

Overview of the CopernicusLAC EO Services Development & Transfer Activity

Report



June 15th 2025

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TERMS AND ACRONYMS

Acronym	Description
ABE	Agencia Boliviana Espacial (Bolivian Space Agency)
AEB	Agência Espacial Brasileira (Brazilian Space Agency)
AEP	Agencia Espacial del Paraguay
ALCE	Agencia Latinoamericana y Caribeña del Espacio (Latin American and Caribbean Space Agency)
ANA	Autoridad Nacional del Agua (National Water Authority) - Peru
AOI	Area of Interest
CAF	Development Bank of Latin America and the Caribbean (Corporación Andina de Fomento) - Venezuela
CDC	Copernicus LAC Panama Centre
CDEMA	Caribbean Disaster Emergency Management Agency
CENAPRED	Centro Nacional de Prevención de Desastres (National Center for Disaster Prevention) - Mexico
CENEPRED	Centro Nacional de Estimación, Prevención y Reducción del Riesgo de Desastres (National Center for Disaster Risk Estimation, Prevention, and Reduction) - Peru
CEOS	Committee on Earth Observation Satellites
CEPREDENAC	Centro de Coordinación para la Prevención de los Desastres Naturales en América Central (Coordination Center for the Prevention of Natural Disasters in Central America)
CIMH	Caribbean Institute for Meteorology and Hydrology
CINCH	Centro de Información y Coordinación Hidrometeorológica (Center for Hydrometeorological Information and Coordination)
CITEC	Centro de Investigación y Tecnología del Clima (Center for Climate Research and Technology)
CNE	Comisión Nacional de Emergencias (National Emergency Commission) - Costa Rica
CONIDA	Comisión Nacional de Investigación y Desarrollo Aeroespacial (National Commission for Aerospace Research and Development) - Peru
CONRED	Coordinadora Nacional para la Reducción de Desastres (National Coordination for Disaster Reduction) - Guatemala
COPECO	Comisión Permanente de Contingencias (Permanent Contingency Commission) - Honduras
CRIS	Crisis Response Information System
DGPC	Dirección General de Protección Civil (General Directorate of Civil Protection) - El Salvador
DMH	Dirección Meteorológica de Honduras (Meteorological Directorate of Honduras)
DRM	Disaster Risk Management
DRR	Disaster Risk Reduction
DTM	Digital Terrain Model
EMS	Emergency Management Services
ENSO	El Niño-Southern Oscillation
EO	Earth Observation
EO Services Development	Earth Observation Services Development
ESA	European Space Agency
ESRIN	European Space Research Institute (part of ESA)
FAN	Fondo de Adaptación Nacional (National Adaptation Fund) - Colombia
FAO	The Food and Agriculture Organization – United Nations
FIRMS	Fire Information for Resource Management System (by NASA)

GDP	Gross Domestic Product
GEP	Global Earthquake Model Program
GFDRR	Global Facility for Disaster Reduction and Recovery
GloFAS	Global Flood Awareness System
IADB	Inter-American Development Bank
IDEAM	Instituto de Hidrología, Meteorología y Estudios Ambientales (Institute of Hydrology, Meteorology, and Environmental Studies) - Colombia
IFI	International Flood Initiative
IGP	Instituto Geofísico del Perú (Geophysical Institute of Peru)
IMHPA	Instituto Meteorológico e Hidrológico de Panamá (Meteorological and Hydrological Institute of Panama)
INDECI	Instituto Nacional de Defensa Civil (National Institute of Civil Defense) - Peru
INFONA	Instituto Forestal Nacional (National Forestry Institute) - Paraguay
INGEMMET	Instituto Geológico Minero y Metalúrgico (Geological, Mining, and Metallurgical Institute) - Peru
INRE	Instituto Nacional de Reforma Agraria (National Institute of Agrarian Reform) - Bolivia
INTPA	International Partnership for the Development of Agrometeorology
JRC	Joint Research Centre
LAC	Latin America and the Caribbean
NBR	Normalized Burn Ratio
NMS	National Meteorological Service
NOAA	National Oceanic and Atmospheric Administration - USA
PMI	Project Management Institute
SAR	Synthetic Aperture Radar
SAT	System of Alert and Response
SEN	Secretaría de Emergencia Nacional (National Emergency Secretariat) - Paraguay
SENAMHI	Servicio Nacional de Meteorología e Hidrología (National Meteorology and Hydrology Service) – Peru and Bolivia
SINAGER	Sistema Nacional de Gestión del Riesgo (National Risk Management System) - Honduras
SINAPROC	Sistema Nacional de Protección Civil (National Civil Protection System) - Mexico
SINCH	Sistema Nacional de Información y Coordinación Hidrometeorológica (National Hydrometeorological Information and Coordination System)
SNGR	Secretaría Nacional de Gestión de Riesgos (National Risk Management Secretariat) - Ecuador
TBD	To Be Defined
UNDP	United Nations Development Programme
UNDRR	United Nations Office for Disaster Risk Reduction
UNEP	United Nations Environment Programme
UNGRD	Unidad Nacional para la Gestión del Riesgo de Desastres (National Unit for Disaster Risk Management) - Colombia
URD	Unidad de Respuesta a Desastres (Disaster Response Unit)
VIDECI	Viceministerio de Defensa Civil (Vice Ministry of Civil Defense) - Bolivia
WB	World Bank

COUNTRY ABBREVIATIONS

Acronym	Description
Caribbean	
CU	Cuba
DO	Dominican Republic
HT	Haiti
JM	Jamaica
AG	Antigua and Barbuda
BB	Barbados
DM	Dominica
GD	Grenada
KN	Saint Kitts and Nevis
LC	Saint Lucia
VC	Saint Vincent and the Grenadines
TT	Trinidad and Tobago
BS	Bahamas
North America	
MX	Mexico
Central America	
BZ	Belize
CR	Costa Rica
SV	El Salvador
GT	Guatemala
HN	Honduras
NI	Nicaragua
PA	Panama
South America	
BO	Bolivia
CO	Colombia
EC	Ecuador
GY	Guyana
PE	Peru
SR	Suriname
VE	Venezuela
AR	Argentina
BR	Brazil
CL	Chile
PY	Paraguay
UY	Uruguay

Executive Summary

Latin American and Caribbean countries and the EU have invested significant effort in reinforcing their institutional relationship, notably in the sphere of Disaster Risk Management (DRM) and Disaster Risk Reduction (DRR). In this context, the European Commission has financed an EO Services Development Activity, which aims to provide scalable EO-based services to DRM users in the region. It has also foreseen the creation of the Copernicus LAC Panama Centre, designated as a regional hub for activities related to Copernicus, the EO component of the European Union Space Programme. The Copernicus Centre ensures a robust, shared infrastructure that can be made available to all countries partnering in the development activity. Finally, a capacity development component ensures resources to develop EO-related capacity.

The Latin America and Caribbean (LAC) region is highly vulnerable to natural disasters, including hurricanes, earthquakes, and floods, which threaten lives, infrastructure, and economic stability. Effective DRR is crucial to mitigate these impacts, enhance resilience, and support sustainable development. Recognizing these challenges, the EU and LAC countries signed a landmark Memorandum of Understanding (MOU) in Barbados in May 2024 to strengthen cooperation on disaster risk management. This agreement prioritizes climate change adaptation, resilient infrastructure, early warning systems, and the enhancement of spatial data management capabilities, which are essential for informed decision-making and effective DRR strategies. The MOU aligns with the Regional Action Plan for the Sendai Framework for Disaster Risk Reduction and supports the UN's Early Warnings for All Initiative, aiming for universal coverage by 2027. The region's most pressing needs include bolstering early warning systems, building resilient infrastructure, fostering community preparedness, and leveraging advanced spatial data for risk assessment and planning.

The CopernicusLAC Panama Centre is a major milestone in the commitment of the EU to collaboration on DRR, creating comprehensive local capacity to exploit EU satellite-based resources. Within this Data Centre, the EO Services Development component represents an innovative approach to capacity building and technology transfer. Grounded in open methodologies that exploit free data sets, founded on a co-development approach, the EO Services Development approach limits on-going costs to processing and advanced add-ons. The EO Services Development & Transfer Activity has the aim to demonstrate available services, scalable at a regional or continental level. The EO based services implemented in this activity are available through the CopernicusLAC center page [\[hyperlink\]](#) which leads to the CopernicusLAC Platform [\[hyperlink\]](#), and open source processing environment available for pre-operational demonstrations and that is fit for transfer to the CopernicusLAC Centre of Panama.

During an initial two-year period, this initiative focuses on DRM-related services, with a view to broadening this to climate change or agriculture in the second half of the four-year project, according to the availability of resources and lessons learned.

In the context of the EO Services Development activities, **the purpose of this *Overview of the CopernicusLAC EO Services Development & Transfer Activity* document is to:**

- Present an overview of the user and stakeholder community for natural hazards and disaster risk management (DRM) in Latin America/Caribbean.
- Present the process of user and stakeholder engagement for EO Services Development Activity.
- Identify user requirements relating to free and open EO-based DRM services.
- Identify the process by which the developments of EO services were chosen and demonstrated.
- Describe the EO information development activity, including the full portfolio of services and their proposed use cases, with accent in the co-development role of the engaged entities.
- Identify a path for further stakeholder engagement to promote sustainability of the developed EO services.

One out of every four disasters in the world are in Latin America and the Caribbean (UNDRR), and 53% of global economic losses from climate-related disasters; the region counts 15 of the world's 60 most affected countries

experiencing two or more risks (World Bank). At the same time, the region also has significant local and regional capacity to build on: it is a promising region for investment in resilience.

The initial approach to user requirements involved a high-level assessment of hazards across the region. As user organizations are often structured around hazards, this allowed the project to determine which areas offered the most promise for service development.

Earth Observations for addressing DRM can be integrated in a context that reflects the institutional framework of natural hazard risk mitigation and management in Latin America and the Caribbean. Ultimately, EO services must be integrated in decision-making frameworks at the national and sub-national level in each country. This framework may include a national civil protection agency, a meteorological agency for weather events, a geohazard agency from seismological and volcanic events, and a statistical bureau for information relating to population and exposure more generally.

For each region, there is a defined structure for collaboration which in some cases includes regional actors for larger events or coordinated DRR efforts:

- in the Caribbean, the Caribbean Disaster and Emergency Management Agency (CDEMA) is the regional disaster management body of the Caribbean Community.
- in Central America, the Coordination Centre for the Prevention of Natural Disasters in Central America (CEPRENAC) is the Central American Integration System (SICA) body tasked with developing and implementing the Regional Disaster Reduction Plan (PRRD).
- in South America, the five Andean countries have developed a common approach through the CAPRADE (The Andean Committee for Disaster Prevention and Assistance) regional coordination body and in March 2024, the region convened ten national DRM authorities, from Peru, Paraguay, Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Uruguay, and Venezuela to create the “South American Working Group for Comprehensive Disaster Risk Management.” The group aims to build a network among government agencies responsible for disaster management and humanitarian assistance across the subregion.

Each of these regional mechanisms represents a privileged means to quickly engage national end-users and to scale up services at a regional level. Their support and engagement as regional stakeholders are critical. Similarly, global or Americas-wide organizations with a vested interest in risk reduction and DRM have a strong regional presence in LAC, whether it be the UNDRR, UNDP, the WMO, the World Bank/GFDRR, CAF, or the Inter-American Development Bank. Each of these organizations has specific objectives for capacity building in the region and those objectives may be served by the EO Services Development Activity.

LAC is a diverse region with distinct subregional hazards requiring targeted DRR strategies. In the Caribbean, hurricanes remain the most significant threat, with countries like Haiti, Jamaica, and the Bahamas frequently experiencing devastating impacts. DRR measures such as enhancing early warning systems, investing in hurricane-resistant infrastructure, and strengthening community-based preparedness are essential for mitigating these impacts. In addition to hydrometeorological risks, the Caribbean also faces challenges from droughts, which can affect water resources and agriculture, underlining the need for water management strategies and drought monitoring systems. Central America is susceptible to intense rainfall, recurrent flooding, and landslides, particularly in countries like Honduras, Guatemala, and El Salvador. Furthermore, the region's increasing susceptibility to wildfires, especially during prolonged dry seasons, demands improved wildfire detection and response systems. Exposure information, including data on built environments and land use, can be integrated into risk assessments to identify areas most at risk and guide effective mitigation and planning.

In South America, hazard profiles vary significantly between subregions. The Andean countries—such as Peru, Ecuador, and Colombia—are prone to earthquakes, volcanic activity, and landslides due to their location along the Pacific Ring of Fire. DRR efforts must include seismic-resistant infrastructure, real-time monitoring of volcanic activity, and landslide risk mapping. Wildfires and droughts are of increasing concern, particularly in the Amazon Basin and southeastern Brazil,

driven by climate variability and land-use changes. Early warning systems for droughts and wildfires, coupled with sustainable land management practices, are critical for these areas. Southern South America, including Argentina, Uruguay, and parts of Brazil, experiences extreme weather events such as hail, tornadoes, and heavy rainfall, often leading to urban flooding. Improved urban drainage systems and green infrastructure solutions can significantly mitigate these risks. Across the region, enhanced hazard mapping, risk assessments, and disaster planning can be achieved by leveraging land use and land cover data, combined with exposure information on built environments. These tools are indispensable for prioritizing interventions and reducing vulnerability across diverse landscapes and hazard types.

The creation of a Copernicus Centre in Panama, designated as a regional hub for activities related to Copernicus, aims to achieve the following objectives:

- Establish a regional data hub, or Copernicus Centre developing synergies with the Copernicus Centre in Chile.
- Establish a regional Copernicus strategy including a data centre for disaster risk management.
- Enhance the resilience of the Latin America and Caribbean (LAC) countries by:
 - Increasing access to Copernicus Sentinel data (e.g. Sentinel) and support for disaster management.
 - Increasing and strengthening capacities of countries and regional organisations, as well as private sector and civil society, to access, process, analyse, and use Copernicus data.

ESA leads the implementation of the hub through three pillars with associated activities:

- **Processing infrastructure** for use by LAC (Copernicus Centre).
- **EO services development** based on Copernicus data (open and free).
- **Stakeholder engagement, training, and knowledge transfer.**

The delivery of the EO Services Development component has been contracted to a consortium, led by Indra (Spain) with CIMA Foundation (Italy), LIST (Luxembourg), Geoapp (Italy), University of Thessaloniki (Greece), Terradue (Italy), Wasdi (Italy), Athena Global (France), and ALSO Space (Belgium). The EO services are initially focussed on DRM and are implemented according to the following principles:

- Utilizing free and open satellite data from the Copernicus programme.
- Implementing open and transferable methodologies, ensuring reusability and adaptability.
- Ensuring co-design and ownership of the services by local users in the region.
- Encompassing three main areas:
 - Risk and recovery mapping.
 - Vulnerability, exposure assessments for preparedness, including baseline maps.
 - Monitoring of extreme weather and climate-related events (e.g. droughts, floods, wildfires).

Developing EO services using agile methods, implies the selection of well-proven methodologies and adaptation to LAC and develop a series of services addressing the main challenges in the region in a variety of topics related to hydromet hazards, geo-hazards and exposure. The services that are being developed are:

- **Flood Extent Mapping:** service for single-event flood detection and delineation with satellite imagery
- **Flood Frequency Mapping:** service for multiple-events flood detection and flood frequency estimation with satellite imagery
- **Flood Hazard Mapping:** service for flood hazard assessment by integrating satellite data and hydrological models
- **Flood Depth Mapping:** service for estimation of depth of water in a flood extent
- **Urban Coherence and Intensity Change Detection:** Service to detect changes using backscatter and coherence from two complex Sentinel-1 image pairs acquired before or after an event.

- **Urban Flood Mapping:** service for event-based flood detection in urban areas using advanced techniques (Proprietary service)
- **Drought Indices:** service for drought analysis based on satellite data and climate trends
- **Burned Area Mapping:** service for Near-Real-Time monitoring of active wildfires
- **Fire Danger Mapping:** service to estimate fire danger based on environmental factors
- **Fire Recovery Mapping:** service to track vegetation recovery after wildfires
- **Landslide Susceptibility and Hazard Mapping:** service to identify areas prone to landslides with Machine Learning
- **Interferometric Stacking:** service for ground motion detection and mapping
- **Terrain Motion 3D Geometric Decomposition:** service to decompose ground motion measurements in vertical and horizontal surface motion components
- **Surface Motion Mapping:** service for high-resolution mapping of surface motion over time (Proprietary service)
- **Population Distribution:** service for providing a distribution of population according to urban settlements.
- **Economic Value Mapping:** service for estimating the economic value of land based on satellite data and assets information

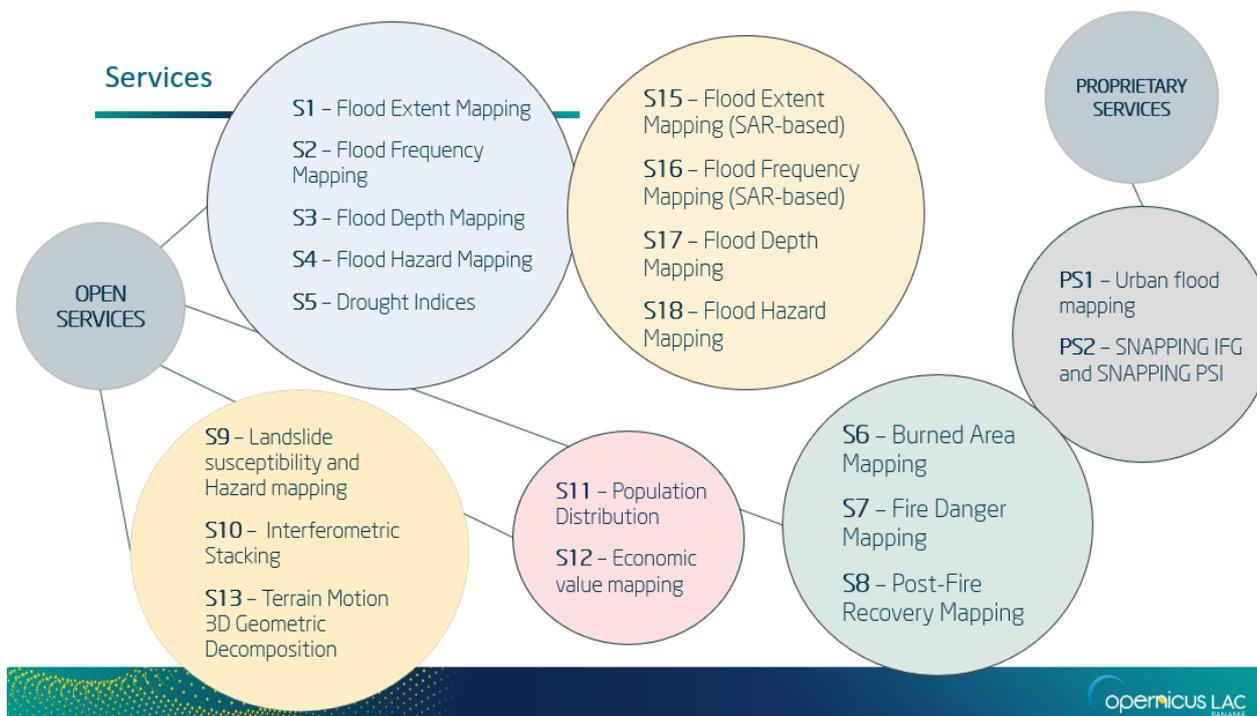


Illustration 1: Scheme of the co-developed services grouped by nature and theme

Demonstrating these EO services is achieved through use cases (UCs) which showcase functionality in specific regions. It implies:

- Iterative cooperation with local users, to ensure co-design and ownership of the services.
- Early application of the EO services into specific regions, indicated by the users.
- Pre-operational delivery of the service, as a transfer of the validated EO product chains to designated users.

Integrating EO services into the CopernicusLAC Panama Centre [\[hyperlink\]](#), which will be the central host and main provider of such services, ensuring accessibility and sustainability throughout the whole region. Alternatively, can be agreed with end users limited local installations of the processing environments on premises of selected users.

Transferring knowledge through capacity building initiatives empowering users to operate processing environments and services independently.

The EO Services Development Activity comprises two phases:

- **Phase 1:** Agile developments over 24 months, for 7 developments of 8-month duration and based on 2-month duration cycles.
- **Phase 2:** Agile developments over 24 months, for 5 developments of 8-month duration and based on 2-month duration cycles.

In addition, the lifetime of each service is divided in three phases:

- **Co-development phase:** algorithms are developed and tested. Each service development is divided into four sprints. At the end of each sprint, a short demonstration of what is achieved is presented to the user. The development phase ends with a final demonstration and one-week of user training (i.e. capacity building).
- **Demonstration phase (pre-operational):** the user interacts with the processing environment, to launch and test the service for a three-month period (baseline). The user provides feedback on the service. The algorithms are deployed in a processing environment that runs on a provisional cloud infrastructure.
- **Operational phase:** The delivery of the steady state of the services. It begins after the pre-operational phase, but only once the necessary processing infrastructure is in place to support end-to-end service deployment.
 - Expected Start: January 2026, assuming the infrastructure is ready.
 - Possibilities:
 - If the demonstration phase ends after January 2026 and the infrastructure is ready, the operational phase begins one month after the demonstration phase concludes.
 - If the infrastructure is not ready at that time, the operational phase will be delayed until the infrastructure becomes available, regardless of when the demonstration phase ends.
- **Service Hosting:** Once the CopernicusLAC Centre becomes operational, it will act as the main hosting node and official service provider. Until then, the platform provider will act as the service supplier.

As this DRR-focused work goes forward, synergies are sought with other related services such as those targeted on response and recovery and already actively used in the region through the Copernicus Emergency Management Services Rapid Mapping and Risk and Recovery efforts, and the International Charter Space and Major disasters. These complementary services need to be expressly acknowledged in relations with the user community to ensure Capacity Building benefits the full range of EO-based DRM-related services.

The Copernicus LAC EO Services Development activities are a significant step forward in bringing the benefits of satellite EO to DRM users in Latin America and the Caribbean. It clearly illustrates the value of Sentinel data to the LAC region, showing how open and free satellite data, when properly integrated into decision-making processes, can steadily enhance disaster risk management across LAC.

1. CONTEXT OF THE REGIONS

1.1 DRR in LAC: Context and Opportunities

One out of every four disasters in the world are in Latin America and the Caribbean (UNDRR), and 53% of global economic losses from climate-related disasters; the region counts 15 of the world's 60 most affected countries experiencing two or more risks (World Bank). At the same time, the region also has significant local and regional capacity to build on: it is a promising region for investments in resilience.

The regions characterised by multiple hazards ranging from hurricane induced flooding in the Caribbean and Central America to flash floods, and broad area riverine floods. Seismic risk is present throughout the region, but to vastly varying extents, ranging from not significant in most of Central America to very high risk in the Ring of Fire in Western South America. In addition, the consultations throughout the region showed a growing concern for drought and for wildfires, which affect even tropical Central America, as well as every country in South America.

As climate change continues to affect regional systems, information about historical hazards and the ability to rapidly update exposure are critical elements that would allow DRM managers to better understand and mitigate risk. Climate change is disrupting cycles ocean currents and water circulation cycles that have been documented since the 1600s. In the South Pacific, the El Nino and La Nina phenomena are still pronounced, but do not behave in the traditional fashion. Rapidly warming sea temperatures have made the impact of the events harder to predict. According to NOAA, "during normal conditions in the Pacific Ocean, trade winds blow west along the equator, taking warm water from South America towards Asia. To replace that warm water, cold water rises from the depths — a process called upwelling. El Niño and La Niña are two opposing climate patterns that break these normal conditions. Scientists call these phenomena the El Niño-Southern Oscillation (ENSO) cycle. El Niño and La Niña can both have global impacts on weather, wildfires, ecosystems, and economies. Episodes of El Niño and La Niña typically last nine to 12 months but can sometimes last for years. El Niño and La Niña events occur every two to seven years, on average, but they don't occur on a regular schedule. Generally, El Niño occurs more frequently than La Niña." In mid-2024, El Niño appeared to be waning, and a return of La Niña was expected for late 2024. Understanding the impact of these phenomena on long-term weather cycles in the region is critical to mitigating the impacts of flooding and drought.

The use of Earth Observation (EO) and Copernicus Sentinel satellites presents a significant opportunity for improving DRR efforts in Latin America and the Caribbean. The Sentinels provide high-resolution, near-real-time data that is invaluable for monitoring environmental changes, mapping hazard-prone areas, and predicting the impact of natural disasters. With the ability to track phenomena such as floods, droughts and wildfires, seismic, and volcanic activity, EO technology enhances the region's capacity for early warning, disaster preparedness, and post-event recovery.



Figure 1: Sentinel-1 derived floodwater over bare soils (green) and urban areas (Itaqui village, Brazil, 2023). Credits: LIST

In particular, the Copernicus Sentinels are a crucial asset for understanding and managing natural hazards, offering long-term, reliable access to satellite data. This empowers decision-makers across the region to design more effective resilience strategies and reduce vulnerability to climate-related disasters, especially in the context of challenges like El Niño and hurricane-induced floods. Moreover, as climate change exacerbates the frequency and intensity of events such as prolonged droughts, wildfires, landslides triggered by heavy rains, and subsidence due to groundwater depletion and land use changes, the data provided by the Copernicus Sentinels is essential for understanding these evolving risks. By offering timely insights into these hazards, the region can better prepare for, and adapt to, the shifting patterns of extreme weather, ultimately safeguarding communities, critical infrastructure, and ecosystems.

In addition to the Sentinel missions, the Copernicus programme provides a comprehensive set of services for monitoring and assessing natural and man-made disasters both during the emergency response phase and outside. The **Copernicus Emergency Management Service (EMS)** consists of geoinformation products and services to better understand and manage disaster risks. It include several components such as:

- **On-Demand Mapping Service**, which comprises Rapid Mapping, Risk and Recovery Mapping ([hyperlink](#))
- **Early Warning and Monitoring Service**, including the [Global Drought Observatory](#), the [Global Flood Awareness System](#) (GloFAS) and the [Global Wildfire Information System](#) (GWIS),
- **Exposure Mapping Service**, which supports risk assessment and preparedness.

The **Joint Research Centre (JRC)** of the European Commission is responsible for the technical implementation and development of many EMS components, ensuring scientific robustness and operational reliability. Meanwhile, **DG ECHO** oversees the overall coordination and operational management of the Copernicus EMS.

The **National Disaster Management Authorities** are the primary requesters of the Copernicus EMS services via the European Union Emergency Response Coordination Centre portal (ERCC, <https://erccportal.jrc.ec.europa.eu/>), which is managed by DG ECHO with technical support from JRC.

1.2 Institutional Framework

Earth Observations for addressing DRM must be adopted in a context that reflects the institutional framework of natural hazard risk mitigation and management in Latin America and the Caribbean. This means ultimately that any contribution of Earth Observation must be included in the actual management framework at the national and sub-national level in every country. Concretely, natural hazard mitigation is a shared responsibility the exact structure of which varies from country to country but ultimately is shared in some fashion between a national civil protection agency, a meteorological agency for weather events, a geohazard agency for seismological and volcanic events, and a statistical bureau for information relating to population and exposure more generally.

However, for each region, there is a defined structure for collaboration and cooperation which in some cases takes on strategic importance given the nature of the risk and the scope of resources allotted to the regional organizations. This is the case in the Caribbean, where the Caribbean Disaster and Emergency Management Agency (CDEMA) is the regional disaster management body of the Caribbean Community. Its role is to be facilitator, driver, coordinator, and motivating force for the promotion and engineering of Comprehensive Disaster Management (CDM) in all 20 participating states. It plays a very hands-on role in the coordination of emergency response but also disaster response capacity-building, mobilizing, and coordination of disaster relief missions, as well as developing and providing comprehensive emergency information.

In Central America, a similar strong coordination capacity is provided by the Coordination Centre for the Prevention of Natural Disasters in Central America (CEPRENAC), the Central American Integration System (SICA) body tasked with developing and implementing the Regional Disaster Reduction Plan (PRRD). It is a specialized institution working towards strengthening regional capacity for disaster prevention, mitigation, and response. The strategic objectives of the PRRD are to promote the incorporation of disaster risk reduction in legislation policies and to develop local resilience to disaster risk, as well as to promote the incorporation of disaster risk analysis in the design and implementation of prevention, mitigation, response, recovery, and reconstruction actions in the countries of the region.

While regional integration has been less pronounced in South America, there is growing attention to the issues related to local disaster risk reduction and management and the five Andean countries have developed a common approach through the CAPRADE (The Andean Committee for Disaster Prevention and Assistance) regional coordination body. There is growing awareness of the importance of regional coordination to address disaster preparedness. It is worth noting that the European Union has invested close to 150 million euros since 1994 in disaster preparedness projects in Bolivia, Brazil, Colombia, Ecuador, Paraguay, Peru, and Venezuela, fostering resilience at community level supported by strong national systems. The EU has also contributed to strengthening the regional disaster preparedness strategies in South America, paving the way for the signing of a dedicated Memorandum of Understanding between the EU and the sub-regional organizations. This agreement focuses on disaster preparedness and risk management, and it became effective in May 2024. Regional disaster management agencies, including CAPRADE and the Regional Mechanism for Disaster Risk Reduction in South America (RMAGIR), have signed as parties to the agreement. In March 2024, the region took a significant step forward by convening ten national DRM authorities, from Peru, Paraguay, Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Uruguay, and Venezuela. They discussed the El Niño phenomenon, disaster risk management, and climate change and signed the Lima Declaration, titled “A South America United in Disaster Prevention and Response.” This creates the South American Working Group for Comprehensive Disaster Risk Management. The group aims to build a network among government agencies responsible for disaster management and humanitarian assistance across the subregion. It also seeks to integrate networks of authorities responsible for CAPRADE and RMAGIR/MERCOSUR, under the new South American Network for Comprehensive Disaster Risk Management. The establishment of this group is a noteworthy move towards a more unified and efficient approach to managing natural disasters in the region.

Each of these regional mechanisms represents a privileged means to quickly engage national end-users and to scale up services at a regional level. Their support and engagement as regional stakeholders are critical. Similarly, international organizations with a vested interest in risk reduction and DRM have a strong regional presence in LAC, whether it be the

UNDRR, the WMO, the World Bank/GFDRR, the Inter-American Development Bank or UNDP. Each of these organizations has objectives for capacity building in the region.

DRR in Latin America and the Caribbean involves a wide range of stakeholders from various sectors working together to minimize the impact of disasters on communities and the environment. In the context of Latin America and the Caribbean, the key stakeholders from different sectors involved in disaster risk reduction includes national DRR governmental structures and related bodies such as specialized hydro-meteorological organizations or seismic research organizations; national bodies specialized in environment, research, science and technology, including space agencies and university-based research institutions; regional bodies supporting DRR activities; international organizations; sub-national authorities including municipalities; non-governmental organizations (NGOs), including community-based organizations and environmental and conservation groups and the private sector acting in DRR activities.

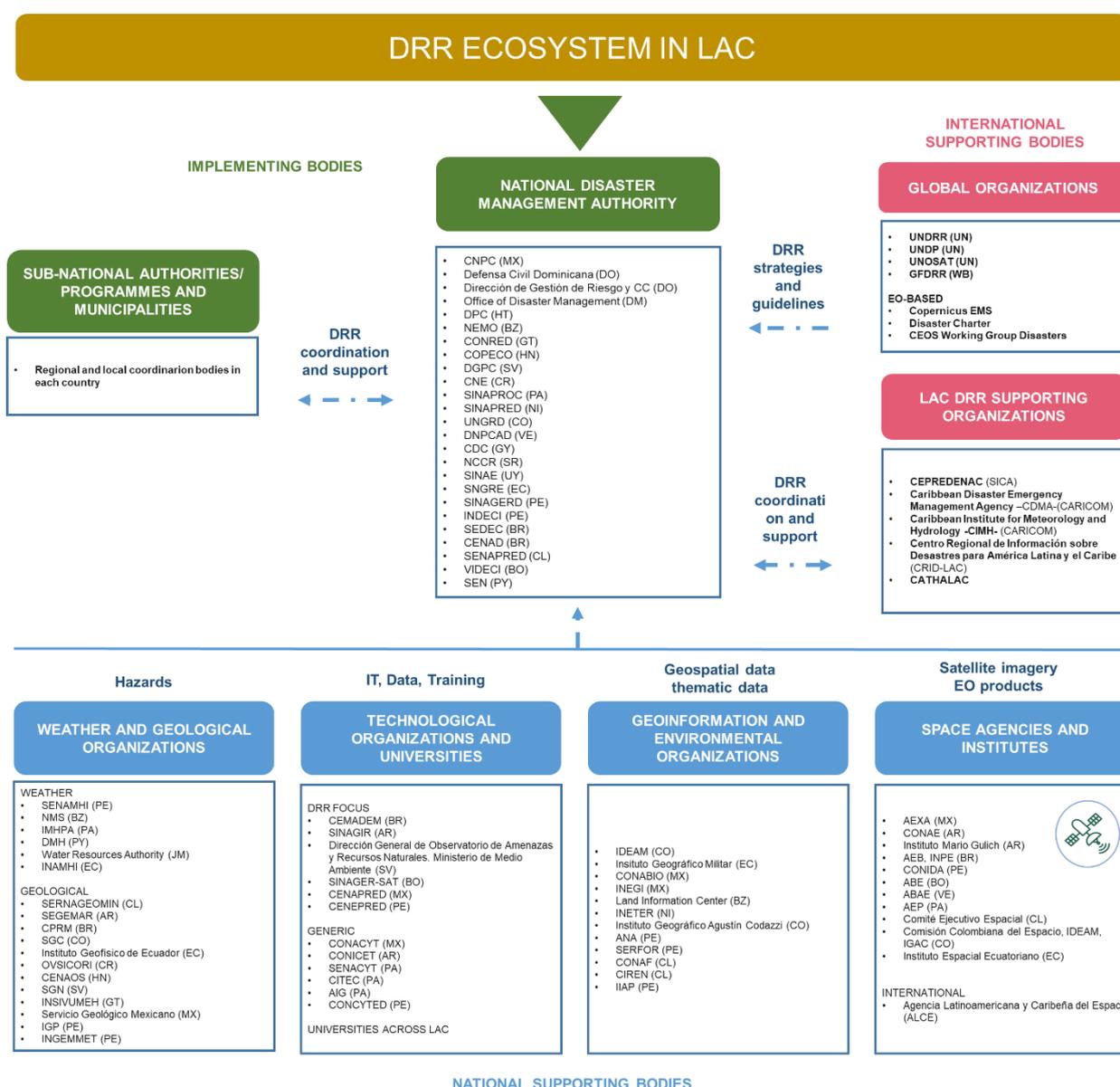


Figure 2: General schema and examples of LAC actors in the international and national DRR governmental structure.

1.2.1 Nationally mandated bodies

National Disaster Management Authorities

Addressing disasters is always a complex issue that involves several distinct institutions working collaboratively, coordinated by one body that has the mandate to address disasters, usually the National Disaster Management Authority, or an ad hoc body reporting directly to the executive authority. It is necessary to recall, however, that the implementation of measures and hence a key part of improved preparedness is the responsibility of local institutions.

While the central coordination and animation role is played by the Disaster Management Agency, especially during response to disasters, this can be significantly modified depending on the type of disaster. Before and during windstorms, hydro-meteorological agencies (national weather services) play a critical role; for major earthquakes seismological agencies play a role in understanding impact and assessing the likelihood of further seismic unrest.

Furthermore, the respective roles of agencies involved change significantly according to the phase of the disaster cycle. While response activity is typically led by a national Disaster Management Agency or national Civil Protection Agency, recovery is led by sectoral ministries (environment, agriculture, public works), and preparedness is also coordinated chiefly by government departments with a lead responsibility for national spending.



Figure 3 : Human settlements in an area highly susceptible to landslides. From the archive of the Geological, Mining and Metallurgical Institute of Peru

The role of local governments in Latin America in DRR and DRM is vital because disasters often have an immediate and significant impact on local communities. Local communities also have the lead role in land use decision-making and the EO-based services envisaged in this activity are specifically geared to that level of decision-making. In its recent review of DRR in the region, UNDRR specifically underlined the key role municipalities play in DRR, and the need to address urban crises and underlying issues such as poverty and socio-economic challenges to be renewed DRR in a sustainable fashion.

When evaluating the role of local governments in relation to those services, the following responsibilities should be considered:

- **Risk Assessment and Planning:** local governments are responsible for conducting risk assessments to identify hazards, vulnerabilities, and exposure within their jurisdictions. Based on these assessments, they develop comprehensive disaster risk reduction plans and strategies.
- **Early Warning and Emergency Response:** local governments establish and operate early warning systems to provide timely alerts to their communities. They coordinate emergency response efforts, including the evacuation of at-risk populations, the provision of shelter, and the distribution of relief supplies during disasters. Local authorities coordinate DRR and DRM efforts with regional and national government agencies, as well as with non-governmental organizations (NGOs), international organizations, and other stakeholders. This coordination ensures a unified and effective response during disasters.
- **Land Use Planning:** local governments regulate land use and zoning to reduce exposure to hazards. They enforce building codes and land-use regulations that aim to prevent construction in high-risk areas, such as floodplains or landslide-prone zones.
- **Infrastructure Resilience:** local authorities are responsible for the resilience of critical infrastructure within their jurisdictions, including roads, bridges, water supply systems, and schools. They oversee infrastructure maintenance and retrofitting projects to ensure they can withstand disasters.
- **Public Education and Awareness:** local governments conduct public awareness campaigns to educate residents about disaster risks, preparedness measures, and evacuation routes. They promote community engagement and involvement in DRR initiatives.
- **Community Engagement:** local governments work closely with local communities, including indigenous and marginalized groups, to involve them in DRR planning and decision-making. They often establish local disaster management committees or councils.
- **Recovery and Rehabilitation:** After a disaster, local governments lead the recovery and rehabilitation efforts in their communities. They coordinate the rebuilding of infrastructure, restoration of essential services, and support for affected populations. Local governments often oversee environmental protection measures, such as reforestation and watershed management, to mitigate the impact of disasters like floods and landslides.
- **Data Collection and Reporting:** local authorities collect and maintain data related to disaster risks, damages, and losses within their communities. This information is critical for assessing the impact of disasters and planning for future risk reduction measures.

1.2.2 Other relevant national bodies

Knowledge management: national weather authorities, geological surveys, universities, and technological organizations

Throughout the region and as in many parts of the world, national weather services play a critical role in predicting and managing the impacts of extreme weather events. These entities are particularly relevant partners for the validation of EO-based products and have access to large repositories of historical data sets relevant to climate impacts and climate-induced disasters (flooding, drought, sea-level change). Weather services are the legally mandated authority for weather information and no EO-based services should be provided without ensuring a strong linkage to their data and information services. In addition, some regional entities contribute to disaster risk management in relation with national authorities. In the Caribbean, the Caribbean Institute for Meteorology and Hydrology (CIMH) -the training arm of the Caribbean Meteorological Organization- plays a unique and capital role as a node of expertise and capacity to be shared not only among its sixteen member nations but across the region, as evidenced by its work in Haiti.

Similarly, geological surveys can be data rich partners in addressing geohazards and sometimes have direct responsibilities tied to the geohazard mitigation and response cycle that would benefit from EO-derived information.

Universities also undertake research and activities relevant to DRM. There are literally hundreds of universities or higher education facilities in the region, and they can play a meaningful role in capacity building activities related to EO-based services. Several universities in Latin America and the Caribbean are actively engaged in leading university-based efforts related to DRM. These universities conduct research, offer academic programs, and collaborate with government agencies, NGOs, other universities, and international partners to enhance DRM and DRR in the region. It is worth noting that NASA recently launched a network of Latin American universities through the AMERIGEO programme and in collaboration with the CEOS WG Disasters (AMERIGEO Labs 4 DRR) to exchange information on best practices for the use of EO for disasters and facilitate access to EO data for university based DRR activities.

Geo-information and environmental organizations

The relationship between environmental organizations such as government ministries but also NGOs and DRM agencies is often overlooked. Both areas are interconnected and have a significant impact on the region's resilience to natural disasters and climate change.

Effective collaboration and communication between environment ministries and environmental NGOs and DRM agencies are essential to ensure that environmental considerations are integrated into disaster risk reduction strategies and that disaster risk reduction efforts do not negatively impact the environment. This integrated approach helps build resilience to both environmental changes and disasters, ultimately contributing to the sustainable development and well-being of communities in Latin America and the Caribbean.

Environment ministries often play a role in coordinating and aligning policies related to disaster risk reduction and environmental protection. They work to ensure that DRR strategies incorporate environmental considerations and that environmental policies account for disaster risks. Environment ministries may also collaborate with DRM authorities to develop land-use planning policies that consider natural hazards, climate change, and ecosystem protection. This coordination aims to reduce vulnerabilities and enhance resilience, but it also promotes ecosystem-based approaches, which use natural ecosystems such as wetlands, forests, and mangroves to reduce disaster risks and enhance resilience to climate-related events.

Agencies and Organizations for Space Affairs

Latin America currently boasts several active space agencies responsible for developing satellite technologies, advancing space exploration, and implementing Earth observation programs. However, in countries without a dedicated space agency, other government bodies and organizations assume crucial roles in space affairs. These include ministries of science and technology, ministries of defence, telecommunications regulators, and foreign ministries, which oversee various aspects of space policy -from satellite regulation to international cooperation on space-related projects. There is a growing trend towards regionalisation, as evidenced by the creation of ALCE in 2020. Now counting 21 signatories, the fledgling Latin America and Caribbean space agency represents nations with collective space spending of \$US 100 million, and while modest, it has reached out to ESA and others to establish partnerships. Though still in its early days, ALCE has achieved tangible progress: agreement signatures, ratifications, establishment of a Caribbean geospatial hub, and preparatory projects like satellite deployment and STEM initiatives. The agency is developing a roadmap for expanding capabilities in service of regional needs. Moreover, various research institutes and national organizations contribute significantly to the advancement of space technologies and Earth Observation across the region. This expanding network of space agencies and associated institutions, even in countries without formal space programs, highlights Latin America's increasing engagement in space exploration, Earth Observation, and satellite technology.

1.2.3 International organizations

Many international stakeholders play key roles in DRM in Latin America and the Caribbean. These organizations and agencies work alongside regional and national authorities to support DRM initiatives, build resilience, and respond to disasters. In particular, the international organizations can play an effective role in encouraging national bodies and governments to adopt EO-based solutions when addressing risk in a national or regional context. Some of these

organizations are global, while others are regional. It is also important to recognize the influence of foreign national organizations in the region. Historically, the US has played the leading role, with both USAID and the US military having strong roles in relation to risk reduction and disaster response in the area. More recently the European Union has played a growing role, with Copernicus EMS being widely used throughout the area for rapid mapping after disasters, and with a growing coordination role between EU development funding and increased resilience. A major new component of this growing regional partnership is the Copernicus LAC initiative.

The EU Commissioner for Crisis Management put forward the following vision of EU-LAC collaboration in 2023: "for three decades, the EU has been present in the Latin America and Caribbean region, strengthening disaster preparedness and emergency response. This support has so far totaled nearly €350 million and reached 30 million people. However, in a region that is among the world's most disaster-prone and subjected to increasingly frequent and impactful disasters, we must act together to further preparedness and keep people safe. Disaster preparedness saves lives, protects communities, and preserves development gains. [...] I am confident that [...] new humanitarian funding will also help strengthen cooperation and risk management across the region."

The EU invested over 42 million Euros in 2023 year in humanitarian aid in the Latin American and the Caribbean region, which includes 13.5 million Euros to enhance disaster preparedness. This funding for 2023 addressed urgent humanitarian needs across the region, including those resulting from the Venezuelan crisis, food insecurity, exposure to natural hazards, transcontinental migration, as well as the consequences of pervasive violence, conflict, and displacement.

Through the recent EU-LAC MOU, the EU has demonstrated its unwavering commitment to supporting increased DRR activity in the region through new capacity building activities and a strong technology transfer around EO for DRM, and EO capacity more generally.

The main international organizations beyond the EU are:

- **United Nations Office for Disaster Risk Reduction (UNDRR):** UNDRR supports countries in Latin America and the Caribbean in implementing the Sendai Framework for Disaster Risk Reduction. They provide technical assistance, capacity-building, and guidance on disaster risk reduction strategies. UNDRR has been a key partner to the EU in the implementation of recent initiatives.
- **United Nations Environment Programme (UNEP):** UNEP works to promote the environment as a disaster risk reduction solution - promoting ecosystem-based approaches such as river basin management, coastal zone management and protected area management to reduce disaster risk and build resilience of vulnerable communities and countries. UNEP has played a catalytic role in bringing together partners across the region on issues such as drought and forest fires, or environmental solutions for improved resilience. In addition, the Forum of Ministers of the Environment of Latin America and the Caribbean is a body that meets under UNEP to discuss environmental issues and priorities within the region.
- **United Nations Development Programme (UNDP):** UNDP collaborates with governments and partners in Latin America and the Caribbean to strengthen resilience, promote sustainable development, and integrate DRM into national development plans. UNDP is also the lead organization within the Tripartite Agreement (UNDP, WB, EU) for Post Disaster Needs Assessment (PDNA) Training, and EO is expected to play an increasing role in supporting PDNAs. UNDP also works closely with UNOSAT (the satellite GIS team within UNITAR) which has for many years produced satellite-derived information products to supports disaster response in Latin America and the Caribbean, as well as the rest of the world.
- **World Bank (WB):** the Bank provides financial and technical support for DRM projects and programs in the region. They focus on disaster risk reduction, recovery, and building resilient infrastructure.
- **Global Facility for Disaster Reduction and Recovery (GFDRR):** GFDRR has a strong presence in the region through its programmes and partners, particularly the WB, but the technical assistance provided through GFDRR

for Recovery and risk reduction can be a means to increase uptake of EO and EO-derived products. GFDRR is also the co-lead with CEOS of the Recovery Observatory (RO), a global initiative launched within CEOS to increase the use of satellites for Recovery.

- **Inter-American Development Bank (IADB):** IADB is a major source of financing for development projects in Latin America and the Caribbean. They fund a wide range of initiatives related to DRM, including infrastructure resilience and climate adaptation.
- **World Meteorological Organization (WMO):** WMO is the UN body tasked with coordinating global weather observations. Its mandate relates to the areas of meteorology (weather and climate), operational hydrology and related geophysical sciences. WMO has a powerful role in contributing to the safety and welfare of humanity by fostering collaboration between its Members' National Meteorological and Hydrological Services and advancing the application of meteorology and hydrology in many societal and economic areas. It has an Americas office which covers the entire region.
- **Caribbean Community (CARICOM):** CARICOM, a regional organization, plays a role in coordinating regional responses to disasters, promoting resilience, and facilitating collaboration among member states.
- **Caribbean Disaster Emergency Management Agency (CDEMA):** under the CARICOM umbrella, CDEMA is a regional organization responsible for coordinating disaster response and risk reduction efforts among Caribbean countries. They work closely with national disaster management agencies and international partners.
- **Central American Coordination Centre for Natural Disaster Prevention (CEPREDENAC):** CEPREDENAC is a regional organization under SICA, the Central American Integration System, a collaborative association of 9 Mesoamerican countries. CEPREDENAC focuses on disaster risk management and reduction. It serves as a coordinating body for disaster risk reduction efforts among Central American countries. It facilitates collaboration and information sharing among member states and regional partners. The organization collects, analyses, and disseminates data and information related to natural hazards, disaster risks, and vulnerabilities in Central America. This includes providing early warning information to member countries. CEPREDENAC also offers training, technical assistance, and capacity-building programs to strengthen the skills and knowledge of professionals, government officials, and communities involved in DRM, as well as organizing large-scale exercises such as the one organized in June 2023 in Panama.
- **Caribbean Institute for Meteorology and Hydrology (CIMH):** CIMH is the training arm of the Caribbean Meteorological Organization, a sixteen-nation specialized organization that focuses on meteorology, hydrology, and climate science in the Caribbean. Its roles and functions in DRM include weather and climate monitoring, early warning systems, climate services, capacity building and research and assessment. CIMH has some expertise in EO data treatment, including both optical and SAR data, and an interest in serving as a regional hub for weather-related EO expertise.
- **Development Bank of Latin America and the Caribbean (CAF):** Headquartered in Caracas, CAF has regional offices in cities including Panama City, Lima, Bogotá, Montevideo, and Buenos Aires. In 2025, CAF approved US\$1.45 billion in regional DRM and infrastructure investments and committed US\$2.5 billion to support blue economy projects. CAF actively supports climate resilience, water security, and early warning infrastructure in its lending portfolio.
- **Water Center for the Humid Tropics of Latin America and the Caribbean (CATHALAC):** CATHALAC is a regional intergovernmental organization dedicated to addressing water-related challenges in Latin America and the Caribbean. CATHALAC focuses on research, capacity building, and technical assistance in areas related to water resources management, environmental sustainability, climate change, and DRR. CATHALAC is active in water resource management, climate change adaptation initiatives, natural disaster monitoring, and capacity building relating to technologies applied to DRR.

- **Centro Regional de Información sobre Desastres para América Latina y el Caribe (CRID-LAC):** CRID-LAC (Regional Disaster Information Center for Latin America and the Caribbean): CRID-LAC is a regional centre dedicated to disaster information management and sharing in Latin America and the Caribbean. CRID-LAC collects, organizes, and disseminates disaster-related information, including data on natural hazards, vulnerabilities, and disaster response efforts. The centre serves as a platform for sharing disaster-related information and best practices among countries and organizations in Latin America and the Caribbean, as well as providing training to reinforce capacity in the region. CRID-LAC provides online resources, databases, and tools to support disaster risk assessment, early warning systems, and decision-making processes.
- **Organization of Eastern Caribbean States (OECS):** OECS countries work together on disaster risk reduction and share resources and expertise to enhance their resilience to hazards.
- **The Andean Committee for Disaster Prevention and Assistance (CAPRADE):** a specialized technical body for disaster reduction in the countries belonging to the Andean Community (CAN). Its member States include Bolivia, Colombia, Ecuador, and Peru. CAPRADE's objective is to contribute to disaster risk reduction in the territories of the Andean sub-region through political coordination and lobbying; strategy and planning; the promotion of disaster prevention; mitigation, preparedness relief and reconstruction; and facilitating cooperation, mutual assistance and exchange of experiences.
- **Regional Mechanism for Disaster Risk Reduction in South America (RMAGIR)**
- **South American Network for Comprehensive Disaster Risk Management:** established in early 2024, this new network integrates CAPRADE and RMAGIR and provides a comprehensive framework to address DRM across ten South American countries.
- **International Federation of Red Cross and Red Crescent Societies (IFRC):** IFRC and its national societies in the region provide humanitarian assistance, disaster response, and community-based risk reduction programs.
- **United Nations Office for Outer Space Affairs (UNOOSA):** UNOOSA promotes the use of space-based technologies, including satellite imagery and remote sensing, for disaster management and emergency response. Its UN-SPIDER programme has established Regional Support Offices (RSOs) in all regions of the world. The RSOs in Latin America Caribbean are: Argentina Regional Support Office (CONAE), Brazil Regional Support Office (INPE), Colombia Regional Support Office, Mexico Regional Support Office, University of the West Indies - Disaster Risk Reduction Centre, Water Centre for the Humid Tropics of Latin America and the Caribbean (CATHALAC). UN-SPIDER conducts capacity-building workshops, training sessions, and technical advisory missions in Latin American countries to strengthen their use of space-based technologies for disaster risk reduction, preparedness, and response. In addition to RSOs, UN-SPIDER is considering opening a regional office in LAC.
- **CCRIF** (Caribbean Catastrophe Risk Insurance Facility) is a non-profit risk pooling organization offering parametric insurance to Caribbean and Central American governments. It provides rapid liquidity after disasters like hurricanes and earthquakes, using proprietary risk models. CCRIF supports resilience-building and collaborates on data-driven modernization efforts

In addition to formal international organizations, collaborative frameworks like the **Committee on Earth Observation Satellites (CEOS)** and the **Group on Earth Observations (GEO)**—particularly its regional arm **AMERIGEO**—support Earth observation (EO) efforts for disaster risk reduction. CEOS has a dedicated **Working Group on Disasters**, which leads initiatives in Latin America such as the **Volcano Demonstrator**, the **Flood Pilot**, and the **Recovery Observatory (RO)**—a joint effort with the World Bank, UNDP, and the EU to enhance satellite use in post-disaster recovery. The RO has been activated in Haiti and Central America, with **CEPREDENAC** coordinating efforts, and was recognized in the UN's **Space 2030 Agenda**. **CONAE**, Argentina's space agency, chairs the CEOS WG Disasters from November 2023 to 2025.

2. THE COPERNICUSLAC EO SERVICES DEVELOPMENT ACTIVITY

2.1 Overview

The Directorate-General for International Partnerships (DG INTPA) of the European Commission, through the Global Gateway and EU-LAC Digital Alliance, is looking to enable cooperation and access to Earth Observation (EO) data to key sectors working in environmental resilience, disaster risk reduction, or adaptation to climate change. In this context, DG INTPA in close cooperation with Panama government, has foreseen the creation of a Copernicus Centre hosted in Panama, the Copernicus LAC hub, designated as a regional hub for activities related to Copernicus, the EO component of the European Union Space Programme. A Contribution Agreement has been signed between DG INTPA and ESA, by which the implementation of the centre has been entrusted to ESA.

The specific objectives of the Copernicus LAC initiative include:

- Set up a Copernicus regional data hub in Panama ([Copernicus LAC Panama](#)) and developing synergies with the future recovery Copernicus Centre in Chile ([Copernicus LAC Chile](#)).
- Increase the access to Copernicus data (e.g. Sentinel).
- Strengthen capacities of countries and regional organizations, private sector, and civil society, to access, process, analyse and use Copernicus data according to their own protocols.

In order to execute the Copernicus LAC and chart its diverse activities, ESA has defined three pillars with associated activities which objectives are being pursued simultaneously. These pillars are:

- **Processing infrastructure** in Panama for use by LAC (Copernicus Panama Centre)
- **EO services development** based on Copernicus data installed at the Copernicus Panama Centre or directly with users
- **Stakeholder engagement** and **knowledge transfer**

The EO services pillar is implemented through the **Copernicus LAC EO Services Development Activity**. ESA contracted a consortium, led by Indra with CIMA Foundation, LIST, Geoapp, University of Thessaloniki, Terradue, Wasdi, Athena Global, and ALSO Space to deliver this project.

2.1.1 Objective and scope

“The main objective of this project is to respond to the geo-information requirements of user organizations by co-developing enhanced EO thematic information products that go beyond EO services currently available in the LAC region taking advantage of the Copernicus Sentinel missions, and to test & evaluate these developments together with user organizations in the framework of their operational activities.”

Based on the main objective, the scope of the Services Development Activity is to:

1. **Respond to priority geo-information needs:** address the highest priority geo-information requirements as expressed by users, aligning with their operational, planning, and strategic goals.
2. **Co-develop EO-Based Information Products:** These products build on the Copernicus Sentinel missions and on end-users’ knowledge, information, and data and go beyond existing EO services in the region.
3. **Demonstrate these EO-Based Information Products** across the LAC region, testing and evaluating them with relevant user organizations.

4. **Develop open-source pre-operational services:** the services are transferred to the CopernicusLAC Panama Centre where they are made available across the region to users.
5. **Use innovative technologies:** incorporate advanced technologies such as Big Data, Cloud Computing, and Artificial Intelligence (AI) in the development and demonstration of EO services.
6. **Support Large-Scale Coverage:** develop EO-based services that can be scaled to support coverage of the entire LAC region, with representative testing areas for demonstrations.
7. **Promote Co-Development with Users:** ensure that the development of EO products and services is done in close collaboration with user organizations, and that user feedback is integrated into iterative development cycles, in order to instil a sense of ownership and ensure long-term uptake.
8. **Build capacity and transfer knowledge:** engage and train national user organizations and their staff to ensure long-term adoption of the EO-based services, with a focus on open-source solutions and knowledge transfer.
9. **Ensure Uptake and Sustainability:** facilitate the future exploitation and operational use of EO services by users beyond the demonstration phase, with the development of Service Level Agreements (SLAs) and capacity-building programs.

The overall goal of the EO Services Development Activity is that the services constitute a Value-Added segment for the Sentinel missions, to make Sentinel data accessible and transform it into geoinformation aligned with priorities in the region in the domain of hazards and risks. The transfer of the necessary tools and knowledge to experts in LAC ensures the full adoption of the Activity outcomes and secures the sustainable and independent exploitation of Copernicus and other satellite data for effective DRM.



Figure 4 : Capacity building session in Colombia on the wildfires' services exploitation and uptake. Credits: Indra

2.1.2 Activities

In accordance with the objective and scope, the Copernicus LAC EO Services Development project is implemented through the following main activities:

- **Engagement with stakeholders and users**, identifying priority themes to guide the developments, through:
 - Identifying relevant users, interacting and developing relations with them and understanding their main priorities.
 - Leveraging support from regional stakeholders related to Disaster Risk Management (e.g., UNDRR, UNDP, IFI), satellite data (e.g., ALCE, CEOS) and private sector.
 - Defining the geographical scope of public geospatial EO information services.
- **Co-development of EO information services** with a focus on Disaster Risk Reduction and Management (DRR/DRM)
 - Utilizing free and open satellite data from the Copernicus programme.
 - Implementing open and transferable methodologies, ensuring reusability and adaptability.
 - Ensuring co-design and ownership of the services by local users in the region, by utilizing their knowledge and adjusting services and capabilities to the entity and to regional needs.
 - Alignment with the themes of risk and recovery mapping; vulnerability and exposure assessments for preparedness; and finally monitoring of extreme weather and climate-related events.
- **Demonstrating EO information services** through use cases (UCs) to showcase functionality and practical use. It implies:
 - Early application of the EO services into specific regions of interest, indicated by the users. These demonstrations constitute the so-called 'Use Cases'.
 - Delivery of the service, as a transfer of the validated EO chains to designated stakeholders identified by ESA.
 - Knowledge transfer through dedicated capacity building actions focused on the exploitation of the services and understanding on their capabilities and results.
 - Provision of access to the services in a pre-operational environment for the users to test the functioning of processing environments and results.
- **Integrating the EO services** into the operational environment (the CopernicusLAC Panama Centre [\[hyperlink\]](#)) ensuring accessibility.

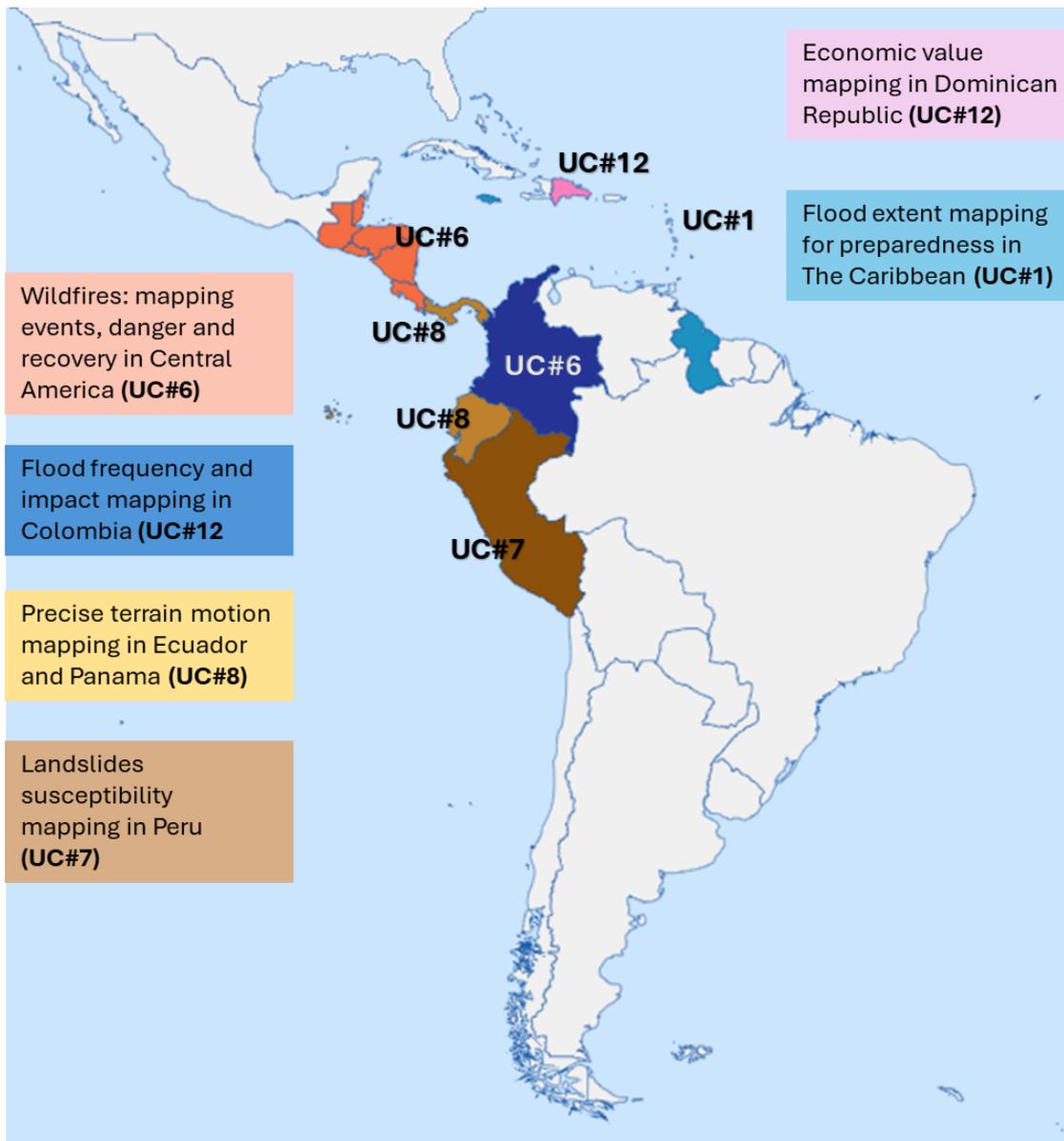


Figure 5: Map of Use Cases in Phase 1 (2024-2025)

2.1.3 Timeline

The EO Services Development Activity comprises the following two phases:

- **Phase 1:** Agile developments over 24 months (2024-2025), for 7 service developments lasting 8 months and based on four cycles of 2 months each.
- **Phase 2:** Agile developments over 24 months (2026-2027), for 5 developments lasting 8 months and based on four cycles of 2 months each.

In turn, the lifetime of each service is divided in three phases:

- **Development phase:** the algorithms are developed and tested. Each service development is divided into four sprints. At the end of each sprint, a short demonstration of what is achieved is presented to the user. The development phase ends with a final demonstration and one week of user training (i.e. capacity building) for the use of the service.

- **Demonstration phase (pre-operational):** a three-month period (baseline) contiguous to development phase. The user interacts with the processing environments, to launch, and test the service (subject to a quota of computational resources financed by the project). The user provides feedback about the service. The algorithms of the service are transferred to the Copernicus LAC Panama Centre for deployment in the processing environment, or to the users directly.
- **Operational phase:** starts right after the pre-operational phase and relies on the existence of processing infrastructure where the end-to-end services are deployed. Additionally, operations require the setting up of a Service Level Agreement between the Panama Centre and users.

2.2 Stakeholder And User Engagement



Figure 6: CopernicusLAC platform landing page. Developed by Terradue Sarl to deploy the EO services developed in the project

In order to articulate the user and stakeholder requirements, it is necessary to define what is understood by user and stakeholder. The term user refers to organizations with a mandated responsibility in DRM and an interest in “using” the services that are being developed to deliver their mandate. This may include a range of users such as civil protection agencies (as coordinators), meteorological organizations, geological surveys and geoscience centres, or even national statistics agencies (exposure). In the broadest sense, anyone with a “stake” (that is interest) in the outcome of a project is a stakeholder. In the retained definition, users and partners are distinguished from stakeholders, and the term stakeholder refers to the residual group of organizations with an interest– obviously every partner and user has a strong interest in the project outcomes. Stakeholders in this definition have regional or global responsibilities which involve development and support of capacity in the region, but not a national mandate in relation to DRM.¹

¹ For the Project Management Institute (PMI), the term stakeholder is used as a general term to describe individuals, groups, or organizations that have an interest in the project and can mobilize resources to affect its outcome in some way. A formal definition of a stakeholder is: “individuals and organizations who are actively involved in the project, or whose interests may be positively or negatively affected as a result of project execution or successful project completion” (Project Management Institute (PMI®), 1996). Project stakeholders usually include the project manager, the customer, team members within the performing organization, and the project sponsor. However, there are more than just these few.”

PMI offers strong advice on the importance of consulting stakeholders: “Forgetting to meet the needs of just one influential and powerful stakeholder at a critical time can possibly ruin a project. Who is that stakeholder and when is that critical time? Typically, very little time is taken to: Clarify who the project stakeholders are. Discover and align their expectations and individual impact on the project. Outline a requirement change process, knowing that the requirements (i.e., needs and expectations) will likely evolve. Relate needs and expectations to risk planning and risk response activities. Conscientiously plan project communication strategies.”

To implement the CopernicusLAC Services Development Activity on behalf of DG INTPA, ESA is liaising closely with DG INTPA representatives and DG ECHO representatives in the LAC region (such as the Regional Office for Latin America and the Caribbean, based in Panama).

For the EO Services Development project, stakeholders external to the project team are identified as those with a vested interest in the project outcomes. The stakeholder engagement strategy positions project outcomes in terms of relevance to agendas of the most critical stakeholders, particularly those who can contribute through influence and resources to project sustainability –these include the World Bank/GFDRR, IADB, UNDRR, UNDP, UNEP-, and other regional players such as CDEMA in the Caribbean, CEPREDENAC in Central America, and the Andean Community in South America. In all, a dozen key stakeholders with a regional or international reach have been identified and already consulted or about to be consulted. The full list is in section 1.2.3. The stakeholder engagement process is not a time-limited exercise. It begins at the beginning of the project, but continues throughout to ensure early active engagement, participation in the development of key objectives and the choice of demonstrations, validation of early outputs and ultimately co-planning the long-term sustainability of EO services.

For the analysis of user requirements, there are two distinct phases, with an initial development phase followed by the kick-off of services developments in phase 1. After that, the consortium continues to capture evolving requirements, but they are not addressed until phase 2 of the project. The Stakeholder Engagement and Knowledge Transfer project is strategically oriented toward fostering stakeholder relationships at a broad institutional level. It maintains a continuous engagement process across multiple tiers and thematic areas, extending beyond Disaster Risk Reduction (DRR) to encompass a wide spectrum of interests. This initiative primarily collaborates with regional and international authorities whose roles are more political than operational. Its core objectives include identifying stakeholder priorities, promoting the visibility and relevance of the Centre, and securing its long-term sustainability.

In contrast, the EO Services Development project concentrates its engagement efforts on end users, emphasizing co-development of services to ensure long-term adoption and operational integration. Given its design, the project typically involves national-level organizations with mandates in Disaster Risk Management (DRM), particularly those focused on prevention and preparedness within defined geographic or functional scopes.

Both projects maintain ongoing coordination to ensure that stakeholder and user engagement is tailored to the respective capacities, mandates, and potential contributions of each entity. This alignment is critical to the effective implementation of the CopernicusLAC initiative, ensuring that outreach and collaboration are context-sensitive and strategically targeted.

2.2.1 The engagement activity

The project began by identifying all the relevant users and stakeholders in the region and compiling a repository to track engagement with these users. The high-level hazard analysis was followed up with the identification of all users and stakeholders in the region. A broad approach to users was retained, and a user database was created, to track outreach and contact with these institutions. These users included not only civil protection agencies, but hydro-meteorological offices, geological surveys and other practitioners that could be direct users of EO-derived services relating to DRM.

In some cases, informal contact with users was already in place through other projects and initiatives. In other cases, users needed to be contacted to be informed of the project and its objectives. A broad outreach activity was engaged in Q1 2024, with overall leadership for users being the responsibility of Indra, and overall leadership for stakeholders being the responsibility of Athena Global.

For stakeholders, the key stakeholders for the project were identified at the outset of the project, and they were contacted in February or March 2024. When possible, face to face meetings took place. When this was not possible, virtual meetings were held. These meetings served to present the project and to identify overriding concerns that stakeholders may have that should be addressed by the project. The priorities raised by the stakeholders and their overriding policy concerns are identified in this document. It was agreed during this early engagement process that the

project would return to the stakeholders after along the project to share the final list of use cases and continue to involve stakeholders in the development of the project. This process unfolds in Q3 2025.

In parallel to the stakeholder engagement, users were contacted to gauge their interest in the use service demonstrations. In some cases, members of the consortium were already in contact with end users, whether civil protection agencies, meteorological agencies, or geological surveys; in other cases, stakeholders recommended specific national agencies that may be interested. Finally, a generic e-mail presenting the project was sent to agencies not already in contact with the project to ensure all national agencies that represented potential users were aware of the initiative.

It is not possible to develop all services in every country in the region. The approach was to identify which services would be of interest in which sub regions and to choose within these sub regions, countries interested in co-developing methodologies to be able to demonstrate in selected areas the usefulness of the services. These could then be scaled to the entire sub region or adapted to other geographies before scaling.

The following sections outline the process established by the EO Services Development consortium to engage both stakeholders and end-user organizations for the project's development. This chapter presents first the key stakeholders that were identified, and why it is important to work collaboratively with them in the development of the project. It then presents the users, how they have been contacted, including who has been contacted, how they have contributed to the setting of priorities in relation to areas of demonstration across the region and what are their main challenges regarding DRM in general and linked to the use of space technology.

2.2.2 Stakeholder discussion

Engaging stakeholders is a critical component in the project lifecycle. It is important to begin the engagement at the outset, as key stakeholders need to share the vision and objectives of the project and feel they can make a real contribution to the outcomes. Lack of involvement of key stakeholders may not have an impact on the technical success of demonstrators but almost certainly affects sustainability beyond the demonstration phase.

The strategy to engage stakeholders is a layered approach. Key stakeholders were identified at the outset of the process so that they could be contacted early, to build a sense of ownership in the EO Services Development project beyond the project partners, and to be sure project goals are aligned with high-level priorities and concerns voiced by stakeholders. The stakeholder engagement process however is not limited to early engagement. Once the project has been presented and concerns are identified, stakeholders are consulted again after the final selection of the demonstrators and are encouraged to share their views on how the project is evolving. In some cases, this involves engaging different parts of the same organizations. For instance, at the World Bank or UNDP, once the demonstrators are selected, it is necessary to engage geographic area stakeholders specific to each country. The engagement process continues during the demonstration phase to encourage involvement by stakeholders in project follow-on planning and sustainability. Finally, key stakeholders are invited to comment on ways and means to improve on the demonstrators and strategies for scaling the demonstrators after the AGILE development is completed.

Through this dedicated engagement process, priorities can be identified and addressed in the EO Services Development project.

The following stakeholders had face-to-face briefings (sometimes with other remote participants) with the engagement team in February and March of 2024: UNDRR (Americas office and regional Barbados Office); DG ECHO; World Bank/GFDRR; World Meteorological Organization (Americas office); UNEP (Americas office); UNDP (Americas); CIMH; and CDEMA.

A remote meeting was held with CEPREDENAC, and IADB was consulted. The following organizations have been identified as key regional stakeholders to be approached in 2025: CAPRADE, RWAGIR, South American WG on Comprehensive DRM, ALCE, IFRC, UNOOSA, CRID-LAC, CAF, and CATHALAC. In parallel to this outreach, a second round of consultations with

the first group of stakeholders will take place to share the results of the user requirements development and the selected case studies and demonstrators.

While each stakeholder has a specific set of interests in relation to DRM in the region, a few overarching concerns shared by multiple stakeholders should be brought forward. The first overarching concern was regarding synergy across existing programs. EO Services Development project should aim to work within the existing institutional framework and benefit from existing programs, in full complementarity. This was brought up specifically in relation to the Early Warnings for All initiative (EW4ALL), which was discussed in detail by UNDRR and WMO, and also to a lesser extent by UNDP and UNEP.

Early Warnings for All is an initiative to ensure that everyone on Earth is protected from hazardous weather, water, or climate events through life-saving early warning systems by the end of 2027. With human-induced climate change leading to more extreme weather conditions, the need for early warning systems is crucial. Systems that warn people of impending storms, floods or droughts are a cost-effective tool that saves lives, reduces economic losses, and provides a nearly tenfold return on investment. Early warning systems have helped decrease the number of deaths and have reduced losses and damages resulting from hazardous weather, water, or climate events. But major gaps still exist, especially in small island developing states and least developed countries. The Early Warnings for All initiative is still being defined and it is unclear whether synergies will be possible, but efforts have been made to reach out to UNDRR and WMO to ensure EO Services Development can benefit from potential synergies.

Another important aspect of DRR in the region is the growing recognition of the links between DRR and climate, and more broadly the environment. UNDRR is implementing the Comprehensive Climate and Disaster Risk Management (CRM) Programme, which seeks to increase the number of countries with national and local DRR strategies. The initiative aims to promote policy coherence with climate change, among other high-level objectives. It is fully aligned with Target E of the Sendai Framework and with the Paris Agreement, including the global goal on adaptation to enhance resilience, reduce climate impacts on ecosystems and biodiversity, and accelerate ecosystem-based adaptation and nature-based solutions. It also synergizes with the Sustainable Development Goals (SDGs), including Goal 13 on Climate Action, where Target 13.2 relates to national planning.

The CRM approach aims to integrate DRR into national adaptation plans (NAPs), climate information and adaptation considerations into DRR plans, and, where relevant and acceptable, develop an integrated plan. The CRM approach is therefore key to making the transition towards integrated plans and policies, underpinned by a shared understanding of risk with a high level of institutional coherence. An integrated approach between DRR and CCA takes into account a range of factors to deliberately strengthen synergies by identifying mutually beneficial opportunities between policies and programs while developing governments' capacities for cross-sectoral planning. Given the strong push towards integrating DRR into NAPs, EO Services Development should consider how they link to these NAPs in South America.

UNDP also supports this process and promotes the integration of DRR and CCA agendas in development processes and has developed a guide to facilitate the review of development coordination, planning, programming, and financing mechanisms, which has been implemented in Cuba, Costa Rica, and Ecuador. In addition to the DRR and CCA governing bodies, the involvement of planning and sustainable development, economy and finance, and sectoral ministries is encouraged. In 2024, Colombia and Panama joined this process.

The stakeholders have expressed a strong desire to see the project leverage existing projects at national levels and contribute to NAPs. UNDP encouraged the engagement team to look at specific projects in countries that would be selected for EO Services Development project demonstrators and seek to make linkages with projects. A similar approach was suggested by the World Bank. This can be achieved by linking relevant projects for a given theme to one of the services of the project in a given country to clearly demonstrate the added value of the activity.

An issue of concern raised by CIMH and CDEMA was the balance to be struck within EO Services Development project between Latin America and the Caribbean. There was concern expressed that the contributions designed for the Caribbean may not be tailored to the specific needs of the sub-region, recognizing its strong specificity, particularly in the context of small island developing states and the need for higher resolution products due to the small size of most states,

and their strong vulnerability to natural hazards. CDEMA expressed a clear desire to track this as the project unfolds, and to ensure that the Caribbean component represents a visible and meaningful portion of the overall demonstrator package.

Several stakeholders expressed concern at the ability of the consortium to scale the solutions that are co-developed with individual end users. It was not immediately clear that a solution developed in one country would be easily scaled to others in the region, even in cases where countries had similar geography and faced similar hazards. National specificities are marked in the region, and this needs to be considered in adapting the scalability strategies. To some extent regional organizations such as CDEMA and CEPREDENAC are ideally suited to help address this, but those organizations are also familiar with the challenge and offered words of caution on regional scalability.

Finally, most of the stakeholders expressed concern about the long-term on-going cost of services being developed. While the initial budget pays for the development of the methodologies and these are based on free and open data sets and free systems, there is a computational cost that needs to be borne by the end users or by the Copernicus LAC Panama Centre, and the long-term cost sharing arrangement is unclear. Stakeholders highlighted the region's limited resources and emphasized that a viable path to sustainability requires both transparent cost structures and a well-defined strategy to manage ongoing financial needs beyond the demonstration phase. While the EO services are designed to be scalable at a continental level, most international organizations recognized that DRR is implemented at a national scale and that national efforts in each country are required to achieve results. This may present resource challenges for the Copernicus LAC effort, both during the project and with regard to sustainability beyond the four-year implementation period.

2.2.3 User discussion

The focus of the first phase of the engagement process has been to contact the National Disaster management mandated organizations and the institutions in charge of space affairs as the optimal way to approach users in the country. This strategy has allowed to have a good first understanding on the ecosystem of users and stakeholders of the country, provided by DRM authorities. After this exercise, the team reached out to other institutions on a case-by-case basis.

For instance, DRM authorities rely on institutes specialized in geological or hydrometeorological issues for the provision of hazard information, or on geographical surveys, other ministries (housing, environment, agriculture) for the provision of exposure data, or in both cases the need of specialized technical advice.

In cases where the national DRM authority did not present a full vision of the user ecosystem, the analysis was completed with additional desktop research.

Of the 148 organizations identified at national level in the mapping process, 34 were directly engaged via interviews. Direct contact with these institutions was possible due to previous relations of the engagement team with users in the region, and the support of Copernicus LAC Stakeholder Knowledge project liaison officers.

Organizations from 14 countries were contacted in this first stage. The remaining countries will be contacted at a second stage, later in Phase 1 (until December 2025), to keep them informed or to promote deeper engagement in the second phase of the project.

As part of the engagement strategy, priority was given to interviewing institutions related to space affairs (6 in total²) and organizations mandated for Disaster Risk Management (11 in total³). In the same meetings or as follow-up sessions, 17 additional organizations of various types were engaged⁴, and their requirements were gathered.



Figure 7 Engaged organizations per country as of date of this document.

End user priorities

Aside from the specific interest in the generation of specific geospatial information described above, the process of requirements gathering led to a few high-level conclusions also reflected in the user stories.

- Incorporation of Copernicus products in current procedures and improvement of their portfolio of services. In many cases, some organizations have the ambition to be national providers of these services.
- Incorporation of Copernicus information to improve current procedures in early warning (including weather forecasting, hydraulic models, climate change scenarios and land change monitoring).

² Argentina: Comisión Nacional Actividades Espaciales (CONAE); Brazil: Instituto Nacional Pesquisas Espaciais (INPE); Perú: Comisión Nacional de Desarrollo e Investigación Aeroespacial (CONIDA); Bolivia: Agencia Boliviana Espacial (ABE); Paraguay: Agencia Espacial de Paraguay (AEP); Ecuador: Instituto Geográfico Militar.

³ Dominican Republic: Defensa Civil Dominicana and Ministerio de Economía, Planificación y Desarrollo, Dirección de Gestión de Riesgo y Cambio Climático; Guatemala: Coordinadora Nacional para la Reducción de Desastres (CONRED); Honduras: Comisión Permanente de Contingencias (COPECO); El Salvador: Dirección General de Protección Civil; Costa Rica: Comisión Nacional de Prevención de Riesgos y Atención de Emergencias (CNE); Panamá: Sistema Nacional de Protección Civil (SINAPROC); Colombia: Unidad Nacional para la Gestión del Riesgo de Desastres (UNGRD); Ecuador: Secretaría Nacional de Gestión de Riesgos (SNGRE); Perú: Insitituto Nacional de Defensa Civil (INDECI); Paraguay: Servicio de Emergencia Nacional (SEN)

⁴ Colombia: Fondo Adaptación, Instituto de Hidrología, Meteorología y Estudios Ambientales (IDEAM), Pontificia Universidad Javeriana. Facultad de Ingeniería; Ecuador: Instituto Geográfico Militar; Guatemala: Administración de Vulnerabilidades y Emergencias of Guatemala Municipality; Mexico: Centro Nacional de Prevención de Desastres (CENAPRED) and Universidad Autónoma del Estado de Mexico (UAEM); Panama: Secretaría Nacional de Ciencia, Tecnología e Información (SENACYT), Autoridad Nacional para la Innovación Gubernamental (AIG), Ministerio de Ambiente, Instituto Meteorológico e Hidrológico de Panama (IMHPA); Autoridad del Canal de Panama (ACP), Comité Regional de Recursos Hidráulicos; Peru: Centro Nacional de Estimación, Prevención y Reducción del Riesgo de Desastres (CENEPRED), Instituto Geofísico del Peru (IGP) and Instituto Geológico, Minero y Metalúrgico (INGEMMET); Paraguay: Instituto Nacional Forestal (INFONA).

- Development of procedures for risk assessment and reporting (especially for hazards considered that are new in the country) mainly for wildfire and drought, considered in many countries as new risks), many times with the objective to prioritize investments or relocate population.
- Inclusion of DRR assessment in comprehensive land management (in the case of large areas affected by events like floods).
- Need to improve capacity through dedicated training.

At the national level, the type of issues generally depends on the profile of the user contacted. Civil Protection agencies are normally interested in rapid-onset disasters and in many cases focused on response. Spatial agencies and geographical surveys have a vested interest in producing geoinformation layers for disasters in a generic way. Other institutes or centres focus their interest in their field of specialization, for instance hydromet offices in hydromet-related hazards, geological institutes in geohazards, ministries or agencies of environment in hazards with an impact in the environment like wildfires or droughts.

User stories have been collected by the engagement team and classified according to use case categories. They are instantiations of EO services and aim to simplify the understanding of how services can be applied. The user stories are based on discussions held with users, and range from very detailed discussions around specific uses, to more general potential applications. To date, 79 user stories have been documented, linked to the following broad topics:

- Hydrometeorological hazards: issues related to floods (detection of the extension of flood events, calculation of flood hazard, detection of floods in urban environments) and their impact (flood extension, flood depth, goods affected by floods), droughts and wildfires (active fire monitoring, burned area mapping, statistics of burned area, emissions caused by wildfires, recovery of areas affected by wildfires).
- Geological hazards: issues related to landslides, and to a lesser extent to subsidence, volcanoes, earthquakes and fault movements, erosion. The technique of ground motion detection applicable to different topics has been mentioned several occasions.
- Exposure: identification of elements at risk like specific types of land cover, especially in the urban context, the analysis of changes in land cover and land use, and especially the economic value of assets.
- Other needs, like the need of processing satellite data or issues not related directly with the disaster risk reduction topic like, the analysis of meteorological events, agricultural productivity, and air and water pollution.

Based on these categories, this is a summary of the main topics of interest expressed by the users. The specific topics of the user stories expressed by the users can be found in the Appendix.

The Caribbean

The Caribbean region is highly susceptible to a range of natural hazards, driven by its geographic location and climatic dynamics. The most significant threats are hydro-meteorological hazards, particularly hurricanes and tropical storms, which frequently affect the region due to its position within the Atlantic Hurricane Belt. These events can cause widespread devastation through extreme winds, storm surges, heavy rainfall, and consequent flooding and landslides, particularly in low-lying and coastal areas. The Caribbean is also situated near the boundary between the Caribbean and North American tectonic plates, making it vulnerable to seismic activity, including earthquakes and tsunamis. Volcanic hazards are also present, notably in the Lesser Antilles, where active volcanoes pose ongoing risks. These natural hazards are exacerbated by climate change, which is increasing the intensity and frequency of extreme weather events, and by socio-economic factors such as high population density in vulnerable areas and limited resources for disaster preparedness and response. The impacts of these hazards are profound, affecting lives, livelihoods, and economies across the region.

The primary concerns identified in the initial assessment are cyclones and their associated hazards, including high winds, flooding, and storm surges. The coordination of needs communication for Caribbean countries has been overseen by the

Caribbean Disaster Emergency Management Agency (CDEMA). Key focus areas include flood hazards linked to cyclonic events, increasing regional attention on droughts as slow-onset phenomena, and the application of seismic techniques for monitoring and analysing terrain deformation.

Central America

Central America is highly vulnerable to a range of natural hazards, primarily due to its geographic and climatic conditions. The region is located at the intersection of multiple tectonic plates, which makes it prone to frequent and intense seismic activity, such as earthquakes and volcanic eruptions. These events are particularly significant in countries like Guatemala, El Salvador, and Nicaragua. Additionally, Central America experiences severe hydro-meteorological hazards, including hurricanes and tropical storms, due to its position in the Atlantic Hurricane Belt. These storms often lead to extensive flooding and landslides, particularly in mountainous areas, and are exacerbated by deforestation and inadequate urban planning. The region is also susceptible to droughts, particularly in the "Dry Corridor" that stretches from southern Mexico to Panama, which is influenced by climatic phenomena such as El Niño-Southern Oscillation (ENSO). These hazards result in considerable socio-economic challenges, including displacement, loss of livelihoods, and significant damage to infrastructure.

Floods and rain-induced landslides were frequently highlighted in the user stories, with a greater emphasis on response measures rather than prevention. In contrast, droughts and wildfires were consistently mentioned during interviews, while earthquakes and volcanic eruptions were noted primarily by specific countries.

South America

South America is predominantly affected by natural hazards related to its geodynamic and climatic conditions. The Andean region, characterized by its position along the Pacific Ring of Fire, is highly susceptible to seismic activity, including earthquakes and volcanic eruptions. Additionally, the continent is frequently impacted by hydro-meteorological hazards. Floods and landslides are common, particularly in regions with heavy rainfall such as the Amazon Basin and the Andean slopes, exacerbated by deforestation and land use changes. Droughts also pose a significant threat, particularly in semi-arid regions, driven by variations in atmospheric circulation patterns such as El Niño-Southern Oscillation (ENSO). These hazards have profound socio-economic impacts, affecting large populations and leading to substantial loss of life and property.



Figure 8: Landslide in Peru. Credits: INDECI

This initial assessment was confirmed in the consultation process, with all users expressing concern about the issue of floods, in the context of exacerbated rain episodes affected by climate change. Andean countries pointed out the issue of landslides in their territory, with less stress put in other geo-hazards. Drought was indeed brought up by several users including Brazil, Bolivia, Paraguay, and Peru, while wildfires were indicated as an important threat by countries like Brazil, Colombia, Bolivia and Paraguay.

2.3 EO Information Development

The activity of "EO Information Development" refers to the development of Earth Observation-based services and platform components. The primary aim of this activity is to create a value-added segment for Sentinel missions, making their data more accessible for Latin-American users and converting it into geoinformation tailored for priority applications in the areas of hazard and risk management.

Based on this goal and the priorities identified in the users and stakeholders' consultation process, sixteen services have been identified: eighteen Open Services and two Proprietary Services (see 2.3.2.). The EO-based services to be developed within the context of this project must be transferable and applicable to any area of Latin America and the Caribbean (although there may be geographical restrictions determined by the methodology). In addition, the transferability might affect either to both code and access (open-source services) or just the access (open-access services by licensing).

The EO services are tested through pre-operational demonstrations in specific 'Use Cases', which are specifically tailored to meet the needs and requirements of local users. The Use Cases are conducted at both local and regional levels, with the objective of evolving into fully operational services for the whole LAC territory by the end of the project. The use cases apply either one service or several services, may include commercial demonstrations of non-open proprietary services, to showcase their capabilities for disaster risk reduction and management.

The criteria for selecting the most suitable country and user for the application of the services are based on prioritizing the most critical, feasible, and impactful geo-information requirements expressed by the user. Additionally, other contextual factors such as regional distribution and variety of capacity levels were also taken into consideration.

2.3.1 Services development and demonstration workflow

The implementation of the EO-based products and services follows a DevOps methodology, focusing on establishing services to be transferred to the users by the end of developments. The designed workflow to work with the users is as follows:

- Select a mature methodology of a company or institution with recognised experience in usage of EO data for Disaster Risk Management associated with the hazard to be addressed in the service (i.e., floodings, droughts, wildfires, geohazards).
- Adapt the methodology if needed to the specific goals of the project (a.k.a. aiming to Disaster Risk Reduction, not emergency management, prioritizing the open-source philosophy to ensure complete transferability and transparency)
- Present the design of the adapted methodology to the users. Discussion and final agreement for a preliminary design.
- Present the Terms of Reference (ToR) to the users, the expected efforts associated to users' roles and agreement. Users provide formal acceptance of the ToR document and commit to roles. Co-Develop the service for eight months. Execute small developments per 2-month sprint, continuously iterating between the development team and the user to check that the results are as expected and correct any discrepancies. Demonstrate the advances in the developments at the end of each sprint in 'demo' sessions.
 - The expected efforts from the users in this period, depending on the agreed roles are:

- (ONLY in case of development support role): Attendance at weekly meetings and/or with the development team for joint decision making that affects the algorithm.
 - Attendance at end-of-sprint demos and provide constructive feedback.
 - Provide the necessary layers of local information at the required resolution as much as possible.
- Conclude developments. A training session to build capacity is conducted in user/stakeholder facilities, with the goal of:
 - transferring the access to the service.
 - transferring the scientific foundations that support the processing chain.
 - transferring the usage of the processing environments.
- Users test the service for three months contiguous to capacity session at the end of sprint 4. The expected efforts are:
 - Interact with the processing environments.
 - Launch and test the service.
 - Provide feedback to the development team.
- The feedback provided by the users is considered for potential evolutions of the service.
- The final version of the service is deployed in the processing environments hosted at the Copernicus LAC Panama Centre for a sustainable operational exploitation, or through another cloud-based processing capacity.

The next table summarizes the roles assigned to users and the corresponding efforts to which they can commit:

Table 1: Summary of users' roles and efforts

Role	Efforts
Base user	<ul style="list-style-type: none"> • To attend the sprint demo meetings • To provide feedback in the sprint demo meetings • To keep attentive to the advances in the developments • To attend the capacity building • To access the processing environments during demonstration phase, launch and test the service and provide feedback
Data provider	<ul style="list-style-type: none"> • Same as base user • Provide geospatial data, if possible, when requested. Might include ground truth.
Validator	<ul style="list-style-type: none"> • Same as base user • Provide ground truth data if not available • Offer a proposal of what would the validation task consist in • Iterate with the development team until a final methodology is accepted • Execute the validation task.
Support for development	<ul style="list-style-type: none"> • Same as base user • Participate in the weekly meetings with the development team. • Participate in the decision making that affects the algorithm. • Execute any needed task to adapt the service to the organization's need.

2.3.2 Proposed services

Table 2: Proposed HYDROMETEOROLOGICAL services and their relevant aspects

Name	Description	Data inputs	Nature	Provider	Products
Flood Extent Mapping (Figure 9, Figure 11)	Delineation of single flood extents through change detection in satellite data	Sentinel-1. Sentinel-2	Open-source	CIMA	Map showing the full reach of a flood of a specific flood event
Flood Frequency Mapping (Figure 11)	Time series analysis of satellite data for flood frequency estimation	Sentinel-1. Sentinel-2	Open-source	CIMA, Wasdi	Map showing areas frequently flooded over time in terms of return period
Flood Hazard Mapping	Merging of flood hazard maps and empirical flood frequency	Sentinel-1. Hydrological model outputs	Open-source	CIMA, LIST	Flood extent for different return periods including estimation of the water depth
Flood Depth Mapping (Figure 11)	Service for estimation of depth of water in a flood extent	Flood extent maps and DEM	Open-source	CIMA, LIST	Map showing the maximum depth of an actual or potential flooded area
Urban Flood Mapping	Service for event-based flood detection in urban areas using advanced techniques.	Sentinel-1 (SLC)	Proprietary, perpetual license	LIST	Flood extent in urban areas
Urban Coherence and Intensity Change Detection	Service providing detection of changes using backscatter and coherence from two Sentinel-1 SLC image pairs acquired before or after an event.	Sentinel-1	Open-source	Terradue	Built-up area mask and change detection map potentially linked to flooded areas (or damaged buildings)
Drought Indices Mapping (Figure 10)	Service for drought analysis based on satellite data and climate trends.	Earth Observation, climatic data	Open-source	Indra, CIMA	Combined drought indices. Downscale and tailoring of the Global Drought Index

Table 3: Proposed WILDFIRES services and their relevant aspects

Name	Description	Data inputs	Nature	Provider	Products
Burned Area Mapping (Figure 12, Figure 13)	Service for Near-Real-Time monitoring of active wildfires.	Sentinel-3, Sentinel-2	Open-source	Terradue	Detection of potential active fires. Delineation of burned areas. Estimation of fire severity
Fire Danger Mapping	Service to estimate fire danger based on environmental factors.	Several static variables and Fire Weather Index (GWIS)	Open-source	Indra	Fire Danger Map
Fire Recovery Mapping	Service to track vegetation recovery after wildfires.	Sentinel-2	Open-source	Indra	Post-fire vegetation recovery estimation based on spectral indices

Table 4: Proposed GEOHAZARDS services and their relevant aspects

Name	Description	Data inputs	Nature	Provider	Products
Landslide Susceptibility and Hazard Mapping (Figure 14, Figure 15)	Service to identify the likelihood and potential hazard of an area to suffer landslides	Sentinel-1, Sentinel-2, Geological layers, elevation data, landslide inventories; ground motion rates	Open-source	Geoapp	Landslide susceptibility maps (per pixel and per slope unit). Landslide hazard map
Terrain Motion. Interferometric Stacking (Figure 16)	Service for mapping average ground motion rates to measure consistent, long-term displacement patterns.	Sentinel-1 (SLC)	Open-source	AUTH	Wide-area, average terrain motion rates per pixel and uncertainties
Terrain Motion. 3D Geometric Decomposition (Figure 16)	Service to facilitate the interpretation of interferometric measurements by providing the actual vertical and horizontal motion components.	Sentinel-1 (SLC)	Open-source	AUTH	Vertical (up, down) and horizontal (East-West) terrain motion components in a regular grid.
Terrain Motion Mapping (SNAPPING IFG and PSI) (Figure 16)	Tool for accurately measure surface displacements and analyse their temporal evolution, at reduced spatial resolution	Sentinel-1 (SLC)	Proprietary, perpetual license	AUTH	Time series of terrain motion rates at point-like targets

Table 5: Proposed EXPOSURE services and their relevant aspects

Name	Description	Data inputs	Nature	Provider	Products
Population distribution (Figure 17, Figure 18)	High-resolution population density estimates	EO data, WSF, OSM	Open-source / perpetual license	DLR	Population density map denoting the number of estimated residents per pixel. Number of residents per building.
Economic Value Mapping	Service for estimating the economic value assets based on satellite imagery and economic data	Sentinel-2, demographic, economic, statistic databases	Open-source	Indra	Map with economic value per sector and overall, per pixel

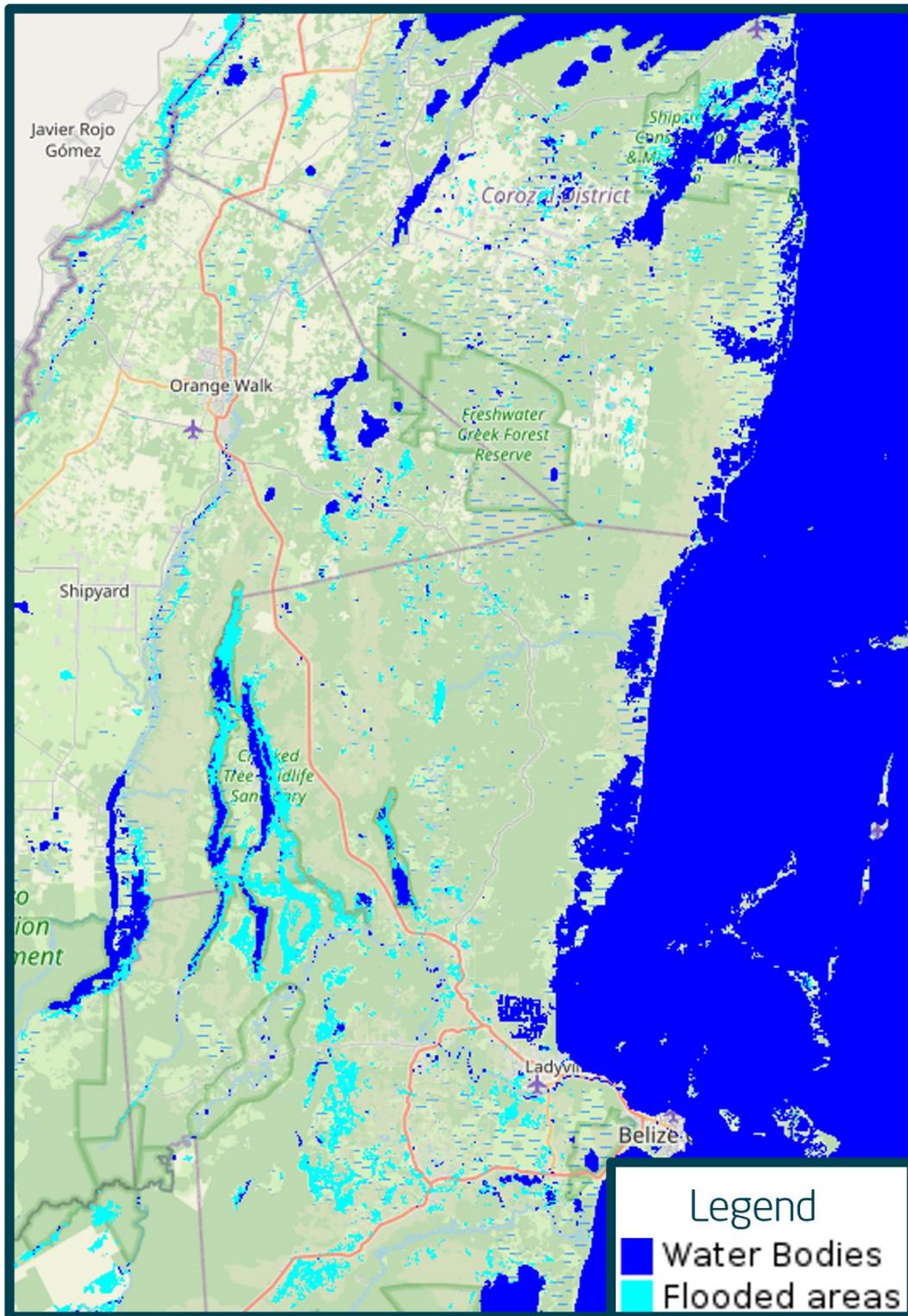


Figure 9: Maximum flood extent in Belize after Eta/Iota hurricanes, 2020. Credits CIMA Foundation and WASDI. Applications for the Caribbean co-developed with CIMH, results validated by NEMO and NHS (Belize)

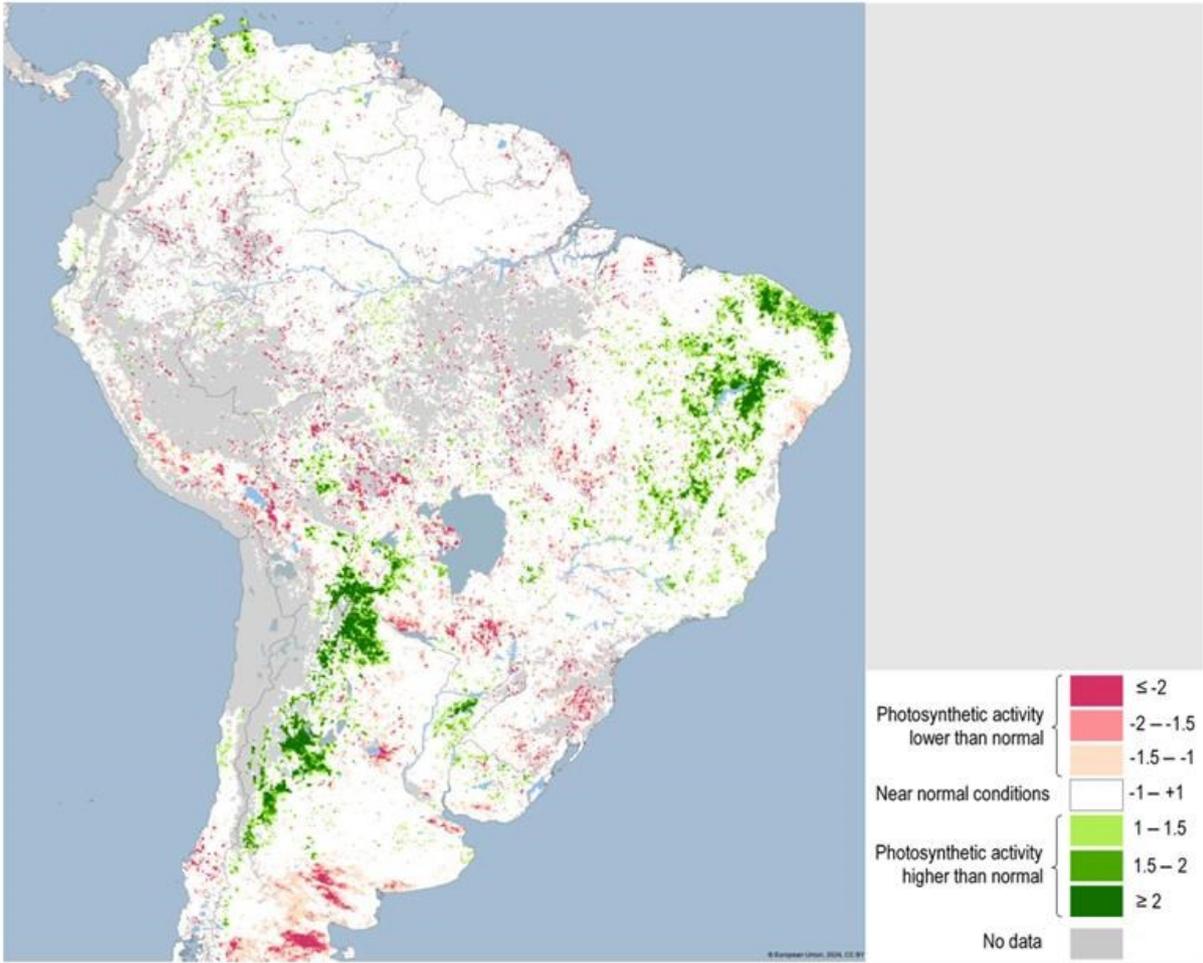


Figure 10 : Satellite-derived fAPAR anomaly indicator (measuring photosynthetic activity of vegetation) in late November 2024. Credits: CIMA Foundation and Global Drought Observatory

Hydrometeorological Hazards Services

Flood Extent Mapping

The FEM service estimates the cumulative extent of flood traces using both Sentinel-1 and Sentinel-2 over a period around a flood event start date, provided in the form of classified raster (flooded, not flooded, permanent water body). The service is developed by CIMA Foundation and WASDI Sarl.



Flood Depth Mapping

The FLDM service provides the maximum water Depth per pixel for a specific flood extent map. The service is co-developed by LIST and CIMA Foundation



Figure 2 – Flood Depth map after dam break in Colombia (2024)



Find more about the Hydrometeorological Hazard services of the CopernicusLAC Platform at: <https://coplac-hydromet-hazards.readthedocs.io/>

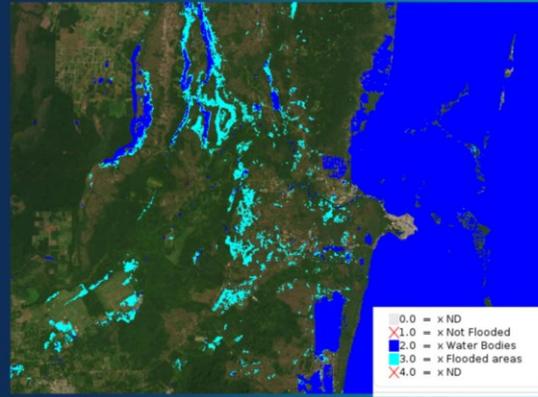


Figure 1 – Flood Extent map over Belize after Hurricanes Eta and Iota (2020)

Flood Frequency Mapping

The FFM service estimates a series of flood records for a user defined period, providing flood extent maps and the associated flood frequency map.



Figure 3 – Flood Frequency map after dam break in Colombia (2024)



Credits: Contains modified Sentinel-1 and Sentinel-2 mission data (2020-2024) processed by CIMA Foundation at CopernicusLAC Specialized Processing Environment

Figure 11: Overview of the Hydrometeorological Hazards Services (i.e., FEM, FLDM, FFM) and products over Colombia and Belize. Credits: CIMA Foundation and WASDI, with the assistance of NEMO (Belize) and Fondo de Adaptación and UNGRD (Colombia)



Figure 12: Fire severity in Concepción (Chile), February 2023. Credits: Terradue.

Burned Area Mapping service

TERRADUE



The BAM service developed by TerraDue uses multitemporal and multi-mission optical imagery to generate active fire detections and burned area products, including estimates of probability, severity, and extent. Below are shown examples of products derived for the 2023 Chile wildfires.



Figure 1 - True color composite from Sentinel-2 L2A imagery acquired on 07 Feb 2023 over Los Ángeles, Chile. In red are superimposed hotspots detected from the VIIRS S-NPP mission and distributed by the NASA FIRMS service.



Figure 2 - Burned Area Map from Sentinel-2 L2A imagery acquired on 07 Feb 2023 near Santa Juana, Región del Biobío, Chile. In red are shown burned areas, in green burnable areas, and in grey regions where no valid observations were available for analysis.



Find more about the Burned Area Mapping service of the CopernicusLAC Platform at: <https://docs.copernicuslac.terradue.com>



Figure 13: Overview of the Burned Area Mapping (BAM) Service and derived product for the 2023 Chile wildfires. Hotspots product actively exploited by Guatemalan institutions led by SE-CONRED

Landslide Susceptibility and Hazard Mapping service

GEOAPP
value your data



The LSHM service developed by Geoapp estimates how likely landslides are to occur in a specific area by analyzing geological, environmental, and climatic conditions. It uses satellite data from Sentinel-1 and Sentinel-2, along with user-provided information and machine learning, to identify areas at risk and evaluate potential hazards by integrating observed ground displacement.

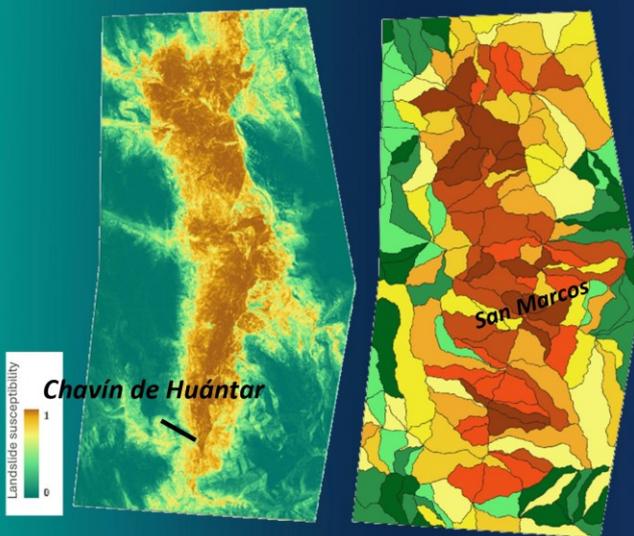


Figure 1 – Landslide Susceptibility map (pixel-based and slope-based)

Credits: Contains original raster and vector data produced by Geoapp for landslide susceptibility and potential analysis, based on user-provided information and global data layers.

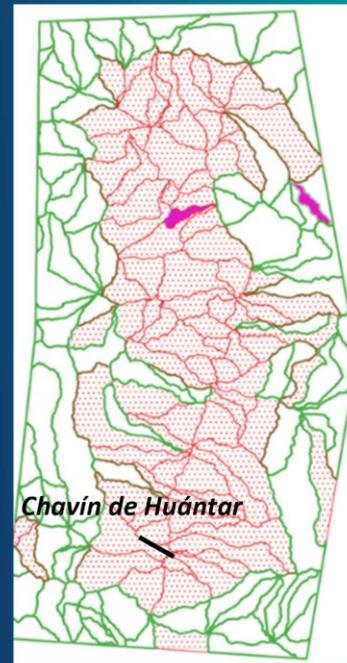


Figure 2 – Potential Hazard Map

Credits: contains modified Copernicus Sentinel-1 mission data (2021-2024), processed by AUTH with the GEP platform.

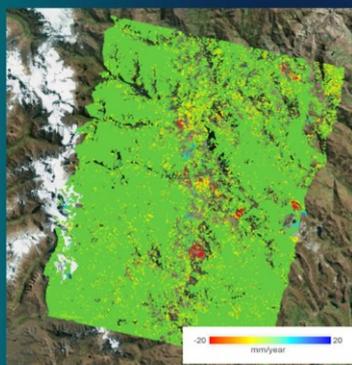


Figure 3 – InSAR displacement data

Find more about the Landslide Susceptibility and Hazard Mapping service of the CopernicusLAC Platform at: <https://docs.copernicuslac.terraeue.com>



Figure 14: Overview of the Landslide Susceptibility and Hazard Mapping (LSHM) Service and derived products.

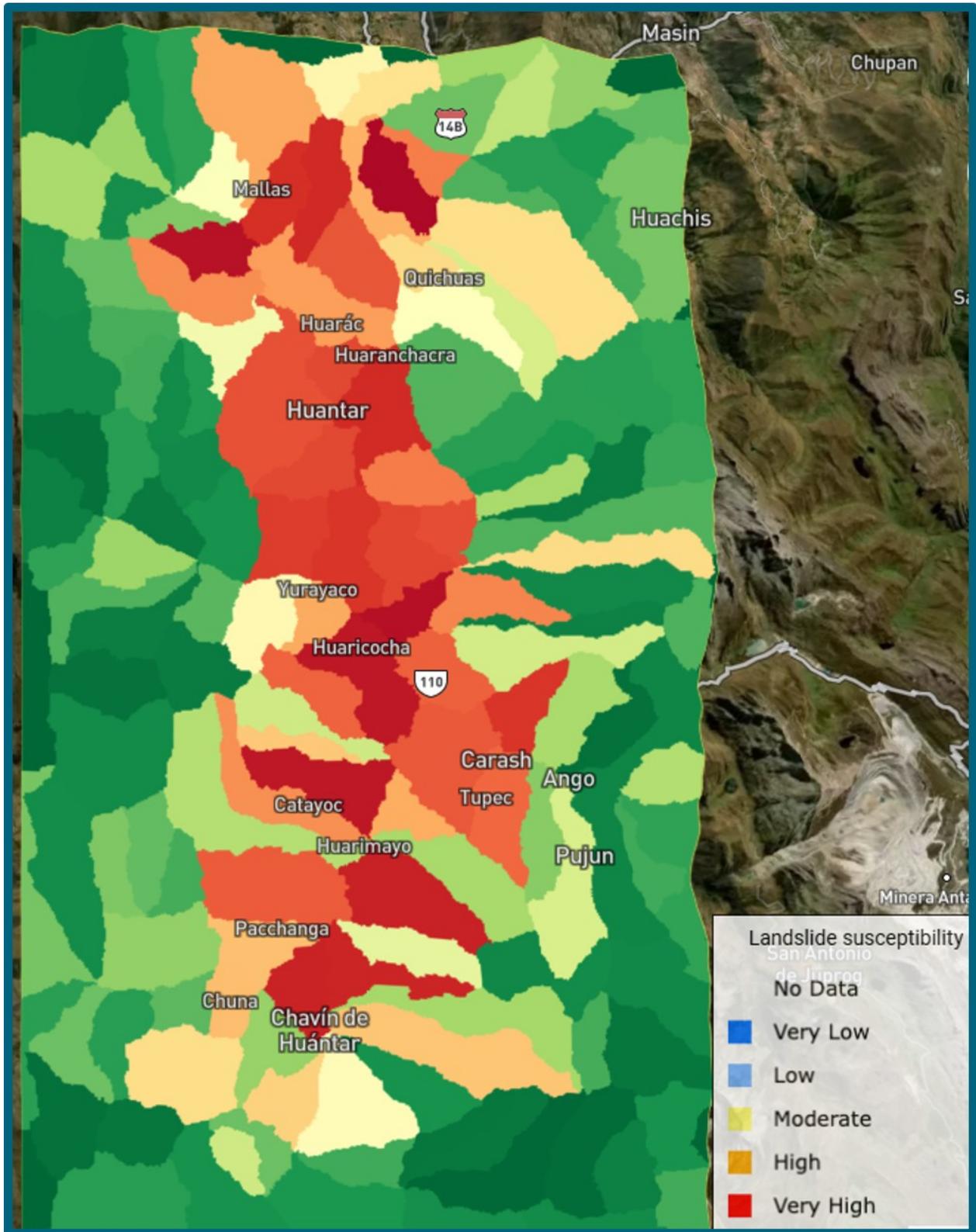


Figure 15: Landslide susceptibility over Chavín de Huántar, per slope unit. Credits: Geoapp and Terradue with the assistance of INGEMMET and IGP for data provision (Peru)



Global Gateway



PROGRAMME OF THE EUROPEAN UNION



copernicus
Europe's eyes on Earth

REPÚBLICA DE PANAMÁ
GOBIERNO NACIONAL

Implemented by 

AIG
Autoridad Nacional para la Innovación Gubernamental

Terrain Motion Services



Instituto Geológico



IGC



ESCUELA POLITÉCNICA NACIONAL



EO Lab
Earth Observation & Geospatial Applications Lab

SNAPPING

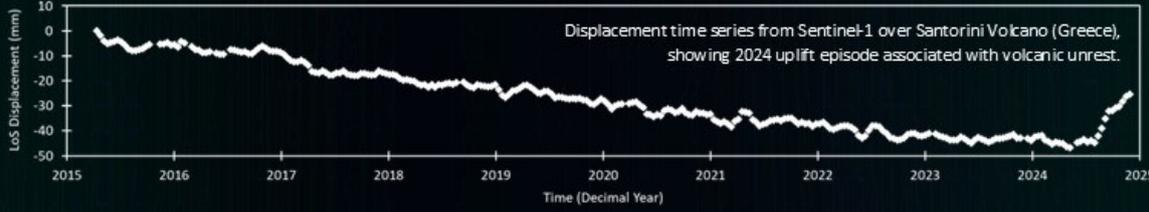
SNAPPING is a service for mapping and monitoring surface motion, utilizing the Persistent Scatterer Interferometry (PSI) technique with Copernicus Sentinel-1 data to deliver average motion rates, associated uncertainties, and displacement time series for point-like targets.

KinesIS

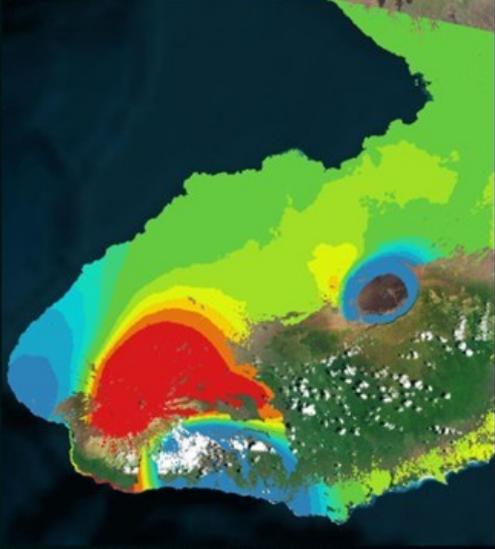
Coherent averaging of multiple Copernicus Sentinel-1 differential interferograms to derive surface motion rate maps and uncertainty estimates, effective in natural terrain, partial vegetation, and areas with linear motion trends.

3DDecomp

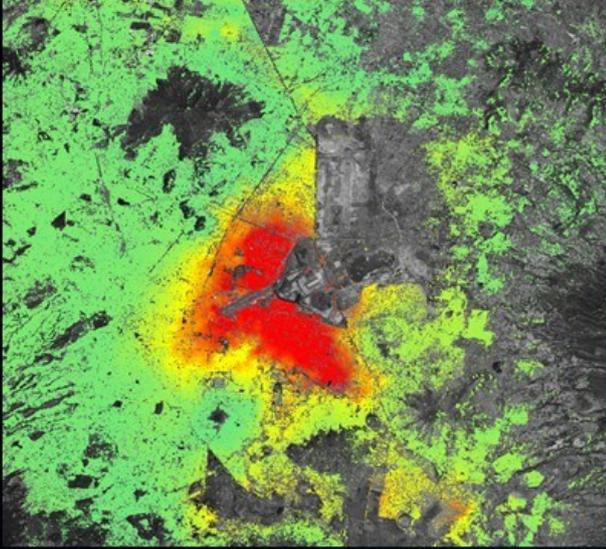
Post-processing SNAPPING and iSTACKING Line-of-Sight (LoS) measurements from ascending and descending Sentinel-1 orbits, calculating the true vertical (Up) and East-West (E-W) motion components.



Displacement time series from Sentinel-1 over Santorini Volcano (Greece), showing 2024 uplift episode associated with volcanic unrest.



SNAPPING PSI measurements over Sierra Negra volcano (Ecuador), reveal a complex deformation pattern, with signals of both subsidence (shown in red) and uplift (in blue).



Pixel-based KinesIS measurements over Mexico City, revealing high gradients of ground deformation.

 Copernicus LAC - Panamá

Figure 16: Overview of Terrain Motion Mapping Services (SNAPPING, Interferometric Stacking, 3D Decomposition) and results over Sierra Negra volcano (Ecuador) and Mexico City. Credits: AUTH with validation of IGEPN (Ecuador)

Settlement Extent

The WSF Tracker provides 6-month 10m resolution mapping of human settlements across the LAC region by jointly leveraging Sentinel-1 radar and Sentinel-2 optical imagery.

The product is updated biannually, ensuring access to up-to-date data for urban planning, disaster risk management, and sustainable development.

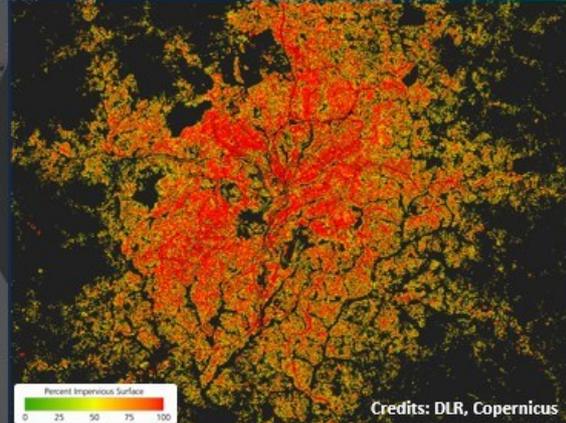


Credits: DLR, Copernicus

Pucallpa (Peru): WSF tracker outlining the 6-month settlement extent growth at 10m spatial resolution from July 2016 to January 2025.

Surface Imperviousness

The WSF Imperviousness layer provides an estimation of the percent impervious surface for those pixels categorized as settlements in the WSF Tracker (at 6-month intervals). This refers to pavements covered by water-resistant materials (e.g., asphalt, concrete, brick, stone, etc.) and compacted soils limiting water penetration.

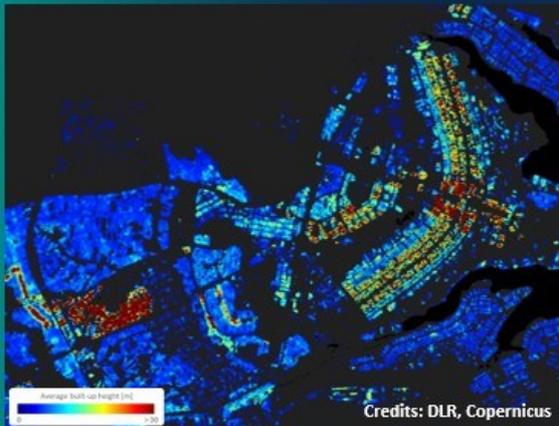


Credits: DLR, Copernicus

Yaoundé (Cameroon): WSF imperviousness estimating the January 2025 percent impervious surface.

Built-Up Height

Generated by leveraging openly available digital elevation models (i.e., GLO-30 Copernicus and ALOS AW3D30), the WSF3D layer provides average building height estimates at 10m resolution. The product is enhanced by integrating the Google Open Buildings 2.5D dataset, which provides AI-derived building height estimates from Sentinel-2 optical imagery.

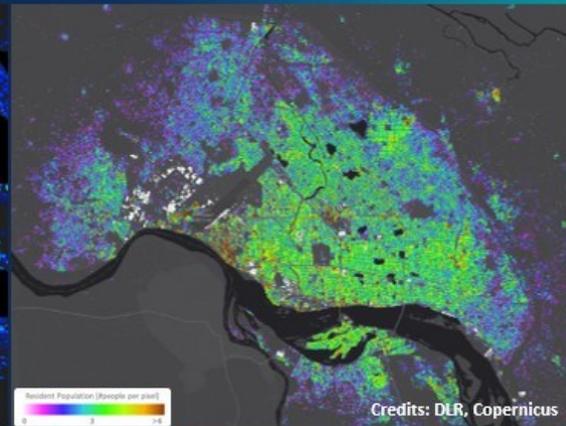


Credits: DLR, Copernicus

Brasília (Brazil): WSF3D estimating building height at 10m spatial resolution.

Population Density Service

The WSF Population service provides high-resolution population density estimates. By leveraging the WSF Tracker for settlement extent, WSF Imperviousness, WSF3D for building height data, and (user-provided) reference total population counts per admin unit, the service redistributes population at 10m spatial resolution.



Credits: DLR, Copernicus

N'Djamena (Chad): WSF population estimating the January 2025 number of residents at 10m spatial resolution.

Figure 17: Overview of the Population Distribution Service and the supporting WSF Layers: WSF tracker, building height, and WSF impervious layer

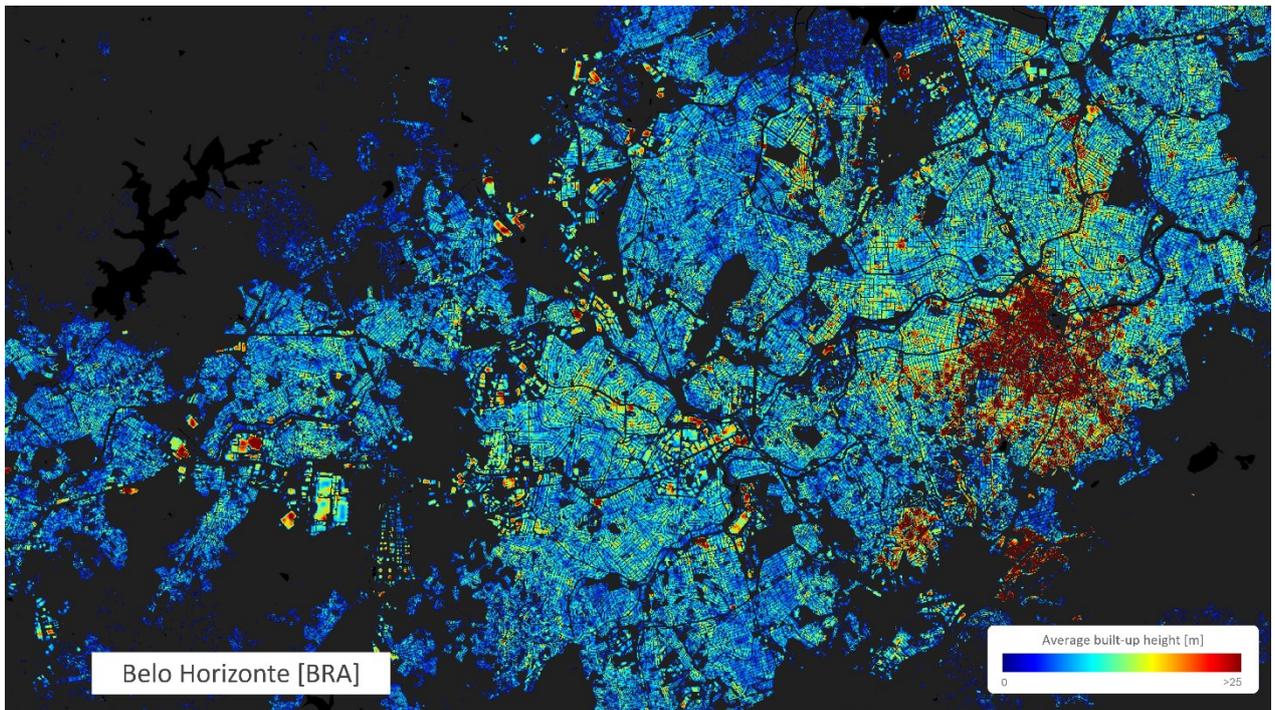


Figure 18: Average built-up height in Belo Horizonte (Brazil). Credits: DLR

2.3.3 Proposed use cases

There are 12 use cases in which the previously listed services are applied. Six are to be implemented in Phase 1 (2024-2025) and six on Phase 2 (2026-2027). Their selection is an ongoing process, influenced by user engagement and the relevance of each case. Use cases of Phase 1 are shaped in the first half of 2024 and use cases of Phase 2 are shaped in the second half of 2025.

Table 6: Proposed use cases, services applied, demonstration areas and actors implied. (a) Phase 1; (b) Phase 2

(a) Phase 1

#	Name	Services applied	Uptake users	Interested stakeholder	Phase and demo area
1	Flood extent mapping for preparedness	Flood Extent Mapping, Urban Flood Mapping (perpetual license over the AOI) and Flood Depth Mapping	CIMH (Caribbean), national meteorological and hydrological entities of Belize, Guyana and Jamaica. Municipalities of Georgetown (GY) and Kingston (JM), Kingston Port Authority (JM)	CDEMA (Caribbean), UNDRR (EW4ALL)	Phase 1. Kingston, (Jamaica), Georgetown (Guyana) and Belize.
2	Flood frequency and impact mapping	Flood Extent Mapping, Urban Flood Mapping (perpetual license over the AOI), Flood Frequency Mapping and Flood Depth Mapping.	Fondo Adaptación, UNGRD (CO), IDEAM	IDEAM (CO) Universidad Javeriana (CO), UNDRR	Phase 1. La Mojana (Colombia)
6	Wildfires: mapping events, danger and recovery	Burned area mapping, Fire Danger Mapping and Fire Recovery Mapping	IDEAM, Ministerio de Ambiente, UNGRD (CO); ICF, COPECO (HN); CONRED, Agric. & Env. Ministries, INAB, CONAP, PACUNAM (GU); DGCP (SV); MiAmbiente, IMHPA (PA), CNE (CR),	INSIVUMEH (GT); UNEP	Phase 1. Colombia, Central América
7	Landslides susceptibility mapping	Landslide Susceptibility and Hazard Mapping	INDECI, INGEMMET, IGP, CENEPRED (PE)	IGP, INGEMMET (PE), CONIDA(PE), WB	Phase 1. Chavín de Huantar- Pomachaca (Huari Prov., Peru)
8	Precise terrain motion mapping	Terrain Motion - Interferometric Stacking, Terrain Motion - 3D Geometric Decomposition, Terrain Motion Mapping - SNAPPING IFG and PSI	Geoscience Institute of Panama and IGEPN (Ecuador)	Committee of engineers and architects	Phase 1. Ecuador and Panama
12	Economic value mapping	Economic Value Mapping	Dirección de Riesgo y Cambio Climático of MEPYD (DO)	National Statistics Office. IGN (DO); UNEP, IADB, UNDRR, CCRIF	Phase 1. Dominican Republic, Haiti

(b) Phase 2. These use cases, AOI and users are only intended and to be confirmed at the end of Phase 1

#	Name	Services applied	Uptake users	Interested stakeholder	Phase and demo area
3	Flood historical records in urban areas	Flood Extent Mapping, Urban Flood Mapping (perpetual license over the AOI), Flood Frequency Mapping, Flood Hazard Mapping and Flood Depth Mapping.	ABE, INRE, Ministry of environment, Municipalities (BO)	SENAMHI, VICEDI (BO), UNDRR	Phase 2. Gran Chaco, Chiquitania, Rurenabanque, Villa Tunari (Bolivia)
4	Flood hazard with hydrological modelling and Earth Observation	Flood Frequency Mapping, Flood Hazard Mapping and Flood Depth Mapping	CONIDA, INDECI, CENEPRED (PE); Instituto Geográfico Militar, SNGR (EC); DGCP (SV); CNE (CR)	ANA, SENAMHI (Peru); IMHPA, Ministerio Ambiente (PA); WMO, UNDRR, UNDP	Phase 2. AOI1: Pacific coast of Peru and Ecuador AOI2: Central América AOI3: TBD
5	Drought and crops surveillance	Drought Indices Mapping	Agencia Espacial de Paraguay, SEN (PY)	DMH (PY), WMO, UNEP, FAO (potentially)	Phase 2. Paraguay (whole country)
9	Wide area terrain motion mapping	Terrain Motion - Interferometric Stacking, Terrain Motion - 3D Geometric Decomposition, Terrain Motion Mapping - SNAPPING IFG and PSI	IGEPN (EC)	Not selected	TBD
10	Mass production of terrain motion measurements for monitoring of geohazards	Terrain Motion - Interferometric Stacking, Terrain Motion - 3D Geometric Decomposition	CENAPRED (MX)	Universidad Autónoma del Estado de Mexico (MX)	Phase 2. Estado de Mexico (Mexico) (22 499 km ²) Second area: TBD
11	Exposure mapping	Population distribution. Layers: WSF Tracker, WSF 3D and WSF Imperviousness.	Instituto Geográfico Militar, SNGR (EC) CNE (CR)	International Relations and Cooperation Unit (CR); World Bank UNDRR UNDP	Phase 2. Ecuador (whole country) Costa Rica (whole country)

2.3.4 The Processing Environments

The deployment of the EO-based services on web processing platforms is a critical aspect of modernizing and democratizing access to geospatial data, particularly for large-scale applications such as Disaster Risk Management and environmental monitoring. These web platforms or geoportals, serve as the interface between satellite-derived data and the end-users, providing the necessary infrastructure for data storage, processing, analysis and visualization.

There are two platforms or geoportals where different tools and services, including those developed in the CopernicusLAC Services Development project, are available for the user: the CopernicusLAC Platform (Figure 19a) and its complementary Specialized Processing Environment (Figure 19b). The [CopernicusLAC platform](#) provides all the catalogue of services developed in this project including hydrometeorological hazards, geohazards, wildfires and exposure. The Specialized

Processing Environment is optimized for Hydromet services and provides access to advanced open-source services that will be transferred and access to proprietary services that are available for demonstration purposes only.

The platforms for EO services are supported by a cloud-based architecture that enhances accessibility, scalability, and performance. The cloud-based nature of these environments also facilitates rapid deployment and integration of new services, ensuring that users can access the most up-to-date tools and data for decision-making.

The platforms and all the services developed run in the infrastructure of the Copernicus LAC Panama Centre when this is fully operational. The Copernicus LAC geoportals are advanced ecosystems designed to provide seamless access to Earth Observation (EO) data from the European Union's Copernicus program, specifically tailored for the Latin America and Caribbean region, empowering them with the data and tools necessary to monitor environmental changes, respond to natural disasters, and support sustainable development.

Their aim is to provide users with direct access to data from the Sentinel satellite missions. These satellites offer a wealth of information, including radar data from Sentinel-1, high resolution optical imagery from Sentinel-2, ocean and land monitoring data from Sentinel-3, and atmospheric composition data from Sentinel-5P. The platforms not only make this data available but also provide a suite of tools to process, analyse and visualize it, all within a user-friendly environment. With it, the main purpose of the CopernicusLAC platform and complementary Specialized PE is to add value by transforming data into information with the services that are customized and tailored for the region.

Interface

The geoportals provide a centralised and intuitive interface that enables users to discover and access EO data with ease. Through a geoportal, users are able to search and retrieve data from the Sentinel missions using a range of filters, including spatial, temporal, and thematic criteria. The portals are designed to be accessible to users of all experience levels, from novice users to seasoned geospatial analysts. It provides a seamless experience for navigating, visualizing, and downloading data, making it easier than ever to integrate EO data into research, policy-making, and operational activities.

The geoportals are not just a data repository— they are a gateway to a broader ecosystem of geospatial tools and services. By providing a user-centric interface, the geoportals ensure that the wealth of EO data is available and actionable, supporting a wide array of applications across the LAC region.

Open and Accessible by Design

The Copernicus LAC platform and Specialized Processing Environment open architecture are designed to be flexible, scalable, and interoperable with other systems. This openness ensures that these ecosystems can easily integrate new technologies and datasets as they become available, making it future-proof and adaptable to evolving needs. The CopernicusLAC platform employ open standards such as the SpatioTemporal Asset Catalog (STAC) and Cloud Optimized Geotiffs (COG) to manage and deliver geospatial data, enabling efficient discovery and access to large volumes of satellite data.

The platform foundation on open-source technologies enhances transparency, reliability, and community-driven innovation. By adopting open-source methods, Copernicus LAC ensures that users are not locked into proprietary solutions and can benefit from a global ecosystem of developers and contributors. This approach also supports the sustainability of these Processing Environments, encouraging the reuse and sharing of tools and resources across the LAC region.

Collaboration and Growth

The Copernicus LAC platform and Specialized Processing Environment are more than just data portals; they are a collaborative ecosystem designed to bring together stakeholders across the LAC region. By providing open access to high-quality EO data, sophisticated processing algorithms, and specialised tools, the platforms enable users to work together on regional challenges, share insights, and develop innovative solutions. This collaborative spirit is essential for addressing the complex environmental and societal issues facing the region.

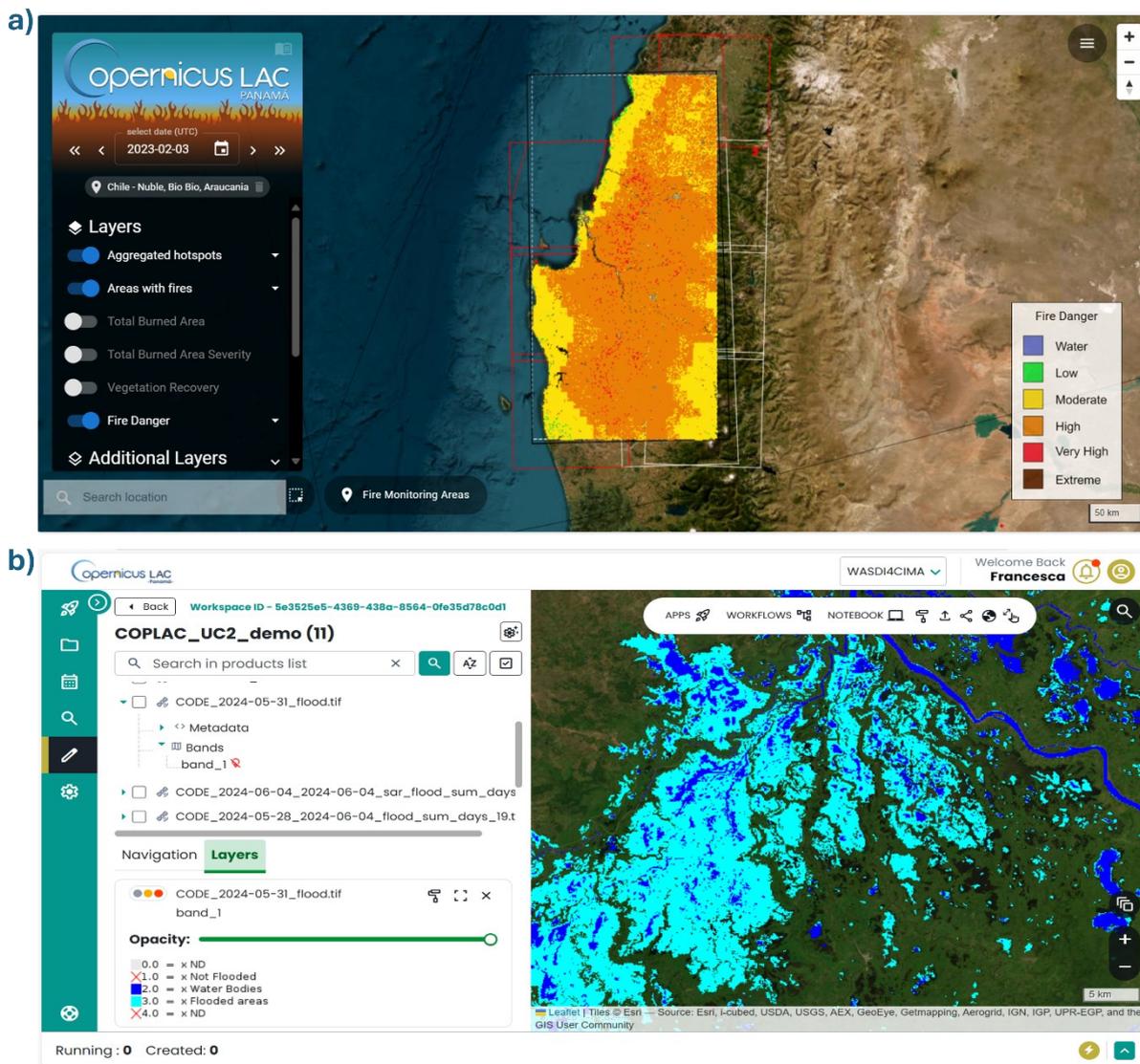


Figure 19: User workspace in: (a) CopernicusLAC platform and (b) Specialized Processing Environment

3. APPROACH TO SUSTAINABILITY

3.1 Overview

The project aims to develop methodologies and demonstrate them in real contexts, using free and open data sets, and transferred methodologies that can be easily implemented in a cloud environment. This means the only recurring cost to users is processing, or add-ons beyond the basic services. By the end of the project, all services must be demonstrated, and these services are designed to be scalable on a regional or continental level. As part of the demonstration process, service providers calculate estimated processing costs to enable end users to work with national governments and international stakeholders to identify resources for sustainability.

The CopernicusLAC Panama Centre will become the regional host and provider of the EO services once these are operational. These will be transferred to the Centre after the demonstration phase within the Processing Environments. The Centre will also be responsible for promoting the services, delivering training, and collaborating with other stakeholders to support capacity development for regional and national partners.

Throughout the project, the consortium liaises with international stakeholders to identify capacity building opportunities that might facilitate sustainability. One such opportunity is presented by Early Warnings for All, which is being fast-tracked in six countries in the region. Certain investments made in the context of that programme may be leveraged for support to EO services when there are overlapping and compatible objectives. In order to achieve tangible results, coordination must take place at the country level in each of the six fast-tracked countries.

In addition to Early Warnings for All, a significant new push is being placed on DRM coordination in South America, and this may present opportunities for synergies with the Copernicus LAC Panama Centre. There is also a continental-wide Ministerial process to develop improved environmental management, which is directly relevant to DRR, and presents another opportunity to raise awareness with regards to the benefit of capacity building to support Copernicus LAC sustainability.

The long-term vision for sustainability is tied to raising awareness within the stakeholder community in order to develop support for capacity development relating to EO on an on-going basis. To achieve this visibility within the stakeholder community, the services should be well aligned with the stakeholder policy considerations and goals as expressed in this document.

Once the services to be demonstrated are identified and the demonstration geographies selected, stakeholder engagement enters a new phase. The project's priorities are to:

Identify stakeholders who could contribute to the Centre once operational;

Collaborate with them to develop early involvement strategies; and

Define specific areas for their contributions.

This approach offers two key advantages: it engages stakeholders early and aligns service development with a scalable model linked to the Copernicus Data Centre.

3.2 Sustainability and Transferability



Figure 20: Capacity building in Guatemala on the wildfires’ services exploitation and uptake. Credits: Indra

Sustainability

From the outset, the activity of Services Development has sought an approach that ensures long-term sustainability. This approach is achieved by early and substantive engagement with stakeholders who are leading players in the DRM ecosystem in the LAC region. These stakeholders, while typically not end users, are in regular contact with end users and ensure support such as capacity building and infrastructure development through regional development programmes.

In the early definition of services, the consortium reached out to a dozen such regional leaders and informed them of the project objectives and sought their input in the definition of the services and the choice of geographies for early demonstration. Stakeholders are continuously informed on the progress and invited to share feedback.

This approach alone does not ensure engagement. In parallel, the consortium is performing an ecosystem review of the main stakeholders to identify their objectives and key programme initiatives in relation to DRM, and to cross-reference the selected services with these objectives and programmes. This allows the project to target specific stakeholders in the definition of post-project planning for services.

This project works in cooperation with the Stakeholder Engagement project that also has a mandate regarding the sustainability of the initiative. The Stakeholder Engagement project focuses on increasing stakeholder and user involvement through continuous outreach, including workshops and events, to raise awareness and promote the use of Copernicus and Earth Observation. It also aims to build regional capacity for processing Sentinel data and applying Copernicus products in decision-making. Additionally, it supports private sector development by assisting Panamanian authorities in establishing a business support and incubation scheme for downstream services. Lastly, it promotes space policy dialogue at the political level across Latin American governments.

Although not focused only on DRM, Liaison officers of this project contribute to the project's outreach by maintaining contact with regional Disaster Management authorities and international support organizations to present relevant services. They also help gather guidance from regional authorities and EU Delegations on DRM mandates, identify key points of contact for service uptake and capacity-building, and facilitate connections when appropriate to support engagement efforts.

The Services Development Activity supports the Panama Centre in promoting these services to ensure that key authorities are aware of their existence and capabilities, and to facilitate future uptake by end users.

Transferability

In this activity, the transfer of services involves delivering service workflows (i.e., generic functionalities), sharing tools and algorithms, providing detailed service documentation, and offering the complete service workflow. Additionally, capacity building is facilitated through dedicated training sessions.

The service transfer is secured by providing open-source code and enabling the transfer of usage (capacity building, user manuals, and draft SLAs), demonstrating the service's readiness for future use.

3.2.1 Transfer of the code: the open-source approach

- The services developed in this project are deployed on a processing environment based on a microservices architecture, where each component must perform a specific task.
- The services are developed with open-source code (mainly Python) using open-source libraries (among others, gdal, rioxarray, rasterio, geopandas, pyogrio).
- The applications within the services are broken down into a collection of smaller components, the microservices, orchestrated with the OGC open standard Common Workflow Language (CWL):
 - The application package employs:
 - a command line tool CWL script to run the microservice as a Docker image
 - A workflow CWL script to orchestrate all Docker images, according to execution sequence, tasks dependencies and the data flows between tools
 - This approach ensures that the application is portable among all supporting execution and processing scenarios and allows the application to be deployed as a web service that complies with the OGC API - Processes standard (OGC 18-062).
- All geospatial assets managed on the processing environment (e.g. input satellite imagery and output application results) must be indexed following the STAC (SpatioTemporal Asset Catalog) standard.
- Usage of GitLab: all the application packages are committed and pushed to a repository visible and accessible to the CopernicusLAC Panama Centre system managers.

3.2.2 Transfer of the usage

The transfer of usage focuses on ensuring that users can effectively operate and maintain the developed EO services beyond the project's lifecycle. This is achieved through a combination of capacity-building initiatives, comprehensive user documentation, and clearly defined Service Level Agreements (draft SLAs).

- **Capacity building:** Dedicated training sessions are organized to provide hands-on experience with the services. These sessions focus on ensuring the availability and empowerment of relevant skilled staff in the user organization, equipping them with the necessary expertise to operate and maintain the services effectively. The goal is to empower users with the knowledge and skills needed for future independent operation, enabling them to confidently manage the services and adapt them to evolving organizational needs.

A program for the training activities has been proposed. The full outline is presented in the Appendix (section 3). The Content of the Capacity Building is summarized below:

- **The goal:** the sustainable EO service transfer through capacity building.
- **Training focus:**
 - i. Navigation in the Processing Environments
 - ii. Understanding remote sensing foundations
 - iii. Service execution: input preparation, outputs interpretation and products applicability.
 - iv. Long-term service management
- **Learning Outcomes:** by the end, participants are able to navigate the processing environment, execute the service, interpret results, apply the EO products, and manage the service independently.
- **Interactive elements:** practical exercises, Q&A sessions and group discussions.
- **User Documentation:** Comprehensive user manuals are provided, detailing the functionality of the services and the processing chains involved. The documentation includes a thorough description of how the services operate, its specifications and the resulting products. This ensures that users have a clear understanding of the processes behind the services, enabling them to effectively interpret the outputs and utilize the products generated.
- **Draft of Service Level Agreement (draft SLA):** The draft SLA formalizes the agreement between the service supplier and the recipient for the exploitation of the developed processing chains during pre-operational phase. These agreements define the specifications of the products to be delivered and establish the roles and responsibilities expected from all the parties involved during the project's duration. The draft SLA constitutes a model that can be used in the operational phase by the CopernicusLAC Panama Centre as long-term service supplier to regulate their relationship with the users beyond the project duration. The objective of the SLA is to ensure clarity on the continued operation and support of the services, fostering long-term collaboration between the supplier and the recipients. The SLA shall clarify the role and activities of the Centre as the services host and supplier and will depict clearly the computational (infrastructure) and operational (manpower) costs derived from the exploitation of the services. The implications of any local setup aside the installation in the Panama Centre should be properly reflected in the SLAs for the operational phase.

4. CONCLUSION

The first conclusion to be drawn from the extensive consultations with stakeholders and end users is the clear relevance of Earth Observations to the work of the Latin American and Caribbean DRM community. There is strong interest in Earth Observation, and some existing capacity. There is a strong desire to better exploit available -especially free- datasets when they can be turned into useful products that address priority hazards and facilitate the implementation of international initiatives.

To effectively demonstrate how the EO Services Development project can make a sustainable contribution to DRM in Latin America and the Caribbean, it is essential to strike a balance across hazards, regions, and countries with varying levels of capacity. This diversity has been a guiding principle in the design and implementation of the services, ensuring that the portfolio responds to a wide range of regional priorities.

The **EO Services Development Activity** has led this engagement process, identifying user needs and co-developing services through an AGILE, iterative methodology. This has resulted in the creation of 18 open-source services supported by over 79 documented "user stories" that reflect real-world applications aligned with institutional mandates. For each service, an implementing partner was selected to collaborate with the consortium, ensuring relevance, ownership and sustainability.

In parallel, the **CopernicusLAC Centre in Panama** plays a strategic role in the regional EO ecosystem, contributing to political-level engagement and coordination. As the recipient of open source EO services developed by the project, Panama is positioned to become the **regional service supplier for Latin America and the Caribbean**. This marks a shift from pilot demonstrations to a scalable, operational model for delivering EO-based solutions across the region.

The Centre also facilitates **connections with regional and international stakeholders** who may contribute the **long-term sustainability** of the EO services. These efforts complement those of the EO Services Development project, which has actively identified future users and stakeholders capable of scaling applications across the region. These stakeholders may support service development, contribute data or technical expertise during pre-operational and operational phases, or help identify long-term funding mechanisms.

By engaging at the political and institutional level, the Centre helps align service delivery with broader strategic goals for disaster risk reduction in Latin America and the Caribbean.

As this DRR-focused work progresses, synergies are sought with complementary services such as those targeted on response and already actively used in the region, as the **Copernicus Emergency Management Services Rapid Mapping**, and the **International Charter Space and Major disasters**. These services must be explicitly acknowledged in user engagement to ensure that capacity building efforts benefit the full range of EO-based DRM services.

Each service is developed with a clear co-development strategy, ideally involving users with a strong sense of ownership and interest in long-term success. The EO Services Development activity ensures that these services are not only technically sound but also socially and institutionally embedded. Local partners may receive encouragement- and potentially financial support- from international stakeholders interested in scaling successful demonstrators across subregions or the entire region.

Anchored by the delivery of services to the Panama Centre and, through it, to the region, the **Copernicus LAC EO Services Development Activity** is a significant step forward in bringing the benefits of satellite EO to DRM users in Latin America and the Caribbean. It is also a critical pre-cursor to new initiatives in other thematic areas such as agriculture or climate change. It is a powerful demonstration of the value of Sentinel data and the potential to build a regional big data ecosystem that empowers users for improved DRR.

Through continuous engagement with stakeholders and an agile development process, the EO Services Development project ensures that evolving user needs across Latin America and the Caribbean are met with relevant, open-source

Earth Observation services. This portfolio of services is built on a solid foundation of user consultations, including an assessment of priorities and needs that continues to be refined through iterative validation and co-development.

The result is a **living demonstration** of how free satellite data—when properly integrated into decision-making processes—can make a sustained contribution to disaster risk management (DRM) in the region. By **delivering a portfolio of open source EO services tailored to LAC**, the project empowers institutions and communities to better understand, anticipate, and respond to hazards, while laying the groundwork for future thematic expansions.

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Services Development Activity