European Commission

DIGITALISATION FOR DEVELOPMENT. A TOOLKIT FOR DEVELOPMENT COOPERATION PRACTITIONERS

INTERNATIONAL PARTNERSHIPS (INTPA)

Copernicus

InfoSheet nº3

This InfoSheet is part of a series on digitalisation and relevance to EU International Partnerships and development cooperation programmes. The Toolkit is designed to provide key definitions, main opportunities and challenges for global development presented by digital transformation, case studies and suggested further reading. Learn more on Cap4Dev

What is Copernicus?

Satellite observations, including imagery and other data can provide key information for a number of areas in which the EU is involved in partner countries, including among others: urban development and planning, agriculture, transport planning and monitoring, migration and border surveillance, water resources provision and quality, energy and natural resource management and monitoring. Information originating from space assets (i.e. satellites) and non space-assets (i.e. sea-, air-borne and ground sensors) has become increasingly critical for informing on and enhancing situational awareness about globally interconnected crises, especially when it comes to disaster risk management and financial preparedness, in which early and reliable information is key in ensuring a timely and efficient response.[1]

Earth Observation (EO) refers to the use of remote observation platforms such as satellites, aircraft and unmanned aerial vehicles (UAV), and sensors that are placed in the sea, land or the air, to gather data about the Earth's condition, monitoring the atmosphere, land, marine and freshwater environments. These images and data are then processed and analysed, producing relevant information that can be used for multiple applications.

Until a few years ago, data gathered through satellites was accessible only to technical experts. Thanks to programmes like Copernicus, the EU´s EO programme, today anyone can access data and information services produced by satellites and *in situ* sensors.

The Copernicus programme is managed by the EC[2] and co-funded by the European Space Agency (ESA). The satellite and ground station infrastructure is developed and operated by the ESA, the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT), and the European Environment Agency (EEA). The EU Member States, as well as third countries, and commercial providers also contribute to Copernicus through the provision of data.

Copernicus collects digital data through a set of EU-owned, dedicated satellites (called Sentinels) and contributing missions (existing commercial and public satellites), which provide complementary high-resolution data.[3] The Copernicus Sentinel satellites have specifically been developed by the ESA for the programme. There are six different satellite missions: Sentinel-1, -2, -3, -5P and -6 are dedicated satellites, while Sentinel-4 and -5 are payloads onboard EUMETSAT's weather satellites. Copernicus couples satellite information with in situ data collected by Member States and international research infrastructures on the ground, at sea or in the air as well as model data. For instance, for air pollution monitoring, in addition to the satellite observations, there are more than 7,500 ground-based air quality measurement stations distributed across Europe used to both feed and validate the numerical atmospheric models of the atmosphere based on satellite observations. Copernicus Services then process and analyse satellite and in situ data, transforming them into value-added information.

Any individual or organisation around the world can access Copernicus data and Services on **a free, full and open access basis**.

Who are Copernicus users?

- Institutions and bodies of the EU,
- Governments and public administrations,
- The private sector,
- Research and academic organisations,
- International organisations,
- NGOs and civil society,
- General public.

The Copernicus Programme with over 12 Terabytes of Earth Observation open data generated daily, is the third largest data provider in the world after Amazon and Google.

[1] Financial Protection Forum, 5 Ways Satellite Data Can Help Prepare for the Unexpected
[2] Directorate-General for Defence Industry and Space (DG DEFIS)
[3] European Commission, Copernicus – Europe's Eyes on Earth, 2015

What is the added value that Earth Observation data can bring to EU external actions and international partnerships?

Overall, data and information coming from EO are extremely relevant in informing EU external actions and international partnership programming towards sustainable development, in multiple fields. For example, satellite imagery can inform evidence-based public policies on urban development, climate change, health, agriculture, as well as disaster preparedness and response. It can also provide the data to support the development of a multitude of services and applications by the private sector.

In parallel, EO has the potential to enhance planning of future EU international partnership actions in the design phase, improve the efficiency of existing operations and activities, leading to better outputs and outcomes, and provide increased transparency, objectivity, and accountability in performing monitoring and evaluation.[3]

Copernicus also provides the following benefits:

- **EO has global coverage**, including providing information on remote or conflict regions. The *COVID-19 pandemic* has highlighted that even if some areas are accessible in principle, they have been heavily affected by travel restrictions. Satellites collect information in all circumstances. Another example is that of the benefits that EO provides to authorities in monitoring severe weather events such as the recent tropical cyclone Harold in the Pacific, which affected communication systems, therefore limiting the information that could be got on the ground.[4]
- **EO is objective**, which is particularly key to compare development indicators. Satellites collect data in the same way all over the world, thus ensuring transparency and objectivity.[5]
- **EO is repeatable, continuous, and timely to acquire and process**. EO data are particularly useful in data-scarce partner countries, which are still in a development phase and can complement other sources of data such as census and surveys.

Copernicus services and their relevance for international partnerships

Raw EO data have no relevance per se without the added value generated by enabling applications. Most final users require user-friendly information rather than raw data. Generation of such information requires appropriate storage for the raw data and technical skills in processing and analysis.

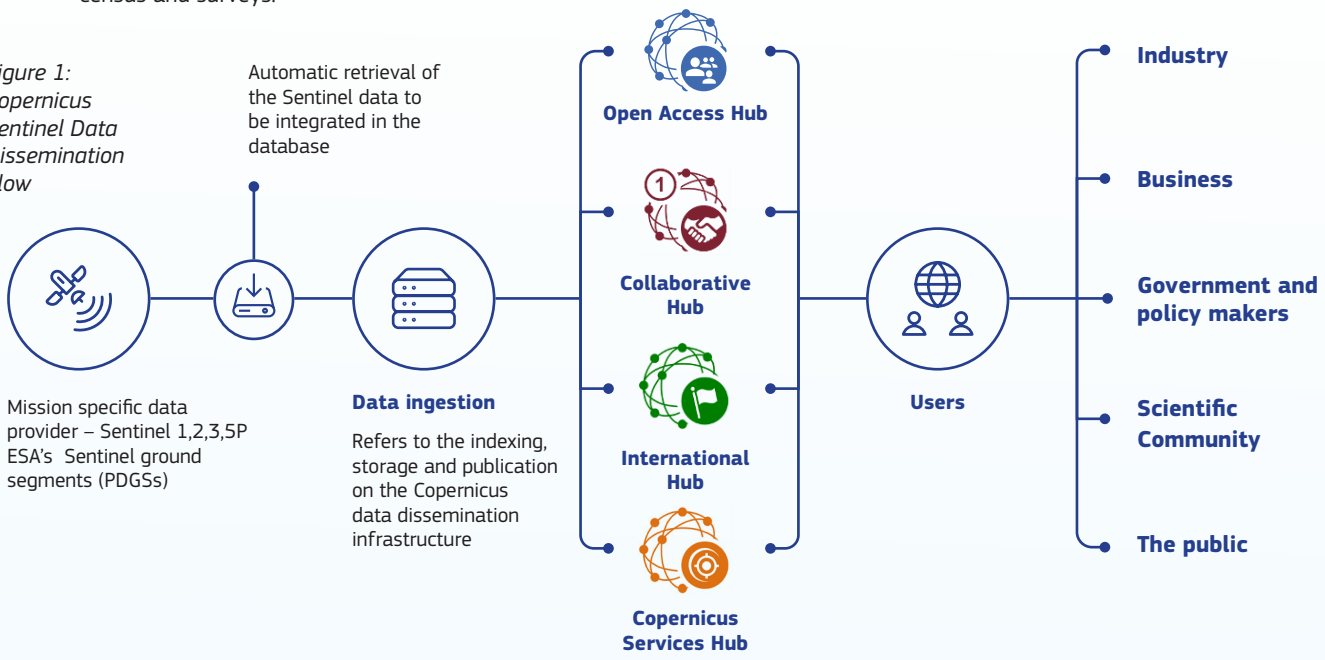
This is the reason why **Copernicus services** transform the raw data acquired by satellites into value-added information, by processing, analysing, and integrating them with other sources and validating the results.

There are six thematic Copernicus services:

The different services deliver a mix of historical, near-real-time data and forecast products, through which final users can monitor changes, identify anomalies and obtain relevant statistical information to support institutional, research and commercial applications.

The information provided by the six Copernicus services can be used to support EU external actions and development cooperation programmes in specific sectors. A good example of EU International cooperation in the field of EO is the Global Monitoring for Environment and Security (GMES) & Africa programme between the EU and African Union (read more *here*). Below is an overview with some examples of how relevant data can be used.

Figure 1: Copernicus Sentinel Data Dissemination Flow



Apart from the hubs displayed in figure 1, an additional way to access Copernicus data is through the five DIAS (data and information access services) online platforms allow users to discover, manipulate, process and download Copernicus data and information. Each platform provides access to the full set of Copernicus data and information, as well as the ability to process and combine it with data from other sources (space and non-space). Their cloud-based systems architecture performs the heavy lifting on the back end, so users get coherent and analysis-ready information on the front end. Because the DIAS platforms are providing mass storage and handling of data, users can begin using information from a single entry point.

[3] Caribou Space, Adoption and Impact of Earth Observation for the 2030 Agenda for Sustainable Development, Farnham, Surrey, United Kingdom. Caribou Space, 2020
[4] Nikhil Seth Satellite imagery — global data for global goals, 7 september 2020, Devex
[5] Idem

Copernicus Atmospheric Monitoring Service (CAMS)

Managed by: European Centre for Medium-range Weather Forecasts (ECMWF).

Main objective: to continuously monitor the composition of the Earth's atmosphere at global and regional scales through the provision of near real time data and forecast products.

Relevant sectors for use: health, renewable energy, climatology. Data can be used for:

Health

- Air quality forecasts,
- Monitor pollutant emissions related to human caused and natural events (e.g. large wildfires, volcanic eruptions),
- Monitor anthropogenic emissions (e.g. from industrial plants).

Energy

Forecasts of desert dust and of other main aerosols (sulfates, sea salts, black and organic carbon), site suitability analysisfor solar plants and facilities, optimizing their design and providing forecasts of irradiance.

Solar radiation maps from CAMS have been used to explore water pumping with solar energy and model solar powered cooking in Africa. Applications using the data are used to calculate expected financial returns for small and large solar energy projects.

Copernicus Marine Environment Monitoring Service (CMEMS)

Managed by: Mercator Ocean International.

Main objective: to provide regular and systematic information about the physical and biological state and dynamics of the ocean and marine ecosystems.

Relevant sectors for use: ship routing services, offshore operations, fishing, aquaculture, pollution. Data can be used for:

Fishing and aquaculture:

- Model fish habitat,
- Map fishing zones,
- Forecast changes in sea levels.

Pollution

- Observe oil spill location and movement,
- Monitor marine litter.

The Ghanaian Navy and the Ghana Fisheries Commission (Monitoring Control and Surveillance Division) are currently using CMEMS for fisheries control.

Copernicus Land Monitoring Service (CLMS)

Managed by: DG JRC, EEA.

Main objective: to provide geographical information on land cover, land use, land cover and use changes over the years, vegetation state and the water cycle at the global, pan-European and local level.

Main areas for use: forest, water, agriculture, energy, food security. Data can be used for:

Agriculture and Forestry

- Track crop production:
  - Provide early warnings on failing crops,
  - Predict crop yields,
  - Allow for smart farming applications such as yield mapping, input management and farm management recording.
- Monitor changes in land cover,
- Detect deforestation and health status of forests.
- Water managementMonitor global inland water bodies and their seasonal replenishment,
- Monitor large lake and river water levels, temperature, turbidity and trophic state.

Copernicus Land products have been used to identify vulnerable areas and prime locations for species' reintroduction in West Africa and monitor the impact of conservation efforts.

Copernicus Climate Change Service (C3S)

Managed by: the European Centre for Medium-Range Weather Forecasts (ECMWF).

Main objective: to respond to changes in the environment and society associated with climate change, through the provision of information for monitoring and predicting in Europe. In addition, it supports climate adaptation and mitigation strategies.

Main areas for use: climate, weather, renewable energy. Data can be used for:

Energy

- Monitor climate indicators and electricity consumption,
- Estimate the combined production from all renewable sources at national and sub-national level in Europe.
- Climate
- Monitor the global climate and its evolution,
- Monitor climate change through Essential Climate Variables (air temperature, sea-ice, CO2, etc.),
- Inform climate related adaptation and mitigation policies in economic sectors.

The C3S helps safeguard health, food and water security in South Africa by providing climate impact indicators and assessments that help adaptation to different climate change issues. During the Tropical Cyclone Kenneth that hit Mozambique in 2019 a number of mapping products were generated before and after the event to support national authorities.

Copernicus Emergency Management Service (CEMS)

Managed by: DG JRC.

Main objective: to deliver early warnings and risk assessments information of floods, forest fires and drought, as well as to provide on request near real time maps and geo-information products for all types of natural and human-made disasters, both at European and global levels.

Main areas for use: Humanitarian aid, disaster-risk management. Data can be used for:

Disaster and emergency prevention, preparedness, response and recovery

Humanitarian crisis and Population displacement

Copernicus Security Service (CSS)

Managed by: FRONTEX, European Maritime Safety Agency (EMSA), EU Satellite Centre (EU SatCen).

Main objective: to enhance crisis prevention, preparedness and response in three main domains: border surveillance, maritime surveillance and support to EU External Action.

Main areas for use: EU security policymaking, border surveillance, maritime surveillance. Data can be used for:

Maritime Surveillance and Border Control:

- Monitor fishing grounds and observable fishing activities at a particular time and location; combat illegal, unreported and unregulated fishing,
- Identify potential smuggling infrastructure and routes,
- Monitor suspect vessels at sea,
- Manage border control.

Copernicus and SDGs

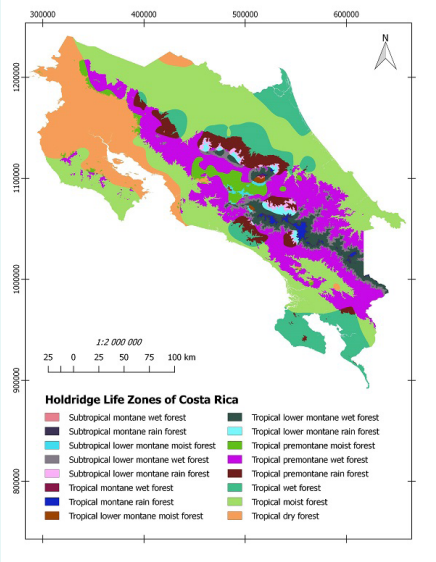
The large amount of data and information generated by Copernicus supports decision-makers in developing suitable policies to achieve their goals and facilitates the monitoring of the SDGs. For instance, CAMS and C3S support the SDG 7 (related to energy). Forecasts of desert dust and other aerosols help predict power efficiency losses and improve the design and management of solar power plants.

Learn more about how Copernicus supports the achiements of SDGs *here*.

CASE STUDY

Climate change impacts on biodiversity in Costa Rica

In ecological terms, Costa Rica is one of the world's most important countries, home to around 5% of the Earth's biodiversity. A quarter of Costa Rica´s land is protected with ecotourism being an important economic contributor. Nonetheless, Costa Rica is threatened by climate change impacts, but lacks the necessary high spatial resolution, consistent, nationwide, openly accessible, quality-checked climate data to support planning and climate adaptation policy making.



Classification of vegetation ecosystems from C3S data for supporting the Costa Rican government's decision-making. (Source: C3S website. Christian Birkel and Joni Dehaspe, University of Costa Rica).

The above-named project is part of an international partnership involving the Copernicus Climate Change Service (C3S) for identifying 'climate sensitive areas' in Costa Rica. The project aims to facilitate climate adaptation through the generation of refined data which support the national park authorities of Costa Rica (SINAC) and other potential national users. Specifically, the project is expected to allow SINAC to better manage protected areas as well as establish biological corridors associated with 'climate sensitive areas' that are useful for building adaptation.

Data collected include precipitation and temperature (the main drivers of vegetation distribution). These data sets are used to classify natural vegetation ecosystems through quantification of the 'Holdridge Life Zones'. By linking these Life Zones with downscaled and bias-corrected climate projections (available through C3S), it is possible to explore future scenarios of how species associated with the Life Zones could potentially move.

Thanks to the project, 44 biological corridors have been identified as of 2018, and management will be implemented nationally over the next 5-10 years. Although the project aims to mainly support the national park authorities of Costa Rica -scale data, data are openly accessible to allusers through the C3S Copernicus service.

CASE STUDY

Insuring Crop Investments in Ethiopia

Farmers in Ethiopia usually have less than 0.5ha of land, which makes them particularly vulnerable to the impacts of drought. Through the GIACIS project (Geo-data for Innovative Agricultural Credit Insurance Schemes), the University of Twente has launched an innovative micro-insurance product to reduce investment risks for smallholder farmers in Ethiopia. The product detects whether there is a risk of drought and other adverse weather conditions that could impact crop development. The main Copernicus source for data is the CGLS Normalized Difference Vegetation Index (NDVI). Complementary sources include meteorological data (temperature, rainfall, etc.), information on agricultural management practices, and factors limiting or reducing crop yields.

The scheme covers against exposure to drought (defined as a negative anomaly in land cover greenness from what is considered climatologically normal) of the farmer's individual fields during the growing season. It does not insure the loss of crop yield, but rather the financial investment (credit line) of the farmer, allowing farmers to take more risks and invest to adopt the recommended inputs.

Benefits for the user include: reliable identification of impacted crops for insurance companies and farmers, fully scalable, low cost, practical and accurate product; moral hazards, and fraud-opportunities are all minimized; no need for field visits once field location is known.

Learn more about Copernicus

DG DEFIS has developed *a series of more than 50 factsheets* on many aspects related to Copernicus (e.g. services, access to finance, access to data, societal and economic benefits etc).

Videos on Copernicus

Copernicus Services

The Copernicus (Massive Open Online Course) MOOC is a free online training enabling users to understand how to use EO data for evidence-based public policy, as well as to develop new products and services, open up new markets, improve quality of life, and make the most of limited resources in a sustainable way.

Interested in using Copernicus? How to start:

Have a look at the websites of the various Copernicus services & examples of their products to see which one would be relevant for your project, business, programme, etc.:

Copernicus Atmosphere Monitoring Service (CAMS)

Copernicus Marine Environment Monitoring Service (CMEMS)

Copernicus Land Monitoring Service (CLMS)

Copernicus Climate Change Service (C3S)

Copernicus Security Service (CSS)

Copernicus Emergency Management Service (Copernicus EMS)

Copernicus: Get in touch

You can find out how to get in touch *here*.

Or send an email directly: support@copernicus.eu

Access to Copernicus Data and information

Use Cases

Main References

Caribou Space, Adoption and Impact of Earth Observation for the 2030 Agenda for Sustainable Development, Farnham, Surrey, United Kingdom. Caribou Space, 2020

Copernicus webpage

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Nikhil Seth, Satellite Imagery — Global Data for Global Goals, 2020, Devex

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ESA, *Sentinel Online Webpage*