

WGDisasters – Meeting 16 (online)  
September 22, 2021



Committee on Earth Observation Satellites

## RO Demonstrator Activities/ Deliverables/ Updates

Hélène de Boissezon, CNES

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# When and how satellite and remote sensing may be used in Recovery



**Disaster Event**



**Post Disaster Needs Assessment**



**Disaster Recovery Framework**



Emergency & Humanitarian Response: satellite imagery of

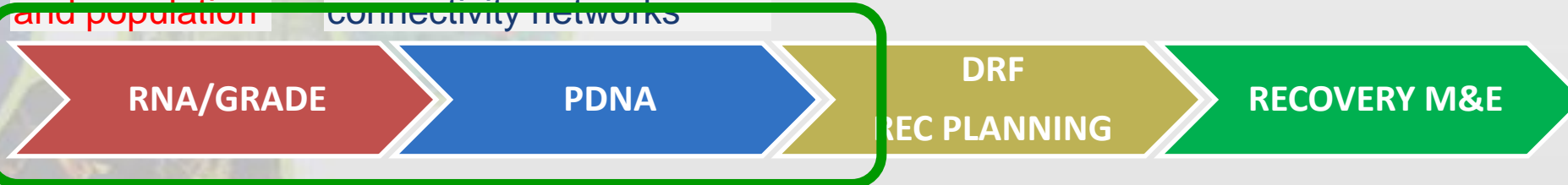
Assessment process supported by more focused, sector specific images of pre and post disaster situation:

Continued use of selected imagery to monitor and document recovery processes 6 Months +

## RO Demonstrator

and population

connectivity networks





## Based on lessons from RO Pilot (2017 – 2020) completed, RO Demonstrator will:

- **Deliver a use and utility report** reviewing and evaluating the timely contribution of EO data/products at several scales
  - **Characterizing impacts on livelihoods and environment**
  - **Assessing general and sectoral needs**
    - Post-Disaster Needs Assessments (PDNAs) with UNDP, EU, World Bank and others for reconstruction and rehabilitation
    - Global RApid-post-disaster Damage Estimation (GRADE) approaches with governments and other stakeholders for reconstruction
  - **Determining extent and scale of damage and losses**
    - Complement Charter observations to complete damage assessment and support recovery planning (3-6 months)
- **Complete 1 RO test then 3 to 5 ROs over 3yrs**
  - **Activation by PDNA Tripartite Agreement partners (UNDP, GFDRR/WB, EU)**
  - **Communicate results to CEOS agencies and stakeholders**



### Maps and analysis at various scales

- **Mid-scale** (10m) overviews of changes in land use and cover updated every 10 days for 6 months
- **High-resolution** hot-zones and lifelines, infrastructure, transport, residences, camps ...updated every 1 to 2 months
- **Integrate essential ancillary data:** terrain validation data, aerial and drone data, statistics, cartography, ....



- **CEOS WGD RO Demo** lead: H el ene de Boissezon (CNES), Andrew Eddy (RO Sec, Consultant to CNES)
- **WB/GFDRR**: Rashmin Gunasekera, Mare Lo, Claudia Soto + ESA liaison (TBD)
- **EU/EC**: Claes Andersson, Dominique Blariaux, Thomas Hockley - Attilio Gambardella, Peter Spruyt
- **UNDP**: Rita Missal
- **UNOSAT**: Samir Belabbes, Einar Bjorgo
- **NASA**: Jean-Paul Vernier
- **ESA** : Philippe Bally, Christoph Aubrecht, Dorella Papadopoulou
  
- **CEOS WGD Leader**: David Green / Dave Borges (NASA)
- **CEOS WGD DCT**: Pierric Ferrier (CNES) (awaiting new DCT lead)
  
- **GEO Sec**: Rui Kotani (GEO Sec Disasters focal point)

- **RO 1<sup>st</sup> “test” activation Beirut explosion : 17 December, 2020**
- **2<sup>nd</sup> RO activation Eta-Iota : March 5<sup>th</sup>, 2021, closing end September 2021**
- **3<sup>rd</sup> RO activation Haiti EQ (and Grace): September 6<sup>th</sup>, 2021, closing early 2022**

**1st RO “test” activation:**

**Overview:** The explosion of a large amount of ammonium nitrate stored in a warehouse in the port of Beirut on the 4th of August 2020, had a devastating outcome not only for the port area but affecting larger areas of Greater Beirut, reaching kilometres inland. The **Reform, Recovery and Reconstruction Framework (3RF)** has been developed by the World Bank Group, United Nations and European Union, bringing together the civil society, the government and the international community in order to provide a roadmap to ensure that people’s needs are addressed through a combination of socio-economic recovery and reform. EMSN087 provides the 3RF with data and information on the baseline damage assessment as for February 2021, and subsequent six monitoring assessments of the reconstruction progress on a quarterly basis beginning in April 2021 and reaching until July 2022.

**Main activity:**

**Production of damage assessment (before and after maps) for Beirut Explosion August 2020**

**Updates every three months (to July 2022, in support of 3RF) to show progress of recovery through change detection maps in affected area around port of Beirut**

Example of Copernicus EMSN 087 product – Beirut damage overview





**2<sup>nd</sup> RO activation : triggered on March 5th for Iota – Honduras, Guatemala, Nicaragua and El Salvador.**

**Damage and loss assessment:**

- **Honduras (ECLAC, IADB, WB): \$US1,900 million**
- **Nicaragua (national assessment): \$US 750 million**
- **COVID restrictions meant most assessment was desk-based. Full extent of damages still uncertain**

**Four main activities:**

- **Repository and continuation of Copernicus EMS Grading maps in Honduras, Guatemala and Nicaragua, useful for the Recovery phase; covering a greater area than ‘small pockets’ of damage assessment conducted by Copernicus EMS;**
- **Sectoral impact analysis – use of EO for agriculture sector impacts in Honduras and Guatemala, and infrastructure in Sula Valley (Honduras).**
- **Develop a framework and decision tree on post disaster activation, choice and use of EO in post disaster analysis for Central America.**
- **Capacity building of interpretation and processing/integration of EO data at CA regional entities such as CEPREDENAC and coordination with CEOS WGCapD**

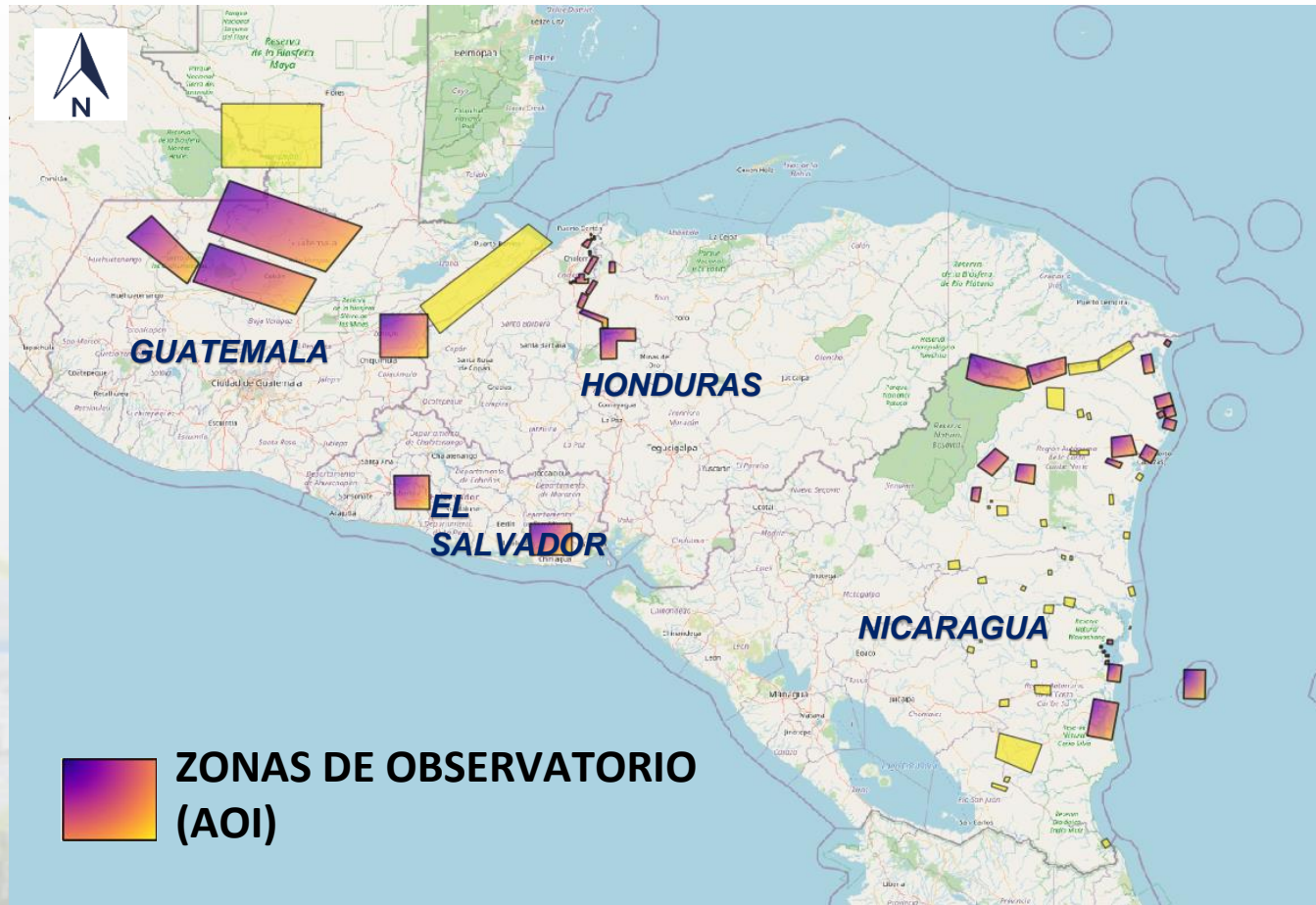






# Priority Damage Zones (post Eta/Iota)\*

Honduras (1,200 km<sup>2</sup>), El Salvador (1,900 km<sup>2</sup>),  
Nicaragua (7,500 km<sup>2</sup>), Guatemala (20,000 km<sup>2</sup>)



\*AOI to be included in RO Iota as agreed by CEPREDENAC and 4 national country partners at 9th April “needs identification” meeting

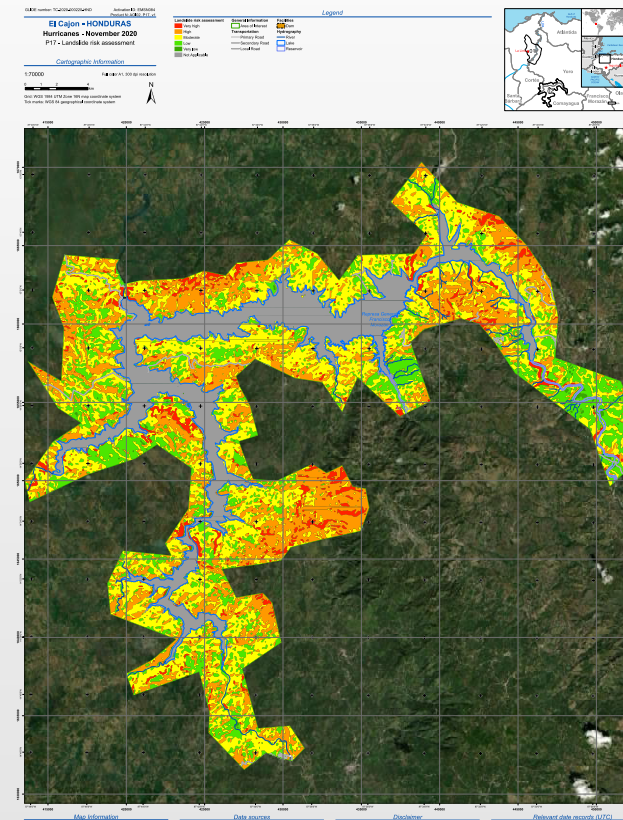
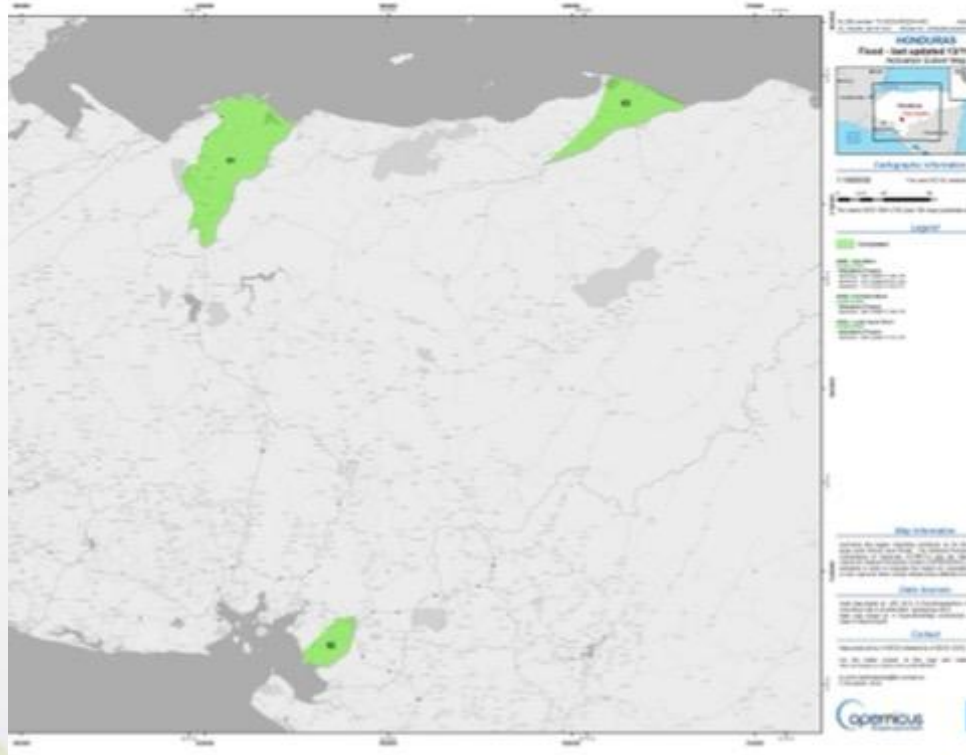


On November 11, Copernicus EMS Rapid Mapping was activated to support information in the Sula Valley, Honduras. Six different products were obtained, most of which include hydrological modeling to estimate the flooding caused by hurricane ETA.

On December 3, Copernicus EMS Risk and Recovery Mapping was activated to produce flood delineation maps and landslide risk maps in the El Cajon Reservoir above the Sula Valley.

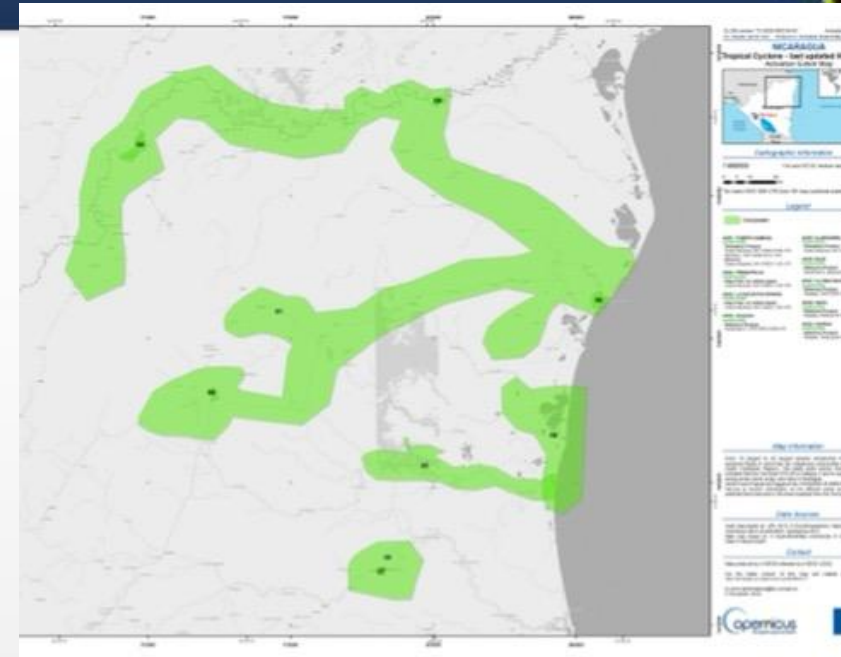
<https://emergency.copernicus.eu/mapping/list-of-components/EMSR481>

<https://emergency.copernicus.eu/mapping/list-of-components/EMSN084>





As a follow-up to the ETA / IOTA events, Copernicus EMS Rapid Mapping was activated to provide information in the northern Caribbean area of Nicaragua. 16 different products were obtained that include identification of the impact zones, affected areas with food insecurity and affected infrastructure. Due to the lack of local data such as a high resolution digital terrain model, flood models could not be obtained.

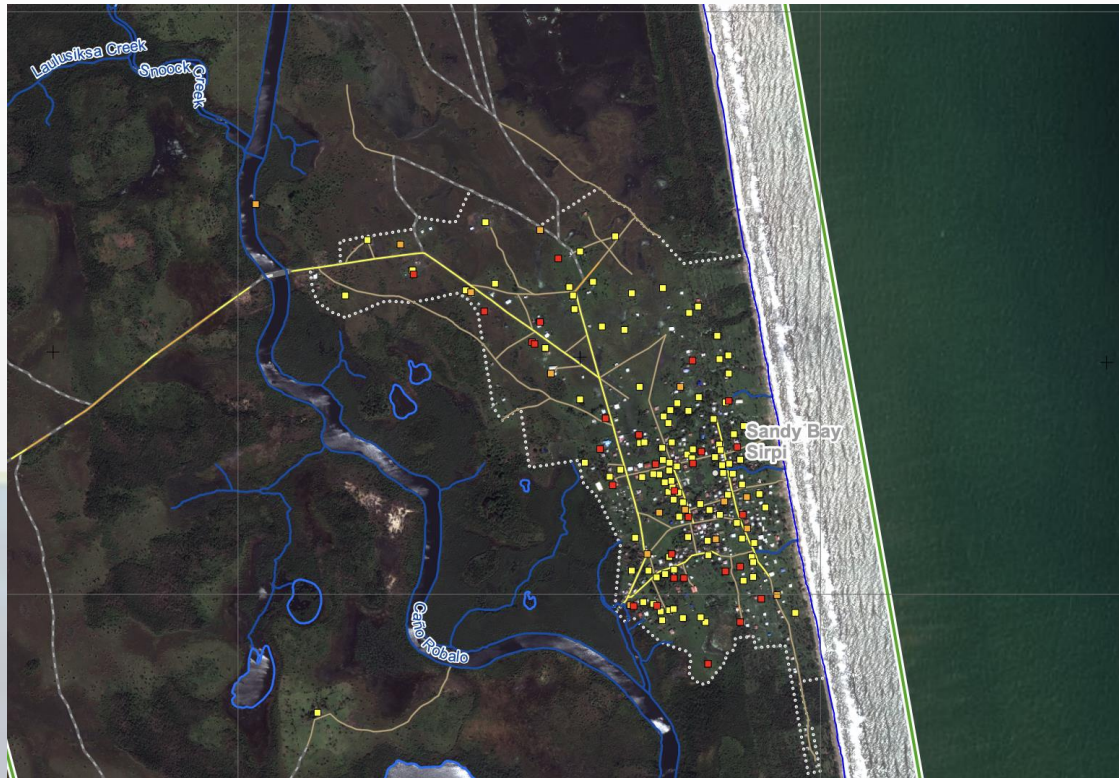


<https://emergency.copernicus.eu/mapping/list-of-components/EMSR477>





## Sandy Bay Sirpi 1:5000, Nicaragua



This RRM activation provides the STANDARD products Flood delineation (P04), with related Impact assessment on assets and population (P14), for eight areas of interest (totalling almost 800 km<sup>2</sup>), as well as Damage assessment (P08) for the area of Sandy Bay Sirpi (25 km<sup>2</sup>).

Sample product for Nicaragua  
RRM activation



As a follow-up to the ETA / IOTA events, the Copernicus EMS Risk and Recovery was activated to support specific areas of Guatemala with information. Two different products were obtained: delineation of floods and analysis of the impact of the flood on the population. Due to the lack of local data such as a high resolution digital terrain model, hydrological flood models could not be obtained.



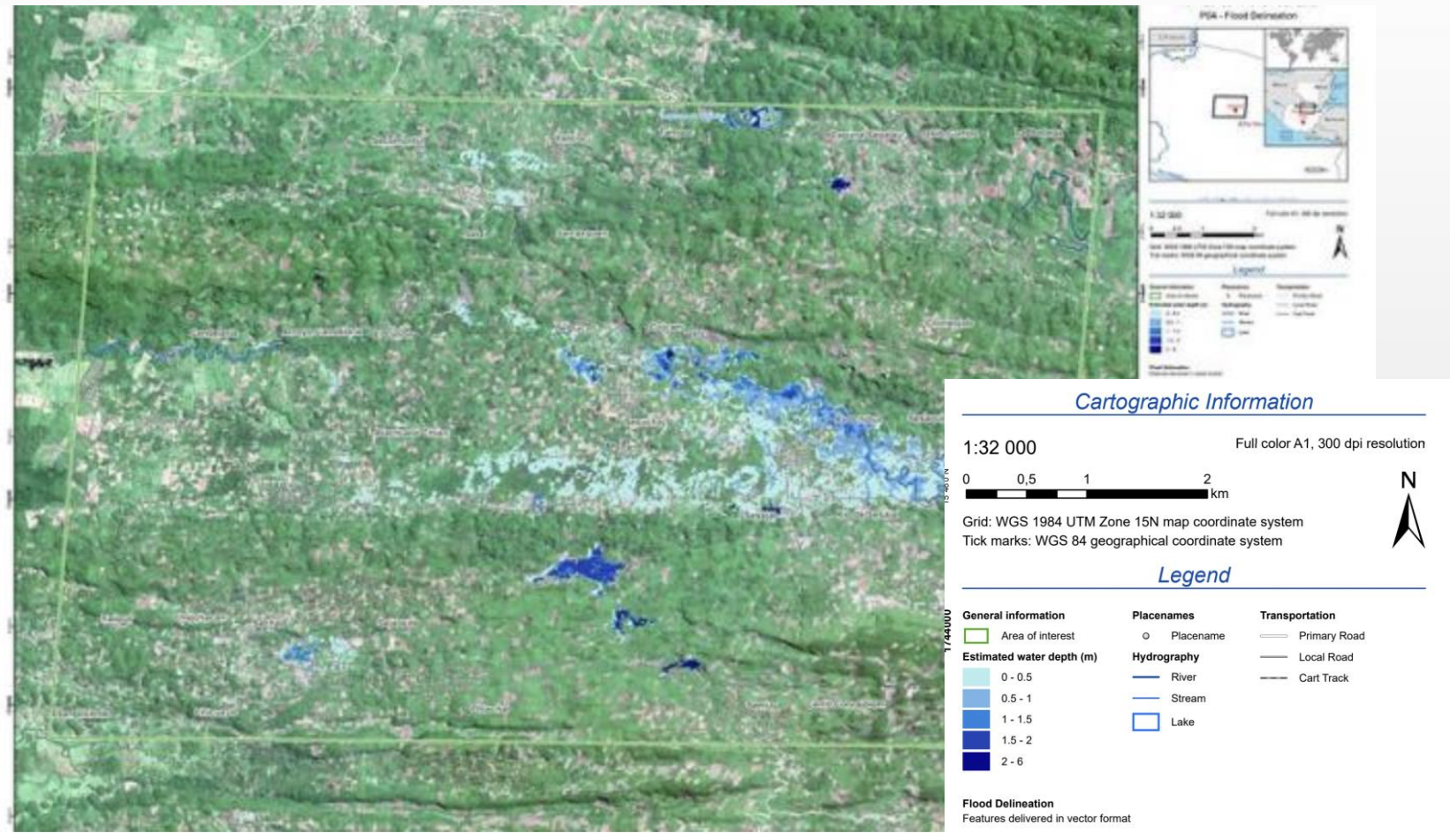




# Copernicus EMSN094 in Nicaragua



Sesajal Flood Delineation 1:32 000, Guatemala



Sample product for Guatemala RRM activation







- **Copernicus EMS:** RRM “Standard” activation requested in two out of four countries affected (not in Honduras where existing activations cover needs, or in El Salvador). Completed.
- **Mid-term VHR satellite monitoring:** CNES and NASA to identify areas for potential VHR acquisitions (beyond September 2021, through GEODARMA request and NASA Planet agreement). CNES data to be given to CEPREDENAC; NASA to use Planet data for agricultural assessments.
- **Interferometric monitoring of flood infrastructure:** monitor Sula Valley for catastrophic flood infrastructure failure. ASI to provide data and eGEOS to provide analysis (September 2021 and January 2022).  
**See following slides!**
- **Capacity development:** request to CEOS WG CapD for support to local and regional capacity (preferably in Spanish)
- **Longer-term risk reduction monitoring:** proposal to GEO-DARMA for longer-term data access and input from WG CapD for support to local and regional capacity.



- Identify new risk created by Eta/Iota and support risk reduction initiatives
- Interferometric monitoring on a selected area in Honduras indicated by CEPREDENAC
- ASI planned CSK acquisitions starting from June 2021 (4 CSK + CSG)
- E-geos will process the data as soon as the stack will have at least 30 images (end of October)
- Preliminary analysis with Sentinel-1





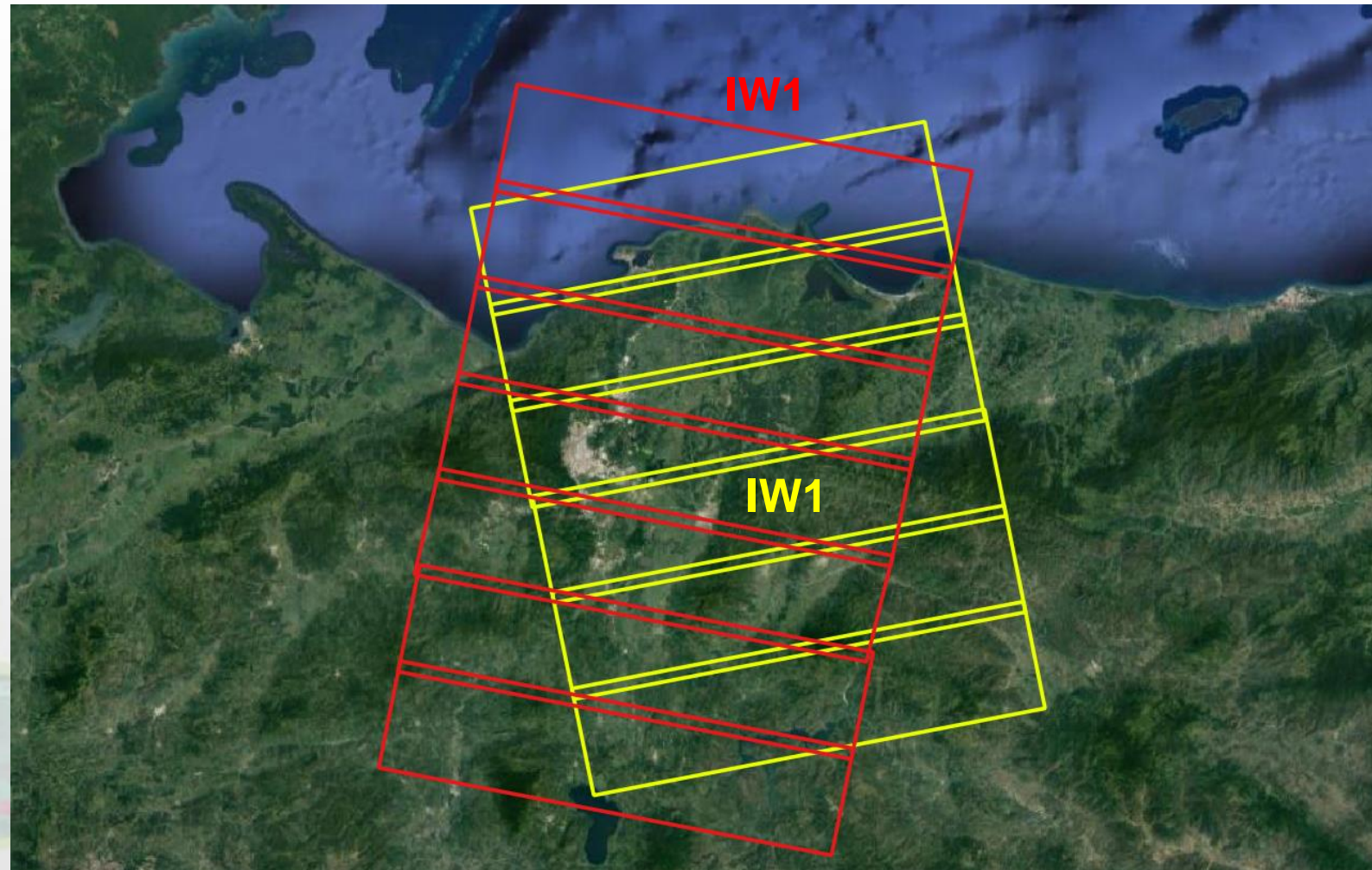


## Track 165

Geometry	Ascending
Polarization	VV
N. Images	142
Acquisition mode	IW
Subswath	IW1
Incidence angle	34.01°
Period of analysis	20150917 - 20210816

## Track 128

Geometry	Descending
Polarization	VV
N. Images	166
Acquisition mode	IW
Subswaths	IW1
Incidence angles	33.73°
Period of analysis	20150506 - 20210826

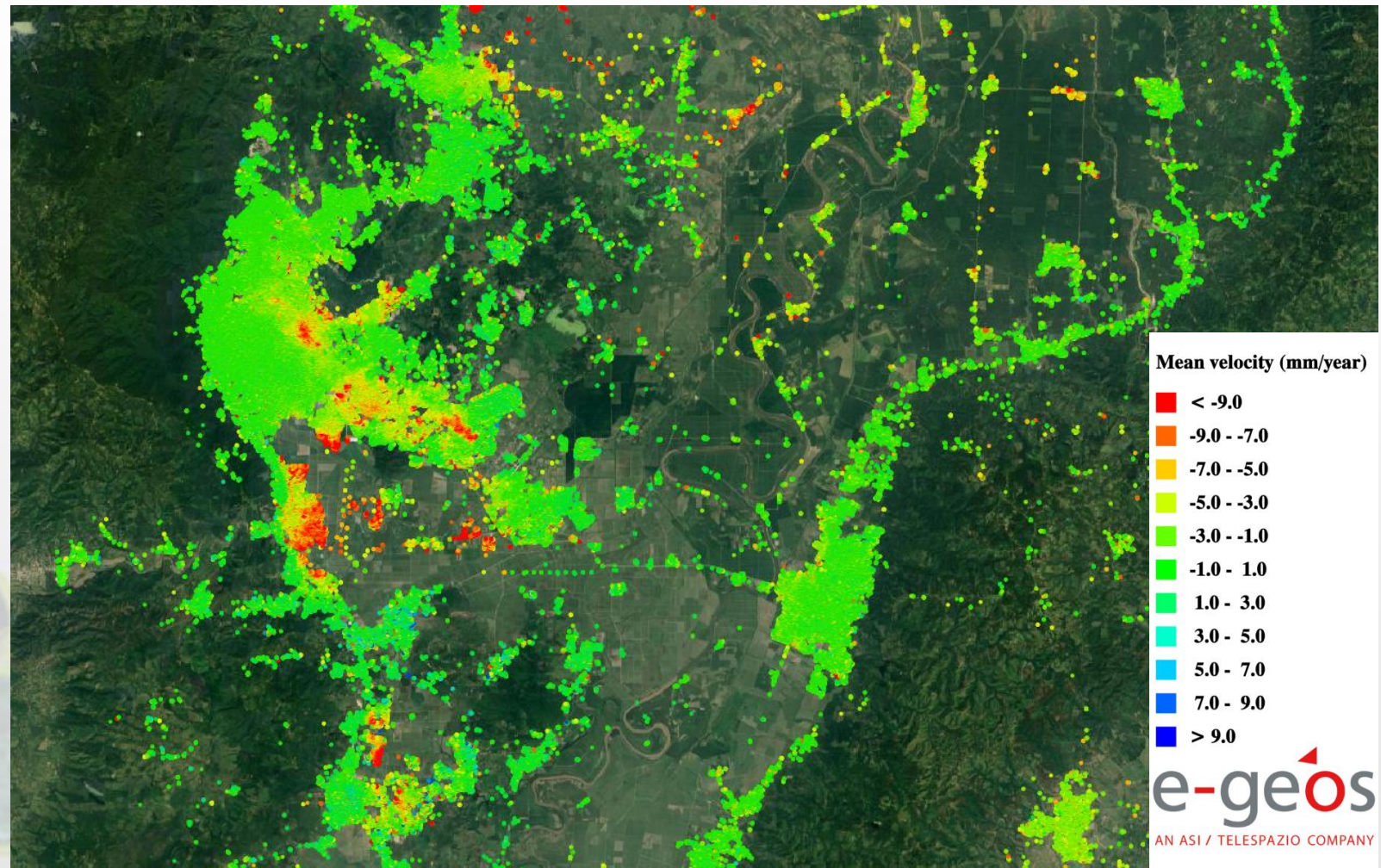






- Preliminary results obtained by performing the PSP-IFSAR processing of 142 Sentinel-1 ascending data
- Period analysis: Sep 2015 – Aug 2021

### Mean velocity map

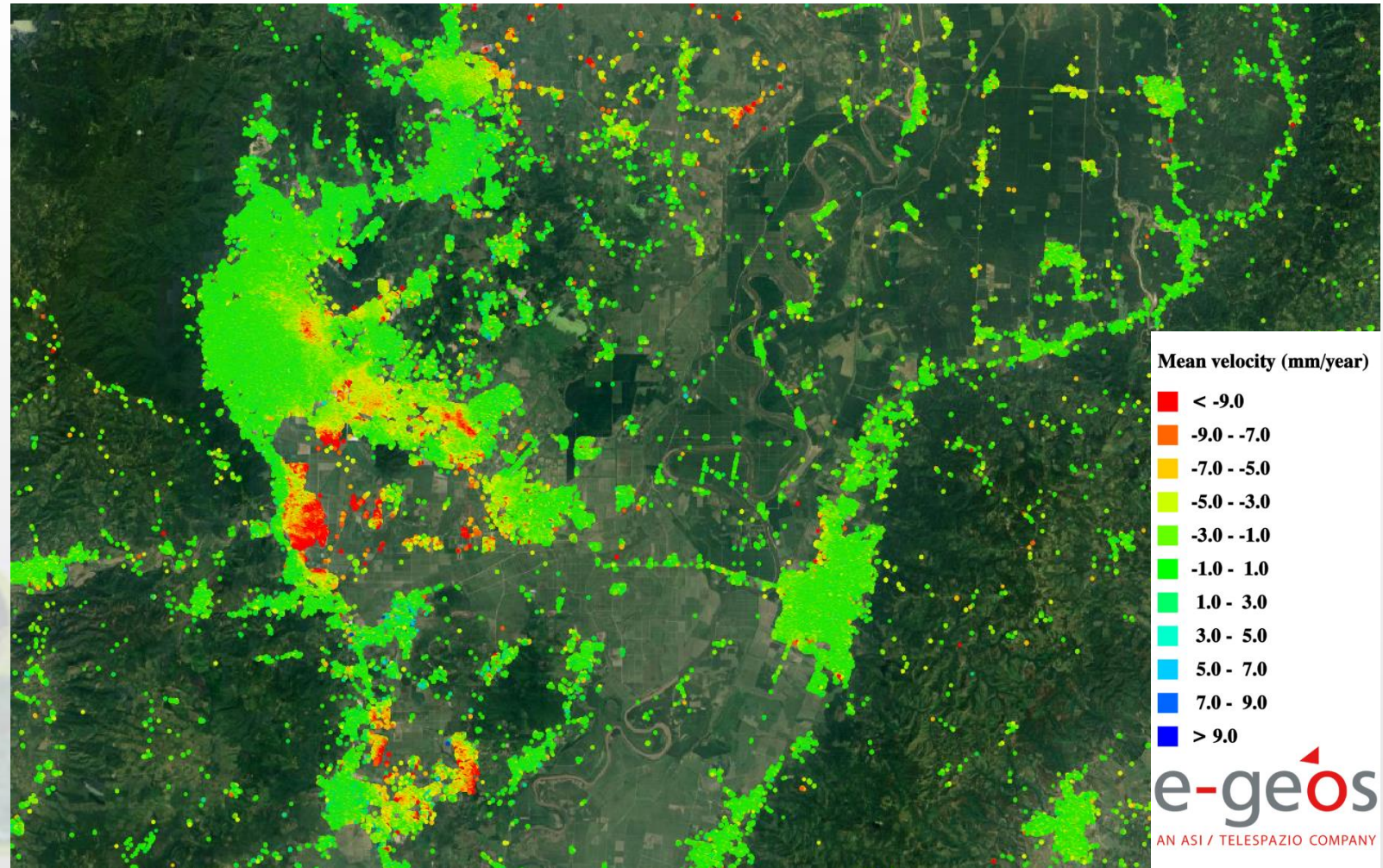






- Preliminary results obtained by performing the PSP-IFSAR processing of 166 Sentinel-1 descending data
- Period analysis: May 2015 – Aug 2021

## Mean velocity map



## PROS

- Access to an extensive and diverse catalog of available products.
- High quality products
- Quick response
- Access to activations process even several months after the events
- Well documented products
- Satellite information from various sources, providers and formats
- Access to technical capacity of international specialists

## CONS

- The request of the products must be through government institutions (for Copernicus EMS), which delayed the process.
- Initial communication for Copernicus is through the European Union delegation in each country and in some cases it can cause confusion.
- There is no clear flow chart of the processes involved for the activation of the different initiatives (coordination across the RO).
- To access the products of the Observatory it is necessary to separately activate Copernicus EMS.
- The beneficiary countries did not use the products delivered optimally for various reasons: ignorance, interpretation capacity and most of the time this information does not reach decision makers in time.



**3<sup>rd</sup> RO activation: September 6<sup>th</sup>, at request of EU on behalf of tripartite team, in support of PDNA and emerging Recovery Framework**

Support Haiti Recovery from EQ and Grace through EO-derived products to augment and validate **PDNA** analysis (by end of September) and EO-derived products to support the **Recovery Framework** (max. six months)

## **Main activities:**

1. Establish a land use map and assess landslide impact (and area) for all three affected departments
2. Based on a "before" / "after" comparison...
  - a) Map and calculate the area of landslides / landslides (in total, and with detail by type of land use as developed in point 1)
  - b. Calculate the surface area of landslides specific to protected areas, in particular Macaya National Park, and provide where appropriate detailed hotspot analysis, analyze possible statistical correlation between land use before the disaster and the occurrence of landslides (i.e. have wooded areas resisted better than non-forested areas?)
3. Identify and assess modifications to the hydrographic network

**RO Liaison Officers: Mathias Studer and Mathilde Caspard, SERTIT**

**Team members:**

**CNES (Helene de Boissezon, Andrew Eddy): Pleiades data**

**ASI (Deodato Tapete): CSK, landslide products**

**NASA (Eric Fielding, Dalia Kirschbaum, Jean-Paul Vernier): landslide products**

**UNOSAT (Samir Belabbes): TBD**

**SERTIT (above + Robin Faivre):**

**CNIGS (Philemon Mondesir): Pleiades damage products, landcover change**

**CIMA (Roberto Rudari, Luca Pulverati): hydrological impact, change detection from CSK**

**EOST (J-P Mallet): Landslide products**

**DLR (TBD): TBC**

**Others: TBC**





Contributor	Contribution	RO Phase	Contribution status
NASA	Landslides	1	Already submitted
	Damage proxy map		
SERTIT	P01 phase 1	1	Confirmed / Waiting for all input data
EOST	Landslides for P01 phase 1	1	Under discussion
ASI (with proposed ESA project sponsorship)	Landslide + change detection map, CSK data Request that ESA sponsor as demo project on GEP	2	Confirmed / waiting for data ESA contribution to be discussed
CIMA	P03 changes to hydrological networks	2	Under discussion
UNOSAT	?	2	To be confirmed (depending upon UNDP request)
CNIGS	P02 Compararison of landuse maps before/after EQ (IOTA <sup>2</sup> )	2	Under discussion
DLR	Data provision	2	To be discussed
CEMS RM	Impact on buildings and roads (+floods)	1	Already submitted
CEMS RRM	P02 Compararison of landuse maps before/after EQ	2	FLEX service to activate



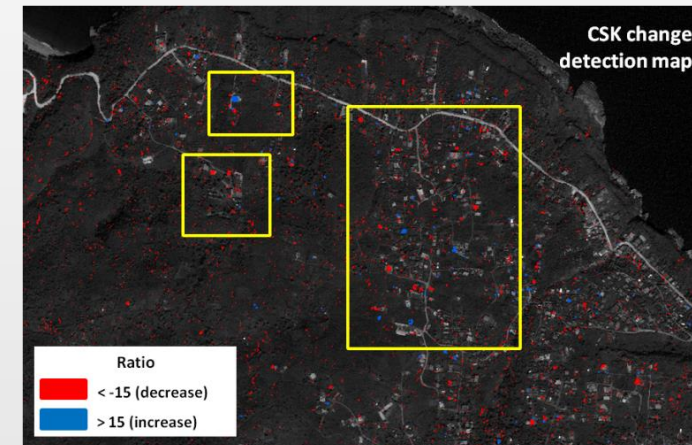
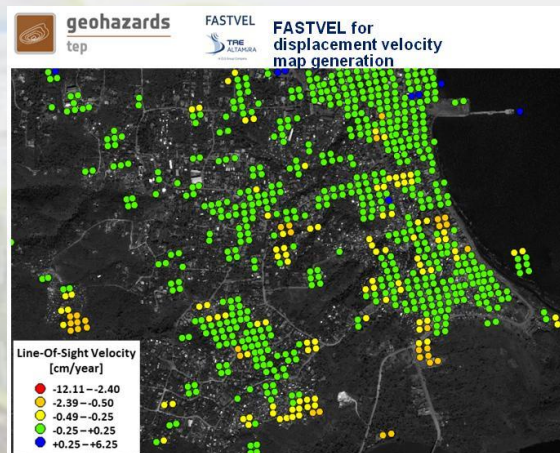
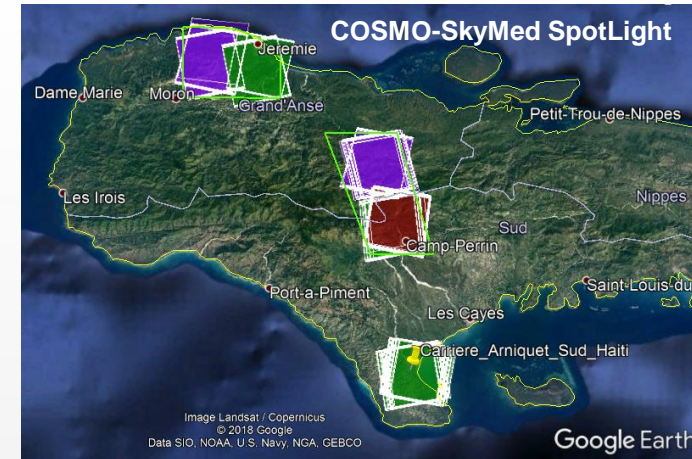
## **P01: Assessment and qualification of areas where EQ/Grace landslides have occurred, in Grand Sud peninsula**

- surface of lost areas in ha (inside and outside Macaya park)
- type of land-use affected by landslides, with at least the following nomenclature :
  - agriculture / annual crops
  - agriculture / other crops
  - wooded natural areas
  - grassland/bush natural areas
  - natural rocky areas
  - urban areas, houses, ...
- surface (in ha) of lost area for each category of land-use, inside and outside Macaya park





- Contribute to Recovery & Reconstruction Framework (i.e. after PDNA analysis)
- New COSMO-SkyMed data over same CEOS RO pilot AOIs (Jérémie, Camp Perrin) - also to share through GEP (**TBC with ESA**)
- SAR pair **change detection analysis** for land surface changes
- Joint interpretation for value adding with Haitian partners
- Available to analyze TerraSAR-X data too (**if new coverage is provided by DLR**)
- Use of ESA GEP to process new Sentinel-1 data (**Request for ESA sponsorship of CEOS RO 2021 EQ DEMO project**)







- International Disaster Charter: <https://cgt.disasterscharter.org/en/729/836>

**Charter Geobrowsing Tool**

**Activation-729 - Earthquake in Haiti**

Activation 729 Acquisitions 545 Products 8 Search

**Filters**

Resolution: Très Basse 0 Basse 15 Moyenne 1 Haute 205 Très Haute 324


Sensor: Optical 535 Radar 10

Satellite:  Select all


<input checked="" type="checkbox"/> CBERS4 1	<input checked="" type="checkbox"/> KANOPUS_V 12	<input checked="" type="checkbox"/> KANOPUS_V_IK 1	<input checked="" type="checkbox"/> LANDSAT8 5
<input checked="" type="checkbox"/> PlanetScope 192	<input checked="" type="checkbox"/> PLEIADES 75	<input checked="" type="checkbox"/> RESURS_P 2	<input checked="" type="checkbox"/> SENTINEL_1 10
<input checked="" type="checkbox"/> US-VHR 254	<input checked="" type="checkbox"/> VISION-1 2		

US-VHR 245  VISION-1 2


Toggle all footprints  Toggle all quicklooks



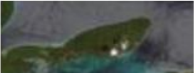
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EO\_IMAGER  
Aug 14, 2021, 03:47 PM




WORLDVIEW\_2  
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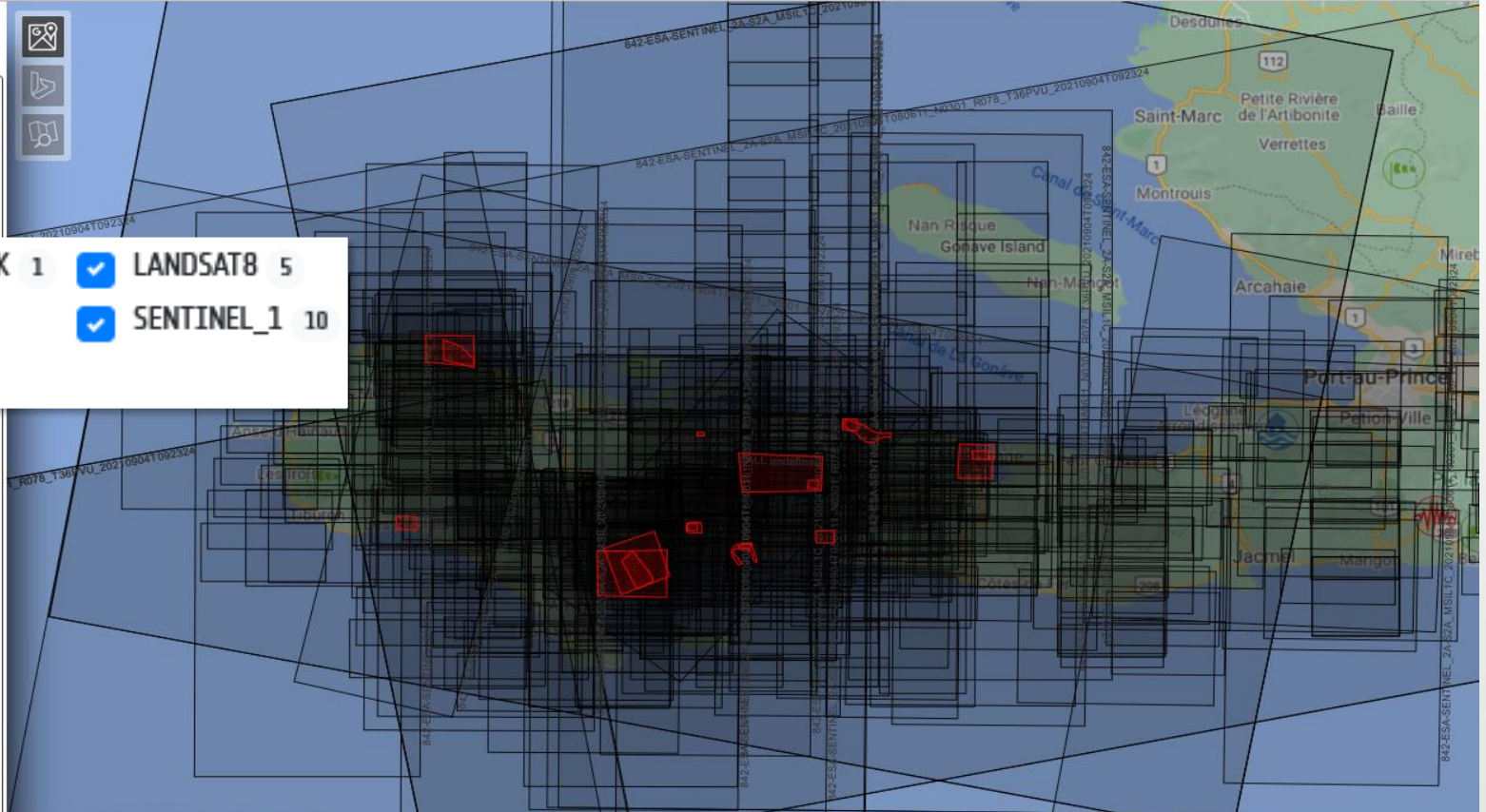
WORLDVIEW\_2



WORLDVIEW\_2



LANDSAT8







- International Disaster Charter: <https://cgt.disasterscharter.org/en/730/840>

**Charter Geobrowsing Tool**

**Activation-730 - Flooding in Haiti**

Activation: 730 | Acquisitions: 39 | Products: 6 | Search

**Filters**

Resolution: Très Basse 0 | Basse 28 | Moyenne 7 | Haute 3 | Très Haute 1

Sensor: Optical 5 | Radar 34

Satellite:  Select all

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<input checked="" type="checkbox"/> SAOCOM-1 4	<input checked="" type="checkbox"/> SENTINEL_1 23	<input checked="" type="checkbox"/> SENTINEL_2 2	<input checked="" type="checkbox"/> TERRASAR_X 4
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Toggle all footprints |  Toggle all quicklooks

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SENTINEL\_1B  
SAR\_ESA  
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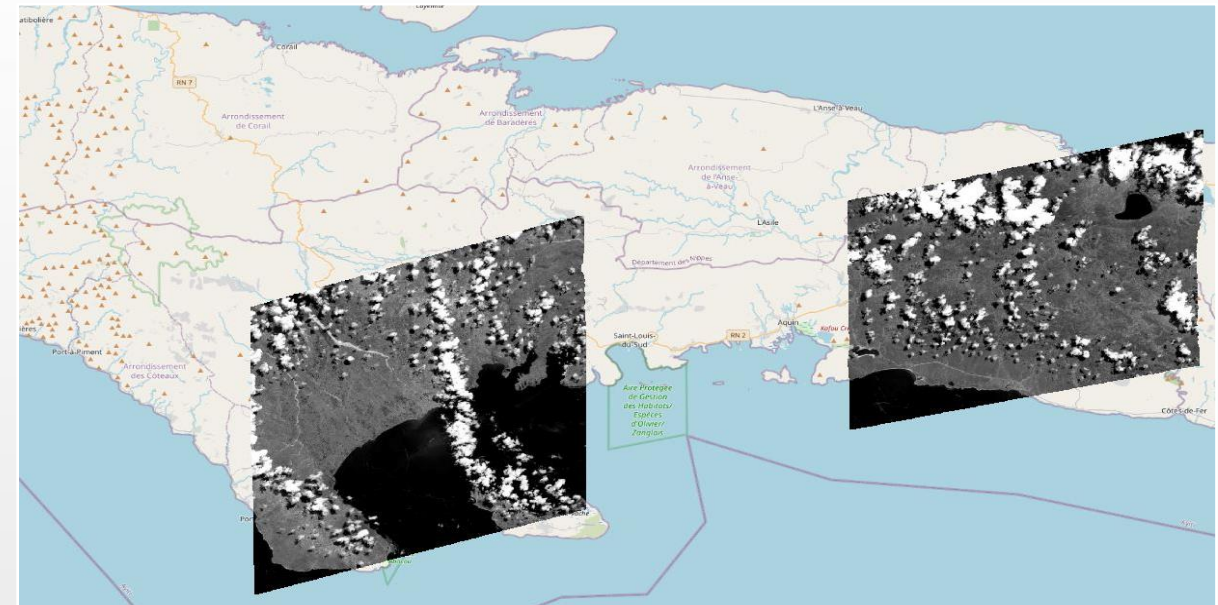
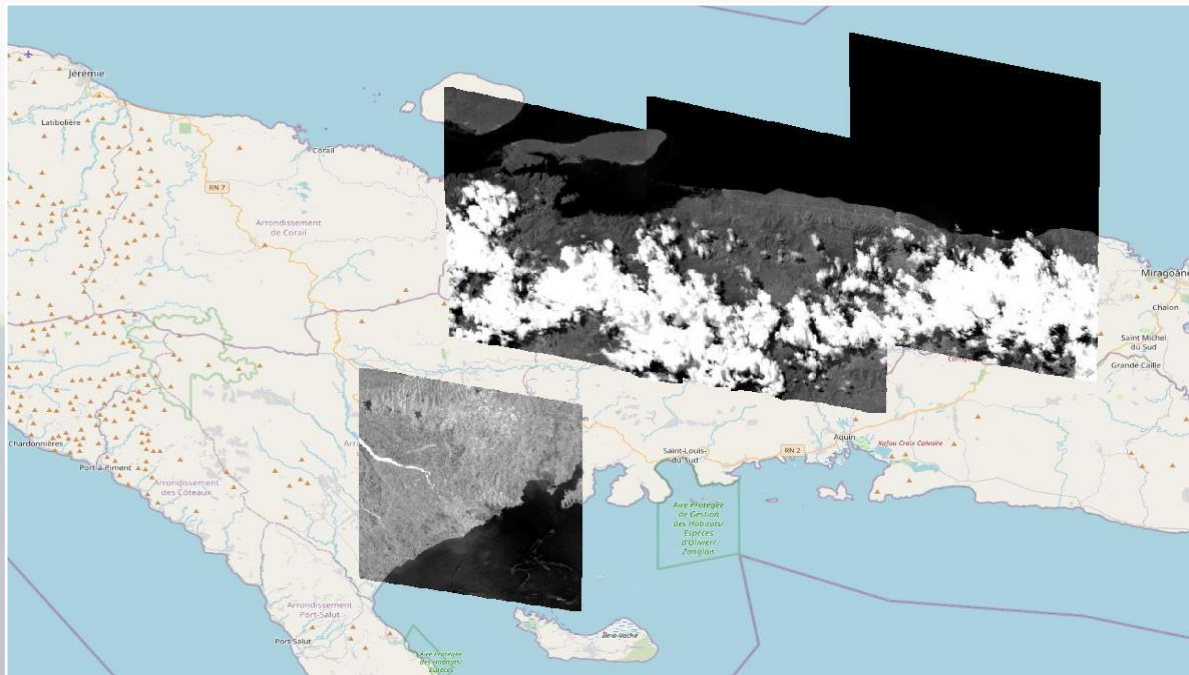
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- DigitalGlobe / Maxar contribution: <https://www.maxar.com/open-data/haiti-earthquake-2021>





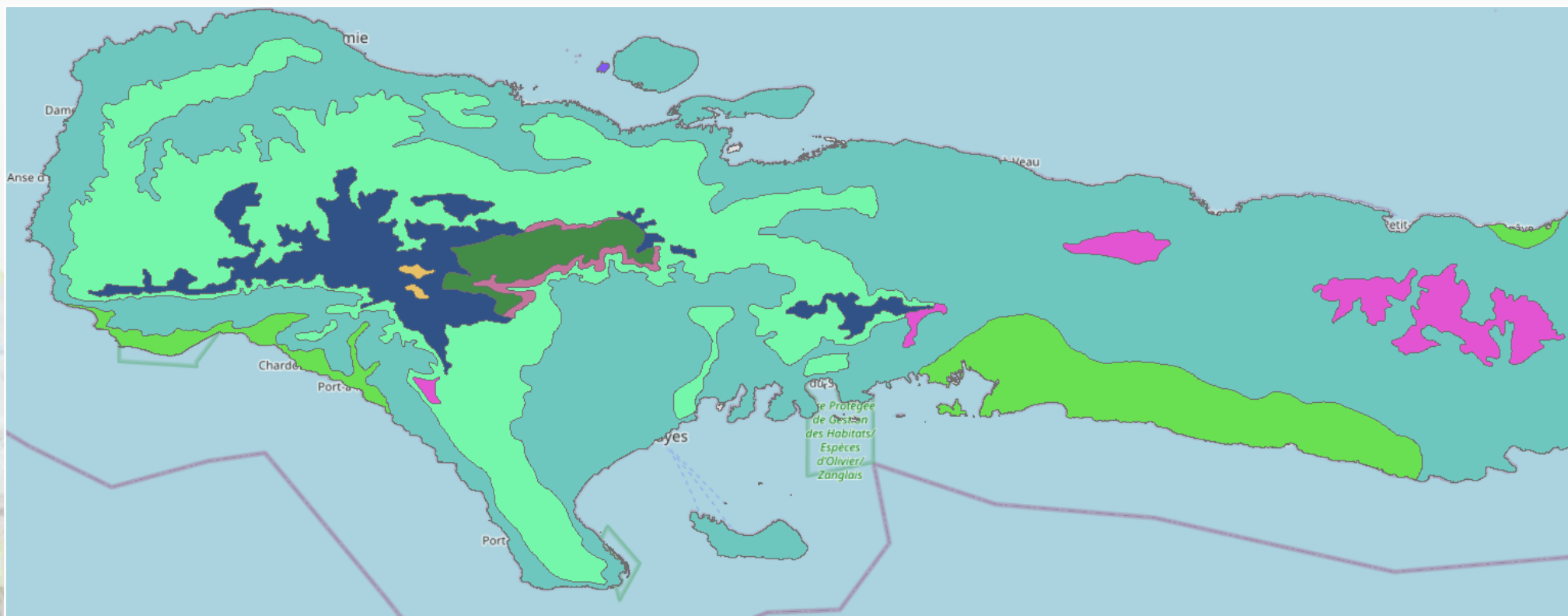


Type: Landuse

Producer: CNIGS

Name: Zone de vie

- Subtropical Dry Forest
- Subtropical Lower Montane Moist Forest
- Subtropical Lower Montane Rain Forest
- Subtropical Lower Montane Wet Forest
- Subtropical Moist Forest
- Subtropical Montane Wet Forest
- Subtropical Rain Forest
- Subtropical Thorn Woodland
- Subtropical Wet Forest













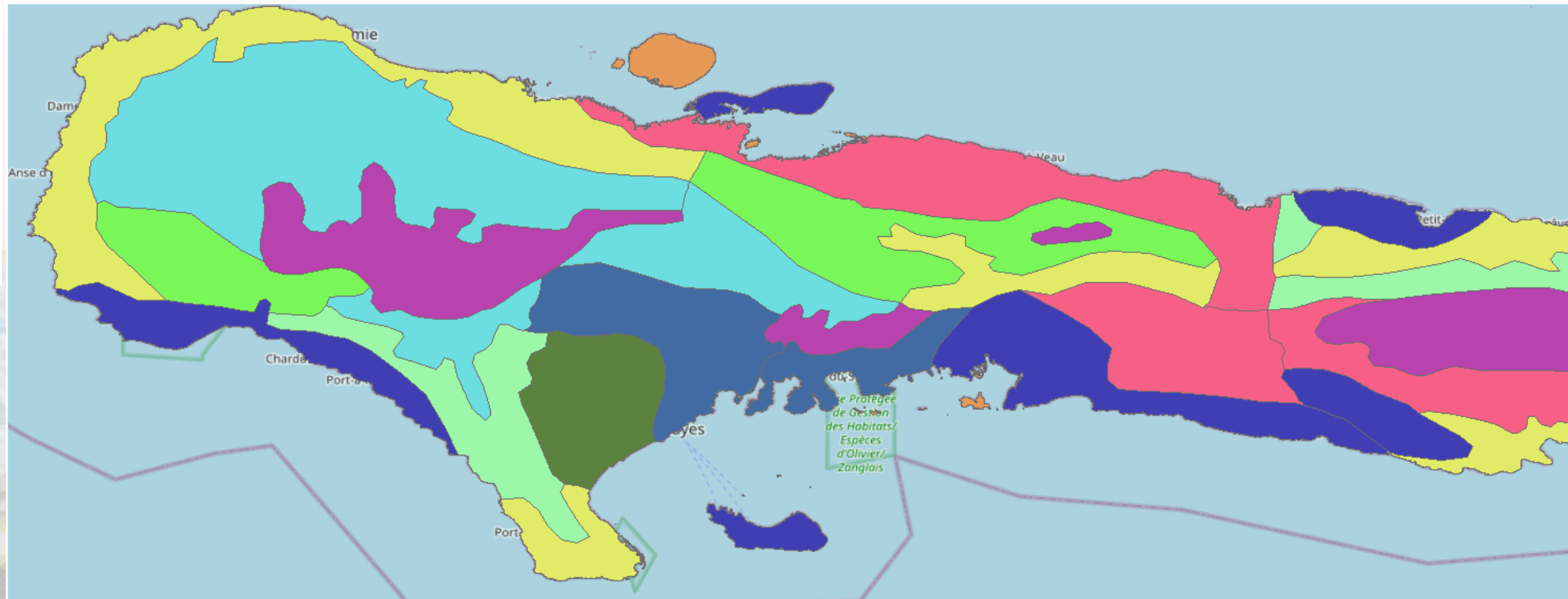


Type: Landuse

Producer: CNIGS

Name: Zone agro-écologique

-  Montagne humide de basses altitudes
-  Montagne semi humide
-  Montagne très humide
-  Plaine aride
-  Plaine humide
-  Plaine irriguée
-  Plaine semi humide
-  Plaine sèche et semi aride
-  Plateau, colline et morne semi-humide
-  Plateau, colline, morne sec et semi aride





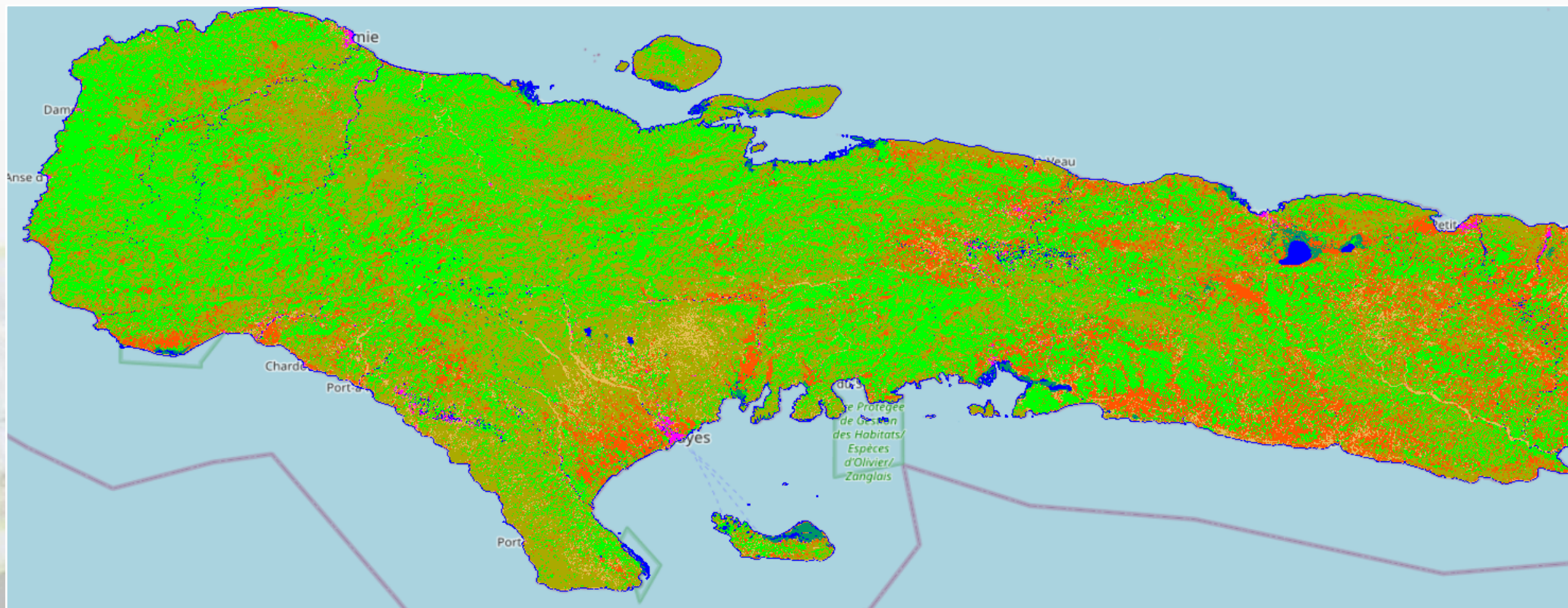


Type: Landuse

Producer: RO 2019

Name: IOTA<sup>2</sup>

- Surfaces bâties
- Cultures
- Végétation arborée
- Végétation herbacée
- Sol nu
- Zone humide
- Surfaces en eau





Type: Landslide / Damage proxy map

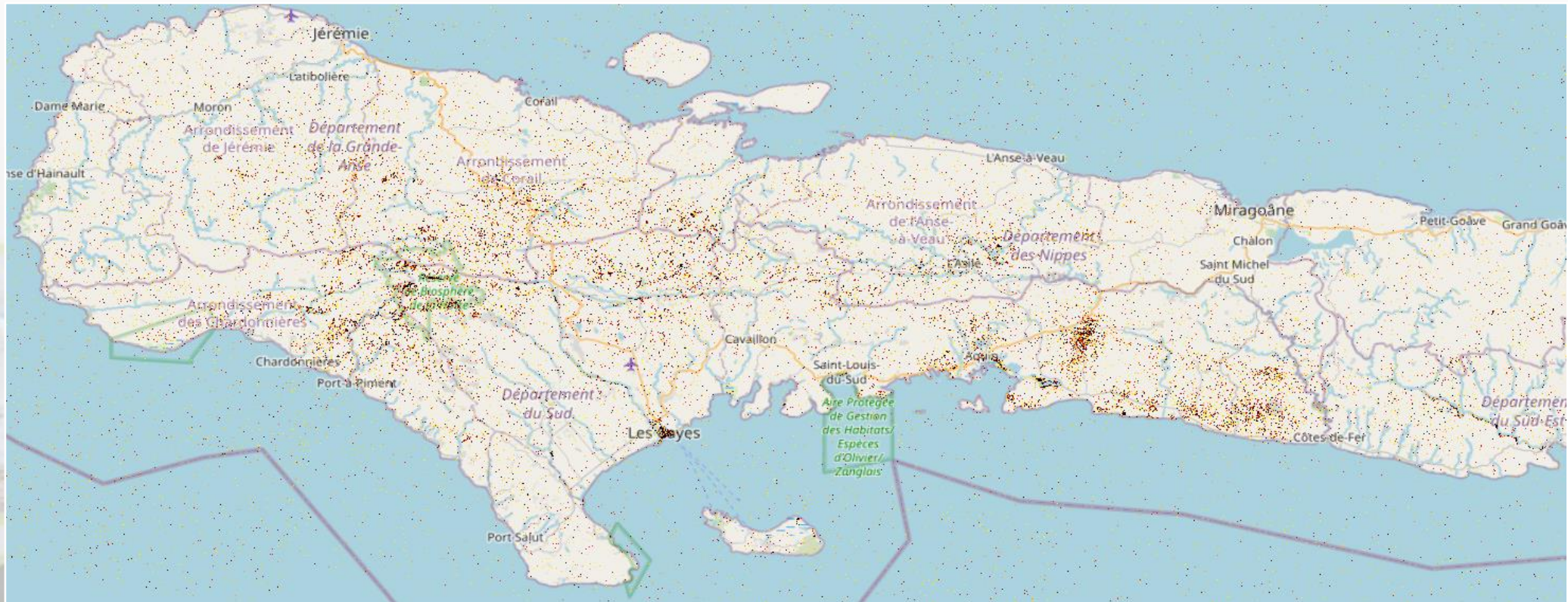
Producer: NASA

Name: ARIA

ARIA\_DPM\_Sentinel-1\_v2.tif

RGB

- Red: Band\_1
- Green: Band\_2
- Blue: Band\_3



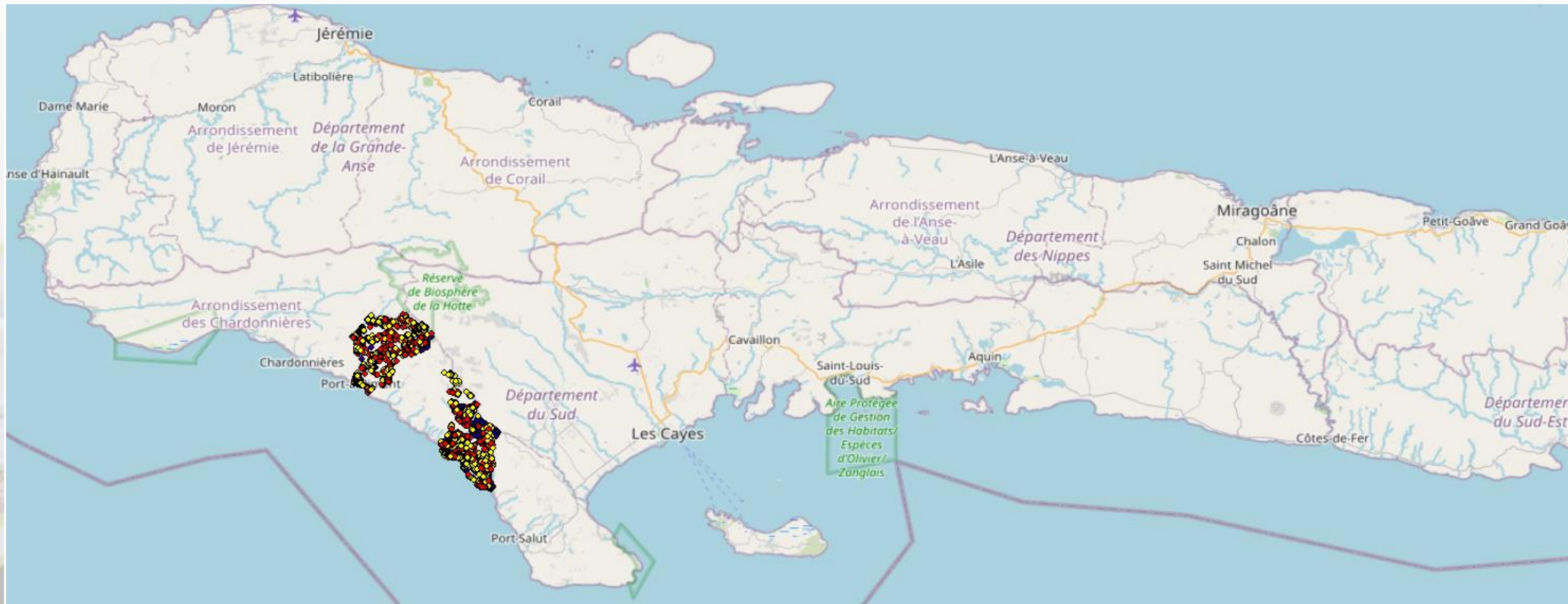




Type: Post 2021 Earthquake built-up impact

Producer: CNIGS

- Roche\_a\_Bateau
  - ◆ <all other values> Dommages
  - ◆ détruit
  - ◆ probablement endommagés
- Port-à-Piment\_batis\_seisme2021
  - ◆ <all other values> Dommages
  - ◆ détruit
  - ◆ probablement endommagés





Type: Impact (on buildings and roads, flood traces)

Producer: CEMS RM - [EMSR535](#)



AOIs

Crisis Information



Temporary camp



Flood trace

Built Up Grading

Destroyed

Damaged

Possibly damaged

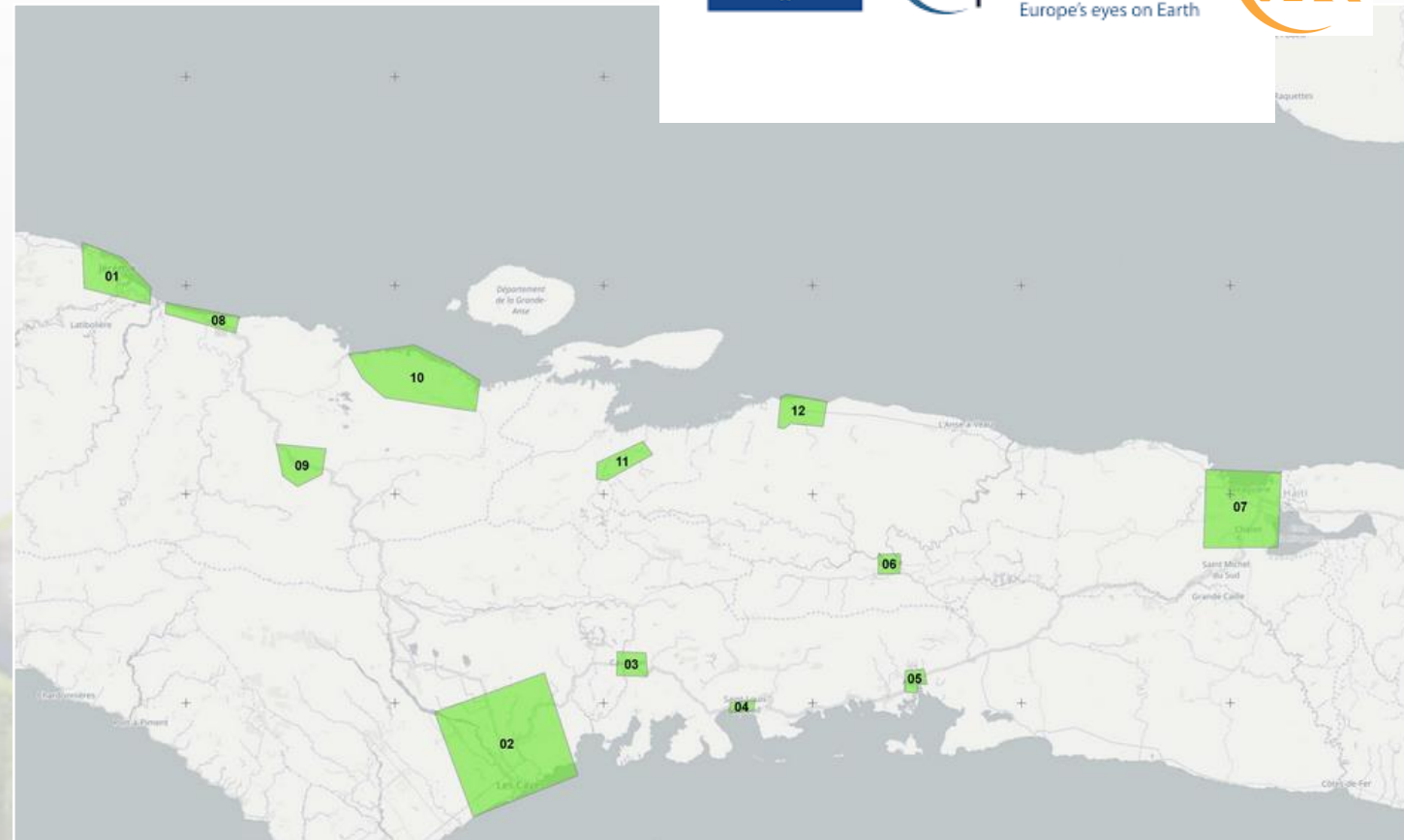
Transportation Grading

Road, Damaged

Road, Possibly damaged

Local Road, No visible damage

Cart Track, No visible damage



**HAITI**  
Earthquake - last updated 21/08/2021  
Activation Extent Map



Cartographic Information

1:300000 Full color ISO A2, medium resolution (200 dpi)  
Tick marks WGS 1984 UTM Zone 18N map coordinate system

Legend

Completed	
AD01 / Jérémie COMPLETED - Grading Product: Pieces: 15/08/2021 15:41 UTC	AD07 / Miragoâne COMPLETED - Grading Product: Pieces: 15/08/2021 15:41 UTC
AD02 / Les Cayes COMPLETED - Grading Product: Pieces: 15/08/2021 15:42 UTC	AD08 / Roseaux COMPLETED - Grading Product: Pieces: 15/08/2021 15:18 UTC
AD03 / Cap-Haïtien COMPLETED - Grading Product: Pieces: 15/08/2021 15:42 UTC	AD09 / Beaumont COMPLETED - Grading Product: Pieces: 15/08/2021 15:19 UTC
AD04 / Saint-Louis-du-Sud COMPLETED - Grading Product: Pieces: 15/08/2021 15:42 UTC	AD10 / Corail COMPLETED - Grading Product: Pieces: 15/08/2021 15:19 UTC
AD05 / Aquin COMPLETED - Grading Product: Pieces: 15/08/2021 15:41 UTC	AD11 / Baradères COMPLETED - Grading Product: Pieces: 20/08/2021 15:52 UTC
AD06 / Lesle COMPLETED - Grading Product: GeoEye-1: 16/08/2021 15:13 UTC	AD12 / Petit-Trou-de-Nippes COMPLETED - Grading Product: Pieces: 15/08/2021 15:19 UTC





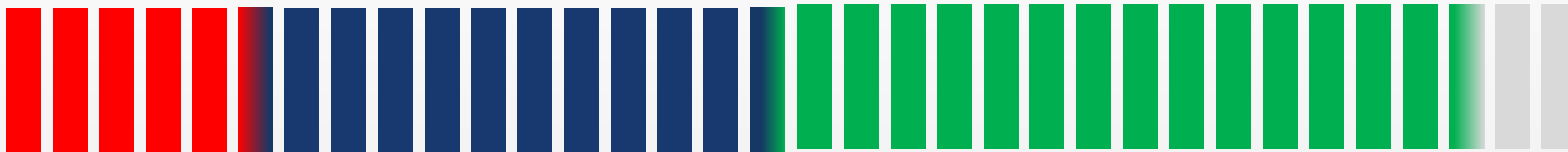
**Disaster Event**



**Post Disaster Needs Assessment**



**Disaster Recovery Framework**



Emergency & Humanitarian Response: satellite imagery of

Assessment process supported by more focused, sector specific images of pre and post disaster situation:

Continued use of selected imagery to monitor and document recovery processes 6 Months +

## Sustainable RO, integrated into Recovery process

and population

connectivity networks

**Emergency Response**

RNA/GRADE

PDNA

DRF  
REC PLANNING

RECOVERY M&E



# Thank you for your attention!

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[andrew.eddy@athenaglobal.com](mailto:andrew.eddy@athenaglobal.com)

