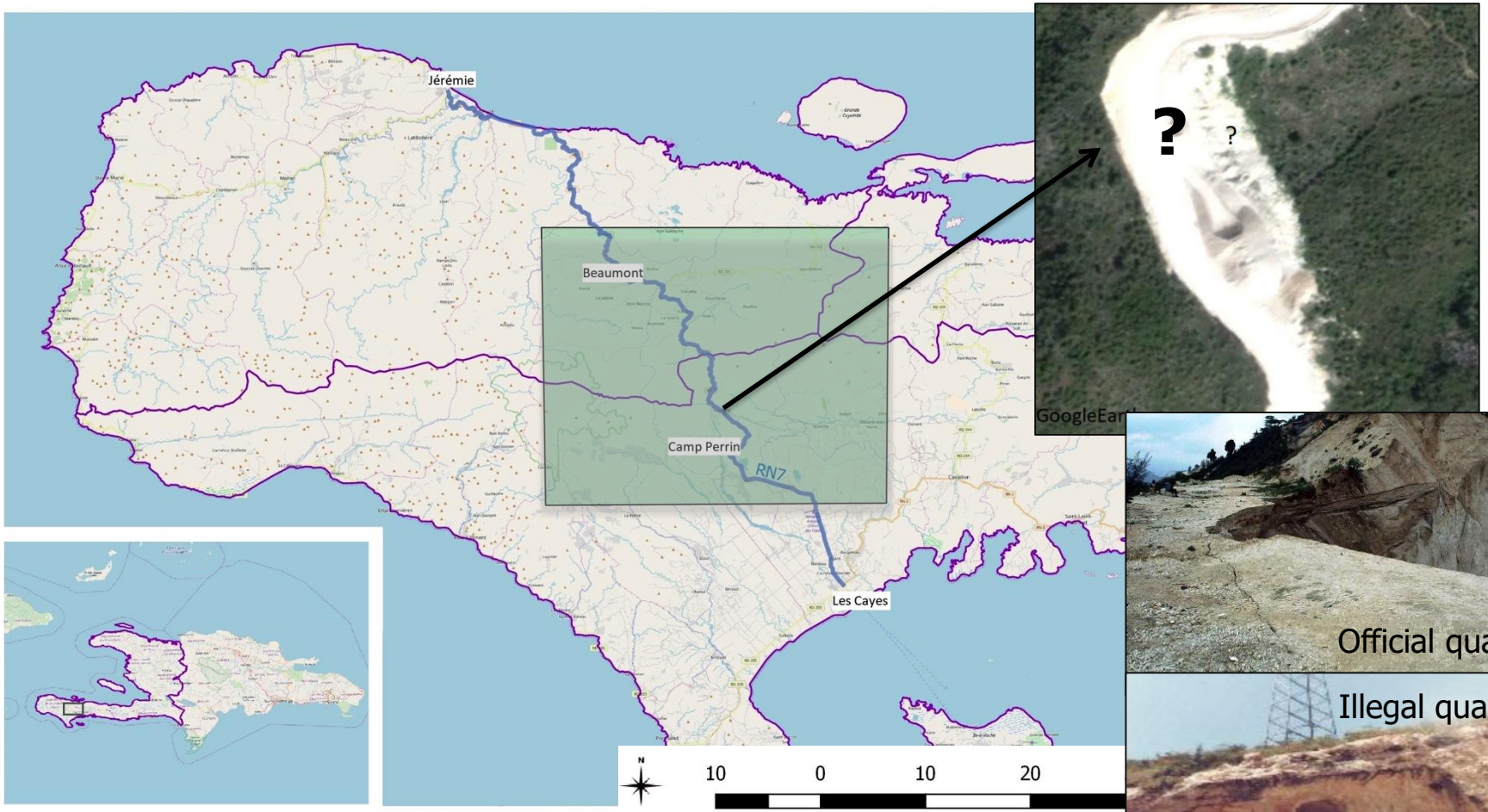
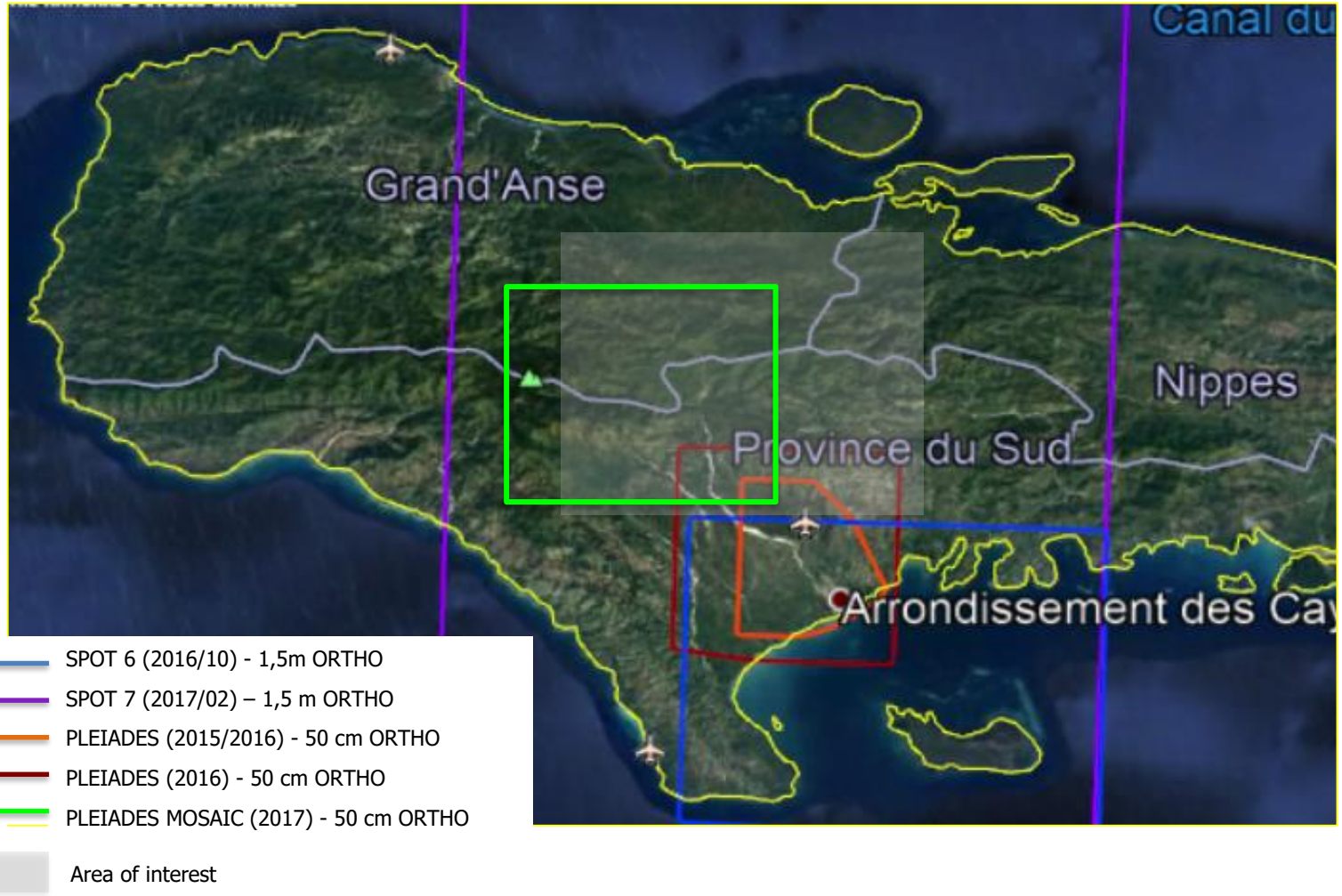
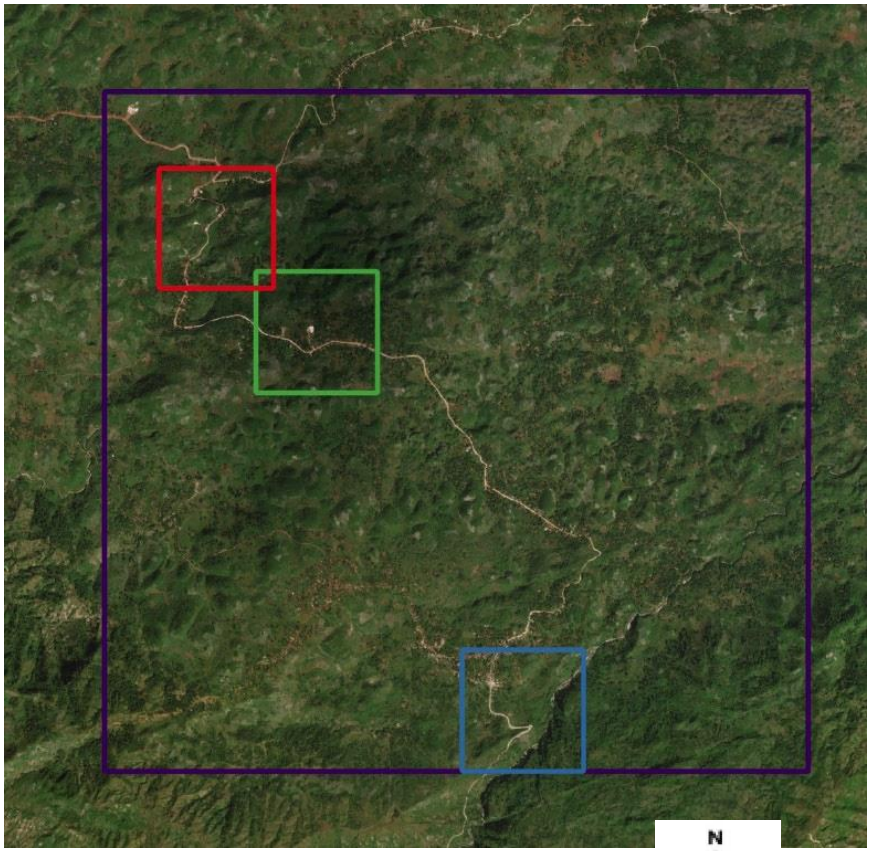


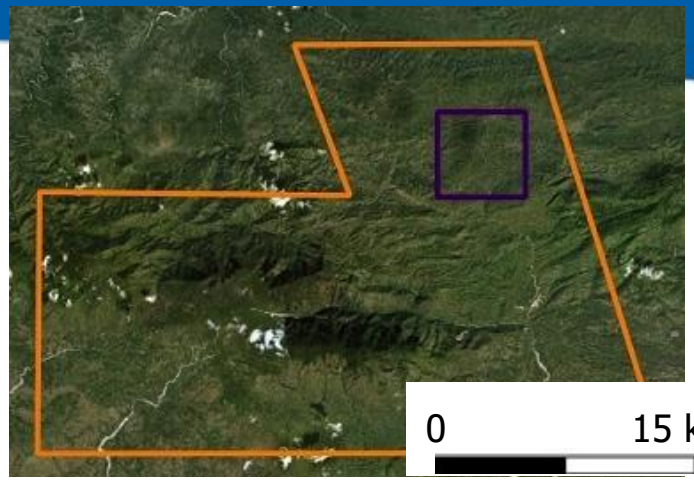
Image dataset (SPOT / PLEIADES)



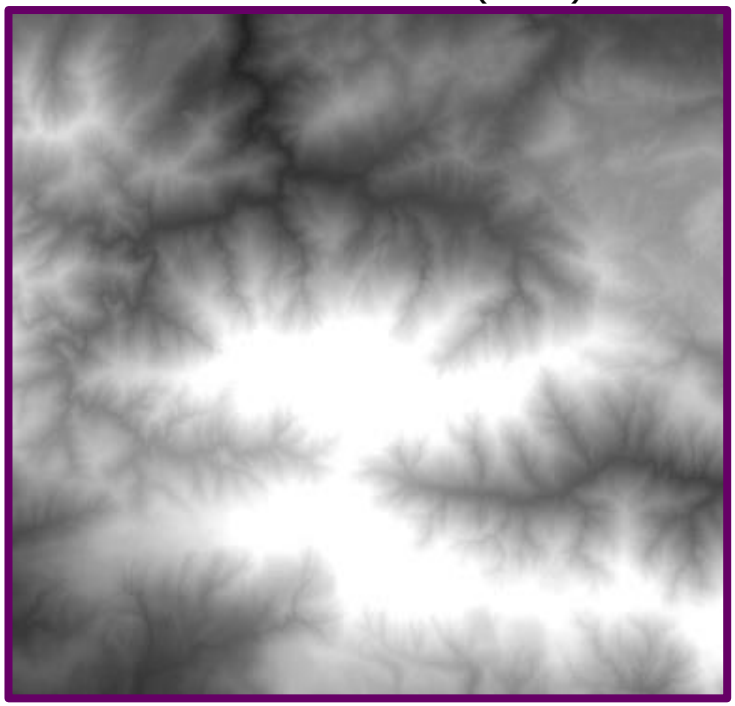
Test areas



PLEIADES (2017) - 50 cm P+MS ORTHO

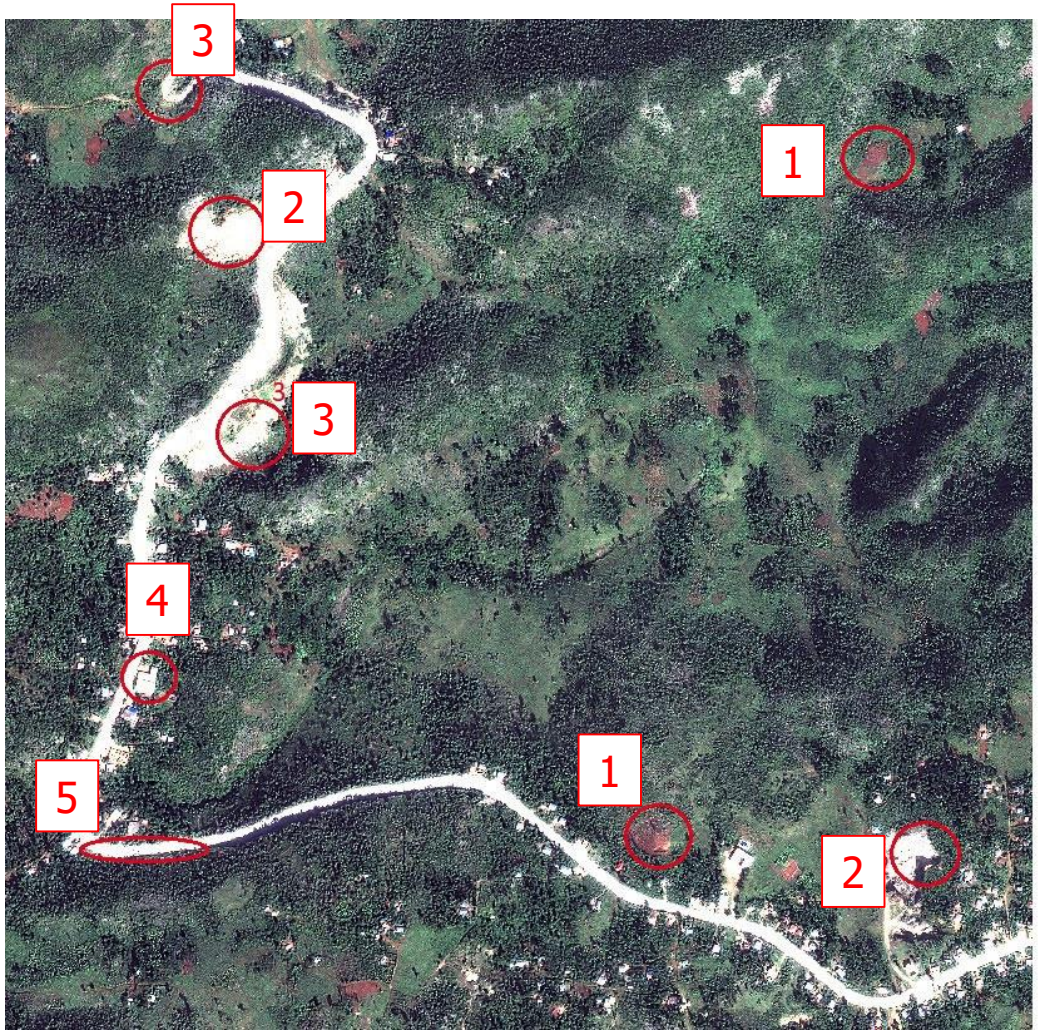


MOSAIC PLEIADES (2017) - 50 cm ORTHO



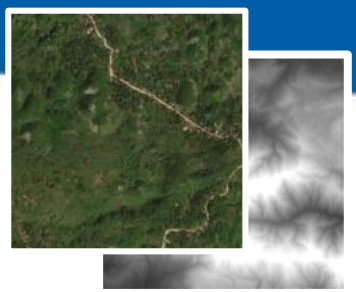
LiDAR DSM (2014 - 1,5m)

Definition of landcover classes



1. Bared soils (red soils, e.g laterite)
2. Mineral extraction surfaces
3. Other mineral surfaces (limestone) (possible mineral extraction surfaces)
4. Houses
5. Roads

Methodology



Features extraction

Spectral

Spectral / Spatial / Topographic

Per-pixel approach

Rules supervised classification

Unsupervised classification

Evaluation

mask

OBIA approach

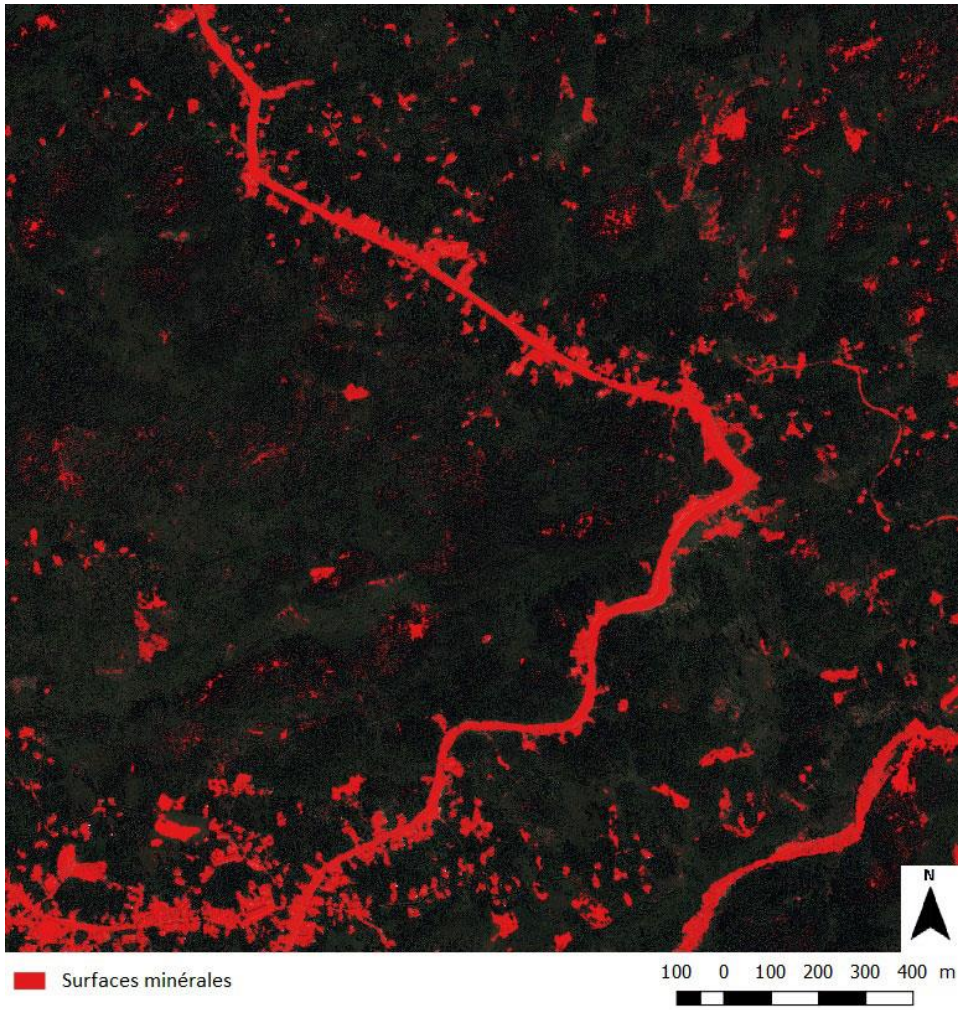
Segmentation (MS and MRS)

Rules supervised classification

Unsupervised classification

Evaluation and post-classification

Per-pixel approach for vegetation masking



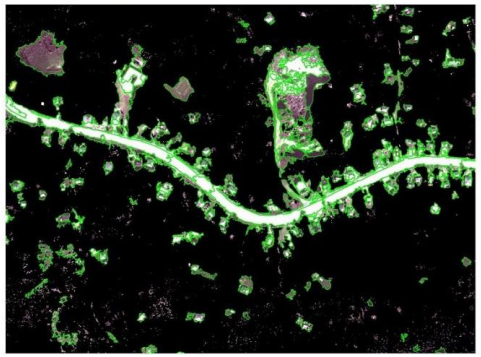
Best result with a k-means in 10 classes on the NDVI index

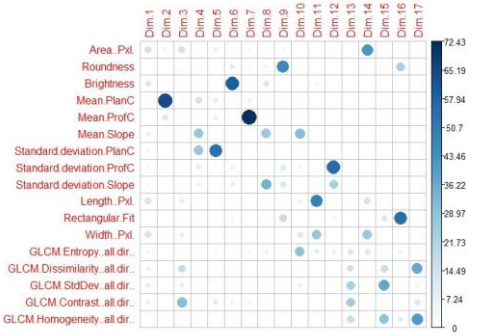
mineral surfaces

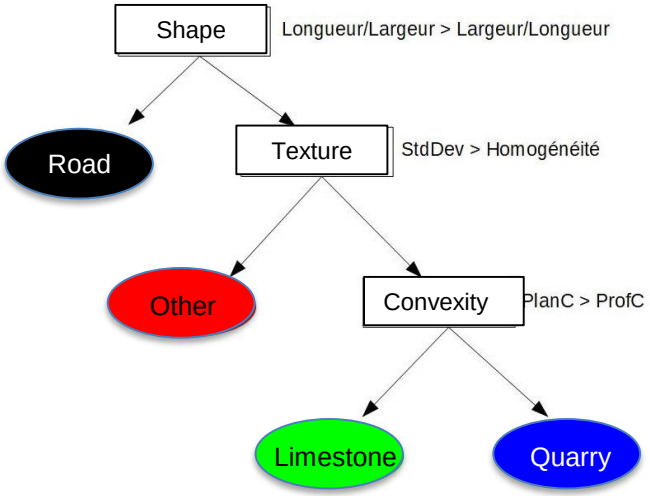
mask (vegetation / shadow)

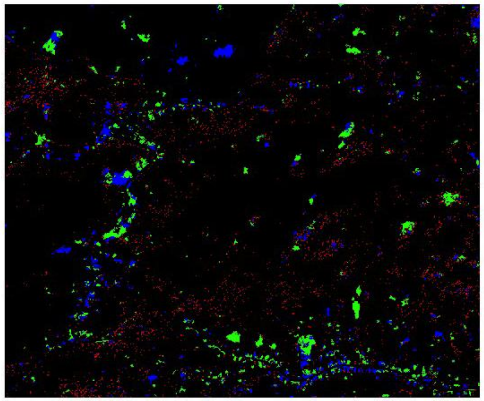
OBIA approach for the detection of mineral extraction areas

- Meanshift segmentation (OTB)
- Knowledge extraction : PCA based on spectral, spatial, texture and topographic features
- Rules based supervised classification -> decision trees
- Results and evaluation





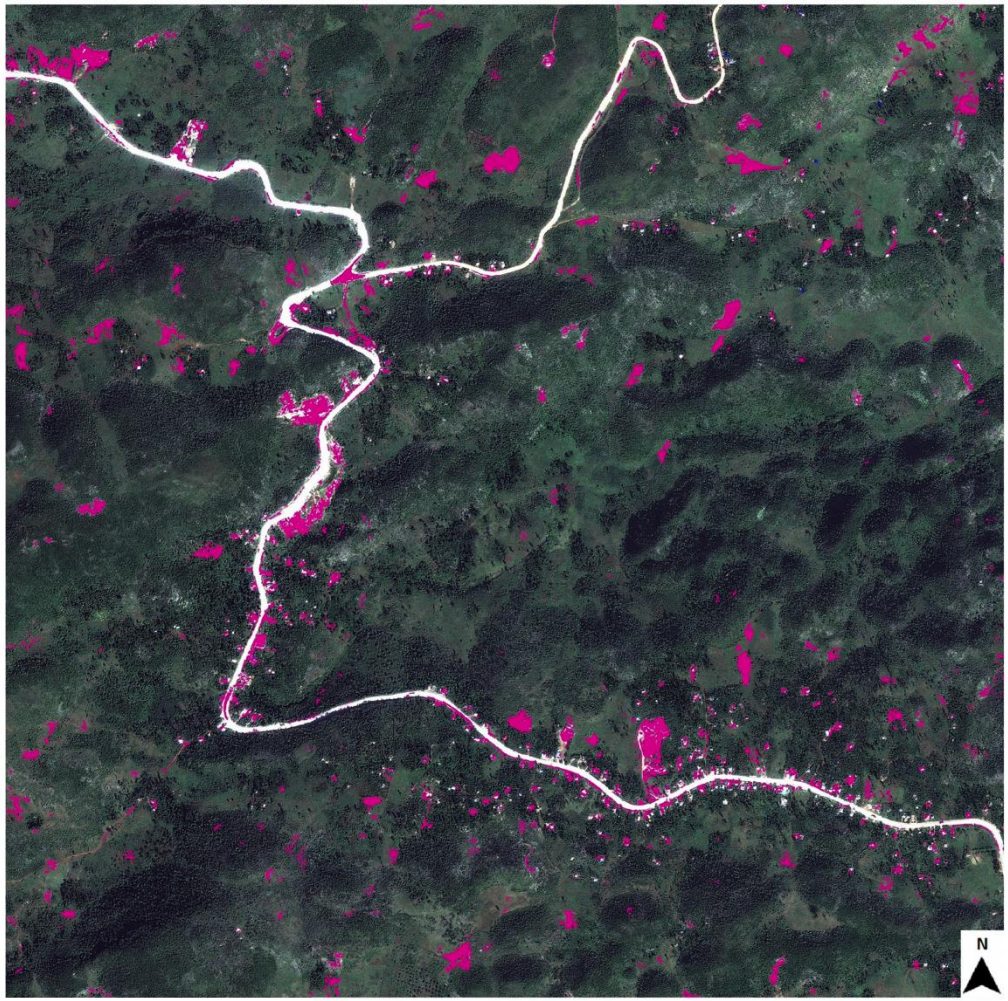




Producer Accuracy	79,37 %
User Accuracy	38,15 %

OBIA approach for the detection of mineral extraction areas

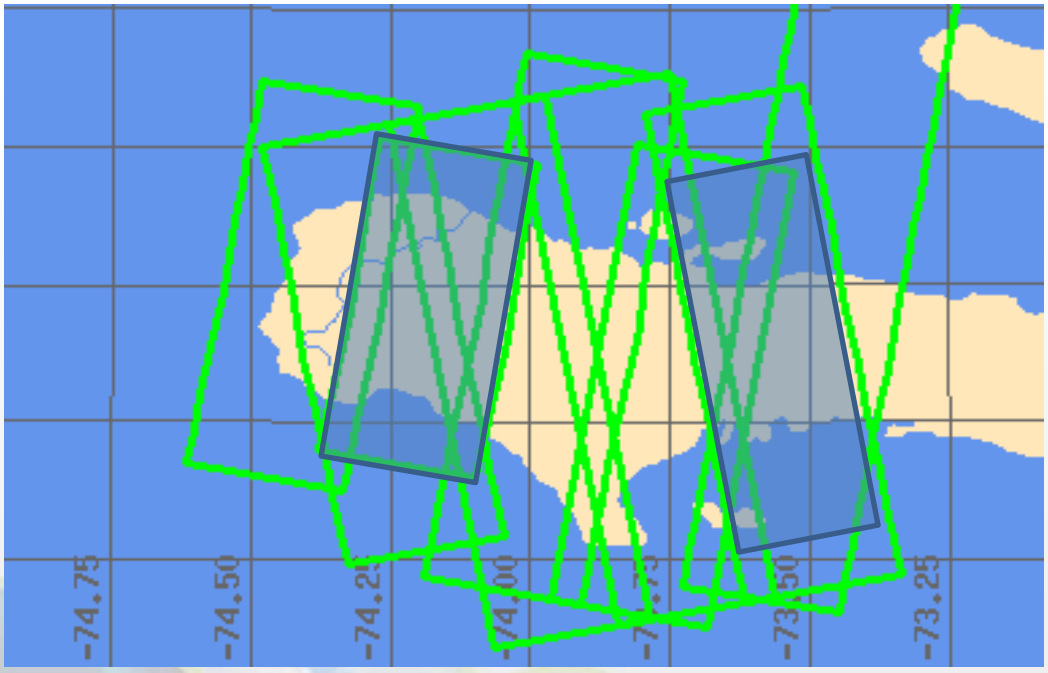
- Meanshift segmentation (OTB)
- Knowledge extraction : PCA based on spectral, spatial, texture and topographic features
- Rules based supervised classifcation -> decision trees
- Results and evaluation
- Post-classification (majority filter)



Conclusions and perspectives

- First tests on several ROIs with interesting results
- Application of the methdology on large Pléiade imagery
- … but need of ground thruth or validation data to assess the results and to apply to ther ROIs
- Enhance the methodology by integrating pre-defined landcover classes (e.g. for instance OSO methodology tuned for Haiti)

DLR



TSX acquisitions are running more smoothly now, and we have concluded the 6th coverage.

- There are open questions still about who will actually work with the data.
  - motivate academia in Germany : master thesis about TSX-based change detection in the given area of Haiti ?
  - ASI work using ESA's Geohazards Exploitation Platform (GEP)

ASI – Terrain motion products

Scientific goals

- Develop experimental scientific products tailored to obtain useful information on ground stability and motions for target areas of the RO
- Test VHR SAR for hotspot mapping via:
  - bespoke COSMO-SkyMed SpotLight campaign in different recovery contexts
  - InSAR processing within ESA Geohazards Exploitation Platform (GEP)

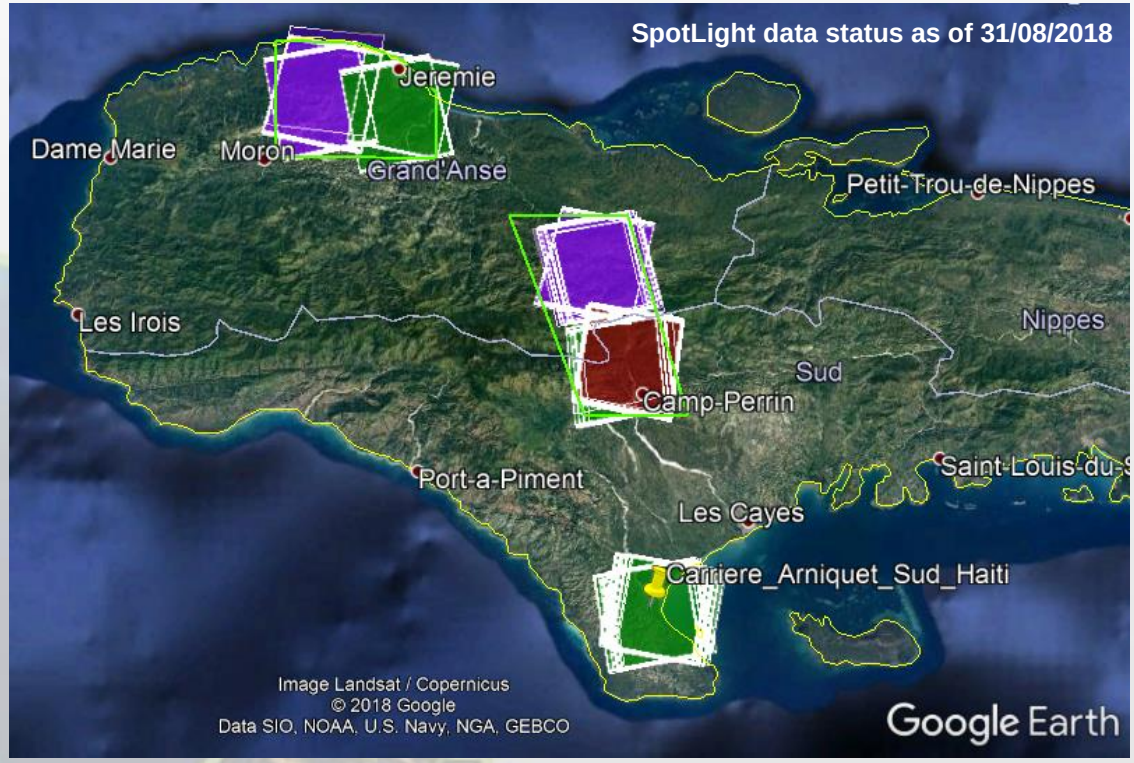
Target areas (<u>stakeholders' priorities</u>)

- Jeremie (urban + rural)
- Camp-Perrin (rural + road network)
- Carriere Arniquet (rural + mining)

ASI – Terrain motion products

Satellite data → newly acquired ASI's COSMO-SkyMed X-band data

- 3-year long tailored monitoring campaign [started on 1st Dec 2017]
- SpotLight images at very high spatial resolution (1 m)
- Ascending and descending mode acquisition geometries, 16 days revisit time



More than 160 COSMO-SkyMed SpotLight scenes already acquired for the target areas

~16 scenes per site, per geometry

(as of 31/08/2018)

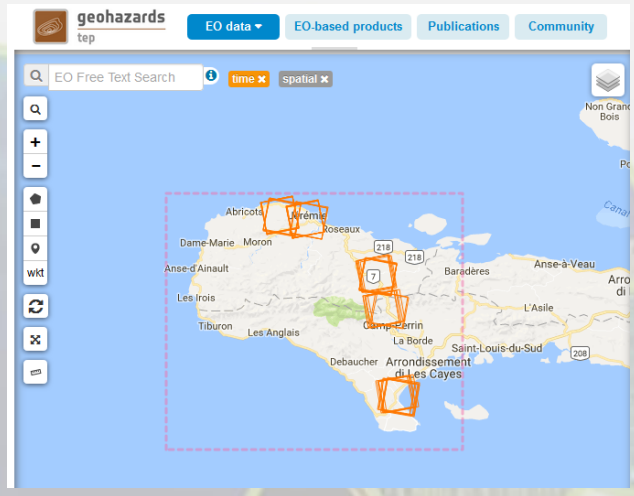
ASI – Terrain motion products

Exploitation of ESA's Geohazards Exploitation Platform (GEP)

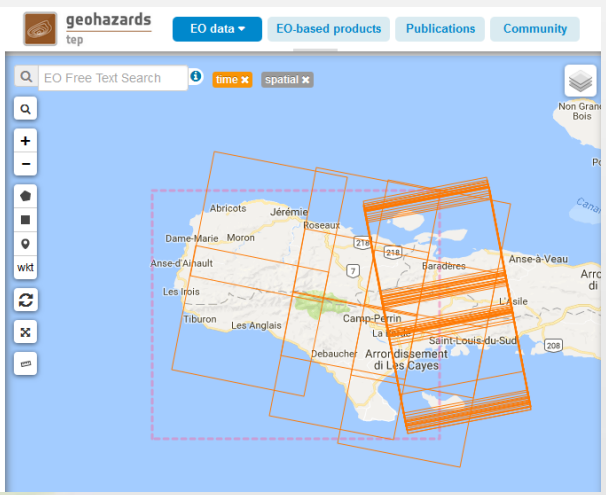
- Feb 2018: RO-Haiti GEP project approved
- Mar/Apr 2018: work with ESA and Terradue to setup GEP account & tools

➢ Task 1: Ingestion of new SAR data into GEP [*Feb 2018 - present*]

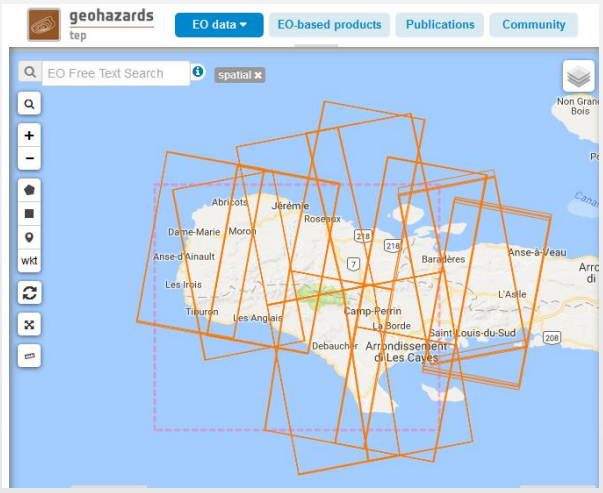
- **COSMO-SkyMed**: regularly uploaded by ASI and ESA onto ESA's ftp since Feb. 2018
- **TerraSAR-X**: link with DLR server established by DLR and ESA in Feb. - Mar. 2018



COSMO-SkyMed SpotLight



COSMO-SkyMed StripMap



TerraSAR-X StripMap

ASI – Terrain motion products

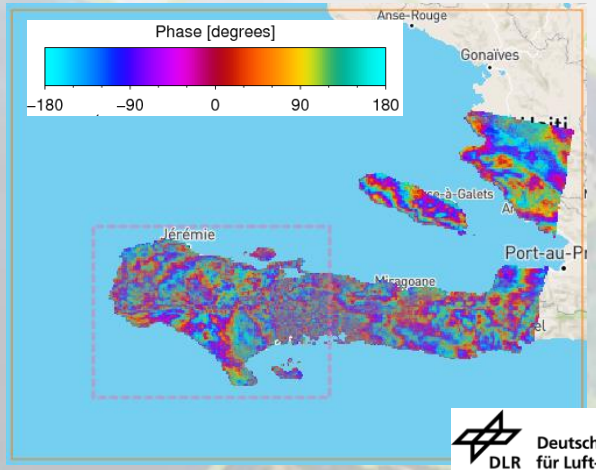
- Task 2: Start testing GEP hosted processing services [*Jun 2018 - present*]
  - **Sentinel-1 Medium Resolution InSAR Browse:** service allowing detection of deformation and surface change, systematically running for selected areas (>20% CEOS seismic active areas, 22 active volcanoes in EU, Latin America, SE Asia) and on-request for major events

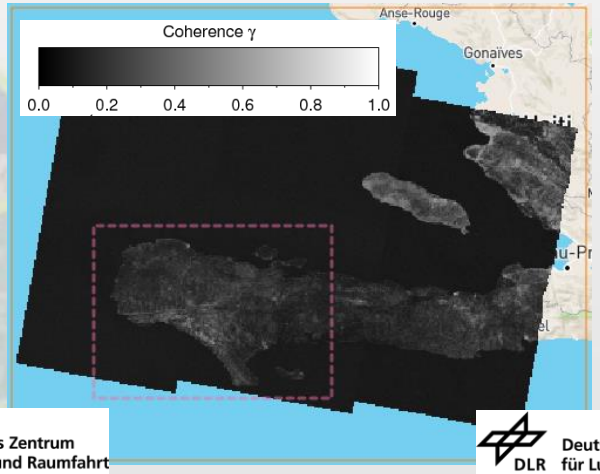
Currently available products in Haiti (only since Feb 2017)

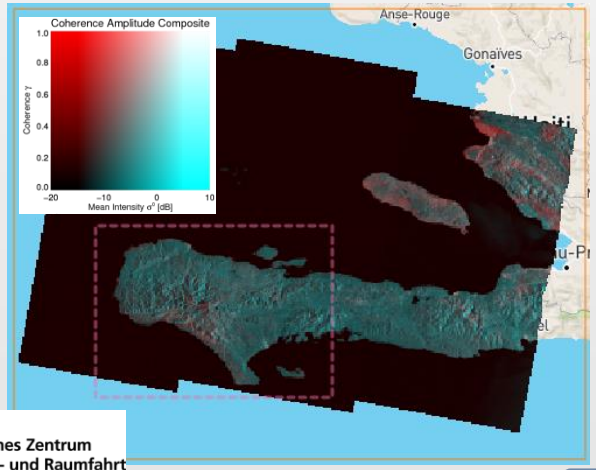
- Differential interferograms
- Coherence maps
- Amplitude change composites
- Coherence-amplitude composites

Example of products for Sentinel-1 pair

14/04/2017-26/04/2017







DLR Deutsches Zentrum für Luft- und Raumfahrt
German Aerospace Center

DLR Deutsches Zentrum für Luft- und Raumfahrt
German Aerospace Center

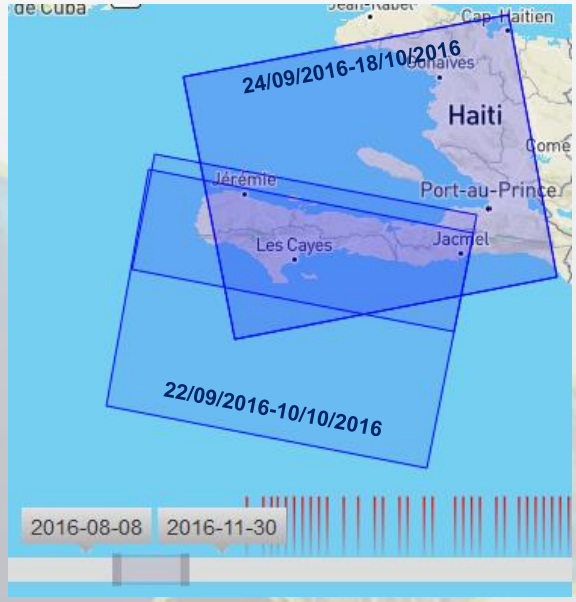
ASI – Terrain motion products

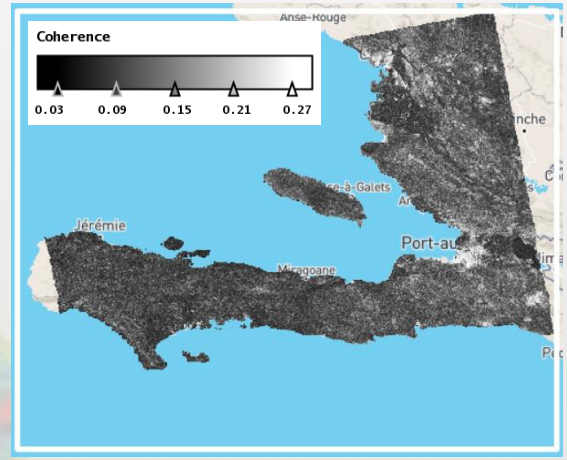
- Task 2: Start testing GEP hosted processing services [*Jul 2018 - present*]
  - **SNAP InSAR:** interferometric processor for Sentinel-1 TOPSAR IW SLC data performed through SNAP (Sentinel Application Platform) - Sentinel-1 Toolbox (S1TBX)

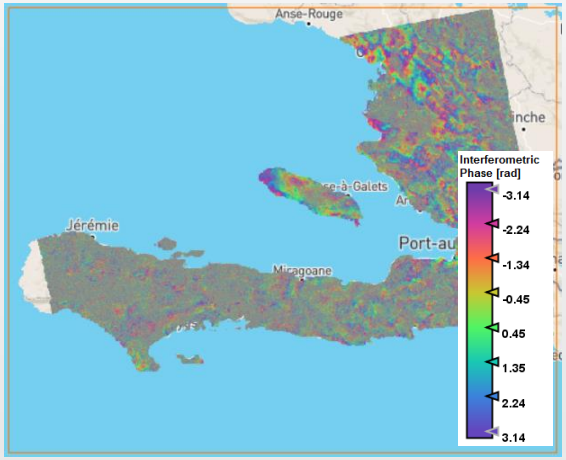
Data pairs (pre- vs. post-Hurricane Matthew)

Processing outputs

- Differential interferograms
- Coherence maps
- Displacement maps







Example of outputs for Sentinel-1 pair

24/09/2016-18/10/2016
(processed in only ~4 hours)

ASI – Terrain motion products

- Task 2: Start testing GEP hosted processing services
  - **NEXT STEPS:** as per the project plan, processing services with COSMO-SkyMed and TerraSAR-X will be tested
    - **SNAP archetype** for COSMO-SkyMed and TerraSAR-X data: to create coherence maps and interferograms
      >>> Processing services to be released
    - **Advanced InSAR**: to process multi-temporal data stacks and extract point targets and their deformation histories
      >>> FASTVEL & P-SBAS processing services already developed to process Sentinel-1 IW data
      >>> SNAP+StaMPS combined processing service to process Sentinel-1 and COSMO-SkyMed time series
      >>> P-SBAS processing service to process COSMO-SkyMed data

    → Will feed into ESA GeoHazards Lab discussion later today during the technical meeting

- Dissemination & capacity building
  - Presentation of GEP trials at *ESA Φ-week EO Open Science event* (Nov 2018)
  - Future training of Haitian partners to use GEP with Sentinel-1 data, and X-band imagery by COSMO-SkyMed and TerraSAR-X

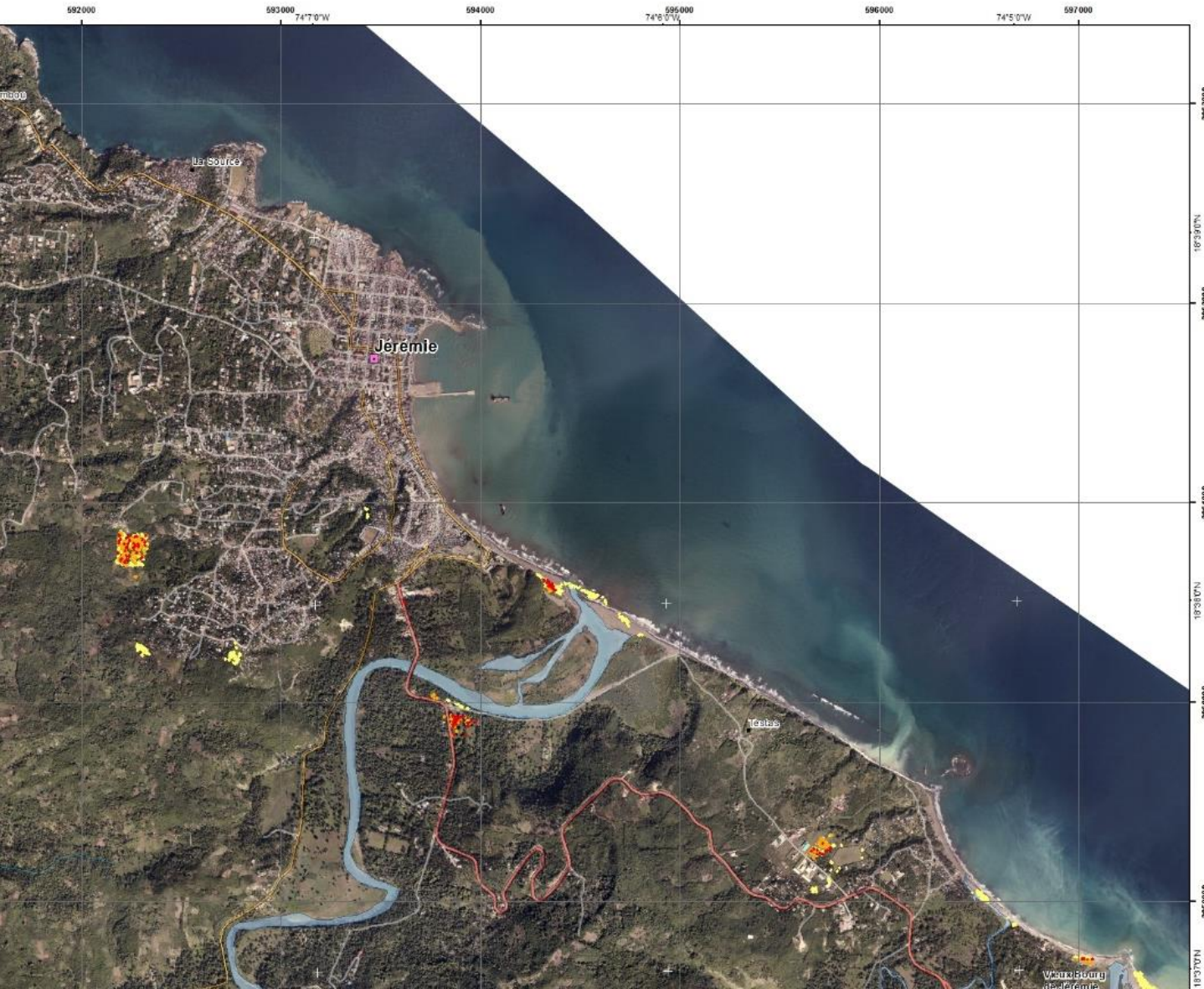
Copernicus EMSN50&51

- EMSN050 “Cities”

Area : Les Cayes and Jérémie

- Reference map
- Damage assessment
- IDP Camps Identification
- IDP Camps monitoring
- Landuse / Landcover
- Reconstruction + 18 months

Copernicus EMSN50 (buildings)



Glide Number: (N/A)

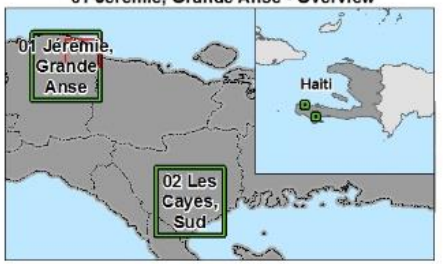
Activation ID: EMSN-050

Product N.: Identification IDP camps Map, v1, English

Post Mathew Damage Assessment and Monitoring of Recovery Activities in the South Region of Haiti

Identification of IDP camps Map

01 Jérémie, Grande Anse - Overview



Cartographic Information

1:15,000

Full color A1, low resolution (100 dpi)

0 0.25 0.5 1 Kilometers

N

Grid: WGS 1984 Zone 18N map coordinate system
Tick marks: WGS 84 geographical coordinate system

Legend

Identification of IDP camps at three different time stages
- t1
- t2
- t3

Transportation
- AP030 - Primary Route
- AP030 - Secondary Route
- AP030 - Local Route
- AQ040 - Bridge Line

Boundaries
- AOI
- Communes CNIGS

Hydrography
- BH140 - River Line
- BH140 - River Area

Population
- AL020 - BUA First Order
- AL020 - BUA Second Order
- AL020 - BUA Village
- AL020 - Suburb/Neighb.
- AL020 - Hamlet

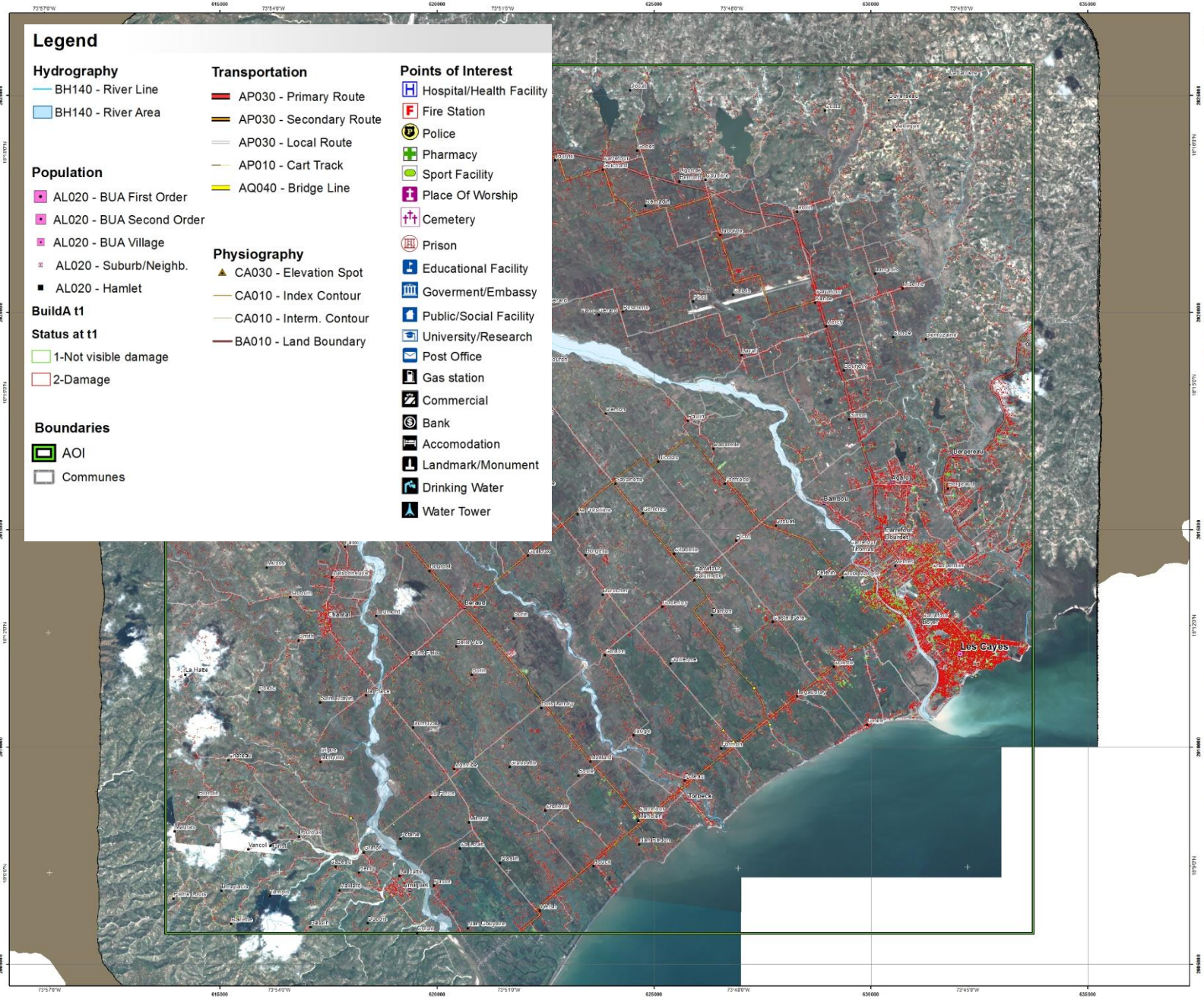
Map Information

Pre-disaster situation analyses for two locations in Haiti: Jeremie (Grand Anse) and Les Cayes (Sud). Post-disaster damage assessment after the hit of Cyclone Mathew, monitoring of reconstruction activities of the assets and evolution of Internally Displaced People camps approximately one year after the event.

The core user of the map is Centre National d'Information Géospatiale (CNIGS) of Haiti and local administrative authorities in charge of planning.

The scope of the map production is to generate a general reference content to support activities of administration in reconstruction work of damages caused by Cyclone Matthew (October 2016).

EMSN050 - Haiti	
AOI	01 Jérémie, Grande Anse
Event type	Cyclone Mathew



Glide Number: (N/A)

Activation ID: EMSN-050
Product N.: Damage Assessment Map, v1, English

Post Mathew Damage Assessment and Monitoring of Recovery Activities in the South Region of Haiti

Damage Assessment Map

02 Les Cayes, Sud - Overview

Cartographic Information

1:40,000

Full color A1, low resolution (100 dpi)

0 0.75 1.5 3 Kilometers

Grid: WGS 1984 Zone 18N map coordinate system
Tick marks: WGS 84 geographical coordinate system

Legend

Damage Assessment Layers in t1
AL015 - General Building Status at t1
1-Not visible damage
2-Damage
Other Damaged Assets Type
Road
Wall/Fence
Bridge
Pylon
Other
Hydrography
BH140 - River Line
BH140 - River Area
Transportation
AP030 - Primary Route
AP030 - Secondary Route
AP030 - Local Route
AP010 - Cart Track
AQ040 - Bridge Line
Population
AL020 - BUA First Order
AL020 - BUA Second Order
AL020 - BUA Village
AL020 - Suburb/Neighb.
AL020 - Hamlet
Boundaries
AOI
Communes CNIGS

Map Information

Pre-disaster situation analyses for two locations in Haiti: Jeremie (Grand Anse) and Les Cayes (Sud). Post-disaster damage assessment after the hit of Cyclone Mathieu, monitoring of reconstruction activities of the assets and evolution of Internally Displaced People camps approximately one year after the event.

The core user of the map is Centre National d'Information Geospatiale (CNIGS) of Haiti and local administrative authorities in charge of planning.

The scope of the map production is to generate a general reference content to support activities of administration in reconstruction work of damages caused by Cyclone Matthew (October 2016).

EMSN050 - Haiti	
AOI	02 Les Cayes, Sud
Event type	Cyclone Matthew

Data Sources

Post-event imagery t1: Pleiades-1B © CNES (2016), distributed by Airbus DS (acquired on 08/10/2016, GSD 0.5 m, approx. 0.6% cloud coverage), and SPOT 7 © CNES (2016), (acquired on 08/10/2016, GSD 1.5 m, approx. 0% cloud coverage), provided under COPERNICUS by the European Union and ESA, all rights reserved.

Vector layers: Damage assessment layers are building footprints and other assets. Building footprints were manually digitized and coded states using pre-event imagery. Status at t1 was classified by visual interpretation using post-event imagery t1. Other damaged assets are represented by a point of observation where type of asset and status at t1 is also coded. Transportation features primary source is OpenStreetMap © OpenStreetMap Contributors. Hydrographic features source is CNIGS, some rivers were manually updated over pre-event imagery. Populated Places primary source is GSH. Administrative boundaries source is CNIGS.

Inset maps: Administrative boundaries source is CNIGS and GADM.

Dissemination/Publication

Map products are available in the Copernicus EMS Portal at the following URL: http://emergency.copernicus.eu/mapping/list-of-components/EMSN050.
Delivery formats are GeoPDF, GeoJPEG and vectors.
No restrictions on the publication of the mapping apply.
All products are © of the European Union.

Disclaimer

The products elaborated in the framework of current mapping in Risk and Recovery mode activation are realized to the best of our ability, optimising the available data and information. All geographic information has limitations due to scale, resolution, date and interpretation of the original data sources. No liability concerning the contents or the use thereof is assumed by the producer and by the European Union. The products are compliant with Copernicus EMS Risk and Recovery Product Portfolio specifications.

Map Production

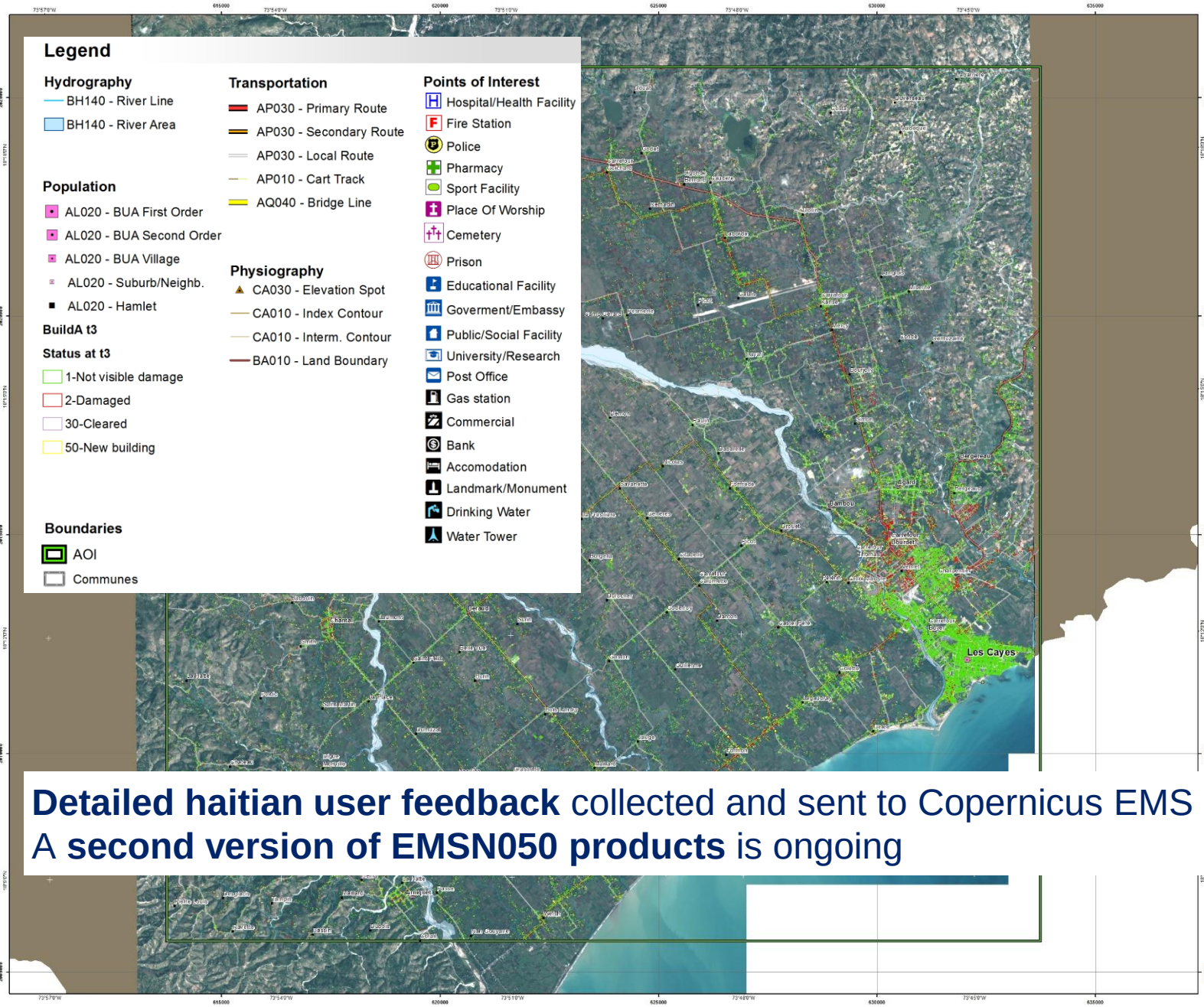
The present map shows the post-event Damage Assessment layers of Building Footprints and Other Damaged Assets in AOI 02 Les Cayes, Sud. Status of features in both layers was coded in time stage t1, right after the hit of Cyclone Mathew. They are accompanied by other reference content layers such as Transportation Network, Hydrography, Populated Places and Administrative Boundaries.
They are all integrated in the EMSN schema geodatabase and updated by means of visual interpretation of post-event imagery.

The estimated geometric accuracy of this product is 1.25m CE90 or better, from native positional accuracy of the background image.
The estimated thematic accuracy of this product is 80% or better, as it is based on visual interpretation of recognizable items on pre-event imagery.
All satellite images have been radiometrically enhanced and orthorectified.

Only the area encased by the Area of Interest has been analyzed.

Contact

Map produced on 03/05/2018 by Indra Sistemas S.A. and Geoville under contract 259811 with the European Commission. All products are © of the European Commission.
Name of the release inspector (quality control): Indra Sistemas S.A.
E-mail: gio-ems-nonrush@ec.europa.eu
http://emergency.copernicus.eu/mapping

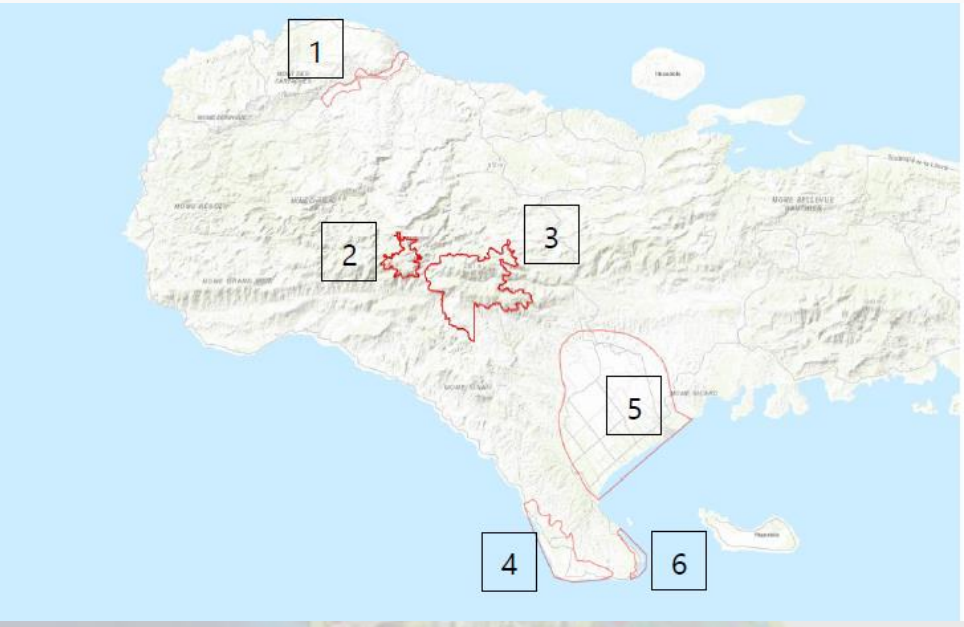


Detailed haitian user feedback collected and sent to Copernicus EMS RRM in July
A **second version of EMSN050 products** is ongoing

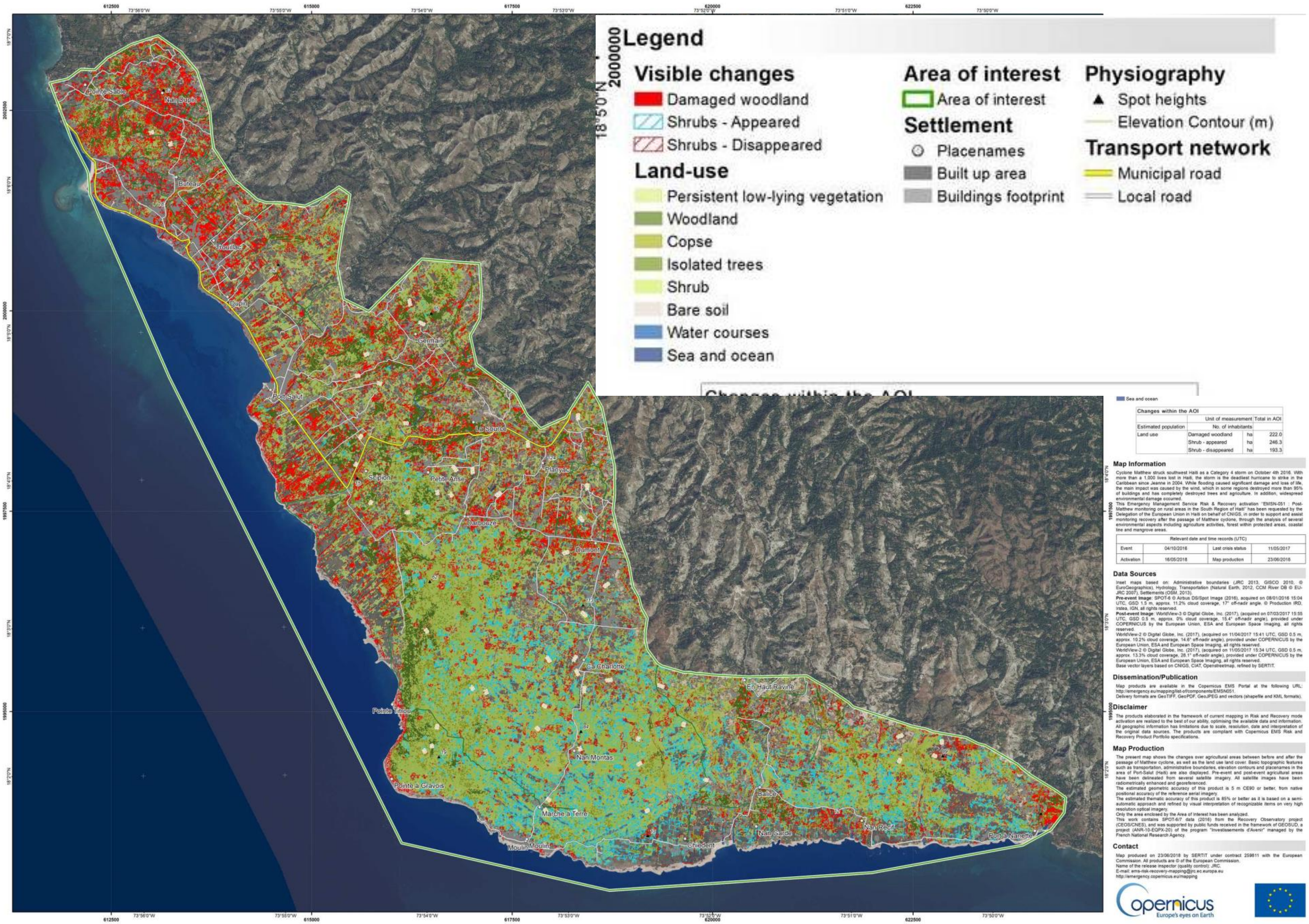
Copernicus EMSN50&51

- EMSN051 “ Environmental”

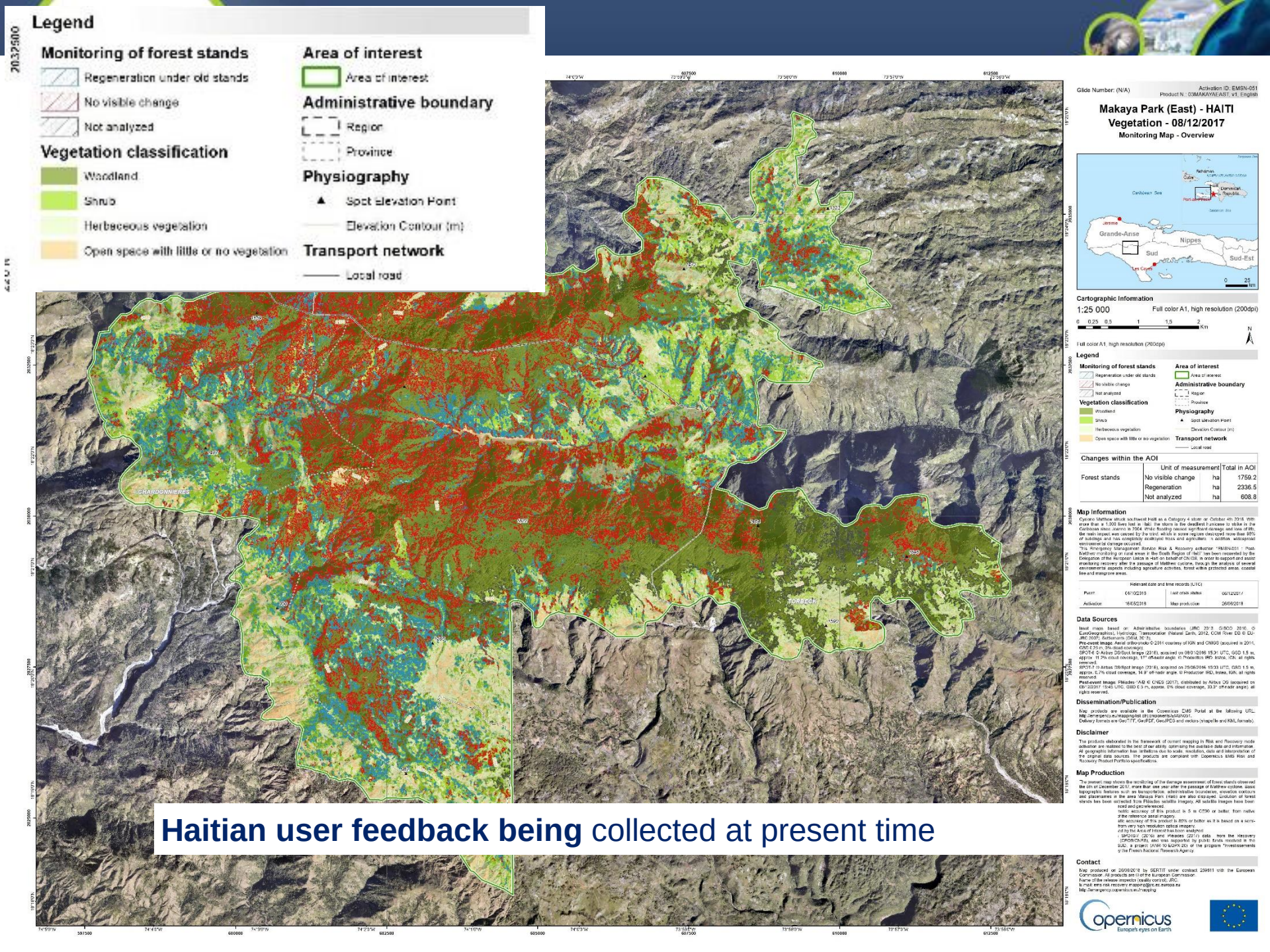
Area : Macaya Park, Port Salut, Les Cayes+Jérémie, Pointe Abacou and Costa line.



- Agricultural activities
- Coastal Line evolution
- Macaya Park classification and monitoring forest damage
- Mangrove monitoring



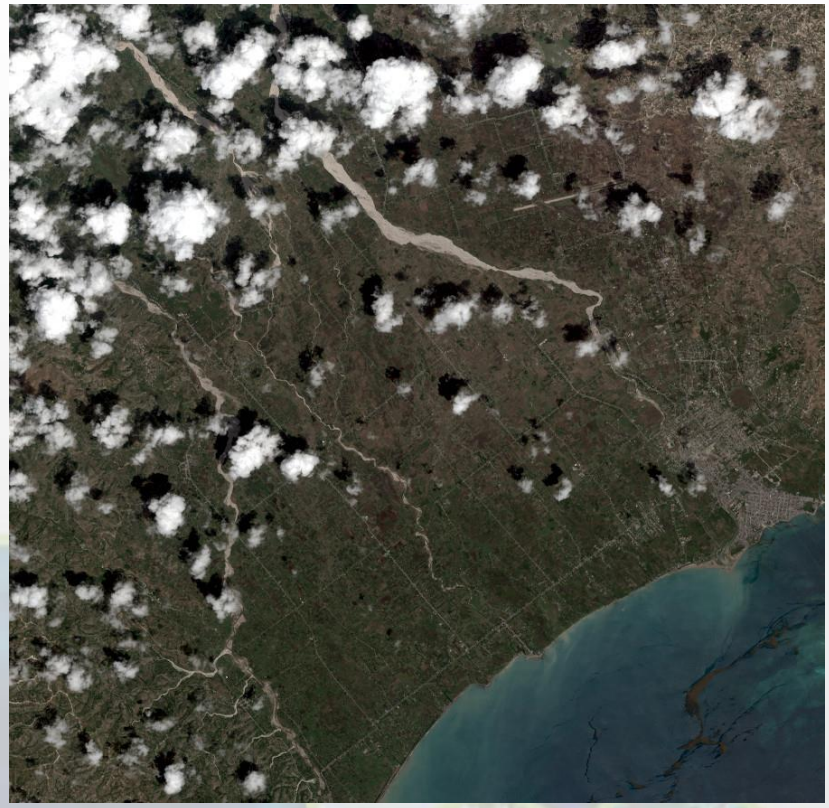
Legend
Visible changes
Damaged woodland
Shrubs - Appeared
Shrubs - Disappeared
Land-use
Persistent low-lying vegetation
Woodland
Copse
Isolated trees
Shrub
Bare soil
Water courses
Sea and ocean
Area of interest
Area of interest
Settlement
Placenames
Built up area
Buildings footprint
Physiography
Spot heights
Elevation Contour (m)
Transport network
Municipal road
Local road
Pointe Sable
Nan Dupin
Buteau
Rouillac
Dupin
Germain
Port Salut
La Source
Scipion
Petite Anse
Planyac
Darbouze
Dumont
Ca Charlotte
En Haut Ravine
Pointe Tirou
Nan Montas
Pointe à Gravois
Marche à Terre
Balice
Nan Roc
Nan Garde
Chiedent
Moulin
Port à Nanette
Changes within the AOI
Unit of measurement
Total in AOI
Estimated population
No. of inhabitants
Land use
Damaged woodland ha 222.0
Shrub - appeared ha 246.3
Shrub - disappeared ha 193.3
Map Information
Data Sources
Dissemination/Publication
Disclaimer
Map Production
Contact
Copernicus
Europe's eyes on Earth



Haitian user feedback being collected at present time

Links with NASA, NOAA, WB Haiti

WB Haiti - Les Cayes Agriculture



Links with a new WB « post Irma » agriculture study in Les Cayes

- How does Climate Change change impact agriculture?
- Understand local impact of Climate Change
- Pioneering work on how one could make a sustainable plain irrigation system

Exchanges of Data (satellite images / ground observations) and sharing results

Another “post Irma” WB study should benefit from RO data in the coming months

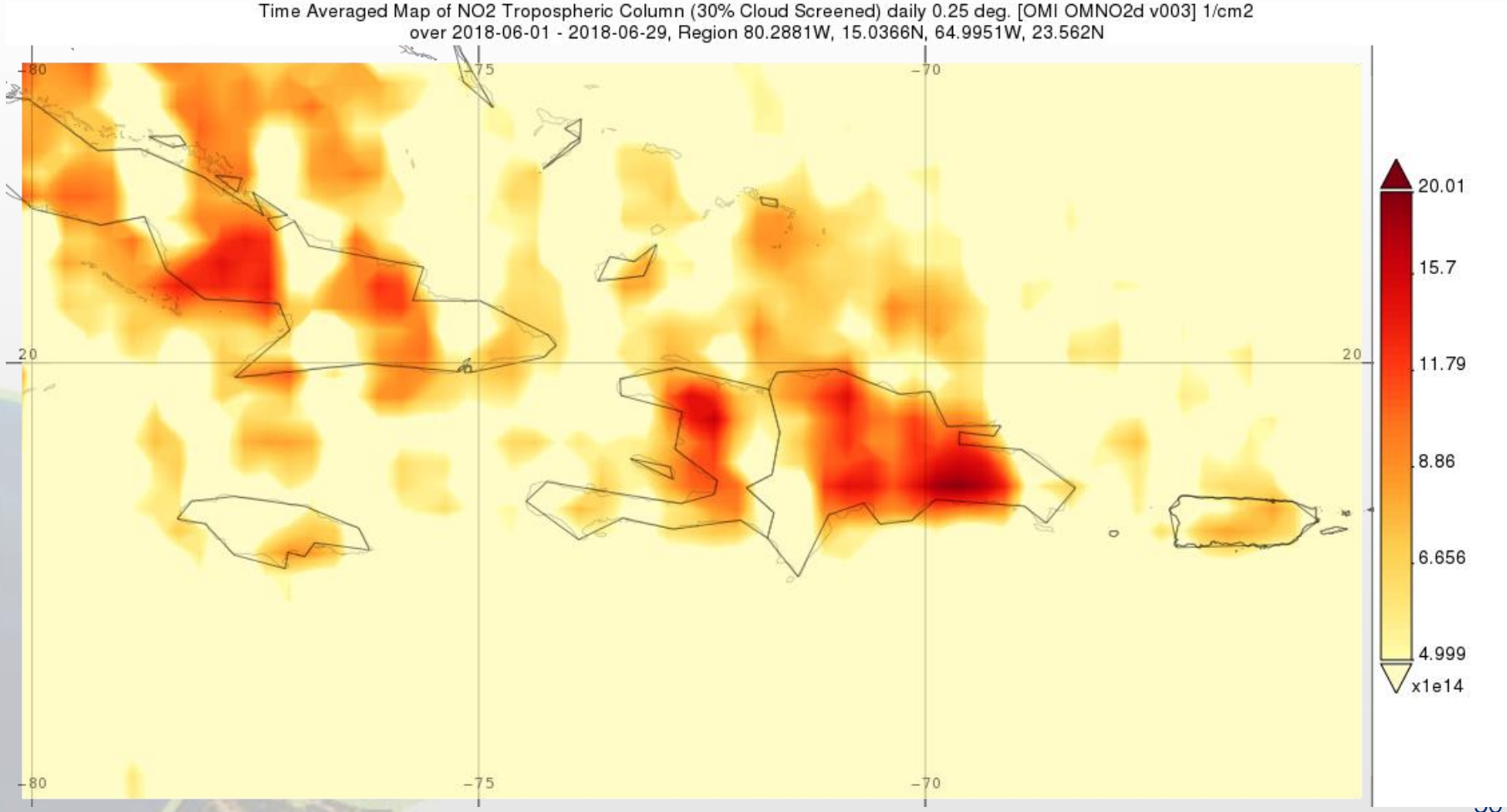
NOAA

Discussions about vector borne diseases evaluation, further expression of interest by Health ministry. Will use L8 and NOAA images but need public health statistical data (accessibility TBC during next mission)

Links with NASA, NOAA, WB Haiti

NASA (Jean Paul Vernier / Ivanco Marie)

preliminary map of nitrogen dioxide pollution over Haiti and the Dom. Rep.



Next Steps

Jan - Sept 2017 – Haiti RO Definition

RO post Matthew definition mission wih local authorities and WB

First Users Workshop RO

MOU discussions between Haitian users (lead CNIGS) and CNES

Implementation of the IT infrastructure

Oct 2017- May 2018 – Start-Up Haiti RO

Incorporation of the first RO products in the infrastructure

User Animation: Technical Seminar, 2nd Workshop (Local, PAP)

Development of a “capacity building plan” and of a “thematic products plan”

RO Products validation by Haitian users

Mid 2018 - 2020 – Haiti RO Operations – Definition and specification of Generic RO

First Haiti RO "early evaluation" report to Steering Committee and WB / UN / UE

Users Workshop May 2019 and Final Users Workshop 2020

Regular images acquisitions and product generation, infrastructure updates, community animation, capacity building setting up

Preparation of the closing of the RO Haiti, evaluation and transfer strategies

Analysis of RO Haiti to derive Generic RO specifications

Outstanding issues for discussion

- Access to US VHR data (Copernicus activation) through NASA or other US partner ?
- Copernicus activation « *52* » on critical infrastructure – highways, ports, airports ?
- Possible new activation of Copernicus RRM for monitoring the evolution of :
  - urban areas (update of EMSN 050) ?
  - agricultural and Natural areas (update of EMSN 051) ?
- New contributions from agencies for capacity building ?
- Other possible contributions ?


Thank you
Merci