



Committee on Earth Observation Satellites

14. Recovery Observatory Demonstrator

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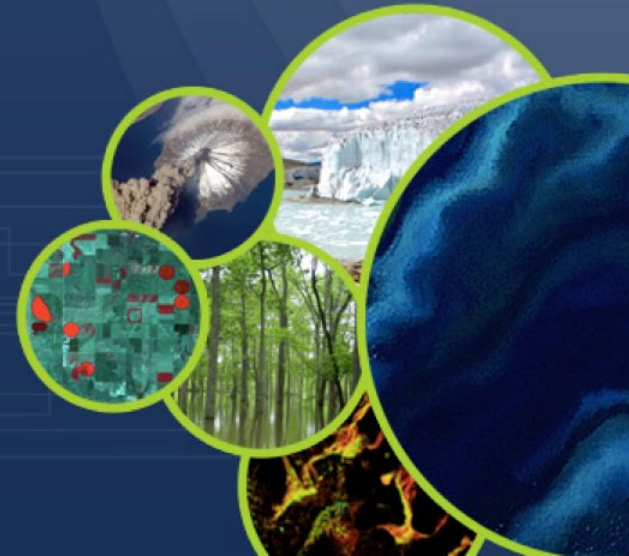
Dominique Blariaux (Particip – EU/FPI)

Marcelo Oyuela (CEPREDENAC)

Mathias Studer and Mathilde Caspard (Icube-SERTIT)

WG Disasters 17 (virtual)

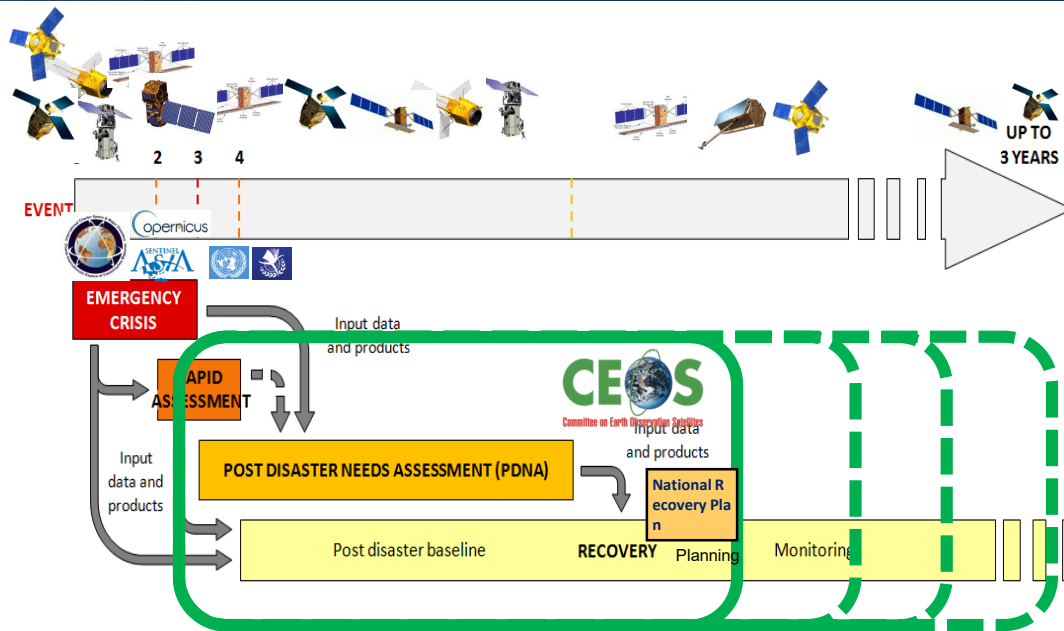
16 March 2022





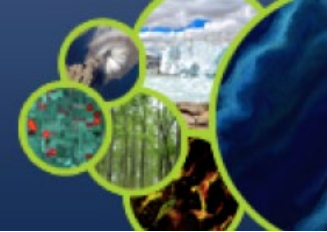
- **Introduction**
- RO Eta-Iota
- RO Haiti EQ
- Concept Paper, Sustainability and Next Steps

Objective in medium term : RO integrated in Recovery process



“Recovery Observatory” : Process allowing operational use of EO for Rapid Assessments, PDNA, Recovery planning & Recovery M&E

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



Disaster Event



Post Disaster Needs Assessment



Disaster Recovery Framework



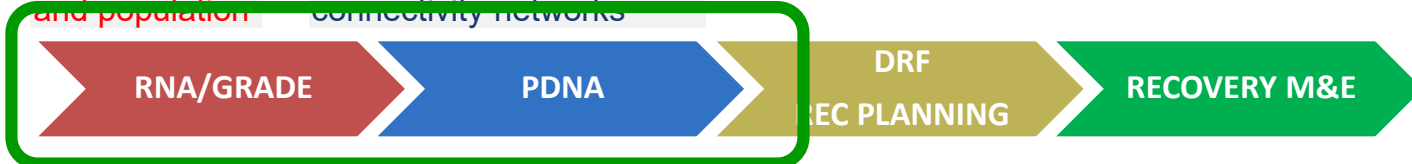
Emergency & Humanitarian Response: satellite imagery of

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



RO Demonstrator

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,



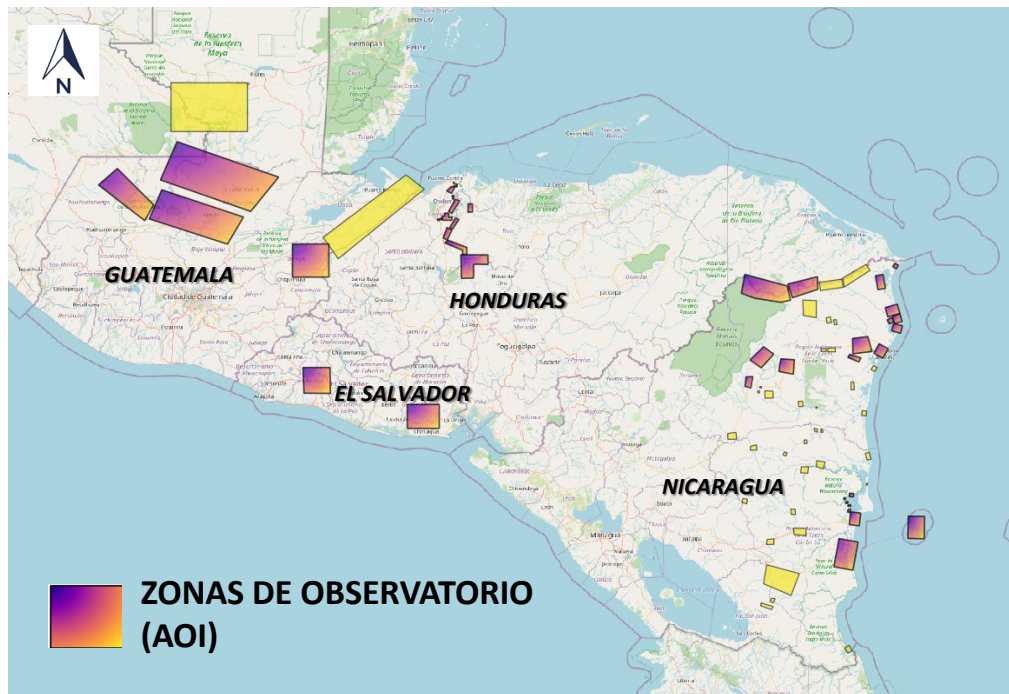
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RO Eta/Iota Project Team



Priority Damage Zones (post Eta/Iota)*

Honduras (1,200 km²), El Salvador (1,900 km²),
Nicaragua (7,500 km²), Guatemala (20,000 km²)



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

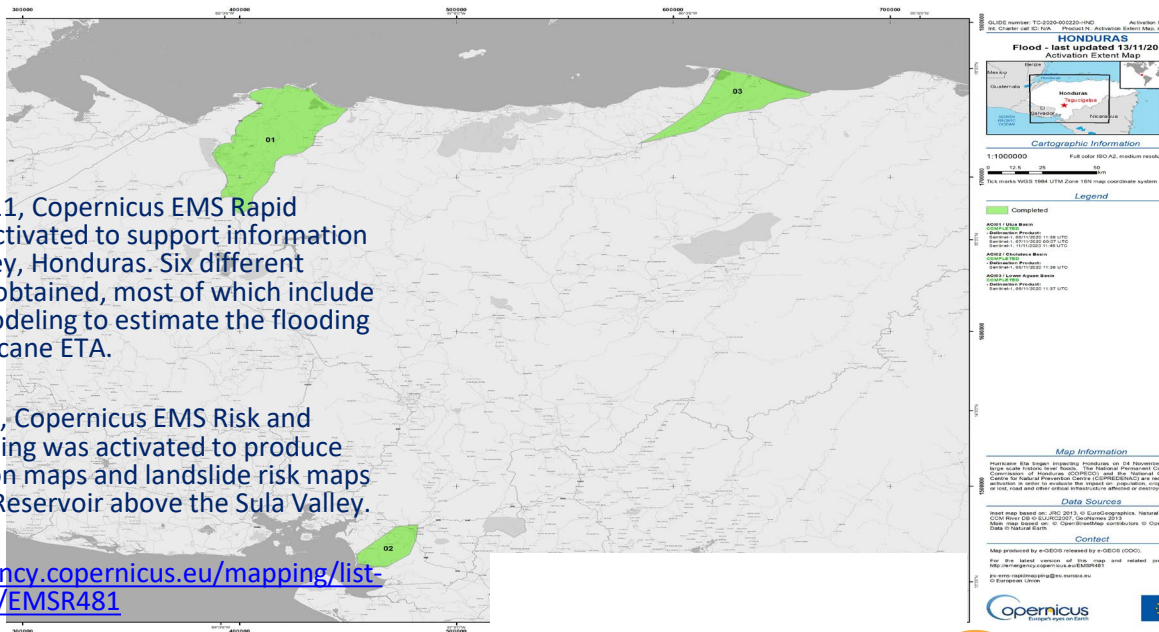


On November 11, Copernicus EMS Rapid Mapping was activated to support information in the Sula Valley, Honduras. Six different products were obtained, most of which include hydrological modeling to estimate the flooding caused by hurricane ETA.

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.

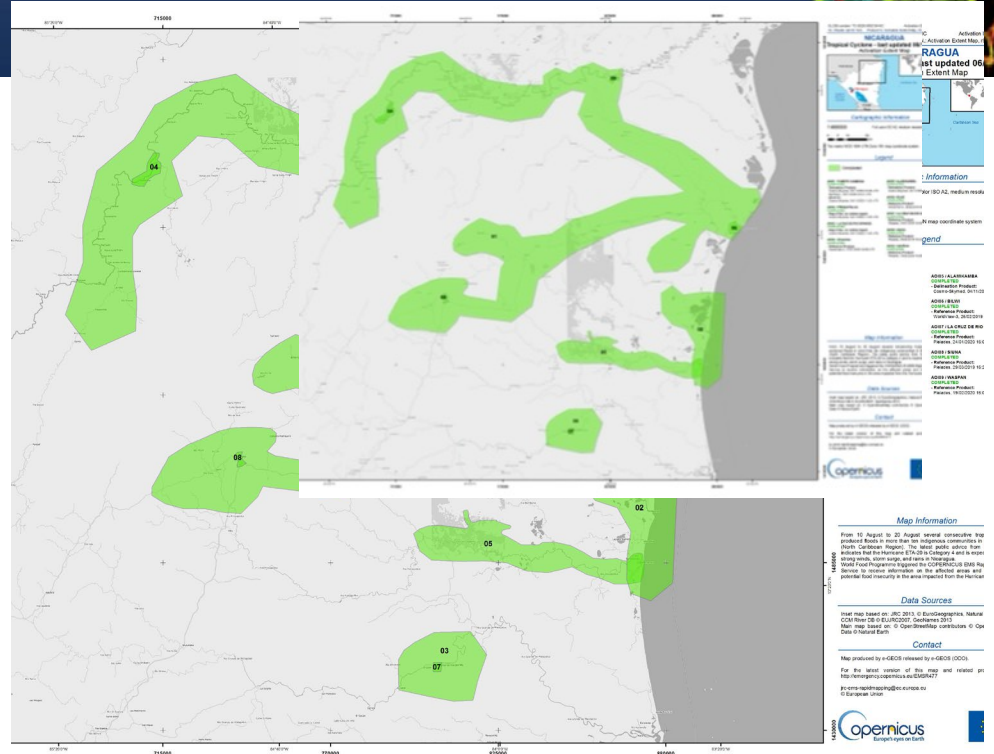
<https://emergency.copernicus.eu/mapping/list-of-components/EMSR481>

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



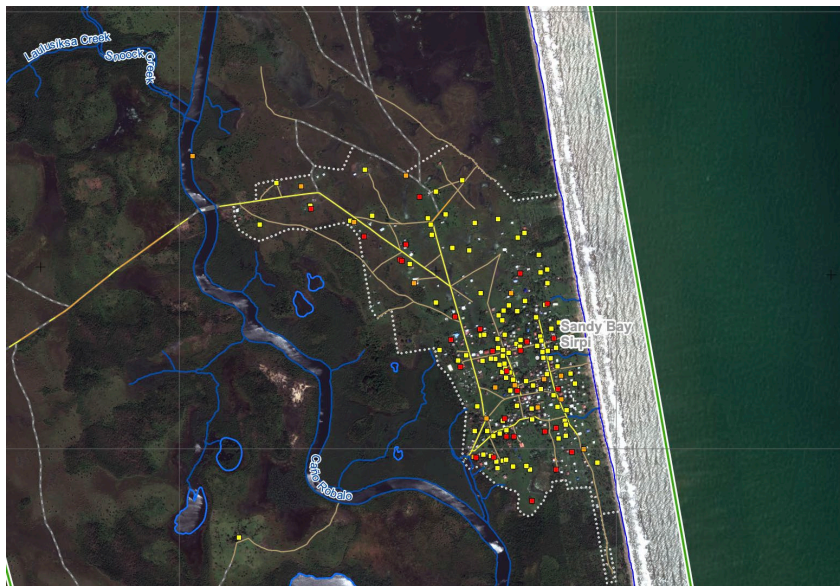
As a follow-up to the ETA / IOTA events, Copernicus EMS Rapid Mapping was activated to provide information in the northern Caribbean area of Nicaragua. 16 different products were obtained that include identification of the impact zones, affected areas with food insecurity and affected infrastructure. 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 km²), as well as Damage assessment (P08) for the area of Sandy Bay Sirpi (25 km²).



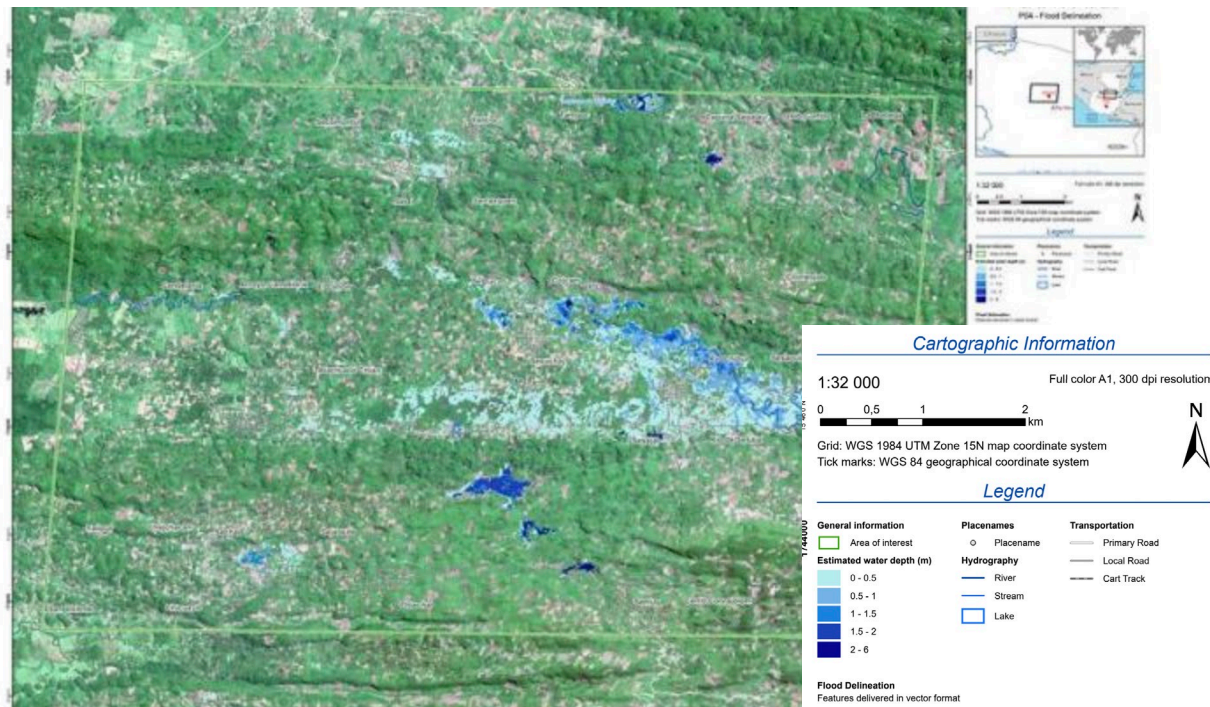
Sample product for Nicaragua RR
M activation

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.





Sesajal Flood Delineation 1:32 000, Guatemala



Sample product for GuatemalaRR
M activation



Imagery and Resources

- 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).
- Interferometric monitoring of flood infrastructure: monitor Sula Valley for catastrophic flood infrastructure failure. eGEOS provided voluntary contribution based on Sentinel-1 data (5 years) and ASI-contributed dedicated acquisitions (3 months – possibility of continuing)
- Capacity development: UN-SPIDER planned CONAE-led capacity development at CEPREDENAC. Interest in SAR interferometry training in future.
- Longer-term risk reduction monitoring: proposal to GEO-DARMA being considered

ASI contribution to RO IOTA

- 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) – on-going now
- eGEOS has processed stack to end October 2021, and could process further
- Initial meeting held in March with CEPREDENAC. Further analysis of results and validation planned. Strong interest from CEPREDENAC. Further discussions with COPECHO planned for April.



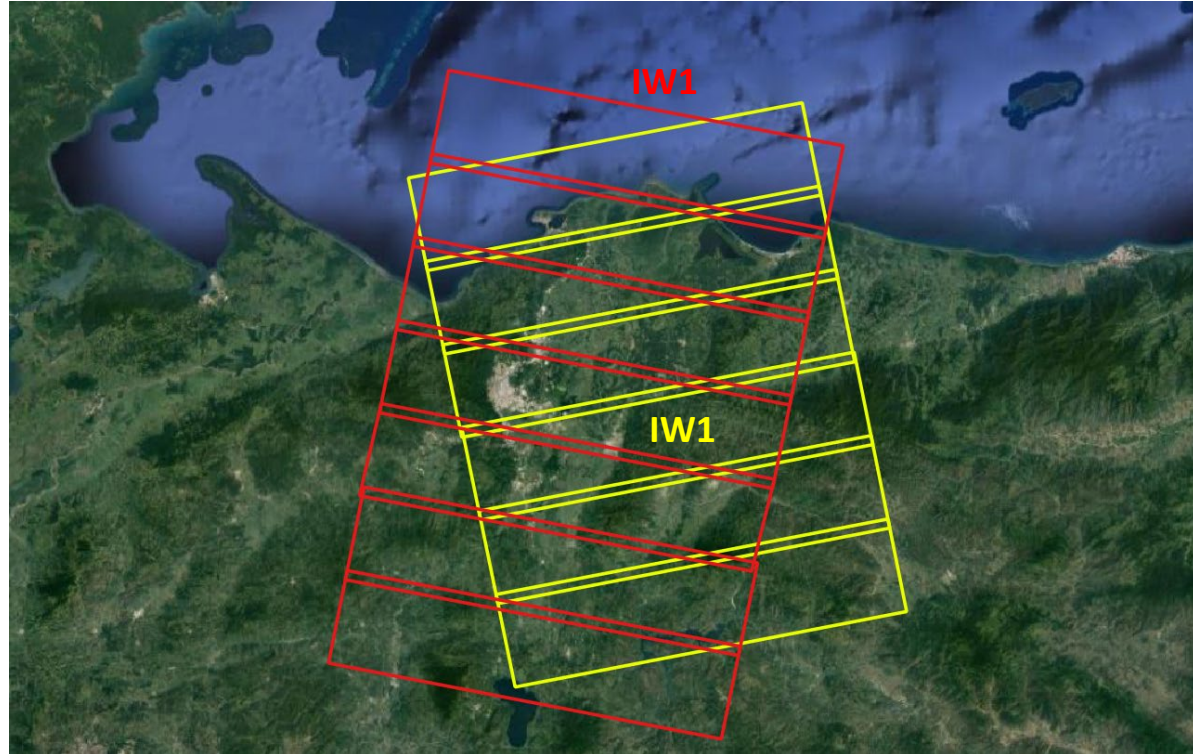
Honduras: Sentinel-1 dataset

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

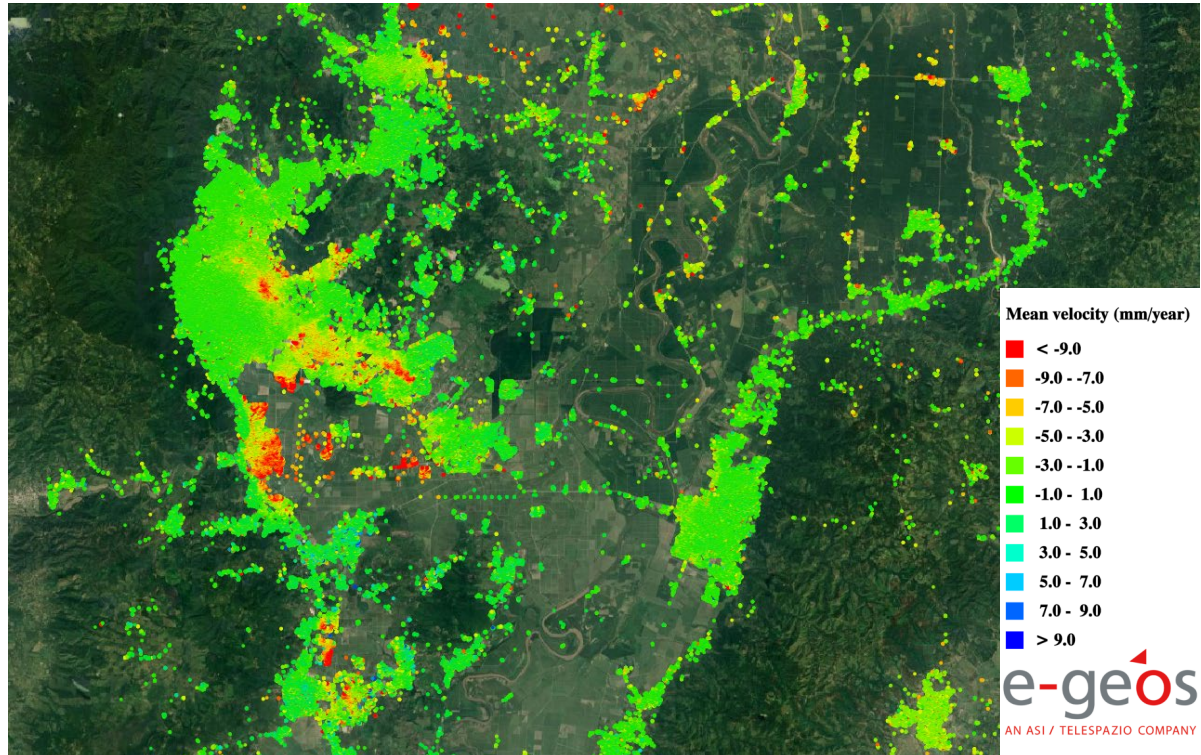
Geometry	Descending
Polarization	VV
N. Images	166
Acquisition mode	IW
Subswaths	IW1
Incidence angles	33.73°
Period of analysis	20150506 - 20210826



Ascending geometry: results

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

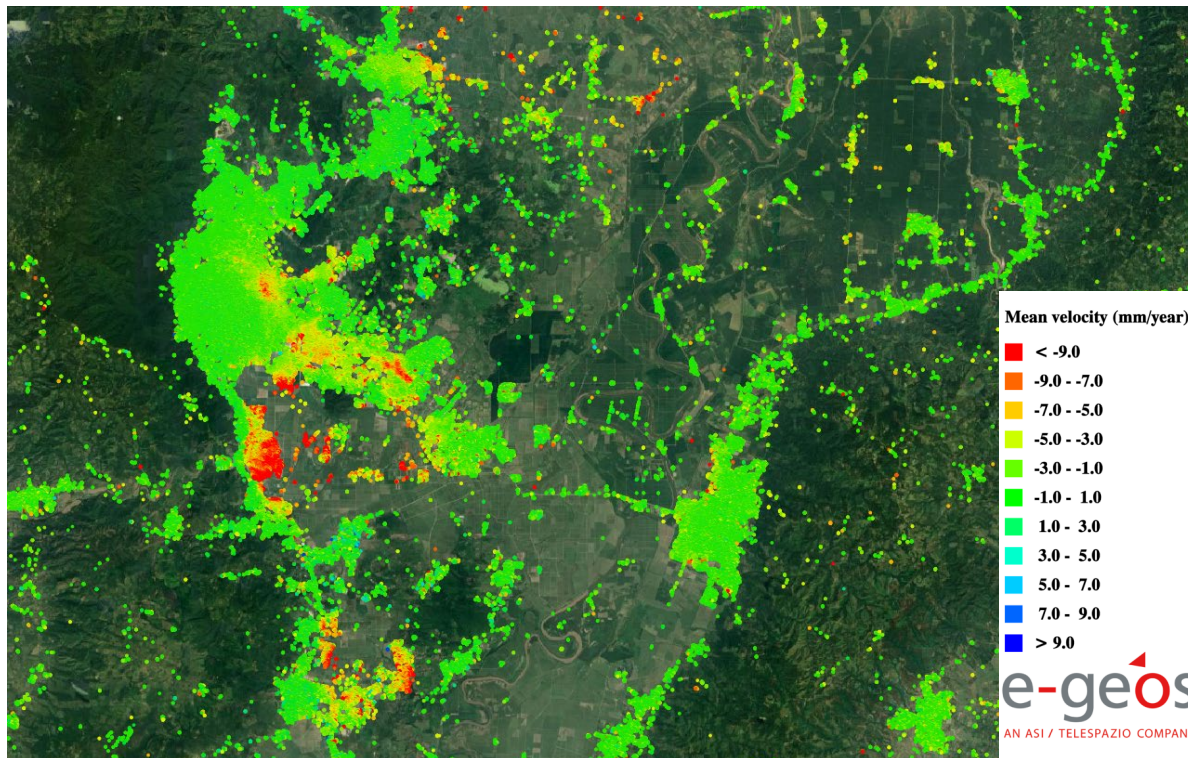
Mean velocity map



Descending geometry: results

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

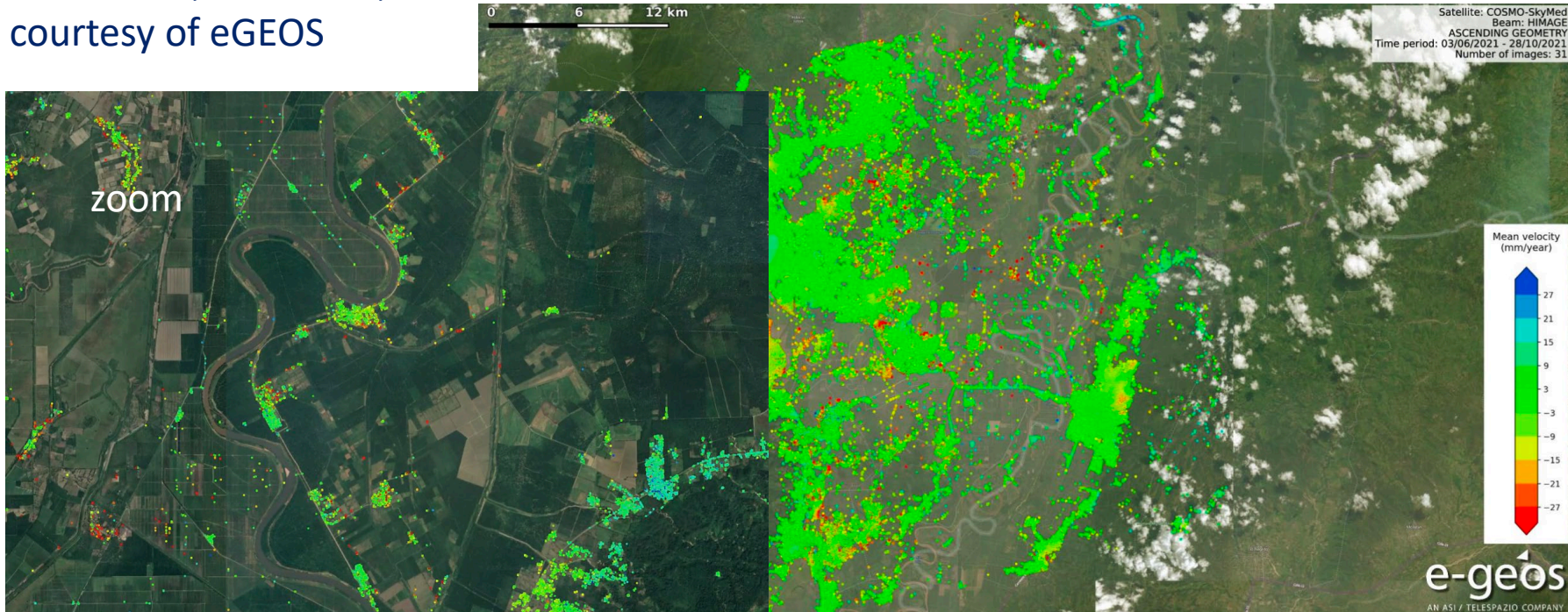
Mean velocity map



Integrated CSK Analysis

- CSK high resolution sample product in San Pedro Pula, Honduras, courtesy of eGEOS

Mean velocity map





PROS

- Access to an extensive and diverse catalog of available products (special interest in SAR interferometry 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 (strong variety covering range of products and geographies)
- Access to technical capacity of international specialists (and possibly follow-ons through capacity building – link to CEOS WGCapD RO training for Decision Makers)

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 some products of the Observatory it is necessary to separately activate other services (e.g. Copernicus EMS).
- The beneficiary countries did not use all the products delivered optimally for various reasons: ignorance, interpretation capacity and most of the time this information does not reach decision makers in time.



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3rd RO activation: September 6th, 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 2021) => PHASE 1
- to support the **Recovery Framework** (by end of February 2022) => PHASE 2

Contributors/Partners





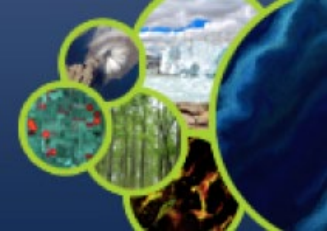
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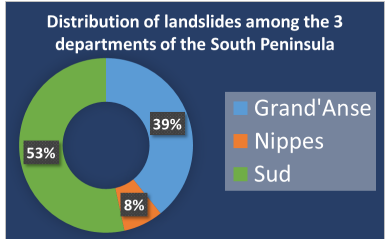
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Initial products:

P01	Assessment and qualification of areas where EQ/Grace landslides have occurred, in South Peninsula	Phase 1
P02	Comparison of landcover maps of the South Peninsula before and after EQ/Grace	Phase 2
P03	Assessment of modifications to the hydrographic network in the South Peninsula, further to EQ/Grace	Phase 2



P01: Assessment and qualification of areas where EQ/Grace landslides have occurred, in South Peninsula



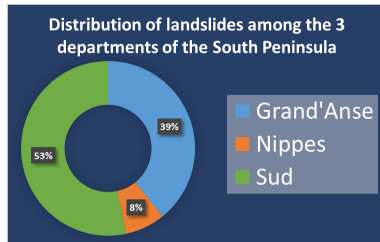
Landslides

South Peninsula: 6949.02 Ha
 Grand'Anse area: 2723.46 Ha





P01: Assessment and qualification of areas where EQ/Grace landslides have occurred, in South Peninsula

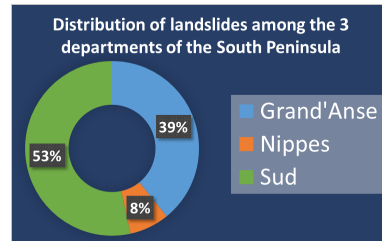


Landslides
 South Peninsula: 6949.02 Ha
 Nippes area: 515.62 Ha

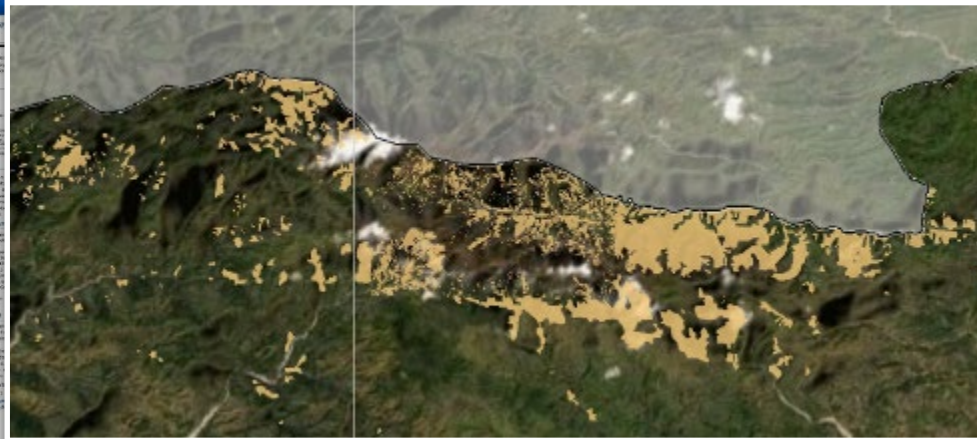




P01: Assessment and qualification of areas where EQ/Grace landslides have occurred, in South Peninsula

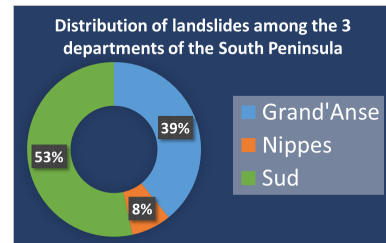


Landslides
 South Peninsula: 6949.02 Ha
 Sud area: 3709.94 Ha





P01: Assessment and qualification of areas where EQ/Grace landslides have occurred, in South Peninsula



Landslides

South Peninsula: 6949.02 Ha
Macaya Park area: 1901.66 Ha





P01: EO: a valuable tool for assessing the agricultural, environmental and economic impact

Les images satellites que nous avons pu recueillir auprès du CEOS¹⁴⁵, font état d'un total de 6, 949,02 ha de glissements de terrain dans l'ensemble des trois départements. Ces informations, croisées avec des données antérieures d'occupation des sols, ont permis de constater une perte de 4,114 ha de végétation arborée : Grand'Anse/ 1,687 ha, Nippes/ 297 ha et Sud : 2,130 ha.

Selon une analyse établie par le SERTIT, plus de 431 Ha de cultures agricoles denses, 567 ha de systèmes agro-forestiers denses, 1251 ha de cultures agricoles moyennement denses et 154 ha de pâturages auraient été affectés par les glissements de terrains dans les trois départements.⁴⁶

Les Dommages : les dommages les plus importants se retrouvent dans le sous-secteur des cultures, avec des dommages sérieux sur les terres agricoles, perdues à la suite des nombreux glissements de terrains et éboulements (13,9 millions \$US) et sur les infrastructures hydro-agricoles, principalement dans le département du Sud (2,4 millions \$US). Le sous-secteur de l'élevage a subi un montant total de dommage de 4,9 millions \$US, notamment avec la disparition d'animaux et les destructions d'infrastructures (poulaillers, porcheries) et pâturages. Dans le sous-secteur de la pêche, les dommages consistent principalement en la destruction ou l'enlèvement des outils de pêche (0,55 million \$US)³¹.

RAPPORTS SECTORIELS

Évaluation Post-Désastre En Haïti



Séisme du 14 août 2021 dans la péninsule sud



Avec l'appui de





Phase 2: Recovery Framework “PRISP” (PLAN DE RELÈVEMENT INTÉGRÉ DE LA PÉNINSULE SUD)

The PDNA report was released on November the 23th

To support the Recovery Framework, 5 products (3 new products) are planned:

P01	<i>Assessment and qualification of landslides</i>	<i>Phase 1</i>	<i>SERTIT</i>	<i>Done</i>
P01bis	Computation of a Landslide risk index	Phase 2	SERTIT	Done
P02	Comparison of landcover maps	Phase 2	CNIGS / ASI	In production
P03	Assessment of modifications to the hydrographic network	Phase 2	CIMA + LIST	Expected in April 2022
P04	Monitoring Mangrove tree cover	Phase 2	Copernicus RRM	SRF in preparation
P05	Built-up area monitoring	Phase 2	Copernicus RRM	SRF in preparation

?

COPERNICUS EMS RRM

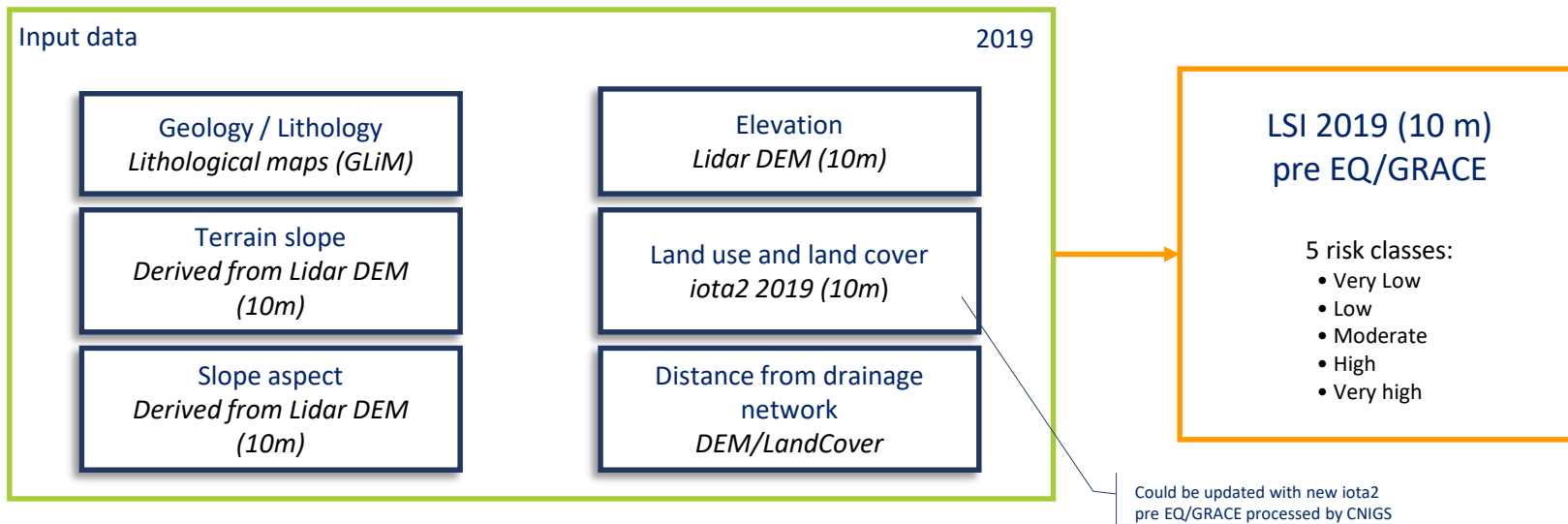
Risk & Recovery Mapping supplies geospatial information in support of Disaster Management activities including prevention, preparedness, risk reduction and recovery phases



Phase 2: Recovery Framework “PRISP” (PLAN DE RELÈVEMENT INTÉGRÉ DE LA PÉNINSULE SUD)

P01bis: Computation of a Landslide susceptibility index (LSI) over the South Peninsula

Methodology: approach based on the work of Vojteková et.al.* that assessed LSI using multi-criteria analysis

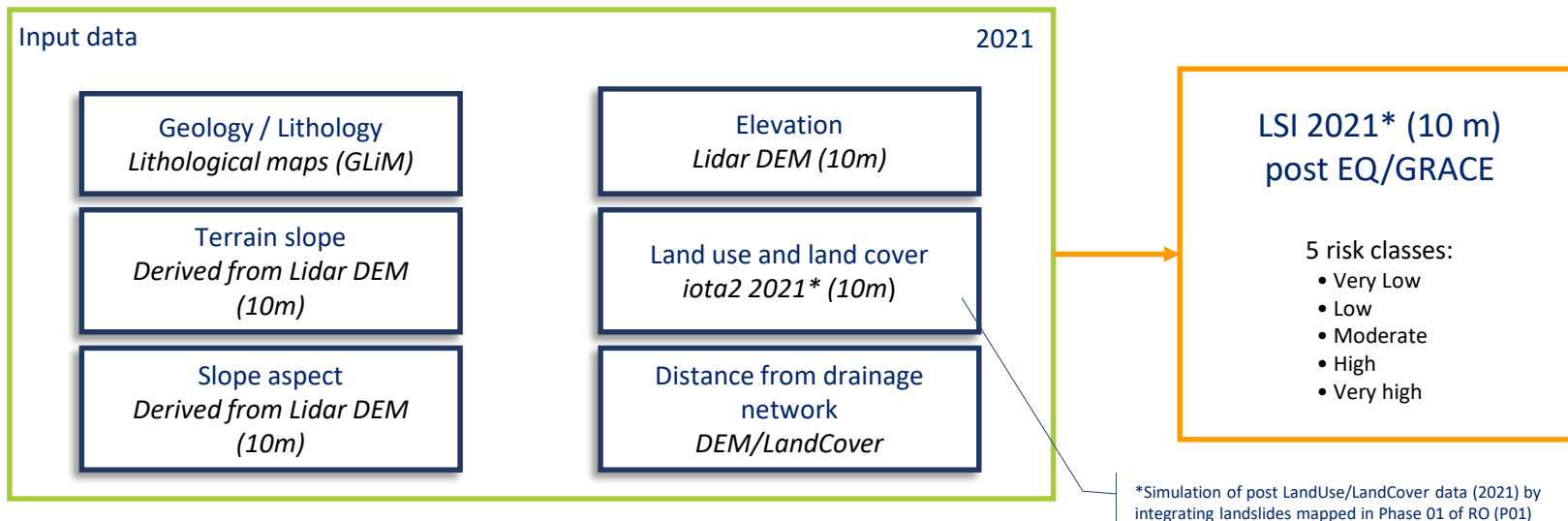


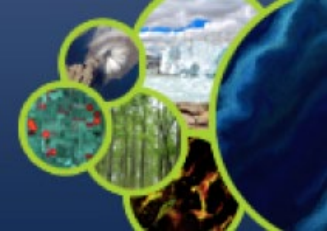


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Phase 2: Recovery Framework “PRISP” (PLAN DE RELÈVEMENT INTÉGRÉ DE LA PÉNINSULE SUD)

P01bis: Computation difference of Landslide susceptibility index (LSI) over the South Peninsula 2019-2021

Methodology: based on a difference of LSI 2019 and LSI 2021 computation

LSI 2021 (10 m)
post EQ/GRACE

-

LSI 2019 (10 m)
pre EQ/GRACE

=

Increase of LSI
2019-2021
*Augmentation du risque
glissement de terrain*



2019

Landslide Risk

- Very High
- High
- Moderate
- Low
- Very low
- Not applicable



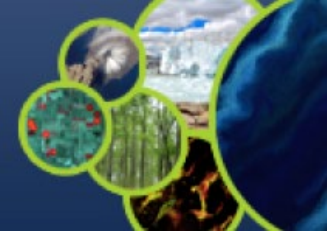


2021


Landslide Risk

- Very High
- High
- Moderate
- Low
- Very low
- Not applicable






2019-2021


 Landslide risk increase



 Bureau d'assistance
Région des Caraïbes
1015 10 mai 2022

Haiti - Péninsule Sud Augmentation du risque glissement de terrain 2019-2021

Cartes de localisation



Information géographique

Projection locale: WGS 1984 UTM Zone 18N Datum: WGS
Projection géographe: Lambert DMS Datum: WGS
Echelle: 1:250 000 sans déformation X

Legende

- Augmentation du risque glissement de terrain

Interpretation

Le 24 août 2021, un séisme de magnitude 7,2 a touché la péninsule sud-est de l'île, soit le 21 août 2021, le séisme tectonique Grand-Sud a également touché la zone. Ces deux événements ont causé de nombreux glissements de terrain sur les 3 départements de Grande-Anse, Nippes et Sud. Entre autres incidents, dans le cadre de 303 jours consécutifs, 73 agents de la coupe gouvernementale de terre ont été tués et 2019 blessés dans la seule zone de glissement de terrain.

Sources des données



Modifications de coupe géométrique de terrain (D3D, Contour), topographique, Annuaire des données, inventaire de coupe, inventaire de coupe de terrain, CAD/CAD (D3D) de coupe, Occupation de sol 2019-2020, Occupation 2021 (Cote 2021) (tableau des glissements de terrain post-2021) de CDES D-CHS/D. © CDES-SERTIT 2022 - © CDES/UNEP/USP/Mapbox.com/© Data Sources © © CDES-2022 par © SERTIT 2022

Carte de travail

Ce produit de Cartographie Digitale a été élaboré en un temps très court, en réponse aux besoins de gestion d'urgence, une nouvelle qualité a été faite selon la procédure ISO 9001:2015 (DIN EN ISO 9001:2015).

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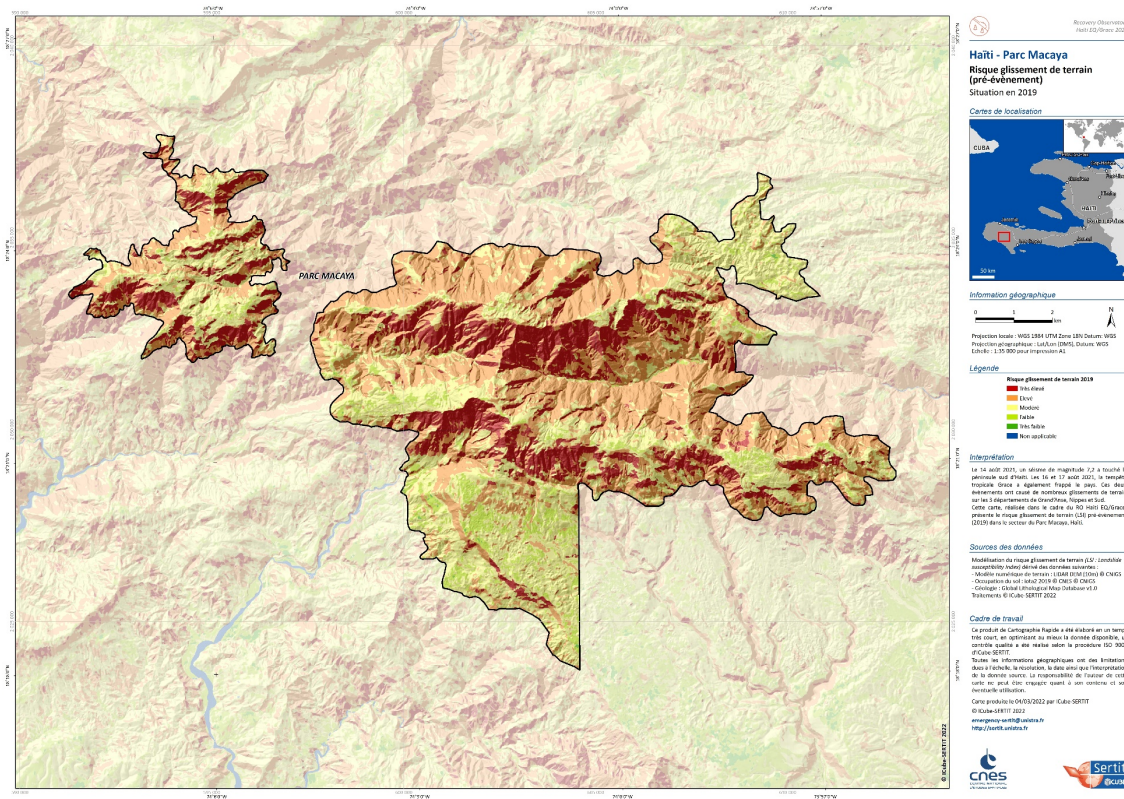
 



2019

Landslide Risk

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- Moderate
- Low
- Very low
- Not applicable

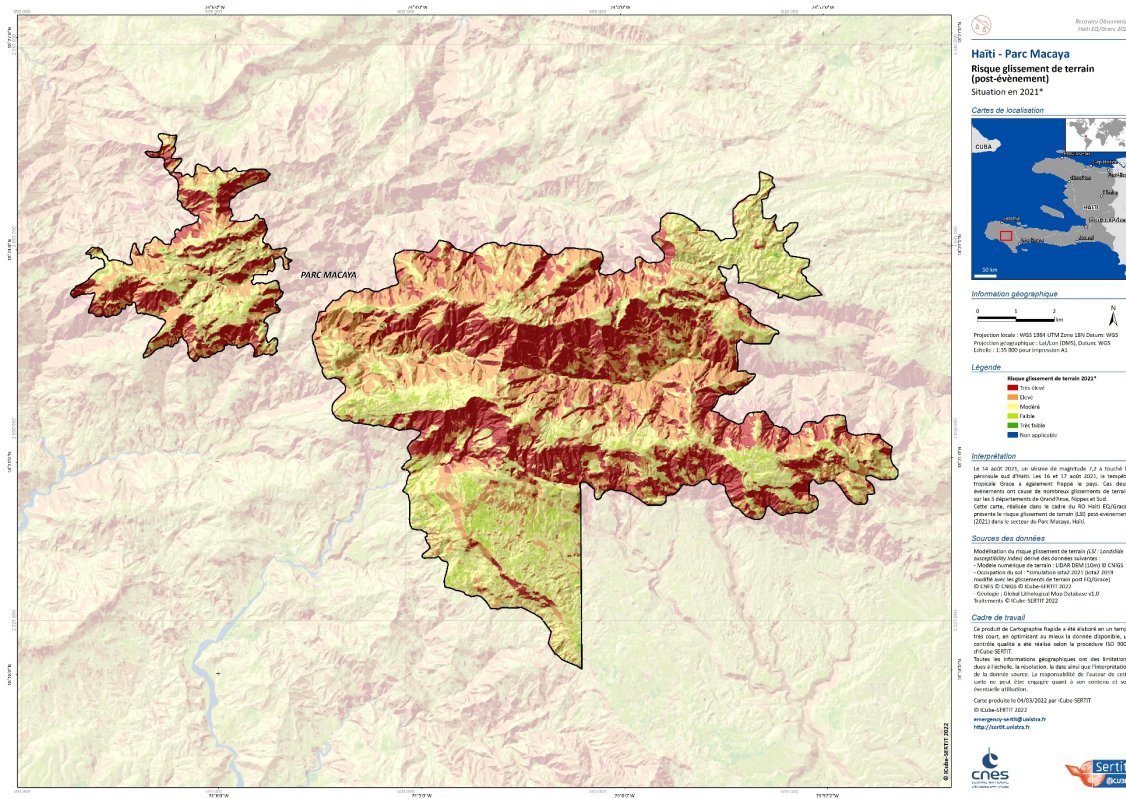




2021

Landslide Risk

- Very High
- High
- Moderate
- Low
- Very low
- Not applicable

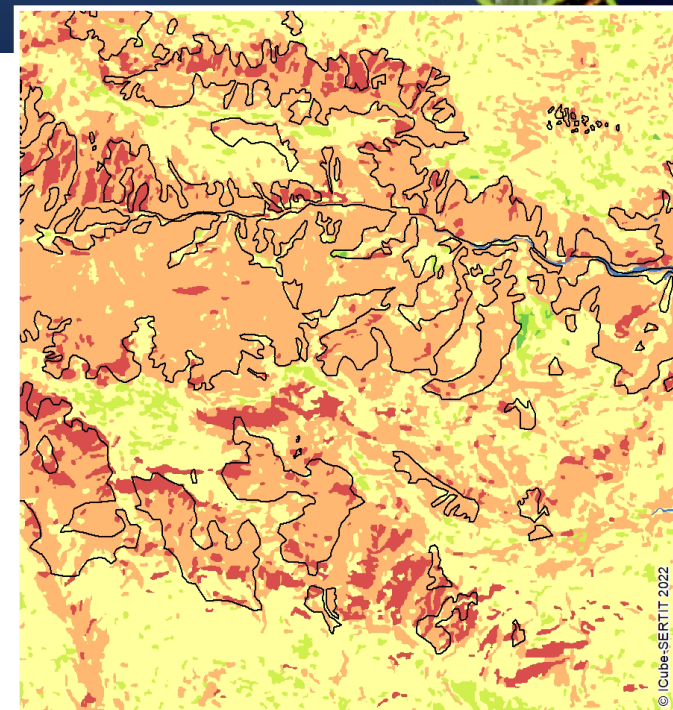




Phase 2: Conclusion & Perspective

P01bis:

- Highlights areas where landslide risk was high before EQ/Grace
- Highlights areas where landslide risk increased after EQ/Grace
- Can be updated with Post EQ/Grace Landcover (iota2 2020-2021) when available (processed by CNIGS)



Landslide risk 2019 (P01bis)



Landslides post EQ/Grace (P01)



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Committee on Earth Observation Satellites

ASI contribution to RO Haiti EQ

By Deodato Tapete (ASI)

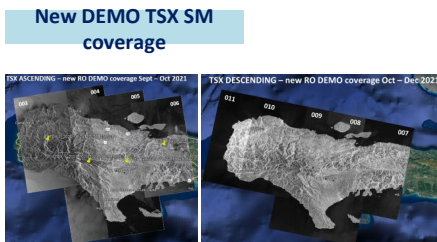
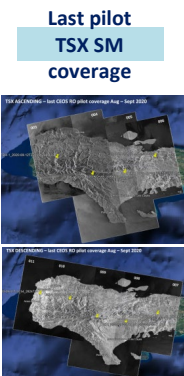
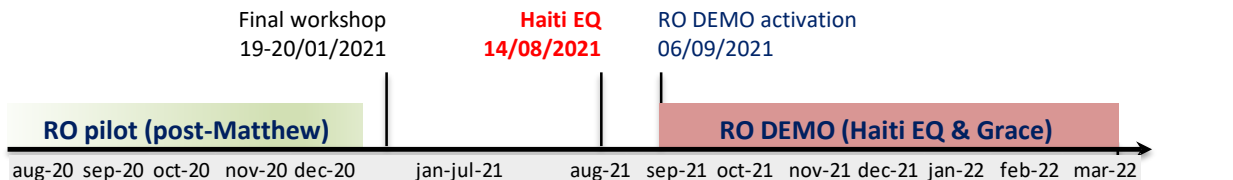
WGDisasters-17 Meeting

Virtual Meeting

16 March 2022



SAR data coverage vs. RO DEMO timeline

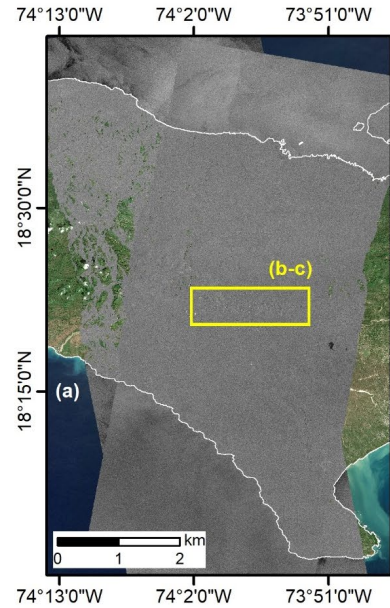


TerraSAR-X RO pilot – RO DEMO pairs			
	ASC		b _{temp} [days]
003	12/09/2020	24/10/2021	407
004	01/09/2020	13/10/2021	407
005	10/08/2020	21/09/2021	407
006	23/09/2020	02/10/2021	374
DESC			
007	10/08/2020	04/11/2021	451
008	23/09/2020	26/11/2021	429
009	21/08/2020	15/11/2021	451
010	12/09/2020	18/12/2021	462
011	01/09/2020	29/12/2021	484

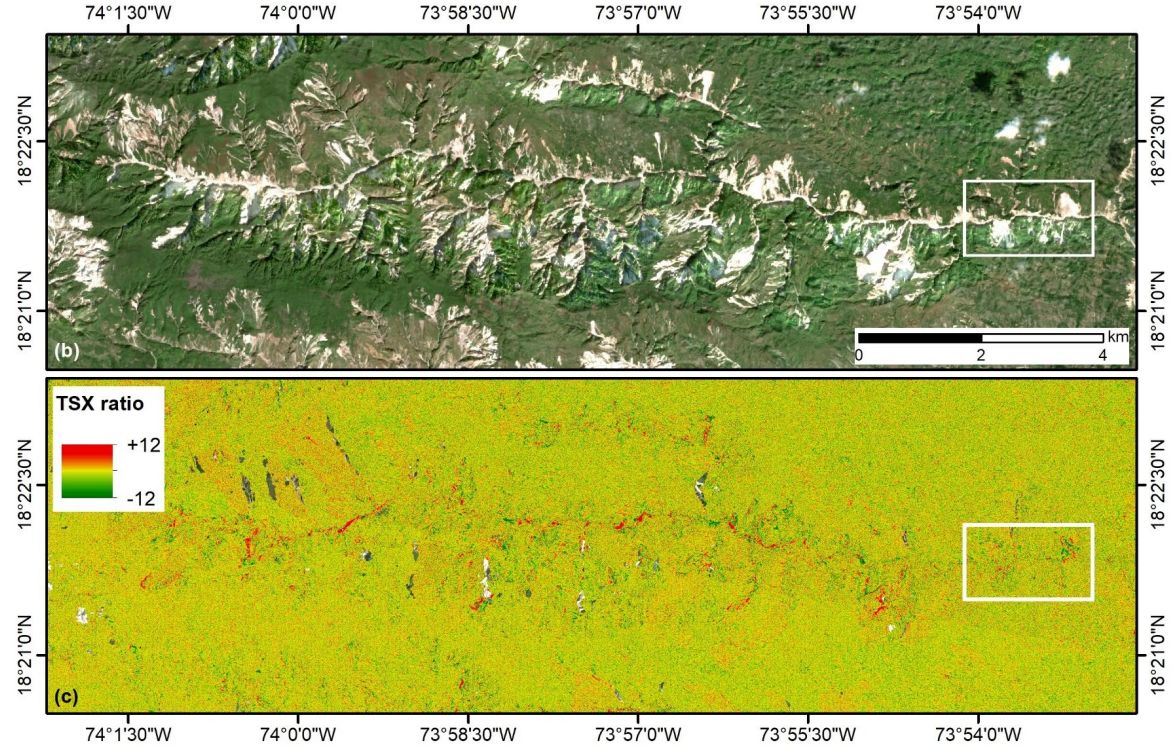
COSMO-SkyMed RO pilot – RO DEMO pairs			
Jeremie East - ASC		b _{temp} [days]	b _{perp} [m]
10/12/2020	31/08/2021	264	-164
	02/10/2021	296	16
Jeremie East - DESC			
15/12/2020	12/09/2021	271	-193
	25/09/2021	284	-179
Camp Perrin North - ASC			
27/11/2020	06/11/2021	344	-131
Camp Perrin North - DESC			
12/12/2020	05/11/2021	328	164
Camp Perrin South - ASC			
05/12/2020	29/10/2021	328	-271
Camp Perrin South - DESC			
04/12/2020	04/11/2021	335	28

TSX change detection (landslides)

TerraSAR-X, SM,
ASC strip 004 + DESC strip 009

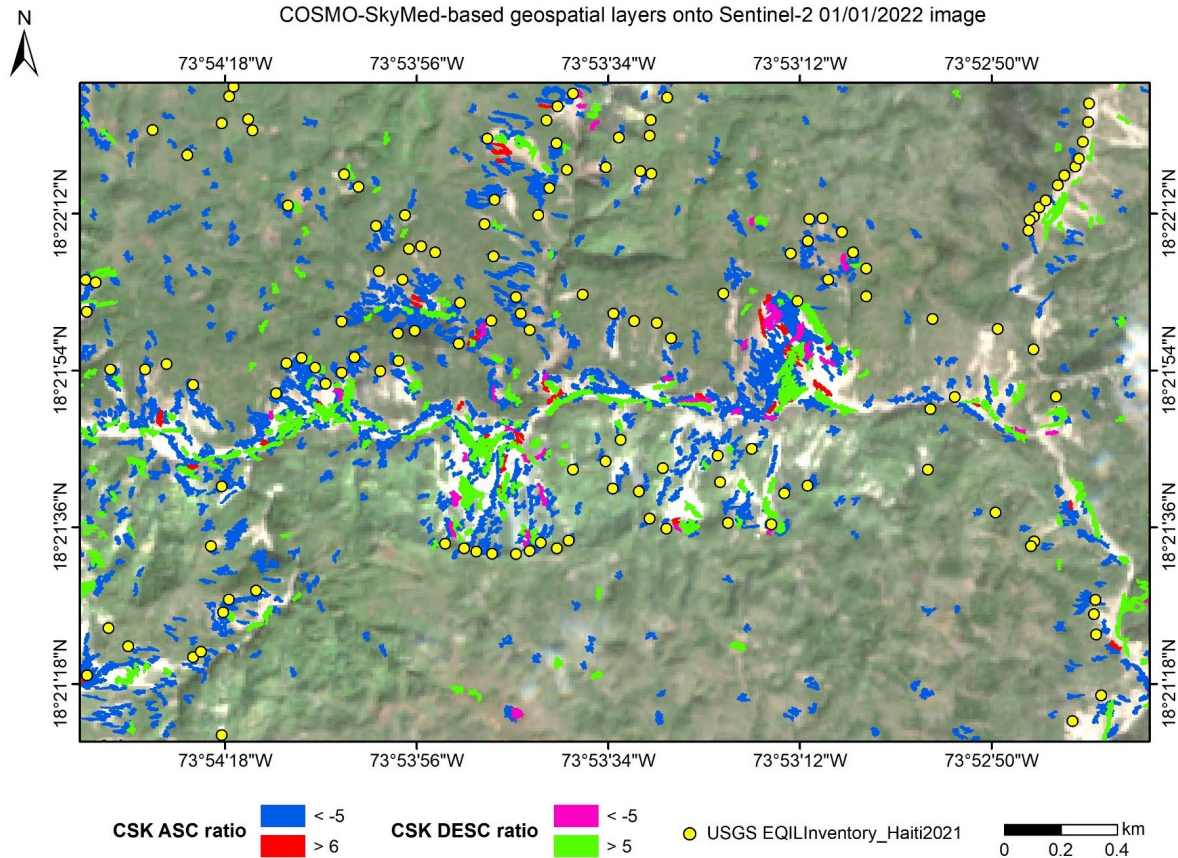


Sentinel-2, cloud-free, 01/01/2022

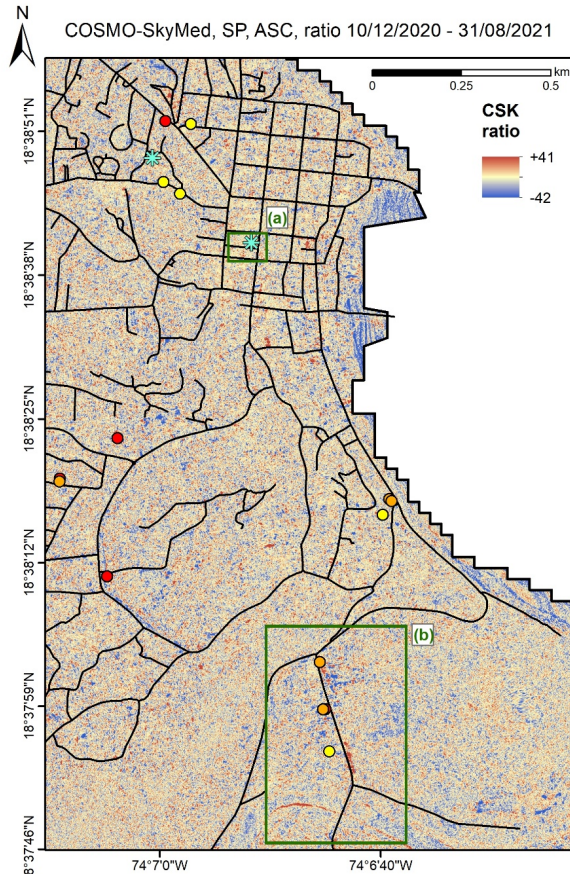


TerraSAR-X, SM, ASC, strip 004, ratio 01/09/2020 - 13/10/2021

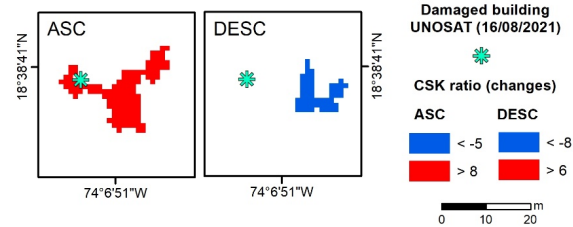
Landslides at Camp Perrin – CSK ASC + DESC



Building damages in Jeremie with CSK



(a) Damaged buildings - Cathedral of Saint Louis Roi of France

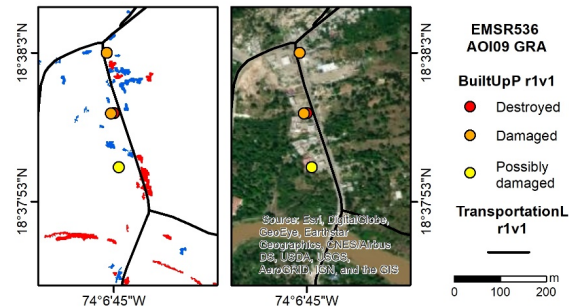


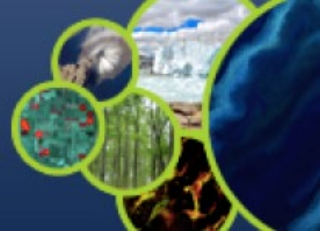
Pre-EQ imagery

On-the-ground evidence



(b) Damaged buildings - Jeremie southern outskirts





- Introduction
- RO Eta-Iota
- RO Haiti EQ
- **Concept Paper, Sustainability and Next Steps**

RO Sustainability

Concept paper and next steps

RO Demo Team meeting held 28 Feb 2022 – creation of subgroup to address sustainability

- Document requirements of a basic RO : what do you need to do and what do you get for 50k (for example) in terms of data and services from a provider
- Document related benefits
- Approach a range of potential donors including trust funds and not for profits active in recovery
- Discuss with Mare/Rashmin and colleagues the logistics and challenges of setting up a trust fund within the GFDRR network
- Explore with Dominique potential sources of on-going EU funding for small scale support on a recurring basis
- Explore with UNDP potential sources of funding and resources
- Explore linkages with existing space sector initiatives (e.g. Copernicus EMS, ESA's GDA, UN-SPIDER, ...)
- Work with GEO to document RO use cases for EO Risk Tool Kit
- Continue outreach: presentations to Living Planet Symposium, ISPRS, others...
- Report back to group by December 2022 face-to-face meeting