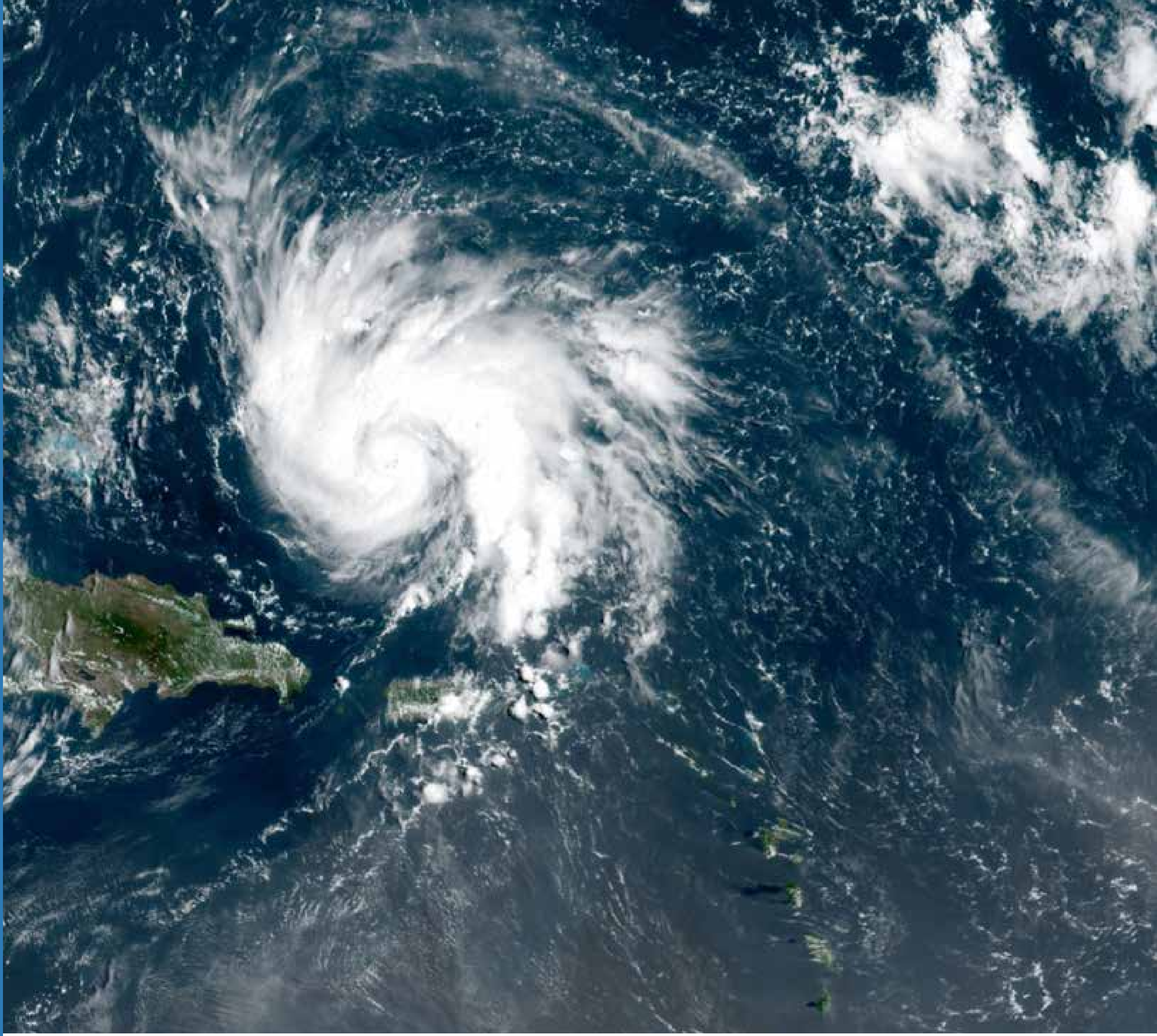

Use of EO Satellites in Support of Recovery from Major Disasters

Taking stock and moving forward

October 2019

The “Generic” Recovery Observatory ad hoc Team

In September 2018, several of the leading organizations involved in applying Earth Observation (EO) satellites to recovery work came together to document their experiences and chart out a better way forward to share EO satellite data in support of recovery from major disasters. Those organizations are:

CEOS (Committee on Earth Observation Satellites) was established in September 1984, on the recommendation of a Panel of Experts on Remote Sensing from Space set up under the aegis of the G7 Economic Summit. Today it boasts 34 members and 28 associate members, including all of the world’s leading remote sensing agencies. Over the past three decades, CEOS has significantly contributed to the advancement of space-based Earth observation community efforts. CEOS agencies communicate, collaborate, and exchange information on Earth observation activities. Since 2014, through the Working Group Disasters, CEOS has increased the contribution of satellite data to recovery from major events.

The **European Union** (EU) is a group of 28 countries that operates as a cohesive economic and political block. The **European Commission** (EC) is an institution of the European Union, responsible for proposing legislation, implementing decisions, upholding the EU treaties, and managing the day-to-day business of the EU. **Copernicus** is the name for the Global Monitoring for Environment and Security program of the EU. Based on satellite and in situ observations, Copernicus delivers near-real-time data and services on a global level, which can also be used for local and regional needs, to help better understand our planet and sustainably manage the environment. The Copernicus Emergency Management Service (EMS) uses satellite imagery and other geospatial data to provide free-of-charge mapping services worldwide, in cases of natural disasters, human-made emergency situations and humanitarian crises. The Rapid Mapping service (RM) consists of the provision of geospatial information within hours or days immediately following a disaster, while Risk & Recovery Mapping (RRM) consists of the on-demand provision of geospatial information in support of Disaster Management activities not related to immediate response. EMS offers other services such as early warning and monitoring which includes systems for floods, droughts and forest fires.

Cover/back cover: Hurricane Dorian over the Caribbean. Image credit: NASA.

Graphic design: ULTRA Designs, Inc.

The **Global Facility for Disaster Reduction and Recovery** (GFDRR) is a global partnership that helps developing countries better understand and reduce their vulnerability to natural hazards and climate change. GFDRR is a grant-funding mechanism, managed by the World Bank, that supports disaster risk management projects worldwide. Working on the ground with over 400 local, national, regional, and international partners, GFDRR provides knowledge, funding, and technical assistance. GFDRR leverages the vast activities of the World Bank Group, including extensive disaster preparedness and recovery programs and associated investments.

UNDP (United Nations Development Program) has been implementing post-disaster recovery for more than two decades. A portfolio review of post-disaster recovery projects suggests that the total expenditure on recovery projects during 2005-15 has been approximately US$ 1 billion. Since 2012, 175 projects on recovery have been accounted for every year. It is a sizeable number of projects, which indicates continuous demand upon UNDP's services in a situation where countries are overwhelmed with a disaster situation.

Under the United Nations Institute for Training and Research (UNITAR), **UNOSAT** is a technology-intensive programme delivering imagery analysis and satellite solutions to relief and development organisations within and outside the UN system to help make a difference in critical areas such as humanitarian relief, human security, strategic territorial and development planning.

The **World Bank Group** is one of the world's largest sources of funding and knowledge for developing countries. Its five institutions share a commitment to reducing poverty, increasing shared prosperity, and promoting sustainable development. With 189 member countries, staff from more than 170 countries, and offices in over 130 locations, the World Bank Group is a unique global partnership: five institutions working for sustainable solutions that reduce poverty and build shared prosperity in developing countries.

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Facing page: Local residents walk on the rubble of collapsed houses completely destroyed by the earthquake at Bhaktapur Durbar Square, near Kathmandu, Nepal on April 28, 2015. Photo: © Srinivas Akella Ramalingaswami - Dreamstime.com.

House filled with seashells from storm surge of Hurricane Matthew, 2016. Photo: © F. Guiffault.

Preface

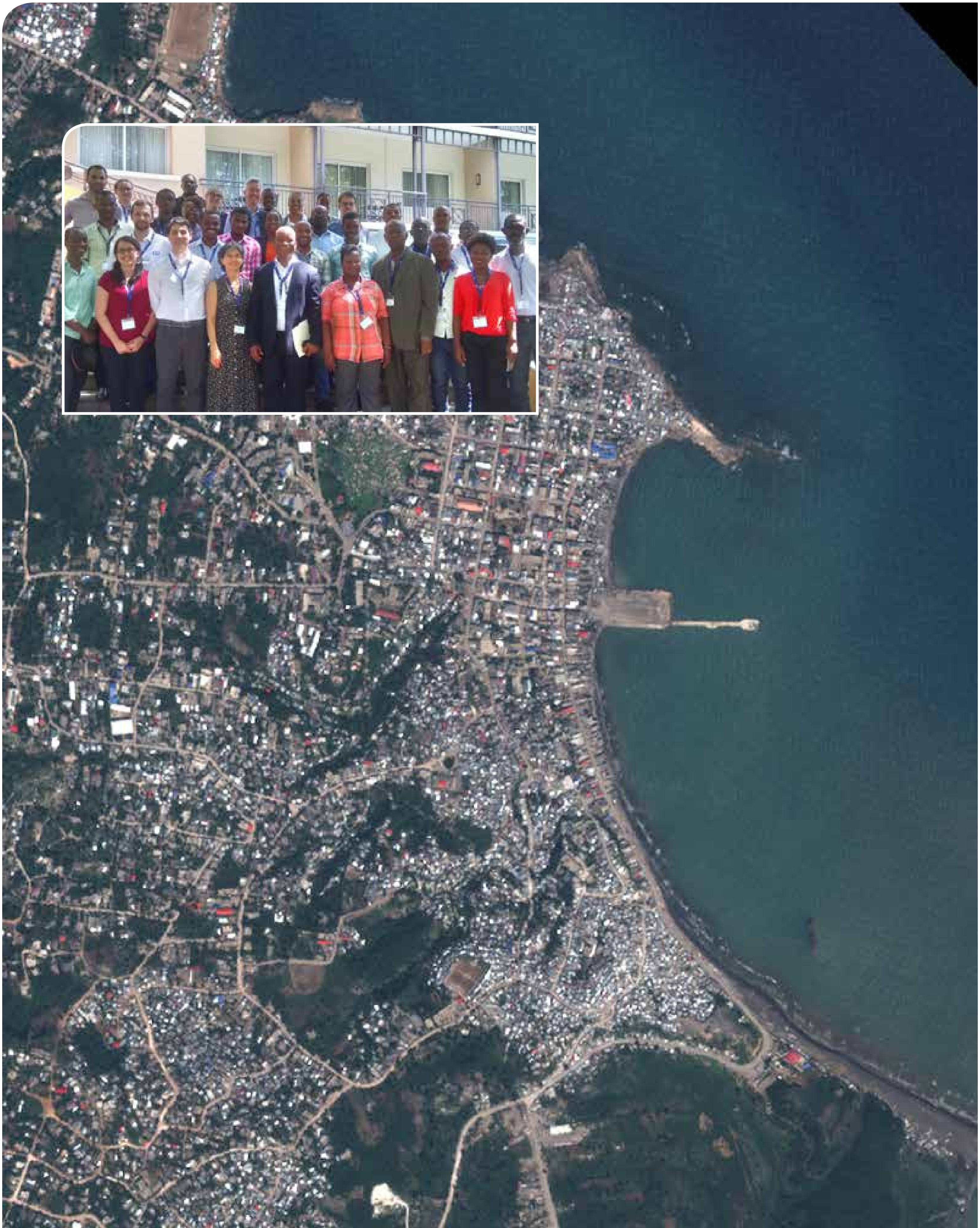
A thorough review of how Earth Observation (EO) satellites are used to support recovery from major disasters is overdue. High-profile initiatives such as the International Charter on Space and Major Disasters—co-founded by CNES and ESA two decades ago—provide ready access to free satellite data during response to major disasters, and indeed have been augmented by partner initiatives such as Sentinel-Asia and the Copernicus Emergency Management Service.

The recovery phase of disasters has not had the same attention or benefited from the same resources. And yet, the world has seen significant disasters in the last decade that have left lasting damage to buildings, infrastructure and ecosystems. Examples of disasters on this scale come quickly to mind: the Sichuan earthquake in 2008, Cyclone Nargis in 2008, the Haiti earthquake in 2010, the East Japan tsunami of 2011, Typhoon Haiyan in 2013, Hurricane Matthew in 2016, Mangkhut Super Typhoon in the Philippines and the Indonesia earthquake and tsunami in 2018, Intense Tropical Cyclone Idai in Mozambique and Hurricane Dorian in The Bahamas in 2019. These large-scale disasters require a holistic approach to recovery that is best offered through systematic use of EO data over the affected area.

Improving our recovery efforts to bring about more resilient recovery is a critical step towards risk reduction. Building back better will improve the lives of those living with risk, and also reduce the impact of disasters in the future. This document is a conscious step in that direction. Born of the common desire across all contributing organizations to see more systematic use of satellites during the recovery process, its principal aim is to increase awareness of what is being done today, and also to raise the profile of opportunities for increased benefit. In some cases, with regard to recovery from conflict for example, where key affected areas are simply not accessible, satellite data represent the primary source of information about damage and impact. The use of satellites alone cannot improve recovery. The satellite data collected must be converted to exploitable information, analysed and then integrated into existing decision processes. These unique data offer strong, complementary information to data currently used, but this benefit can only be enjoyed if satellite data are collected in a timely fashion and used to generate information products. Overcoming the hurdles and challenges of data access is necessary for data integration during the recovery planning and monitoring process.

As partners in the drafting of this document, we welcome the opportunity to share our experiences, and moreover invite new partners to join in planning the improved exploitation of these data in future recovery efforts. This advocacy paper is the first step in a broader opportunity to collaborate on the establishment of a generic Recovery Observatory (RO) capability, which offers unique advantages to the international recovery community and warrants further exploration and development.

President of CNES, Jean-Yves Le Gall



0.7m Pléiades satellite images over the city of Jérémie © CNES 2017, Distribution AIRBUSDS. Inset: Participants of the Haiti Post-Matthew RO User Workshop held in Port-au-Prince, May 2019.

Executive Summary

This document provides a thorough review of how Earth Observation (EO) satellites are used to support recovery from major disasters. It serves as an advocacy paper, a first step in a broader opportunity to collaborate on the establishment of a generic recovery observatory capability.

High-profile initiatives such as the International Charter Space and Major Disasters and Copernicus' Emergency Management Service provide access to free satellite data during response to major disasters. Increased development and more extreme weather events have brought more disasters. Large-scale disasters require a holistic approach to recovery that is best offered through systematic use of EO data over the affected area. Improving our recovery efforts, to bring about more resilient recovery, is a critical step towards risk reduction, according to Sendai Framework. Building back better will improve the lives of those living with risk, and also reduce the impact of disasters in the future.

There are significant resources available for early recovery, including those deployed by the Charter, Copernicus and UNOSAT. As an example, Copernicus produces:

- *Reference maps* that provide a comprehensive and updated knowledge of the territory and relevant assets in a disaster risk reduction context.
- *Pre-disaster situation maps* that provide relevant and up-to-date thematic information that can help planning for contingencies on areas vulnerable to hazards, aiming to minimize loss of life and damage.
- *Post-disaster situation maps* that provide relevant and up-to-date thematic information for the needs of reconstruction planning and progress monitoring, mapping long-term impact, etc. These maps may need to be updated frequently.

In order to be effective, satellite contributions to recovery should be a major contributor to the **Post Disaster Needs Assessment** or the **Recovery and Peacebuilding Assessment** process. This is however only one step in a process that aims to support recovery from event through to delivery of a **national recovery plan**, and the monitoring of its delivery. While satellite Earth observations are not systematically used, many recent PDNAs have made effective use of satellites, including: Dominica 2015; Seychelles 2016; Lao PDR 2018; Indonesia 2018.

Significant challenges remain to implementing systematic use of satellite EO for PDNAs and Recovery:

- Lack of clear institutional arrangements to identify and access data and value-added information products;
- Cost of value adding, which is poorly understood and requires advance budgeting, and in some cases cost of satellite data, which for some applications can be prohibitive;
- Development of capacity in developing countries, especially to process and add value to data;
- For some purposes, inherent limitations of satellite data.

The Generic Recovery Observatory ad hoc team, made up of CEOS satellite agencies, the World Bank/GFDRR, UNDP, UNOSAT, and the European Union, aims to develop a collaborative approach to address these challenges and deliver more comprehensive satellite support after major disasters on a recurring basis.

1 Introduction

Disaster Risk Reduction involves coordinated action across every phase of the disaster cycle: warning, preparedness, response, and recovery. National space agencies have long been active in relation to early warning and response to disasters and almost two decades ago the French Space Agency and the European Space Agency, soon joined by the Canadian Space Agency, created the International Charter Space and Major Disaster, dedicated to providing free and easy access to satellite data during major crises. The Charter is regularly activated by authorized users in a range of countries around the world to access satellite data and value-added products in the immediate aftermath of disasters, typically as many as 40 times a year. Other initiatives now supporting the response phase include Sentinel-Asia initiative and the Copernicus Emergency Management Service.

CEOS Disasters Working Group initiated a series of thematic pilots in 2014 dealing with floods, seismic hazards, volcanoes, and landslides with a view to increasing the role of satellites in reducing risk during the preparedness phase, working on long-term risk reduction. Several of these pilots have become demonstrators, aiming to increase the scope and impact of the benefits achieved.

http://ceos.org/ourwork/workinggroups/disasters/

In this context, the recovery phase has had less attention from satellite agencies, even as awareness of its critical importance has risen with relief agencies and development banks. As stated in the Sendai Framework for Disaster Risk Reduction, rebuilding with resilience has become a clearly articulated goal within the international recovery community, and satellites have a role to play in supporting recovery planning and long-term recovery monitoring. Ultimately, recovery managers should have simple access to key data sets in an uninterrupted fashion from the event through response and early recovery, including post-disaster needs assessment, and support for the elaboration and monitoring of a national recovery plan.

Objectives of a Recovery Observatory

The Generic Recovery Observatory ad hoc Team aims to demonstrate that the improved availability of satellite Earth Observation during the recovery phase can:

- *Improve the accuracy and completeness of early assessment information;*
- *Inform longer-term recovery planning;*
- *Support recovery monitoring from early assessment onwards.*

In order to achieve these goals, it is critical to identify the right entry points in decision making processes for satellite-based products, and ensure timely delivery of accurate products.

1.1 International Actors in Recovery

The European Commission (EC), the United Nations Development Group (UNDG), and the World Bank (WB) adopted the Post Disaster Needs Assessment (PDNA) and Recovery and Peacebuilding Assessments (RPBAs) processes in their "Joint Declaration on Post Crisis Assessments and Recovery Planning" on 25 September 2008.

This Tripartite Agreement has become the basis for a standardized process to assess damage after major events, and this process is typically a major milestone during recovery. Satellite data can play a key role in supporting information collection during this process, but more work is required between satellite agencies and PDNA teams to explore standard processes to collect and integrate satellite data in PDNA reporting.

PDNA Tripartite Agreement

Based on the well-established procedures for quantitative damage and loss assessment of disasters originally developed by the United Nations Economic Commission for Latin America and the Caribbean in 1972, the PDNAs sought to provide "*a harmonized and coordinated approach for an objective, comprehensive, and government-led assessment of post-disaster damages, losses, and recovery needs." This expanded effort was undertaken to apply a joint analytical methodology for supporting countries in their development of a "comprehensive recovery plan that would lead to a sustainable development process where risk reduction in the face of disasters is explicitly considered.*"

The PDNA provides a systematic means to synthesize rapid data collection, analysis, and recovery planning applicable across the multiple societal sectors of production, infrastructure, social dimensions, human development, finance, macro-economic interests, and crosscutting development concerns. The findings and recommendations of the needs assessment are considered in terms of a country's short-, medium- and long-term recovery needs. They influence the determination of resource requirements that will have lasting impacts on individuals, personal livelihoods, human and social development, and a government's national interests.

Since 2009, PDNAs have been conducted in more than 50 countries following an official request by governments after the occurrence of natural disasters, as defined in accepted international terminology at the time. PDNAs have been refined through experience, becoming accepted as the international standard for the post-disaster assessment methodology.

From the Final PDNA Evaluation Report, 2018

https://www.gfdrr.org/sites/default/files/publication/Final_PDNA_Evaluation_Report.pdf

1.2 The PDNA and RPBA Processes

1.2.1 Post-Disaster Needs Assessments (PDNAs)

The PDNA is an internationally accepted methodology for determining the physical damages, economic losses, and costs of meeting recovery needs after a disaster through a government-led process. As of oct 2019, more than 80 PDNAs were conducted using the methodology elaborated by the EU, UNDP, and the World Bank (WB). A 10-year anniversary review was conducted by the UNDP and World Bank's GFDRR with support from the EU in 2017. Some of the key findings included:

Time frames for conducting assessments: While PDNA Guidelines indicate that the exercise takes 6–12 weeks, the majority of cases took 3–4 weeks. Some of the tradeoffs of a shorter time frame are fewer field visits, reliance on secondary data not collected by the PDNA team, and less accurate or comprehensive information on social parameters and household impacts. Rapid assessment techniques should be considered when specific information is desired more quickly. However, rapid assessments cannot be equated with or replaced by the comprehensive and collaborative features that characterize PDNAs.

Other issues related to conducting assessments: The quality of PDNAs is enhanced with the timely availability of national and international technical experts, crosscutting specialists, and up-to-date rosters of expertise with the required language capabilities. Damage, loss, and recovery data need to be appropriate and current, but are usually reliant on existing institutional capacities.

Outcomes of the assessments: Achieving intended outcomes is a function of the purposes and aims among the government and its partners, the efficacy of the PDNA in advancing recovery, and the ability to provide added value to multiple stakeholders.

Comprehensiveness of the assessment: PDNAs produce a wealth of data and analyses of losses, damages, and priority recovery costs, as well as recovery actions in a thorough and accessible manner.

Financial allocation for recovery: Comprehensive and validated PDNA information is a contributing factor for mobilizing external resources for recovery.

https://reliefweb.int/report/world/post-disaster-needs-assessment-pdna-lessons-decade-experience-2018

1.2.2 Recovery and Peacebuilding Assessments (RPBAs)

RPBAs are processes to support more effective and coordinated re-engagement in countries emerging from conflict or political crisis. RPBAs offer countries a standardized and internationally sanctioned approach to identify the underlying causes and impacts of conflict and crisis, and to help governments develop a strategy for how to prioritize recovery and peacebuilding activities over time.

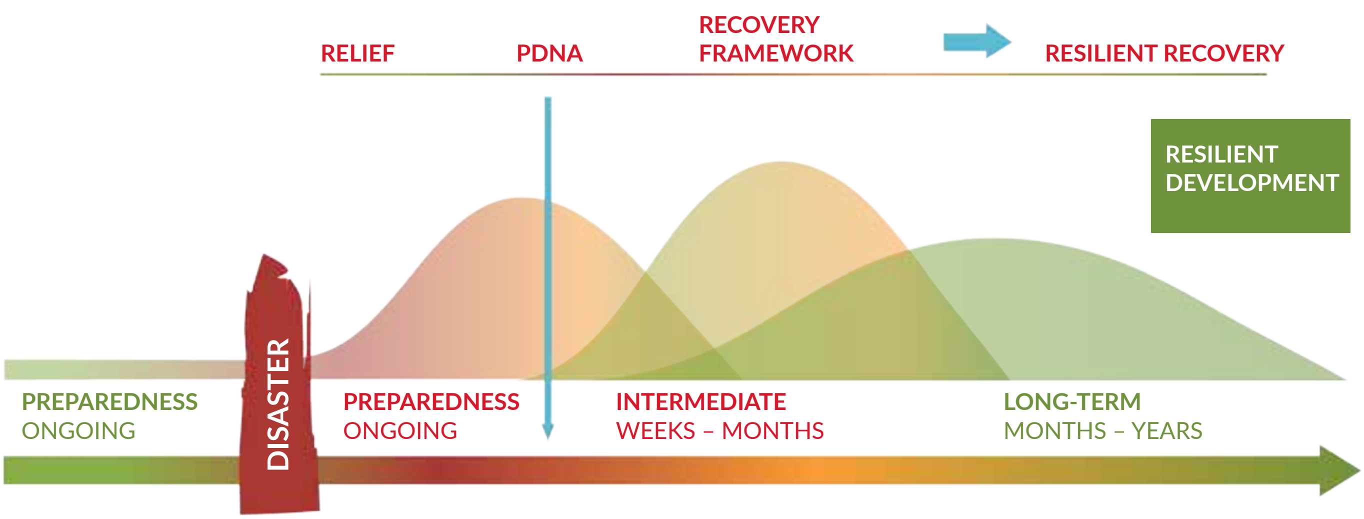
The RPBA includes both the assessment of needs and the national prioritization and costing of these needs in an accompanying transitional results matrix. The process involves a scoping mission to agree on the approach and methodology for the assessment, an analysis of the drivers of conflict, an assessment of the impact of the conflict, an estimation of recovery priorities, and a strategy for the implementation and financing of these. It often concludes with a pledging conference to raise funds for recovery and peacebuilding efforts.

The RPBA methodology is conducted under the Joint Declaration on Post-Crisis Assessments and Recovery Planning signed by the World Bank, the United Nations and the European Union. The declaration commits the three organizations to work with national governments to assess and prioritize recovery and peacebuilding needs.

http://www.worldbank.org/en/topic/fragilityconflictviolence/brief/recovery-peacebuilding-assessments-faqs

2 Recovery Issues and EO Satellite Contributions

The timeline of a recovery from a major disaster will vary according to the type of disaster and the scale of the damage, as well as the sector being considered. However, it can typically be divided into two periods: one during and immediately after the event, where the focus is on assessing the impact and planning the recovery; and a second period during which the rebuilding and recovery process is being undertaken and monitored. Whether during this assessment and early planning period or during the longer-term monitoring, satellite data have a unique role to play, providing a holistic view, with the possibility of low-cost frequent revisits.



Source: Ricardo Zapata-Marti, PARTICIP, Presentation to G-RO ad hoc Team

Ideally, satellite imagery is used seamlessly from the event through assessment and recovery planning, to the development of a national recovery plan and to monitor its implementation. The table below identifies the types of information required during early baseline mapping and during longer-term monitoring, and shows in **blue** information needs that can be informed using satellite imagery:

Clearly satellites cannot inform all needs, but EO data can offer information in relation to many of them. Historically it has been challenging to access satellite data in a timely fashion to generate information products during the PDNA/RPBA process. This hurdle is essentially an institutional issue, as there is no technical barrier to generating the information. The sections below provide examples of standard products available to support early recovery and recovery planning.

	Baseline mapping	Monitoring
Buildings, shelters	> Buildings footprint mapping > Building attributes (roof type, height indication, collapsed or partially collapsed) > Indicate density of damaged buildings > Urban blocks with indication of damage > Landfill sites, debris storages	> Building removal and construction > Change in urban land use, morphology and density > Indicate type of dwelling reconstruction > Landfill sites, debris storages monitoring
Camps	> Location of spontaneous and organized gathering areas > Location of temporary dwellings > Land use, open spaces	> Camp removal and installation > Tent removal and installation > New land use / open spaces
Transport	> Accurate transport network mapping with detailed metadata (type, damage level) > Accessibility analysis > Proximity analysis > Traffic activity analysis	> Rebuilt transport facilities > New transport facilities > Removal of transport facilities > Accessibility analysis > Proximity analysis > Traffic activity analysis
Infrastructures	> Mapping of utilities and services infrastructures (administration, education, healthcare, power - water - sanitation facilities…) with detailed metadata (type, level of damage)	> Recovered infrastructures > Infrastructure removal and construction
Environment	> Landcover, open spaces > Affected landcover (e.g. burn scar with fire damage severity…)	> Change in landcover, open spaces > Indicate loss of vegetation > Vegetation re-growth
Topography	> Risk analysis (vulnerability to flood, to water run-off risk, to soil erosion…)	> Risk analysis

2.1 Early Recovery and Recovery Planning

During the early recovery phase, baseline information is critical, as is information relating to buildings, camps, and an overview of the damage by sector. In the immediate aftermath of a disaster, various processes may be employed to assess damages, ranging from an informal rapid assessment, to a GRADE assessment, or a fully-developed PDNA or RPBA. There are several services that address baseline information for response, which can be a useful starting point for baseline information for recovery. The two are not however synonymous, and some baseline response data sets do not have the requisite information to serve as an adequate baseline for recovery.

2.1.1 Copernicus Risk and Recovery Products

The **Copernicus Emergency Management Service (EMS)** uses satellite imagery and other geospatial data to provide free of charge mapping service in cases of natural disasters, human-made emergency situations and humanitarian crises throughout the world.

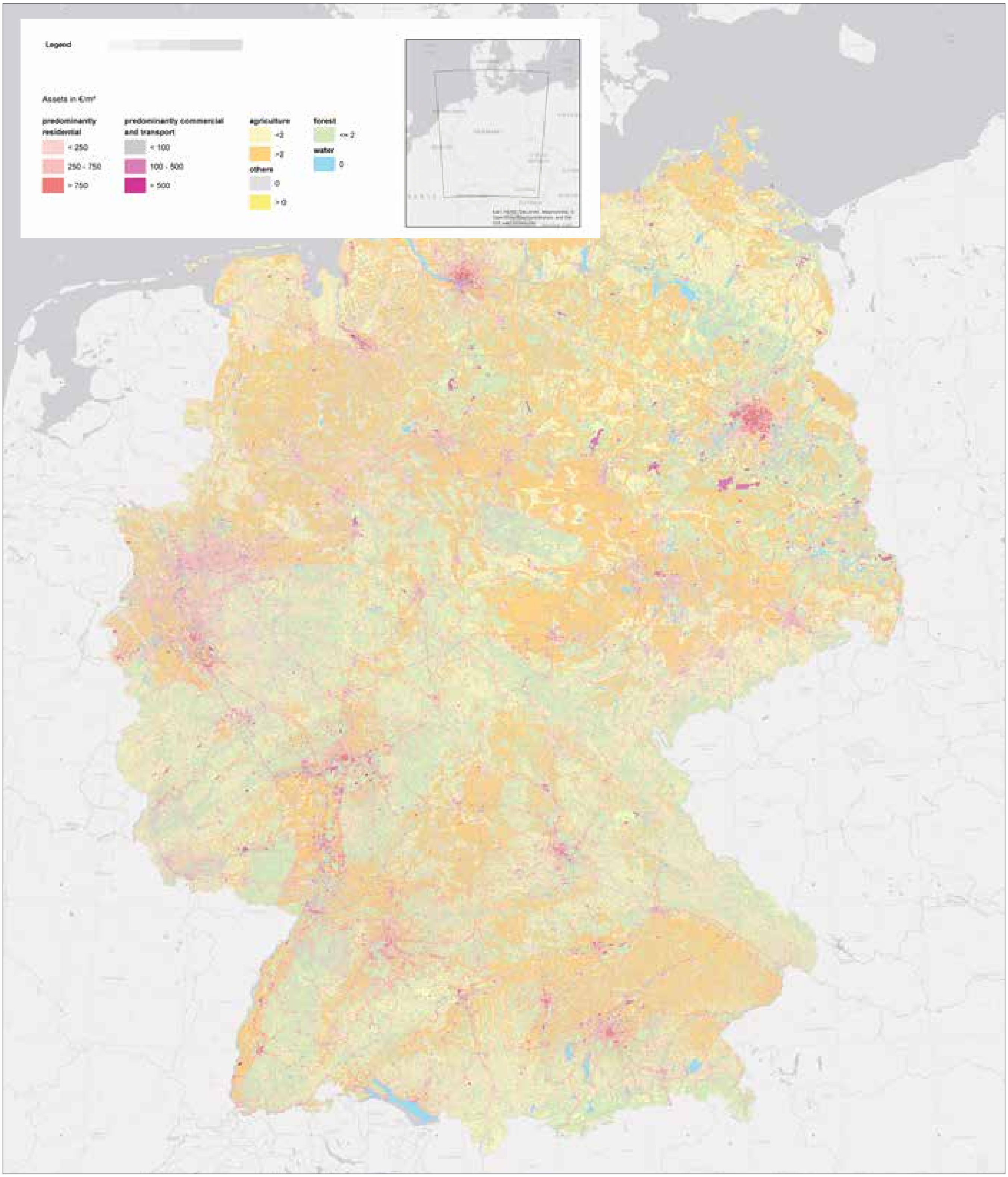
The Copernicus Emergency Management **Rapid Mapping Service** offers on-demand and fast provision (hours-days) of geospatial information in support of emergency management activities immediately following disaster. The service is based on the acquisition, processing and analysis, in rapid mode, of satellite imagery and other geospatial raster and vector data sources, and social media when relevant. There are four product types: one pre-event and three post-event products. Updates can be scheduled for post-event products (called monitoring). A **Reference Product** is normally based on a pre-event image captured as close as possible prior to the event. The three post-event products are the **First Estimate Product, Delineation Products,** and **Grading Product**s.

After the response phase, **Risk & Recovery Mapping** offers on-demand geospatial information, supporting emergency management activities not related to the immediate response phase. This service addresses prevention, preparedness, disaster risk reduction or recovery phases and is divided in 2 sub-categories: Risk and Recovery Standard (STD) for a predefined set of standardized products (portfolio of 20 STD products), and Risk and Recovery Flex (FLEX) for tailor-made studies.

Risk and Recovery Mapping is designed to allow users to request a range of products, based on their specific needs. In particular, the service will support EU Member States in the context of the Union Civil Protection Mechanism and the Sendai Framework for Disaster Risk Reduction. By providing locally relevant information, the RRM products are relevant at city and regional level and can support processes such as cost-benefit analysis of major investment projects for disaster prevention and climate change adaptation.

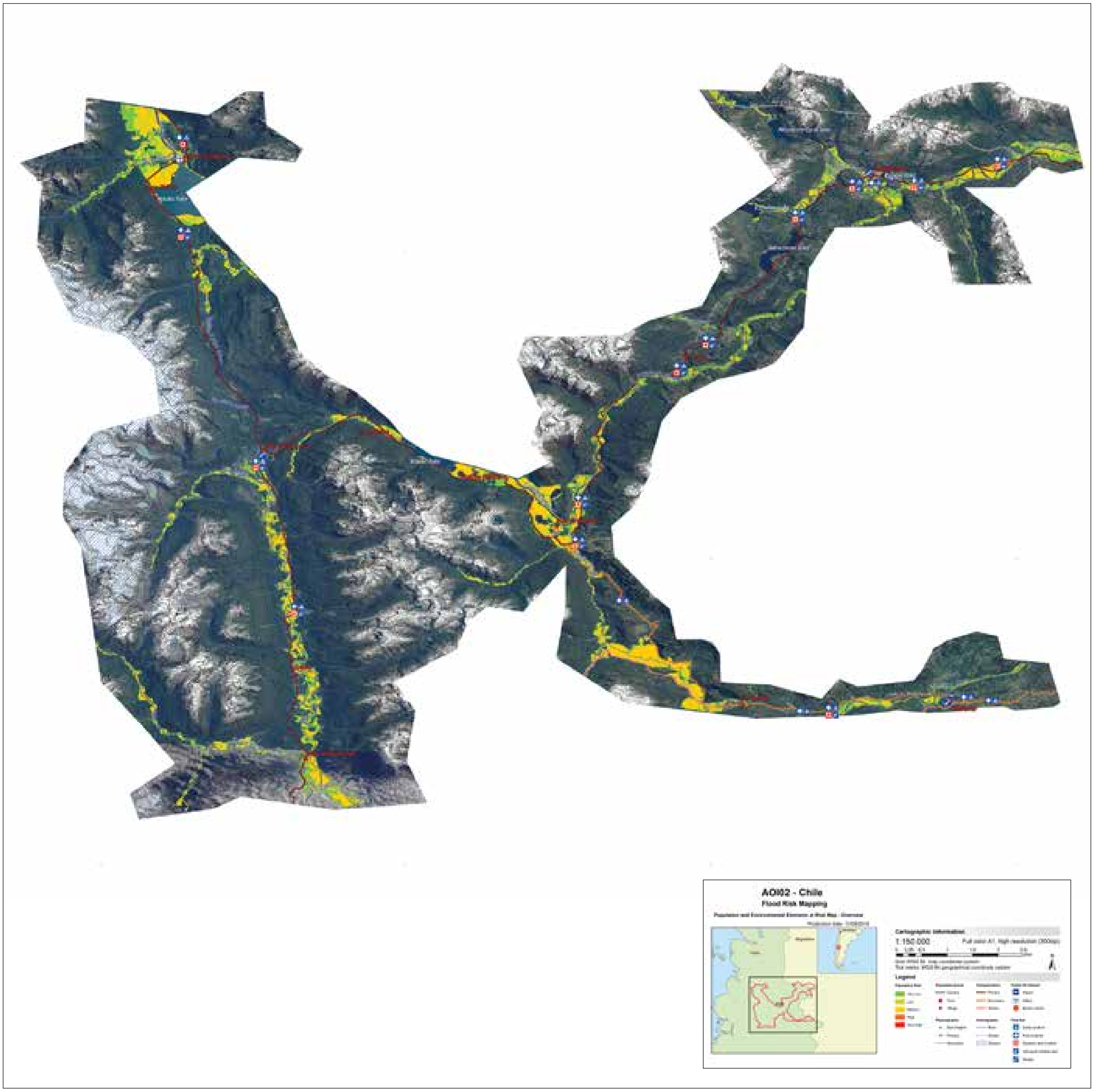
Since its inception in 2012, the Risk and Recovery Mapping service has been activated more than 60 times (October 2019).

1) Reference maps provide a comprehensive and updated knowledge of the territory and relevant assets in a disaster risk reduction context.



EMSN024: Basic European Assets Map, Germany.

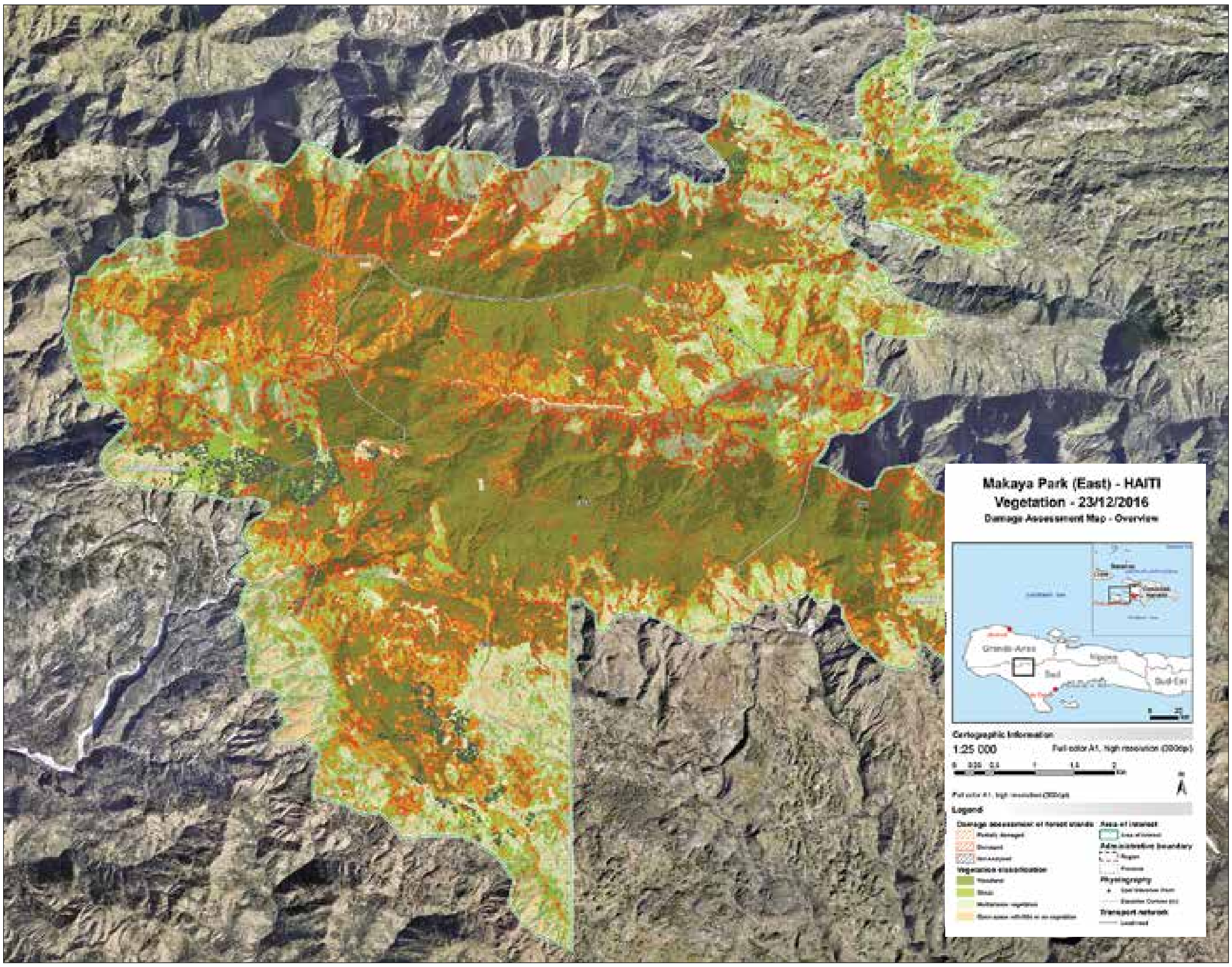
2) Pre-disaster situation maps provide relevant and up- to-date thematic information that can help planning for status, evacuation plans, modelling scenarios. Examples: hazard exposure, vulnerability, resilience, risk contingencies on areas vulnerable to hazards, aiming to minimize loss of life and damage.



Chile, 2018, Population and Environmental Elements at Risk Map - Flood Risk Mapping, EMSN 053.

3) Post-disaster situation maps provide relevant and up-to-date thematic information for the needs of reconstruction planning and progress monitoring, mapping long-term impact, etc. These maps may need to be updated frequently. Examples: post disaster needs assessment, recovery plans, reconstruction/rehabilitation monitoring, Internally Displaced Persons (IDP) monitoring, Refugee Camp monitoring.

In the context of the Haiti RO, the Copernicus Risk and Recovery Mapping Service was activated (EMS50 and 51) to monitor the status of reconstruction in the affected areas, to assess damage to Macaya Park, and to assess the impact of the hurricane on the coastline (mangroves) and agriculture.



Macaya East, Forest damage assessment, 2018. Courtesy of Copernicus EMS.

2.1.2 UNOSAT Products

UNOSAT has been involved since the inception of PDNAs and is part of the established PDNA framework between the EU, WB, and UNDP. UNOSAT has supported operations for several initiatives/experiences within the PDNA framework:

- UNOSAT contributed in 2008 to the publication of the definition of PDNA guideline volume B on the use of Geospatial information and satellite-derived analysis;
- UNOSAT developed a tool kit in 2009 for early recovery clusters which describes satellite-based products that might be relevant for PDNA operations and also Standard Operating Procedures with the JRC;

- After the 2010 Haiti earthquake, UNOSAT was involved in the Collaborative (geo) Spatial Assessment (CoSA) to establish uniform procedures pertaining to the preparation for, the performance of, and the reporting of collaborative remote sensing damage assessment; over 300,000 buildings were analysed for damage with satellite and aerial imagery;
- In October 2017, UNDP and UNOSAT signed a Standard Operating Procedure to streamline the use of geospatial technologies for UNDP Country Offices and Regional Hubs for emergency and crisis response, early warning and preparedness, risk assessments and recovery planning at country and regional levels.

In some instances, International Charter products or Copernicus EMS Rapid Mapping products have been used in the context of PDNAs, but without a systematic approach to engage the resources of these organizations or benefit from regular synergy.

The following examples provide some recent success stories of in-country support:

Dominica 2015: In support of this PDNA, UNOSAT provided an inventory of the landslides that affected the southern part of Dominica Island using very high-resolution imagery.

Seychelles 2016: This PDNA was specific to the Farquhar atoll in Seychelles with the aim of assessing the impact on Coconut plantations areas after the passage of the Fantala tropical cyclone.

More recently, in 2018, two PDNAs were produced by UNOSAT in collaboration with UNDP:

Lao PDR 2018: following the heavy rains and subsequent floods that affected the country in August 2018, UNOSAT determined the widespread flooding extent and duration from mid-July to end of August using big data analytics to assess the severity of the event us on population and crops;

Indonesia 2018: (28 September 2018, Sulawesi earthquake and the related tsunami) UNOSAT provided timely building damage mapping service and a consolidated building damage database aggregating damage information from various mapping agencies all over the world and also provided a dynamic decision support through a live web map.

Clearly, a more detailed review of past PDNA experiences and the development of a new approach leveraging satellite EO and other technologies would be beneficial.

Victims of the 2018 earthquake and tsunami in Indonesia scavenge the remains of their ruins.

2.2 Recovery Monitoring and Capacity Building

Once the recovery has been planned and implementation has begun, the information needs supporting long-term recovery are different from those supporting early recovery and planning. The emphasis changes from damage assessment to monitoring recovery. Long-term monitoring is more focused on environmental needs and infrastructures that were damaged. Eventually, recovery monitoring gives way to a new situation which is that of on-going development support. A critical component of this long-term work is capacity building, which includes training for exploitation of satellite EO.

In many cases, the end users with information needs change from the recovery planning period to the recovery monitoring period.

The sections below provide examples of long-term monitoring initiatives that have been led by members of the Generic Recovery Observatory ad hoc Team.

2.2.1 UNOSAT Support for Long-term Monitoring

UNOSAT has more than a decade of practical experience in the design, development and delivery of innovative training solutions to strengthen technical capacities of governmental authorities, senior decision makers, humanitarian experts and master students in the uses and applications of EO and Geospatial Information Technology for Disaster Risk Reduction:

- Emergency Response & Humanitarian Operations including Early Recovery and PDNA, RPBA;
- Flood and Drought Management;
- Water Resource Management & Environmental Monitoring;
- Sustainable Development Goals (SDGs) Monitoring.

The signed Standard Operating Procedures between UNOSAT and UNDP in 2017 includes this capacity building component and joint training in Istanbul and New York have been already organized to streamline use of geospatial technologies. This training was delivered as part of UNDP's Crisis Response Package Training on Disaster and Recovery Planning and Coordination. It involved 47 participants from UNDP country offices around the world and highlighted the need for EO data during emergency, early recovery, and post disaster operations.

Following the devastating impact of Hurricane Matthew in Haiti in 2016, UNOSAT was requested by the FAO to evaluate, via medium-resolution spatial imagery, the impact of the storm and its effects on vegetated surfaces in the departments of Grand'Anse and South. It also evaluated Matthew's impact and effects on the Tiburon mangrove, and on Macaya National Park, in particular by assessing the impact on woodland areas using very high spatial resolution imagery.

2.2.2 CEOS and the Haiti Recovery Observatory (RO)

In parallel to the UNOSAT agricultural damage assessment, a broader effort was underway to use satellite data in support of long-term recovery following Hurricane Matthew. In December 2016, CEOS triggered the creation of a Haiti Recovery Observatory (RO). A team made up of CEOS agencies, national partners, and international Disaster Risk Management (DRM) stakeholders was created, with leadership from three Haitian champions:

- Centre National d'Information Geo-Spatiale (CNIGS, Co-lead with CNES),
- Comité interministériel d'aménagement du territoire (CIAT), and
- Observatoire national pour l'environnement et la vulnérabilité (ONEV).

The aim of the RO is to:

- Demonstrate in a high-profile context the value of using satellite Earth Observations to support recovery from a major disaster;
- Work with the recovery community to define a sustainable vision for increased use of satellite Earth observations in support of recovery;
- Establish institutional relationships between CEOS satellite data providers and stakeholders from the international recovery community;
- Foster innovation around high-technology applications to support recovery.

Haiti RO Local User Workshop, Regional Haitian Civil Protection Offices, Jeremie, May 2019.

The main benefits from the establishment of the RO include:

- providing key information (analytical, geospatial) about the recovery to support end-users in their decision-making processes and progress monitoring;
- obtaining access to regular imaging of affected area over a long period, especially for higher resolution data not typically available;
- compiling in a single framework the key data sets (both satellite images and large number of other data) and use them seamlessly;
- establishing a "real-life" demonstrator to identify where EO brings useful information in the recovery phase and defining "best practice" for the DRM community;
- demonstrating usefulness of satellite EO, together with other datasets, on a large scale for short and long-term recovery monitoring;
- demonstrating applications tied to very high-resolution imagery and to high frequency high resolution images, to open the way to broader use of satellite EO after smaller and more regular events.

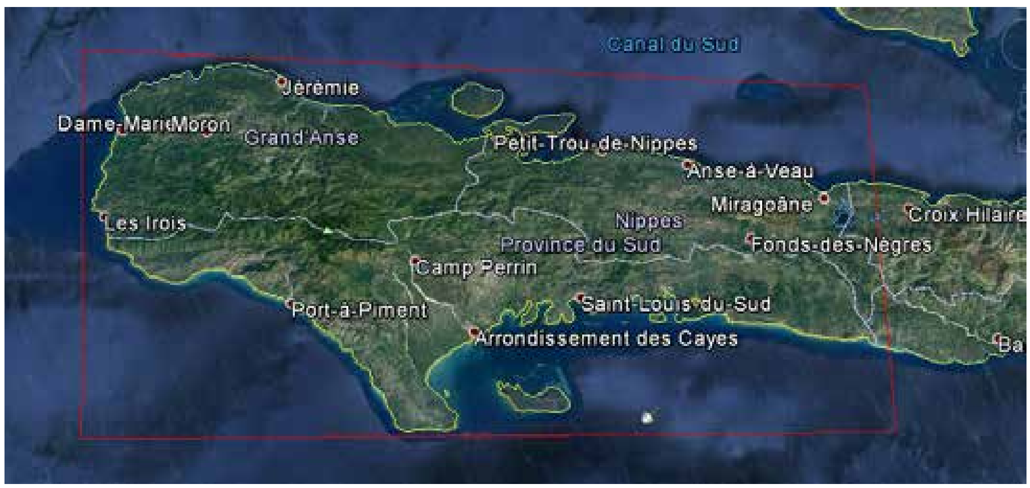
The RO has arranged for satellite data to be used to track reconstruction of buildings, rehabilitation of transportation networks, renewed agricultural activities, and environmental rehabilitation, including recovery from damage in the Macaya Park and in coastal mangroves along the south coast.

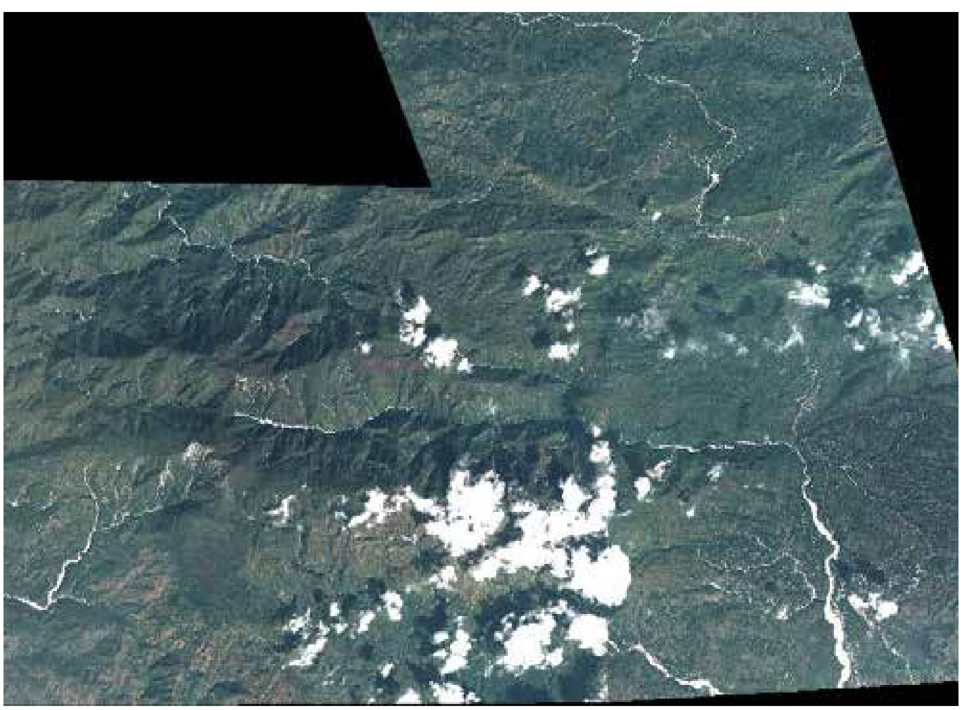
The table below presents the main product categories of the Haiti RO:

Product Category	User	Satellite Data (resolution, mode)
Land Use	Baseline data	10m optical
Built Areas	CIAT/Planning ministry	<1m optical
Environmental Impact	ONEV / Ministry of Environment	10m and 5m optical
Agriculture	Ministry Agriculture	10m and 2.5m optical
Macaya Park/ Forests	ANAP / ONEV / Ministry of Environment	1m SAR and <1m optical
Watersheds	ONEV/ Ministry of Agriculture	1m SAR and <1m optical
Terrain Displacement and Quarries	BME / Ministry of Public Works	1m SAR and <1m optical

1 m SAR change detection along Grand'Anse river in Jérémie, Haiti. COSMO-SkyMed® Products ©ASI 2018. All Rights Reserved (ASI RO-Haiti license).

Recovery Observatory Area of Interest, credit Google Earth.





0.7 m Pleiades satellite image over Macaya Park © CNES 2017, distribution AIRBUS DS.

3 Challenges and Lessons Learned

The experiences gathered in applying EO satellite data to disaster recovery have highlighted several lessons learnt and have also identified several challenges that need to be addressed as we move forward. It is worth stating that there is unquestionable benefit to using satellite data during recovery. While this is true for natural disaster recovery, it is perhaps even more true for conflict situations, where access to the affected area may be problematic in the early recovery period. This benefit to recovery is present at multiple levels, whether only a small amount of data is used, or whether a significant effort is made to integrate satellite data into the full recovery process. More work is required to determine where the most appropriate balance between cost and benefit is achieved, and this balance may be different according to different users or in different disaster situations. After reviewing the collected experiences of the G-RO ad hoc Team, the key challenges below were identified.

3.1 Institutional Arrangements

Establishing a RO requires clear institutional arrangements and predefined processes before the disaster, such as those established in the context of the PDNA Agreement or for the International Charter Space and Major Disasters. For the Haiti RO for example, there was a long lead time to establish the activity: approval of CEOS agencies in principle was granted 6 weeks after Matthew hurricane, but data allocations and product definition took an additional 5 months. This challenge is tied to the connection between satellite agencies, the international community, and local stakeholders. Local champions and users play a critical role but typically have no dedicated funding in the early recovery; apart from provision of RO geo-information products, they await capacity building for long-lasting effects in the country.

From an institutional perspective, agreements are required between international stakeholders and the national government, but also with satellite data providers. In the CEOS framework (best effort, in-kind contribution) space agencies have difficulty in supporting near real-time operations in early aftermath of disasters, and in general are not equipped to deal with near real-time tasking and delivery for CEOS projects. The PDNA requires very rapid but not near real-time tasking and delivery, and this requires close coordination between PDNA leads and CEOS members. Furthermore, proper support to recovery requires continuity of acquisitions.

Finally, given that response end users and recovery end users are not the same, and needs differ for each phase, there is often a disconnection between data collected for Charter and Copernicus activations (generally focussed on people and cities) and data acquired for long-term recovery needs (damage to agriculture, land cover change and environmental issues).

PDNAs and rapid assessments are sectoral and often lack standardization; many agencies and actors can be conducting such assessments at the same time, which poses additional coordination challenges for national disaster management authorities. Sectoral assessments carried out in isolation often lack the recovery and reconstruction considerations necessary to promote early recovery, in comparison to a well-coordinated, asset-based, multi-sectoral assessment. The existence of arrangements before disasters also facilitates the collection of pre-event baseline data sets which are critical to making rapid assessments of change. The quality of satellite-based products, particularly during the very early recovery period, requires a solid baseline of pre-event satellite data. This is challenging because the volume of data required to properly image all potentially affected areas is high.

There is a clear need for coordination among imaging agencies. The CEOS Working Group on Disasters offers one forum where such coordination can take place, but this requires input from users on the areas most likely to be affected by disasters, so that the appropriate baseline data can be collected across multiple agencies and satellite sensors. Better baseline data acquisition plans would consider which areas are subject to risk, but also which areas are liked to be most impacted by potential disasters.

3.2 Addressing Cost of Data and Value Adding

In some cases, the best applicable data is only available commercially, and this involves significant cost. Finding the right mechanism to address this cost is a major hurdle, and addressing the need for cost effective value-adding solutions is critical. However, data cost is only part of the problem. Very few risk and reconstruction managers, including in the developed world, have the capacity to fully exploit satellite imagery. This role is played by practioners, from either academia or the commercial sector, who have the capacity to interpret satellite data and generate useful value-added products to inform decision-making. This process is increasingly automated but remains labor intensive, and in some cases expensive. A proper cost-benefit analysis is required to determine which applications are the most valuable in a given recovery situation, and funds must be identified to support the capacity required to turn data into information. Funding for applications and value-adding activity is even more important, and for the most part there are no dedicated budgets for this.

While CEOS agencies have a track record of delivering value through no-exchange-of-funds projects, there is a clear sustainability issue without dedicated funding. In some cases, programs exist to alleviate the cost, such as the Copernicus Risk and Recovery service, but in this case the work is carried out by European companies which, for the most part, are disconnected from local realities and capacities. Finding a means to connect this service and others like it to local capacity would improve the lasting impact of support on resilient recovery. Finally, long-term collaboration requires a dedicated program budget for management, reporting, dissemination, and missions to affected areas. Such a program could make effective use of other related technologies that leverage satellite EO such as new cloud processing facilities and tools for improved use of free satellite data, such as ESA's Geohazard Thematic Exploitation Platform.

3.3 Capacity Building

Working in the developing world with satellite data offers a range of specific challenges tied to local capacities and capacity development. As a starting point, it can be challenging to identify local partners that can serve as a recipient for data and products relating to the event. Generating these products in a disconnected fashion presents technical difficulties (due to lack of familiarity with the local context), but also results in a product that is not endorsed and taken up by local authorities mandated to respond to the disaster and to reconstruct in the aftermath. It is critical that satellite-based products be developed in close cooperation with local authorities and, whenever possible, by local value adders. This requires training to build local capacity.

3.4 Resilient Recovery

A proper RO is far more than a collection of satellite data and associated satellite-based information products. The RO should provide a forum for exchange and development of science-based products that inform the recovery process. It is a mechanism to engage the scientific community interested in the specific event, to increase awareness in the operational community of the existence of products that can inform their decisions, as well as to engage them in the validation of those products, and train users to apply solutions without outside assistance.

The ultimate legacy of recovery support should be resilient recovery – the ability for the national agencies to learn from the disaster, to respond more effectively in the future to similar events, and to be less reliant on outside help in addressing disasters. In this respect, capacity building in country is critical to supporting satellite-based applications. Currently, there is no clear mechanism to ensure that support during early recovery and long-term monitoring leads to capacity development.

3.5 Satellite Data Limitations

Satellite data offers a holistic view, with incomparable scope and renewed information at only an incremental cost. How beneficial this is may depend on the type and scale of the disaster.

In some cases, flying a drone over an affected area is the most cost-effective means to establish a data baseline. For other, larger areas, satellites offer the only cost-effective means of understanding disaster impact and monitoring recovery. When very large areas are flooded for example, satellite data may prove the only way to rapidly assess the scope of the catastrophe and to regularly provide an update on receding waters. In the case of an earthquake in a dense urban environment, while satellite data may initially inform on the extent of damage in different neighbourhoods, in-situ data is better suited to providing a comprehensive picture of the nature and severity of the damage. When disaster strikes over a very broad area, satellites may be better able to pinpoint areas affected requiring intervention. Some applications require regular revisit over long periods – e.g. damage to fragile ecosystems (protected areas). In other cases, the satellite data required is at very high resolution, and when applied to very broad areas is not cost effective.

In addition, there are inherent limitations due to the technical nature of the sensors. Flooding situations often involve clouds, and optical sensors cannot see through the clouds. SAR (Synthetic Aperture Radar) sensors operate at different bandwidths and have coherence issues with regard to vegetation, water content, or water surface roughness. In each case, a summary cost-benefit is required to assess to what extent satellites might contribute, and which ones are required.

Regardless of resolution, some information cannot be determined by satellite, for example:

- Moderate damages to built-up areas: even at very high resolution, satellites see rooftops but cannot determine the status of a damaged building if its roof has not been damaged; roof damages can be detected in some cases, but only on large roof surfaces, with major damage;
- Changes to vegetation (agriculture or natural vegetation) may require spectral information only accessible at medium scale with specific wavelengths, when for other cases high or very high resolution is needed over the same area, requiring multiple satellites.

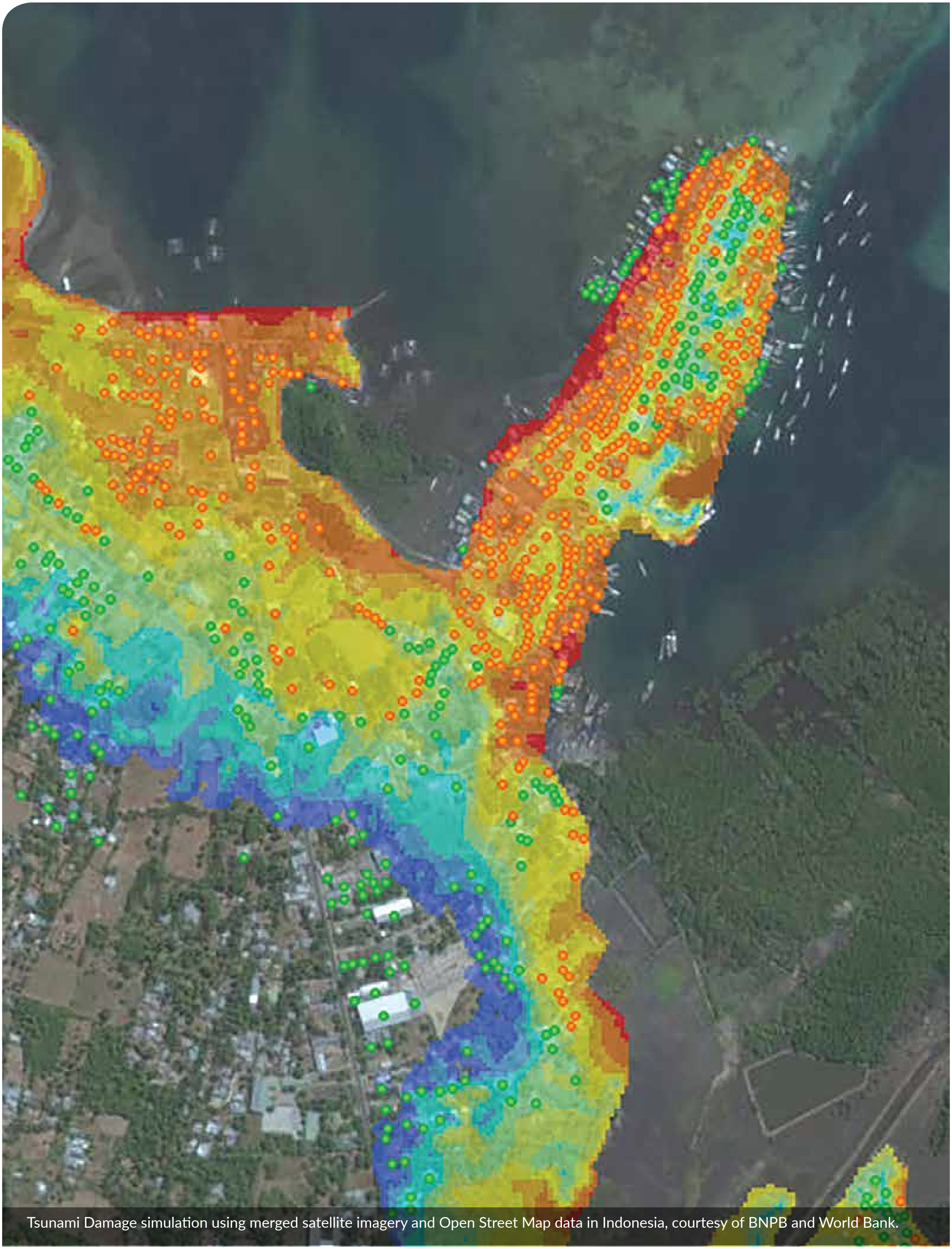
In early damage assessment, satellites are not used regularly, even for topics such as agriculture, where a synoptic view would offer valuable complement to in-situ, detailed information (usually these data are collected in situ and an extrapolation is made to establish damage); in this case the hurdle is usually tied to the timeliness requirement, or more simply to the lack of awareness of PDNA managers of what is possible, or where to obtain it.

Despite a desire for simple, standard products, determining what that standard products should be is challenging; each area affected, each end user, has specific needs and relevant products address these needs and requirements. While it is straightforward to determine the need for baseline data and early assessment products, determining detailed specifications often requires knowledge of the area affected, in the circumstances considered.

While satellites offer incomparable scope and breadth of information, they cannot replace in-situ evaluation for the quality and depth of point-related information. Satellites inform on the built environment, and on natural affects, but are not useful for social impact aspects of the PDNA.

With this in mind, satellites must be integrated into a holistic recovery approach and be used to better guide field observations, which are a critical, necessary complement to the satellite-based products.

Finally, it is worth noting that most very high-resolution satellites have legal restrictions on the access, use, and sharing of data, which in some cases will severely limit the ability to apply a satellite solution.



Tsunami Damage simulation using merged satellite imagery and Open Street Map data in Indonesia, courtesy of BNPB and World Bank.

4 Implementing More Systematic EO Satellite Data Use

Establishing a generic capacity to support major disaster recovery represents a significant organizational, logistical and financial challenge. The hurdles identified include institutional frameworks that need to be established to set out data entry points in existing recovery mechanisms, a more thorough review of the types of information required and the available sources, the issue of information generation and how it is financed, the challenge of reinforcing local capacity during recovery, and ultimately, how to sustain multiple recovery observatories with adequate technical competencies in parallel over many months, or in some cases years.

In this context, a clear hand-off from recovery to development is required to ensure that efforts are synergistic. This is ultimately tied to the question of who the **end user** of satellite support for recovery is to be. If the end user is the national government, within that government it may evolve from the Civil Protection Authority to the Environment or Planning Ministry as the time from the event elapses. However, even if the national government is the end user, the roles of the international stakeholder community at the supranational level and the roles of the local communities at the last mile must be clearly defined, recognised, and funded.

Sample Recovery Observatory coverage at different resolutions over a single area.

Collection of satellite images and maps at several scales during 2 to 3 years after a major disaster

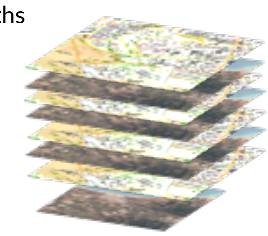
***Ancilliary data remain indispensable:* terrain validation data, aerial and drone data, statistics, cartography...**

Overview area

Mid-scale products from Sentinel data at 10m resolution

- Change in landcover, open spaces
- Vegetation loss or re-growth
- Agriculture

Update frequency:
every 10 days to 6 months



Hot spot zooms

Large-scale products from very high resolution data

- Urban areas, housing, ...
- Transport infrastructure, coastal areas, ...
- IDP camps, ...
- Specific areas of interest

Update frequency:
every 2 to 4 months

In setting up a generic RO capacity (G-RO), the ad hoc Team must consider **logistic issues** such as the number maximum of activations at the same time; the effort in-kind of G-RO team; and other issues including the duration of each RO activation. Some effort is expected in relation to defining standard G-RO products, while recognizing that each event is unique, and that there will always be a need for tailored products, that this customization requires funded partners for value-adding activity. Clearly, there is a need to explore in a demonstrator capacity how a generic and competent RO capability could be set up with support from institutional stakeholders. This would allow to flesh out the issues relating to on-going data provision from baseline pre-event data, through event data, response data, and data to support PDNA needs, and finally early recovery planning and monitoring until the approval of a National Recovery Plan.

Such a demonstrator activity could begin by determining the appropriate **cost-benefit balance** at different levels of effort. There are free resources in place now. Addressing awareness and establishing clear lines of communication can increase collaboration around these resources, "crowd-funded" efforts with volunteers using these open data could then prove to be an accelerator.

Understanding the level of centralization, openness and resources required for different levels of benefit is a critical step toward moving forward on use of satellite EO. The table on page 27 provides on an indicative basis the type of benefit that can be achieved at different support levels.

In order to be successful, the RO effort must include a robust **Capacity Building** Plan. While international help is needed and welcome after an event, there must be a vision for legacy planning that enables local authorities to take up the monitoring effort after initial efforts are underway. In some cases, even international support could be restructured to favor the development of **regional capacity** nodes in developing countries, when a national solution is not available. This approach will reinforce capacity in neighboring countries and lead to risk prevention and a more solid response during the next event in the region. In order to achieve this, it is critical to adopt an **open data** approach where data dedicated to the event are freely available for value-adders and universities in the region, even months and years after the catastrophe, and to set up a funding mechanism and a shared capacity for local and regional entities to participate in longer-term recovery product generation. This can prove challenging with some sensors and may require a flexible approach where original satellite data is not shared but derived products are available. When considering local capacity, one must consider not only ministries and institutes but also the critical role played by academia, especially in developing countries.

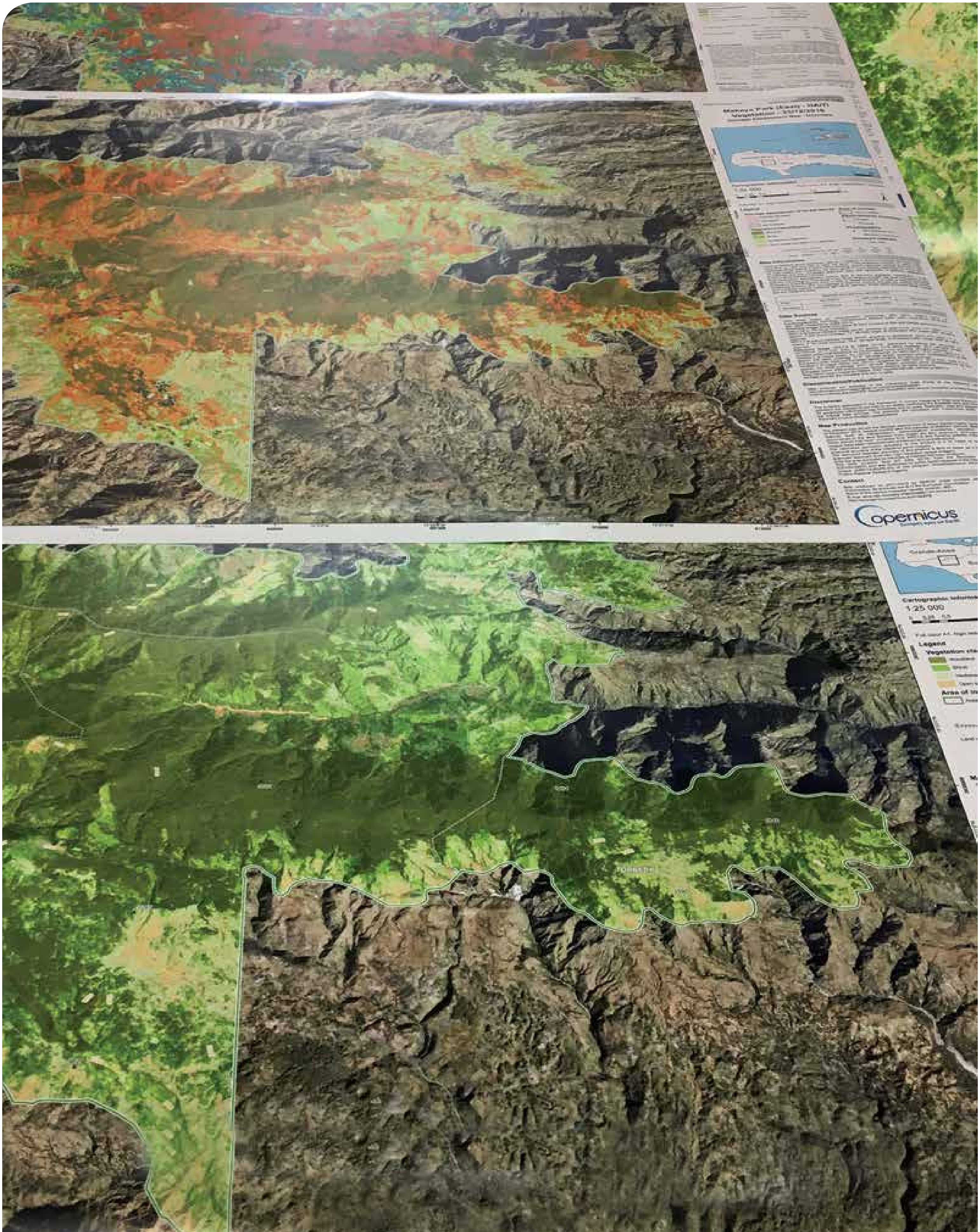
Finally, the G-RO activity must examine its very nature to determine whether it is a set of **guidelines or best practices** to follow, or whether it is more ambitious, and aims to set up a programme or activity, or create a tool that becomes **standard** within the PDNA/RPBA and recovery planning community. In this context, the roles and responsibilities of the international recovery stakeholders and development banks, as well as the satellite community and other players, must all be clearly defined, including linkages to major and emerging initiatives already active in the area, including the International Charter, Sentinel Asia, Copernicus, ARIA (NASA JPL), Space Climate Observatory, UNOSAT, UNOOSA, UNDP, and more recently initiatives within ESA aimed at providing easier access to EO resources for development. One such initiative is the EO4SD (Earth Observation for Sustainable Development) programme proposed by the European Space Agency, which explicitly addresses issues such as Disaster Risk Reduction and Disaster Risk Financing.

The Generic Recovery Observatory ad hoc Team will work together in the coming months to define **scenarios** for improved collaboration between international recovery stakeholders, and explore with CEOS agencies and other satellite partnerships such as Copernicus and International Charter mechanisms for improving access and fast-tracking development of value adding resources. In this sense, this advocacy paper is the **first step in a broader effort** to improve the use of EO satellites for recovery from major disasters. In the

Data	Products	Comments	Budget
> Free and open data sets from imagers that acquire regularly without specific tasking (e.g. Landsat, Sentinels and similar sensors).	> Large scale analysis at country scale and/or regional scales. Analytical results.	> Lower resolution offers synoptic but not detailed view. > Interpretation straightforward.	> No cost / Best effort basis
> Merge open data with selected acquisitions of commercial, higher resolution and targeted imagery. > Small value adding budget to generate a few tailored recovery analyses and products in the weeks following a disaster.	> Large scale analysis using HR images (e.g. Sentinels, Landsat) combined with more specific analysis using VHR images (cost). Analytical results associated with a comprehensive report.	> Would require institutional arrangement for fast activation after events. > Available now through Copernicus service with European value-added providers. > Suited to PDNA but offers no long-term benefit for local capacity.	> Between 20,000 and 50,000 USD
> Dedicated satellite-based input to the recovery process over several months including regular use of submetric optical and SAR data over relatively large areas on a recurring basis. > Addresses multiple data types and products. > Contributes to recovery across a range of different areas (e.g. agriculture, built-up environment, environmental damage, infrastructure, etc.).	> Large scale analysis using HR images (e.g. Sentinels, Landsat) combined with more specific analysis using VHR images (cost). > Analytical results combined with the related report. > Hands-on training to develop local capacity development. > Implementation of long-term analysis plan and capacity building for future PDNAs.	> Depending on when the products are required, funding may come from a small PDNA-dedicated funding mechanism, or the larger Recovery Plan. > Analysis of large volumes of data may require advanced computing resources and analysis competencies. > Would offer framework for longer-term capacity building support and academic training.	> About 300,000 USD

near future, satellite EO can support monitoring for sustainable recovery and improve our ability to build back better. This involves not only making satellite EO more accessible, but integrating it with other data sources, in an information flow that supports decision making at the national level, while leveraging resources at the international level.

The Generic Recovery Observatory ad hoc Team welcomes your feedback and input. For suggestions, comments, or questions, please contact marelo@worldbank.org and helene.deboissezon@cnes.fr.



Copernicus Risk and Recovery products generated for Hurricane Matthew Recovery, presented during Haiti RO User Workshop, May 2019.

5 Background Information

http://ceos.org/ourwork/workinggroups/disasters/

https://reliefweb.int/report/world/post-disaster-needs-assessment-pdna-lessons-decade-experience-2018

https://www.undp.org/content/undp/en/home/2030-agenda-for-sustainable-development/planet/disaster-risk-reduction-and-recovery/post-disaster-needs-assessments.html

https://ec.europa.eu/fpi/what-we-do/available-support-conducting-rpbas-and-pdnas_en

http://www.worldbank.org/en/topic/fragilityconflictviolence/brief/recovery-peacebuilding-assessments-faqs

https:// https://www.gfdrr.org

https://www.cepal.org/en

https://www.unescap.org/our-work/ict-disaster-risk-reduction

https://www.uneca.org/

http://www.un-spider.org/space-application

https://emergency.copernicus.eu/mapping/

https://www.recovery-observatory.org/drupal/en

ANNEX 1 PDNA Tripartite Agreement partners

UNDP

Within the UN family, UNDP coordinates on behalf of the UN system and has supported more than 15 RPBAs in the last three years. These assessments—carried out in the aftermath of earthquakes, cyclones, floods and droughts—have formed the basis for governments and other stakeholders to develop recovery plans and allocate required resources. In an effort to make this critical tool widely applicable, UNDP organizes training programs at global, regional and national levels. The UNDP has signed a Standard Operating Procedure with UNOSAT to support the PDNA/RPBA process and ensure closer coordination of recovery support efforts.

The United Nations Economic Commission for Latin America and the Caribbean (ECLAC) has been a pioneer in the field of disaster assessment and in the development and dissemination of the Damage and Loss Assessment (DaLA) methodology. Since 1991, three editions of the Handbook for Disaster Assessment have been produced, all of them supporting remote sensing data as a key component of the assessment tool kit. The UN Economic and Social Commission for Asia and the Pacific (ESCAP) promotes technological innovations to prevent disasters and build resilience in the most disaster-prone region in the world. Satellite EO, scientific expertise, and Geographic Information Systems (GIS) allow comprehensive hazard and risk assessments, knowledge and information sharing, through reliable geo-referenced information and early warning systems. In order to ensure inclusive and sustainable socio-economic development, ESCAP promotes the integrated use of space-based data to complement socio-economic indicators and ground-based data. UN activities in Africa aim at developing ICT (Information and Communications Technology), in order to better manage logistics during emergencies as well as to model and forecast disaster events. ICT, including space-based technologies, helps in developing knowledge and decision support tools for early warning, mitigation and response planning.

In December 2006 "United Nations Platform for Space-based Information for Disaster Management and Emergency Response - UN-SPIDER" was established. The UN-SPIDER program provides a gateway to space information for disaster management support, by serving as a bridge to connect the disaster management, risk management and space communities. It aims at being a facilitator of capacity-building and institutional strengthening, in particular for developing countries. UN-SPIDER is an open network providing space-based solutions to support disaster management activities.

https://www.undp.org/content/undp/en/home/2030-agenda-for-sustainable-development/planet/disaster-risk-reduction-and-recovery/post-disaster-needs-assessments.html

https://www.cepal.org/en

https://www.unescap.org/our-work/ict-disaster-risk-reduction

https://www.uneca.org/

http://www.un-spider.org/space-application

World Bank and the Global Facility for Disaster Reduction and Recovery (GFDRR)

GFDRR's Resilient Recovery program is involved in every major disaster, helping affected countries assess damage as well as economic losses and needs, plan for recovery, and be better prepared to respond in the future. From hurricanes in the Caribbean to earthquakes in Nepal, the program has a record of supporting governments to rebuild lives and create a safer future through resilient recovery. And the program works with the disaster-prone countries before events in order to enhance their readiness for post-disaster recovery. This is achieved in close coordination with the United Nations, the European Union, and the World Bank, a partnership that has produced guides and tools for conducting PDNAs and developing disaster recovery frameworks (DRFs). Since 2012, GFDRR has leveraged over $US 6.5 billion in recovery and reconstruction funding in over 50 countries. The goal of GFDRR is to help governments strengthen recovery systems prior to a disaster; to enable a quicker and resilient post-disaster recovery; to facilitate the assessment of damage, losses, and recovery needs after disasters; to support governments in planning, financing, and implementing a recovery program; and to develop and disseminate knowledge to strengthen the capacity of key stakeholders. GFDRR leverages the vast activities of the World Bank Group, including extensive disaster preparedness and recovery programs and associated investments.

The GRADE (Global Rapid postdisaster Damage Estimation) approach (developed by the World Bank and supported by GFDRR) can provide an initial rapid estimation of the physical post-disaster damage incurred by key sectors within two weeks of the disaster. The approach aims to create an independent, credible sectoral quantification of the spatial extent and severity of a disaster's physical impact, addressing specific damage information needs in the first few weeks after a major disaster, and complementing the more comprehensive PDNA process.

https://www.gfdrr.org

The European Union (EU) and European Commission (EC)

The European External Action Service (EEAS) is the European Union's diplomatic service. The European Union plays important roles in diplomacy, the promotion of human rights, development and humanitarian aid and working with multilateral organizations.

Working alongside the EEAS, the service for Foreign Policy Instruments (FPI) at the European Commission (EC) is responsible for operational expenditures in the crucial area of EU external action. It reports directly to the High Representative of the Union for Foreign Affairs and Security Policy/Vice-President of the European Commission. It works very closely with both EEAS and EU Delegations around the world.

Since 2012, the Service for Foreign Policy Instruments (FPI) has provided support to the "Joint Declaration on Post Crisis Assessments and Recovery Planning" through a dedicated project office. Support has been provided to both global processes and country assessments, with EU Delegations supported in over 20 countries. The FPI manages operations including their financing. Whilst decision-making rests with country offices, the joint Declaration is supported at headquarter level by High-Level Advisory Groups and Secretariats.

Typically, FPI support to PDNAs/RPBAs includes:

Support to assessment missions

- Provision of technical expertise to PDNA/RPBA processes and missions (senior coordinating role and/or sector specific technical support)
- Support to EU Delegations to assist Governments, including advice on PDNA/RPBA processes and how the EU can take part in such assessment missions

Methodologies & Tools development

- Contribution to further develop the joint PDNA/RPBA methodologies
- Development of assessment tools

Capacity Development

- Development of PDNA/RPBA capacity building tools
- Training of national authorities and regional/international organisations
- Capacity building/Information sessions targeting EU Delegations/EU HQ services

https://ec.europa.eu/fpi/what-we-do/rpba-and-pdna-resources_en

ANNEX 2 List of PDNA activity performed

List of PDNAs (full comprehensive PDNA, rapid needs assessments, partial assessments), as of October 2019

Countries	PDNA Year	Type of Disaster	Additional info
Lao PDR	2019	Floods	
Iran	2019	Floods	
Bahamas	2019	Cyclone	Dorian
Mozambique	2019	Cyclone	Idai
Zimbabwe	2019	Cyclone	Idai
India (Odisha)	2019	Floods	
Mali (Bamako)	2019	Floods	
Comoros	2019	Cyclone	Kenneth
Tonga	2018	Cyclone	Gita
Somalia	2018	Flood	
Somalia	2018	Drought	
Democratic Republic of Congo	2018	Flood and Erosion	
Guatemala	2018	Volcanic Eruption	Fuego
Ivory Coast	2018	Abidjan floods	
Indonesia	2018	Earthquake and tsunanmi	Sulawesi
Uganda	2018	Landslides / Floods	Bududa
India (Kerala)	2018	Floods	
Rwanda	2018	Floods	
Djibouti	2018	Cyclone	Sagar
Tunisia	2018	Floods	

Countries	PDNA Year	Type of Disaster	Additional info
Dominica	2017	Hurricane	Maria
Antigua and Barbuda	2017	Hurricane	Irma
Vietnam	2017	Typhoon	Damrey
Sri Lanka	2017	Landslides and Floods	
Nepal	2017	Floods	
Sierra Leone	2017	Landslides and Floods	
St. Vincent & the Grenadines	2016	Flood	
Haiti	2016	Cyclone	Matthew
Vietnam	2016	Flood	
Sri Lanka	2016	Floods and Landslides	
Seychelles	2016	Cyclone	Fantala
Fiji	2016	Cyclone	Winston
Malawi	2015-2016	Drought	
Myanmar	2015	Flood and Landslides	
Georgia	2015	Flood	
Nepal	2015	Earthquake	
Vanuatu	2015	Cyclone	Pam
Malawi	2015	Flood	
Cabo Verde	2014-2015	Volcanic Eruption	Fogo
Serbia	2014	Flood	
St. Vincent & the Grenadines	2014	Flood	
Bosnia & Herzegovina	2014	Flood	
Philippines	2014	Typhoon	Hayan
Burundi (in French)	2014	Cyclone	
Solomon Islands	2014	Cyclone	

Countries	PDNA Year	Type of Disaster	Additional info
Seychelles	2013	Cyclone	
Fiji	2013	Cyclone	
Angola	2012-2016	Drought	
Nigeria	2012	Flood	
Samoa	2012	Cyclone	
Malawi	2012	Flood	
Bhutan	2011	Earthquake	
Pakistan	2011	Flood	
Thailand	2011	Flood	
Djibouti	2011	Drought	
Lao PDR	2011	Typhoon	Haima
Lesotho	2011	Flood	
Uganda	2010-11	Drought	
Benin	2010	Flood	
Guatemala	2010	Tropical Storm	
Togo	2010	Flood	
Pakistan	2010	Flood	
Moldova	2010	Flood	
Haiti	2010	Earthquake	
El Salvador	2010	Tropical Storm	
Cambodia	2009	Typhoon	Ketsana
Lao PDR	2009	Typhoon	Ketsana
Indonesia	2009	Earthquake	
Samoa	2009	Tsunami	
Philippines	2009	Cyclone	

Countries	PDNA Year	Type of Disaster	Additional info
Bhutan	2009	Earthquake	
Burkina Faso (in French)	2009	Flood	
Senegal	2009	Flood	
Central African Republic	2009	Flood	
Namibia	2009	Flood	
Kenya	2008-2011	Drought	
Yemen	2008	Tropical Storm	
Haiti	2008	Cyclones	Fay, Gustave, Hanna, Ike
India	2008	Flood	
Myanmar	2008	Cyclone	Nargis
Bolivia	2008	Flood	
Madagascar	2008	Cyclone	

Floods in the mountains of Guatemala. Photo: greenaperture.

WORLD BANK GROUP

GFDRR
Global Facility for Disaster Reduction and Recovery

UNDP

CEOS