Committee on Earth Observation Satellites

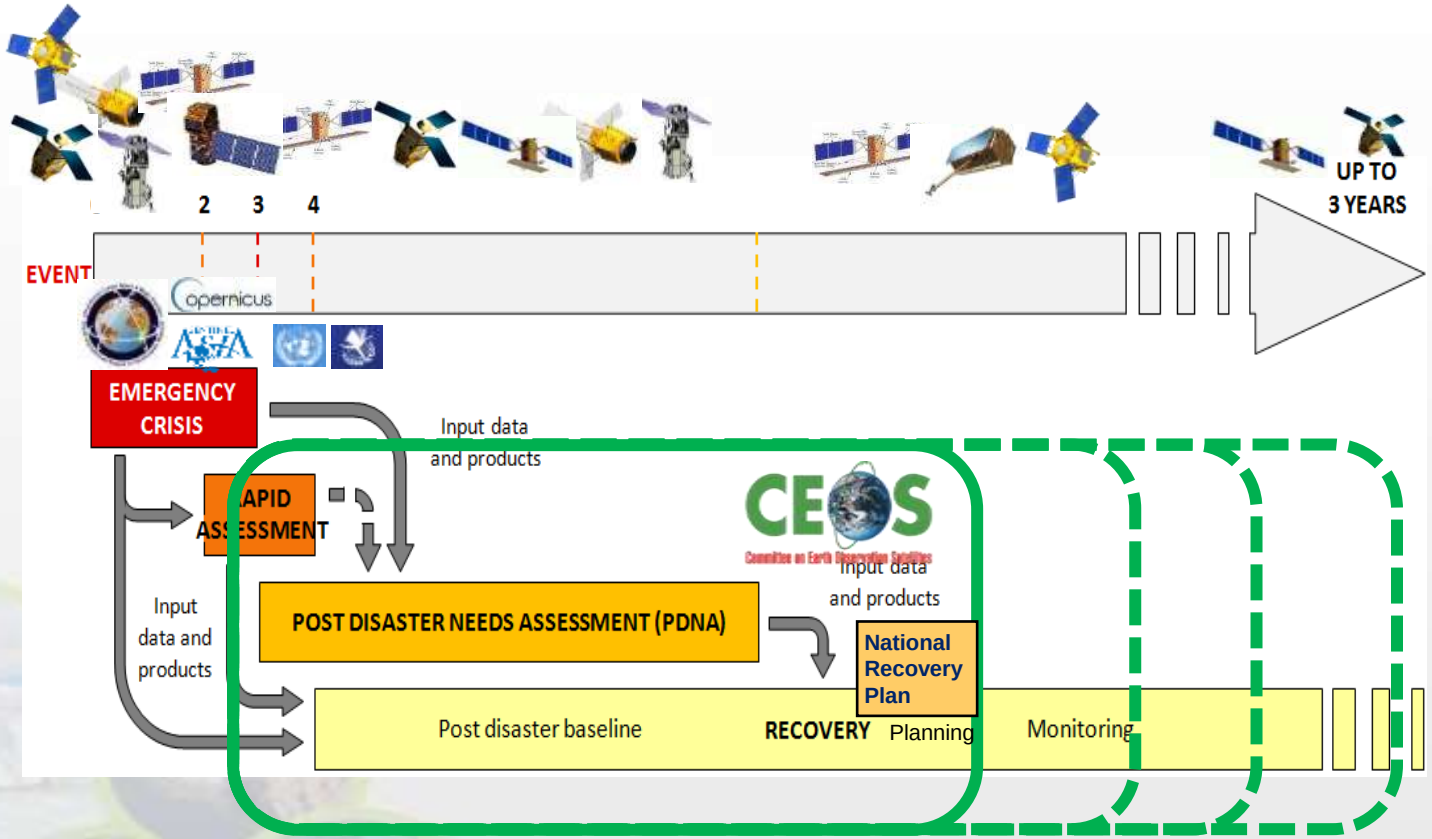
Recovery Observatory Demonstrator –

CEOS-led initiative with World Bank, UNDP and the EU/FPI

Presentation to RSO Coordination Meeting, 16 November 2022
Vienna, Austria

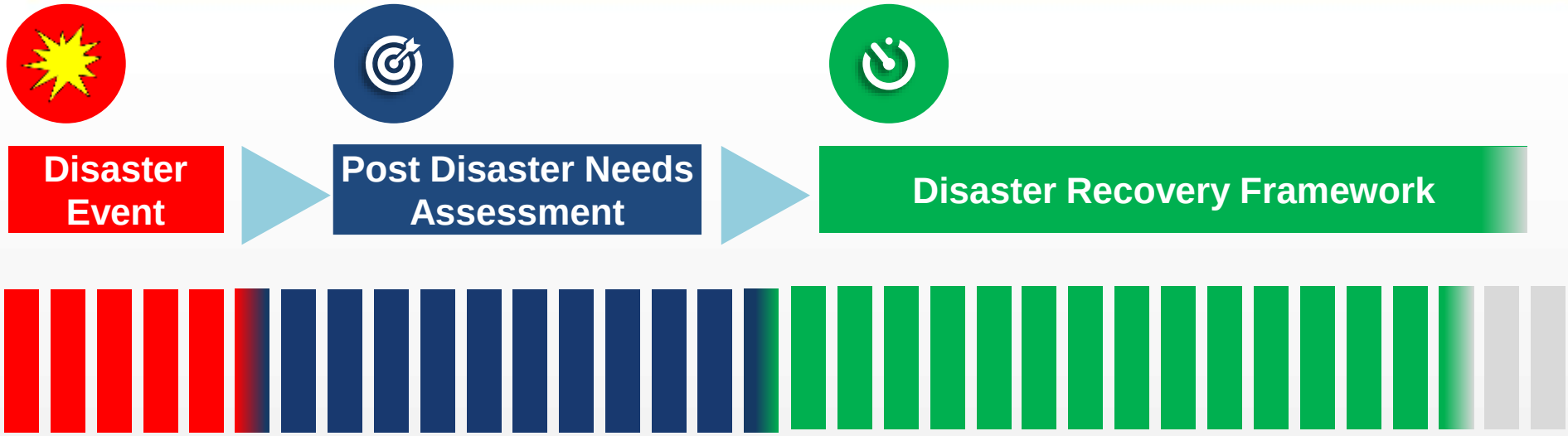
Linda Tomasini (CNES)
Helene de Boissezon (CNES)
Andrew Eddy (Athena Global)

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

Satellite EO and remote sensing used in Recovery



Emergency & Humanitarian Response: satellite imagery of affe infra and population

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

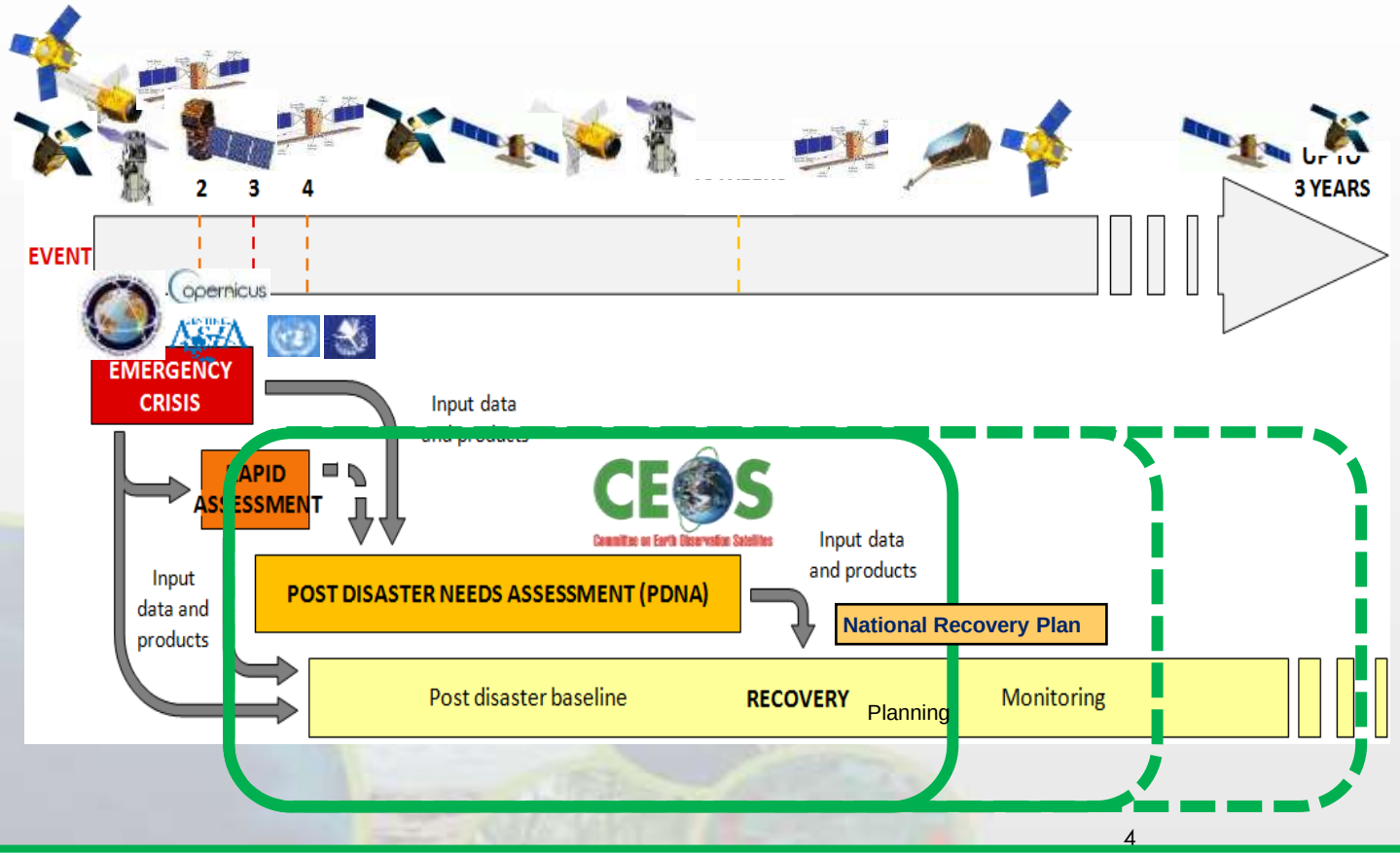
Continued use of selected imagery to monitor and document recovery processes 6 Months +

RO Demonstrator

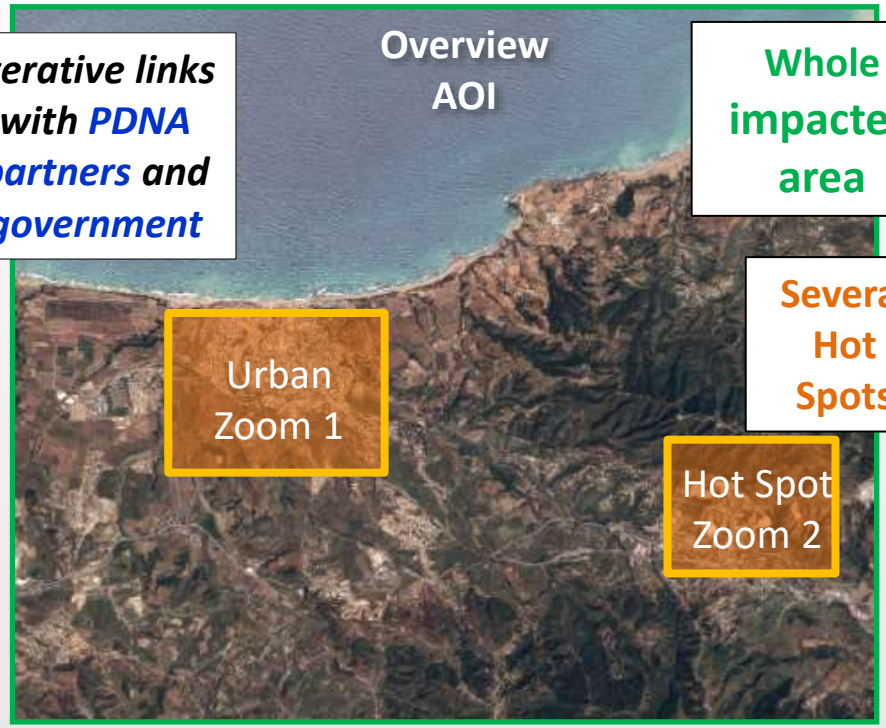
RNA/GRADE → PDNA → DRFramework REC PLANNING → RECOVERY M&E

Recovery Observatory (RO) Demo philosophy

Satellites have become critical for Response to disasters… but what about Recovery?



Collection of satellite images and maps at several scales during ~ 6 months after a major disaster



Iterative links with PDNA partners and government

Whole impacted area

Several Hot Spots

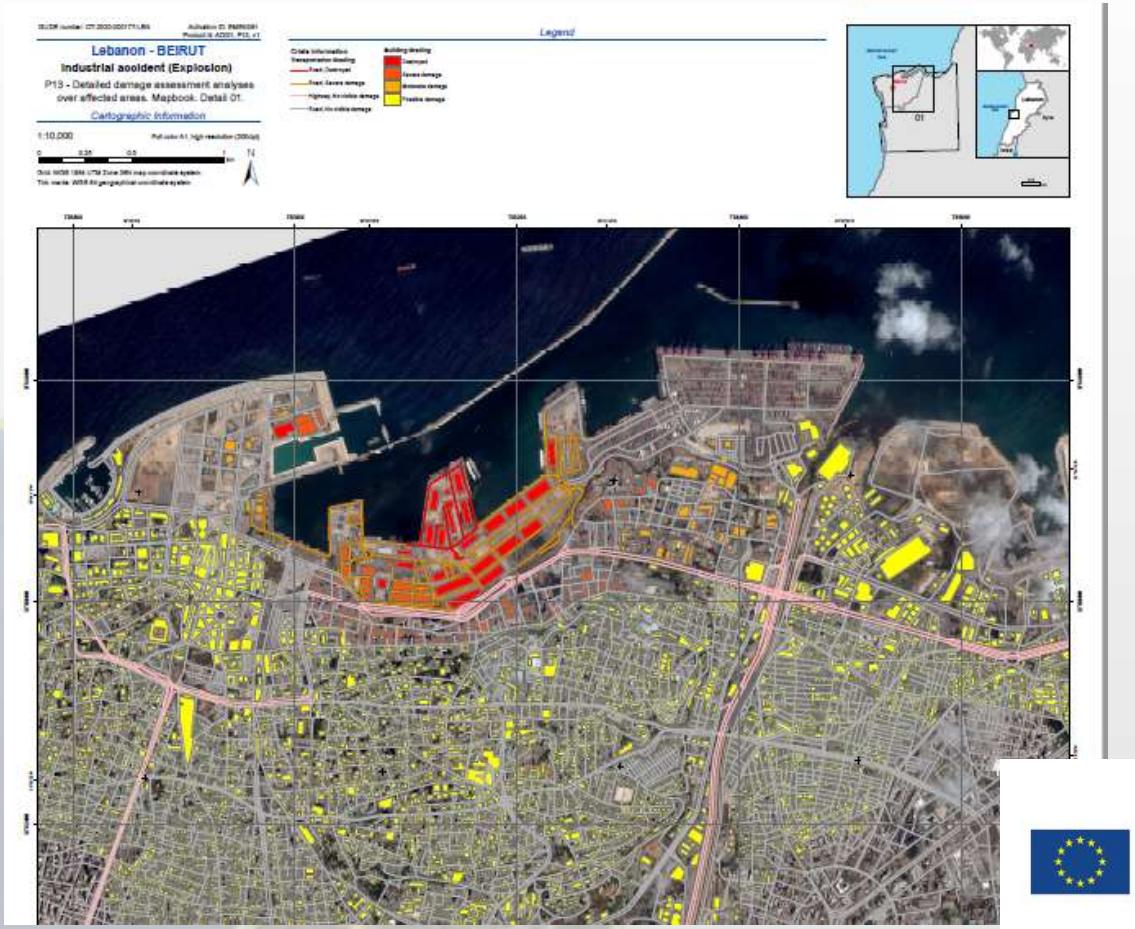
"Recovery Observatory" : Process allowing operational use of EO for PDNA, Recovery Planning, then M&E

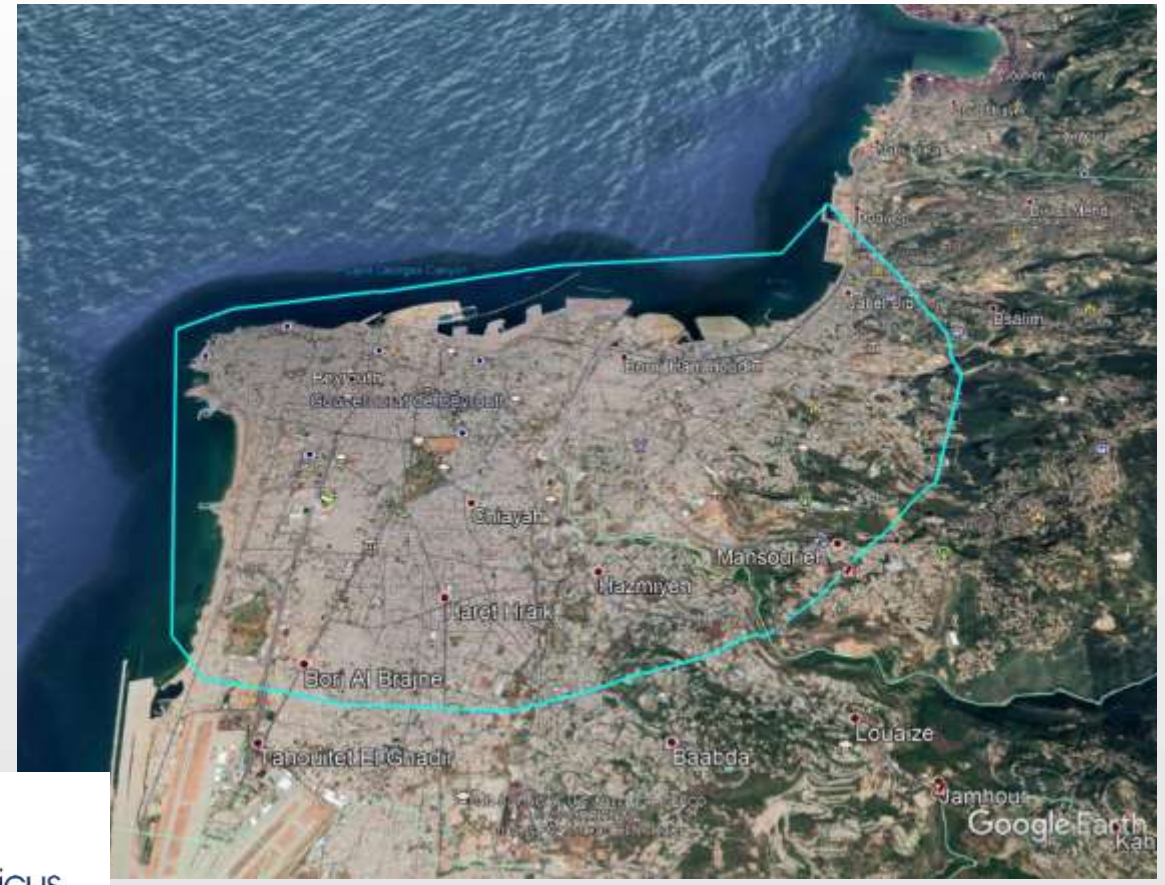
Ancillary data are indispensable: *terrain validation data, aerial and drone data, statistics, cartography, ….*

RO Demonstrator 1 : Beirut blaze

RO “test case” : Beirut blazes - activated by European Union FPI (+ UNDP, WB/GFDRR) in January 2021

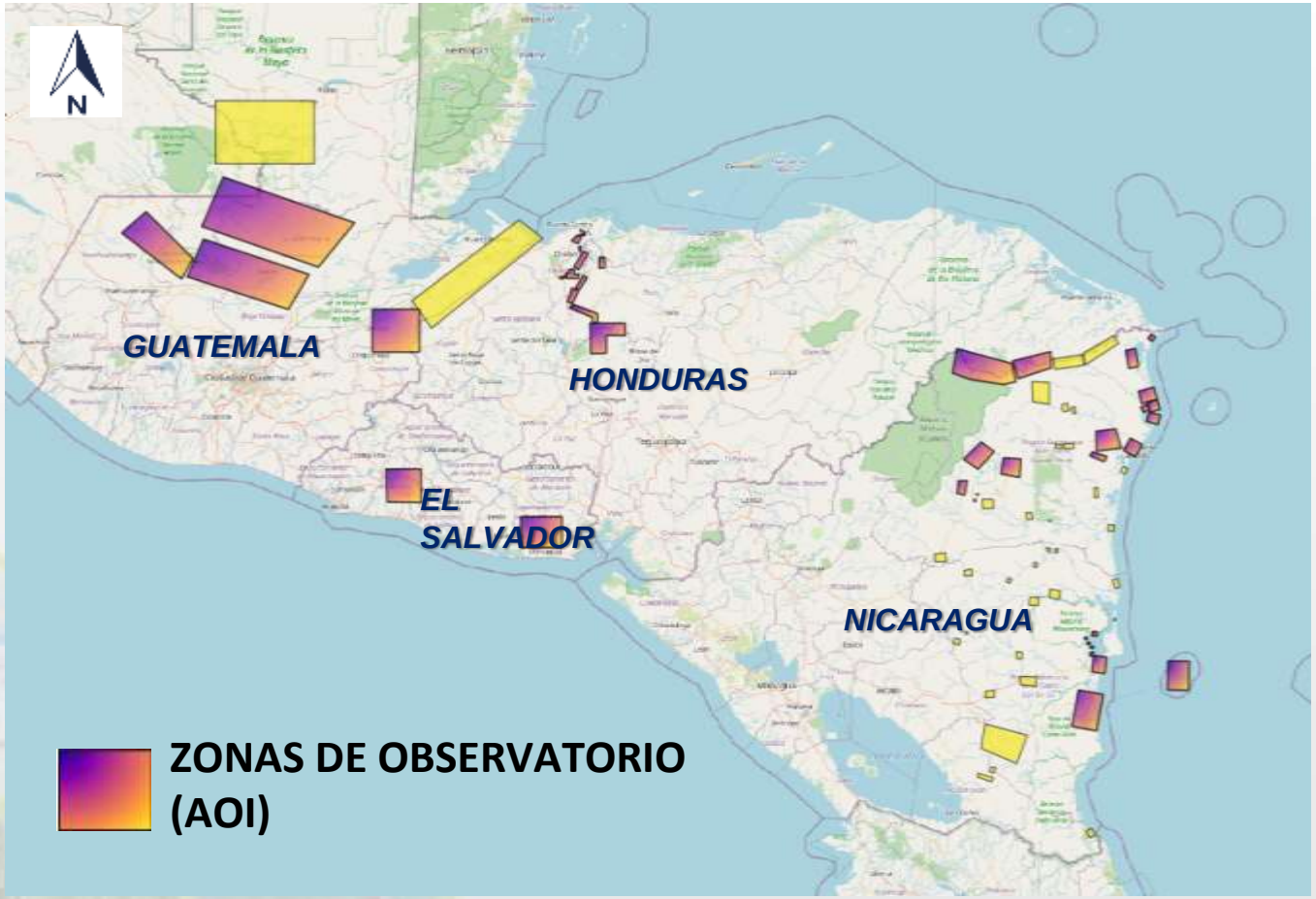
- **Copernicus EMS R&R activation (from fall 2020) to be updated every three months for one year**





RO Demo2 on Eta/Iota hurricane impact in Central America

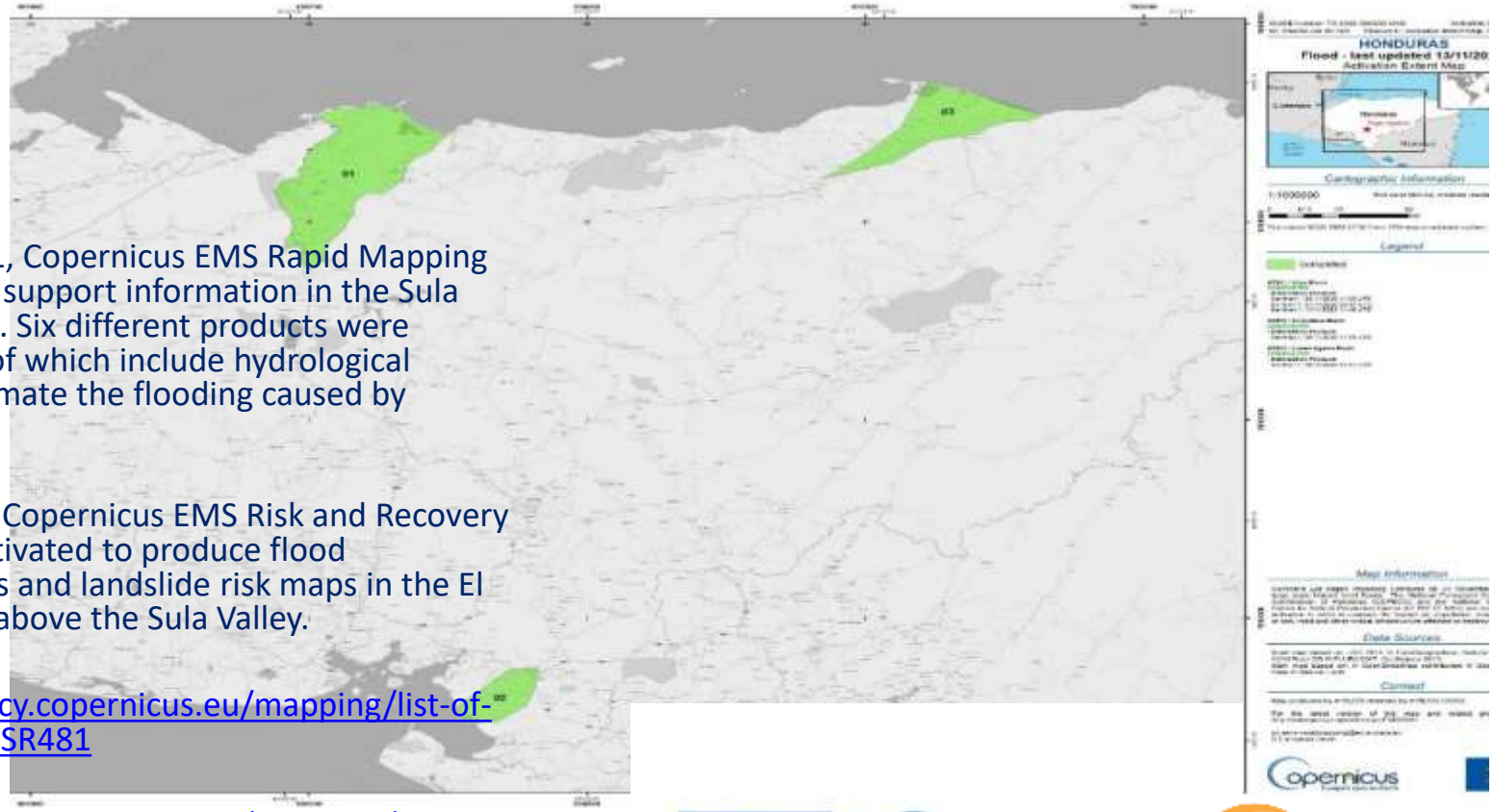
RO Demo2 : Priority Damage Zones (post Eta/Iota)*



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

RO Demo2 - Honduras

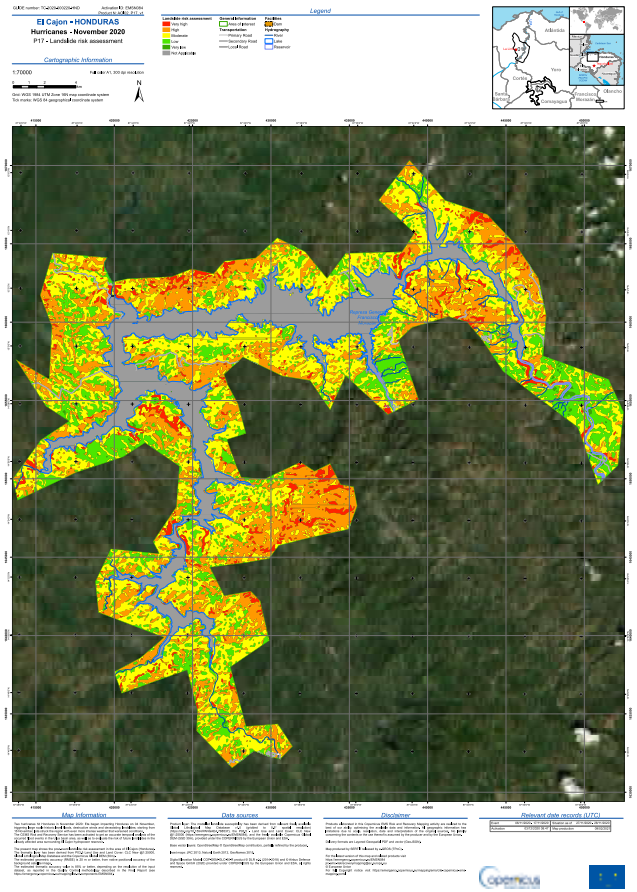


On November 11, Copernicus EMS Rapid Mapping was activated to support information in the Sula Valley, Honduras. Six different products were obtained, most of which include hydrological modeling to estimate the flooding caused by hurricane ETA.

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

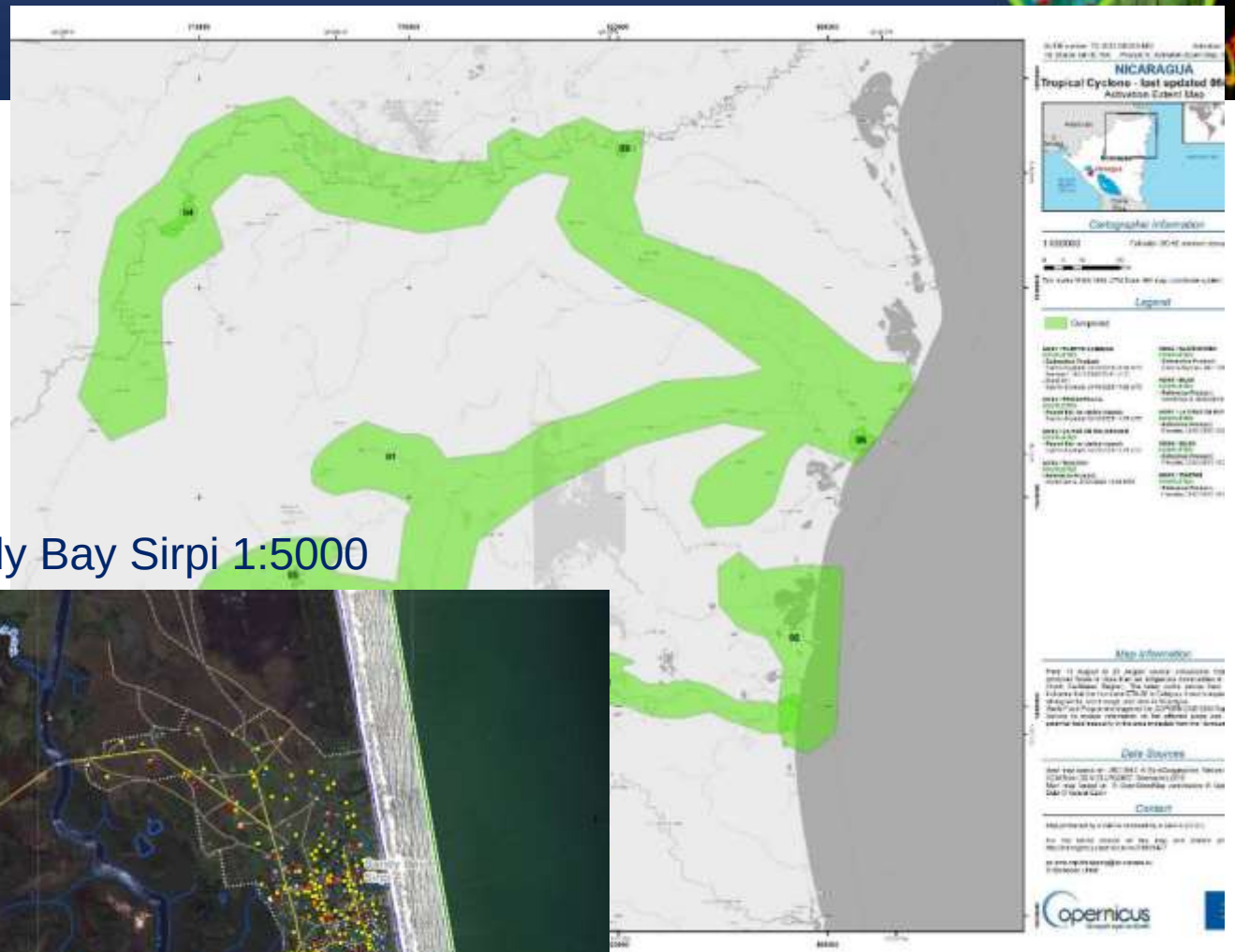
https://emergency.copernicus.eu/mapping/list-of-components/EMSN084



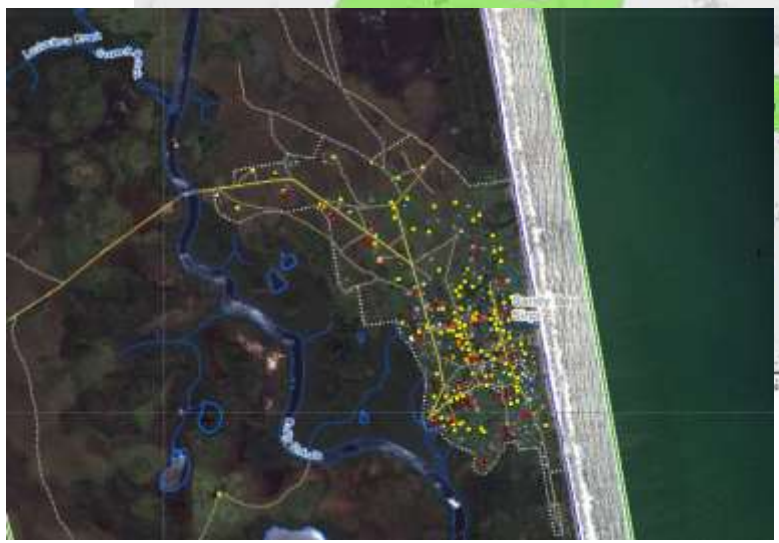
RO Demo2 - Nicaragua

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



Sample product for Nicaragua RRM activation

Italian Space Agency activities on Eta/Iota RO Demo2

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 CosmoSkyMed (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 COPECO planned.

CSK high resolution sample product in Sula Valley, courtesy of eGEOS

RO Demo2 : Italian Space Agency activities on Eta/Iota

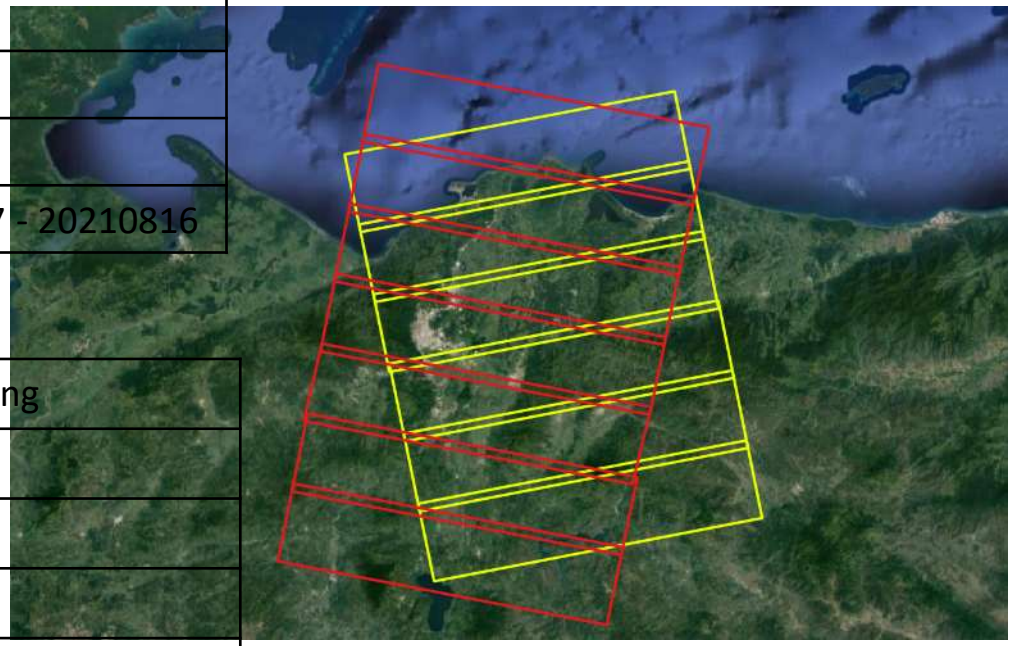
Track 165

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

Honduras: Sentinel-1 dataset



Integrated CosmoSkyMed analysis

Mean velocity map

RO Demo3 : Haiti 2021
Earthquake & Grace tropical storm

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** => PHASE 2

Contributors/Partners

CNES Centre National d'Études Spatiales
CEOS
Sertit ICUBE
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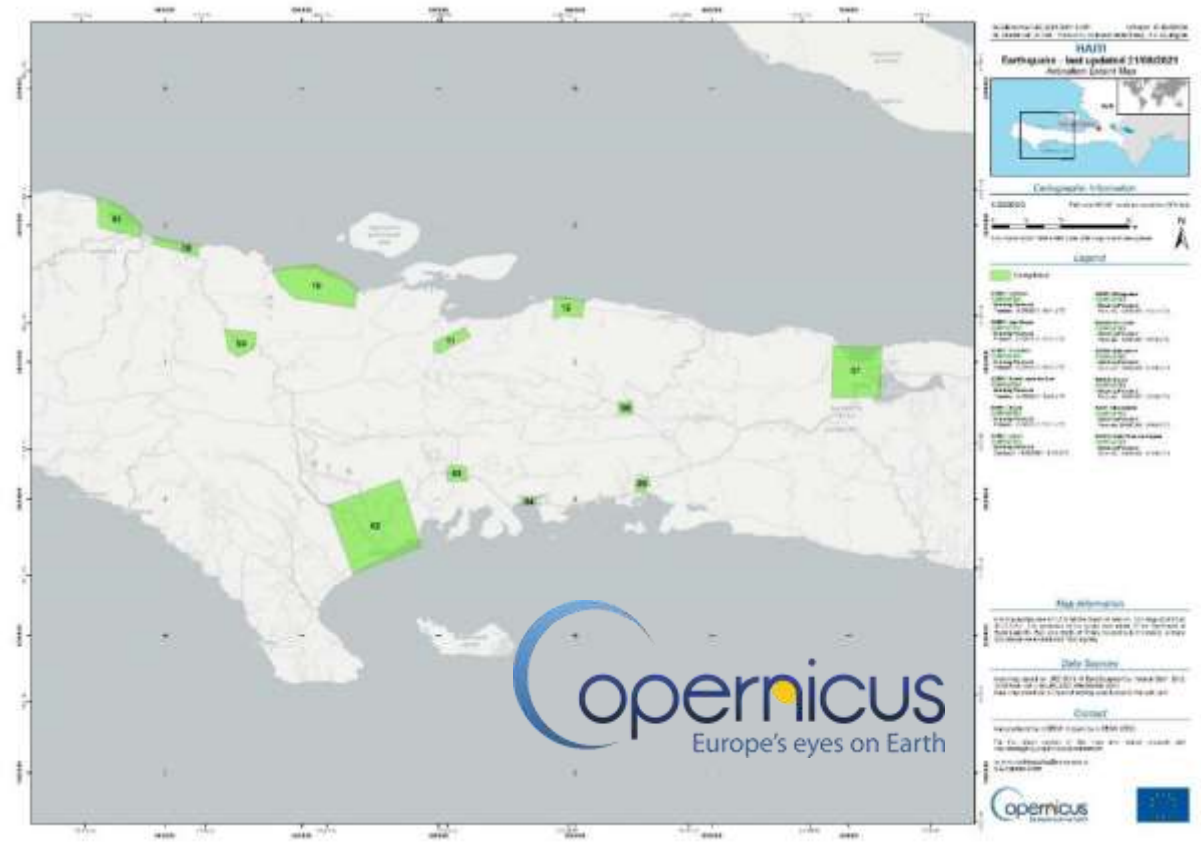
DLR
NASA
cima RESEARCH FOUNDATION
BGC
UNOSAT
LIST Luxembourg Institute of Science and Technology
CNIGS
Ministère de l'Environnement
CIAT Comité Interministériel d'Aménagement du Territoire
PRIMATURE
Agriculture, Ress. Naturelles, Développement Rural
CARIBACT
MPCE
IOM • OIM
Commission européenne
EU Delegation in Haiti
Foreign Policy Instruments
participp
THE WORLD BANK
UNDP

RO Demo3 : Haiti 2021
Earthquake & Grace tropical storm

Macaya park view from Chantal, 30/11/2021 ©Michèle Oriol (CIAT)

Haiti 2021 earthquake : Emergency Response by CEMS, Charter



14 AUGUST 2021

Earthquake in Haiti

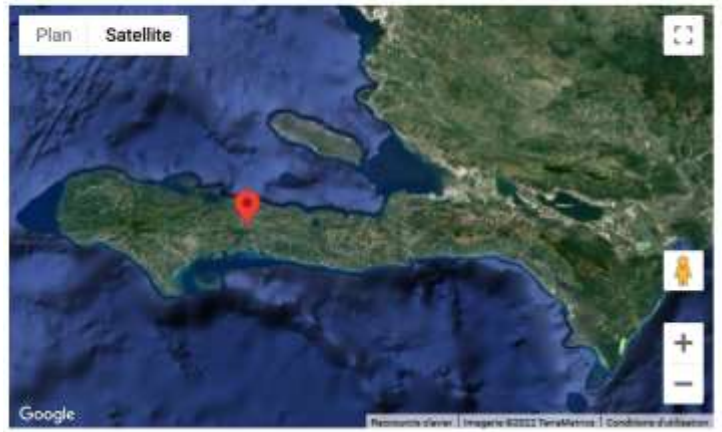
Browse activations on map

Type of Event:	Earthquake
Location of Event:	Haiti
Date of Charter Activation:	2021-08-14
Time of Charter Activation:	22:20
Time zone of Charter Activation:	UTC+02:00
Charter Requestor:	Direction de la Protection Civile de Haiti UNITAR on behalf of UN Operations and Crisis Center (UNOCC) CENAPRED
Activation ID:	729
Project Management:	ICube-SERTIT

17 AUGUST 2021

Flooding in Haiti

Browse activations on map



Type of Event:	Flood
Location of Event:	Haiti
Date of Charter Activation:	2021-08-17
Time of Charter Activation:	20:15
Time zone of Charter Activation:	UTC+02:00
Charter Requestor:	Direction de la Protection Civile de Haiti
Activation ID:	730
Project Management:	ICube-SERTIT

- 2 International Charter Space & Major Disasters activations (earthquake, then flood events)
- 1 EMS Copernicus Rapid Mapping activation (earthquake)

RO Demo3 – Haiti EQ 2021
Phase 1: support to the PDNA

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:

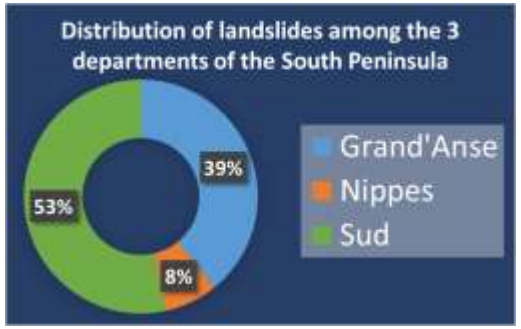
- to augment and validate **PDNA** analysis (by end of September 2021) => PHASE 1
- to support the **Recovery Framework** => PHASE 2

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	

RO Demo3 – Haiti EQ 2021
Phase 1: support to the PDNA

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



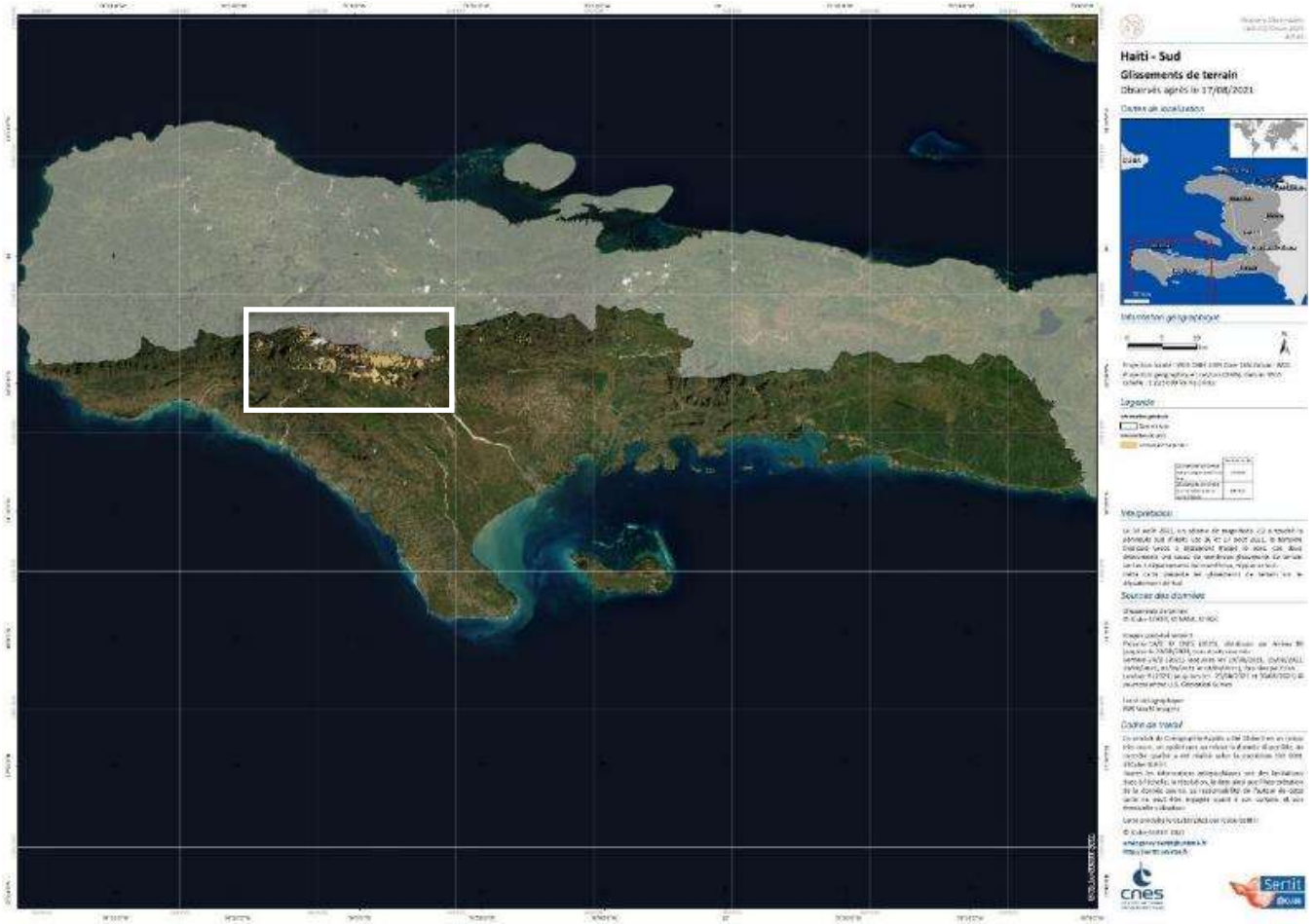
Landslides

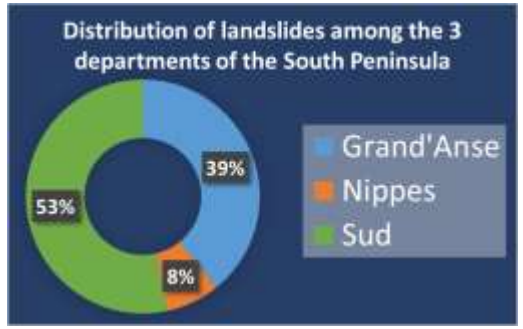
South Peninsula: 6949.02 ha

Grand'Anse area: 2723.46 ha

RO Demo3 – Haiti EQ 2021
Phase 1: support to the PDNA

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





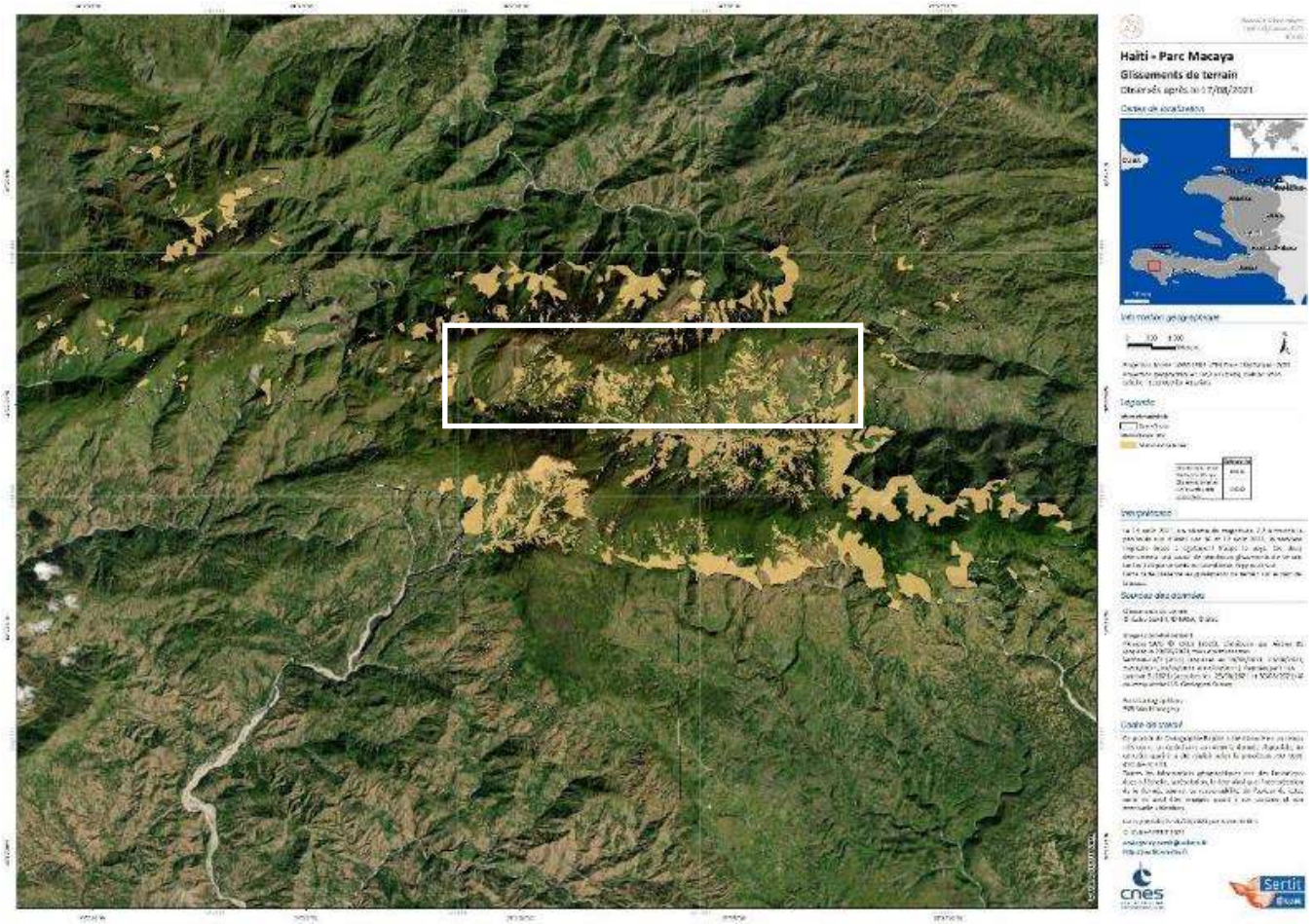
Landslides

South Peninsula: 6949.02 ha

Sud area: 3709.94 ha

RO Demo3 – Haiti EQ 2021
Phase 1: support to the PDNA

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 **(27%)**

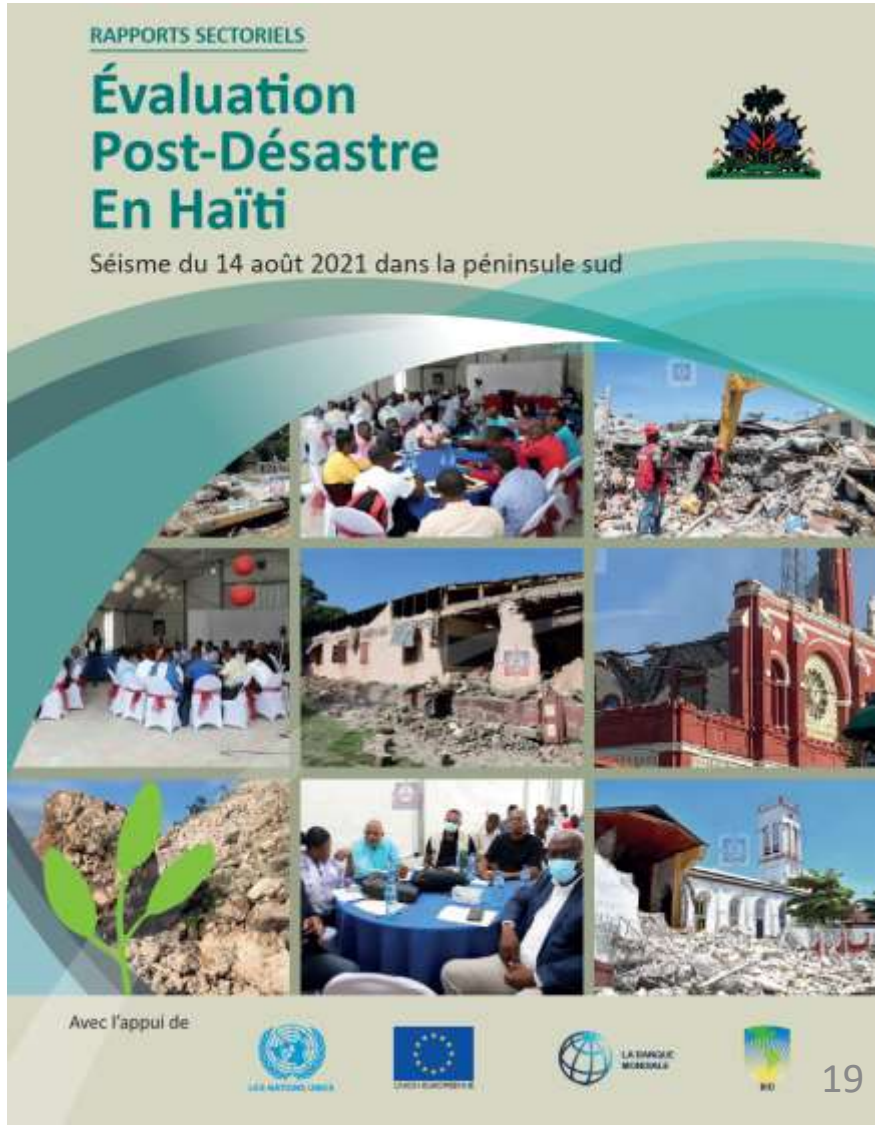
RO Demo3 – Haiti EQ 2021
Phase 1: PDNA including RO results and figures

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

Les images satellites que nous avons pu recueillir auprès du CEOS[115], 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'ensevelissement des outils de pêche (0,55 million $US)[31].



RO Demo3 – Haiti EQ 2021
Phase 2: support to Recovery Framework

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

Landslide Risk 2021

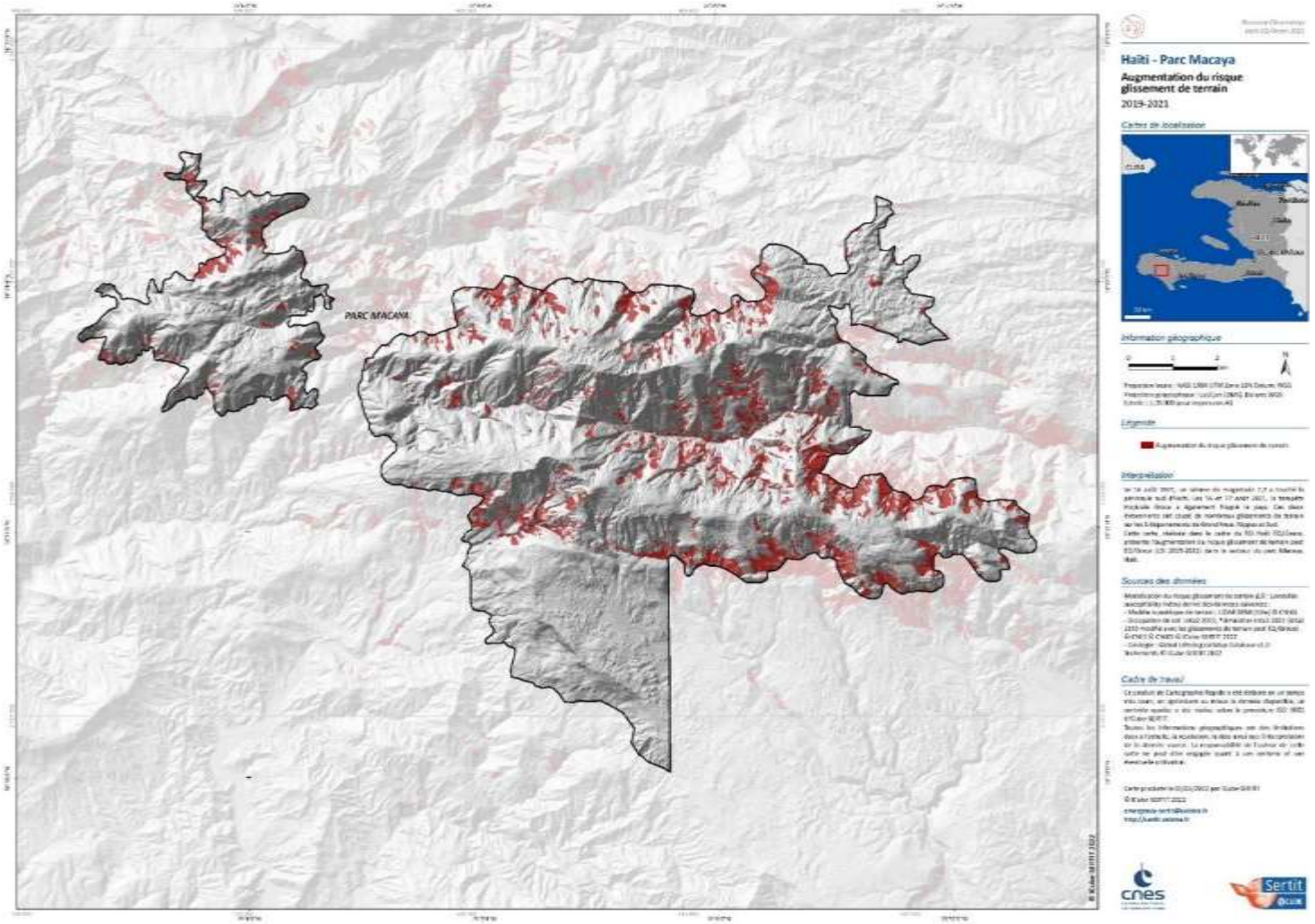
- Very High
- High
- Moderate
- Low
- Very low
- Not applicable

RO Demo3 – Haiti EQ 2021
Phase 2: support to Recovery Framework

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

2019-2021

Landslide risk increase



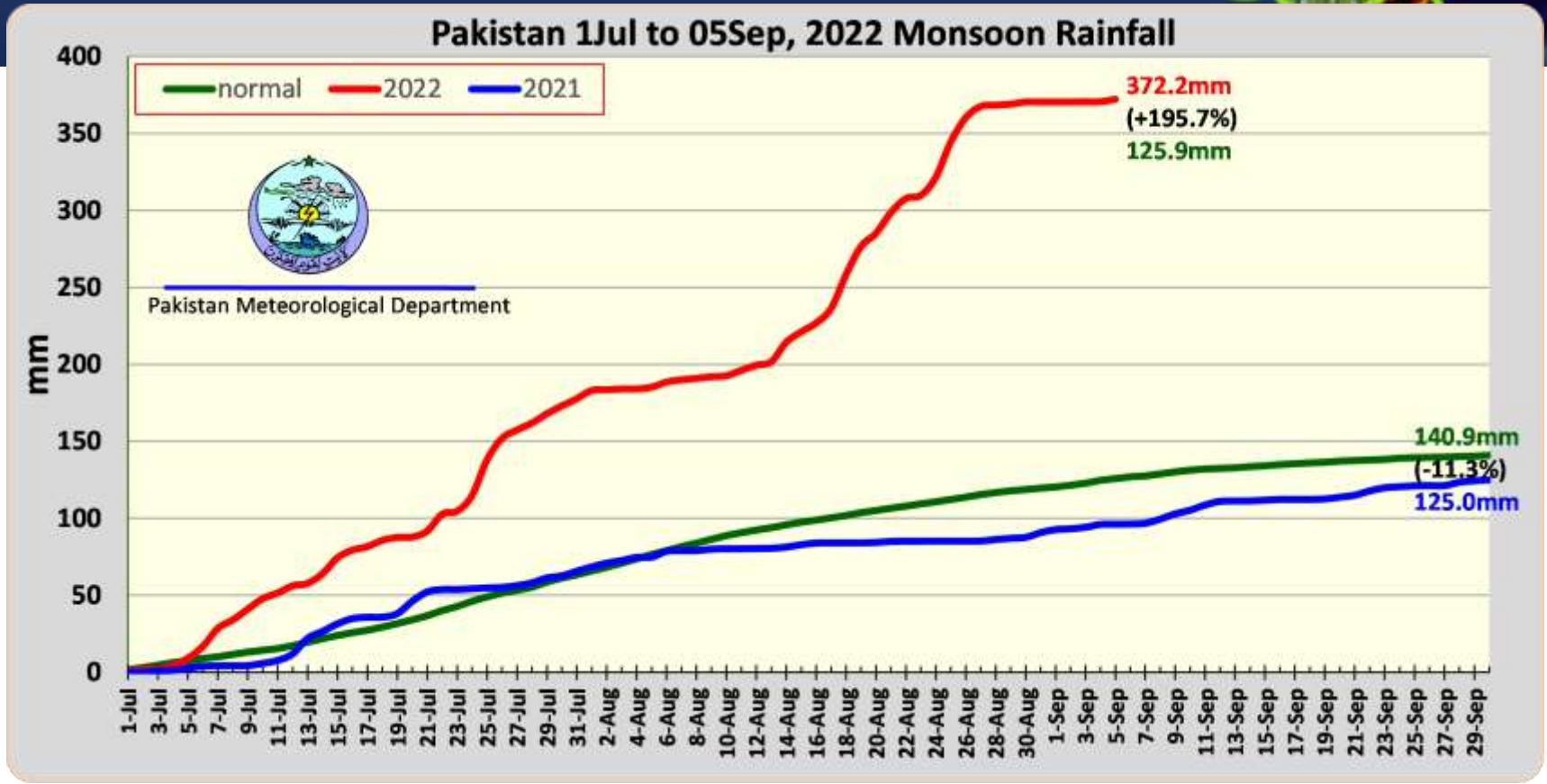
RO Demo4 activation : Pakistan

The **4th Recovery Observatory Demonstrator** has been triggered 20 September at request of EU, on behalf of the tripartite team (**EU / World Bank and UNDP**), in support of:

- the **Post Disaster Need Assessment**
- the **Recovery Framework**

RO Demo 4 – Pakistan Floods

- Since mid-June 2022, severe heat waves caused stronger monsoon rains and melting glaciers
- Worst recorded flood event in Pakistan - submerged one-third of country, impacting 4,2 million people and killing more than 1,500 people



PDNA needs

- PDNA officially activated on September 16, 2022
- EU coordinates the PDNA process and lead the agriculture sector

- RO activation focussed on providing complementary information to what was already committed (e.g. WB/IPSOS and ESA/CIMA/LIST contributions)
- The analysis will focus on 84 districts that have been identified as « calamity districts »
- Needs has been expressed concerning:

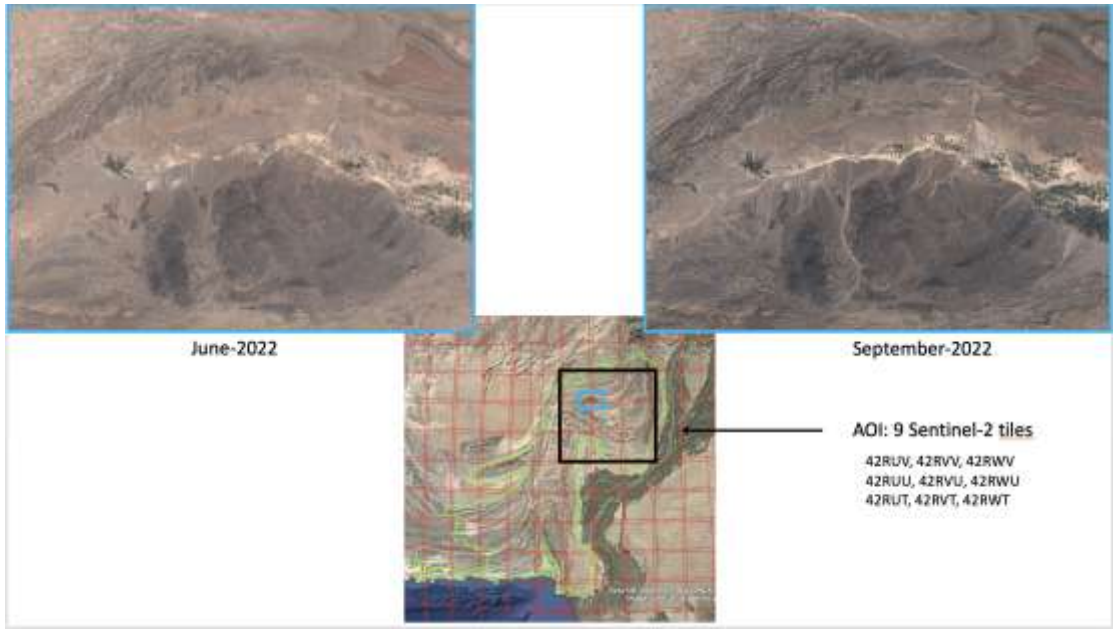
- potential landslides that may have impacted orchards
- potential impacted Natural Park and Reserve

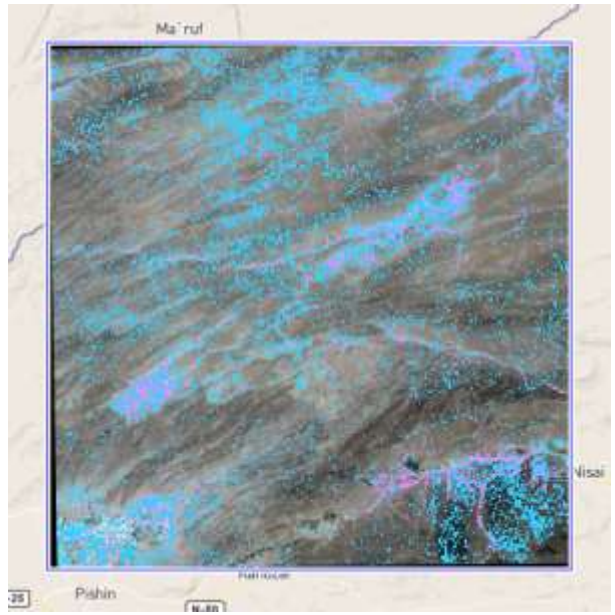
The 84 calamity districts with a priority level

CEOS contributions

Potential landslides detection

- EOST launch some automated process with the ALADIM machine learning service, exploited on GEP, over a part (9 Sentinel-2 tiles) of Balochistan Province





CEOS contributions

Multi-sources flood extraction layers:

- Gathering
- Analysis and validation

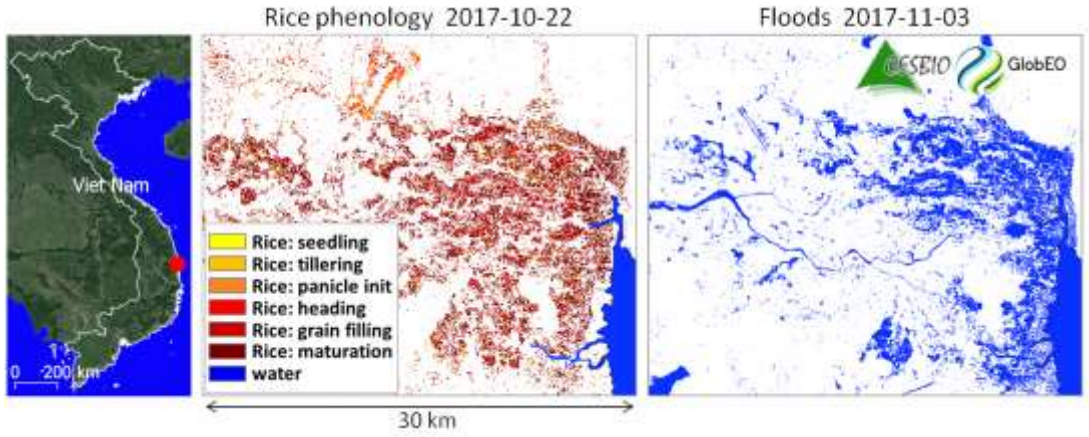
Flood synthesis product:

- Generation
- Intersection with landuse/lancover layer
- Statistics derivation

Impact on natural protected areas

Other "ROs" : VietARRO - Vietnam Agriculture Resilient Recovery Observatory

- Triggered in the framework of SCO (**Typhoon Damrey**, 2017)
- Managed by CNES and VAST/VNSC with the support of Athena Global. VietARRO Phase 1 2020-2022; Phase2 planned 2023…
- **Target user** : Ministry of Agriculture and Rural Development, Vietnam National Disasters Management Agency (MARD/VNDMA)
- Need to assess accurately affected rice extent and yield loss and to monitor agriculture recovery process; provide overarching spatial framework to support recovery after major disasters in Vietnam
- **Products :** Water extent/flood maps (time series, duration), Rice maps, Growth status, Sowing dates,…



Partner contributions

Openly available response data and products

- International Charter
- Copernicus EMS RM
- Sentinel-Asia
- UNOSAT
- Open-source sat data (Landsat, Sentinels, DTM)
- Data bases (landcover, population,..)

CEOS best efforts RO data and products

- Dedicated acquisitions of commercial data
- Complex satellite products (e.g. SAR interferometry)
- RO liaison officer and overall coordination
- Value adding services
- Capacity building

Ad hoc contributions: academia, international organizations (e.g. CEMS, FAO, UN)

- Linkages to Copernicus Risk and Recovery and ESA GDA, EO Clinic
- Value adding services
- Expert analysis
- Integration of other advanced data sources (e.g. social media, drones, …)

Integrated Situational Awareness to support recovery:

- Informed PDNA;
- Pre and post disaster baselines;
- Medium term monitoring;
- Capacity building assessment and plan.

RO Capacity Building Activities for Decision Makers

Joint UNOOSA-CNES-ASI-CONAE action in the CEOS 2022-24 workplan

Objective : **Raise awareness of DRM decision-makers** about the **added-value of Earth Observation** data for **Recovery** monitoring after disasters

Workshops targeting decision makers in three regions showcasing RO demonstrator products and more generally the use of satellites for recovery:

- Latin America/Caribbean with the support of **CEPREDENAC**
  (1st event during **Annual regional DRM Forum, 6 December El Salvador**)
- Africa (first semester 2023) – partners to be identified
- South-East Asia (second semester 2023) – partners to be identified

Conclusions and Next Steps

- After nearly 2 years of activity, an efficient **RO Demonstrator community** working in **best effort** mode :
  - ✓ **Data providers**: ASI, CNES, ESA/Copernicus, DLR, International Charter Space & Major Disasters
  - ✓ **Value adder contributors**: Copernicus EMS, BGC, NASA, CIMA, LIST, CNIGS, ICube-SERTIT

- **Operational results :**
  - ✓ **on Lebanon :** monitoring of reconstruction regularly provided to **Reform, Recovery and Reconstruction Framework (3RF)**
  - ✓ **on Haiti : f**irst products delivered in a relative rush mode that **directly inform the PDNA with quantitative data (environmental and agricultural damage)**
  - ✓ **on Pakistan:** first products delivered in rush mode; some critical areas not addressed; coordination issues with broader recovery effort; better coordination of resources could have provided more comprehensive results.
- **Various** products generated and diverse types of satellite made available

- Excellent **collaboration** between the **stakeholders** and the **RO team**; RO team responsive to new needs expressed.

- **1 or 2 more activation** expected between now and late 2023
- Final report to CEOS Plenary and global stakeholder community in late 2023