



EO Supporting the Sustainable Development Goals

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This area provides a wide list of success stories categorized according to the [United Nations Sustainable Development Goals](#) (UN SDGs). This area allows interested EO user communities to identify EO applications based on the SDGs. The UN SDGs are at the heart of the UN 2030 Agenda for Sustainable Development, providing a blueprint for the people, planet, and its resources now and in the future.

Only the SDGs where EO can make a sound contribution have been displayed. To know more about the success stories linked to products or applications, you can refer to the [EO in Action](#) section, selecting the appropriate product page.



i. SDGs

In September 2015, the [UN General Assembly](#) ratified the 2030 Agenda on Sustainable Development, a new transformative, integrated and universal agenda that aims to end poverty, promote prosperity and people's well-being while protecting the environment. The core of the 2030 agenda is the 17 sustainable development goals (SDGs) and their 169 associated targets, which should be achieved by 2030. The SDGs are being launched with an emphasis on collecting data that will be extensive and specific enough to serve these needs. They are designed to balance the three dimensions of sustainable development: the economic, social and environmental.

Earth observation (EO) is a powerful instrument to support the reporting on Sustainable Development Goals (SDGs) and indicators and the provision of relevant information to effectively monitor progress towards the SDG targets, and the degree of compliance with the International Agreements. It helps on the provision of critical information on natural resources, government operations, public services, or population demographics. This actionable information helps on the SDG implementation role, monitoring, reporting, and the facilitation and shaping of reporting methods, policy and tools. These insights can inform national priorities and help determine the most effective paths for action on national issues. EO is a critical data source for monitoring and driving progress against the SDGs.

Effective monitoring of the SDG and reporting of the progress towards the SDG targets require the use of multiple types of data such as EO which together with modern data processing and analytics, offer new opportunities to track sustainable development.

The 17 Sustainable Development Goals (SDGs) of the 2030 Agenda

Goal 1. End poverty in all its forms everywhere.

Goal 2. End hunger, achieve food security and improved nutrition and promote sustainable agriculture.

Goal 3. Ensure healthy lives and promote well-being for all at all ages.

Goal 4. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

Goal 5. Achieve gender equality and empower all women and girls.

Goal 6. Ensure availability and sustainable management of water and sanitation for all.

Goal 7. Ensure access to affordable, reliable, sustainable and modern energy for all.

Goal 8. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.

Goal 9. Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.

Goal 10. Reduce inequality within and among countries.

Goal 11. Make cities and human settlements inclusive, safe, resilient and sustainable.

Goal 12. Ensure sustainable consumption and production patterns.

Goal 13. Take urgent action to combat climate change and its impacts.

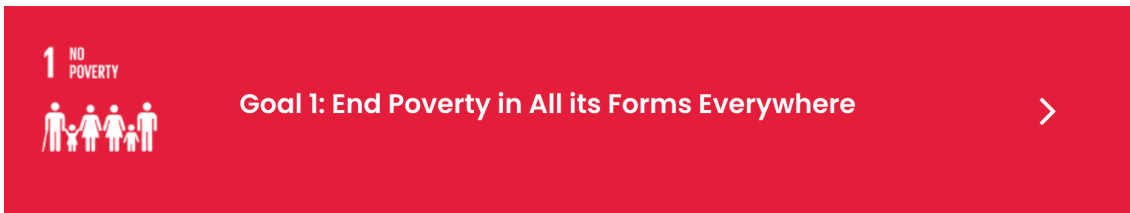
Goal 14. Conserve and sustainably use the oceans, seas and marine resources for sustainable development.

Goal 15. Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.

Goal 16. Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels.

Goal 17. Strengthen the means of implementation and revitalize the global partnership for sustainable development.

ii. SDG 1 - No Poverty



ii.1 Goal: End poverty in all its forms everywhere.

EO data offer an invaluable opportunity for better-informing development policies and quantifying various targets. How can EO be used to help countries achieve specific targets? *Source: [ESA compendium of EO contributions to the SDG Targets and Indicators](#)*

Target 1.1: By 2030, eradicate extreme poverty for all people everywhere, currently measured as people living on less than \$1.25 a day.

(eo services focus on: Mapping spatial distribution of risk of poverty)

Target 1.2: By 2030, reduce at least by half the proportion of men, women and children of all ages living in poverty in all its dimensions according to national definitions.

Earth Observation (EO) data can be used to track and target poverty, and aid the allocation of scarce resources which can help improve human livelihoods. EO can be used to map spatial distribution of socioeconomic deprivations, as well as providing information that may indicate areas at risk of poverty (e.g. contribute towards famine early warning systems) (NASA, 2018). EO data can be used to forecast weather, monitor fires, determine populations at risk from flooding/landslides, analyse climate change and map land cover change (e.g. deforestation and degradation). These factors can all help identify areas currently at risk from poverty, and in the future.

Satellite images can also be used to estimate economic activity (e.g. through monitoring night lights) and mapping houses (e.g. slums), which can be identified through satellite images using physical parameters, clustering of structures with or without a road network, irregular and haphazardly grouped temporary, poorly-constructed or semi-permanent households (Montana et al., 2016). Further, these datasets can be combined with in-field survey data (from socioeconomic household surveys, social media, mobile phone networks) (Leidig & Teeuw, 2015), and often by additionally using machine learning algorithms (Jean et al., 2016), can estimate consumption expenditure and asset wealth of the region analysed. Such approaches can assist efforts to track and target poverty.

(eo services focus on: Estimate economic activity, mapping areas and its resources)

Target 1.4: By 2030, ensure that all men and women, in particular the poor and the vulnerable, have equal rights to economic resources, as well as access to basic services, ownership and control over land and other forms of property, inheritance, natural resources, appropriate new technology and financial services, including microfinance.

Improving human well-being and access to services, EO data can help develop various proxy indicators of human well-being, for example access to services such as electric power, as well as patterns of human interaction

Remote sensing and call data records can help monitor access to basic services. Call Data Records (CDR) provide information on where, when, how and with whom someone made a mobile phone call – mainly used for billing purposes, but also provide spatial information on

patterns of human interaction. Mobile phone usage and movement can indicate household access to financial resources and services, for example, via electronic money schemes such as M-Pesa. Remote sensing can capture information on biophysical properties such as rainfall, temperature and vegetation cover as well to variables such as infrastructure (e.g. railway, main roads, waterways), distance to water sources and power plants, electricity use, agriculture productivity and distance to roads and urban areas (which reflects access to markets and information). The state of the road network (e.g. if it's a dirt track or an impervious road) can be derived through Open Street Map, but can be combined with remote sensing data to provide a more detailed picture.

(eo services focus on: Estimate economic activity and access to basic services)

Target 1.5: By 2030, build the resilience of the poor and those in vulnerable situations and reduce their exposure and vulnerability to climate-related extreme events and other economic, social and environmental shocks and disasters.

The frequency and severity of natural disasters have been increasing in the last decades. Research has revealed that it is generally the poor who tend to suffer worst from disasters. The fact that climate change is expected to increase the frequency and intensity of these events threaten to derail international efforts to eradicate poverty.




The importance of EO in disaster management and assessment has gained increasing significance over the past years. One of the ways EO can contribute to build resilience of vulnerable populations is through disaster-risk reduction. EO datasets and methods can contribute to disaster risk management and reduction by providing relevant information to the full cycle of disaster and environmental shock management: mitigation, preparedness, warning and response.

EO has proven successful for a wide range of disaster types, particularly for flooding, extreme drought events, earthquakes, landslides and volcanic eruptions. In fact, EO data is providing a reliable data basis for deriving useful information such as the extent of damaged area along with the land-use types as well as the population affected. This can be done through hazard mapping and risk modelling, real time monitoring, producing input data for feeding early warning systems, or for producing maps to support disaster response actions. For a comprehensive review on how EO can contribute to disaster-risk management, see ESA (2015). EO data lies also at the heart of climate modelling, which represent key tools to inform actions aiming to reduce vulnerability to climate change.

(eo services focus on: Build resilience of vulnerable populations contributing to management of disaster risk reduction. Indicator 1.5.2: Disaster Damage)

EO Products/Services supporting the SDGs

EO services contributing to SDGs CopernicusRiskRelay

- User: Public organization (universities, research labs) and industry
- Challenge/Needs: Build resilience of vulnerable populations contributing to the management of disaster risk reduction by monitoring of natural and anthropogenic disasters.
- Initiative: EU Cohesion Fund - “Competitiveness of the Bulgarian Industry 2007-2013”
- Results: Developed Geospatial Web portal for disaster mapping. The portal visualize disaster information from different sources as the automatically integrated data from the Copernicus EMS and additionally activations for disasters are processed and mapped by the service provider.
- Service Provider: RST-TTO, BAS

Target 1.5: By 2030, build the resilience of the poor and those in vulnerable situations and reduce their exposure and vulnerability to climate-related extreme events and other economic, social and environmental shocks and disasters.
 Indicator 1.5.2: Disaster Damage
 Target 13.1: Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries.










Figure: Visualization of Copernicus Risk Relay Portal interface and evaluation of the flooded critical infrastructure in Miziya, Bulgaria in 2014

EO services contributing to SDGs Rheticus® Safeland

- User: Regional to local authorities, Environmental protection agencies, Civil engineering companies
- Challenge/Needs: Land instability represents a serious source of danger for citizens safety, infrastructure safeguarding and environmental protection. Prioritize areas based on the level of concern to better manage inspection and investments for stability works represents a huge need
- Initiative: Internal Development
- Results: The service gives a level of concern to each portion of a territory allowing customers to easily detect areas with a high level of concern, prevent potential damage, better organize field inspections, and achieve cost-effective management of the territory. The service provides the proper knowledge to support planners to avoid critical issues deriving from not full pictures of in progress phenomena.
- Service Provider: Planetek Italia's Rheticus platform

Target 1.5.: eo services focus on: Build resilience of vulnerable populations contributing to management of disaster risk reduction. Indicator 1.5.2: Disaster Damage
 Target 9.1.: eo services based on Inform on infrastructures development & planning.
 Target 11.5.: eo services based on Mapping of vulnerable disaster areas & early warning systems

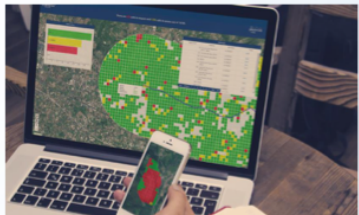




Figure: Rheticus® Safeland service geoportal with analytics tools





References link <http://copriskrelay.rst-tto.com/>



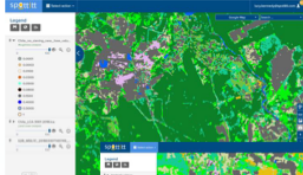
References links
 • <https://www.rheticus.eu/rheticus-services/safeland/>

EO services contributing to SDGs
10m resolution Habitat Classification (Land Cover Analysis)





- User: International, national, regional and local government bodies and agencies, NGO's and specific industries.
- Challenge/Needs: Large scale analysis and digital mapping of current and past habitats from 64 square km and upwards in size. Used to map areas and resources plus access to basic facilities and see how these have changed over time.
- Initiative: Developed as part of ESA Business Applications funded SEWISS project which developed a range of site selection tools for onshore wind developers.
- Results: Commercially available service derived from Sentinel 2 imagery. Global coverage. Automated service request/delivery. Cost £1/square km. Volume discounts available.
- Service Provider: Spottitt Ltd.


- Target 1.1: By 2030, eradicate extreme poverty for all people everywhere, currently measured as people living on less than \$1.25 a day.
 - Mapping areas and resources
- Target 1.3: implement nationally appropriate social protection systems and measures for all, including floors, and by 2030 achieve substantial coverage of the poor and the vulnerable
 - Mapping access to basic facilities



Spottitt 10m resolution habitat classification Chile



Spottitt 10m resolution habitat classification Thailand



<https://www.spottitt.com/about/spottitt-features/land-cover-analysis-lca/>

EO services contributing to SDGs
Disaster and risk intelligence




- Users: organisation with a mandate in disaster management, humanitarian and development aid, government agencies, international organisations, (re-)insurance
- Challenge/needs: Mayday.ai products are reducing the impact of natural and human-made disasters, with a particular focus on early detection and risk management
- Initiative: commercialisation starting as of autumn 2021
- Results: reduced impact (less fatalities, economic damage and environment degraded), increased resilience, lower insurance premiums/insurance more competitive, higher awareness
- Service provider: [Mayday.ai](https://www.mayday.ai)

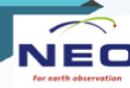
Target: 1.5: By 2030, build the resilience of the poor and those in vulnerable situations and reduce their exposure and vulnerability to climate-related extreme events and other economic, social and environmental shocks and disasters.



Mayday.ai's disaster and risk platform

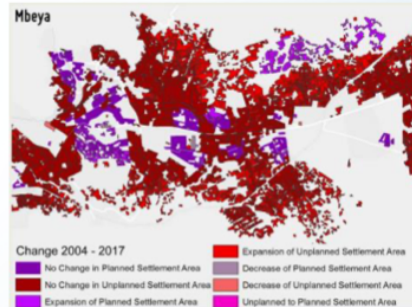


EO services contributing to SDGs Informal settlement mapping



- User: city planner, policy makers, hazard management department
- Challenge/Needs: The haphazard development of informal settlements is in a consequence of uncontrolled urban growth and represents a major challenge for urban planners and city authorities. Many countries have inadequate data and little knowledge on informal settlement locations, their spatial extent and growth patterns. This product maps the slum and informal settlement areas and the changes through years to assist in a better understanding these areas by providing insights into the extent, spatial patterns, expanding trends. It also contributes to the estimation of the vulnerability to natural hazards and the assessment of related risks.
- Initiative: Earth Observation for Sustainable Development (EO4SD) – European Space Agency (ESA) program, aims to achieve increasing the uptake of satellite based information in the financial institutions' regional and global development programmes with a focus on urban development, agriculture and rural development . It aims to meet the long term, strategic geospatial information needs in the individual developing countries as well as international and regional development organisations.
- Results: 1) mapping the informal settlement areas from different years using EO data 2) mapping the changes through the years 3) derived the statistics on the changed extent
- Impact: The settlements are dynamic with frequent population fluctuations, temporal and spatial high resolution EO data can provide city planners with data which would be otherwise difficult to obtain. In developing countries, traditional field mapping is difficult as well as time and cost consuming. Satellite data based analysis is therefore a unique tool for rehabilitation activities.

Target 11.1: By 2030, ensure access for all to adequate, safe and affordable housing and basic services and upgrade slums.



Informal settlement changes



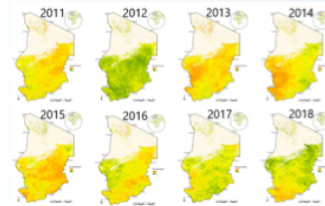
EO4SD program website:
<https://eo4sd-urban.info/>

EO services contributing to SDGs Characterizing Drought Risk and Impact



- User: Welthungerhilfe (largest private aid organisation in Germany)
- Challenge/Needs:
 - Global identification of drought hazard, exposure and risk
- Initiative: Global Resource Water (GRoW) which is part of FONA - Research for Sustainable Development (German Federal Ministry of Education and Research)
- Results:
 - Development of a drought probability model that can be transferred globally
 - Spatially explicit description of drought risks by considering three components: drought hazard, exposure and vulnerability
 - Web-based information system for comprehensively characterizing drought events and crop related information products such as farming systems (rainfed vs. irrigated agriculture)
 - Impact: Early identification of the need for international food aid
- Service Provider: Remote Sensing Solutions GmbH

Target 1.5: By 2030, build the resilience of the poor and those in vulnerable situations and reduce their exposure and vulnerability to climate-related extreme events and other economic, social and environmental shocks and disasters.



Yearly drought hazard for the Republic of Chad



The integrated drought tool and portal



<https://grow-globedrought.net/>

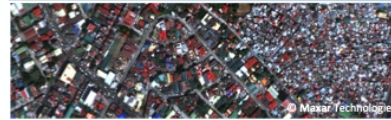
EO services contributing to SDGs Informal settlement AI toolchain



- User: UN; World bank, NGO's & aid organizations, central and sub-national governmental institutions, insurance sector, ...
- Challenge/Needs:
 - Identify slums using AI techniques;
 - Evaluate the evolution of slums over time and predict their future expansion including population estimates;
 - Understanding of informal settlement development and the relation with access to key services;
 - Analysis of exposure to natural hazards
- Initiative: Transferable Open-source community tool
- Results:
 - A tool which is transferrable to various regions (already applied in Asia & Latin-America)
 - A tool which make us of different type of data
 - A tool which can be run by local technical operators
- Service Provider: [Geographic Information Management NV](#)

Target 1.1: By 2030, eradicate extreme poverty for all people everywhere, currently measured as people living on less than \$1.25 a day.

Target 1.2: By 2030, reduce at least by half the proportion of men, women and children of all ages living in poverty in all its dimensions according to national definitions.



EO services contributing to SDGs Rheticus® Wildfires



- User: National Park Authorities
- Challenge/Needs: easily detect burnt area, improve fire severity classification, vegetation regrowth monitoring as well as detection of potentially illegal infrastructure activities within burnt areas.
- Initiative: Internal Development
- Results: Timely analyse and plan recovery activities for parks, forests and remote areas affected by wildfires. By means of maps, geo-analytics, and pre-set reports park managers and authorities will be able to coordinate and manage response teams, while also detecting any illegal man-made activity.
- Service Provider: Planetek Italia's Rheticus platform

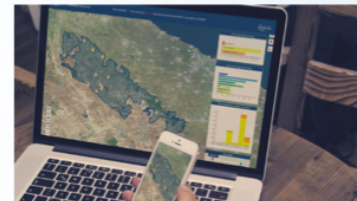


Figure: Rheticus® Wildfires service geoportal with analytics tools

References links

- <https://www.rheticus.eu/rheticus-services/wildfires/>
- <https://www.rheticus.eu/case-history/wildfires-capture-from-space/>

Target 1.5.: eo services focus on: Build resilience of vulnerable populations contributing to management of disaster risk reduction.

Target 15.1.: eo services based on Monitor land use and land cover change on land ecosystems.

Indicator 15.1.1: Forest areas

Target 15.2.: eo services based on Progress towards sustainable forest management (biomass, area of change, etc) Indicator 15.2.1: Sustainable forest management

Target 15.4.: eo based on Conservation & sustainable management of mountain ecosystems (protected areas, green cover) Indicator 15.4.2: Mountain green cover



EO services contributing to SDGs

[Disaster management] AgroApps Agl toolset

- User:** Agric. Insurance companies, Claim adjusters, Underwriters
- Challenge/Needs:** Improve decision making and automation of business processes throughout the value chain. Build resilience of vulnerable populations contributing to management of disaster risk reduction.
- Initiative:** Climate change is expected to worsen the frequency, intensity, and impacts of extreme weather events. As a result, economic losses are expected to increase significantly and pose considerable challenges to the insurance sector.
- Results:** A Toolset of services that enables remote monitoring and unbiased damage assessment, reduces the number of on-site visits for claim verification, reduces operational and administrative costs for policies and claims handling, allows the creation of more personalised contracts.
- Service Provider:** **AgroApps P.C.**




Target 1.5: By 2030, build the resilience of the poor and those in vulnerable situations and reduce their exposure and vulnerability to climate-related extreme events and other economic, social and environmental shocks and disasters.
Indicator 1.5.2.: Direct economic loss attributed to disasters in relation to global gross domestic product (GDP)



Drought Monitoring and Damage Assessment



AgroApps Agl toolset

EO services contributing to SDGs

Mayday.ai – real time disaster and risk intelligence

- Users:** organisation with a mandate in disaster management, humanitarian and development aid, government agencies, international organisations, (re-)insurance
- Challenge/Needs:** Mayday.ai’s platform provides risk-reduction guidance, disaster early-warning and a common operating picture during evolving disasters. At the policy level, Mayday directly supports the implementation of the Sendai Risk Framework and shifts focus from disaster response to prevention. First responders can more effectively contain disasters. The intelligence is also made available to civilians who are guided to reduce risks and can communicate with authorities during events of crises.
- Initiative:** commercialisation starting as of autumn 2021
- Results:** reduced impact (less fatalities, economic damage and environment degraded), increased resilience, lower insurance premiums/insurance more competitive, higher awareness
- Service Provider:** **Mayday.ai**




Target: 1.5: By 2030, build the resilience of the poor and those in vulnerable situations and reduce their exposure and vulnerability to climate-related extreme events and other economic, social and environmental shocks and disasters.



Mayday.ai’s disaster and risk platform



www.AgroApps.gr



EO services contributing to SDGs
Monitoring of illegal dumping of waste

planetek italia

1 NO POVERTY
 9 INDUSTRY, INNOVATION AND INFRASTRUCTURE
 11 SUSTAINABLE CITIES AND COMMUNITIES

- User: Urban planning departments
- Challenge/Needs: enabling continuous monitoring of land use/ land-cover changes, soil consumption, impervious surfaces assessment, and urban heat islands detection, as well as supporting spatial planning to achieve smart growth.
- Initiative: H2020 Eugenius
- Results: allows to monitor urban changes and their evolutionary trend over time, facilitating planning activities and land management
- Service Provider: Planetek Italia's Rheticus platform

Target 1.5.: eo services focus on: Build resilience of vulnerable populations contributing to management of disaster risk reduction.
 Target 9.1.: eo services based on Inform on infrastructures development & planning.
 Target 11.3.: eo services based on Urban growth monitoring for sustainable use of land. Indicator 11.3.1: Land consumption
 Target 11.6.: eo services based on Spatial mapping of cities & waste management
 Target 11.7.: eo services based on Mapping extend of urban areas



Figure: Rheticus® Urban Dynamics service geoportall with analytics tools

References: <https://www.rheticus.eu/rheticus-services/urban-dynamics/>

EARSC
 European Association
 of Remote Sensing
 Companies


EO services contributing to SDGs
Loss of Green Space Analysis

spottitt


1 NO POVERTY

- User: International, national, regional and local government bodies and agencies, NGO's.
- Challenge/Needs: Large scale analysis and digital mapping at 10m down to sub meter resolution of loss of green infrastructure between two dates.
- Initiative: Developed as part of Spottitt's range of environmental services.
- Results: Commercially available service derived from a range of different sources of optical imagery with 10m down to 50cm resolution. Global coverage. Cost £0.50/square km excluding imagery cost. Volume discounts available.
- Service Provider: Spottitt Ltd.

- Target 1.2: By 2030, reduce at least by half the proportion of men, women and children of all ages living in poverty in all its dimensions according to national definitions.
 - Target 1.2 Mapping areas and resources
- Target 1.3: implement nationally appropriate social protection systems and measures for all, including floors, and by 2030 achieve substantial coverage of the poor and the vulnerable
 - Target 1.3 Mapping access to basic facilities



Spottitt 10m loss of green space analysis Oxfordshire



Spottitt 50cm resolution loss of green space analysis West Midlands Combined Authority

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 of Remote Sensing
 Companies

www.spottitt.com

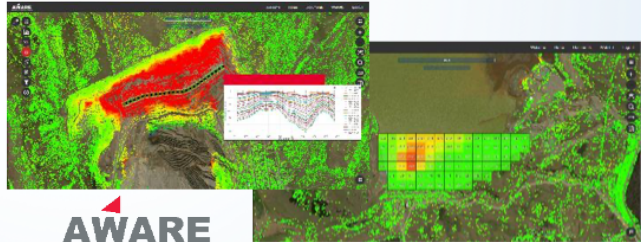
EO services contributing to SDGs

Buildings & infrastructures displacements monitoring



- User: Public authorities, utilities
- Challenge/Needs: improve resilience of buildings and infrastructures through their continuous monitoring for early detection of threats that can affect people safety or services provisions
- Initiative: e-Geos internal development based on the continuous refinement of e-GEOS proprietary Persistent Scatterer Pair (PSP) SAR interferometry technology and on a continuous feed of end users requirements for improving Aware platform functionalities
- Results: Aware platform provides with high precision and accurate positioning analysis of buildings and infrastructures through satellite interferometric analysis (PSP technique), Fast Movements analysis, GNSS services. AWARE returns the analysis through portal & toolbars, providing analysis & supporting tools to add further value to the geospatial data.
- Service Provider: e-Geos

Target 1.5 By 2030, build the resilience of the poor and those in vulnerable situations and **reduce their exposure and vulnerability to climate-related extreme events and other economic, social and environmental shocks and disasters**
Target 9.1 Develop **quality, reliable, sustainable and resilient infrastructure**, including regional and transborder infrastructure, to support economic development and human well-being
Target 9.4 By 2030, **upgrade infrastructure and retrofit industries to make them sustainable**, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes



Heatmap On Points Density Generated On The Fly Over The Selected Area On A Selected Ps Dataset



References link: <https://www.e-geos.it/#/hub/hubPlatforms/platform/platform-aware>

EO services contributing to SDGs
Rheticus® Safeway



- User: Engineering & transport infrastructure management companies
- Challenge/Needs: reduce service disruptions and/or threats for people.
- Initiative: Internal Development
- Results: the service allows an “a priori” approach, helping to highlight problems before they become critical. As a result, operators better manage their financial resources, ensure people’s safety, environmental protection and the safeguarding of assets at all stages of the life cycle of infrastructures, from design to production, management and maintenance.
- Service Provider: Planetek Italia’s Rheticus platform

Target 1.5.: eo services focus on: Build resilience of vulnerable populations contributing to management of disaster risk reduction. Indicator 1.5.2: Disaster Damage
Target 9.1.: eo services based on Inform on infrastructures development & planning.
Target 11.5.: eo services based on Mapping of vulnerable disaster areas & early warning systems



Figure: Rheticus® Safeway service geoportal with analytics tools



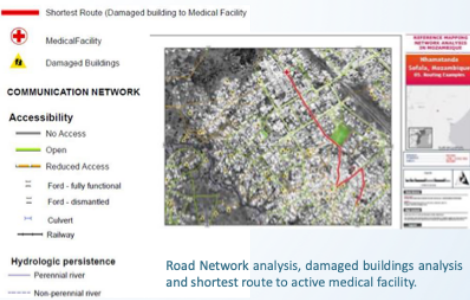
References links
 • <https://www.rheticus.eu/rheticus-services/safeway/>

EO services contributing to SDGs
Basic services damage assessment



- **User:** NGO HELPCODE, with a focus on Health Aid
- **Challenge/Needs:** Mozambique
 - Support the evaluation of access to basic services after cyclone IDAE
 - Support analysis of economic losses by measuring the impact of on productive land
- **Initiative:** BIGMIG serves the international Aid and Development Community. Aims to showcase the potential of EO to support the better understanding, prevention and management of forced human migrations, also from the resilience point of view.
- **Results:** GMV assessed cyclone damages in basic infrastructures (government, health centres, etc), evaluated access and mapped alternative paths to reach the active ones. GMV also determined the level of crop damage so that farmers could claim the insurance payments
- **Service Provider:** GMV (<https://gmV.com/en-es/sectors/space>)

Target 1.4: By 2030, ensure that all men and women, in particular the poor and the vulnerable, have equal rights to economic resources, as well as access to basic services, ownership and control over land and other forms of property, inheritance, natural resources, appropriate new technology and financial services, including microfinance.
 Ind. 1.4.1: Proportion of population in households with access to basic services
 Target 1.5: By 2030, build the resilience of the poor and those in vulnerable situations and reduce their exposure and vulnerability to climate-related extreme events and other economic, social and environmental shocks and disasters.
 Ind. 1.5.2: Disaster damage



References link

EO services contributing to SDGs
Vulnerability maps



- **User:** ONU agencies, Governments, NGOs.
- **Challenge/Needs:** updated information on the vulnerable population for food, health, education, infrastructure, etc. programs.
- **Initiative:** Develop and validated with UNICEF Global. Generation and periodic update of a Geo-spatially located population estimates grid for areas where official population information is not available, accurate, or updated. The grid cell size is 100x100m. The nature of the information generated is tabular and includes location, demographic parameters (total population, target population disaggregated according to needs) and geospatial covariates (i.e. distance to market, land cover, etc).
- **Results:** Vaccine / health campaigns optimization. Food programs optimization. Scalable and replicable to other countries.
- **Service Provider:** SPACESUR

Target 1.1: By 2030, eradicate extreme poverty for all people everywhere, currently measured as people living on less than \$1.25 a day.
 Target 1.2: By 2030, reduce at least by half the proportion of men, women and children of all ages living in poverty in all its dimensions according to national definitions.
 Target 1.4: By 2030, ensure that all men and women, in particular the poor and the vulnerable, have equal rights to economic resources, as well as access to basic services, ownership and control over land and other forms of property, inheritance, natural resources, appropriate new technology and financial services, including microfinance.
 Target 1.5: By 2030, build the resilience of the poor and those in vulnerable situations and reduce their exposure and vulnerability to climate-related extreme events and other economic, social and environmental shocks and disasters.



WWW.SPACESUR.COM

EO services contributing to SDGs
Rheticus® Agriculture



- User: Agriculture, winegrowers and/or agriculture associations, National / Local Authorities, insurance companies
- Challenge/Needs: Generating land cover map it allows to optimize the farm's management at the local, regional and national levels. Further, by using the biomass health indicator (vegetation index, Reflectance Index, Moisture Index, Leaf Area Index, Water index), the service can also work as a diagnostic tool and serve as an early warning system, allowing the agricultural community to detect and counter potential problems before they spread widely and negatively impact crop productivity.
- Results: designed to help farmers in daily crop production tasks.
- Service Provider: Planetek Italia's Rheticus platform
- Reference: <https://www.rheticus.eu/>



Figure: Rheticus® Agroculture service geoportal with analytics tools

Target 1.5: By 2030, build the resilience of the poor and those in vulnerable situations and reduce their exposure and vulnerability to climate-related extreme events and other economic, social and environmental shocks and disasters.
 Target 2.4: By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality.
 Target 6.4: By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity.
 Target 13.1: Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries



EO services contributing to SDGs
Mayday.ai – disaster and risk intelligence platform



- Users: organisation with a mandate in disaster management, humanitarian and development aid such government agencies, international organisations, NGOs (health divisions) or the (re)insurance sector
- Challenge/Needs: Reduce impact of natural & human-made disasters, with focus on early detection & risk management.
- Initiative: Mayday.ai's provide specific products helping on the monitoring of sustainable agriculture including food production. Products provide risk related to air pollution magt, urban/infrastructure planning (floodings, heat waves). Its products also help on the monitoring of natural habitats avoiding degradation or reducing the impact of wildfires and restoration. Overall they bring full transparency to the area of disaster and help to democratise the data for manegement activities. Its commercialisation starts as of autumn 2021
- Results: reduced impact (less fatalities, economic damage & environment degraded), increased resilience, lower insurance premiums/insurance more competitive, higher awareness, in-depth knowledge. Scalability and replicability products
- Service Provider: [Mayday.ai](https://www.mayday.ai)



Target 1.5: Mapping spatial distribution of risk of poverty
 Target 2.4: Agricultural productivity & env. impact of agriculture. Indicator 2.4.1: Sustainable agriculture
 Target 3.9: Monitor the level of air quality data
 Target 6.3: Water quality detection & monitoring. Indicator 6.3.2: Ambient water quality
 Target 9.a: Sustainable and resilient infrastructure development
 Target 11.4: Protect and safeguard the world's cultural and natural heritage
 Target 12.4: Waste management
 Target 13.1: Identifying, monitoring and preparing for climate related hazards
 Target 15.2: Progress towards sustainable forest management (biomass, area of change, etc) Indicator 15.2.1: Sustainable forest management
 Target 15.5: Reduce the degradation of natural habitats, halt the loss of biodiversity
 Target 16.1: Effective, accountable and transparent institutions
 Target 16.10: Ensure public access to information



Mayday.ai's disaster and risk platform

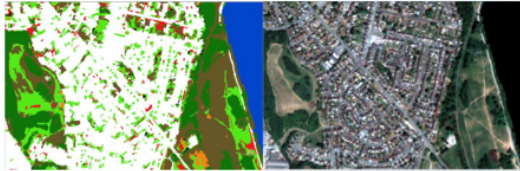


EO services contributing to SDGs
50cm resolution Habitat Classification (Land Cover Analysis)

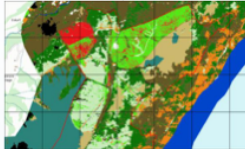



- User: International, national, regional and local government bodies and agencies, NGO's and specific industries.
- Challenge/Needs: Large scale sub meter resolution analysis and digital mapping of current and past habitats from 25 square km and upwards in size. Used to map in great detail areas and resources plus access to basic facilities and see how these have changed over time.
- Initiative: Initially developed with the support of Warwickshire Wildlife Trust, has now been successfully used across the UK and Northern Europe. For best results use imagery taken during the growing season.
- Results: Commercially available service derived from sub meter resolution optical imagery. Global coverage. £20/square km when using existing imagery £27/square km when using freshly captured imagery. Volume discounts available.
- Service Provider: Spottitt Ltd.


- Target 1.2: By 2030, reduce at least by half the proportion of men, women and children of all ages living in poverty in all its dimensions according to national definitions.
 - Target 1.2 Mapping areas and resources
- Target 1.3: implement nationally appropriate social protection systems and measures for all, including floors, and by 2030 achieve substantial coverage of the poor and the vulnerable
 - Target 1.3 Mapping access to basic facilities



Spottitt 50cm resolution habitat classification Birmingham





Spottitt 50cm resolution habitat classification Scotland




www.spottitt.com

EO services contributing to SDGs
Flood Metrics

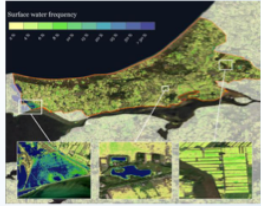



- User: Local Authorities/NGO's
- Challenge/Needs: Flooding events are detrimental to people, assets, infrastructure and the economy, and the effects are being felt worldwide. Timely data and information on flood extent is needed to assess damages and manage risks.
- Initiative: Commercial product as a result of several years R&D
- Results: Through the combined use of both optical and SAR (radar) satellite data in high spatiotemporal resolution (e.g., Sentinel-1 and 2 (10 m) or higher resolution (~ 1 m) commercial sensors when needed), flood extent can be mapped and monitored regardless of cloud conditions and time of day. This can be used operationally to monitor the impacts and extent of ongoing flooding's and historical time-series can be analysed to assess historical surface water frequency, which can be used to inform physical planning and climate mitigation strategies.
- Service Provider: DHI GRAS – Flood Metrics


Target 1.5: By 2030, build the resilience of the poor and those in vulnerable situations and reduce their exposure and vulnerability to climate-related extreme events and other economic, social and environmental shocks and disasters.



Example: Flood extent map using Sentinel 1 SAR (radar)



Example: Surface water frequency using fused optical and radar data



Reference: <https://floodmetrics.dhigroup.com/home> / <https://www.dhi-gras.com/projects/eo4sdg/>

EO services contributing to SDGs Rheticus® Building Check

planetek
italia



- User: Local governmental authorities in charge of monitoring building stability - Architectural Heritage Conservation Services - Development Banks
- Challenge/Needs: Monitoring building stability is a key requirement for local administrations in order to prevent damages to their assets and ensure people safety and security and/or to have reliable information on buildings stability in order to properly design and tailoring property insurance coverage policies.
- Initiative: Internal Development
- Results: to simplify recovery plans, remediation and/or maintenance activities of existing assets. As a results, operators and stakeholders better manage their financial resources and reduce threats for their assets, cultural heritage and people.
- Service Provider: Planetek Italia's Rheticus platform

Target 1.5.: eo services focus on: Build resilience of vulnerable populations contributing to management of disaster risk reduction. Indicator 1.5.2: Disaster Damage
Target 9.1.: eo services based on Inform on infrastructures development & planning.
Target 11.5.: eo services based on Mapping of vulnerable disaster areas & early warning systems



Figure: Rheticus® Building Check service geoportal with analytics tools



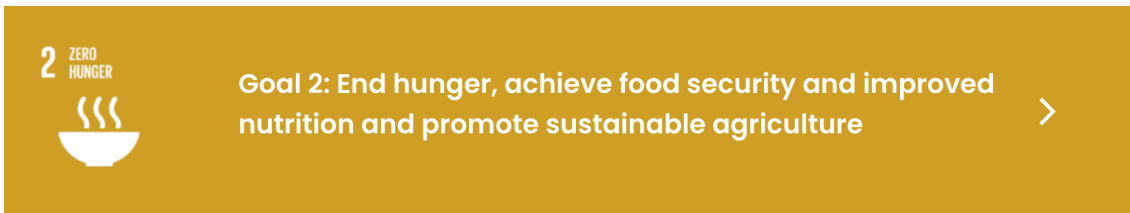
References links
https://www.esa.int/Applications/Observing_the_Earth/Copernicus/Sentinel-1/Using_satellite_information_to_help_rebuild_after_a_disaster

1

Relevant Success Stories

- [Image support for land tenure mapping](#)
- [Satellite images contributing to rescue persons](#)
- [Infrastructure Development Planning](#)
- [Supporting agricultural and food security decisions](#)

iii. SDG 2 - Zero Hunger



iii.1 Goal: End hunger, achieve food security and improved nutrition and promote sustainable agriculture.

EO data offer an invaluable opportunity for better-informing development policies and quantifying various targets. How can EO be used to help countries achieve specific targets? *Source: [ESA compendium of EO contributions to the SDG Targets and Indicators](#)*

Target 2.3: By 2030, double the agricultural productivity and incomes of small-scale food producers, in particular women, indigenous peoples, family farmers, pastoralists and fishers, including through secure and equal access to land, other productive resources and inputs, knowledge, financial services, markets and opportunities for value addition and non-farm employment.

Smallholder farmers play a key role in global food production, particularly in developing countries. It is estimated that small-scale farming systems provide up to 80 percent of the food supply in Asian and sub-Saharan Africa. These systems usually host the majority of poor and hungry people worldwide. Therefore, increasing agricultural productivity in these systems would be key to achieve food security.

Even though EO has been proven potentially useful to contribute to the management of farming, pastoral and forestry systems at regional scales, particularly by generating data to feed crop simulation models and early warning systems, it still has limitations to provide the type of fine scale data needed to feed models operating at the farm scale. This is mainly due to the need for high spatial and temporal resolution and repeat monitoring on demand, which satellites cannot yet guarantee (Jin et al. 2018, Kasampalis et al. 2018). The [Global Ecosystem Dynamics Investigation Lidar \(GEDI\)](#), to be launched in 2018, is expected to produce promising data to fill this gap, at least for forestry systems.

Further efforts are needed in order to implement ways to put the information derived from crop simulation models and early warning systems in the hands of small-scale food producers, as required by this target. Recent pilot cases suggest that information derived from EO, such as weather forecasts, can be made accessible to small-scale food producers even in isolated areas in a way that can inform crop management decisions, such as the time to plant and crop variety selection (UNDP, 2016).

As this indicator is classified as Tier 3, no internationally established methodology or standards are yet available.

(eo services focus on Management of farming)

Target 2.4: By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality.

Continuing population and consumption growth is likely to increase the global demand for food in the next decades. The achievement of food security will require profound changes in the global food and agriculture system. At the same time, unsustainable agriculture expansion has created numerous environmental problems, such as soil erosion, water pollution as well as greenhouse gases emissions. This target aims to contribute to this goal by increasing the economic, social and environmental sustainability of agricultural practices, including through enhancing the resilience to climate change and extreme weather events.

EO methods can play an important role in increasing agricultural productivity as well as minimising the environmental impact of the agricultural sector. Some of the ways EO has proven successful to contribute to increase the sustainability of agricultural production include: (1) yield estimation, (2) vegetation vigour and drought stress monitoring, (3) assessment of crop phenological development, (4) crop acreage estimation and cropland mapping and (5) mapping of disturbances and land use/land cover (LULC) changes (Atzberger, 2014). EO datasets can also be used by countries to inform spatial land use planning and minimize the potential environmental impact of crop expansion through optimizing the allocation of lands (Laurence et al. 2014). In addition to crops, satellite remote sensing techniques can also be applied for rangeland monitoring and management (Ali et al. 2016). EO data and methods can be useful for assessing the future exposure to climate change as well as to extreme weather events, as explained in the 1.5.2 indicator factsheet.

(eo services focus on Agricultural productivity & env. impact of agriculture. Indicator 2.4.1: Sustainable agriculture)

EO Products/Services supporting the SDGs

EO services contributing to SDGs [Sustainable Agriculture] AgroApps Agriculture and Food Systems toolkit

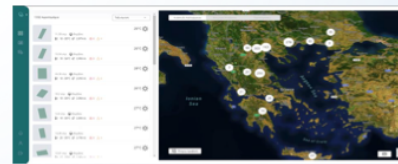


- **Users:** Farmers, Farmers Associations., Agri-consultants, AgriFood Companies, Policy makers, Public sector
- **Challenge/Needs:** To support the implementation of resilient agricultural practices that increase productivity and production, strengthen capacity for adaptation to climate change, progressively improve soil quality and minimize the environmental impact of farming (services focus on Agricultural productivity & env. impact of agriculture).
- **Initiative:** Agricultural production needs to expand faster than population growth to tackle food security while reducing food losses and minimising its environmental impact.
- **Results:** The toolkit comprises a number of microservices such as: i) crop growth monitoring; ii) tillage scheduling; iii) irrigation scheduling; iv) variable rate mid-season N fertilization; v) yield estimation; vi) cereals protein content
- **Service Provider:** AgroApps P.C.

Target 2.4: By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality.
Indicator 2.4.1: Proportion of agricultural area under productive and sustainable agriculture



Services based on the combination of weather and satellite data



Registered and monitored crops throughout the cultivation period



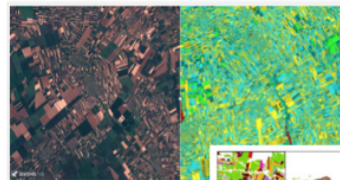
www.AgroApps.gr

EO services contributing to SDGs Sen4CAP

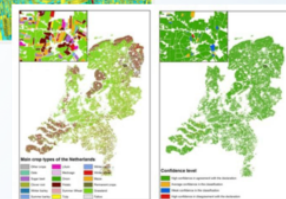


- **User:** EO data user, Farmer, Paying/Food Agency
- **Challenge/Needs:** The Sentinels for Common Agricultural Policy - Sen4CAP project aims at providing to the European and national stakeholders of the CAP validated algorithms, products, workflows and best practices for agriculture monitoring relevant for the management of the CAP. The aim of Sen4CAP is to ensure sustainable agriculture productivity.
- **Initiative:** Sen4CAP system has been set up by ESA to develop an end-to-end processing and analysis pipeline aimed at the European and national stakeholders of the CAP, providing them with validated algorithms, products, workflows, and best practices for agriculture monitoring relevant for the management of the CAP. The Sen4CAP software is available as open-source freeware and is very well suited to be run in a cloud-computing environment. It's available as an ready to use image on CREODIAS platform. The solution pays particular attention to provide evidence how Sentinel derived information can support the modernization and simplification of the CAP in the post 2020 timeframe.
- **Results:** Sen4CAP is used for crops health status monitoring and harvest prediction. The agriculture monitoring products consist of: cultivated crops type map, biophysical status indicator (NDVI, LAI, fAPAR, Fcover), grassland mowing.
- **Service Provider:** CloudFerro

Target 2.4: By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality.



Sen4CAP – crops classification






Sen4CAP – crops type maps



<https://creodias.eu/eo-data-software-based-services>

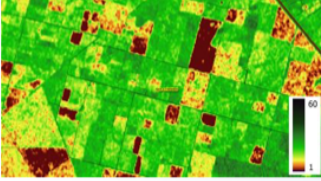
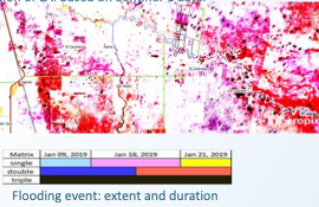
Crop monitoring based on Sentinel-1 SAR data




- User: Local authorities / NGOs
- Needs: Gapless time-series data with high spatial and temporal resolution for crop monitoring, change detection and yield estimation.
- Challenge: Implementation of early warning in case of hazards and loss estimation on broad scale to mitigate food shortages.
- Initiative: Use reliable Sentinel-1 data and derive different indices to monitor anomalies in crop growth, biomass development, drought condition and leaf area index (LAI) for yield approximation.
- Results: Permanent crop monitoring and change detection seasonal and perennial (baseline). Yield forecast based on LAI. Support for insurance schemes and disaster management.
- Service Provider: cropix


Target 2.4: By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality.







<https://cropix.ch/imap-en/>

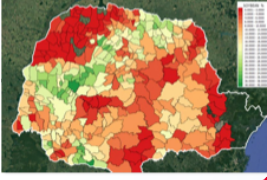

EO services contributing to SDGs Crop monitoring services


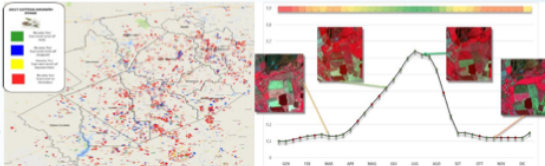





- User: Public authorities, insurances, farmers
- Challenge/Needs: Monitor crop status, reduce fertilizer and chemical usage, optimize water management, preserve soil quality
- Initiative: e-Geos internal development, based on the requirements of the EU CAP, insurances and big farmers
- Results: Continuous provision of indices, parameters and indicators for monitoring agricultural plots for identifying crop status, identify possible problems potentially affecting crop yield, verify the presence of agricultural practices for maintaining land productivity

Target 2.4: By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality.



Service Provider: e-Geos through Agrigeo platform
<https://www.e-geos.it/#/hub/hubPlatforms/platform/platform-agrigeo>

EO services contributing to SDGs MRV for commodities (Sustainable management of agroforestry systems)

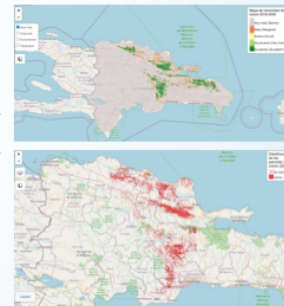


- **User:** Dominican Republic (DR) Ministry of Environment and Natural Resources, Ministry of Agriculture (Cocoa Dept.), DR Cocoa Foundation (producers assoc.) and National Cocoa Commission.
- **Challenge/Needs:**
 - Boost the value chain of sustainable organic cocoa, certify a zero-deforestation cocoa value-chain
 - Support Measurement, Reporting and Verification (MRV) strategy in the country. Plan the cocoa production strategy and Certify a cocoa value chain without deforestation.
 - Contribute to demonstrate the role of cocoa in fighting climate change.
 - Support decision-making to modernize cocoa value chain and attract investors.
- **Initiative:** Cocoa is an opportunity to boost economy a reduce the high poverty rates in the DR, the world leader producer of organic cocoa. Need to identified the most suitable land for cocoa cultivation; mapped present cocoa farms and conclude on their role in reducing CO₂ emissions (MRV4C).
- **Results:** GMV set up an MRV system, and as part of it, identified the most suitable land to grow cocoa (without losing sight of the natural protected areas); monitored one-year forest loss and drought, in particular, around the current cocoa farms; generated a ML classification of cocoa farms and estimated Above ground Biomass.
- **Service Provider:** GMV NSL (<https://gmv.com/en-es/sectors/space>)

Target 2.4: By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality.

Target 8.2: Achieve higher levels of productivity of economies through diversification, technological upgrading and innovation, including through a focus on high value added and labor-intensive sectors

Land suitability for cocoa growing based on agroecological and climatic parameters (above) and Cocoa Farms classification(below).



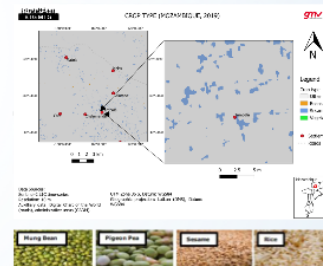
EO services contributing to SDGs Small-holder crop characterization and mapping



- **User:** NGO Ayuda en Acción (www.ayudaenaccion.org) with focus on Development
- **Challenge/Needs:**
 - Support NGO's Agricultural Transformation programme for smallholders in Cabo Delgado, Northern Mozambique.
 - Scaling of current NGO operations from 15,000 to 50,000 fields.
- **Initiative:** BIGMIG is the initiative framing this service. BIGMIG aims to support with different EO services the work of the international Aid and Development Community
- **Results:** smallholders farms acreage determination and assessed productivity. In-season nowcasting of crop growth for harvest and market planning. Monitoring of year on year changes in agricultural practices.
 - Among the main difficulties faced:
 - Mostly small-scale field parcels (majority < 1 ha).
 - Extensive area to survey, difficult to access.
 - Sparse distribution, irregular geometries.
 - Clouds- Context not fit for visual interpretation. GMV approach focused on Convolutional LSTMs for EO.

Target 2.3: By 2030, double the agricultural productivity and incomes of small-scale food producers, in particular women, indigenous peoples, family farmers, pastoralists and fishers, including through secure and equal access to land, other productive resources and inputs, knowledge, financial services, markets and opportunities for value addition and non-farm employment.

Ind 2.3.1 Volume of production per labor unit



Intermingled beans, sesame and vegetables in small scale farms of Cabo Delgado, Mozambique. Crop identification used Sentinel 2 data and ground data. Approach included remote sensing and machine learning



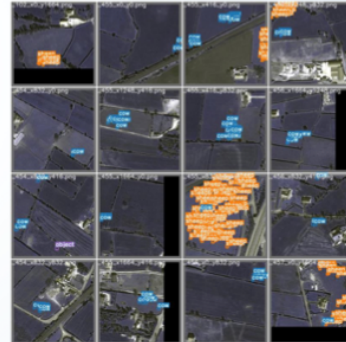
Service Provider: GMV (<https://gmv.com/en-es/sectors/space>)
References link

EO services contributing to SDGs Livestock Monitoring



- **User:** Agricultural and environmental agencies
- **Challenge:** Using AI to monitor and track livestock. These algorithms are being trained across a range of satellite resolutions. This help to identify unsustainable agricultural expansion.
- **Initiative:** Being able to accurately differentiate between cattle and sheep at 0.5m, across a range of land covers, is breaking new ground in a lot of ways but is a real challenge.
- **Results:** This project is currently being implemented in Northern Ireland. According the Minister of Agriculture, Environment, and Rural Affairs Edwin Poots “Monitoring numbers and location of grazing cattle and sheep is essential for disease management purposes, and for validation of agricultural and environmental support schemes.” Benefits and future use cases for this work are endless. Example rang from: risk of animal death due to wildfires toto better control overgrazing of highland areas, encouraging regeneration of flora and grasslands.
- **Service Provider:** The Icon Group

Target 2.4: By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality.



Identifying the difference between cow and sheep



<https://www.icon.ie/projects>

EO services contributing to SDGs Large-scale crop monitoring



- **User:** Agrifood businesses
- **Challenge/Needs:** Supporting agribusiness’s environmental transition by helping actors across the supply chain move away from intensive agriculture. Encouraging a top-down promotion of environmentally friendly farming, through partnerships with Earthworm Foundation or MyEasyFarm.
- **Initiative :** Large-scale identification of crops, crop rotation and cover duration through EO, to monitor soil conservation and contribute to carbon storage quantification.
- **Results:** pending
- **Service Provider:** Kermap

Target 2.4: By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality.



2020 crop cover identification from Kermap's agri.nimbo.earth platform



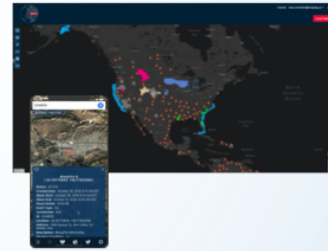
<https://agri.nimbo.earth/>

EO services contributing to SDGs Mayday.ai – environmental modelling and monitoring



- Users: organisation with a mandate in disaster management, humanitarian and development aid, government agencies, international organisations, (re-)insurance, agriculture sector
- Challenge/Needs: Mayday's platform allows real time environmental monitoring. Early detection allows policy makers to preserve ecosystems (i.e. preventing intentional wildfires). Dynamic risk monitoring also agricultural practices that are adapted to climate change risks, including adequate crop planning and precision farming. This also results in more precise and competitive insurance products. Moreover, it allows supply chain monitoring, thereby increasing food security.
- Initiative: commercialisation starting as of autumn 2021
- Results: reduced impact (less fatalities, economic damage and environment degraded), increased resilience (i.e. food security), lower insurance premiums/insurance more competitive, higher awareness
- Service Provider: [Mayday.ai](https://www.mayday.ai)

Target 2.4: By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality.



Mayday.ai's disaster and risk platform

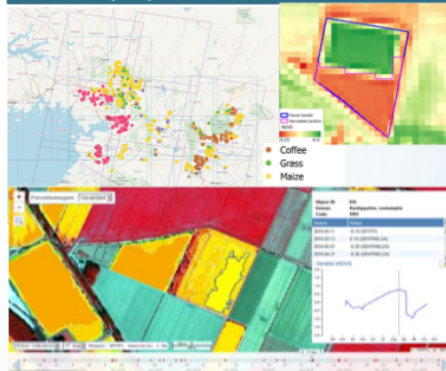


EO services contributing to SDGs Crop Monitoring for Food Security



- User: smallholder farmers in SSA/Kenya, farm cooperatives, agricultural agencies, finance institutes/banks, providers of advisory services and agri inputs
- Challenge/Needs: Improving yield, input use efficiency and income of smallholder farms in SSA/Kenya by monitoring crop growth at plot level to detect anomalies and deficiencies, and combining satellite data with weather, soil and farm management data to provide timely crop and farm specific advice through SMS.
- Initiative: This development was part of a Public-Private Partnership funded by the Geodata for Agriculture and Water Facility (G4AW) of the Dutch Ministry of Foreign Affairs. The CROPMON project ran from 2015-2019. A new project is in development to continue the work started under the CROPMON project.
- Results: 1) Methods for deriving vegetation indices from satellite imagery and coupling them to specific crop development patterns for coffee, maize, wheat, sugarcane and grassland and 2) identifying under-performing plots. 3) Automatic workflows developed to provide real-time monitoring using a combination of different satellite platforms and sensors 4) Development of a web platform to visualise crop growth and development. 5) A total of 41,000 farms mapped, profiled and provided weekly with farm advisory services by SMS for up to 3 years.
- Impact: Recorded improvements of yield, input use efficiency and farm income ranging up to 40%. Direct reach 196,000 farm households. Estimated indirect reach in excess of 2 million farm households.
- Service Provider: NEO BV

Target 2.4: By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality.





Crop monitoring using satellite imagery




NEO agriculture solutions:
<https://g4aw.spaceoffice.nl/en/g4aw-projects/g4aw-projects/13/cropmon.html>
<https://www.neo.nl/crop-parcel-monitoring/>
<https://www.neo.nl/precision-agriculture/>
<https://www.neo.nl/crop-management/>

EO services contributing to SDGs

Agricultural parcel activity monitoring

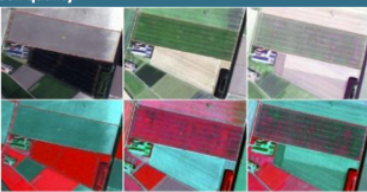
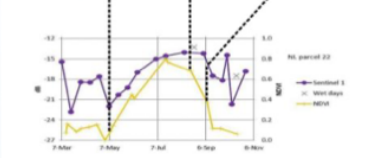



- User: farmers, agriculture agencies and cooperatives
- Challenge/Needs: Monitoring the status of crops on parcel level to detect anomalies in crop and management behaviour. Monitoring of agricultural activities such as mowing, harvest, tillage (e.g. ploughing) to help enforce the implementation of agricultural and environmental policies and regulations.
- Initiative: Control with remote sensing of EU Common Agricultural Policy (CAP). The EU Commission has introduced the possibility for member states to implement a monitoring approach as a substitute for the “on the spot” controls.
- Results: 1) agriculture markers are developed using satellite imagery to detect farming events such as mowing, harvest and tillage (ploughing) activities in grassland, annual crops and parcels to monitoring whether regulations are implemented at local scale. 2) mapping crop classification 3) automatic workflows are developed to improve the efficiency of the system.
- Impact: This system provided the user with a set of activity detections on parcel level that they could use in their decision workflow to determine farmers’ compliance with the CAP rules, and help reduce significantly manual inspection needed in the fields.
- Service Provider: NEO BV



NEO agriculture solution:
<https://www.neo.nl/crop-parcel-monitoring/>
<https://www.neo.nl/precision-agriculture/>
<https://www.neo.nl/crop-management/>



Target 2.4: By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality.

Crop monitoring using satellite imagery

EO services contributing to SDGs

Classification and mapping of agricultural land

- User: National authorities, sectorial agencies
- Challenge/Needs: Mapping of areas with natural or other limitation for agricultural use as a basis for developing agricultural strategies.
- Initiative:
 - Integration of Sentinel-1 and Sentinel-2 time series,
 - Application of pixel based and object based image analysis,
 - Machine Learning classification of agricultural land and different crop types,
 - Detection the status of agricultural land usage,
 - Detection and mapping of terrasses in agricultural use.
- Results: Map of used and unused agricultural land for the territory of Croatia in the scale 1:5000
- Service Provider: Oikon Ltd. – Institute of Applied Ecology








Figure: Classification of agricultural land (left), 1:5000 map of agricultural land in Croatia (right)

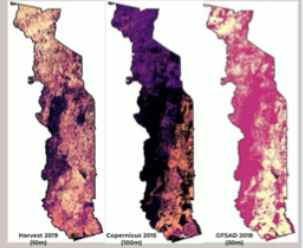
EO services contributing to SDGs

High resolution crop mapping for smallholder farms

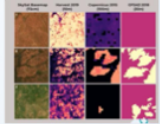
- User:** NASA Harvest and its consortium of scientists and agricultural stakeholders.
- Challenge/Needs:** NASA Harvest was working with the Togolese government to support a program called Yolim, a digital and interest-free loan program intended to improve yields and livelihoods of Togolese farmers by funding farmer essentials via digital wallets to increase production during the COVID-19 pandemic. The census occupation data they would normally use to locate their farmers, who are underrepresented smallholder farmers, were not high resolution and were often outdated. This led to a need for a spatial map of where crops were growing as a proxy for where the smallholder farmers lived.
- Initiative:** NASA Harvest worked with Planet to get a 2019 basemap of SkySat images at 72 centimeter per pixel resolution and combine this with the PlanetScope quarterly base map to see the seasonality of agriculture. This enabled NASA harvest to create a high resolution crop map of Togo to support the Yolim program using satellite data and machine learning to create these crop and non-crop labels from these images instead of a ground survey.
- Results:** The government was able to use this map to support their Yolim program and locate smallholder farms in the region.
- Service Provider:** Planet





Target 2.4: By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality.



Rapid Response Crop Maps during COVID-19








<https://www.planet.com/pulse/nasa-harvest-event-encourages-collaboration-for-a-sustainable-future/>

<https://nasa.harvest.org/>

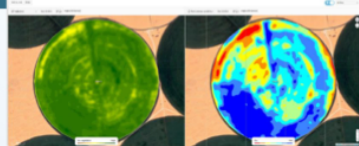
EO services contributing to SDGs

Sustainable Agriculture – Irrigation Efficiency

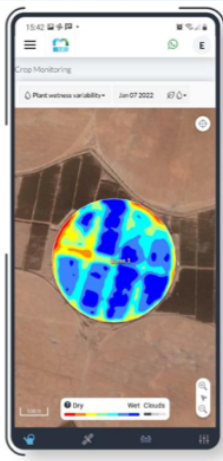
- User:** Farmers
- Challenge/Needs:** As water becomes an increasingly precious commodity, we must change the way we use it—particularly within agriculture. The current efficiency of irrigation is low, with less than 65 percent of the water actually being used by the crops, offering room for more sustainable systems to make a difference.
- Initiative:** Manna Irrigation is using global PlanetScope monitoring and archive into their solution, providing field-level prediction services for irrigation of agricultural fields.
- Results:** The Manna Irrigation Intelligence solution delivers actionable information to farmers and growers around the globe so they can make better-informed, more confident irrigation decisions to help combat the global water and food crisis.
- Service Provider:** Manna Irrigation






Target 2.3: By 2030, double the agricultural productivity and incomes of small-scale food producers, in particular women, indigenous peoples, family farmers, pastoralists and fishers, including through secure and equal access to land, other productive resources and inputs, knowledge, financial services, markets and opportunities for value addition and non-farm employment.



Plant wetness and vegetation vitality monitoring. Source: Manna Irrigation.





EO services contributing to SDGs Rheticus® Agriculture



- User: Agriculture, winegrowers and/or agriculture associations, National / Local Authorities, insurance companies
- Challenge/Needs: Generating land cover map it allows to optimize the farm's management at the local, regional and national levels. Further, by using the biomass health indicator (vegetation index, Reflectance Index, Moisture Index, Leaf Area Index, Water index), the service can also work as a diagnostic tool and serve as an early warning system, allowing the agricultural community to detect and counter potential problems before they spread widely and negatively impact crop productivity. Initiative: Internal Development
- Results: designed to help farmers in daily crop production tasks.
- Service Provider: Planetek Italia's Rheticus platform
- Reference: <https://www.rheticus.eu/>



Figure: Rheticus® Agroculture service geoportal with analytics tools

Target 1.5: By 2030, build the resilience of the poor and those in vulnerable situations and reduce their exposure and vulnerability to climate-related extreme events and other economic, social and environmental shocks and disasters.
 Target 2.4: By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality.
 Target 6.4: By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity.
 Target 13.1: Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries



EO services contributing to SDGs Rheticus® Aquaculture



- User: Fish & Shellfish farms
- Challenge/Needs: threats caused by climate change and worsening of environmental conditions may cause variations on quantity and quality of nutrients, or on sea temperature eventually affecting productivity, mussels' quality or sanitary conditions.
- Initiative: several mussel farming sites monitored as agreed with Associazione Mediterranea Acquacoltori.
- Results: improving production efficiency, by monitoring seawater quality parameters, and potential risks to livestock, assessing the optimal time for selling products.
- Service Provider: Planetek Italia's Rheticus service

References links
 • <https://www.rheticus.eu/rheticus-services/aquaculture/>

Target 2.3.: eo services focus on Management of farming
 Target 6.4.: eo services based on Water user efficiency. Indicator 6.4.1: Water user efficiency & 6.4.2: Water stress

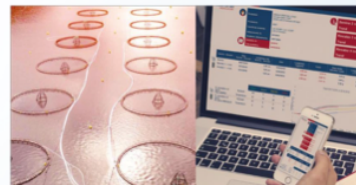





Figure: Rheticus® Aquaculture service delivering daily reports and analytics



EO services contributing to SDGs National Research Programme “Smart Crop Production”



- **User:** State organization (Ministries), Public organization (universities, research labs) and industry
- **Challenge/Needs:** Sustainable management of natural resources, reduction of the harmful impact of agriculture on the environment and climate, reduction of the use of pesticides and increase of the quality and safety of crop production
- **Initiative:** National Research Programme “Smart Crop Production”, funded by the Ministry of Education and Science of the Republic of Bulgaria
- **Results:** Development and implementation of models using satellite images, AI, UAV data, digital methods for diagnostics, prognosis and management of the production of high quality crop production and decision making.
- **Service Provider:** RST-TTO, BAS

- Target 2.4.: By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality.
 - Indicator 2.4.1: Sustainable agriculture
- Target 15.1: By 2020, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements.
 - Indicator 15.1.1: Forest areas
- Target 15.2: By 2020, promote the implementation of sustainable management of all types of forests, halt deforestation, restore degraded forests and substantially increase afforestation and reforestation globally.
 - Indicator 15.2.1: Sustainable forest management
- Target 15.3: By 2030, combat desertification, restore degraded land and soil, including land affected by desertification, drought and floods, and strive to achieve a land degradation-neutral world. (land cover, productivity and carbon stocks)
- Target 15.4: By 2030, ensure the conservation of mountain ecosystems, including their biodiversity, in order to enhance their capacity to provide benefits that are essential for sustainable development.
 - Indicator 15.4.2: Mountain green cover

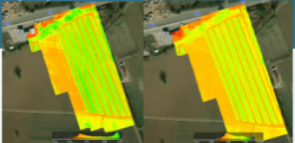





Figure: Vegetation indices applied to measure crop health



EO services contributing to SDGs Earth Observation data for Agriculture and Forestry






- **User:** Agricultural companies, intensive and extensive farming programs, independent farmers
- **Challenge/Needs:** Visualization of the land, the evolution of crops, and the impact of weather on a continuous basis
- **Initiative:** Accessible and affordable EO data for the agribusiness sector to optimize future yields and enable food security
- **Results:** Capability of monitoring agricultural health enables actions that help towards food security. Refer to case study: [Food Security: Using EO Data to Monitor Agricultural Health](https://satellogic.com/2022/08/24/food-security-using-ao-data-to-monitor-agricultural-health/)
- **Service Provider:** Satellogic


Target 2.3: By 2030, double the agricultural productivity and incomes of small-scale food producers, in particular women, indigenous peoples, family farmers, pastoralists and fishers, including through secure and equal access to land, other productive resources and inputs, knowledge, financial services, markets and opportunities for value addition and non-farm employment. (*Management of farming*)

Target 2.4: By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality. (*Agricultural productivity & env. impact of agriculture*)





Voznesensk in Southern Ukraine. Ukraine is a top exporter of wheat. Earth Observation data can help gather actionable insights on crops and renewable energy projects alike.

<https://satellogic.com/2022/08/24/food-security-using-ao-data-to-monitor-agricultural-health/>
<https://satellogic.com/earth-observation/agriculture-forestry/>




EO services contributing to SDGs CropEO





- User: Cooperatives, farmers
- Challenge/Needs: Crop development anomalies detection
- Initiative: CropEO – Crop growth monitoring, comparison between fields and with the previous years if relevant and early alerts when a deviation is observed at field level
- Results: early alerts on growth deviation
 - Benefits: (i) Early and precise detection of crop development anomalies, at various scales (plot and farm) and timelines (DoD, YoY) (ii) Plan field interventions accordingly (iii) Use workforce relevantly (iv) Adapt crop rotation
 - Impact: (i) Prevent unnecessary field visits and save money (ii) Adapt field interventions to the real situation of each crop (iii) Reduce anomalies over time and gain farm homogeneity for better crop yield and increased revenues
 - Highly repeatable solution
- Service Provider: TerraNIS


Target 2.3: By 2030, double the agricultural productivity and incomes of small-scale food producers, in particular women, indigenous peoples, family farmers, pastoralists and fishers, including through secure and equal access to land, other productive resources and inputs, knowledge, financial services, markets and opportunities for value addition and non-farm employment.



Level of heterogeneity observed in each field






Annual comparison of the growth cycle of one field



<http://www.terraris.fr/en/precision-viticulture/>

EO services contributing to SDGs Oenoview Stress

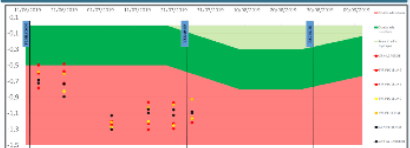




- User: Winegrowers, wine cooperatives, vine consultants
- Challenge/Needs: Control of water stress, early detection of water stress
- Initiative: We developed a model estimating the stem potential that gives you the level of water stress compared with the ideal one depending on the date, vine variety and wine objectives, based on satellite imagery.
- Results: early alerts, control of water stress and corrective actions (irrigations or other field interventions)
 - Benefits: (i) Receive alerts and notifications with actionable information at the right time to schedule irrigation (ii) Build precise knowledge of each plot over time and adapt field work accordingly (iii) Understand and follow precisely the soil water content and its structure
 - Impact: Use the right amount of water needed by your crops to eventually increase quality and crop yield, and save water
 - Scalability: (i) Highly repeatable solution (ii) Outcome-focused offering
- Service Provider: TerraNIS


Target 2.4: By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality.

Target 6.4: By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity.


Indicator 6.4.2.: Water stress



Evolution on the water stress level for each plot



Water stress level per plot



EO services contributing to SDGs
Wago

2 ZERO HUNGER
6 CLEAN WATER AND SANITATION

terraNIS
4 New Information Services

- User: Cooperatives, farmers
- Challenge/Needs: Adjust the water inputs to the crop needs and have early detection of drought
- Initiative: Wago gives water balance monitoring and irrigation recommendations at field level. It is based on Sentinel-2 images and an approved scientific model originally developed by Cesbio, the *Centre for Space Studies of the Biosphere*. The end-user can save water and time
- Results: early alerts and irrigation recommendations at field level.
- Benefits: (i) Follow on the same platform vegetation index and water balance to get a complete overview of the crop evolution and current situation (ii) Receive alerts and notifications with actionable information at the right time to schedule irrigation (iii) Build precise knowledge of each plot over time and plan crop rotation accordingly (iv) Understand and follow precisely the soil water content and its structure
- Impact: Use the right amount of water needed by your crops to eventually increase quality and crop yield, and save water
- Highly repeatable solution, Clear market focus with distinctive market positioning, Outcome-focused offering, SaaS type of sales process
- Service Provider: TerraNIS

Target 2.4: By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality.
Target 6.4: By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity.
Indicator 6.4.2.: Water stress

Alerts and irrigation recommendations at field level

Water balance per field

EARSC
European Association
of Remote Sensing
Companies

<http://www.terraNIS.fr/en/precision-agriculture-wago-irrigation/>

Relevant Success Stories

- [Implementing & managing agriculture projects](#)
- [Infrastructure Development Planning](#)
- [Supporting agricultural and food security decisions](#)

iv. SDG 3 - Good Health & Wellbeing



iv.1 Goal: Ensure healthy lives and promote well-being for all at all ages.

EO data offer an invaluable opportunity for better-informing development policies and quantifying various targets. How can EO be used to help countries achieve specific targets? *Source: [ESA compendium of EO contributions to the SDG Targets and Indicators](#)*

Target 3.3: By 2030, end the epidemics of AIDS, tuberculosis, malaria and neglected tropical diseases and combat hepatitis, water-borne diseases and other communicable diseases.

This target aims to end three of the world's major epidemics, which combined claim millions of lives per year (Murray et al., 2014). This makes this target one of the SDG targets with the greatest potential impact in terms of reducing mortality.

The utility of EO methods for improving the understanding, prevention, and control of vector-borne diseases has been extensively demonstrated, particularly for malaria (Gebreslasie, 2015). EO data has been used, for instance, to derive environmental data to feed malaria risk models, identification of potential vector habitats and to inform the development of early warning systems. Some of the EO-derived data that have been applied to malaria epidemiology include: land cover, land and sea surface temperature vegetation indices such as NDVI and enhanced vegetation index, precipitation and actual evapotranspiration. Results of the models developed with EO-derived data can be useful to identify locations where the risk of disease is highest and direct resources to the population most in need. EO-derived data can also be applied to develop risk models for other tropical diseases such as dengue or schistosomiasis, among others.

(eo services focus on Assessment of diseases)

Target 3.9: By 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination.

EO data can be used to monitor the level of air quality data (e.g. PM2.5, CO2, CO, NOx, SO2) (van Donkelaar et al., 2010) water quality data (E.g. Chlorophyll-a, turbidity) (Mohamed, 2015), as well as soil pollution data (e.g. concentration of hydrocarbons) (Karkush et al., 2014). These can be correlated with census data on human health and mortality to monitor progress towards reducing the number of deaths and illness from hazardous chemicals and air, water and soil and contamination. In order to reduce the number of deaths by creating public awareness, a wider forecasting system based on modelling EO data for the likely risk of danger from hazardous chemicals and air, water and soil pollution and contamination is needed.

(eo services focus on Monitor the level of air quality data)

EO Products/Services supporting the SDGs

EO services contributing to SDGs
GreenSSLM - Satellite-collected climate data on atmospheric chemistry

- **User:** Government Agencies, Public Authorities, NGOs, Research Orgs, Industrial Businesses, Agricultural Businesses.
- **Challenge/Needs:** Increasing complexity and size of data that needs to be analysed for air quality information to make sense and be used effectively.
- **Initiative:** Multi-source continuous monitoring interface, able to process and evaluate a multitude of complex environmental factors which characterize the holistic status of the atmosphere over an area.
- **Results:** This solution monitoring the level of air quality data aims at the optimization of environmental monitoring and research to ensure augmentation of social and economic benefits.
- **Service Provider:** Aratos Systems.




Target 3.9: By 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination.



Downwelling Surface longwave radiation flux: The emission of longwave radiant energy from land surfaces is reduced dramatically when concentration of aerosols in the atmosphere is increased.

EO services contributing to SDGs
DIPTERON: Detection of Aedes Mosquito Risk Areas


- **User:** Health authorities
- **Challenge/Needs:** Prevention and control of *Aedes* mosquito diseases such as Dengue, Zika and Chikungunya
- **Initiative:** Detecting risk areas using AI predictions. Application based on artificial intelligence that combines satellite data from earth observation and terrestrial data. Produces a prediction model of 4 weeks in advance for outbreaks of Dengue, Zika or Chikungunya providing risk areas for these diseases
- **Results:** Contribute to monitor and report outbreaks of *Aedes* mosquito diseases with an early warning system (fast, accurate and inexpensive). The direct impact is the reduction of economic losses in global health systems since governmental and non-governmental organizations can use the application for mitigation actions. At present the application has 85% of accuracy for detecting risk areas
- **Service Provider:** DIPTERON UG




Target 3.3: By 2030, end the epidemics of AIDS, tuberculosis, malaria and neglected tropical diseases and combat hepatitis, waterborne diseases and other communicable diseases



Figures showing DIPTERON tool for the assessment of diseases



<https://www.greensslm.com/>



www.dipteron.com

LTPy: learning tool on Atmospheric composition

- User: researchers, scientist communities
- Challenge/Needs: to provide a Jupyter-based training on accessing, processing and visualizing atmospheric composition data from a variety of satellite sensors, including Sentinel-5P, Sentinel-3, GOME-2, IASI and CAMS data.
- Initiative: Learning Tool for Python (LTPy) on Atmospheric Composition committed by EUMETSAT. During the LTPy development, a user-friendly workflow of the Copernicus DIAS service WEKEO was developed and shared with the WEKEO team.
- Results: [LTPy portal](#) and synergy with the WEKEO initiative, relevant for providing harmonised access to Copernicus data and services.
- Service Provider: EUMETSAT (MEEO as technical partner)




Target 3.9: By 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination.




LTPy training platform – login interface



LTPy – EO data access

ESA RACE platform RAPID ACTION ON CORONAVIRUS AND EO

- User: governmental bodies, decision makers, public authorities
- Challenge/Needs: use EO data to better understand the effect of the COVID19 pandemic on transport and related pollution, its socio-economic impact and to observe recovery processes.
- Initiative: Joint cooperation between ESA and the European Commission on COVID19 and EO
- Results: RAPID ACTION ON CORONAVIRUS AND EO – RACE platform (<https://race.esa.int/>). The platform demonstrates how the use of Earth observation data can help shed new light on societal and economic changes currently taking place owing to the coronavirus pandemic.
- Service Provider: ESA (MEEO as technical partner)




Target 3.3: By 2030, end the epidemics of AIDS, tuberculosis, malaria and neglected tropical diseases and combat hepatitis, water-borne diseases and other communicable diseases.



RACE platform maps and indicators – example on water quality regional map on North Adriatic sea. In the Venice lagoon, low Chlorophyll concentration pattern can be linked to the decrease of maritime traffic and tourism during the pandemic lockdown, as highlighted by high resolution Sentinel-2 images.



<https://ltpy.adamplatform.eu>
https://trainhub.eumetsat.int/atmosphere/30_case_studies



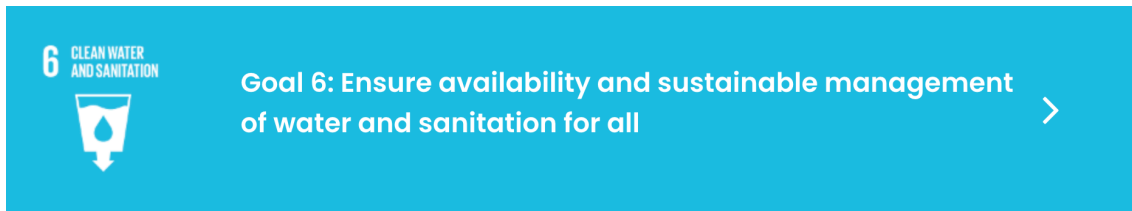
<https://race.esa.int/>

Relevant Success Stories

- [Successful Integration of EO-Based Observations and Machine Learning in Spring Peak Flow Forecasting](#)
- [EOs adding value to historical water availability and quality information services](#)
- [Harvester Season](#)
- [Future climate projection of heat indices for Austrian major cities](#)
- [Satellite based detection of oil spills](#)
- [The GOS4M Knowledge Hub designed for end-users to assess the effectiveness of measures undertaken under the Minamata Convention on Mercury.](#)
- [DMCii supports the fight with illegal logging in the Amazon](#)

- [Sea turbidity monitoring](#)
- [Improving waste management practices](#)

v. SDG 6 - Clean Water



v.1 Goal: Ensure availability and sustainable management of water and sanitation for all.

EO data offer an invaluable opportunity for better-informing development policies and quantifying various targets. How can EO be used to help countries achieve specific targets? *Source: [ESA compendium of EO contributions to the SDG Targets and Indicators](#)*

Target 6.1: By 2030, achieve universal and equitable access to safe and affordable drinking water for all.

One of the most essential uses of water is for domestic consumption within households. This purpose is captured in target 6.1, which seeks to guarantee safe and affordable drinking water for drinking and hygiene purposes for all. Households are an important share of total water use and therefore represent a significant sector in achievement of target 6.4 on water use efficiency. "Safe" water is considered to be free of contaminants and is determined by the quality of untreated water prior to human consumption.

The necessity of the target, for a supply of high water quality in the first place, is threatened by conversion of wetlands, forests and woodlands to agriculture around populated areas and water catchments. This target is therefore linked to the protection of the water catchment which is the focus of target 6.6 and the quality of water in target 6.3. The use of land cover change data, particularly in models to estimate the impact on water supplies in the event of widespread deforestation and land conversion, is a powerful way to show how drinking water becomes both unsafe and unaffordable in the event of a water supply being compromised by the conversion of natural ecosystems which regulate it. As EO-based observations are primary inputs to such models, countries can be supported towards achievement of target 6.1 by implementing such models and to plan for better baseline water quality through regulation of land use in water catchments.

(eo services based on Assess water use efficiency)

Target 6.3: By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally.

Target 6.3 aims to improve ambient water quality, important for protecting both ecosystem health and human health, by eliminating, minimizing and significantly reducing different streams of pollution into water bodies. The main sources of water pollution include wastewater from households, commercial establishments and industries (point sources), as well as run-off from urban and agricultural land (non-point sources). Water quality can be measured in different ways and EO methods of water quality detection differ from those based on in-situ assessment. Therefore EO support to this target will be limited by what can be detected based on current sensor technology. EO is important in ongoing, routine water quality monitoring of large water bodies, ideally in combination with in situ sampling. Yet it is feasible, although challenging, to use EO as a monitoring tool for illegal contamination of water supplies. The release of certain hazardous chemicals and materials, for example, can alter the opacity, turbidity and colour of

lakes, rivers or other water bodies, which can be sensed from a multispectral or hyperspectral sensor. Armed with this EO-derived information on sudden declines in water quality, e.g. due to dumping of hazardous materials, water management authorities could track down polluters. However, the spatial resolution of the Sentinel 3 Ocean and Land Colour Imager (OLCI) is likely to be too coarse to accurately detect such events, while the Sentinel 2 Multi Spectral Imager (MSI), although better suited in terms of spatial resolution, is too sparse in terms of revisit time (5 days). A combination of commercial and free sensors (OLCI, S-2, L8, SPOT, RapidEye, IKONOS) could be an option for targeted, local efforts at detection of pollution events. EO can also support countries with the target by assessment of the risk of eutrophication of a country's water bodies by monitoring ambient nutrient pollution in standing waters.

(eo services based on Water quality detection & monitoring. Indicator 6.3.2: Ambient water quality)

Target 6.4: By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity.

Target 6.4 addresses water scarcity, aiming to ensure there is sufficient water for the population, the economy and the environment by increasing water-use efficiency across all sectors of society. Finding a balance between demands for water from environmental requirements and human demand is essential to maintaining ecosystem health and resilience. An imbalance due to unsustainable levels of demand can result in water stress with negative effects on economic development, increasing competition and potential conflict among users. This requires effective supply and demand management policies and an increase in water-use efficiency.

EO has an obvious – if yet unrecognised – contribution to the monitoring of the target in quantifying surface water changes over time, water consumed by key water-user sector such as agriculture, as well as soil moisture deficits. Therefore EO can help countries achieve water use efficiency gain targets by identify areas of current and future surface water deficits, e.g. through hydrological models, based on EO parameters such as evapotranspiration, soil moisture and surface water, and by modelling supply and demand across sectors based on land use change. In agricultural areas, EO can monitor how effectively water uptake by vegetation is translated into crop yield, using a metric that is referred to as agriculture water productivity (yield/m³ of water consumed). This can ultimately help countries to plan for water deficits in advance of stresses such as climate extremes or when demand is excessive. The number of people suffering from or potentially affected by such water deficits could then be calculated based on demographic statistics. A range of options exists for coping with water scarcity that address the supply side or the demand side or a combination of the two, depending on the bio-physical and socio-economic context.

(eo services based on Water user efficiency. Indicator 6.4.1: Water user efficiency & 6.4.2: Water stress)

Target 6.6: By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes.

For the purposes of this target, water-related ecosystems are grouped into five categories: 1) vegetated wetlands, 2) rivers and estuaries, 3) lakes, 4) aquifers, and 5) artificial waterbodies. Water-related ecosystems contain and maintain the global stock of freshwater, from which water related services flow to society. They are characterised by high biodiversity and because biodiversity and because they are carbon-rich, are important for climate change mitigation. In terms of services they provide micro climate regulation, e.g. minimising the negative impacts of urban heat islands. They capture and store water and maintain water quality since they can decompose and /or absorb water pollutants. Therefore this target promotes the sustainable management of water catchment ecosystems such as wetlands, rivers, lakes, reservoirs and groundwater, as well as water-related forests and mountains, which are crucial for provision of these services. The ecosystem based approach is important for flood regulation, public water supply and access to clean drinking water. In this respect, target 6.6 is the starting point for other water-related targets as it aims to protect water at source. As water-related



ecosystems are often highly complex and very diverse, management is challenging and monitoring is expensive and time consuming. Therefore EO provides a standardised monitoring approach which can capture the multiple dimensions of change from hydrological to biophysical processes. However as this target is focused on the watershed EO at high spatial resolution, e.g. Landsat and Sentinel-1/2 (10-30m) should be acquired. For example, high resolution land cover change can be used to track changes in water- related ecosystems, to assess the success of catchment-wide restoration efforts and the effectiveness of protection measures or to identify threats to sensitive habitat. Other EO products such as the extent of water bodies and their temporal dynamics, as well as digital terrain models, are inputs to models that assess the availability of surface and ground water.

(eo services based on Monitoring the extent of water related ecosystems over time. Indicator 6.6.1: Water-related ecosystems)


EO Products/Services supporting the SDGs

EO services contributing to SDGs
[Water user efficiency] **AgroApps Hydro**


- **User:** Water Management Authorities, Irrigation Associations, River Basin Authorities, Water Agencies, Policy Makers And Regulators, Farmers.
- **Challenge/Needs:** Water Managing and Monitoring authorities need Services that will enable water resource monitoring, decision making under uncertainty, water systems analyses, and hydro-meteorological forecast and warning.
- **Initiative:** Climate change is altering hydrological cycles whilst increasing the frequency and intensity of droughts and water scarcity.
- **Results:** Acting as a combination of AgroApps Remote Sensing Imagery Hub and Weather Intelligence Engine, AgroApps Hydro is focusing mainly on the needs of the public sector and delivers a better understanding of how water resources are used (including irrigation requirements and illegal abstractions) as well as valuable evidence for evaluating/benchmarking the efficiency of water related actions for farming.
- **Service Provider:** AgroApps P.C.



Target 6.4: by 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity, and substantially reduce the number of people suffering from water scarcity
Indicator 6.4.1: Change in water use efficiency over time



Detection of irrigation events and illegal abstractions




Evapotranspiration and crop water requirements


Target 6.4: By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity.

- **User:** Governments/Agro food producers, NGOs
- **Challenge/Needs:** The increase of water use efficiency is essential for the global agricultural sector – both on local and regional scales. Food security and quality are dependent on how planners, irrigation managers, government institutions and farmers communicate and coordinated land use, water use and extraction. A large majority of worldwide freshwater withdrawals are for agricultural use and specifically for crop irrigation comprising up to 70% of withdrawn freshwater resources. Better use of water resources is becoming critical in many places.
- **Initiative:** Commercial product as a result of several years R&D
- **Results:** Agri360.io is a set of irrigation planning tools to assess water use efficiency based on primarily remotely sensed images ingested into a hydrological model allowing farmers and water utility managers to estimate, forecast and plan irrigated water use and water use efficiency in agriculture.
- **Service Provider:** DHI GRAS




Irrigation demand

Example: The satellite data coupled with advanced modelling and weather forecast allow us to forecast irrigation demand.






www.AgroApps.gr




Reference: <https://agri360.io/> / <https://www.dhi-gras.com/projects/eo4sdg/>

EO services contributing to SDGs Mapping freshwater ecosystems



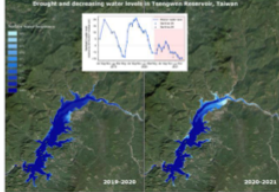
- User: National and regional authorities, water managers, NGOs
- Challenge/Needs: Assessing the amount of small- and large-scale water resources in a river basin, including discharge and recharge is crucial for water resource management, reduction of flood risks, and decision-making in water sensitive sectors. Furthermore, it is essential for efficient planning and steering of reservoir development and management.
- Initiative: Commercial product as a result of several years R&D
- Results: The freshwater mapping solution provides a number of key products to monitor the state and dynamics of freshwater ecosystems, including detailed mapping and monitoring of open water bodies, including reservoirs and lakes, and their seasonal changes; estimations of surface water volume and river discharge; and wetland mapping and characterisation.
- Service Provider: DHI GRAS




Reference: <https://www.dhi-gras.com/solutions/surface-water-monitoring/>
<https://www.dhi-gras.com/projects/eo4sdg/>

Target 6.6: By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes.

Target 15.1: By 2020, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements.







Example: Coupled surface water dynamics and water levels mapping to assess the impacts of drought on water resources.




Example: Wetland monitoring in Chad

EO services contributing to SDGs Impervious surface mapping



- User: Environmental authorities, city planners, local authorities
- Challenge/Needs: Impervious surfaces have a direct impact on the volume, duration and intensity of surface runoff; groundwater recharge; water quality and the hydrological cycle. Spatially explicit information about the amount, location and type of impervious surfaces aids decision making in the context of sustainable urban planning, water resource management, climate mitigation and greening strategies.
- Initiative: Commercial product as a result of several years R&D
- Results: The impervious surface data depicts spatially explicit information about the amount, extent, location and type of impervious surfaces, using advanced image analysis of satellite imagery or aerial photos. By applying novel machine learning technology and cloud processing, the solution is highly automated, and scalable, and can be applied anywhere worldwide at a specific point in time to differentiate between various types of impervious surface roads (e.g. roads, rooftops, parking lots) and pervious areas (e.g. parks, lakes, streams).
- Service Provider: DHI GRAS




Reference: <https://www.dhi-gras.com/solutions/urban-mapping/>
<https://www.dhi-gras.com/projects/eo4sdg/>

Target 6.3: By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally.

Target 9.1: Develop quality, reliable, sustainable and resilient infrastructure, including regional and trans- border infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all.

Target 11.3: By 2030, enhance inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management in all countries.



Example: The impervious surface mapping solution provides fast and accurate information about urban land cover in grid cell resolutions from submeter levels to 10 m.

EO services contributing to SDGs

Mapping mangroves

- User: National and regional authorities, NGOs
- Challenge/Needs: Mangroves are critical ecosystems which provide coastal protection from storm surges, control floods, stabilize coastlines and enhance biodiversity. Furthermore, mangroves are a central component of the blue carbon ecosystem. Knowledge about mangrove extent, structure and dynamics is key to inform mangrove conservation and restoration planning and management.
- Initiative: Commercial product as a result of several years R&D
- Results: Applying supervised machine learning algorithms, mangroves are accurately mapped and characterized using high resolution satellite data. The mangrove extent product provides an accurate spatial delineation of areas covered by mangrove communities, while a detailed characterization product provides added information on species compositions and/or mangrove structures (e.g. height, density, or biomass).
- Service Provider: DHI GRAS

Reference: <https://www.dhi-gras.com/> / <http://maps.eo4sd-water.net/airbmp1/>
<https://www.dhi-gras.com/projects/eo4sdg/>

6 CLEAN WATER

13 CLIMATE ACTION

15 LIFE ON LAND

Target 6.6: By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes.

Target 13.1: Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries.

Target 15.1: By 2020, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements.

Example: Combined mangrove extent and density data product (Delta Saloum National Park, Senegal).

EO services contributing to SDGs

Marine Observer

- User: National and regional authorities, Port authorities, offshore stakeholders, aquaculture and fishery
- Challenge/Needs: Timely, accurate and spatially coherent information on water quality parameters is needed to underpin informed and effective water quality strategies; control port water pollution and impacts from offshore activities and; support early warnings of algae blooms, red tides and sediment plumes.
- Initiative: Commercial product as a result of several years R&D
- Results: Marine Observer provides a large-scale overview of key water quality parameters, including Chlorophyll concentration and Total Suspended Matter (TSM), enabling stakeholders to get a quick overview of the past and current status of the marine waters in their area of interest. The service is available globally and access to archived and up-to-date information in near-real-time is served through custom tailored data portals.
- Service Provider: DHI GRAS

Reference: <https://marineobserver.dhigroup.com/> / <https://www.dhi-gras.com/projects/eo4sdg/>

6 CLEAN WATER

14 LIFE BELOW WATER

Target 6.3: By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally.

Target 14.1: By 2025, prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution.

User interface of Marine Observer Denmark – available at <https://marineobserver.dhigroup.com/denmark>

Example: Chlorophyll concentrations in the entry towards the port of Hamburg.

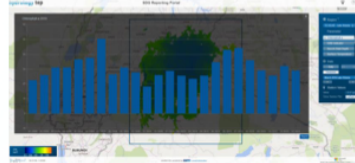
EO services contributing to SDGs Water Quality mapping and monitoring

EOMAP
detect more.



- User: World Water Quality Alliance (WWQA) and UN Environment Programme (UNEP)
- Challenge/Needs: Hot spot analysis informing indicator 6.3.2
- Initiative: Drivers for WWQA are human health, ecosystem health and food security/safety. This commercial water quality service supports this in high resolution globally. End users are fishery organizations, national lake authorities and disaster management organisations.
- Results: Parameters like turbidity, chlorophyll-a, water temperature, harmful algae blooms and deduced trophic state provide valuable proxies in areas lacking traditional, ground-based water quality monitoring. EOMAP's water quality services use sensor independent technology including high resolution sensors like Sentinel-2A/B and Landsat 8 (10-30 m) in combination with commercial very high resolution sensors (2 m). Ready to use information is available through easy access web applications, providing details about seasonal and spatial dynamics. Reporting functions are included in the service line.
- Service Provider: EOMAP

Target 6.3: By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally.
6.3.2: Proportion of bodies of water with good ambient water quality



Chlorophyll-a time series displayed in the SDG Reporting portal: <http://sdg6-hydrology-tep.eu/>



Harmful algae bloom detected by Sentinel-2 in 10m resolution Lake Victoria

EARSC
European Association
of Remote Sensing
Companies

<https://www.eomap.com/services/water-quality/>

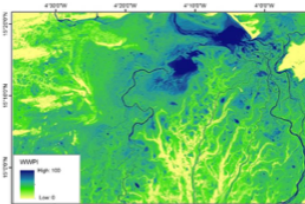
EO services contributing to SDGs Water extent and dynamics mapping

GeoVille

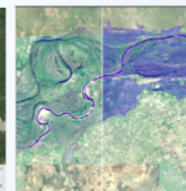


- **Users:** Water planning agencies, Environmental agencies
- **Challenge:** Capturing the multiple dimensions of change from hydrological and biophysical processes related to water, and derive actionable information to protect ground water sources, support restoration efforts, quantify climate change impact, forecast food security issues, etc.
- **Initiative:** Provision of water and wetland dynamics based on time-series data of Landsat, Sentinel-2, and Sentinel-1 to detect changes and trends in wetland areas as well its dynamics
- **Results:** Highly automated wetland identification covering both seasonal changes of surface soil wetness and permanent water bodies as well as the detection of long-term developments under the changing climate. Mapping the extent of wetness areas including water bodies. Satellite-based time-series information and associated statistics help identify trends over longer time periods and their dynamics. Presentation of result through a full SDG monitoring system by developing a plugin specifically for reporting on SDG 6.6.1 and web interface for dissemination.

Target 6.6: By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes.



Water and Wetness Probability Index (WWPI) Inner Niger Delta (2017 - 2018)



Source: River Flowing in Shana, 1:10,000, EARSC/Climate Partnership

EARSC
European Association
of Remote Sensing
Companies

- **Service provider:** GeoVille

References: <https://eo4society.esa.int/projects/worldwater-surface-water-dynamics/>
<https://eo4society.esa.int/projects/eo4sd-water/>

1

EO services contributing to SDGs Water catchment assessment



- User: Eau de Paris (French water agency, 3 million users)
- Challenge/Needs: Systematic, automatized qualification of land cover to improve knowledge of agricultural practices on water catchment areas and assess their vulnerability to pollutant transfers.
- Initiative: Use of EO and deep-learning process for crop identification at farming plot scale, cover crop classification and crop rotation cycles.
- Results: Improvement of agricultural practices by farming partners through payment for environmental services programme.
- Service Provider: Kermap

Target 6.1: By 2030, achieve universal and equitable access to safe and affordable drinking water for all.

Target 6.6: By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes.



Infrared crop classification on water catchment area in the Greater Paris region – ©Kermap



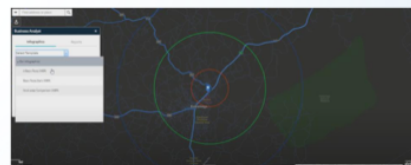
defis.eaudeparis.fr

EO services contributing to SDGs Mayday.ai – environmental monitoring module



- Users: organisation with a mandate in disaster management, humanitarian and development aid, government agencies, international organisations, NGOs, health verticals, utilities
- Challenge/Needs: Mayday's platform allows environmental monitoring/of disasters in real time and high levels of granularity. The platform allows the ingestion of proprietary data for a sharper common operating picture once chemical pollution happens.
- Initiative: commercialisation starting as of autumn 2021
- Results: reduced impact (less fatalities, economic damage and environment degraded), higher awareness
- Service Provider: [Mayday.ai](https://www.mayday.ai)



Target 6.3: By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally.



Mayday.ai's disaster and risk platform, providing community or event-centred monitoring



EO services contributing to SDGs
Freshwater ecosystem monitoring

- **User:** Public institutions governing nature protecting areas and institutions governing and protecting freshwater bodies
- **Challenge/Needs:** Chlorophyll-a content monitoring in large freshwater bodies
- **Initiative:** Use of Sentinel-2 MS imagery to detect the process and estimate the degree of eutrophication in Vrana lake, a largest freshwater lake in Croatia. Vrana Lake in details:
 - the largest lake in Croatia (~ 30 km²)
 - Shallow Lake, average depth = 2 m
 - Lowland, crypto-depression on carbonate background
 - Mesotrophic
- **Results:** maps showing the dynamics of Chlorophyll-a content in Vrana lake form 2016. to 2017.
- **Service Provider:** Oikon Ltd. – Institute of Applied Ecology

Target 6.6: By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes. EO services based on Monitoring the extent of water related ecosystems over time. Indicator 6.6.1: Water-related ecosystems

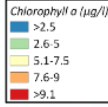
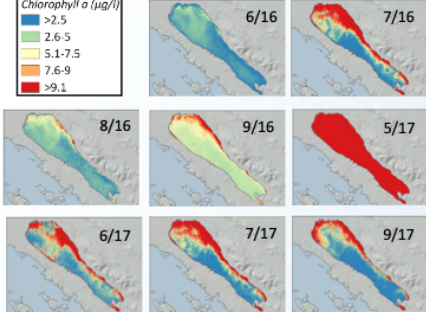






Figure: Eutrophication of Vrana lake in Croatia detected from Sentinel-2 imagery

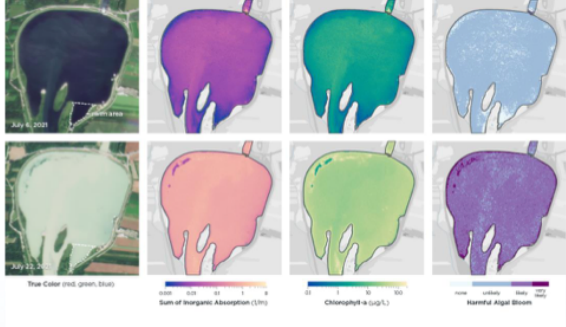


EO services contributing to SDGs
Monitoring and Detecting Harmful Algae Blooms (HABs)





- **User:** public authorities – water management
- **Challenge/Needs:** Monitoring and detecting harmful algae blooms fast and accurately is essential as they are extremely harmful to the environment and human life.
- **Initiative:** EOMAP leverages the value added of Planet’s near-daily SuperDove satellites’ green and yellow spectral data to monitor and detect HAB outbreaks fast with greater accuracy.
- **Results:** Integrating Planet’s SuperDove data, EOMAP’s HAB Indicator classifies the probability that toxic bacteria are present in water bodies to create a daily dashboard monitoring at-risk areas.
- **Service Provider:** EOMAP

Target 6.3: By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally.



Derived measurements from 8-band data courtesy EOMAP. These show conditions before (July 6, 2021) and during (July 22, 2021) a harmful algal bloom in Mandichosee, Bavaria, Germany. PLEASE DO NOT SHARE WITHOUT CONSENT.



EO services contributing to SDGs Rheticus® Agriculture



- User: Agriculture, winegrowers and/or agriculture associations, National / Local Authorities, insurance companies
- Challenge/Needs: Generating land cover map it allows to optimize the farm's management at the local, regional and national levels. Further, by using the biomass health indicator (vegetation index, Reflectance Index, Moisture Index, Leaf Area Index, Water index), the service can also work as a diagnostic tool and serve as an early warning system, allowing the agricultural community to detect and counter potential problems before they spread widely and negatively impact crop productivity.
- Initiative: Internal Development
- Results: designed to help farmers in daily crop production tasks.
- Service Provider: Planetek Italia's Rheticus platform
- Reference: <https://www.rheticus.eu/>



Figure: Rheticus® Agroculture service geoportal with analytics tools

Target 1.5: By 2030, build the resilience of the poor and those in vulnerable situations and reduce their exposure and vulnerability to climate-related extreme events and other economic, social and environmental shocks and disasters.
 Target 2.4: By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality.
 Target 6.4: By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity.
 Target 13.1: Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries



EO services contributing to SDGs Rheticus® Aquaculture



- User: Fish & Shellfish farms
- Challenge/Needs: threats caused by climate change and worsening of environmental conditions may cause variations on quantity and quality of nutrients, or on sea temperature eventually affecting productivity, mussels' quality or sanitary conditions.
- Initiative: several mussel farming sites monitored as agreed with Associazione Mediterranea Acquacoltori.
- Results: improving production efficiency, by monitoring seawater quality parameters, and potential risks to livestock, assessing the optimal time for selling products.
- Service Provider: Planetek Italia's Rheticus service

References links
 • <https://www.rheticus.eu/rheticus-services/aquaculture/>

Target 2.3.: eo services focus on Management of farming
 Target 6.4.: eo services based on Water user efficiency. Indicator 6.4.1: Water user efficiency & 6.4.2: Water stress

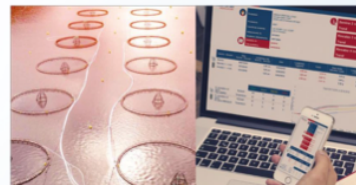



Figure: Rheticus® Aquaculture service delivering daily reports and analytics



EO services contributing to SDGs Rheticus® Network Alert



6
CLEAN WATER
AND SANITATION

9
INDUSTRY, INNOVATION
AND INFRASTRUCTURE

- User: Water and Wastewater Utilities
- Challenge/Needs: improving inspection planning & efficiency of water and sewerage networks, by enabling predictive analysis to prevent structural failures.
- Initiative: Internal Development
- Results: multi-utilities improved stressed pipeline detection and inspection efficiency of about 40%
- Service Provider: Planetek Italia's Rheticus platform

Target 6.4.: eo services based on Water user efficiency. Indicator 6.4.1: Water user efficiency & 6.4.2: Water stress
Target 9.1.: eo services based on Inform on infrastructures development & planning.





Figure: Rheticus® Network Alert service geoportail with analytics tools


1

References links

- <https://www.rheticus.eu/rheticus-services/network-alert/>
- Video of Hera Group use case, winner of the World Smart City Award 2019




EO services contributing to SDGs Change in the extent of water-related ecosystems




6
CLEAN WATER
AND SANITATION

- User: Statistical Office Rwanda, RAMSAR, Wetland practitioners
- Challenge/Needs: Wetland monitoring and reporting obligations for environmental and sustainability policies at different scales
- Initiative:
 - SWOS: Satellite-based Wetland Observation Service
 - DeMO Wetlands: Copernicus-based Detection and Monitoring of tropical Wetlands
- Results:
 - Satellite-based geo-information products required for wetland monitoring and reporting obligations in regard to SDG 6.6.1
 - Development of a range of wetland monitoring products, to monitor all wetlands at country scale
 - Impact: Provides statistics for target 6.6.1 at country scale
 - Interactive map: <https://www.remote-sensing-solutions.com/DemosWetland/DeMo-Wetlands.html>
 - Publication: <https://doi.org/10.1016/j.rse.2020.111892>
- Service Provider: Remote Sensing Solutions GmbH

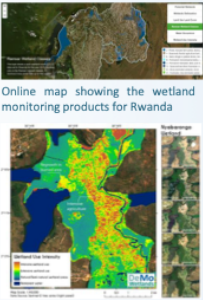
Target 6.1: By 2030, achieve universal and equitable access to safe and affordable drinking water for all.
Indicator 6.6.1: Water-related ecosystems



Online map showing the wetland monitoring products for Rwanda




High resolution information product on wetland use intensity



References links

- <https://www.remote-sensing-solutions.com/DemosWetland/DeMo-Wetlands.html>
- <https://doi.org/10.1016/j.rse.2020.111892>



EO services contributing to SDGs
Monitoring Changes in Groundwater Storage



- User: Governmental entities, NGOs, humanitarian aid organizations
- Challenge/Needs: Increasing amount of groundwater abstraction resulting in significant decline over time, thereby increasing irrigation costs, consequential ecological imbalance, and affected livelihood of populations dependent on groundwater based agriculture
- Initiative: Short-term and Long-term analysis to understand groundwater variability
- Results: Analysis revealed the groundwater deficit areas in the country, thus showing withdrawals in these areas that have exceeded recharge.
- Service Provider: Space4Good (IOM UN Migration)

Target 6.4: By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity. Indicator 6.4.1 and 6.4.2: Water use efficiency and Water stress

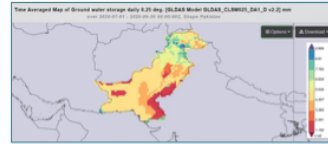


Fig 1. Groundwater Storage Map

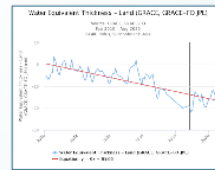


Fig 2. Water Equivalent Thickness



References link: <https://www.space4good.com/portfolio>

EO services contributing to SDGs
10m resolution Habitat Classification (Land Cover Analysis)



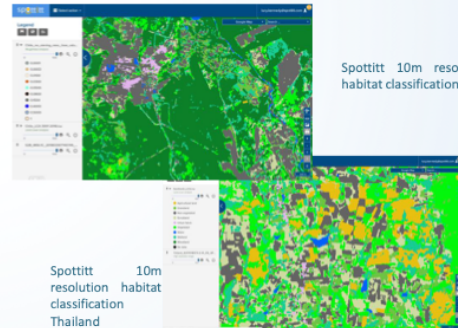
- User: International, national, regional and local government bodies and agencies, NGO's.
- Challenge/Needs: Large scale analysis and digital mapping of current and past habitats from 64 square km and upwards in size. Used to understand how change in habitat can impact water related ecosystems and ultimately the provision of drinking water for all.
- Initiative: Developed as part of ESA Business Applications funded SEWISS project which developed a range of site selection tools for onshore wind developers.
- Results: Commercially available service derived from Sentinel 2 imagery. Global coverage. Automated service request/delivery. Cost £1/square km. Volume discounts available. [Service details](#).
- Service Provider: Spottitt Ltd.

Target 6.1: By 2030, achieve universal and equitable access to safe and affordable drinking water for all.

- Assess water use efficiency

Target 6.6: By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes.

- Extent of water related ecosystems



Spottitt 10m resolution habitat classification Chile

Spottitt 10m resolution habitat classification Thailand



<https://www.spottitt.com/about/spottitt-features/land-cover-analysis-lca/>

EO services contributing to SDGs
50cm resolution Habitat Classification
(Land Cover Analysis)




- User: International, national, regional and local government bodies and agencies, NGO's and specific industries.
- Challenge/Needs: Large scale sub meter resolution analysis and digital mapping of current and past habitats from 25 square km and upwards in size. Used to map in great detail how change in habitat can impact water related ecosystems and ultimately the provision of drinking water for all.
- Initiative: Initially developed with the support of Warwickshire Wildlife Trust, has now been successfully used across the UK and Northern Europe. For best results use imagery taken during the growing season.
- Results: Commercially available service derived from sub meter resolution optical imagery. Global coverage. £20/square km when using existing imagery £27/square km when using freshly captured imagery. Volume discounts available.
- Service Provider: Spottitt Ltd.

Target 6.1: By 2030, achieve universal and equitable access to safe and affordable drinking water for all.

- Assess water use efficiency

Target 6.6: By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes.

- Extent of water related ecosystems



Spottitt 50cm resolution habitat classification Birmingham



Spottitt 50cm resolution habitat classification Scotland




EO services contributing to SDGs
Pipeline Shield - Water

- User: Water network owners and operators.
- Challenge/Needs: Depending on geography up to 40% of water is lost through leakage of our water networks. Water network encroachment (vegetation and 3rd party) detection and monitoring, and water leakage detection.
- Initiative: Developed as part of Spottitt's range of monitoring services for utility network operators. The work focuses on reduction of network losses predominantly in rural areas.
- Results: Commercially available 'Pipeline Shield' service derived from optical imagery with 50cm resolution. Global coverage. Cost £27/ km. Volume discounts available. Trials completed/ongoing in Australia, UK and Western Europe.
- Service Provider: Spottitt Ltd.

Target 6.4: By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity.

- Monitor water use efficiency



Water leakage risk detection





Potential water leak detection



www.spottitt.com

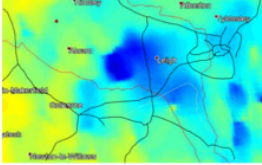
EO services contributing to SDGs Reality Check - Water

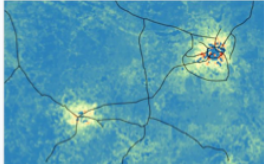
- User: Water network owners and operators.
- Challenge/Needs: Depending on geography up to 40% of water is lost through leakage of our water networks. This service enables water network owners and operators to understand the current and changing risk posed by flooding (corrosion), land motion (line stress) and a whole host of other climate factors to the integrity of their networks.
- Initiative: Developed as part of Spottitt’s range of services for utility network operators. Clients able to choose the climate factors most relevant for their geography with data going back 10 years or more.
- Results: Commercially available ‘Reality Check’ service. Global coverage. Cost £120 per 1,000 square km of territory. Volume discounts available.
- Service Provider: Spottitt Ltd.

Target 6.4: By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity.


- Monitor water use efficiency



Land motion






Soil moisture and flooding frequency




www.spottitt.com

EO services contributing to SDGs iEMOWAF

- User: State organization (Ministries), Public organization (universities, research labs) and industry
- Challenge/Needs: Better water management and flood prevention in Bulgaria
- Initiative: PECS-ESA
- Results: Monitoring of important water quality parameters - turbidity, chlorophyll a, total suspended matter, coloured dissolved matter and harmful algae bloom in inland and coastal lakes in order to support Bulgarian water authorities responsible for water quality monitoring.
- Service provider: RSICS Ltd., TAKT-IKI Ltd.

- Target 6.3: By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally.
 - Indicator: 6.3.2: Ambient water quality
- Target 6.4: By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity.
 - Indicator 6.4.1: Water user efficiency & 6.4.2: Water stress
- Target 6.6: By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes.
 - Indicator 6.6.1: Water-related ecosystems
- Target 14.1: By 2025, prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution.



References link: <http://i.emowaf.eu/>




Figure: iEMOWAF, Visualization of Varna Lake, Bulgaria CHL data

EO services contributing to SDGs

Oenoview Stress

- User: Winegrowers, wine cooperatives, vine consultants
- Challenge/Needs: Control of water stress, early detection of water stress
- Initiative: We developed a model estimating the stem potential that gives you the level of water stress compared with the ideal one depending on the date, vine variety and wine objectives, based on satellite imagery.
- Results: early alerts, control of water stress and corrective actions (irrigations or other field interventions)
 - Benefits: (i) Receive alerts and notifications with actionable information at the right time to schedule irrigation (ii) Build precise knowledge of each plot over time and adapt field work accordingly (iii) Understand and follow precisely the soil water content and its structure
 - Impact: Use the right amount of water needed by your crops to eventually increase quality and crop yield, and save water
 - Scalability: (i) Highly repeatable solution (ii) Outcome-focused offering
- Service Provider: TerraNIS





Target 2.4: By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality.

Target 6.4: By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity.

Indicator 6.4.2.: Water stress



Evolution on the water stress level for each plot



Water stress level per plot

EO services contributing to SDGs

Wago

- User: Cooperatives, farmers
- Challenge/Needs: Adjust the water inputs to the crop needs and have early detection of drought
- Initiative: Wago gives water balance monitoring and irrigation recommendations at field level. It is based on Sentinel-2 images and an approved scientific model originally developed by Cesbio, the *Centre for Space Studies of the Biosphere*. The end-user can save water and time
- Results: early alerts and irrigation recommendations at field level.
- Benefits: (i) Follow on the same platform vegetation index and water balance to get a complete overview of the crop evolution and current situation (ii) Receive alerts and notifications with actionable information at the right time to schedule irrigation (iii) Build precise knowledge of each plot over time and plan crop rotation accordingly (iv) Understand and follow precisely the soil water content and its structure
- Impact: Use the right amount of water needed by your crops to eventually increase quality and crop yield, and save water
- Highly repeatable solution, Clear market focus with distinctive market positioning, Outcome-focused offering, SaaS type of sales process
- Service Provider: TerraNIS





Target 2.4: By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality.

Target 6.4: By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity.

Indicator 6.4.2.: Water stress



Alerts and irrigation recommendations at field level



Water balance per field



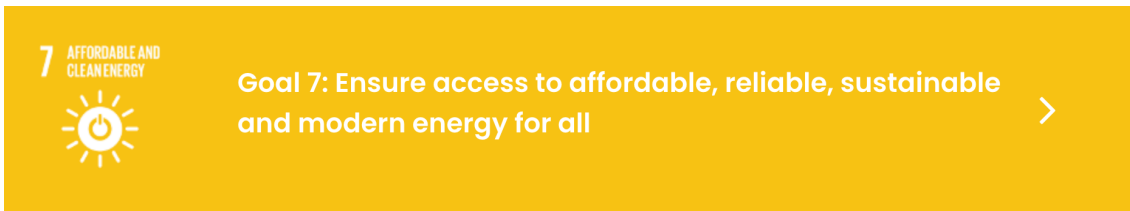
<http://www.terraniis.fr/en/precision-agriculture-wago-irrigation/>

Relevant Success Stories

- [EO data services for management of coastal zones](#)
- [Successful Integration of EO-Based Observations and Machine Learning in Spring Peak Flow Forecasting](#)
- [EOs adding value to historical water availability and quality information services](#)
- [Harvester Season](#)
- [Future climate projection of heat indices for Austrian major cities](#)
- [Satellite based detection of oil spills](#)
- [Detect and monitor oil slicks](#)
- [Sea turbidity monitoring](#)

- [Satellite-based oil spill detection](#)
- [Satellite based oil spill detection and impact assessment – The chronology of the Deepwater Horizon Accident](#)

vi. SDG 7 - Affordable & Clean Energy



vi.1 Goal: Ensure access to affordable, reliable, sustainable and modern energy for all.

EO data offer an invaluable opportunity for better-informing development policies and quantifying various targets. How can EO be used to help countries achieve specific targets? *Source: [ESA compendium of EO contributions to the SDG Targets and Indicators](#)*

Target 7.1: By 2030, ensure universal access to affordable, reliable and modern energy services.

Approximately 1 billion people still have no access to electricity, 50% of which live in sub-Saharan Africa. Access to energy is essential for achieving many sustainable development goals, from poverty reduction, improved health care, gender equity, and education to combating climate change. Energy accounts for around 60% of total global greenhouse gas emissions and while energy sources are transitioning from coal, to natural gas, to renewables, global energy use is still primarily based on fossil fuels. In this context, Target 7.1 can be achieved and monitored with the integration of EO data. Applicable on a larger scale, remote sensing data is able to give information that by field surveys alone would be more time consuming and often difficult to gain because of the accessibility of many locations. The regular collection of EO ensures the long-term availability of data to monitor the status of remote and rural settlements. A useful data source is night-time luminosity data, which can collect daily variations at sufficiently low light levels to detect artificial lights at night across remote and rural areas. Night time lights products have been used for a vast range of purposes for more than 50 years, including to map the distribution of economic activity, poverty levels and to generate CO2 emission maps. In particular, the NASA's Black Marble product suite can be used to monitor in near-real time areas not reached by centralized electricity services, and then inform the development of investment and implementation plans for electrical infrastructures aiming to protect and/or increase energy access by the highest number of people in a country.

EO-based technologies for monitoring access to different types of energy resources varies depending on the details of the information needed. For instance, the type of energy source (e.g. solar panels, diesel power generators, nationwide electrical networks) can only be acquired using high resolution EO data in combination with sophisticated statistical techniques, but various use cases (e.g., from Zambia to Pakistan) show the high potential that EO have to monitor several aspects of this target.

(eo services based on Access to energy (status of settlements). Indicator 7.1.1: Access to electricity)

EO Products/Services supporting the SDGs

EO services contributing to SDGs

Solar panel mapping and monitoring



- User: policy makers, energy solution companies and investors, and utility sector
- Challenge/Needs: information on the recent and past numbers (increase over time) of installed solar panels plays an important factor in policy and activities regarding the energy transition. Conventional data sources do not provide full insight into these numbers due to level of detail or incompleteness.
- Initiative: NEO has developed a service in which solar panels for the full area of the Netherlands are being monitored using aerial and satellite imagery. To manage the scope, NEO has developed deep learning models for solar panel classification that have been integrated into a monitoring system. The service contains locations with easy to use relations to national key registrations, as well as power output estimations. The data is used for various purposes, such as: to design or validate government policies involving renewable energy, monitor net capacity risks, monitor risks involving gas pipeline proximity, as input for energy transition advisors.
- Results: 1) detect the installed solar panels on roofs using deep learning 2) estimate the installable capacity and generated yearly power potential 3) building the online environment to visualize the mapping and results and provide ease of access to clients
- Impact: the service is used by several parties that work on a national level in the Netherlands, several Dutch provinces and a large number of municipalities. Depending on their needs, these clients either get the data on request when an action is scheduled, or have a contract to receive several updates per year.



Service Provider: NEO BV

NEO Solar panel monitoring service:
<https://zonnepanelen.neo.nl/landing>

Target 7.1: By 2030, ensure universal access to affordable, reliable and modern energy services.



Rooftop solar panels

EO services contributing to SDGs

Solar PV site selection



- User: Solar PV developers, energy intensive industries
- Challenge/Needs: Remote discovery and scouting of large buildings with suitable rooftop size for solar PV installation. Remote estimation of a settlements potential energy usage requirement based on number and size of buildings. Remote estimation of local energy generation/network installation costs based on building number and location.
- Initiative: Developed as part of ESA Business Applications funded SEWISS project which developed a range of site selection tools for renewable energy developers.
- Results: Commercially available service. Global coverage. Automated service request/delivery. £16.45 per square km Pay as you Go or subscription options. [Service details](#). Used by international clients who have remotely studied buildings and rooftops all over the world.
- Service Provider: Spottitt Ltd.



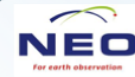
<https://www.spottitt.com/about/spottitt-features/>

Target 7.1: By 2030, ensure universal access to affordable, reliable and modern energy services.



Building recognition analysis

EO services contributing to SDGs Assess rooftop solar energy potential



- User: policy makers, energy solution companies and investors, and utility sector
- Challenge/Needs: Assess rooftop solar energy potential for cities worldwide
- Initiative: Sustainable energy development program funded by SDG Fund and ESMAP from the World Bank Group. Solar photovoltaic (PV) electricity generation has potential to help make power more affordable and cleaner when it displaces more expensive, more polluting alternatives. In spite of the attractive economics and great potential of rooftop solar PV energy to provide clean and reliable energy, in many emerging markets, the adoption and scaling up of rooftop solar installations remains challenging due to the lack of access to data/tool for feasibility studies, finance and reliable/quality technical partners. This service aims to address the barrier of lacking accurate PV potential data for planning and investment decisions.
- Results: 1) estimate the rooftop suitable area for solar panel installation 2) estimate the installable capacity and generated yearly power potential 3) mapping the energy potential per building sector and per administrative units 4) building the online platform to visualize the mapping and results 5) provide access to the data to the public
- Impact: The service has been provided to 15 cities in developing countries global wide so far. The mapping results are highly valued by regional bank teams and the government counterparts as it provides detailed information at individual building level for analysis and facilitates the project planning. It allows decision making based on data-driven approach.
- Service Provider: NEO BV

Target 7.1: By 2030, ensure universal access to affordable, reliable and modern energy services.



Rooftop solar energy potential



Rooftop solar potential:
https://energydata.info/organization/6c36a5eb-4cd6-4616-b530-da46f8b04ed3?vocab_regions=AFR
 NEO Solar panel monitoring service:
<https://zonnepanelen.neo.nl/landing>

EO services contributing to SDGs Onshore wind site selection



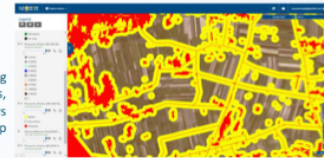
- User: Onshore wind developers, energy intensive industries
- Challenge/Needs: Remote discovery and scouting of small and large scale sites with suitable geography for onshore wind development all over the world.
- Initiative: Developed as part of ESA Business Applications funded SEWISS project which developed a range of site selection tools for renewable energy developers.
- Results: Commercially available service which provides land cover and land roughness, building recognition, site and turbine selection analyses derived from a selection of open source and commercial optical imagery. Global coverage. Automated service request/delivery. Pay as you Go or subscription options. [Service details](#). Used by international clients who have remotely studied sites all over the world.
- Service Provider: Spottitt Ltd.

Target 7.1: By 2030, ensure universal access to affordable, reliable and modern energy services.



Land roughness for wind simulation input



Site selection avoiding trees, roads, buildings, national parks, railways and land with a steep incline



<https://www.spottitt.com/about/spottitt-features/>

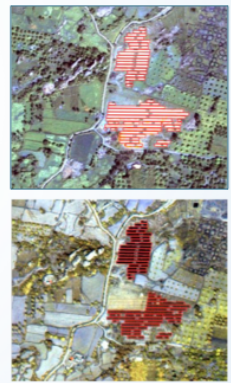
EO services contributing to SDGs

Earth Observation for Energy and Sustainability





- **User:** Oil and gas, utilities, mining sector, renewable energy sector.
- **Challenge/Needs:** If every person must have access to energy, we must provide that energy and ensure the infrastructure is ready to fulfill that purpose. Climate change also creates additional challenges for energy suppliers, like having to cope with unexpected surges in electricity demand due to an unpredictable weather; developing countries are likely to suffer a greater impact from climate change than other nations.
- **Initiative:** Affordable EO data assists in monitoring remote and large-scale critical infrastructure, exploring and planning new sites, assessing compliance, and measuring output of specific renewable energy projects.
- **Results:** Continuous overview of critical infrastructure allows access to affordable, reliable and modern energy services without interruptions. Case study: [Solar Energy: Using EO Data to Measure the Capacity of Solar Parks](#)
- **Service Provider:** Satellogic

Target 7.1: By 2030, ensure universal access to affordable, reliable and modern energy services. (status of settlements).
Indicator 7.1.1: Access to electricity.





Using geospatial software or a set of APIs, managers can analyze an image of a solar panel farm and estimate its PV (photovoltaic) Panel Evolution in terms of area and capacity.



<https://satellogic.com/2022/06/23/solar-energy-using-EO-data-to-measure-the-capacity-of-solar-parks/>
<https://satellogic.com/earth-observation/energy-sustainability/>

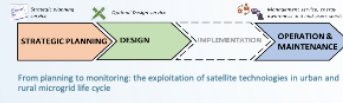
EO services contributing to SDGs

MOWGLI: MicrO reNwable Grid for rural Indian areas

- **User:** Electrification (Microgrid Owner, Designer, Operator)
- **Challenge/Needs:** Electrification is a combination of different steps: setting up of electricity infrastructure, providing connectivity to households, give adequate access to quality power at affordable rates. To ensure energy access in rural area it is needed to improve the energy availability, reliability, quality.
- **Initiative:** Through the ARTES 4.0 Downstream Applications by ESA (European Space Agency) the MicrO reNwable Grid for rural Indian areas was launched. Microgrids are distributed systems of localised renewable generation, distribution network and load - are being increasingly deployed particularly in rural areas to achieve energy access.
- **Results:** Satellite-based services to support and improve the different phases of the microgrid projects. Software for Microgrid optimal design and Operation & Maintenance (O&M) services. Usage Awareness for Indian Rural Area
- **Service Provider:** ESA and i-EM


Target 7.1. By 2030, ensure universal access to affordable, reliable and modern energy services. **Indicator 7.1.1:** Access to electricity



From planning to monitoring: the exploitation of satellite technologies in urban and rural microgrid life cycle

<https://sdg.esa.int/activity/mowgli-4458>
<https://business.esa.int/projects/mowgli>

PLANNER: Urban area identification and classification by satellite imagery




Main features

- » Satellite imagery (EO) classification
- » Load assessment

Output

- » Strategic planning with the site identification
- » Site Feasibility Index

TAILOR: Microgrid optimal sizing & design




Main features

- » Renewable energy assessment
- » Microgrid sizing and design with best components choice

Output

- » Microgrid tailored design report
- » Microgrid Feasibility Index
- » Technical design and services enabled: tele education, tele medicine, Smart payments, Priority booking

MANAGER: Microgrid Operation & Maintenance (O&M) services




Main features

- » Real-time monitoring
- » Predictive maintenance
- » Energy Management real time System (EMS)
- » Load generation and extreme weather forecasting
- » Energy thief detection

Output

- » Information for O&M activities

SMART: Energy services and awareness for end-users




Main features

- » Payment services: Pay-as-you-go, Smart booking, Priority booking
- » Energy awareness services: Community leasing, Tele-Medicine, Tele-Education, O&M training

Output

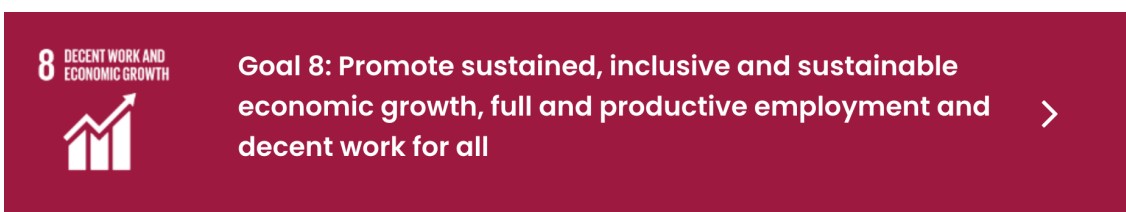
- » Mobile and Smartphone application



Relevant Success Stories

- [Thermal & Carbon efficiency](#)
- [How Geospatial technologies can support the planning and operation of power farms](#)

vii. SDG 8 - Decent Growth and Economic Growth



vii.1 Goal: Ensure access to affordable, reliable, sustainable and modern energy for all.

EO data offer an invaluable opportunity for better-informing development policies and quantifying various targets. How can EO be used to help countries achieve specific targets? *Source: [ESA compendium of EO contributions to the SDG Targets and Indicators](#)*

Target 8.2: Achieve higher levels of productivity of economies through diversification, technological upgrading and innovation, including through a focus on high value added and labor-intensive sectors


Digital connectivity and EO-based technologies for monitoring access to different types of natural resources.

(eo services based on sustainable management of a defined labor intensive sector such agriculture)

EO Products/Services supporting the SDGs


EO services contributing to SDGs Managing Ethical Supply Chains

- User:** Government agencies and land conservation managers.
- Challenge/Needs:** The primary challenge in conserving the Amazon's resources is achieving detailed, up-to-date visibility of the condition of wildlands. Previous imaging solutions collected data on an annual basis – much too infrequently to spot illegal activity in time to prevent it from advancing.
- Initiative:** In partnership with Amazon Conservation and the Peruvian government, Planet's data provided insights on illegal mining operations that have plagued the Amazon rainforest for years.
- Results:** Planet's imagery has been used to shine a light on illegal supply sourcing. This data helped the government identify and shutdown illegal mining operations, ensuring more sustainable land management.
- Service Provider:** Planet




8 DECENT WORK AND ECONOMIC GROWTH

Target 8.4: Improve progressively, through 2030, global resource efficiency in consumption and production and endeavour to decouple economic growth from environmental degradation, in accordance with the 10-year framework of programmes on sustainable consumption and production, with developed countries taking the lead




Recent expansion of gold mining deforestation in the buffer zone of AmaraKaeri Communal Reserve (Cusco region). © 2020, Planet Labs Inc.



<https://www.planet.com/pulse/how-amazon-conservation-is-cracking-down-on-illegal-mining-with-planet-data/>

EO services contributing to SDGs MRV for commodities (Sustainable management of agroforestry systems)

- User:** Dominican Republic (DR) Ministry of Environment and Natural Resources, Ministry of Agriculture (Cocoa Dept.), DR Cocoa Foundation (producers assoc.) and National Cocoa Commission.
- Challenge/Needs:**
 - Boost the value chain of sustainable organic cocoa, certify a zero-deforestation cocoa value-chain
 - Support Measurement, Reporting and Verification (MRV) strategy in the country. Plan the cocoa production strategy and Certify a cocoa value chain without deforestation.
 - Contribute to demonstrate the role of cocoa in fighting climate change.
 - Support decision-making to modernize cocoa value chain and attract investors.
- Initiative:** Cocoa is an opportunity to boost economy a reduce the high poverty rates in the DR, the world leader producer of organic cocoa. Need to identified the most suitable land for cocoa cultivation; mapped present cocoa farms and conclude on their role in reducing CO₂ emissions (MRV4C).
- Results:** GMV set up an MRV system, and as part of it, identified the most suitable land to grow cocoa (without losing sight of the natural protected areas); monitored one-year forest loss and drought, in particular, around the current cocoa farms; generated a ML classification of cocoa farms and estimated Above ground Biomass.
- Service Provider:** GMV NSL (<https://gmv.com/en-es/sectors/space>)

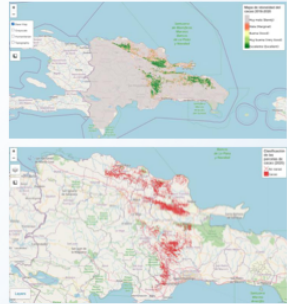


2 ZERO HUNGER


8 DECENT WORK AND ECONOMIC GROWTH

Target 2.4: By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality.

Target 8.2: Achieve higher levels of productivity of economies through diversification, technological upgrading and innovation, including through a focus on high value added and labor-intensive sectors



Land suitability for cocoa growing based on agroecological and climatic parameters (above) and Cocoa Farms classification(below).



viii. SDG 9 - Industry, Innovation & Infrastructures



viii.1 Goal: Build resilient infrastructure, promote inclusive and sustainable industrialisation and foster innovation.

EO data offer an invaluable opportunity for better-informing development policies and quantifying various targets. How can EO be used to help countries achieve specific targets? *Source: [ESA compendium of EO contributions to the SDG Targets and Indicators](#)*

Target 9.1: Develop quality, reliable, sustainable and resilient infrastructure, including regional and trans- border infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all.

Infrastructures that are sustainable, durable and disaster-resilient, provide the basic and essential structures to a country to effectively function, but also allow to generate employment and wealth and drive economic development. This target is strongly linked to other sustainable development goals, including zero hunger, no poverty, good health and well-being, as well as quality education. Rural development processes, including access to markets, education and health services, cannot succeed without a reliable access to roads year-round. EO data can inform the production of efficient and effective plans for infrastructures development and management. The global coverage of remote sensing images allows the identification of areas currently lacking infrastructures for transportation or energy access. These data coupled with information on topography, land cover, precipitation patterns, climate change scenarios, can support the development of climate resilient infrastructures. EO data has been widely used to extract infrastructures such as urban areas, roads and dams using data at different spatial resolution (e.g. rural roads can be detected just with high resolution images) and different techniques (e.g. supervised and unsupervised classification, neural networks, and mathematical morphology). Research is also currently focused on using high resolution or radar data to monitor the status of infrastructures, particularly in areas prone to natural disasters, such as flooding, but also in areas affected by conflicts. The need to plan for regional and trans-border infrastructure is also well served by EO since it is technology that crosses borders and is not limited by a single country's or region's national data collection systems. In theory, open access EO data should help countries collaborate on shared infrastructure projects.

(eo services based on Inform on infrastructures development & planning. Indicator 9.1.1: All season roads)

Target 9.4: By 2030, upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes, with all countries taking action in accordance with their respective capabilities.

EO data can be used to measure pollutants that arise from industries and infrastructure. Satellite data can also be used to locate potential pollutant hotspots through analysis of global emissions, and monitoring pollution plumes. Satellites also collect weather and climate data, which can aid decision-making in relation to clean energy installations. For example, satellites can be used to forecast surface wind field data to guide operations of wind turbines, and predict their energy


input into power grids. It can also be used to map photovoltaic solar electricity potential, based on solar irradiance climatology – which can be used to aid solar energy installation.

(eo services based on Mapping & measurement of pollutants emissions)

EO Products/Services supporting the SDGs

EO services contributing to SDGs *Rheticus® Safeland*

- User: Regional to local authorities, Environmental protection agencies, Civil engineering companies
- Challenge/Needs: Land instability represents a serious source of danger for citizens safety, infrastructure safeguarding and environmental protection. Prioritize areas based on the level of concern to better manage inspection and investments for stability works represents a huge need
- Initiative: Internal Development
- Results: The service gives a level of concern to each portion of a territory allowing customers to easily detect areas with a high level of concern, prevent potential damage, better organize field inspections, and achieve cost-effective management of the territory. The service provides the proper knowledge to support planners to avoid critical issues deriving from not full pictures of in progress phenomena.
- Service Provider: Planetek Italia's Rheticus platform



Target 1.5.: eo services focus on: Build resilience of vulnerable populations contributing to management of disaster risk reduction. Indicator 1.5.2: Disaster Damage
Target 9.1.: eo services based on Inform on Infrastructures development & planning.
Target 11.5.: eo services based on Mapping of vulnerable disaster areas & early warning systems





Figure: Rheticus® Safeland service geoportal with analytics tools



References links

- <https://www.rheticus.eu/rheticus-services/safeland/>

1

EO services contributing to SDGs *Urban tree registration and update*

- User: governments (national, provinces, municipalities), utilities sector and urban planning
- Challenge: Trees and greenery play a vital role in our living environment. In addition, they keep the city cool thanks to shade and evaporation, improve air quality, dampen noise, and add biodiversity. They can also cause problems for infrastructure above and below the surface. By knowing the location of all trees, it becomes possible to analyze their impact on our environment.
- Initiative: Nationwide up to date tree register of all 120 million trees.
- Results: 1) technology to map and monitor all trees and landscape elements in the Netherlands. 2) The database contains tree crowns (including height, diameter and more) and tree stem positions for all individual trees 3) It is permanently updated using LiDAR, satellite imagery and crowd sourced data. 4) It is being actively used for all kinds of purposes, including synchronization with local tree databases, risk inventories and green studies.
- Service Provider: NEO BV



Target 9.1: Develop quality, reliable, sustainable and resilient infrastructure, including regional and trans- border infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all.





NEO mapping and monitoring services:
<https://www.neo.nl/tree-registers/>

Urban trees

EO services contributing to SDGs - Look Soil sealing/surface imperviousness mapping



- User: governments (national, provinces, municipalities), utilities sector and urban planning
- Challenge: in recent years extreme rainfall has appeared much more frequently than before. Urban environments have not been designed to deal with such high capacities of water. Climate adaptation has become a serious topic on the agendas of governments on different levels: how can we redesign urban landscapes to be sustainable and guarantee liveability. Summarized: the stone environment should be more green. In the public space the government should come up with solutions that improve drainage without overloading the sewer systems, for private areas owners should be motivated to contribute by green gardens, green roofs, etc. Data on this topic is very scarce. NEO provides governments or their partners (advisors, engineers) data to use as input for models, to track down risks or manage policies. Important aspect is to keep the infrastructure data/maps up to date so it reflects the most recent (realistic) situation.
- Initiative: soil sealing/surface imperviousness map and monitoring service
- Results: 1) mapping the surface sealing in public and private spaces to identify sewer overload, flood risk, stone area concentrations, heat stress for data analysis. 2) a tool to support in public awareness of climate adaption (visualisation). 3) a supportive system for efficient asset management (e.g. underground cables). 4) automated workflow using open source data to provide up to date insights
- Service Provider: NEO BV

Target 9.1: Develop quality, reliable, sustainable and resilient infrastructure, including regional and trans- border infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all.



Surface sealing area



NEO mapping and monitoring services:
<https://www.neo.nl/imperviousness-surface-sealing/>

EO services contributing to SDGs SignalEyes geo-information updating service



- User: municipalities, utilities sector and urban planning
- Challenge: keeping the cadastral/infrastructure data/maps up to date so it reflects the most recent situation for better city management and planning.
- Initiative: The SignalEyes geo-information updating service is developed by NEO to serve the needs of efficient and timely map/information updating from both public and private sectors.
- Results: 1) mapping the objects and the changes in the infrastructure (building, roads and pipeline etc.) data/map 2) keeping the information updated in the map regularly 3) automating the updating process based on EO data and Artificial Intelligence techniques.
- Impact: The service has been used for a large number Dutch municipalities to improve the efficiency of the map updating working process. The automatic change detection of current maps based on EO data has fasten the processing and reduced the conventional heavy manual work and therefore the cost. It has paved the new direction for future map updating.
- Service Provider: NEO BV

Target 9.1: Develop quality, reliable, sustainable and resilient infrastructure, including regional and trans- border infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all.



Infrastructure data mapping and change detection



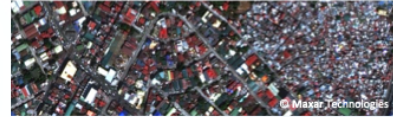
NEO mapping and monitoring services:
<https://www.neo.nl/topography-updating/>
<https://www.neo.nl/signaleyes-for-actionable-insights/>

EO services contributing to SDGs Informal settlement AI toolchain



- User: UN; World bank, NGO's & aid organizations, central and sub-national governmental institutions, insurance sector, ...
- Challenge/Needs:
 - Identify slums using AI techniques;
 - Evaluate the evolution of slums over time and predict their future expansion including population estimates;
 - Understanding of informal settlement development and the relation with access to key services;
 - Analysis of exposure to natural hazards
- Initiative: Transferable Open-source community tool
- Results:
 - A tool which is transferrable to various regions (already applied in Asia & Latin-America)
 - A tool which make us of different type of data
 - A tool which can be run by local technical operators
- Service Provider: [Geographic Information Management NV](#)

Target 9.1: Develop quality, reliable, sustainable and resilient infrastructure, including regional and trans-border infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all.

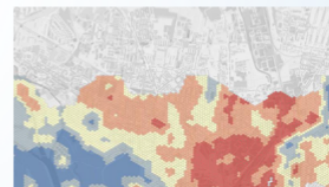


EO services contributing to SDGs Mayday.ai – dynamic risk modelling and heat wave detection



- Users: organisation with a mandate in disaster management, humanitarian and development aid, government agencies, international organisations, construction sector, (re-)insurance
- Challenge/Needs: Mayday's rich real time and historical data allows dynamic risk modelling that can be used for urban/infrastructure planning
- Initiative: a heatwave product pilot underway first involving some 10 German cities as testing partners (a BMVI and DLR-supported project) and a subsequent adaptation for the African region
- Results: reduction of impact (less fatalities, economic damage and environment degraded), increased resilience through better urban planning, in-depth knowledge
- Service Provider: [Mayday.ai](#)

Target 9.a: Facilitate sustainable and resilient infrastructure development in developing countries through enhanced financial, technological and technical support to African countries, least developed countries, landlocked developing countries and small island developing States.



Heat island mapping – city of Leipzig



EO services contributing to SDGs Impervious surface mapping

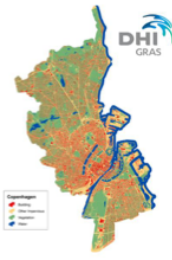


- User: Environmental authorities, city planners, local authorities
- Challenge/Needs: Impervious surfaces have a direct impact on the volume, duration and intensity of surface runoff; groundwater recharge; water quality and the hydrological cycle. Spatially explicit information about the amount, location and type of impervious surfaces aids decision making in the context of sustainable urban planning, water resource management, climate mitigation and greening strategies.
- Initiative: Commercial product as a result of several years R&D
- Results: The impervious surface data depicts spatially explicit information about the amount, extent, location and type of impervious surfaces, using advanced image analysis of satellite imagery or aerial photos. By applying novel machine learning technology and cloud processing, the solution is highly automated, and scalable, and can be applied anywhere worldwide at a specific point in time to differentiate between various types of impervious surface roads (e.g. roads, rooftops, parking lots) and pervious areas (e.g. parks, lakes, streams).
- Service Provider: DHI GRAS

Target 6.3: By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally.

Target 9.1: Develop quality, reliable, sustainable and resilient infrastructure, including regional and trans-border infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all.

Target 11.3: By 2030, enhance inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management in all countries.



Example: The impervious surface mapping solution provides fast and accurate information about urban land cover in grid cell resolutions from submeter levels to 10 m.



Reference: <https://www.dhi-gras.com/solutions/urban-mapping/>
<https://www.dhi-gras.com/projects/ea4sdg/>

EO services contributing to SDGs Rheticus® Network Alert



- User: Water and Wastewater Utilities
- Challenge/Needs: improving inspection planning & efficiency of water and sewerage networks, by enabling predictive analysis to prevent structural failures.
- Initiative: Internal Development
- Results: multi-utilities improved stressed pipeline detection and inspection efficiency of about 40%
- Service Provider: Planetek Italia's Rheticus platform

Target 6.4.: eo services based on Water user efficiency. Indicator 6.4.1: Water user efficiency & 6.4.2: Water stress

Target 9.1.: eo services based on Inform on infrastructures development & planning.



Figure: Rheticus® Network Alert service geoportals with analytics tools

- References links
- <https://www.rheticus.eu/rheticus-services/network-alert/>
 - [Video of Hera Group use case, winner of the World Smart City Award 2019](#)



EO services contributing to SDGs
Monitoring of illegal dumping of waste



- User: Urban planning departments
- Challenge/Needs: enabling continuous monitoring of land use/ land-cover changes, soil consumption, impervious surfaces assessment, and urban heat islands detection, as well as supporting spatial planning to achieve smart growth.
- Initiative: H2020 Eugenius
- Results: allows to monitor urban changes and their evolutionary trend over time, facilitating planning activities and land management
- Service Provider: Planetek Italia's Rheticus platform

Target 1.5.: eo services focus on: Build resilience of vulnerable populations contributing to management of disaster risk reduction.
 Target 9.1.: eo services based on Inform on infrastructures development & planning.
 Target 11.3.: eo services based on Urban growth monitoring for sustainable use of land. Indicator 11.3.1: Land consumption
 Target 11.6.: eo services based on Spatial mapping of cities & waste management
 Target 11.7.: eo services based on Mapping extend of urban areas



Figure: Rheticus® Urban Dynamics service geoportall with analytics tools

References: <https://www.rheticus.eu/rheticus-services/urban-dynamics/>



EO services contributing to SDGs
Asset Shield



- User: Infrastructure owners and operators.
- Challenge/Needs: Infrastructure encroachment (vegetation and 3rd party) detection, monitoring, and change detection.
- Initiative: Developed as part of Spottitt's range of monitoring services for utility network operators. The work focuses on reducing asset encroachments and changes predominantly in rural areas.
- Results: Commercially available 'Asset Shield' service derived from optical imagery with 50cm resolution. Global coverage. Cost £27/ km. Volume discounts available. Trials completed/ongoing in Australia, UK and Western Europe.
- Service Provider: Spottitt Ltd.

Target 9.1 Target 9.1: Develop quality, reliable, sustainable and resilient infrastructure, including regional and trans- border infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all.

- infrastructure development, planning and monitoring



Gas leakage risk detection

Potential gas leak detection






www.spottitt.com

EO services contributing to SDGs

OKEANOS: Integrated solution for oil spills at sea

- User: Oil & Gas companies, Environmental/Maritime Authorities, Maritime Ports, NGOs
- Challenge/Needs: oil spill detection, characterization & trajectory forecasting, Identification of source. ESG reporting
- Initiative: commercial product developed in partnership with CMCC srl, as a one-stop-shop for oil spill monitoring and forecasting at sea. OKEANOS constitutes a user-friendly, convenient, accurate and agile tool to have advanced situational awareness and optimise decision making
- Results: AI-based platform that provides early warnings of detected oil spills, identification of source and trajectory forecasting. The analytics provide unique features like thickness mapping and quantification of oil released at sea
- Service Provider: Orbital EOS

Target 9.4: By 2030, upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes, with all countries taking action in accordance with their respective capabilities.

Target 14.1: By 2025, prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution.

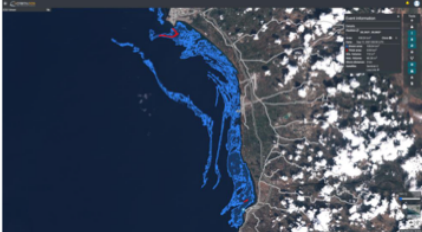



Fig. Digital interface of OKEANOS, showing oil spill in Banyias terminal, Syria






<https://www.rempec.org/en/news-media/rempec-news/incident-involving-a-fuel-leakage-into-the-mediterranean-sea-from-the-banyias-thermal-station-syria-1>

<https://www.orbitaleos.com/>

EO services contributing to SDGs

Buildings & infrastructures displacements monitoring

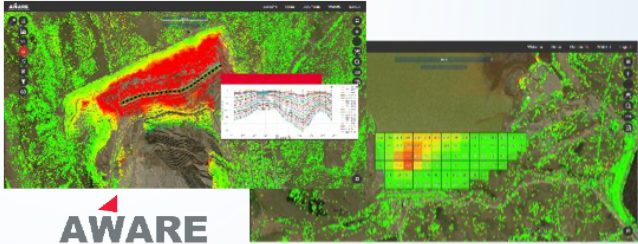
- User: Public authorities, utilities
- Challenge/Needs: improve resilience of buildings and infrastructures through their continuous monitoring for early detection of threats that can affect people safety or services provisions
- Initiative: e-Geos internal development based on the continuous refinement of e-GEOS proprietary Persistent Scatterer Pair (PSP) SAR interferometry technology and on a continuous feed of end users requirements for improving Aware platform functionalities
- Results: Aware platform provides with high precision and accurate positioning analysis of buildings and infrastructures through satellite interferometric analysis (PSP technique), Fast Movements analysis, GNSS services. AWARE returns the analysis through portal & toolbars, providing analysis & supporting tools to add further value to the geospatial data.
- Service Provider: e-Geos

Target 1.5 By 2030, build the resilience of the poor and those in vulnerable situations and **reduce their exposure and vulnerability to climate-related extreme events and other economic, social and environmental shocks and disasters**


Target 9.1 Develop quality, reliable, sustainable and resilient infrastructure, including regional and transborder infrastructure, to support economic development and human well-being

Target 9.4 By 2030, **upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes**



AWARE
Aware: Watching of Assets and Infrastructures

Heatmap On Points Density Generated On The Fly Over The Selected Area On A Selected Ps Dataset



References link: <https://www.e-geos.it/#/hub/hubPlatforms/platform/platform-aware>

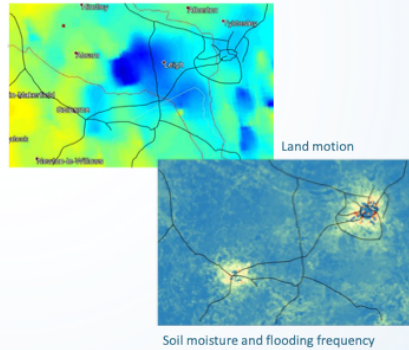
EO services contributing to SDGs
Reality Check - Infrastructure



- **User:** Infrastructure owners and operators.
- **Challenge/Needs:** Not all infrastructure has been exposed to the same risks. This service enables infrastructure owners and operators to understand the current and changing risk posed by flooding (corrosion), land motion (line stress) and a whole host of other climate factors to the integrity of their assets.
- **Initiative:** Developed as part of Spottitt’s range of services for utility network operators. Clients able to choose the climate factors most relevant for their geography with data going back 10 years or more.
- **Results:** Commercially available ‘Reality Check’ service. Global coverage. Cost £120 per 1,000 square km of territory. Volume discounts available.
- **Service Provider:** Spottitt Ltd.

Target 9.1 Target 9.1: Develop quality, reliable, sustainable and resilient infrastructure, including regional and trans-border infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all.

- infrastructure development, planning and monitoring



www.spottitt.com

EO services contributing to SDGs
EO for infrastructure monitoring and planning



- **User:** Local governments, utilities, transportation organizations, infrastructure stakeholders
- **Challenge/Needs:** To support the planning, development, and maintenance of critical infrastructure at scale for a sustainable future
- **Initiative:** Enabling nations and organizations to identify opportunities for sustainable development as well as monitoring operations to manage resources and ensure safety
- **Results:** Affordable data to develop or enhance a geospatial program to serve a variety of infrastructure, resource, and community needs
- **Service Provider:** Satellogic

Target 9.1: Develop quality, reliable, sustainable and resilient infrastructure, including regional and trans-border infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all.
 (Inform on infrastructures' development & planning. Indicator)
 9.1.1: All season roads.



A capture of Lubumbashi, a city in the Democratic Republic of the Congo. Earth Observation data can help monitor critical infrastructure for economic activities — such as the airport visible on the left side of the image — and help plan for critical infrastructure based on the updated terrain information.



<https://satellogic.com/earth-observation/critical-infrastructure/>

EO services contributing to SDGs Observatory of Urban Green Areas



9
INDUSTRIAL INFRASTRUCTURE AND INFRASTRUCTURE

11
SUSTAINABLE CITIES AND COMMUNITIES

13
CLIMATE ACTION

- User: Municipality of Thessaloniki
- Challenge/Needs: Provide a Green Areas monitoring Tool capable to calculate the sufficiency of vegetation per district and municipal unit in the Municipality using EO data. The tool will support the evaluation of the status of the Sustainable Development Goals (SDGs) set by the Municipality
- Initiative: Maintenance and upgrade of Municipality's Spatial Data Infrastructure (SDI) with additional EO / Copernicus data and services
- Results: The Observatory of Urban Green Areas application provides actionable insights from the valorization of Satellite data towards sustainable urban planning and design. EO, geospatial data, and the information provided through Observatory of Urban Green Areas play insightful roles in monitoring targets, tracking progress, as well as helping the Municipality and stakeholders make informed decisions toward achieving the Sustainable Development Goals. The Service can be replicated to support additional Municipalities since it uses freely available Copernicus and Census data.
- Service Provider: Geospatial Enabling Technologies



The Observatory of Urban Green Siting by GET

Target 9.1.: EO services based on Inform on infrastructures development & planning

Target 11.3.: EO services based on Urban growth monitoring for sustainable use of land.

Target 11.7.: EO services based on Mapping extend of urban areas

Target 13.1.: EO services based on Identifying, monitoring and preparing for climate related hazards

EO services contributing to SDGs Rheticus® Urban Dynamics



1
PEOPLE

9
INDUSTRIAL INFRASTRUCTURE AND INFRASTRUCTURE

11
SUSTAINABLE CITIES AND COMMUNITIES

- User: Urban planning departments
- Challenge/Needs: enabling continuous monitoring of land use/ land-cover changes, soil consumption, impervious surfaces assessment, and urban heat islands detection, as well as supporting spatial planning to achieve smart growth.
- Initiative: H2020 Eugenius
- Results: allows to monitor urban changes and their evolutionary trend over time, facilitating planning activities and land management
- Service Provider: Planetek Italia's Rheticus platform

References links

- <https://www.rheticus.eu/rheticus-services/urban-dynamics/>



Figure: Rheticus® Urban Dynamics service geoport with analytics tools

Target 1.5.: eo services focus on: Build resilience of vulnerable populations contributing to management of disaster risk reduction.

Target 9.1.: eo services based on Inform on infrastructures development & planning.

Target 11.3.: eo services based on Urban growth monitoring for sustainable use of land. Indicator 11.3.1: Land consumption

Target 11.6.: eo services based on Spatial mapping of cities & waste management

Target 11.7.: eo services based on Mapping extend of urban areas

References links

- <https://www.rheticus.eu/rheticus-services/urban-dynamics/>

EO services contributing to SDGs Rheticus® Safeway



- User: Engineering & transport infrastructure management companies
- Challenge/Needs: reduce service disruptions and/or threats for people.
- Initiative: Internal Development
- Results: the service allows an “a priori” approach, helping to highlight problems before they become critical. As a result, operators better manage their financial resources, ensure people’s safety, environmental protection and the safeguarding of assets at all stages of the life cycle of infrastructures, from design to production, management and maintenance.
- Service Provider: Planetek Italia’s Rheticus platform

Target 1.5.: eo services focus on: Build resilience of vulnerable populations contributing to management of disaster risk reduction. Indicator 1.5.2: Disaster Damage
 Target 9.1.: eo services based on Inform on infrastructures development & planning.
 Target 11.5.: eo services based on Mapping of vulnerable disaster areas & early warning systems



Figure: Rheticus® Safeway service geoportals with analytics tools

References links

- <https://www.rheticus.eu/rheticus-services/safeway/>



EO services contributing to SDGs Rooftop Potential Analysis



- User: Urban Planners, City Developers, Architects, Municipalities
- Challenge/Needs: Dense population of the Netherlands needs efficient planning to maximize land use and urban planning potential
- Initiative: Created Roof Potential Map of existing and potential rooftop uses within Rotterdam city centre - users can utilize map to find practical and environmentally friendly solutions
- Results: Map visualizing existing rooftop uses, classified into 16 categories, indicating blue or green infrastructures and solar energy potential
- Service Provider: Space4Good (Gemeente Rotterdam + Zoarchitecten)

Target 9.1: Develop quality, reliable, sustainable and resilient infrastructure, including regional and trans- border infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all.
 Target 9.4: By 2030, upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes, with all countries taking action in accordance with their respective capabilities.
 Target 11.1: By 2030, ensure access for all to adequate, safe and affordable housing and basic services and upgrade slums.
 Target 11.3: By 2030, enhance inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management in all countries.





Detected roof types of Rotterdam overlaid on an RGB image



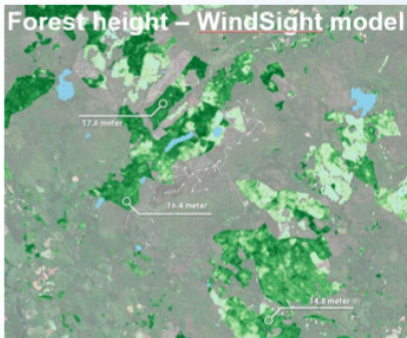
References link: <https://www.space4good.com/portfolio>

EO services contributing to SDGs

WindSight





- User: On shore wind industry
- Challenge/Needs: Accurate estimations of wind energy resources are highly complex and time consuming - ultimately relying on consistent, accurate and timely surface roughness data. Yet, in many cases especially in forested sites, such data is inaccessible or simply not available.
- Initiative: The services and products of WindSight were developed by DHI GRAS during Innwind: an Innovation Fund Denmark partnership from 2017-2020 with VESTAS, Vattenfall, EMD and DTU that aimed to improve the accuracy and coverage of map layers that are used as input to state-of-the-art flow models
- Results: WindSight includes 5 different high-resolution data products on land cover, key forest characteristics, historical and future changes, topography and surface roughness. Novel forest products provide detailed insight on current and historical forest height and forest density. Together with improved land cover product, these provide the backbone of the surface roughness product and provides insight on roughness length. The data can be input to a wide range of software and modelling methods including WindPRO, WaSP and CFD tools.
- Service Provider: DHI GRAS



Target 9.4: By 2030, upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes, with all countries taking action in accordance with their respective capabilities.





Example: the WindSight model is a low cost – fast delivery forest height model with grid size of 20m




Reference: <https://windsight.dhigroup.com/> / <https://www.dhi-gras.com/projects/eo4sdg/>

EO services contributing to SDGs

Rheticus® Building Check







- User: Local governmental authorities in charge of monitoring building stability - Architectural Heritage Conservation Services - Development Banks
- Challenge/Needs: Monitoring building stability is a key requirement for local administrations in order to prevent damages to their assets and ensure people safety and security and/or to have reliable information on buildings stability in order to properly design and tailoring property insurance coverage policies.
- Initiative: Internal Development
- Results: to simplify recovery plans, remediation and/or maintenance activities of existing assets. As a results, operators and stakeholders better manage their financial resources and reduce threats for their assets, cultural heritage and people.
- Service Provider: Planetek Italia's Rheticus platform



Target 1.5.: eo services focus on: Build resilience of vulnerable populations contributing to management of disaster risk reduction. Indicator 1.5.2: Disaster Damage
Target 9.1.: eo services based on Inform on infrastructures development & planning.
Target 11.5.: eo services based on Mapping of vulnerable disaster areas & early warning systems

Figure: Rheticus® Building Check service geoportail with analytics tools

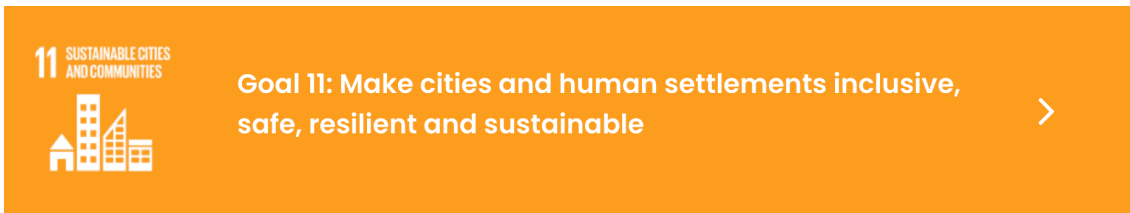


References links
https://www.esa.int/Applications/Observing_the_Earth/Copernicus/Sentinel-1/Using_satellite_information_to_help_rebuild_after_a_disaster

Relevant Success Stories

- [Ship arrival time service](#)
- [Pipeline Infrastructure in the Netherlands](#)
- [Environmental impact of road construction](#)
- [Assisting urban planning activities](#)
- [Monitoring service for railways](#)
- [EUROSENSE-Land cover monitoring](#)
- [Surface Deformation Monitoring with InSAR](#)
- [Oilfield performance study: Ghawar oilfield \(Saudi Arabia\)](#)

ix. SDG 11 - Sustainable Cities & Communities



ix.1 Goal: Make cities and human settlements inclusive, safe, resilient and sustainable.

EO data offer an invaluable opportunity for better-informing development policies and quantifying various targets. How can EO be used to help countries achieve specific targets? *Source: [ESA compendium of EO contributions to the SDG Targets and Indicators](#)*

Target 11.1: By 2030, ensure access for all to adequate, safe and affordable housing and basic services and upgrade slums.

“Currently, an estimated 1.6 billion people live in inadequate housing globally, of which 1 billion live in slums and informal settlements”. The rapid urban growth of recent decades has led to an increase of slums and informal settlements, as well as air pollution and inadequate basic services and infrastructure. The lack of proper urban planning and management can bring tenure insecurity, increase poverty, pollution, health risks, as well as a higher vulnerability and exposure to natural and technological hazards. To make urban spaces more inclusive, safe, resilient and sustainable the development, monitoring and management of better forms of urban plans are urgently needed. Many local governments ignore the extent of slums. “Slums disappear not through being removed, but by being transformed”, and in order to carry out this transformation the extent, the physical characteristics as well as the dynamics of slums, such as their densification and expansion, need to be understood and monitored. EO can help both understanding and monitoring slums, but can also link their morphology with socio-economic data, as well as help to identify hazardous areas where many of these settlements are located. An increased number of studies in the last 15 years have been published on the use of EO to understand geography and dynamics of slums, thanks to the availability of very-high-resolution (VHR) data and the advances in the methodologies to analyse them. The use of EO can support monitoring of slums and informal settlements growth, thanks to their frequent coverage of large areas, for which it would be difficult to regularly undertake on the ground household surveys. By knowing the dynamics and the extent of slums, sustainable urban plans and slum improvement policies can be developed and monitored, including the improvement of the building structures, access to water, electricity and other basic needs. VHR images are also increasingly used by slum communities and NGOs as a basis for mapping and enumeration, who then use the data to negotiate for recognition and their right to the city and its services.

(eo services based on Understand and monitor slums & informal settlements. Indicator 11.1.1: Informal settlements)

Target 11.2: By 2030, provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons.

EO data can inform the production of efficient and effective plans for road infrastructures and shipping routes (although, the global coverage of remote sensing images allows the identification of areas currently lacking infrastructures for transportation. This data can be combined with

census data to provide more detailed information on public transport that cannot be measured through EO (e.g. railways and subways), as well as data on vulnerable people. EO data has been widely used to extract infrastructures such as urban areas, roads and dams using data at different spatial resolution (e.g. rural roads can be detected just with high resolution images) and different techniques (e.g. supervised and unsupervised classification, neural networks, and mathematical morphology). Research is also currently focused on using high resolution or radar data to monitor the status of infrastructures, particularly in areas prone to natural disasters, such as flooding, but also in areas affected by conflicts (Roberts et al., 2006). The need to plan for regional and trans-border infrastructure is also well served by EO since it is technology that crosses borders and is not limited by a single country's or region's national data collection systems. In theory, open access EO data should help countries collaborate on shared infrastructure projects.

(eo services based on Assess production & efficiency for road infrastructures & shipping routes)

Target 11.3: By 2030, enhance inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management in all countries.

Urban areas are rapidly expanding to accommodate the growing number of people moving to cities. "From 2000 to 2015, in all regions of the world, the expansion of urban land outpaced the growth of urban populations". An uncontrolled urban sprawl can lead to the increase of carbon emissions, poverty, health and safety risks, social inequalities, and vulnerability to natural disasters. The achievement of this target will ensure that land is used efficiently, allowing sustainability and inclusiveness, but it also provides the foundation for attaining other sustainable development goals related to health, food security, energy, safety and poverty. Urban growth needs to be monitored and managed to ensure the sustainable use of land. The improvement of EO technology and the availability of high temporal and spatial resolution images, as well as the advancement in the methodologies proposed to identify built up areas from satellite images, have created a good opportunity to plan and monitor urban development. EO has been used for the direct monitoring and dynamic simulation of urban expansion since the '60s and new models and methods are continually being proposed and tested. Remote sensing data can support the generation of country specific urban expansion models and inform the development of sustainable urban plans. In particular, they can inform the development of urban plans that include the increase of green spaces where these are lacking, identify where these spaces have the capacity to mitigate natural hazard such as floods, and therefore should be prioritise for protection, which are the most vulnerable areas to disaster, as well as to enhance infrastructures such as roads or access to energy, in poorer areas of the city, to include its inclusiveness. The effectiveness of these plans can then be regularly monitored and adapted through EO.

(eo services based on Urban growth monitoring for sustainable use of land. Indicator 11.3.1: Land consumption)

Target 11.5: By 2030, significantly reduce the number of deaths and the number of people affected and substantially decrease the direct economic losses relative to global gross domestic product caused by disasters, including water-related disasters, with a focus on protecting the poor and people in vulnerable situations.

This target seeks to reduce the adverse effects of natural disasters. It recognises the growing impact of natural disasters around the world and the heightened risk, especially to vulnerable populations, e.g. in unplanned urban settlements without adequate protection or planning. It targets both slow-onset, climate related disasters such as sea level rise and extreme weather events. Human loss is the main focus of the target, both in terms of mortality and injury, and negative economic impacts of disasters. This target also relates to targets 1.3, 1.5, 3.6, 3.9, 15.3, 12.1 and 14.2 as well as related targets in the Sendai Framework for Disaster Risk Reduction 2015-2030. EO can play a role in both planning and achievement of this target. For planning purposes, EO can map both the areas that are vulnerable to disasters, e.g. coastal, low-lying areas or areas of deforested, steep slope, susceptible to landslides as well as to map vulnerable populations, e.g. through informal urban settlement mapping. EO also has a role to

play in planning for natural disasters by the provision of early warnings systems where flooding, fires and landslides pose a risk to people and their material goods. In order to achieve the target EO can be used to assess the overlap or proximity between vulnerable population and areas prone to disaster and the extent of change in this overlap area in order to ascertain if the human related loss is increasing or decreasing over time. Although not EO-derived, globally gridded GDP data can contribute to the achievement of this target by mapping the geographic location of the poor (see indicators 1.2.2 and 1.2.1).

(eo services based on Mapping of vulnerable disaster areas & early warning systems)

Target 11.6: By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management.

Minimising the per capita environmental impact of cities is challenged by traffic congestion, lack of funds to provide basic services, a shortage of adequate housing, declining infrastructure and rising air pollution within cities. This target covers aspects of waste generated by cities and aims to reduce the amount of solid waste generated and air polluted, while encouraging better waste management. Therefore EO can be used in three major aspects of this target – the spatial mapping of cities and the sources of pollution, the identification and treatment of waste in and around cities and in planning better waste management for per capita pollution reduction.

Firstly, satellite observations of human settlement are increasingly more sophisticated allowing the impact of cities to be assessed based on their spatial extent and density. EO-derived maps of cities allow the size, shape and other metrics of urban setting (e.g. monitored from which likely environmental impact could be inferred. Within cities there are identifiable sources of aerosol emissions such as power plants and various industrial processes. urban population) to be These sources generate significant amounts of particulates, e.g. fine particulate matter (PM2.5), which can have adverse effects on human health. Remote sensing of dry PM2.5 mass concentration near the ground is now feasible. In addition to particulates, trace gases that affect air quality are now routinely monitored over large urban areas.

In addition to air pollution, solid waste management can be supported in cities by using EO as a tool to evaluate the impact of different phases of the waste cycle. In particular, very high resolution EO has been shown to be effective in the detection of illegal waste disposal sites through visual image interpretation and classification as well as the monitoring of the spread of municipal landfill sites using multi-temporal thermal Landsat imagery.

(eo services based on Spatial mapping of cities & waste management. Indicator 11.6.2: Urban air quality)

Target 11.7: By 2030, provide universal access to safe, inclusive and accessible, green and public spaces, in particular for women and children, older persons and persons with disabilities.

Green and public spaces in cities are important for human well-being and economic development and should be sustainable spaces for all to use equally. Increasingly there are inadequate, poorly designed, or privatized public spaces in cities that generate exclusion and marginalization for inhabitants, especially those who are vulnerable.


This target addresses the drastic reduction in the quality of green and public space in cities and seeks to make them safe and inclusive for all regardless of gender, age or level of mobility. Public space is made of streets and green and open spaces in public use. EO can help countries to achieve this target because it is a useful tool to establish the extent of urban areas as well as to do an inventory of open space in cities, especially green open space. The challenge in using EO to complete the target will be in discerning what private and public space is as they will have the same spatial characteristics from an EO point of view. Furthermore the notion of access is complicated as it implies freedom of movement and this not a practically measurable quantity from EO. Therefore while certain aspects of the target can be planned for using EO, much will

depend on other in situ data sources or local ancillary data such as cadastral records, land use or basic topography.

(eo services based on Mapping extend of urban areas)

EO Products/Services supporting the SDGs

EO services contributing to SDGs Rheticus® Safeland



- User: Regional to local authorities, Environmental protection agencies, Civil engineering companies
- Challenge/Needs: Land instability represents a serious source of danger for citizens safety, infrastructure safeguarding and environmental protection. Prioritize areas based on the level of concern to better manage inspection and investments for stability works represents a huge need
- Initiative: Internal Development
- Results: The service gives a level of concern to each portion of a territory allowing customers to easily detect areas with a high level of concern, prevent potential damage, better organize field inspections, and achieve cost-effective management of the territory. The service provides the proper knowledge to support planners to avoid critical issues deriving from not full pictures of in progress phenomena.
- Service Provider: Planetek Italia's Rheticus platform

Target 1.5.: eo services focus on: Build resilience of vulnerable populations contributing to management of disaster risk reduction. Indicator 1.5.2: Disaster Damage
Target 9.1.: eo services based on Inform on Infrastructures development & planning.
Target 11.5.: eo services based on Mapping of vulnerable disaster areas & early warning systems





Figure: Rheticus® Safeland service geoportal with analytics tools


1



References links



- <https://www.rheticus.eu/rheticus-services/safeland/>

EO services contributing to SDGs Informal settlement AI toolchain




- User: UN; World bank, NGO's & aid organizations, central and sub-national governmental institutions, insurance sector, ...
- Challenge/Needs:
 - Identify slums using AI techniques;
 - Evaluate the evolution of slums over time and predict their future expansion including population estimates;
 - Understanding of informal settlement development and the relation with access to key services;
 - Analysis of exposure to natural hazards
- Initiative: Transferable Open-source community tool
- Results:
 - A tool which is transferrable to various regions (already applied in Asia & Latin-America)
 - A tool which make us of different type of data
 - A tool which can be run by local technical operators
- Service Provider: [Geographic Information Management NV](#)

Target 11.1: By 2030, ensure access for all to adequate, safe and affordable housing and basic services and upgrade slums.
Target 11.2: By 2030, provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons.
Target 11.3: By 2030, enhance inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management in all countries.
Target 11.5: By 2030, significantly reduce the number of deaths and the number of people affected and substantially decrease the direct economic losses relative to global gross domestic product

https://www.gdtr.org/sites/default/files/program/Learn%20more_%20the%20City%20Resilience%20Scan.pdf

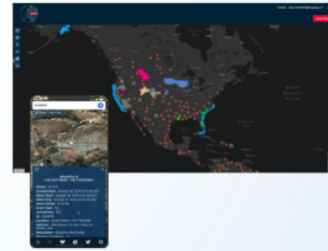


EO services contributing to SDGs Mayday.ai – real time disaster and risk intelligence



- Users: organisation with a mandate in disaster management, humanitarian and development aid, government agencies, international organisations, NGOs
- Challenge/Needs: Mayday's products are reducing the impact of natural and human-made disasters on the population, economies and the world's cultural and natural heritage by focusing on prevention. This is possible through an effective risk reduction by the authorities and citizens (i.e. awareness-raising and guidance over the mobile app). Moreover, early containment that is possible with Mayday's early detection features and common operating picture considerably reduce damage that disasters can cause.
- Initiative: commercialisation starting as of autumn 2021
- Results: reduction of impact (less fatalities, economic damage and environment degraded), increased resilience, strategic farming
- Service Provider: [Mayday.ai](https://www.mayday.ai)

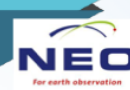
Targets: 11.4: Strengthen efforts to protect and safeguard the world's cultural and natural heritage, **11.5:** By 2030, significantly reduce the number of deaths and the number of people affected and substantially decrease the direct economic losses relative to global gross domestic product caused by disasters, including water-related disasters, with a focus on protecting the poor and people in vulnerable situations.



Mayday.ai's disaster and risk platform

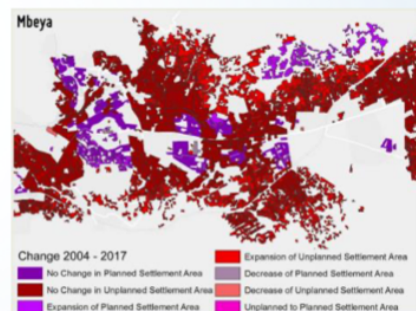


EO services contributing to SDGs Informal settlement mapping



- User: city planner, policy makers, hazard management department
- Challenge/Needs: The haphazard development of informal settlements is in a consequence of uncontrolled urban growth and represents a major challenge for urban planners and city authorities. Many countries have inadequate data and little knowledge on informal settlement locations, their spatial extent and growth patterns. This product maps the slum and informal settlement areas and the changes through years to assist in a better understanding these areas by providing insights into the extent, spatial patterns, expanding trends. It also contributes to the estimation of the vulnerability to natural hazards and the assessment of related risks.
- Initiative: Earth Observation for Sustainable Development (EO4SD) – European Space Agency (ESA) program, aims to achieve increasing the uptake of satellite based information in the financial institutions' regional and global development programmes with a focus on urban development, agriculture and rural development . It aims to meet the long term, strategic geospatial information needs in the individual developing countries as well as international and regional development organisations.
- Results: 1) mapping the informal settlement areas from different years using EO data 2) mapping the changes through the years 3) derived the statistics on the changed extent
- Impact: The settlements are dynamic with frequent population fluctuations, temporal and spatial high resolution EO data can provide city planners with data which would be otherwise difficult to obtain. In developing countries, traditional field mapping is difficult as well as time and cost consuming. Satellite data based analysis is therefore a unique tool for rehabilitation activities.

Target 11.1: By 2030, ensure access for all to adequate, safe and affordable housing and basic services and upgrade slums.



Informal settlement changes



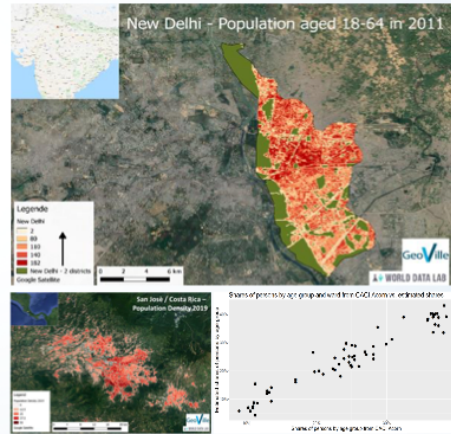
EO4SD program website:
<https://eo4sd-urban.info/>

EO services contributing to SDGs
Population density, modelling and forecasting



- **Users:** Development Agencies, Urban planning Agencies, IFIs
- **Challenge:** Enhancing census data with EO to provide high resolution and accuracy estimations of demographic parameters, and its evolution in time, to inform sustainable urban plans, specifically for slums and informal settlements' improvement policies.
- **Initiative:** DemographEye – Automated population density mapping and modelling using EO data + modelling and forecasting of a variety of demographic variables at global scale and at unprecedented resolution.
- **Results:** EO data significantly improves existing census data through a modelling approach based on land cover and land use information. DemographEye links EO derived population density with state-of-the-art demographic models. The unique approach not only provides spatially explicit demographic data along with information on other parameters (age, health, education, income), but also allows long-term forecasting at different levels of granularity (25, 50 & 100m)

Target 11.3: By 2030, enhance inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management in all countries.



• **Service provider:** GeoVille
 References: <https://business.esa.int/projects/agespot>

EO services contributing to SDGs
Impervious surface mapping



- **User:** Environmental authorities, city planners, local authorities
- **Challenge/Needs:** Impervious surfaces have a direct impact on the volume, duration and intensity of surface runoff; groundwater recharge; water quality and the hydrological cycle. Spatially explicit information about the amount, location and type of impervious surfaces aids decision making in the context of sustainable urban planning, water resource management, climate mitigation and greening strategies.
- **Initiative:** Commercial product as a result of several years R&D
- **Results:** The impervious surface data depicts spatially explicit information about the amount, extent, location and type of impervious surfaces, using advanced image analysis of satellite imagery or aerial photos. By applying novel machine learning technology and cloud processing, the solution is highly automated, and scalable, and can be applied anywhere worldwide at a specific point in time to differentiate between various types of impervious surface roads (e.g. roads, rooftops, parking lots) and pervious areas (e.g. parks, lakes, streams).
- **Service Provider:** DHI GRAS

Target 6.3: By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally.

Target 9.1: Develop quality, reliable, sustainable and resilient infrastructure, including regional and trans-border infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all.

Target 11.3: By 2030, enhance inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management in all countries.



Example: The impervious surface mapping solution provides fast and accurate information about urban land cover in grid cell resolutions from submeter levels to 10 m.



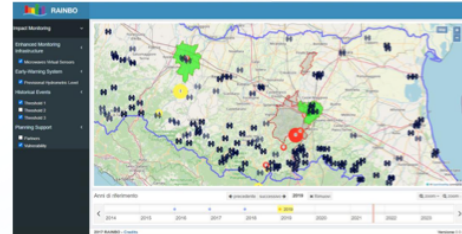
Reference: <https://www.dhi-gras.com/solutions/urban-mapping/> // <https://www.dhi-gras.com/projects/eo4sdg/>

RAINBO: monitoring and predicting severe rainfall events and their impact



- User: municipalities, public authorities
- Challenge/Needs: to improve knowledge, methods and tools in response to extreme weather events.
- Initiative: RainBO (LIFE15 CCA IT 000035), coordinated by LEPIDA SpA.
- Results: monitoring framework (web platform) based on an integrated network of traditional sensors (river hydrometric information, radar and raingauge rainfall data etc) and new technologies (microwave link technology for precipitation estimation). API available to integrate outputs within other services/platforms; possibility to scale-up with new monitoring modules to extend the geographic domain.
- Service Provider: LEPIDA SpA for the whole RainBO platform (API available). MEEO Srl for the near-real time rainfall monitoring based on microwave link technology.

Target 11.5: By 2030, significantly reduce the number of deaths and the number of people affected and substantially decrease the direct economic losses relative to global gross domestic product caused by disasters, including water-related disasters, with a focus on protecting the poor and people in vulnerable situations.



RainBO webGIS interface – historical events monitoring on the project pilot areas of the Emilia Romagna region (Italy): vulnerability areas in green, microwave link sensors in black, yellow and red dots for river level alert threshold overcoming.



<http://webgis.rainbolife.eu/impactmonitoring/>
<https://www.rainbolife.eu/>
<https://www.lepida.it/>

EO services contributing to SDGs Monitoring of illegal dumping of waste



- User: Urban planning departments
- Challenge/Needs: enabling continuous monitoring of land use/ land-cover changes, soil consumption, impervious surfaces assessment, and urban heat islands detection, as well as supporting spatial planning to achieve smart growth.
- Initiative: H2020 Eugenius
- Results: allows to monitor urban changes and their evolutionary trend over time, facilitating planning activities and land management
- Service Provider: Planetek Italia's Rheticus platform

Target 1.5.: eo services focus on: Build resilience of vulnerable populations contributing to management of disaster risk reduction.
 Target 9.1.: eo services based on Inform on infrastructures development & planning.
 Target 11.3.: eo services based on Urban growth monitoring for sustainable use of land. Indicator 11.3.1: Land consumption
 Target 11.6.: eo services based on Spatial mapping of cities & waste management
 Target 11.7.: eo services based on Mapping extend of urban areas



Figure: Rheticus® Urban Dynamics service geoport with analytics tools



References: <https://www.rheticus.eu/rheticus-services/urban-dynamics/>

EO services contributing to SDGs
Monitoring of illegal dumping of waste

AIR & SPACE EVIDENCE

11 SUSTAINABLE CITIES AND COMMUNITIES

- Users: environmental agencies, regulators, law enforcement
- Challenge: Detect and deter illegal dumping of waste to help governments fight organized crime, minimize the environmental threat, and recover billions of euros in lost tax revenue.
- Initiative: We develop feature and change detection models using free and open source SAR and optical data to identify potential illegal landfills. This was supported by ODINE, the EU incubator for innovative open data startups.
- Results: Our initial screening model removes 99.4% of the surveyed land mass from consideration. A closer examination of the images of the remaining areas allows us to highlight potential illegal landfills and produce evidence of the scale and duration of the illegal burning and dumping activity.
- Service Provider: Air & Space Evidence Ltd

Target 11.3.: eo services based on Urbeo services based on Inform on infrastructures development & planning. an growth monitoring for sustainable use of land. Indicator 11.3.1: Land consumption
 Target 11.6.: eo services based on Spatial mapping of cities & waste management
 Target 11.7.: eo services based on Mapping extend of urban areas



Fig. Extracted from Air & Space Evidence site. Detection Model Evidence Investigations, which uses satellite data and algorithms to find unknown illegal sites.

References: <http://www.space-evidence.net/about-us/>

EARSC
 European Association
 of Remote Sensing
 Companies

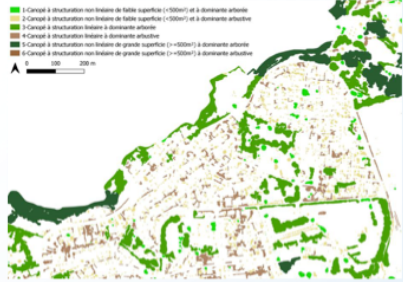
EO services contributing to SDGs
Urban vegetation mapping

KERMAP

11 SUSTAINABLE CITIES AND COMMUNITIES

- User: City of Limoges (Pop: 130,000)
- Challenge/Needs: Diagnosis of urban vegetation, green infrastructure and ecosystem services within the city
- Initiative: Fine mapping of vegetation (tree, shrub and grass) through EO, modelling of accessibility to green spaces, identification of urban heat and cool islands, ecosystem services classification
- Results: Creation of new green spaces, revegetation of the Vienne river banks, preservation of non-artificialized areas
- Service Provider: Kermap

Target 11.7: By 2030, provide universal access to safe, inclusive and accessible, green and public spaces, in particular for women and children, older persons and persons with disabilities.



Fine mapping of vegetation in Limoges – ©Kermap

EARSC
 European Association
 of Remote Sensing
 Companies

Kermap.com

EO services contributing to SDGs Observatory of Urban Green Areas



9
INFRASTRUCTURE
AND TRANSPORT

11
SUSTAINABLE
CITIES AND
COMMUNITIES

13
CLIMATE
ACTION

- User: Municipality of Thessaloniki
- Challenge/Needs: Provide a Green Areas monitoring Tool capable to calculate the sufficiency of vegetation per district and municipal unit in the Municipality using EO data. The tool will support the evaluation of the status of the Sustainable Development Goals (SDGs) set by the Municipality
- Initiative: Maintenance and upgrade of Municipality's Spatial Data Infrastructure (SDI) with additional EO / Copernicus data and services
- Results: The Observatory of Urban Green Areas application provides actionable insights from the valorization of Satellite data towards sustainable urban planning and design. EO, geospatial data, and the information provided through Observatory of Urban Green Areas play insightful roles in monitoring targets, tracking progress, as well as helping the Municipality and stakeholders make informed decisions toward achieving the Sustainable Development Goals. The Service can be replicated to support additional Municipalities since it uses freely available Copernicus and Census data.
- Service Provider: Geospatial Enabling Technologies



The Observatory of Urban Green Siting by GET

Target 9.1.: EO services based on Inform on infrastructures development & planning

Target 11.3.: EO services based on Urban growth monitoring for sustainable use of land.

Target 11.7.: EO services based on Mapping extend of urban areas

Target 13.1.: EO services based on Identifying, monitoring and preparing for climate related hazards

EO services contributing to SDGs Rheticus® Safeway



1
PEOPLE

9
INFRASTRUCTURE
AND TRANSPORT

11
SUSTAINABLE
CITIES AND
COMMUNITIES

- User: Engineering & transport infrastructure management companies
- Challenge/Needs: reduce service disruptions and/or threats for people.
- Initiative: Internal Development
- Results: the service allows an “a priori” approach, helping to highlight problems before they become critical. As a result, operators better manage their financial resources, ensure people’s safety, environmental protection and the safeguarding of assets at all stages of the life cycle of infrastructures, from design to production, management and maintenance.
- Service Provider: Planetek Italia’s Rheticus platform



Figure: Rheticus® Safeway service geoportal with analytics tools

Target 1.5.: eo services focus on: Build resilience of vulnerable populations contributing to management of disaster risk reduction. Indicator 1.5.2: Disaster Damage

Target 9.1.: eo services based on Inform on infrastructures development & planning.

Target 11.5.: eo services based on Mapping of vulnerable disaster areas & early warning systems

References links

- <https://www.rheticus.eu/rheticus-services/safeway/>



References link: <https://demos6.getmap.gr/greenobservatory/>

EO services contributing to SDGs Rheticus® Urban Dynamics



- User: Urban planning departments
- Challenge/Needs: enabling continuous monitoring of land use/ land-cover changes, soil consumption, impervious surfaces assessment, and urban heat islands detection, as well as supporting spatial planning to achieve smart growth.
- Initiative: H2020 Eugenius
- Results: allows to monitor urban changes and their evolutionary trend over time, facilitating planning activities and land management
- Service Provider: Planetek Italia's Rheticus platform

References links

- <https://www.rheticus.eu/rheticus-services/urban-dynamics/>

Target 1.5.: eo services focus on: Build resilience of vulnerable populations contributing to management of disaster risk reduction.
 Target 9.1.: eo services based on Inform on infrastructures development & planning.
 Target 11.3.: eo services based on Urban growth monitoring for sustainable use of land. Indicator 11.3.1: Land consumption
 Target 11.6.: eo services based on Spatial mapping of cities & waste management
 Target 11.7.: eo services based on Mapping extend of urban areas



Figure: Rheticus® Urban Dynamics service geoportail with analytics tools

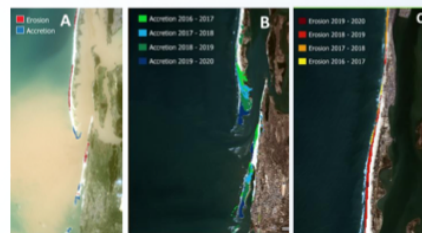


EO services contributing to SDGs Natural disasters – Monitoring coastal erosion



- User: West Africa Coastal Areas Management Program (WACA), Governmental authorities of the Republic of Maldives (coastal zone management, institutions involved in financial planning of infrastructure projects, the tourism industry and entities involved in early warning and resilience)
- Challenge/Needs:
 - Support long term resilience measures
 - Identification and prioritization of coastal zone management
- Initiative: PrepaCoast (Development under a Kick-start Activity of ESA Business Applications)
- Results:
 - Online tool (powered by Google Earth Engine platform) to map coastal erosion and accretion
 - Impact: Identification of communities and infrastructure at risk. Improved decision-support for coastal protection
- Service Provider: Remote Sensing Solutions GmbH

Target 11.5: By 2030, significantly reduce the number of deaths and the number of people affected and substantially decrease the direct economic losses relative to global gross domestic product caused by disasters, including water-related disasters, with a focus on protecting the poor and people in vulnerable situations.



Example: coastal erosion monitoring tool in Senegal. A) Intra-annual changes, B) annual accretion and C) annual erosion



Example: coastal erosion monitoring tool in the Maldives



<https://business.esa.int/projects/prepacoast>



EO services contributing to SDGs Monitoring real state development



- **User:** 5 cities in Poland (including Wroclaw)
- **Challenge/Needs:** Monitoring real estate development to ensure development is reflected in the city's to cadastre and property tax registry
- **Initiative:** The service was delivered to the city of Wroclaw, where Planet teamed up with SatRevolution to create an alert system flagging new buildings, extensions or urban land use changes not reflected in the cadaster.
- **Results:** The Treasury used the solution to verify whether the reported land use change matches the recorded property tax scheme and plan tax controls. Initial results reflected EUR 1 million additional revenue.
- **Service Provider:** SatRevolution

Target 11.3: By 2030, enhance inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management in all countries.

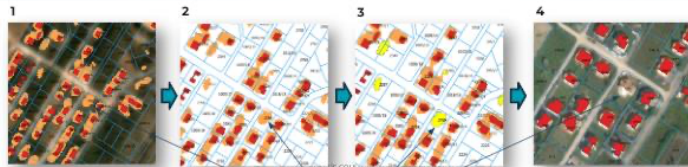


Figure (left) shows how the system flags mismatched between urban land use and cadastral records

IDENTIFIED INCONSISTENCY

Reference: <https://youtu.be/6RVf4zQ-E8Q>



EO services contributing to SDGs Mayday.ai – disaster and risk intelligence platform



- **Users:** organisation with a mandate in disaster management, humanitarian and development aid such government agencies, international organisations, NGOs (health divisions) or the (re)insurance sector
- **Challenge/Needs:** Reduce impact of natural & human-made disasters, with focus on early detection & risk management.
- **Initiative:** Mayday.ai's provide specific products helping on the monitoring of sustainable agriculture including food production. Products provide risk related to air pollution magt, urban/infrastructure planning (floodings, heat waves). Its products also help on the monitoring of natural habitats avoiding degradation or reducing the impact of wildfires and restoration. Overall they bring full transparency to the area of disaster and help to democratise the data for manegement activities. Its commercialisation starts as of autumn 2021
- **Results:** reduced impact (less fatalities, economic damage & environment degraded), increased resilience, lower insurance premiums/insurance more competitive, higher awareness, in-depth knowledge. Scalability and replicability products
- **Service Provider:** [Mayday.ai](https://www.mayday.ai)

- Target 1.5: Mapping spatial distribution of risk of poverty
- Target 2.4: Agricultural productivity & env. impact of agriculture. Indicator 2.4.1: Sustainable agriculture
- Target 3.9: Monitor the level of air quality data
- Target 6.3: Water quality detection & monitoring. Indicator 6.3.2: Ambient water quality
- Target 9.a: Sustainable and resilient infrastructure development
- Target 11.4: Protect and safeguard the world's cultural and natural heritage
- Target 12.4: Waste management
- Target 13.1: Identifying, monitoring and preparing for climate related hazards
- Target 15.2: Progress towards sustainable forest management (biomass, area of change, etc) Indicator 15.2.1: Sustainable forest management
- Target 15.5: Reduce the degradation of natural habitats, halt the loss of biodiversity
- Target 16.1: Effective, accountable and transparent Institutions
- Target 16.10: Ensure public access to information



Mayday.ai's disaster and risk platform



EO services contributing to SDGs
Spatial impacts of forced displacement for evidence-based decision making, coordination and durable solutions



- **User:** The Asian Development Bank
- **Challenge/Needs:** Changzhi City, in the central region of the People’s Republic of China, is at the beginning of a transition towards a modern and diverse urban economy. Its current dependency on coal-mining has led to air, water, and soil pollution, as well as subsidence from underground mining which poses a threat to public safety and health. Climate change is expected to bring increased temperatures, which will only exacerbate the health issues associated with poor air quality.
- **Initiative:** EO4SD Climate resilience
- **Results:** GMV provided the ADB with examples of how to include EO data in new economic prospects to help decision makers to identify nature-based, environmentally sensitive, green and inclusive tourism, trekking paths, and preserve historic villages, all whilst taking into account the impact of future climate change. Among the EO products derived, a map of presence and type of green urban areas (discriminating between arboreal and non-arboreal vegetation) and a map of extreme heat
- **Service Provider:** GMV (<https://gmv.com/en-es/sectors/space>)

Target 11.7: By 2030, provide universal access to safe, inclusive and accessible, green and public spaces, in particular for women and children, older persons and persons with disabilities.
 Ind. 11.7.1: Average share of the built-up area of cities that is open space for public use for all.



Vegetation strata and green infrastructure cover in Changzhi, China



EO services contributing to SDGs
CityLST/GreenSSLM – Atmosphere and Hazards monitoring in cities



- **User:** Government Agencies, Public Authorities, NGOs, Local Government, Businesses, Citizens’ Groups.
- **Challenge/Needs:** Cities, their industrial areas, and their related communities have intricate planning and varying degrees of settlement density and infrastructure. This produces a multitude of variables that directly affect efficiency and production, as well as vulnerability and slower reaction time to natural and man-made disaster.
- **Initiative:** A platform that can combine information collected across multiple sources, analysis of satellite data with cutting edge algorithms, and an innate understanding of disaster indicators, monitoring and management.
- **Results:** Multi-purpose platform with precise mapping of findings including vulnerable disaster areas & early warning systems, validated multilayered information that can be trusted, and a great understanding of disaster indicators and monitoring for early warning against and better management of crises.
- **Service Provider:** Aratos Systems.

Target 11.5: By 2030, significantly reduce the number of deaths and the number of people affected and substantially decrease the direct economic losses relative to global gross domestic product caused by disasters, including water-related disasters, with a focus on protecting the poor and people in vulnerable situations.

Target 11.6: By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management. Indicator 11.6.2: Urban air quality




Spatial distribution of land surface temperature in the city of Rotterdam.



<https://www.citylst.com/>

<https://www.greenslm.com/>

EO services contributing to SDGs Rooftop Potential Analysis


- User: Urban Planners, City Developers, Architects, Municipalities
- Challenge/Needs: Dense population of the Netherlands needs efficient planning to maximize land use and urban planning potential
- Initiative: Created Roof Potential Map of existing and potential rooftop uses within Rotterdam city centre - users can utilize map to find practical and environmentally friendly solutions
- Results: Map visualizing existing rooftop uses, classified into 16 categories, indicating blue or green infrastructures and solar energy potential
- Service Provider: Space4Good (Gemeente Rotterdam + Zoarchitecten)

Target 9.1: Develop quality, reliable, sustainable and resilient infrastructure, including regional and trans- border infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all.

Target 9.4: By 2030, upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes, with all countries taking action in accordance with their respective capabilities.

Target 11.1: By 2030, ensure access for all to adequate, safe and affordable housing and basic services and upgrade slums.

Target 11.3: By 2030, enhance inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management in all countries.



Detected roof types of Rotterdam overlaid on an RGB image



References link: <https://www.space4good.com/portfolio>

EO services contributing to SDGs Earth Observation data for Sustainable Development




- User: Local governments, real estate, humanitarian aid, emergency response
- Challenge/Needs: Monitor human activity and rapid development to understand impact on environment, access to critical resources, emergency response planning, and opportunities for sustainable development projects
- Initiative: Smart city planning, urban renewal projects, humanitarian and refugee programs
- Results: Source to build or enhance a geospatial database for ongoing studies, long-term projects, and disaster response.

[It Takes a Global Village: Building True Digital Twins to Drive Geospatial Adoption / Improving Disaster Response with Earth Observation Data](#)


- Service Provider: Satellogic

- Target 11.1: By 2030, ensure access for all to adequate, safe and affordable housing and basic services and upgrade slums.

- Target 11.3: By 2030, enhance inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management in all countries.

- Target 11.5: By 2030, significantly reduce the number of deaths and the number of people affected and substantially decrease the direct economic losses relative to global gross domestic product caused by disasters, including water-related disasters, with a focus on protecting the poor and people in vulnerable situations.

- Target 11.7: By 2030, provide universal access to safe, inclusive and accessible, green and public spaces, in particular for women and children, older persons and persons with disabilities



This capture shows the deep seaport of Berbera, in Somalia. True digital twins can feature Digital Surface Models (DSM) that provide 3D shapes of structures such as warehouses or quays. True digital twins can also point out how many ships are docked on a certain date.



<https://satellogic.com/earth-observation/critical-infrastructure/>
<https://satellogic.com/2022/09/14/true-digital-twins/>
<https://satellogic.com/2022/03/29/ogc-disaster-pilot-project-21-improving-disaster-response-with-earth-observation-data/>

EO services contributing to SDGs Environmental Indicators SaaS



- User: Municipalities, urban planners, smart cities, consultancy firms
- Challenge/Needs: Improve urban planning. Early warning systems detecting vulnerable areas for climate extremes. Evaluate green areas quality and ecosystem services.
- Initiative: Offer in a unique platform easy access to environmental indicators data, always updated, multi-scale levels (municipality – neighbourhood), targets achievement and expected.
- Results: more than 15 cities monitored, more than 100 indicators managed.
- Service Provider: Green Urban Data, Sentinel-2,3,5, Urban Atlas, Landsat 8, Planet, others

Target 11.3: By 2030, enhance inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management in all countries.

Target 11.5: By 2030, significantly reduce the number of deaths and the number of people affected and substantially decrease the direct economic losses relative to global gross domestic product caused by disasters, including water-related disasters, with a focus on protecting the poor and people in vulnerable situations.

Target 11.6: By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management.

Target 11.7: By 2030, provide universal access to safe, inclusive and accessible, green and public spaces, in particular for women and children, older persons and persons with disabilities.



Drought & Vegetation quality SaaS Indicator for Fuenlabrada (Spain)

Urban Heat Islan SaaS Indicator from Zaragoza (Spain)



greenurbandata.com

EO services contributing to SDGs Monitoring of illegal dumping of waste



- Users: environmental agencies, regulators, law enforcement
- Challenge: Detect and deter illegal dumping of waste to help governments fight organized crime, minimize the environmental threat, and recover billions of euros in lost tax revenue.
- Initiative: We develop feature and change detection models using free and open source SAR and optical data to identify potential illegal landfills. This was supported by ODINE, the EU incubator for innovative open data startups.
- Results: Our initial screening model removes 99.4% of the surveyed land mass from consideration. A closer examination of the images of the remaining areas allows us to highlight potential illegal landfills and produce evidence of the scale and duration of the illegal burning and dumping activity.
- Service Provider: Air & Space Evidence Ltd

Target 11.3.: eo services based on Urbeo services based on Inform on infrastructures development & planning. an growth monitoring for sustainable use of land. Indicator 11.3.1: Land consumption
Target 11.6.: eo services based on Spatial mapping of cities & waste management
Target 11.7.: eo services based on Mapping extend of urban areas



Fig. Extracted from Air & Space Evidence site. Detection Model Evidence Investigations, which uses satellite data and algorithms to find unknown illegal sites.



References: <http://www.space-evidence.net/about-us/>

EO services contributing to SDGs: Urban planning



- User: ONU agencies, Governments, Local Governments.
- Challenge/Needs: Urban planning, access to services, risk reduction, green agenda.
- Initiative: SmartGov Initiative aims to implement digital transformation strategies for Government 4.0 in the cities and local governments based on the application of EO satellites and geospatial technologies. The digital transformation strategies consist in solutions for Spatial Data Infrastructure (SDI), Multipurpose Cadastre, Infrastructure and Change Control, Trees and Green Spaces, Environment and Waste, Comprehensive Risk Management, among others, based on our big data geospatial platform Geo.Platform, Earth observation satellites, specific training and expert consulting.
- Results: Implemented in several cities across Argentina. Optimized income for local government, better services and city planning for citizens. These solutions and experiences were designed based on scalable technologies and services throughout the national territory with the aim of reaching a wide range of Cities and Local Governments, training them and supporting them in their digitization processes for a more intelligent, efficient and closer government to every citizen.
- Service Provider: SPACESUR

Target 11.1: By 2030, ensure access for all to adequate, safe and affordable housing and basic services and upgrade slums.
 Target 11.3: By 2030, enhance inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management in all countries.
 Target 11.5: By 2030, significantly reduce the number of deaths and the number of people affected and substantially decrease the direct economic losses relative to global gross domestic product caused by disasters, including water-related disasters, with a focus on protecting the poor and people in vulnerable situations.
 Target 11.6: By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management.
 Target 11.7: By 2030, provide universal access to safe, inclusive and accessible, green and public spaces, in particular for women and children, older persons and persons with disabilities.

Geo.Platform | SmartGov

Welcome to SmartGov on Cloud

Solution module for green spaces management



WWW.SPACESUR.COM

VEG-GAP: vegetation impact on air quality



- User: municipalities, public authorities, urban air quality planner, citizens
- Challenge/Needs: to provide new information for urban air quality plans, by investigating the vegetation's effects on air quality in the cities, its impact on temperatures and further changes on air pollution, understanding whether urban green, in some chemical and atmospheric conditions, can entail health risks for humans and vegetation ecosystems. Bologna, Milan and Madrid are the three project pilot cities using urban green for adaptation to climate change.
- Initiative: Veg-Gap LIFE preparatory project (LIFE18 PRE IT 003 project) coordinated by ENEA.
- Results: web based Information platform designed for responsible authorities to plan their interventions on urban vegetation and pollution reduction as well as to inform citizens. Possibility to scale up by adding further air quality monitoring module and to be replicated on further cities.
- Service Provider: MEEO Srl (for the web application) under the supervision of ENEA as project coordinator and cloud infrastructure provider

Target 11.6: By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management.
 Indicator 11.6.2: Urban air quality

Veg Gap
Vegetation for Urban Green Air Quality Plans



LIFE-18 PRE IT 003 - The VEG-GAP project has received funding from the LIFE Programme of the European Union

Daily temperature variation (with and without vegetation) map of Bologna for a summer day and temporal analysis with hourly, daily and monthly time range.



<https://www.lifeveggap.eu/>
<https://veggapplatform.enea.it>

EO services contributing to SDGs Flood risk mapping for urban development

- User: City/Municipality administrations for urban development.
- Challenge/Needs: City of Kutina soil map update with regards to the area of frequent flooding.
- Initiative: Use of Sentinel-1 SAR GRD imagery for:
 - Detecting significant increase in soil water and surface water.
 - Detecting the frequency and length of floods.
 - Mapping affected areas, and updating the soil map
 - Providing data of flooding risk to urban development planners
- Results: Soil map updated for areas prone to flooding events, map of areas with special risk of flooding
- Service Provider: Oikon Ltd. – Institute of Applied Ecology

Target 11.3: By 2030, enhance inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management in all countries.

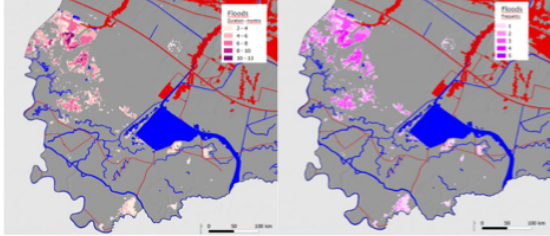


Figure: Flood duration (left) and frequency (right) map of City of Kutina, created using Sentinel-1 data



EO services contributing to SDGs Rheticus® Building Check






- User: Local governmental authorities in charge of monitoring building stability - Architectural Heritage Conservation Services - Development Banks
- Challenge/Needs: Monitoring building stability is a key requirement for local administrations in order to prevent damages to their assets and ensure people safety and security and/or to have reliable information on buildings stability in order to properly design and tailoring property insurance coverage policies.
- Initiative: Internal Development
- Results: to simplify recovery plans, remediation and/or maintenance activities of existing assets. As a results, operators and stakeholders better manage their financial resources and reduce threats for their assets, cultural heritage and people.
- Service Provider: Planetek Italia's Rheticus platform

Target 1.5.: eo services focus on: Build resilience of vulnerable populations contributing to management of disaster risk reduction. Indicator 1.5.2: Disaster Damage
Target 9.1.: eo services based on Inform on infrastructures development & planning.
Target 11.5.: eo services based on Mapping of vulnerable disaster areas & early warning systems



Figure: Rheticus® Building Check service geoportal with analytics tools

References links
https://www.esa.int/Applications/Observing_the_Earth/Copernicus/Sentinel-1/Using_satellite_information_to_help_rebuild_after_a_disaster

EO services contributing to SDGs
Greencity

11 SUSTAINABLE CITIES AND COMMUNITIES

terraNIS
4 New Information Services

Target 11.3: By 2030, enhance inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management in all countries.

- User: Cities and public entities
- Challenge/Needs: Urban growth monitoring for sustainable use of land. Indicators of the vegetation state and components in the cities and public entities, tool to help urban vegetation planning.
- Initiative: We provide indicators and dashboards to evaluate the biodiversity and well being of cities and give action tools for cities to take concrete actions and measure the impact. Greencity is based on satellite imagery and local open data.
- Results: Greener cities, preservation of biodiversity in cities, improvement of urban citizens well-being.
 - Benefits: (i) Follow a wide variety of customized indicators to characterize and analyse urban biodiversity (ii) Get a one-stop shop for all green-related data in a given territory (iii) Update, change, replace all or some indicators over time if needed
 - Impact: (i) Define high-priority action areas (ii) Allocate restricted resources to the relevant zones (iii) Work retroactively to analyse real impact of past projects (iv) Get actionable and justified data to craft future projects (v) Communicate and collaborate effectively across departments and functions
- Scalability: (i) Clear market focus (ii) Highly repeatable solution (iii) Unique market differentiation

• Service Provider: TerraNIS

EARSC
European Association
of Remote Sensing
Companies

<http://www.terrnis.fr/en/environment-territories-greencity/>



Low and high vegetation over a city based on satellite imagery

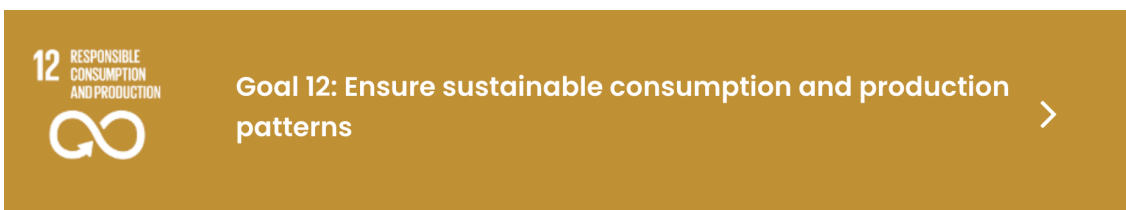


Example of biodiversity vegetation dashboard

Relevant Success Stories

- [Assisting urban planning activities](#)
- [Monitoring service for railways](#)
- [Forest cover mapping in Cambodia](#)
- [Lidar data processing](#)
- [DMCii supports the fight with illegal logging in the Amazon](#)
- [Improving seismic surveys: planning, acquisition and processing](#)
- [Improving waste management practices](#)

x. SDG 12 - Responsible Consumption & Production



x.1 Goal: Responsible Consumption and Production

EO data offer an invaluable opportunity for better-informing development policies and quantifying various targets. How can EO be used to help countries achieve specific targets? *Source: [ESA compendium of EO contributions to the SDG Targets and Indicators](#)*

Target 12.4: By 2020, achieve the environmentally sound management of chemicals and all wastes throughout their life cycle, in accordance with agreed international frameworks, and significantly reduce their release to air, water and soil in order to minimize their adverse impacts on human health and the environment

(eo services based on assessment of air, water or soil quality pollution parameters on the human health)

EO Products/Services supporting the SDGs

EO services contributing to SDGs

Mayday.ai – environmental monitoring module

- Users: organisation with a mandate in disaster management, humanitarian and development aid, government agencies, international organisations, NGOs, health verticals, utilities
- Challenge/Needs: Mayday's platform allows environmental monitoring/of disasters in real time and high levels of granularity. The platform allows the ingestion of proprietary data for a sharper common operating picture once air pollution or chemical pollution happen. With Mayday, early detection and containment becomes way more effective and cost-efficient compared to other monitoring approaches.
- Initiative: commercialisation starting as of autumn 2021
- Results: reduction of impact (less fatalities, economic damage and environment degraded), increased resilience

Service Provider: [Mayday.ai](https://www.mayday.ai)




Target: 12.4: By 2020, achieve the environmentally sound management of chemicals and all wastes throughout their life cycle, in accordance with agreed international frameworks, and significantly reduce their release to air, water and soil in order to minimize their adverse impacts on human health and the environment.



Mayday.ai's disaster and risk platform, providing community or event-centred monitoring

EO services contributing to SDGs

Mayday.ai – disaster and risk intelligence platform

- Users: organisation with a mandate in disaster management, humanitarian and development aid such government agencies, international organisations, NGOs (health divisions) or the (re)insurance sector
- Challenge/Needs: Reduce impact of natural & human-made disasters, with focus on early detection & risk management.
- Initiative: Mayday.ai's provide specific products helping on the monitoring of sustainable agriculture including food production. Products provide risk related to air pollution magt, urban/infrastructure planning (floodings, heat waves). Its products also help on the monitoring of natural habitats avoiding degradation or reducing the impact of wildfires and restoration. Overall they bring full transparency to the area of disaster and help to democratise the data for manegement activities. Its commercialisation starts as of autumn 2021
- Results: reduced impact (less fatalities, economic damage & environment degraded), increased resilience, lower insurance premiums/insurance more competitive, higher awareness, in-depth knowledge. Scalability and replicability products
- Service Provider: [Mayday.ai](https://www.mayday.ai)




Target: 1.5: Mapping spatial distribution of risk of poverty

Target 2.4: Agricultural productivity & env. impact of agriculture. Indicator 2.4.1: Sustainable agriculture

Target 3.9: Monitor the level of air quality data

Target 6.3: Water quality detection & monitoring. Indicator 6.3.2: Ambient water quality

Target 9.a: Sustainable and resilient infrastructure development

Target 11.4: Protect and safeguard the world's cultural and natural heritage

Target 12.4: Waste management

Target 13.1: Identifying, monitoring and preparing for climate related hazards

Target 15.2: Progress towards sustainable forest management (biomass, area of change, etc) Indicator 15.2.1: Sustainable forest management

Target 15.5: Reduce the degradation of natural habitats, halt the loss of biodiversity

Target 16.1: Effective, accountable and transparent institutions

Target 16.10: Ensure public access to information

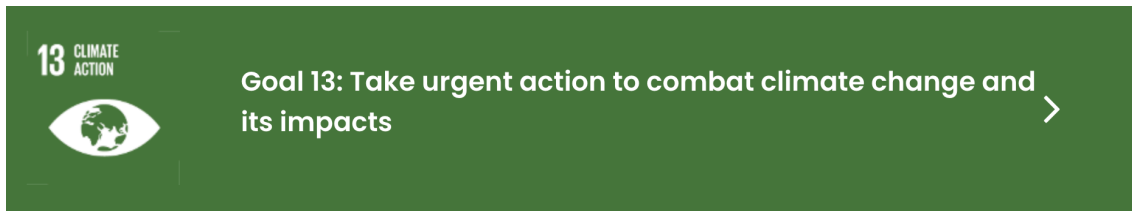


Mayday.ai's disaster and risk platform






xi. SDG 13 - Climate Action



xi.1 Goal: Take urgent action to combat climate change and its impacts.

EO data offer an invaluable opportunity for better-informing development policies and quantifying various targets. How can EO be used to help countries achieve specific targets? *Source: [ESA compendium of EO contributions to the SDG Targets and Indicators](#)*

Target 13.1: Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries.

This target is complementary to the global targets of the Sendai Framework for Disaster Risk Reduction, specifically targets A and B. The definition of hazard, according to the open-ended intergovernmental expert working group of the UNISDR (United Nations Office for Disaster Risk Reduction (UNISDR) and United Nations General Assembly (UNGA), 2016), is “a process, phenomenon or human activity that may cause loss of life, injury or other health impacts, property damage, social and economic disruption or environmental degradation”. Hazards may be natural, anthropogenic or socio-natural in origin.

EO can be used by countries in two ways, both in planning for the target, though a more robust system of identifying, monitoring and preparing for climate related hazards and natural disasters and in achieving the target, through improved resilience to disasters through ecosystem-based adaptation strategies. For the former, EO is a powerful monitoring technology to track natural, anthropogenic or socio-natural hazards on the land or sea surface. Populations in the path of disasters can be prepared and alert to disasters before they occur if EO is used effectively in an early warning system, e.g. in tracking hurricanes approaching coastlines, tracking wildfires near human settlements or in detecting terrain movements prior to volcanic eruptions. For the latter, strengthening resilience and adaptive capacity to disasters requires longer term planning. Ecosystem-based approaches to climate change adaptation are included in many disaster risk reduction strategies as they provide a natural buffer to hazards while providing other ecosystem services to surrounding communities. EO is useful as a national planning tool for the target in ecosystem-based adaptation to natural disasters because it can map the extent of such ecosystems as well as potential areas for increasing the extent and composition of these ecosystems to strengthen resilience. For example coastal ecosystems such as mangroves are readily mapped through EO and can be conserved and resorted to strengthen resilience to coastal hazards such as storm surges and wave damage.

(eo services based on Identifying, monitoring and preparing for climate related hazards)

EO Product/Service supporting the SDGs

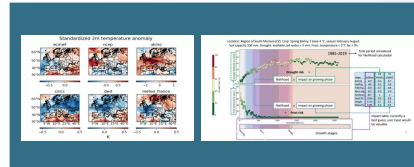
EO services contributing to SDGs AgroApps Climate Intelligence Engine



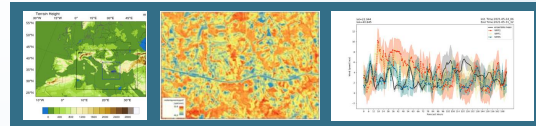
- **User:** Farmers, Farmers Associations., Agri-consultants, AgriFood Companies, Policy makers, Public sector
- **Challenge/Needs:** To make better, data-driven decisions and: i. support a more effective farm/parcel management and related options for adaptation on climatic changes; ii. guide and assist local and regional policy formulation leading to better landscape management; iii. enable protection against climatic risks and implementation related to mitigation on microclimate changes. Services based on Identifying, monitoring and preparing for climate related hazards.
- **Initiative:** Agriculture is perhaps the most weather/climate dependent sector of the economy, and changes in the weather/climatic patterns are strongly affecting it, in terms of the productivity, risk assessment/management, and environmental preservation.
- **Results:** Climate services supporting the climate smart farm management and land-use planning.
- **Service Provider:** AgroApps P.C.

Target 13.1: strengthen resilience and adaptive capacity to climate related hazards and natural disasters in all countries

Multi-model seasonal forecasts (left) and historical climate risk analysis.



High resolution deterministic forecasts (2x2km), hyperlocal weather with fusion techniques and multi-model medium range ensembles (from left to right).



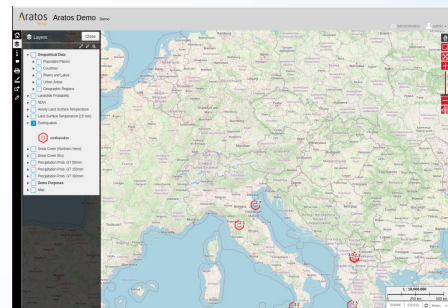
www.AgroApps.gr

EO services contributing to SDGs Disaster Control – Real-time identification and monitoring of climate hazards



- **User:** Government Agencies, Public Authorities, NGOs, Research Orgs, Agricultural Businesses, First Responders.
- **Challenge/Needs:** Lack of planning and lack of a suitable system for the management of climate related hazards allows for otherwise preventable disasters to lower quality of life, create financial and structural catastrophe and endanger entire habitats as well as human life.
- **Initiative:** Near-real time images and data from satellite sources on ongoing and past natural disasters (fires, earthquakes, landslides, etc.) as well as natural phenomena and weather condition changes.
- **Results:** A complete disaster management system for identifying, planning and preparation against natural and climate related hazards with added capabilities of monitoring and post-crisis evaluation on an easy to understand and use interactive map interface.
- **Service Provider:** Aratos Systems.

Target 13.1: Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries.



Distribution of earthquake incidents in Europe in a "typical" day.



<https://www.aratosdisastercontrol.com/>

EO services contributing to SDGs Mapping mangroves



- User: National and regional authorities, NGOs
- Challenge/Needs: Mangroves are critical ecosystems which provide coastal protection from storm surges, control floods, stabilize coastlines and enhance biodiversity. Furthermore, mangroves are a central component of the blue carbon ecosystem. Knowledge about mangrove extent, structure and dynamics is key to inform mangrove conservation and restoration planning and management.
- Initiative: Commercial product as a result of several years R&D
- Results: Applying supervised machine learning algorithms, mangroves are accurately mapped and characterized using high resolution satellite data. The mangrove extent product provides an accurate spatial delineation of areas covered by mangrove communities, while a detailed characterization product provides added information on species compositions and/or mangrove structures (e.g. height, density, or biomass).
- Service Provider: DHI GRAS

Target 6.6: By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes.

Target 13.1: Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries.

Target 15.1: By 2020, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements.



Example: Combined mangrove extent and density data product (Delta Saloum National Park, Senegal).



Reference: <https://www.dhi-gras.com/> / <http://maps.eo4sd-water.net/airbmp1/> / <https://www.dhi-gras.com/projects/eo4sdg/>

EO services contributing to SDGs Submerged Aquatic Vegetation (SAV)



- User: Environmental authorities, NGO's
- Challenge/Needs: The health of aquatic vegetation is a key indicator of the ecological status and environmental state of ocean and estuarine waters. They provide critical functions which are difficult to replace, such as: habitats and spawning grounds for many different marine species; adding oxygen to the water and remove excess CO₂; improve water quality by absorbing excess nutrients; stabilise sediment and reduce erosion. Due to the nature of their important ecosystem functions, up-to-date knowledge about SAV abundance and growth dynamics is critical, to assess the impacts of management efforts and monitor overall marine health.
- Initiative: Commercial product as a result of several years R&D
- Results: By applying a combination of the latest optical satellite imagery, novel machine learning techniques and advanced data processing the extent, dynamics and density of SAV is accurately mapped in 10 m spatial resolution. The approach is highly scalable and has been applied to map national level submerged aquatic vegetation in both Denmark and Sweden. A cloud-based web application has been further developed as a flexible framework for on demand user mapping of SAV, at scale, in a non-specialist environment.
- Service Provider: DHI GRAS

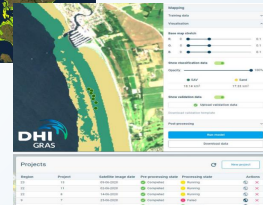
Target 13.1: Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries.

Target 14.1: By 2025, prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution.





Example: National mapping of submerged aquatic vegetation in Denmark

Example of the graphical user interface in the web application which facilitates user friendly classification to enable non-experts to do advanced machine learning based image classifications.



Reference: https://www.dhi-gras.com/projects/sav_se/ / <https://www.dhi-gras.com/projects/eo4sdg/>

EO services contributing to SDGs Urban heat islands analysis

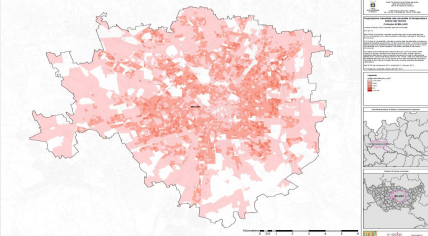



- User: Urban planning agencies, Civil Protection, City Authorities, Energy providers
- Challenge/Needs: Improve resilience of more vulnerable population versus heat island generated in urban area during hot period, enabling the identification of more exposed area with higher priority for the settlements of green and blue area
- Initiative: Life Metro Adapt (EC)
- Results: Service for the provision of thermal anomalies maps and population vulnerability map for supporting authorities and service providers in the proper planning of prevention actions in case of urban heat islands during hot periods
- Service Provider: e-Geos


Target 13.1: Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries

Target 13.2 Integrate climate change measures into national policies, strategies and planning



Target 13.3 Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning



Urban Heat island risk map (Milan)



EO services contributing to SDGs Urban Heat Vulnerability Map

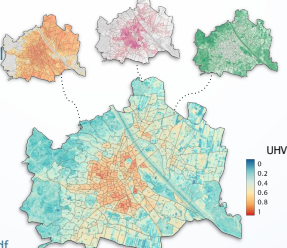



- User: Municipalities
- Challenge/Needs: Protect citizen from heat stress during summer. Have a holistic approach of the thermal threat over the city and define a heat mitigation strategy roadmap.
- Initiative: Identify through our Urban Heat Vulnerability Map the neighbourhood where the exposure to high temperature is strong, where a high-density of vulnerable people live and with very few vegetation or cooling infrastructure.
- Results:
 - A road map for cooling action at the city-level
 - Initiative of the Cool Street + project
 - 500+ citizens interviewed gave positive feedback regarding the city's initiative
- Service Provider: Ecoten urban comfort


• Target 13.1: Strengthen **resilience and adaptive capacity to climate-related hazards** and natural disasters in all countries

• Target 13.2: Integrate **climate change measures** into national policies, strategies and planning


• Target 13.3: Improve education, **awareness-raising** and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning



UHVI



From spatial data → To local climate action



European Association of Remote Sensing Companies

<https://urban-comfort.eu>
<https://urban-comfort.eu/reports/vienna-uhvm.pdf>
https://urban-comfort.eu/leaflets/eu_handbook_sdg.pdf

EO services contributing to SDGs Observatory of Urban Green Areas



- User: Municipality of Thessaloniki
- Challenge/Needs: Provide a Green Areas monitoring Tool capable to calculate the sufficiency of vegetation per district and municipal unit in the Municipality using EO data. The tool will support the evaluation of the status of the Sustainable Development Goals (SDGs) set by the Municipality
- Initiative: Maintenance and upgrade of Municipality's Spatial Data Infrastructure (SDI) with additional EO / Copernicus data and services
- Results: The Observatory of Urban Green Areas application provides actionable insights from the valorization of Satellite data towards sustainable urban planning and design. EO, geospatial data, and the information provided through Observatory of Urban Green Areas play insightful roles in monitoring targets, tracking progress, as well as helping the Municipality and stakeholders make informed decisions toward achieving the Sustainable Development Goals. The Service can be replicated to support additional Municipalities since it uses freely available Copernicus and Census data.
- Service Provider: Geospatial Enabling Technologies

Target 9.1.: EO services based on Inform on infrastructures development & planning
 Target 11.3.: EO services based on Urban growth monitoring for sustainable use of land.
 Target 11.7.: EO services based on Mapping extend of urban areas
 Target 13.1.: EO services based on Identifying, monitoring and preparing for climate related hazards



The Observatory of Urban Green Siting by GET



References link: <https://demos6.getmap.gr/greenobservatory/>

EO services contributing to SDGs GHGSat Industrial Methane Monitoring



- Users: industrial operators (e.g. oil and gas, landfills, mining), governments and financial services.
- Challenge: need for global measurement and transparency in greenhouse gas emissions from industrial facilities.
- Initiative: monitors and characterizes methane emissions from oil and gas and other industrial facilities.
- Results: Support emissions reduction with
 - 1) Rapid detection and quantification of large methane leaks (e.g. unconventional oil and gas)
 - 2) Detection of methane hotspots and predictive analytics for large areas
 - 3) Satellite and aircraft tasking for regular monitoring
- Service Provider: GHGSat

Target 13.2.: Integrate climate change measures into national policies, strategies, and planning 13.2.2 (i.e. "annual greenhouse gas emissions")

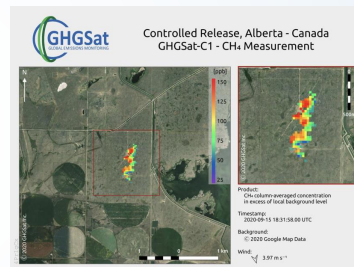


Fig. GHGSat concentration map, showing smallest methane emission ever detected by satellite (GHGSat data overlaid on high resolution optical images)



References: <https://www.ghgsat.com/en/>

EO services contributing to SDGs Climate change impact analysis

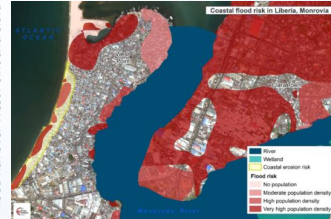
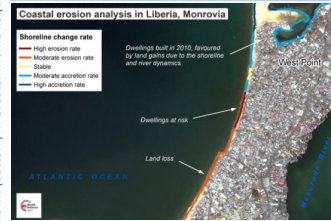
- **User:** The World Bank Group
- **Challenge/Needs:** Provision of data and analytics to support the design of evidence-based policies and plans that improve the resilience of Monrovia metropolitan region (Liberia) to current and future climate risks
- **Initiative:** EO4SD Climate Resilience Cluster for WB project: Monrovia Integrated Development Project
- **Results:** Analysis of the coastal hazards through the analysis of the shoreline erosion (1984 -2019) and the geomorphologic analysis of the Monrovia's coast, and the exposure to coastal risks through the analysis of coastal flooding risk due to sea level rise and urban subsidence, the analysis population exposed and the analysis of critical infrastructures and residential areas exposed.
Capacity Building: several training, informative and hands-on sessions
- **Service Provider:** GMV



<http://eo4sd-climate.gmv.com/>



Target 13.1: Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries.
Indicator Analysis of coastal loss



Estimation of shoreline retreat from 1984 to 2019 in West Point (above) / Analysis of flood risk over West Point and Clara Town (bottom) in Greater Monrovia (Liberia)

EO services contributing to SDGs Environmental Indicators SaaS

- **User:** Municipalities, urban planners, smart cities, consultancy firms
- **Challenge/Needs:** Identify most vulnerable areas to climate related hazards. Evaluate the climate adaptation contribution of natural and green areas.
- **Initiative:** Offer in a unique platform easy access to environmental indicators data, always updated, multi-scale levels (municipality – neighbourhoods), targets achievement and expected.
- **Results:** more than 15 cities monitored (Spain & US), more than 100 indicators managed.
- **Service Provider:** Green Urban Data, Sentinel-2,3,5, Urban Atlas, Landsat 8, Planet, others



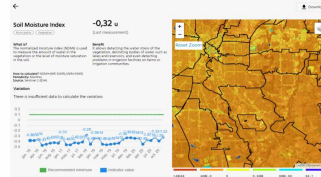
Green Urban Data is a startup since 2018 that combines satellite and urban information to offer different SaaS products

greenurbandata.com

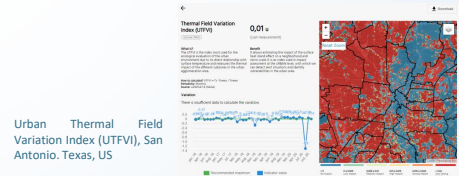


Target 13.1: Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries.

San Antonio, Environmental indicators



Soil Moisture SaaS Indicator For San Antonio, Texas, US



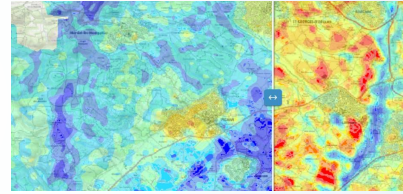
Urban Thermal Field Variation Index (UTFVI), San Antonio, Texas, US

EO services contributing to SDGs
Mapping urban heat and green



- User: Greater Montpellier area (Pop. : 480,000)
- Challenge/Needs: Improving knowledge of, and alleviating urban heat island phenomena across the city in the wake of extreme heat events. Resilience and adaptive capacity to climate-related hazards
- Initiative: production and analysis of satellite thermography, climate-oriented land-use mapping and high-detail vegetation mapping over a 400 sq. km. area
- Results: Programmes and incentives towards revegetation and tree plantation, including a municipal plan for an additional 50,000 trees by 2030, aiming at local climate regulation among others ecosystemic services
- Service Provider: Kermap

Target 13.1: Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries.



Night/day satellite thermography, Greater Montpellier area



High-detail vegetation mapping, Greater Montpellier area 1



[Montpellier use case on kermap.com](https://www.kermap.com/en/monpellier-use-case)

EO services contributing to SDGs
Observatory of Urban Green Areas



- User: Municipality of Thessaloniki
- Challenge/Needs: Provide a Green Areas monitoring Tool capable to calculate the sufficiency of vegetation per district and municipal unit in the Municipality using EO data. The tool will support the evaluation of the status of the Sustainable Development Goals (SDGs) set by the Municipality
- Initiative: Maintenance and upgrade of Municipality's Spatial Data Infrastructure (SDI) with additional EO / Copernicus data and services
- Results: The Observatory of Urban Green Areas application provides actionable insights from the valorization of Satellite data towards sustainable urban planning and design. EO, geospatial data, and the information provided through Observatory of Urban Green Areas play insightful roles in monitoring targets, tracking progress, as well as helping the Municipality and stakeholders make informed decisions toward achieving the Sustainable Development Goals. The Service can be replicated to support additional Municipalities since it uses freely available Copernicus and Census data.
- Service Provider: Geospatial Enabling Technologies

Target 9.1.: EO services based on Inform on infrastructures development & planning
 Target 11.3.: EO services based on Urban growth monitoring for sustainable use of land.
 Target 11.7.: EO services based on Mapping extend of urban areas
 Target 13.1.: EO services based on Identifying, monitoring and preparing for climate related hazards



The Observatory of Urban Green Siting by GET



References link: <https://demos6.getmap.gr/greenobservatory/>

EO services contributing to SDGs Mayday.ai – real time disaster and risk intelligence



- **Users:** organisation with a mandate in disaster management, humanitarian and development aid, government agencies, international organisations, NGOs, diverse business verticals
- **Challenge/Needs:** Mayday.ai's platform provides risk-reduction guidance, disaster early-warning and a common operating picture during evolving disasters, which become more frequent and damaging due to climate change. At the policy level, Mayday directly supports the implementation of the Sendai Risk Framework and shifts focus from disaster response to prevention. First responders can more effectively contain disasters. The intelligence is also made available to civilians who are guided to reduce risks and can communicate with authorities during events of crises.
- **Initiative:** commercialisation starting as of autumn 2021
- **Results:** reduced impact (less fatalities, economic damage and environment degraded), increased resilience, higher awareness
- **Service Provider:** [Mayday.ai](https://www.mayday.ai)

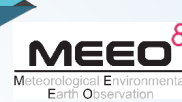
Targets: 13.1: Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries, **13.3:** Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning.



Mayday's earthquake mapping

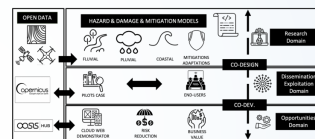


SAFERPLACES: PLUVIAL, FLUVIAL AND COASTAL FLOOD HAZARDS AND RISKS



- **User:** public authorities, municipalities, researchers
- **Challenge/Needs:** designed to advice identification and assessment of flood risk mitigation measures and plans, inform climate adaptation and disaster risk reduction strategies
- **Initiative:** Saferplaces (EIT Climate-KIC project), coordinated by Gecosistema Srl.
- **Results:** a Saferplaces cloud web tool based on innovative climate, hydrological and hydraulic, topographic and economic modelling techniques to assess pluvial, fluvial and coastal flood hazard and risk in urban environments under current and future climates. 10 pilot areas (Rimini, Pamplona, Cologne, Milano, Fuenlabrada etc). Global version available to cover further areas.
- **Service Provider:** Gecosistema Srl for the web application, MEEO Srl for the flooding mask based on EO data

Target 13.1: Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries.



Saferplaces platform concept



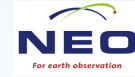
Saferplaces web tool interface



<https://saferplaces.co/>
<http://platform.saferplaces.co/>



EO services contributing to SDGs Flood risk mapping



- User: city planning, disaster mitigation
- Challenge/Needs: measure the flood extent, flood hazard and estimate flood risk for gain insight into better city planning and risk mitigation
- Initiative: Earth Observation for Sustainable Development (EO4SD) – European Space Agency (ESA) program, aims to achieve increasing the uptake of satellite based information in the financial institutions' regional and global development programmes with a focus on urban development, agriculture and rural development . It aims to meet the long term, strategic geospatial information needs in the individual developing countries as well as international and regional development organisations.
- Results: 1) mapping flood extent of historical flooding events based on EO data of multiple years 2) deriving flood hazards 3) mapping the flood risk by combing the land use land cover information 4) providing statistics on the flooding events
- Impact: The satellite imagery based mapping product provides the means to acquire the most recent information about the extents and impacts of on-going flood emergency. It is a key tool for monitoring hazardous flood events and as well as risk assessment. This information is highly valuable for planning and construction of new residential, industrial or commercial development zones at the outskirts of large urban agglomerations. The product is highly evaluated by the World Bank local team as it helps in the project designing and planning to shorten the preparation time from years to several months.

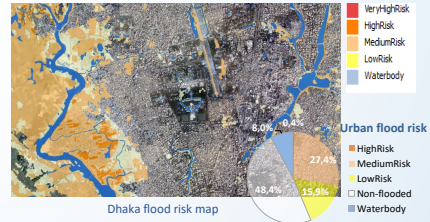


EO4SD program website:
<https://eo4sd-urban.info/>

Target 13.1: Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries.



Dhaka Flood in August 2017



Dhaka flood risk map

EO services contributing to SDGs FIRO: Assessing damages in powerlines



- User: Energy companies, Insurance companies
- Challenge/Needs: Severe storms cause damages in powerlines, something that has to be assessed rapidly to restore electricity. A first assessment is often very costly, and sometimes impossible due to bad weather in remote locations
- Initiative: Innovation in EO, Proof of Concept with Red Eléctrica Española, willing to have a fast, agile and scalable tool for the assessment of damages in powerlines.
- Results: FIRO (Fast Imagery for Response Operations) is a digital AI-based platform that provides VHR SAR satellite imagery in NRT to assess damages in segments of powerlines
- Service Provider: Orbital EOS



<https://www.ree.es/es/sala-de-prensa/actualidad/nota-de-prensa/2020/12/el-nuevo-programa-nacional-de-algoritmos-verdes-nos-permitira-disenar-algoritmos-eficientes-energeticamente>

Target 13.1: Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries.

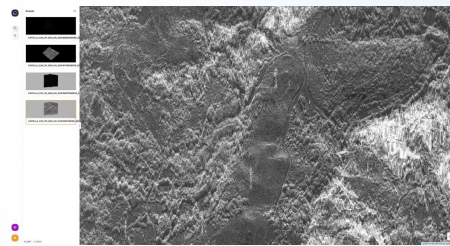


Fig. Digital interface of FIRO, showing pylons of powerlines. © satellite image Capella Space

EO services contributing to SDGs

SAMS: Shoreline Automatic Monitoring System




- **Users:** Environmental Agencies, Maritime Ports, Public Administrations
- **Challenge/Needs:** assess and track coastal erosion processes. Coastal erosion is a major disruptor of tourism and real state for Spanish Mediterranean coast, implying high costs in restoration.
- **Initiative:** Open Innovation in Climate-related Risks. This project aimed at developing EO solutions for tackling issues related to climate change.
- **Results:** SAMS (Shoreline Automatic Monitoring System). Digital cloud-based system that automatizes the process of shoreline detection in temporal series of satellite images, providing digital maps and statistics. The tool can be used to analyse historical data and infer cause-effect in coastal erosion processes and also as a recurrent monitoring tool.
- **Service Provider:** Orbital EOS






Target 13.1: Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries.




Fig. SAMS analytic results, showing areas of erosion in the coast of Gandia, Spain

EO services contributing to SDGs

Mapping California Forests and Wildfire

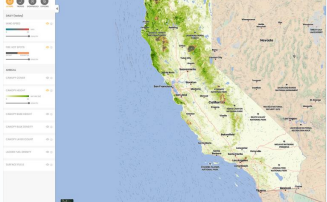




- **User:** Government, researchers and nonprofits working on forest restoration and wildfire mitigation efforts.
- **Challenge/Needs:** The methods for tracking and mapping wildfires and hazards have been inadequate, offering vegetation fuel maps that are static, low resolution and outdated. Government agencies, first responders, municipalities and other organizations traditionally lack the tools to proactively plan for and build long-term resilience to wildfire.
- **Initiative:** The California Forest Observatory (CFO) is a new data-driven forest monitoring system designed to dynamically map forest structure and vegetation fuel loads at the individual tree level. Powered by a partnership between Planet, Salo Sciences and Vibrant Planet, with support from the Gordon and Betty Moore Foundation, the CFO provides unprecedented and continuously updated views of wildfire hazard and forest health for California.
- **Results:** This wall-to-wall, statewide data sets a new standard for how we research, plan for, and respond to wildfires in California. The tech leverages artificial intelligence, satellite imagery and airborne LiDAR to produce detailed data on vegetation fuels—including tree heights, canopy cover, density and understory ladder fuels. Combining these fuses data with weather and topography to assess wildfire hazards across the landscape.
- **Service Provider:** Planet

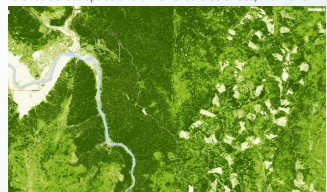


<https://www.planet.com/pulse/cfo-mapping-new-standard-wildfire>
<https://www.planet.com/pulse/monitoring-wildfire-risk-using-space-and-ai/>

Target 13.1 Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries



The California Forest Observatory web platform displays trends across space and time. © Salo Sciences, Inc. 2020



EO services contributing to SDGs Rheticus® Agriculture



- User: Agriculture, winegrowers and/or agriculture associations, National / Local Authorities, insurance companies
- Challenge/Needs: Generating land cover map it allows to optimize the farm's management at the local, regional and national levels. Further, by using the biomass health indicator (vegetation index, Reflectance Index, Moisture Index, Leaf Area Index, Water index), the service can also work as a diagnostic tool and serve as an early warning system, allowing the agricultural community to detect and counter potential problems before they spread widely and negatively impact crop productivity. Initiative: Internal Development
- Results: designed to help farmers in daily crop production tasks.
- Service Provider: Planetek Italia's Rheticus platform
- Reference: <https://www.rheticus.eu/>



Figure: Rheticus® Agroculture service geoportal with analytics tools

Target 1.5: By 2030, build the resilience of the poor and those in vulnerable situations and reduce their exposure and vulnerability to climate-related extreme events and other economic, social and environmental shocks and disasters.
 Target 2.4: By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality.
 Target 6.4: By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity.
 Target 13.1: Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries



EO services contributing to SDGs Rheticus® Marine



- User: National and Regional Governmental Institutions in charge of environmental monitoring and reporting - Policy and Decision Makers, from international to local level - Stakeholders (e.g. industries involved in offshore drilling, wind plants, wastewater services, desalination, fishery and aquaculture, tourism and recreational activities, etc.);
- Challenge/Needs: Understand seawaters' quality, health and evolution over time, to easily spot trends and anticipating risky situations and harmful events.
- Initiative: Copernicus Marine Environment Monitoring Service (CMEMS)
- Results: helping customers in the public sector to implement environmental policies from local to international level, meeting the requirements in the field of marine environment policy (e.g. MSFD, WFD).
- Service Provider: CMEMS and EMODnet

Target 13.1.: eo services based on Identifying, monitoring and preparing for climate related hazards
 Target 14.1.: eo services based on Integrating data & monitoring for marine pollution. Indicator 14.1.1: Coastal marine pollution






Figure: Rheticus® Marine service geoportal with analytics tools



References links
<https://marine.copernicus.eu/services/use-cases/rheticus-marine-support-eu-marine-strategy>
<https://www.rheticus.eu/rheticus-services/marine/>

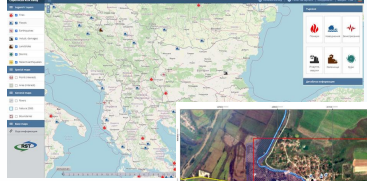

EO services contributing to SDGs CopernicusRiskRelay




- **User:** Public organization (universities, research labs) and industry
- **Challenge/Needs:** Build resilience of vulnerable populations contributing to the management of disaster risk reduction by monitoring of natural and anthropogenic disasters.
- **Initiative:** EU Cohesion Fund - “Competitiveness of the Bulgarian Industry 2007-2013”
- **Results:** Developed Geospatial Web portal for disaster mapping. The portal visualize disaster information from different sources as the automatically integrated data from the Copernicus EMS and additionally activations for disasters are processed and mapped by the service provider.
- **Service Provider:** RST-TTO, BAS

Target 1.5: By 2030, build the resilience of the poor and those in vulnerable situations and reduce their exposure and vulnerability to climate-related extreme events and other economic, social and environmental shocks and disasters.
Indicator 1.5.2: Disaster Damage
Target 13.1: Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries.



References link <http://copriskrelay.rst-tto.com/>


Figure: Visualization of Copernicus Risk Relay Portal interface and evaluation of the flooded critical infrastructure in Miziya, Bulgaria in 2014

EO services contributing to SDGs Monitoring Climate Change For Disaster Response




- **User:** Local and national governments, emergency response teams, humanitarian aid and disaster relief organizations
- **Challenge/Needs:** Identifying, monitoring, and mitigating climate-related hazards and catastrophes with updated data and across remote areas
- **Initiative:** Local, national, and international programs. Satellogic is working with CC35 on the GREEN+ Jurisdictional Programme.
- **Results:** Consistent data and flexible licensing enables greater collaboration across teams for more effective outcomes
- **Service Provider:** Satellogic

Target 13.1: Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries (services based on Identifying, monitoring and preparing for climate related hazards)





CROSS-SDG
<https://satellogic.com/2022/04/22/earth-day-2022-monitoring-climate-change-with-earth-observation-data/>
<https://satellogic.com/2022/03/29/ogc-disaster-pilot-project-21-improving-disaster-response-with-earth-observation-data/>
<https://satellogic.com/earth-observation/environment-climate/>

Lismore, in NSW, Australia. Flash floods are especially challenging for rescue and emergency response units. Earth Observation satellites can capture ground conditions quickly and at scale, enabling timely analysis for disaster response as well as recovery. This includes monitoring water levels, identifying structures, assessing damaged infrastructure, and detecting at-risk areas.

EO services contributing to SDGs Biomass Estimations

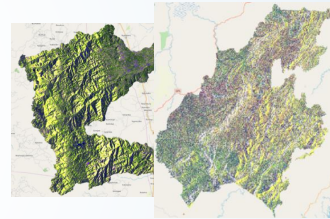
- User: Carbon market actors, certifiers and verifiers, project managers, supply chain managers, NGOs, offsetters
- Challenge/Needs: Biomass estimations using remote sensing provide unlimited opportunities, such as carbon sequestration monitoring, carbon credit conversion, yield and resource predictions, and risk assessments.
- Initiative: Biomass estimations in three different ecoregions were able to determine biomass estimations for agroforestry and mixed-tropical forests to a high level of accuracy.
- Results: Scalable biomass estimation for conversion to carbon credits, monitoring (auditing) over time, historical data comparisons for accurate and permanent carbon sinks.
- Service Provider: Space4Good (Rabobank, Arsari Enviro)



References link: <https://www.space4good.com/portfolio>



Target 13.1: Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries.



Biomass visualization of mixed, tropical forests based on radar data.

EO services contributing to SDGs Fire detection

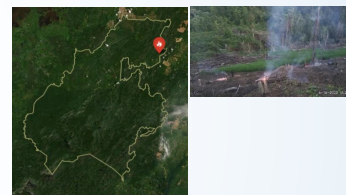
- User: Concession managers, conservation entities, governments, NGOs, forestry, agriculture
- Challenge/Needs: A need for fire detection insights and alerts for local operatives to better mitigate the destruction of fire activities in mixed tropical forests in near-real-time
- Initiative: Near-real-time feedback on fires in mixed tropical systems integrated into social media communication channels in field
- Results: Incident validation reports provide a complete overview of the kinds of activities and extent of the damage, improving area monitoring and implementation of mitigation procedures. Since 2020, 112 fires have been detected in 200K region.
- Service Provider: Space4Good (Rabobank, Arsari Enviro)



References link: <https://www.space4good.com/portfolio>



Target 13.1: Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries.



Fire Detection with confirmation feedback of incident, 2020



Fire detection over time, 2021

EO services contributing to SDGs Flood Risk/Extent Mapping

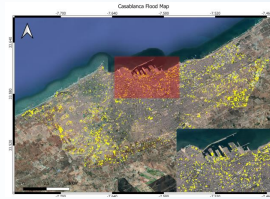
- User: Regional authorities, municipalities, water works, city planners, humanitarian aid organizations
- Challenge/Needs: Request for a high-resolution flood-assessment in Morocco.
- Initiative: Determined approximate flooding dates, then selected 2 before and after **Sentinel-1** images for the flood extent mapping and used a thresholding method on the Sentinel difference image (after-before). The methodology was further refined by masking the flood pixels from areas of permanent water bodies.
- Results: This result could serve as a second reference to the Global Precipitation Measurement (GPM) data that was being used by several World Bank clients and insurers
- Service Provider: Space4Good (World Bank)



References link: <https://www.space4good.com/portfolio>



Target 13.1: Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries.



Flooding Extent Map, Casablanca, 2021



EO services contributing to SDGs NO2 Monitoring for Socio-Economic Recovery Assessment

- User: Economists, cities, planners, regional governance, national governments
- Challenge/Needs: Monitoring NO2 as a proxy for post covid economic recovery as an added insight into correspond emissions activities in line with economic activities in Indonesia, Vietnam and MENA cities
- Initiative: Monitor air pollution and in particular nitrogen dioxide (NO2) using Sentinel 5P data and visualizing this for use by the World Bank in a customized platform relaying analytics and correlations.
- Results: A local analysis explored the NO2 patterns and behaviours across different areas in Indonesia and Vietnam before and during the COVID-19 crisis. Although the pandemic is a shared event, these areas show individual fingerprints and unique behaviours to this global situation. The platform is still in use.
- Service Provider: Space4Good (World Bank Group)



References link: <https://www.space4good.com/portfolio>



Target 13.1: Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries.



NO2 Sentinel-5P maps pre and post Covid-19 lockdown



Sentinel 5P based NO2 emissions monitoring map over time.

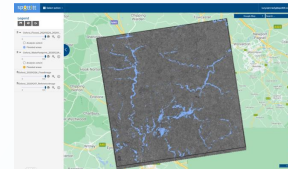
EO services contributing to SDGs Near real time flood monitoring



- User: International, national, regional and local government bodies and agencies, NGO's and specific industries.
- Challenge/Needs: No fuss, remote tasking of SAR satellites to capture flood imagery and online delivery of flood extent and depth analytics with 2 hours of receipt of imagery from provider. Get an accurate digital understanding of the scale of a flood incident.
- Initiative: Developed with the support of Innovate UK funding and the UK's Environment Agency. Single image water extent and the more accurate double image flood extent analysis provided globally. Analysis accuracy can be further increased via the use of higher resolution digital elevation data.
- Results: Commercially available service derived from 1m and 3m SAR imagery.
- Service Provider: Spottitt Ltd.

Target 13.1: Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries.

- identifying and monitoring climate hazards



Flood extent Oxford. Flooding Dec 2020



<https://spottitt.com/2020/09/09/eyes-in-the-sky-for-the-uk-environment-agency/>

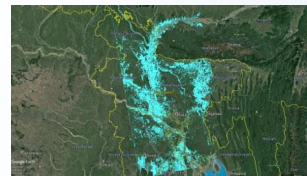
EO services contributing to SDGs Historical flood monitoring



- User: International, national, regional and local government bodies and agencies, NGO's and specific industries.
- Challenge/Needs: Analysis of historical flooding events using existing SAR imagery in support of parametric insurance models, flood modelling, flood mitigation investment etc. Get an accurate digital understanding of the scale of a flood incident.
- Initiative: Developed with UK Space Agency funding as part of a project to develop a parametric insurance product for the government of Bangladesh. Single image water extent and the more accurate double image flood extent analysis provided globally. Analysis accuracy can be further increased via the use of higher resolution digital elevation data.
- Results: Commercially available service predominantly derived from Sentinel-1 SAR imagery but we have experience with commercial imagery from providers such as Iceye and Telespazio
- Service Provider: Spottitt Ltd.

Target 13.1: Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries.

- identifying and monitoring climate hazards




Flood extent Bangladesh 2017



www.spottitt.com

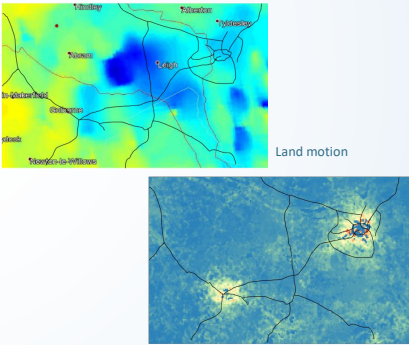
EO services contributing to SDGs
Reality Check

spottitt 

- User: International, national, regional and local government bodies and agencies, NGO's and specific industries.
- Challenge/Needs: Not all locations are exposed to the same climate risks. This service enables customers to understand the current and changing risk posed by flooding, land motion, and a whole host of other climate factors to the integrity of their assets and lives of the local population.
- Initiative: Developed as part of Spottitt's range of services for utility network operators. Clients able to choose the climate factors most relevant for their geography with data going back 10 years or more.
- Results: Commercially available 'Reality Check' service. Global coverage. Cost £120 per 1,000 square km of territory. Volume discounts available.
- Service Provider: Spottitt Ltd.

Target 13.1: Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries.

- identifying and monitoring climate hazards



EARSC
European Association
of Remote Sensing
Companies

www.spottitt.com

Relevant Success Stories

- [The Food Security & Sustainable Agriculture showcase: Remote sensing based crop monitoring for Early Warning - The GEOGLAM Crop Monitor Impact](#)
- [CGI-Live land](#)
- [CGI- eSURGE](#)
- [Offshore winds and resources](#)
- [Agrowth: A satellite based crop monitoring platform](#)
- [High PV Penetration in urban area](#)
- [Identification of synergetic SDGs using heterogeneous data and deep learning models](#)
- [A live map of mountain hazards for the Alps and the world](#)
- [How satellite Earth Observation can help with monitoring for the Water Framework Directive](#)
- [EO data in support of Protected Areas monitoring](#)
- [DynaCrop – unlocking EO services for the food production value chain](#)
- [Integration of EO and model data for the monitoring of volcanic plumes critical to aviation: the Mt Etna case of 12 March 2021](#)
- [Flood Risk & Impact assessment through automatic change detection of S-1+S-2 images \(FRIEND pilot\)](#)
- [Improved well-field management with Sentinel-1 SAR data](#)
- [A complete meteo-hydrological chain to support early warning systems from weather scenarios to flooded areas: the Apollo medicane use case](#)

xii. SDG 14 - Life below Water



xii.1 Goal: Conserve and sustainably use the oceans, seas and marine resources for sustainable development.

EO data offer an invaluable opportunity for better-informing development policies and quantifying various targets. How can EO be used to help countries achieve specific targets? *Source: [ESA compendium of EO contributions to the SDG Targets and Indicators](#)*

Target 14.1: By 2025, prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution.

This target addresses the need to reduce marine pollution by recognising the land-based sources that emit pollutants such as nutrients and plastic debris. It is therefore an interconnected target that seeks to join land and sea based approaches to pollution reduction and prevention. In setting a deadline for achievement of this target by 2025, the community must act quickly towards global pollution reduction. EO is useful in relation to this target because it has both land, sea and coastal coverage thereby enabling integrated monitoring, e.g. of land based debris which accumulates on shorelines before being transported seaward. Equally, EO can monitor the location and extent of inland waterways, including their water quality as mentioned in relation to SDG 6, enabling the transport of land based, water-dissolved pollutants such as excessive nutrients to be monitored. At sea, the detection of surface, coarse marine debris is an experimental area for EO but with increasing sophistication this technique could yield results in being able to map large debris fields and plot their movement for subsequent intervention and clean up. Evaluation of coastal eutrophication status, anomalies and trends is a challenging but evolving application of EO and contributes to the land-based pollution reduction aspect of this target.

(eo services based on Integrate data & monitoring for marine pollution. Indicator 14.1.1: Coastal marine pollution)

Target 14.3: Minimize and address the impacts of ocean acidification, including through enhanced scientific cooperation at all levels.

As the ocean's biology and biochemistry is largely under sampled, this target presents a significant challenge for countries hence the stated need to enhance scientific cooperation at all levels. Nevertheless, this enhanced scientific cooperation should involve the remote sensing community, at least at the target level. For instance, EO can support countries in planning for and setting targets on minimising ocean acidification, as part of a wider climate change monitoring/management strategy. EO could help countries with significant marine areas to identify areas at risk from acidification and estimate their extent, e.g. of waters with aragonite close to its saturation level, below which organisms find it more difficult to form and retain their shells. EO can also be used as a diagnostic tool, e.g. to map the impacts of ocean acidification on coral reefs. The utility of the satellite measurements comes in obtaining a synoptic view where few or no in situ measurements of the carbonate system exist. Although EO is limited to the

ocean surface layer, these observations are important because the change in carbonate chemistry due to atmospheric CO₂ occurs in the ocean surface first.

(eo services based on Planning for setting targets for ocean acidification. Indicator 14.3.1: Ocean acidification)

Target 14.4: By 2020, effectively regulate harvesting and end overfishing, illegal, unreported and unregulated fishing and destructive fishing practices and implement science-based management plans, in order to restore fish stocks in the shortest time feasible, at least to levels that can produce maximum sustainable yield as determined by their biological characteristics

This target is aimed at regulation through consistent reporting of overfishing as well as restoration of already depleted fish stocks. The most conservative estimates suggest that illegal, unreported and unregulated (IUU) fishing on the high seas, affecting species such as tunas and sharks, is worth US\$1.25 billion annually (Global Ocean Commission, 2014). Current measures taken for implementing, monitoring and enforcing plans for fish stock conservation at the national level are mostly inadequate.

Satellite remote sensing has the potential to improve plans for monitoring and management of fisheries in a number of ways (Stuart et al. 2011a). For example satellite data on ocean parameters such as temperature, salinity, phytoplankton and chlorophyll- a concentrations can help identify ocean areas where fish tend to aggregate (e.g. thermal fronts) and to estimate primary production. Studies have shown that satellite remote sensing of primary production in the ocean could be used to support fish stock assessments, for example, using ocean colour images to infer primary production and estimate global fish biomass. This would be particularly useful for this target given that the fish stock assessments demand high levels of technical capacity and data, which is currently lacking at country level. However, the uptake of satellite remote sensing in fisheries management has so far been limited. This is due to a number of reasons, including the spatial and temporal inadequacy of available ocean colour data for fisheries management purposes, lack of technical capacity to analyse remote sensing data sets, and the limited accuracy of ocean colour algorithms for coastal areas, where most fishing activities take place (Stuart et al. 2011b, Wilson 2011).



(eo services based on Support fish stocks assessments)

EO Product/Service supporting the SDGs

EO services contributing to SDGs

Sargassum detection for operational and seasonal planning

- Users: public administrations, tourism, fisheries, maritime transport
- Challenge: massive strandings of sargassum (Sargassum fluitans and Sargassum natans) in the Caribbean region
- Initiative: synergy of 8 satellite sensors: 3 wide-swath ocean color sensors, 3 optical HR sensors, +2 SAR HR sensors. 1) Qualitative and quantitative monitoring by calculation of the sargassum index> Develop specific index (NFAI (Normalized Floating Algae Index) 2) Detected raft drift modeling and landing estimation.
- Results: Prediction of immediate landings, Coastal management and clean-up operations, Seasonal prediction of Sargassum inflows for the Lesser Antilles, Expected impact on fishing and tourism, Daily satellite detection to help sailors avoid Sargasso mats, maritime safety
- Service Provider: CLS

Target 14.2.: sustainably manage and protect marine and coastal ecosystems with a view to avoiding significant adverse impacts, including by strengthening their resilience, and taking steps to restore them to restore the health and productivity of the oceans.

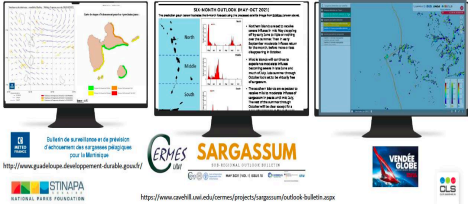




Fig. <https://www.cavehill.uwi.edu/cermes/projects/sargassum/outlook-bulletin.aspx>

EO services contributing to SDGs

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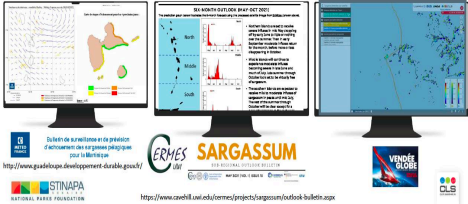




Fig. <https://www.cavehill.uwi.edu/cermes/projects/sargassum/outlook-bulletin.aspx>

EARSC
European Association
of Remote Sensing
Companies


References: <https://e-shape.eu/index.php/showcases/pilot5-4-sargassum-detection-for-seasonal-planning>

EO services contributing to SDGs

Marine Observer



- User: National and regional authorities, Port authorities, offshore stakeholders, aquaculture and fishery
- Challenge/Needs: Timely, accurate and spatially coherent information on water quality parameters is needed to underpin informed and effective water quality strategies; control port water pollution and impacts from offshore activities and; support early warnings of algae blooms, red tides and sediment plumes.
- Initiative: Commercial product as a result of several years R&D
- Results: Marine Observer provides a large-scale overview of key water quality parameters, including Chlorophyll concentration and Total Suspended Matter (TSM), enabling stakeholders to get a quick overview of the past and current status of the marine waters in their area of interest. The service is available globally and access to archived and up-to-date information in near-real-time is served through custom tailored data portals.
- Service Provider: DHI GRAS




Reference: <https://marineobserver.dhigroup.com/> / <https://www.dhi-gras.com/projects/eo4sdg/>

EO services contributing to SDGs

Submerged Aquatic Vegetation (SAV)


- User: Environmental authorities, NGO's
- Challenge/Needs: The health of aquatic vegetation is a key indicator of the ecological status and environmental state of ocean and estuarine waters. They provide critical functions which are difficult to replace, such as: habitats and spawning grounds for many different marine species; adding oxygen to the water and remove excess CO₂; improve water quality by absorbing excess nutrients; stabilise sediment and reduce erosion. Due to the nature of their important ecosystem functions, up-to-date knowledge about SAV abundance and growth dynamics is critical, to assess the impacts of management efforts and monitor overall marine health.
- Initiative: Commercial product as a result of several years R&D
- Results: By applying a combination of the latest optical satellite imagery, novel machine learning techniques and advanced data processing the extent, dynamics and density of SAV is accurately mapped in 10 m spatial resolution. The approach is highly scalable and has been applied to map national level submerged aquatic vegetation in both Denmark and Sweden. A cloud-based web application has been further developed as a flexible framework for on demand user mapping of SAV , at scale, in a non-specialist environment.
- Service Provider: DHI GRAS



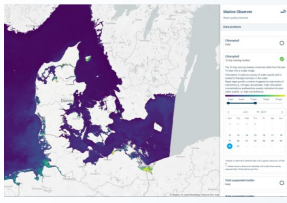
Reference: https://www.dhi-gras.com/projects/sav_se/ / <https://www.dhi-gras.com/projects/eo4sdg/>

Target 6.3: By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally.

Target 14.1: By 2025, prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution.

User interface of Marine Observer Denmark – available at <https://marineobserver.dhigroup.com/denmark>


Example: Chlorophyll concentrations in the entry towards the port of Hamburg.



Example: National mapping of submerged aquatic vegetation in Denmark



Example of the graphical user interface in the web application which facilitates user friendly classification to enable non-experts to do advanced machine learning based image classifications.





Properties	Area	Percentage	Classification
Water	12	100%	Water
Submerged Aquatic Vegetation	1	8%	Submerged Aquatic Vegetation
Other	107	912%	Other

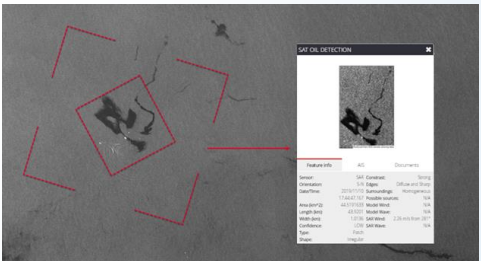
Example: National mapping of submerged aquatic vegetation in Denmark

EO services contributing to SDGs


SeonSE platform for oil spills detection

- User: agencies for marine resources management, oil & gas companies, environmental agencies
- Challenge/Needs: reduce the impact of oil spills on the marine environment through early detection and monitor in support to systematic environmental monitoring and emergency recovery action
- Initiative: e-Geos internal development, based on requirements and requests from agencies and oil & gas companies
- Results: Routine and on-demand sea monitoring services for oil spill detection, statistical analysis, support to emergency management and recovery activities, protection of Marine Protected Areas, impact assessment on protected areas
- Service Provider: e-Geos through SeonSe platform



Satellite oil spill detection with **SEONSE**
Smart Eyes on 5Eas 1



References link: <https://www.e-geos.it/#/hub/hubPlatforms/platform/platform-sense>

Target 14.1 By 2025, prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution

Target 14.2 By 2020, sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts, including by strengthening their resilience, and take action for their restoration in order to achieve healthy and productive oceans

EO services contributing to SDGs

Keeping an eye on aquatic plastic litter




- User: Lactec Brazil, The Sea Cleaners
- Challenge/Needs: Reporting aquatic litter pollution from local to global scale
- Initiative: ESA Eyes on Plastic (Feasibility study) to improve the detection, alerting and collection of aquatic litter. The aim of this service is supporting a plastic-less society and circular economy.
- Results: Online data access and visualization for all water-related data types and sources, including EO based data via a user friendly portal/webApp. Mapping and monitoring of plastic litter globally, with results largely depending on the input data (satellite, camera, drone, ROV). For any freely selected virtual test station the 'Eye on Plastic' will provide image data and a proxy for the amount of plastic litter identifying high, medium or low pollution.
- Service Provider: EOMAP



Together with ground data provided by the customer the sensor based information is analysed in the cloud. As a result, the plastic litter amount is provided via a web portal (mock up).





<https://business.esa.int/projects/eyes-on-plastic>
<https://www.eomap.com/services/water-quality/>

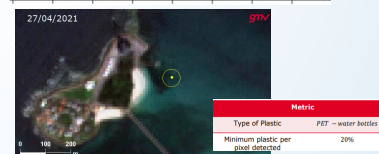
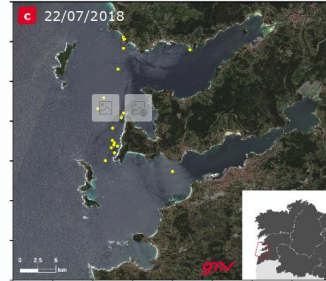
Target 14.1: By 2025, prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution.

EO services contributing to SDGs Beach litter detection service



- **User:** Fundación Biodiversidad at the Ministry for the Ecological Transition and the Demographic Challenge, Spain.
- **Challenge/Needs:** contribute to the conservation and sustainable use of ocean, seas and marine resources by detecting beach litter from the space. Develop a service to detect possible marine debris, able also to classify and quantify according to pixel-level litter fraction present.
- **Initiative:** BEWATS. Main difficulty was the lack of sufficient and suitable ground-truth data. Also variable sea-condition, waves, sun glint, wind can create diverse textures along the sea surface such that detection of small amount of litter (compared to the pixel size) becomes challenging.
- **Results:** A Sentinel-2 data and machine-learning –based system to detect remote marine litter detection; tested in several hotspot in Spain's NW coast. Flow trajectory model and Earth observation based results. The system was further tested in projects ATIN-BLUECO and PLESS
- **Service Provider:** GMV

Target 14.1: By 2025, prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution. Indicator 14.1.1: Coastal marine pollution



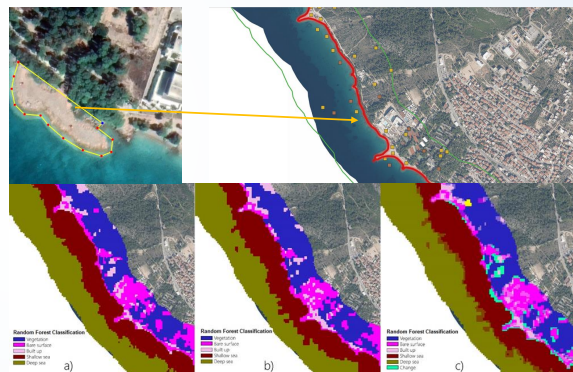
References link

EO services contributing to SDGs Monitoring of Coastal zones



- **User:** Public administration, coastal governing bodies, sectorial Ministries
- **Challenge/Needs:** Monitoring of coastal zone and identification of negative human influence
- **Initiative:** To develop, in the long term, an automated process based on Sentinel 2 imagery, which would detect several types of activities destructive to the ecosystem, such as: gridding of karst coastline to create beaches, embanking and refeeding the karst coastline with gravel, dumping construction material on the shore and construction of illegal piers.
- **Results:** Online, per-request, service for active monitoring of negative human influence on the coast
- **Service Provider:** Oikon Ltd. – Institute of Applied Ecology

Target 14.1: By 2025, prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution. Indicator 14.1.1: Coastal marine pollution



Sample of negative coastal influence (Upper image) with classified situation before (a), after (b), and detected change (c)



References link: [The European Space Agency \(ESA\) and Oikon sign two contracts for remote sensing projects in Croatia – Oikon d.o.o.](#)

EO services contributing to SDGs
OKEANOS: Integrated solution for oil spills at sea



- User: Oil & Gas companies, Environmental/Maritime Authorities, Maritime Ports, NGOs
- Challenge/Needs: oil spill detection, characterization & trajectory forecasting, Identification of source. ESG reporting
- Initiative: commercial product developed in partnership with CMCC srl, as a one-stop-shop for oil spill monitoring and forecasting at sea. OKEANOS constitutes a user-friendly, convenient, accurate and agile tool to have advanced situational awareness and optimise decision making
- Results: AI-based platform that provides early warnings of detected oil spills, identification of source and trajectory forecasting. The analytics provide unique features like thickness mapping and quantification of oil released at sea
- Service Provider: Orbital EOS

Target 9.4: By 2030, upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes, with all countries taking action in accordance with their respective capabilities.

Target 14.1: By 2025, prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution.



Fig. Digital interface of OKEANOS, showing oil spill in Baniyas terminal, Syria



<https://www.rempec.org/en/news-media/rempec-news/incident-involving-a-fuel-leakage-into-the-mediterranean-sea-from-the-baniyas-thermal-station-syria-1>

<https://www.orbitaleos.com/>

EO services contributing to SDGs
Rheticus® Marine



- User: National and Regional Governmental Institutions in charge of environmental monitoring and reporting - Policy and Decision Makers, from international to local level - Stakeholders (e.g. industries involved in offshore drilling, wind plants, wastewater services, desalination, fishery and aquaculture, tourism and recreational activities, etc.);
- Challenge/Needs: Understand seawaters' quality, health and evolution over time, to easily spot trends and anticipating risky situations and harmful events.
- Initiative: Copernicus Marine Environment Monitoring Service (CMEMS)
- Results: helping customers in the public sector to implement environmental policies from local to international level, meeting the requirements in the field of marine environment policy (e.g. MSFD, WFD).
- Service Provider: CMEMS and EMODnet

Target 13.1.: eo services based on Identifying, monitoring and preparing for climate related hazards

Target 14.1.: eo services based on Integrating data & monitoring for marine pollution. Indicator 14.1.1: Coastal marine pollution



Figure: Rheticus® Marine service geoportal with analytics tools



References: <https://marine.copernicus.eu/services/use-cases/rheticus-marine-support-eu-marine-strategy>
<https://www.rheticus.eu/rheticus-services/marine/>

EO services contributing to SDGs

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References links

- <https://marine.copernicus.eu/services/use-cases/rheticus-marine-support-eu-marine-strategy>
- <https://www.rheticus.eu/rheticus-services/marine/>

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Figure: Rheticus® Marine service geoportal with analytics tools

EO services contributing to SDGs

iEMOWAF





- User: State organization (Ministries), Public organization (universities, research labs) and industry
- Challenge/Needs: Better water management and flood prevention in Bulgaria
- Initiative: PECS-ESA
- Results: Monitoring of important water quality parameters - turbidity, chlorophyll a, total suspended matter, coloured dissolved matter and harmful algae bloom in inland and coastal lakes in order to support Bulgarian water authorities responsible for water quality monitoring.
- Service provider: RSICS Ltd., TAKT-IKI Ltd.

References link: <http://i.emowaf.eu/>

- Target 6.3: By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally.
 - Indicator: 6.3.2: Ambient water quality
- Target 6.4: By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity.
 - Indicator 6.4.1: Water user efficiency & 6.4.2: Water stress
- Target 6.6: By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes.
 - Indicator 6.6.1: Water-related ecosystems
- Target 14.1: By 2025, prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution.



Figure: iEMOWAF, Visualization of Varna Lake, Bulgaria CHL data

Relevant Success Stories

- [Satellite based oceanography](#)
- [GIO water and wetlands](#)
- [Satellite based detection of oil spills](#)
- [The GOS4M Knowledge Hub designed for end-users to assess the effectiveness of measures undertaken under the Minamata Convention on Mercury.](#)
- [Detect and monitor oil slicks](#)
- [Satellite-based oil spill detection](#)
- [Ocean Model Circulation Operational Validation](#)
- [Operational risk in ice-prone waters](#)

- [Satellite based oil spill detection and impact assessment – The chronology of the Deepwater Horizon Accident](#)

xiii. SDG 15 - Life on Land



xiii.1 Goal: Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.

EO data offer an invaluable opportunity for better-informing development policies and quantifying various targets. How can EO be used to help countries achieve specific targets? *Source: [ESA compendium of EO contributions to the SDG Targets and Indicators](#)*

Target 15.1: By 2020, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements.

This target aims to ensure sustainable management and monitoring, and use of terrestrial ecosystems including freshwater ecosystems and their restoration. It is an ambitious target which considers the interrelatedness of life in different elements of terrestrial ecosystems - mountains, wetlands, arid lands and forests and that the health of one part impacts the other.

EO can play multiple roles in achieving the target as it is a crucial part of the monitoring strategies for conservation, restoration and sustainable use of terrestrial ecosystems. The availability of multi-decadal time series datasets of the (global) land surface from multiple satellite sensors means that there are fewer remote sensing data gaps and greater ability to monitor long term changes over greater areas. Multi-scale land-cover information can be retrieved over whole countries which, complemented with field data, can support integrated land use plans, including evaluation of the services provided by terrestrial and freshwater ecosystems. Remote sensing data coupled with modelling tools can support the identification of priority areas for ecosystem services provision that needs specific management activities. It can also be used to monitor the effectiveness of restoration activities planned for these sites or to assess their status over time. Optical or radar sensors, or a combination of the two, can detect not just forest cover area, but also other attributes as wetlands, lakes and to estimate their biophysical parameters, as well as surface and volume measures.

Existing indicators primarily report on the extent to which areas are conserved (15.1.2) or sustainably used (15.1.1), therefore, there is a gap for an indicator on the restoration of these ecosystems. For example, indicator 15.1.1 only includes forest areas – drylands and mountains are considered under indicators 15.3.1, 15.4.1 and 15.4.2. Similarly, freshwater ecosystems are monitored using indicator 6.6.1 – so are not considered under target 15.1. EO has a lot of potential here as it can effectively monitor land cover change over time with high accuracy both at very high to high spatial resolution. The identification of terrestrial and inland freshwater ecosystems which have been modified by humans paves the way for a tool that could identify areas for habitat restoration. Moreover, FAO is custodian of these SDGs and will work closely with other partners.

(eo services based on Monitor land use and land cover change on land ecosystems. Indicator 15.1.1: Forest areas)

Target 15.2: By 2020, promote the implementation of sustainable management of all types of forests, halt deforestation, restore degraded forests and substantially increase afforestation and reforestation globally.

Forests are a key terrestrial ecosystem, providing various ecosystem services, including food, biodiversity, protection from soil erosion, climate change mitigation. This ecosystem is rapidly disappearing, “thirteen million hectares of forests are being lost every year while the persistent degradation of drylands has led to the desertification of 3.6 billion hectares”, and this indicates the need for effective strategies to reduce deforestation and implement sustainable forest and land management practices. Together with target 15.1, this target ensures that forests are efficiently managed, and a sustainable balance between conservation and the use of natural resources is achieved. EO can be used to assess the change in forest extent and quality (e.g. degradation), but also to plan for the effective implementation of activities aiming to achieve the sustainable management of forest. Satellite images and subsequent analyses can help to identify sites where to implement reforestation and afforestation activities, as well as areas that are at higher risk of deforestation because of past forest clearing for agriculture or because of the proximity to infrastructures such as roads, and their protection should be prioritised. Different types of EO sensor systems are available (optical, radar and LiDAR) and can be used to map forest change based on type of forest, climatic conditions, technical capacity available in the country. Mapping forest degradation and biomass change is generally more challenging than monitoring forest extent, but new promising methods are being developed and tested.

(eo services based on Progress towards sustainable forest management (biomass, area of change, etc) Indicator 15.2.1: Sustainable forest management)

Target 15.3: By 2030, combat desertification, restore degraded land and soil, including land affected by desertification, drought and floods, and strive to achieve a land degradation-neutral world.

Land degradation, defined as “a state whereby the amount and quality of land resources necessary to support ecosystem functions and services and enhance food security remain stable or increase within specified temporal and spatial scales and ecosystems” (decision 3/COP.12, UNCCD, 2015a) is negatively impacting the well-being of billions of people (IPBES, 2018). Already at this point, there have been a number of global initiatives aiming to halt land degradation and restore degraded land. The global community’s efforts to halt desertification, maintain and restore land and soil productivity, and to mitigate the effects of drought are spearheaded by the United Nations Convention to Combat Desertification (UNCCD) which was adopted in Paris on 17 June 1994. As the dynamics of land, climate and biodiversity are intimately connected, the UNCCD collaborates closely with the other two Rio Conventions; the Convention on Biological Diversity (CBD) and the United Nations Framework Convention on Climate Change (UNFCCC). The vision of the UNCCD aligns in particular with the CBD’s Aichi Biodiversity Target 15, which aim to restore at least 15% of degraded ecosystems; the Bonn Challenge (2011) and its regional initiatives to restore more than 150 million hectares; and most recently, the UN Sustainable Development Goals (SDGs) (Sims et al. 2017). Target 15.3 is strongly aligned with the land degradation neutrality (LDN) target setting process of the UNCCD which is supporting interested countries (now) through a dedicated target setting programme (TSP), including the definition of national baselines, targets and associated measures to achieve LDN by 2030. While 120 countries are in the process of setting voluntary targets, 80 countries already have. As part of the TSP, the UNCCD has selected data partners to assist countries with data for target setting in the absence of national data. These include the ISRIC soil grids, the JRC Land productivity dynamics data layer and the ESA-CCI land cover. All of these global datasets are reliant on EO data as inputs thereby directly contributing to countries in the LDN Target Setting Program.

(eo based on Proportion of land degraded (land cover, productivity and carbon stocks))

Target 15.4: By 2030, ensure the conservation of mountain ecosystems, including their biodiversity, in order to enhance their capacity to provide benefits that are essential for sustainable development.

Mountain ecosystems are hotspots of biodiversity and provide essential ecosystem services for population living in and beyond mountain areas. Accordingly, their safeguard is of primary importance to help achieving certain SDGs. This is explicitly recognized in SDG 15 through this target, which is fully dedicated to conserving mountain ecosystems so that their biodiversity and the services that flow from them are not in peril and are sustained in the long term.

EO can help support the conservation and sustainable management of mountain ecosystems through multiple ways. The applicability of EO to monitor land use dynamics and the drivers of land use change, such as expansion of human settlements or crop conversion, as well as their implications for biodiversity, has been extensively proven. EO data, such as Digital Elevation Models (DEMs) or data on climate and dynamic processes, can also be used to feed models that assess the supply of and demand for mountain ecosystem services. These models, in turn, could be combined with information derived from climate or land use change scenarios to assess how the provision of ecosystems services could be affected by them, allowing to identify priority areas to implement adaptation actions.



(eo based on Conservation & sustainable management of mountain ecosystems (protected areas, green cover) Indicator 15.4.2: Mountain green cover)

EO Products/Services supporting the SDGs

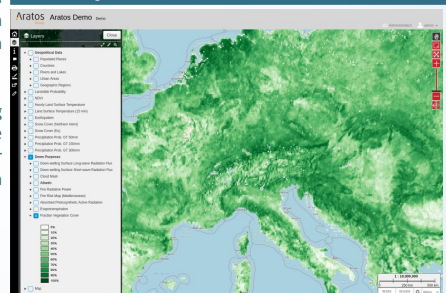
EO services contributing to SDGs
GreenSSLM – Forest and area conservation and sustainability management

- User:** Government Agencies, Public Authorities, NGOs, Research Orgs, Ecosystem Conservation Organizations, Forestry.
- Challenge/Needs:** Monitoring and understanding land use / land cover change and sustainability is a very challenging task, due to the amount and diversity of all relevant interacting factors acting upon an ecosystem. No innate historical record to help identify man-made or natural changes.
- Initiative:** A platform that manages a vast variety and quantity of space data in order to calculate a set of parameters indicating the presence of alterations on a given ecosystem's status (biomass, area of change, protected areas, green cover...etc)
- Results:** A cloud-based interface, satellite and remote sensing monitoring information, output from a combination of multiple algorithmic models, the results of which are analytically studied by environmental experts to deliver solutions which promote conservation and sustainability in areas where human and wildlife co-existence and vegetation growth is of the essence.


Service Provider: Aratos Systems.

- Target 15.1: By 2020, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements. Indicator 15.1.1: Forest areas.
- Target 15.2: By 2020, promote the implementation of sustainable management of all types of forests, halt deforestation, restore degraded forests and substantially increase afforestation and reforestation globally. Indicator 15.2.1: Sustainable forest management
- Target 15.4: By 2030, ensure the conservation of mountain ecosystems, including their biodiversity, in order to enhance their capacity to provide benefits that are essential for sustainable development. Indicator 15.4.2: Mountain green cover






Fraction of Vegetation Cover corresponds to the fraction of ground covered by green vegetation.



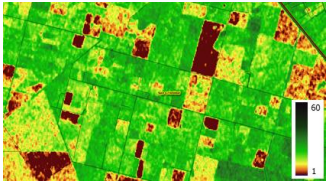
<https://www.greenslsm.com/>

Crop monitoring based on Sentinel-1 SAR data

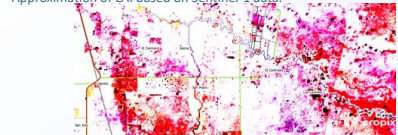
- User:** Local authorities / NGOs
- Needs:** Gapless time-series data with high spatial and temporal resolution for crop monitoring, change detection and yield estimation.
- Challenge:** Implementation of early warning in case of hazards and loss estimation on broad scale to mitigate food shortages.
- Initiative:** Use reliable Sentinel-1 data and derive different indices to monitor anomalies in crop growth, biomass development, drought condition and leaf area index (LAI) for yield approximation.
- Results:** Permanent crop monitoring and change detection seasonal and perennial (baseline). Yield forecast based on LAI. Support for insurance schemes and disaster management.
- Service Provider:** cropix

Target 2.4: By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality.




Approximation of LAI based on Sentinel-1 data



Matrix	Jan 09, 2019	Jan 16, 2019	Jan 23, 2019
single			
double			
triple			

Flooding event: extent and duration



<https://cropix.ch/imap-en/>

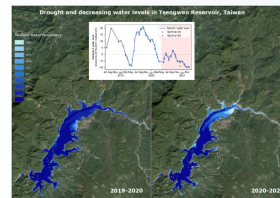
EO services contributing to SDGs Mapping freshwater ecosystems



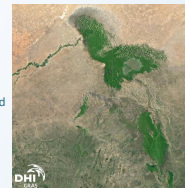
- User: National and regional authorities, water managers, NGOs
- Challenge/Needs: Assessing the amount of small- and large-scale water resources in a river basin, including discharge and recharge is crucial for water resource management, reduction of flood risks, and decision-making in water sensitive sectors. Furthermore, it is essential for efficient planning and steering of reservoir development and management.
- Initiative: Commercial product as a result of several years R&D
- Results: The freshwater mapping solution provides a number of key products to monitor the state and dynamics of freshwater ecosystems, including detailed mapping and monitoring of open water bodies, including reservoirs and lakes, and their seasonal changes; estimations of surface water volume and river discharge; and wetland mapping and characterisation.
- Service Provider: DHI GRAS

Target 6.6: By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes.

Target 15.1: By 2020, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements.



Example: Coupled surface water dynamics and water levels mapping to assess the impacts of drought on water resources.



Example: Wetland monitoring in Chad



Reference: <https://www.dhi-gras.com/solutions/surface-water-monitoring/>
<https://www.dhi-gras.com/projects/eo4sdg/>

EO services contributing to SDGs Mapping mangroves

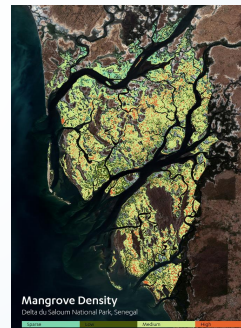


- User: National and regional authorities, NGOs
- Challenge/Needs: Mangroves are critical ecosystems which provide coastal protection from storm surges, control floods, stabilize coastlines and enhance biodiversity. Furthermore, mangroves are a central component of the blue carbon ecosystem. Knowledge about mangrove extent, structure and dynamics is key to inform mangrove conservation and restoration planning and management.
- Initiative: Commercial product as a result of several years R&D
- Results: Applying supervised machine learning algorithms, mangroves are accurately mapped and characterized using high resolution satellite data. The mangrove extent product provides an accurate spatial delineation of areas covered by mangrove communities, while a detailed characterization product provides added information on species compositions and/or mangrove structures (e.g. height, density, or biomass).
- Service Provider: DHI GRAS

Target 6.6: By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes.

Target 13.1: Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries.

Target 15.1: By 2020, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements.



Example: Combined mangrove extent and density data product (Delta Saloum National Park, Senegal).



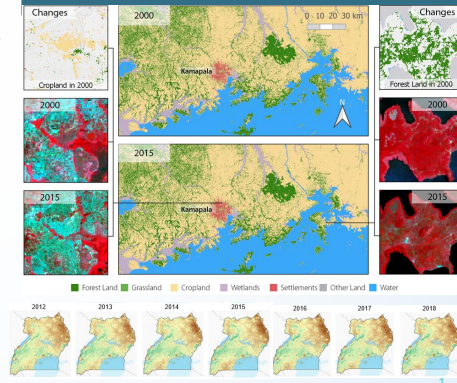
Reference: <https://www.dhi-gras.com/> / <http://maps.eo4sd-water.net/airbmp1/>
<https://www.dhi-gras.com/projects/eo4sdg/>

EO services contributing to SDGs
Land degradation mapping



- **Users:** Development Agencies, Governmental Org., IFIs
- **Challenge:** Entice governmental organizations to use EO derived data to fight critical reduction or loss of the biological or economic productivity and complexity of rain fed cropland, irrigated cropland, or range, pasture, forest and woodlands.
- **Initiative:** Land degradation mapping - combination information of land cover and land use changes with trends in the vegetation productivity to analyse the likelihood of degrading or improving environments.
- **Results:** Tailored EO processing chains to generate degradation maps based on sub-indicator 15.3.1 corresponding to Land cover & land cover changes, land productivity changes and carbon stock changes, based on the classes: forest land, grassland, cropland, wetlands, settlements & other, to support assessment, planning, implementation, monitoring reporting obligations.

Target 15.3: By 2030, combat desertification, restore degraded land and soil, including land affected by desertification, drought and floods, and strive to achieve a land degradation-neutral world.
Target 13.1: Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries.



• **Service provider:** GeoVille

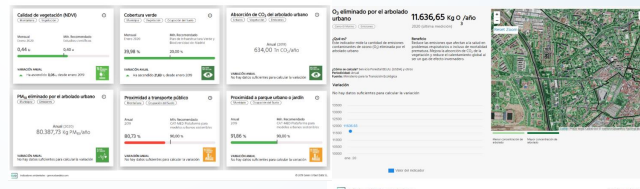
References: <https://eo4society.esa.int/projects/eo4sdgs/>
<https://www.eo4idl.eu/>

EO services contributing to SDGs
Environmental Indicators SaaS



- **User:** Municipalities, urban planners, smart cities, consultancy firms
Challenge/Needs: Evaluate natural and green areas status, ecosystem services provided and other benefits.
- **Initiative:** Offer in a unique platform easy access to environmental indicators data, always updated, multi-scale levels (municipality – neighbourhoods), targets achievement and expected.
- **Results:** Monitor land use and land cover change on land ecosystems in more than 15 cities monitored, more than 100 indicators managed.
- **Service Provider:** Green Urban Data, Sentinel-2,3,5, Urban Atlas, Landsat 8, Planet, others

Target 15.1: By 2020, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements.
Target 15.2: By 2020, promote the implementation of sustainable management of all types of forests, halt deforestation, restore degraded forests and substantially increase afforestation and reforestation globally.
Target 15.3: By 2030, combat desertification, restore degraded land and soil, including land affected by desertification, drought and floods, and strive to achieve a land degradation-neutral world.
Target 15.4: By 2030, ensure the conservation of mountain ecosystems, including their biodiversity, in order to enhance their capacity to provide benefits that are essential for sustainable development.



Vegetation ecosystem services evaluation for Marbella (Spain)



O3 pollution avoided by vegetation, Marbella (Spain)



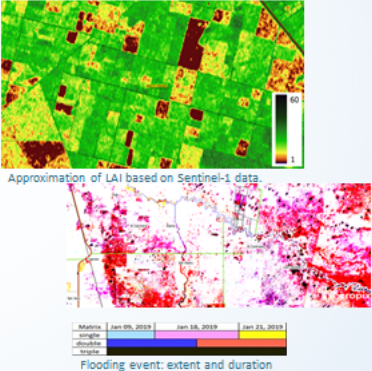
greenurbandata.com

Crop monitoring based on Sentinel-1 SAR data

- User: Local authorities/ NGOs
- Needs: Gapless time-series data with high spatial and temporal resolution for crop monitoring, change detection and yield estimation.
- Challenge: Implementation of early warning in case of hazards and loss estimation on broad scale to mitigate food shortages.
- Initiative: Use reliable Sentinel-1 data and derive different indices to monitor anomalies in crop growth, biomass development, drought condition and leaf area index (LAI) for yield approximation.
- Results: Permanent crop monitoring and change detection seasonal and perennial (baseline). Yield forecast based on LAI. Support for insurance schemes and disaster management.
- Service Provider: cropix





Target 2.4: By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality.



Approximation of LAI based on Sentinel-1 data.


4




<https://cropix.ch/imap-en/>

EO services contributing to SDGs Sustainable management of forests


- User: Dordogne Province
- Challenge/Needs: Environmental impact of agriculture. Collecting geographic information to implement sustainable forest management actions and preserve biodiversity through green infrastructure consolidation.
- Initiative: Fine mapping of forests, hedges and lone trees all over the Dordogne province (9,000 sq. km.), biomass quantification, terrain classification for sustainable tree-harvesting and logging
- Results: Production of open-access, province-wide information to help local authorities implement long-term plans for sustainable forest management and biodiversity preservation
- Service Provider: Kermap



Target 15.2: By 2020, promote the implementation of sustainable management of all types of forests, halt deforestation, restore degraded forests and substantially increase afforestation and reforestation globally.



Capture of Dordogne département's open-access forest map produced by Kermap



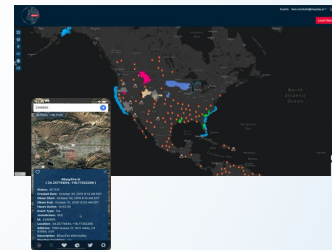
[Maison numérique de la biodiversité Dordogne-Périgord](https://www.maison-numerique.fr/)

EO services contributing to SDGs Disaster and risk intelligence



- Users: organisation with a mandate in disaster management, humanitarian and development aid, government agencies, international organisations, forestry, agriculture sector
- Challenge/needs:
 - Mayday.ai products raise awareness about the protection of forests, particularly in relation of reducing the impact of wildfires and restoration
 - Mayday.ai products can be used for monitoring to avoid degradation of natural habitats
- Initiative: commercialisation starting as of autumn 2021
- Results: reduced impact (less fatalities, economic damage and environment degraded), protection of forests and natural habitats
- Service provider: [Mayday.ai](https://www.mayday.ai)

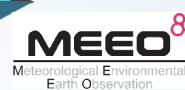
Targets: 15.2: By 2020, promote the implementation of sustainable management of all types of forests, halt deforestation, restore degraded forests and substantially increase afforestation and reforestation globally. **15.3:** By 2020, promote the implementation of sustainable management of all types of forests, halt deforestation, restore degraded forests and substantially increase afforestation and reforestation globally. **15.5:** Take urgent and significant action to reduce the degradation of natural habitats, halt the loss of biodiversity and, by 2020, protect and prevent the extinction of threatened species.



Mayday.ai's disaster and risk platform



MADAMES-AX: Mitigation and ADaptation Analysis for Mediterranean Ecosystem Services



- User/pilot area: forest managers of Agro-Forestry Consortium of Comunelli di Ferriere (<http://www.consorziodiferriere.com/>)
- Challenge/Needs: Starting from the need of the wood industry (Leroy Merlin Italy involved) to quantify the ecosystem services. Focus on assessment and monitoring of the carbon sequestration and biomass production of a forest area located in the Comunelli di Ferriere Consortium; validation of a scaling business model to support sustainable management of the forest ecosystems.
- Initiative: EIT Climate-KIC Project "MADAMES-AX (Mitigation and ADaptation Analysis for Mediterranean Ecosystem Services)" Carried out in 2020 by MEEO and the Euro-Mediterranean Center on Climate Change (CMCC), with the strong collaboration of PEFC Italy and of Agro-Forestry Consortium of Comunelli di Ferriere.
- Results: demonstrator to support sustainable management of the forest ecosystems, by providing two main indicators: Carbon Use Efficiency (CUE) and Water Use Efficiency (WUE) which are proxies of less or more functioning forests to adapt to changing environmental conditions
- Service Provider: MEEO/CMCC

Target 15.2: By 2020, promote the implementation of sustainable management of all types of forests, halt deforestation, restore degraded forests and substantially increase afforestation and reforestation globally. **Indicator 15.2.1:** Sustainable forest management



Demonstrator forest area in the Ferriere Municipality (Piacenza Province in Emilia Romagna Region, Italy)



- <https://www.madames-ax.info/>
- <https://storymaps.arcgis.com/stories/4a402e80f97740489b6e53b6dd22466e>



Logos of the project consortium partners

EO services contributing to SDGs Forest mapping and change detection



- Users: governments (national, provinces, municipalities), forestry organisations
- Challenge/Needs: Forests are an important element of the environment. It is therefore not allowed to cut trees without a permission. The enforcement of this law is difficult however, as areas are enormous and human resources limited. There is a need to monitor trees and forests in an automated way. The user is however not interested in every single disappeared tree, as not all trees fall under the nature conservation law. It is therefore necessary to make use of smart filtering to only deliver relevant changes to the end user.
- Initiative: Automated monitoring system to detect changes in forests for regulation enforcement.
- Results: The nationwide tree database of the Boomregister that was developed by NEO is used as baseline. LiDAR and satellite data is used as source for the monitoring. We use deep learning algorithms to signal where trees have disappeared, and filter them to only keep the most relevant ones.
- 1) mapping land use land cover maps 2) derive the changes through the years 3) mapping the forest extent 4) detect illegal logging activities
- Service Provider: NEO BV

Target 15.1: By 2020, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements.

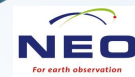


In orange the trees that are signaled as disappeared



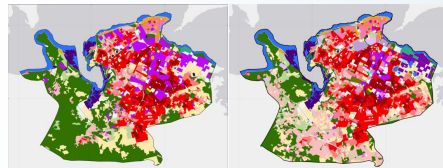
Neo environmental monitoring solutions:
<https://www.neo.nl/forest-and-tree-protection/>
<https://www.neo.nl/natural-vegetation-mapping-and-monitoring/>

EO services contributing to SDGs Land use land cover (change) mapping



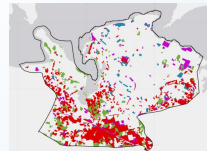
- User: land administration, forest management, city planning
- Challenge/Needs: monitoring the land use modification, identify land degradation, forest conservation
- Initiative: Earth Observation for Sustainable Development (EO4SD) – European Space Agency (ESA) program; Earth Observation for Sustainable Development (EO4SD) – European Space Agency (ESA) program, aims to achieve increasing the uptake of satellite based information in the financial institutions' regional and global development programmes with a focus on urban development, agriculture and rural development . It aims to meet the long term, strategic geospatial information needs in the individual developing countries as well as international and regional development organisations. The land use/land cover product represent a detailed status of spatial –temporal land use/land cover patterns on the level of individual cities or larger administrative areas.
- Results: 1) mapping land use land cover maps 2) derive the changes through the years 3) mapping the forest extent 4) detect illegal logging activities
- Impact: The high temporal resolution combined with low production costs allow the comparison of the capacity of specific locations relative to the projected demand arising from growth in populations and economic activities (World Bank, 2010) With such information urban planners can easily capture infrastructure bottlenecks and spatial structures important to be improved and prioritize activities and investments.
- Service Provider: NEO BV

Target 15.1: By 2020, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements.



Mtwaru 2008 land use land cover

Mtwaru 2017 land use land cover



Land use land cover change between 2008 and 2017



Neo environmental monitoring solutions:
<https://www.neo.nl/forest-and-tree-protection/>
<https://www.neo.nl/natural-vegetation-mapping-and-monitoring/>
<https://eo4sd-urban.info/>

EO services contributing to SDGs

Forest ecosystem monitoring and invasive species detection



- **User:** Public administration, forest governing bodies, sectorial Ministries
- **Challenge/Needs:** Extensive monitoring of the status of forest ecosystem in the Spačva basin, the largest pedunculate oak basin in Europe
- **Initiative:** Use of a wide spectre of EO systems (MODIS, Landsat8, Sentinel-2) and various *in situ* techniques to monitor the health and productivity of the forest ecosystem and to visualize the dynamics of the spread of Oak lace bug, an invasive species infesting and destroying oak forests in Europe.
- **Results:** Forest ecosystem monitoring study, data on the spread of invasive species and suggestions on the way to control the effect.
- **Service Provider:** Oikon Ltd. – Institute of Applied Ecology

Target 15.1: By 2020, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements.

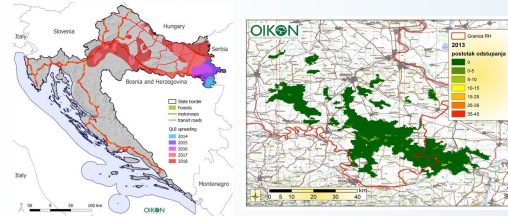


Figure: Routes of spreading of oak lace bug in Croatia (left), spread dynamics in the Spačva basin (right)



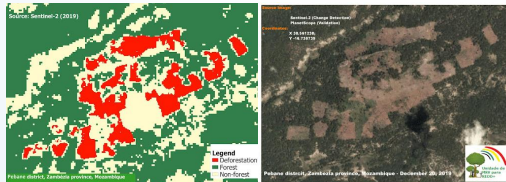
References link: <https://oikon.hr/the-spread-of-oak-lace-bug-in-croatia/> and <https://oikon.hr/the-study-about-effectiveness-of-measures-for-prevention-of-spreading-of-the-oak-lace-bug/>

EO services contributing to SDGs
Preventing global deforestation



- **User:** national forest authorities, NGOs, researchers, UNFAO, public (global public good)
- **Challenge/Needs:** Despite the vital contributions to our Earth, roughly 30 football fields of tropical forests are destroyed per minute.
- **Initiative:** Norway's International Climate and Forests Initiative (NICFI) is a pioneering program to stop global deforestation, offering Planet data across 64 tropical countries to support the prevention of deforestation and help save the world's tropical forests.
- **Results:** This data is integrated into a data platform that helps reduce and reverse tropical forest loss - for example, by improving early deforestation detection, forest area change estimations, classification of drivers of deforestation, and monitoring and intervention of forest degradation.
- **Service Provider:** NICFI

Target 15.1: By 2020, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements.




The Government of Mozambique is using Planet Scenes data to validate deforestation events and improve forest area change estimation and mapping. Source: Herculio Odorico, Government of Mozambique. Planet Explore 2020.




Reference: <https://www.nicfi.no/>

EO services contributing to SDGs Protecting Tropical Rainforests from Deforestation

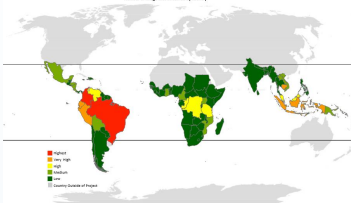


- **User:** Government, nonprofit, and conservation initiatives across the tropics.
- **Challenge/Needs:** Lack of access to high-resolution imagery within the tropics limits the ability to protect the world's tropical forests against deforestation and tackle climate change.
- **Initiative:** In partnership with Norway's International Climate and Forests Initiative (NICFI), Planet's satellite data is providing comprehensive access to high-resolution monitoring of the global tropics, helping improve tropical forest monitoring systems, validating deforestation alerts, and enabling regional and global conservation organizations.
- **Results:**
 - Initiatives across the world have been leveraging Planet's high-resolution satellite imagery, free of charge, helping to save the world's tropical forests while simultaneously improving the livelihoods of those who live off of and near the forests.
 - Planet Basemaps are now what users most actively choose on Global Forest Watch (GFW), accounting for 63% of basemap selections and 62,000 toggles on the GFW platform.
 - Over 8,500 users from over 130 countries and the public, private, and civil society sectors have signed up to access and download the NICFI data through the Planet platform.
 - More recently, Planet has teamed with Google to make its imagery available within the Earth Engine platform, which brings the power of Google's cloud to the NICFI community to run analysis at scales not possible through traditional means.
- **Service Provider:** Planet, KSAT, and Airbus




<https://www.planet.com/pulse/planet-ksat-and-airbus-awarded-first-ever-global-contract-to-combat-deforestation/>

<https://www.planet.com/pulse/nicfi-users-make-progress-towards-reducing-and-reversing-tropical-forest-loss/>



This heat map shows the top streamed tile counts across countries with access to high-resolution satellite data through the NICFI Satellite Data Program. Credit: KSAT

EO services contributing to SDGs Rheticus® Wildfires



- **User:** National Park Authorities
- **Challenge/Needs:** easily detect burnt area, improve fire severity classification, vegetation regrowth monitoring as well as detection of potentially illegal infrastructure activities within burnt areas.
- **Initiative:** Internal Development
- **Results:** Timely analyse and plan recovery activities for parks, forests and remote areas affected by wildfires. By means of maps, geo-analytics, and pre-set reports park managers and authorities will be able to coordinate and manage response teams, while also detecting any illegal man-made activity.
- **Service Provider:** Planetek Italia's Rheticus platform

References links

- <https://www.rheticus.eu/rheticus-services/wildfires/>
- <https://www.rheticus.eu/case-history/wildfires-capture-from-space/>

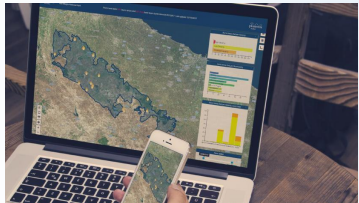



Figure: Rheticus® Wildfires service geoportal with analytics tools

Target 1.5.: eo services focus on: Build resilience of vulnerable populations contributing to management of disaster risk reduction.

Target 15.1.: eo services based on Monitor land use and land cover change on land ecosystems. Indicator 15.1.1: Forest areas

Target 15.2.: eo services based on Progress towards sustainable forest management (biomass, area of change, etc) Indicator 15.2.1: Sustainable forest management

Target 15.4.: eo based on Conservation & sustainable management of mountain ecosystems (protected areas, green cover) Indicator 15.4.2: Mountain green cover



1

EO services contributing to SDGs Conservation and restoration of peatlands

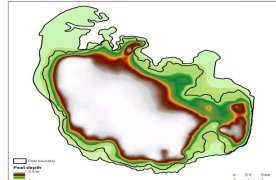
- User: Indonesian Peat Restoration Agency (BRG - Badan Restorasi Gambut)
- Challenge/Needs:
 - The location, extent and status of peatlands are often unknown.
 - Accurate peatland maps needed to support conservation and restoration efforts
 - Assess the carbon storage potential of peatlands for GHG emissions abatement plans
- Initiative: NICFI & UNOPS: Restoring Indonesian Peatlands
- Results:
 - Mapping the extent of 15 million hectares of peatland in Indonesia
 - Estimation of the peat thickness and volume & modeling fire hazard
 - Creation of an updated map of peatland extent based on peat surface topography (DTM) and current and historic multispectral satellite imagery
 - Mapping of drainage network and hydrological analysis, assessment of the number of necessary canal blocking locations for restoration
 - Impact: Data-driven decision support for large scale peatland restoration
- Service Provider: Remote Sensing Solutions GmbH



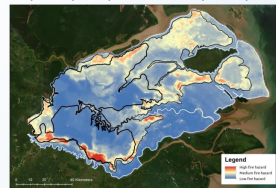
Peat Prize: <https://www.packard.org/insights/news/indonesian-peat-prize-winner-announced-new-mapping-method-will-protect-carbon-rich-peatlands/>References link



Target 15.1: By 2020, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements.



Map example of peat extent and peat depth



Model for Peatland fire hazard, Sumatra, Indonesia.

EO services contributing to SDGs National Research Programme “Smart Crop Production”

- User: State organization (Ministries), Public organization (universities, research labs) and industry
- Challenge/Needs: Sustainable management of natural resources, reduction of the harmful impact of agriculture on the environment and climate, reduction of the use of pesticides and increase of the quality and safety of crop production
- Initiative: National Research Programme “Smart Crop Production”, funded by the Ministry of Education and Science of the Republic of Bulgaria
- Results: Development and implementation of models using satellite images, AI, UAV data, digital methods for diagnostics, prognosis and management of the production of high quality crop production and decision making.
- Service Provider: RST-TTO, BAS



- Target 2.4.: By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality.
 - Indicator 2.4.1: Sustainable agriculture
- Target 15.1: By 2020, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements.
 - Indicator 15.1.1: Forest areas
- Target 15.2: By 2020, promote the implementation of sustainable management of all types of forests, halt deforestation, restore degraded forests and substantially increase afforestation and reforestation globally.
 - Indicator 15.2.1: Sustainable forest management
- Target 15.3: By 2030, combat desertification, restore degraded land and soil, including land affected by desertification, drought and floods, and strive to achieve a land degradation-neutral world. (land cover, productivity and carbon stocks)
- Target 15.4: By 2030, ensure the conservation of mountain ecosystems, including their biodiversity, in order to enhance their capacity to provide benefits that are essential for sustainable development.
 - Indicator 15.4.2: Mountain green cover

Figure: Vegetation indices applied to measure crop health



EO services contributing to SDGs
EO data for sustainable forestry



- **User:** Governments and forestry industry
- **Challenge/Needs:** Progress towards sustainable forest management and prevent encroachment or illicit activities
- **Initiative:** Provide reliable EO data to assess wildfire risk, detect illegal logging, monitor growth and health. Satellogic teamed up with CC35 to support the GREEN+ Jurisdictional Programme, which aims to monitor compliance and mitigate deforestation
- **Results:** The goal is to help jurisdictions committed to UN’s 30x30 goal and protect at least 30% of the world’s land and oceans.
- **Service Provider:** Satellogic

-Target 15.1: By 2020, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements.
 -Target 15.2: By 2020, promote the implementation of sustainable management of all types of forests, halt deforestation, restore degraded forests and substantially increase afforestation and reforestation globally.
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 - Target 15.4: By 2030, ensure the conservation of mountain ecosystems, including their biodiversity, in order to enhance their capacity to provide benefits that are essential for sustainable development.



Forest in Brazil. Modern conservation programs can rely on EO data. Earth Observation data is an essential source of information that can help teams visualize and quantify progress.



<https://satellogic.com/earth-observation/agriculture-forestry/>

EO services contributing to SDGs
Pest and Disease Monitoring for Horticulture



- **User:** Horticulturalists
- **Challenge/Needs:** Inefficient horticultural practices coupled with aggressive plagues and diseases can cause a decrease in the yield of up to 40%. Need to monitor land use and land cover change on land ecosystems
- **Initiative:** Space4Fauna mobile application capable of predicting/detecting plagues and diseases. Moisture, greenness, humidity, and temperature of crops are monitored using satellite imagery and are used to determine and map the risk of a plague or disease outbreaks.
- **Results:** Farmers can monitor the state of their crops and as a result, take action accordingly.
- **Service Provider:** Space4Good (Fauna + Parsec)

Target 15.1: By 2020, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements.



Web portal: <https://s4f.space4good.com/>



References link: <https://www.space4good.com/portfolio>

EO services contributing to SDGs
Illegal Logging Detection and Prediction (ILDAP)



- User: Land managers, conservation entities, agroforestry, timber/forestry, commercial, upstream supply chain managers
- Challenge/Needs: Illegal logging occurring in regenerated, conserved or active forested areas needs to be better monitored and mitigated.
- Initiative: Near-real-time detection and alerts, monitoring of deforestation over time, and predictions
- Results: Successful near-real-time detections of illegal logging for mitigation, predictions of risk areas based on proxies enabled better planning and regulation, interventions in time have been successful. 573 deforestation detections since 2019 in 200K ha. region.
- Service Provider: Space4Good (Arsari Enviro Industry, Amnesty International)

Target 15.2: By 2020, promote the implementation of sustainable management of all types of forests, halt deforestation, restore degraded forests and substantially increase afforestation and reforestation globally.
 Indicator 15.2.1: Sustainable forest management



Fig 1. ILDAP Features

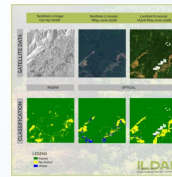


Fig 2. Remote sensing based classifications



<https://business.esa.int/projects/ildap> and <https://www.space4good.com/portfolio>

EO services contributing to SDGs
Pest and Disease Risk Mapping in Timber



- User: Forestry sector, governments and supply chain managers
- Challenge/Needs: Bark beetles often target weakened trees by breeding between the bark and the wood of the tree. Outbreaks seriously impact the timber industry, water quality, fish and wildlife and property values
- Initiative: Development of two risk models that classify the timber plantations in 7 risk levels; 1 being very low risk and 7 being high risk. Both models use a combination of **Sentinel-2** imagery, soil information, weather data and forest conditions to best determine where beetles are likely to emerge
- Results: Successful risk mapping of bark beetles including weather models and in-situ data sources.
- Service Provider: Space4Good (Kanton Bern)

Target 15.1: By 2020, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements.
Target 15.2: By 2020, promote the implementation of sustainable management of all types of forests, halt deforestation, restore degraded forests and substantially increase afforestation and reforestation globally.



Bark beetle risk modelling in state forests including weather models and in-situ data sources.



Beetles affect lumber industry, water quality, wildlife and property value



References link: <https://www.space4good.com/portfolio>

EO services contributing to SDGs Parametric insurance



- User: Insurance companies and forestry operators
- Challenge/Needs: If a fire episode occurs, the forest owner and operator have to know the exact burnt surface from a neutral actor to estimate the loss and be compensated as defined in their insurance contract.
- Initiative: After each fire episode we establish the exact burnt area along with a degree of severity to the insurance company as a neutral actor so that the client can be compensated properly. This service is based on satellite images.
- Results: Parametric insurance, fairly compensated insured forest owners
 - Benefits: (i) Work with relevant and compelling data (time, geographic zone) (ii) Cover a very wide area with a high level of granularity (iii) Access data globally, even for very remote areas
 - Impact: (i) Facilitate fair damage assessment (ii) Build knowledge on post-fire biodiversity recovery
 - Scalability: (i) Clear market focus (ii) Unique market differentiation (iii) Highly repeatable solution (iv) Outcome-focused offering
- Service Provider: TerraNIS



Target 15.1: By 2020, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements.

Target 15.3: By 2030, combat desertification, restore degraded land and soil, including land affected by desertification, drought and floods, and strive to achieve a land degradation-neutral world.



Forest burnt area after a fire episode

Relevant Success Stories

- [Mapping long term trends in deforestation in tropical regions](#)
- [Forest Management in Sweden](#)
- [TerraSAR - X 3D mapping geological survey in Indonesia](#)
- [TerraSAR - X support to deforestAction in Borneo](#)
- [Mapping and monitoring forest changes](#)
- [TanDEM-X & TerraSAR-X support to REDD+ MRV](#)
- [Implementing & managing agriculture projects](#)
- [EUROSENSE-Land cover monitoring](#)
- [EUROSENSE- Forest monitoring](#)
- [Forest cover mapping in Cambodia](#)
- [The GOS4M Knowledge Hub designed for end-users to assess the effectiveness of measures undertaken under the Minamata Convention on Mercury.](#)
- [Lidar data processing](#)
- [Supporting agricultural and food security decisions](#)
- [New UNESCO world heritage thanks to remote sensing and 4D GIS technology](#)
- [DMCii supports the fight with illegal logging in the Amazon](#)

xiv. SDG 16 - Peace, Justice & Strong Institutions



Goal 16: Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels >

xiv.1 Goal: Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels.

EO data offer an invaluable opportunity for better-informing development policies and quantifying various targets. How can EO be used to help countries achieve specific targets? *Source: [ESA compendium of EO contributions to the SDG Targets and Indicators](#)*

Target 16.1: Significantly reduce all forms of violence and related deaths everywhere.

(eo services focus on: [Monitoring critical assets](#))

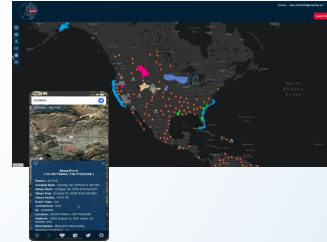
EO Products/Services supporting the SDGs

EO services contributing to SDGs Mayday.ai – democratised access to disaster intelligence

- Users: organisation with a mandate in disaster management, humanitarian and development aid, government agencies, international organisations, NGOs, civilians
- Challenge/Needs:
 - Today only selected public services and corporates have a privileged access to disaster management information. Mayday democratises this intelligence allowing anyone, including civilians to directly protect themselves, their communities, assets and prevent the loss of habitat
 - Mayday's products bring full transparency with forensic accuracy to the area of disaster and resources management, which increases ownership, accountability and transparency
- Initiative: commercialisation starting as of autumn 2021
- Results: accessibility of information, increased accountability and transparency,
- Service Provider: [Mayday.ai](https://www.mayday.ai)



Targets: 16.6: Develop effective, accountable and transparent institutions at all levels, **16.10:** Ensure public access to information and protect fundamental freedoms, in accordance with national legislation and international agreements.



Mayday.ai's disaster and risk platform

EO services contributing to SDGs Increasing Peace and Transparency



- **User:** Defense and intelligence organizations.
- **Challenge/Needs:** Despite the international community’s efforts to sanction North Korea for its development of weapons of mass destruction, the country continues to receive illicit commodity supplies through adept evasion techniques. North Korea has obtained imported refined petroleum products needed to make weapons through secretive supply transfers at sea.
- **Initiative:** The Center for Advanced Defense Studies, otherwise known as C4ADS, is a non-profit organization located in Washington, D.C. that provides data-driven analysis and evidence-based reporting on global conflict and transnational security issues. Through Planet, C4ADS uses satellite data to conduct in-depth investigative studies to monitor North Korea’s illicit procurement networks.
- **Results:** By imaging Earth with a near-daily cadence, Planet has enabled greater transparency and political accountability globally. With Planet’s tasking resources, analysts have been able to identify illicit North Korean shipping operations in violation of United Nations sanctions.
- **Service Provider:** Planet

Target 16.4: By 2030, significantly reduce illicit financial and arms flows, strengthen the recovery and return of stolen assets and combat all forms of organized crime.



SkySat imagery of Diamond 8 delivering oil at Nampo Oil Terminal in North Korea © 2018, Planet Labs Inc.



<https://www.planet.com/pulse/planets-data-used-to-reveal-illicit-shipping-networks-delivering-fuel-to-north-korea-in-violation-of-un-sanctions/>

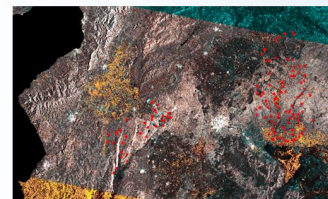
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EO services contributing to SDGs UXO Detection and Post-Conflict Assessments



- **User:** Humanitarian aid NGOs, United Nations, government agencies (The Halo Trust, The Carter Center)
- **Challenge/Needs:** Potential to monitor and support conflict resolution in war-torn regions using remote sensing and geospatial analysis for post conflict relief, reparations and UXO extraction.
- **Initiative:** Use of satellite imagery to assess, verify, and monitor the consequences of military conflict and detect potential sites for unexploded ordnance.
- **Results:** The project enabled a better understanding of the consequences of conflict, urban damage, and growth for good with the added benefit of protecting lives on the ground and supporting peacebuilding activities. UXO detections, as seen, were successful and aided in understanding UXO extraction insights using satellite data.
- **Service Provider:** Space4Good

Goal 16: Promote just, peaceful and inclusive societies



Detection points in red of Unexploded ordnance (UXOs).



References link: <https://www.space4good.com/portfolio>

xv. Cross-SDGs

This is a section in which we present EO services that contribute to achieving more than one Sustainable Development Goals (Cross-SDGs) following EO platforms dedicated to extract customize services on agriculture, forestry, urban planning, water quality, etc.

EO data offer an invaluable opportunity for better-informing development policies and quantifying various targets. How can EO be used to help countries achieve specific targets? *Source: [ESA compendium of EO contributions to the SDG Targets and Indicators](#)*

xv.1 Cross contribution to achieve Sustainable Development Goals



EO Products/Services supporting the SDGs

EO services contributing to SDGs
CREODIAS

- User: Earth Observation data users
- Challenge/Needs: Access to Earth Observation data from different sources. Possibility to use one flexible and reliable infrastructure for data access, storage, processing and sharing.
- Initiative: CREODIAS is a public cloud computing platform with Earth Observation data repository. The platform offers online, direct and immediate access to Copernicus Sentinel satellites data and Services, Envisat and Landsat data, other EODATA and VHR collection. Its design allows Third Party Users to prototype and build their own value-added services and products. CREODIAS consists of: EO Browser - satellite imagery browser with ability to visualize chosen Earth Observation images; EO Finder - advanced search engine, designed for selecting products based on sets of specific variables - such as time, place, collection, processing level; Cloud Dashboard serves as a tool for overview and management of processing resources. Data processing is fundamental phase in value chain offered with CREODIAS. Pursuing most efficient and favorable solutions, platform offers full set of virtual resources. Virtual Machines with a choice of different operating systems available, easily mounted storage volumes with object storage solutions, virtual network and appliances like firewalls and VPN concentrators.
- Results: One common environment enabling EO data access, storage, processing and sharing.
- Service Provider: CloudFerro




EARSC
European Association of Remote Sensing Companies

<https://creodias.eu/>



CREODIAS – EO Finder tool


EO services contributing to SDGs Remote Transfer for EODATA

- User: Earth Observation data user,
- Challenge/Needs: Remote transfer for EODATA service enables connecting with CREODIAS repository from an external infrastructure via S3 protocol. This connectivity allows users to attach the data directly to processing and workflow located on their own cloud environment without having to download the data beforehand.
- Initiative: All those who manage projects based on Earth Observation satellite data know what bandwidth is required and how much space is needed to maintain and transmit this data. Downloading data from publicly available repositories often involves long lead times due to limited bandwidth and queues.
- Results: This solution makes it possible to process large amounts of satellite data with easy access to them using your own infrastructure, in projects that do not allow the use of a cloud platform or resulting from the possession of an extensive external infrastructure.
- Service Provider: CloudFerro



Remote Transfer for EODATA



<https://creodias.eu/remote-transfer-for-eodata>

Mayday.ai – disaster and risk intelligence platform




- Users: organisation with a mandate in disaster management, humanitarian and development aid such government agencies, international organisations, NGOs (health divisions) or the (re)insurance sector
- Challenge/Needs: Reduce impact of natural & human-made disasters, with focus on early detection & risk management.
- Initiative: Mayday.ai's provide specific products helping on the monitoring of sustainable agriculture including food production. Products provide risk related to air pollution magt, urban/infrastructure planning (floodings, heat waves). Its products also help on the monitoring of natural habitats avoiding degradation or reducing the impact of wildfires and restoration. Overall they bring full transparency to the area of disaster and help to democratise the data for manegement activities. Its commercialisation starts as of autumn 2021
- Results: reduced impact (less fatalities, economic damage & environment degraded), increased resilience, lower insurance premiums/insurance more competitive, higher awareness, in-depth knowledge. Scalability and replicability products
- Service Provider: [Mayday.ai](https://www.mayday.ai)



Mayday.ai's disaster and risk platform



Target 1.5: Mapping spatial distribution of risk of poverty

Target 2.4: Agricultural productivity & env. impact of agriculture. Indicator 2.4.1: Sustainable agriculture

Target 3.9: Monitor the level of air quality data

Target 6.3: Water quality detection & monitoring. Indicator 6.3.2: Ambient water quality

Target 9.a: Sustainable and resilient infrastructure development

Target 11.4: Protect and safeguard the world's cultural and natural heritage

Target 12.4: Waste management

Target 13.1: Identifying, monitoring and preparing for climate related hazards

Target 15.2: Progress towards sustainable forest management (biomass, area of change, etc) Indicator 15.2.1: Sustainable forest management


Target 15.5: Reduce the degradation of natural habitats, halt the loss of biodiversity

Target 16.1: Effective, accountable and transparent institutions

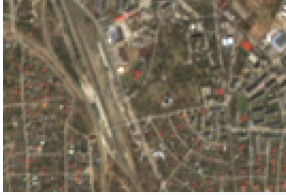
Target 16.10: Ensure public access to information

EO services contributing to SDGs


Sentinel-2: Resolution Enhancer (s2enh)



- User: Earth Observation data users
- Challenge/Needs: Sentinel-2: Resolution Enhancer (s2enh) allows better and more precise identification of all targets where traditional Sentinel-2 imagery cannot perform due to its low resolution.
- Initiative: The S2enh processor, which allows for resolution enhancement in images for 8 spectral channels with simultaneous preservation of radiometric quality.
- Results: The result of the processing is a Sentinel-2 L2A product with a resolution of 2.5m GSD, saved as a multilayer geoTIFF file. The solution gives the possibility to access current and historical data of the Sentinel-2 in the so far unavailable resolution.
- Service Provider: CloudFerro




Sentinel-2 imagery 10 m resolution




Sentinel-2 imagery +s2enh 2.5 m resolution

S2enh – comparison of Sentinel-2 imagery



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<https://creodias.eu/sentinel-2-resolution-enhancer>



EO services contributing to SDGs

CLEOS



AN ASI / TELESPAZIO COMPANY

- User: Geospatial Information developers, providers and users
- Challenge/Needs: Unique access point to geospatial data, multi-cloud/hybrid cloud processing platform, integrated AI capabilities, professional marketplace for self-service provision, API for platform automation and interoperability.
- Initiative: CLEOS initiative is fully funded by e-GEOS with the aim of delivering a state-of-art solution for internal needs (e.g. geospatial digital services development and provision) and for external Customers (e.g. Developer Portal and Marketplace). CLEOS is the all-in-one solution to master the Digital Revolution of Geoinformation Services. CLEOS offers direct access to a wide set of Space and non Space Data, Information Products and predefined Processing Services. Through the Developer Portal, expert users can build, test and scale their own Geoinformation services. Through a rich and secure set of APIs, external Platforms and Systems can exploit CLEOS services in highly automated, machine-to-machine transactions.
- Results: CLEOS is fully operational today and it is already supporting projects related to several domains (e.g agriculture, environmental monitoring, air quality assessment)
- Service Provider: e-GEOS



CLEOS Marketplace





European Association of Remote Sensing Companies

References link: <https://www.cleos.earth/>



EO services contributing to SDGs - Cross SDG EO data for land monitoring and disaster response



- **User:** Forestry industry, governments, emergency response teams, and community organizations
- **Challenge/Needs:** Consistent, scalable data across large areas for a multitude of analyses
- **Initiative:** Helping governments and collaborative initiatives access and disseminate consistent, accurate information that enables more effective and multi-prong approaches to addressing community, environmental, and other needs
- **Results:** Cohesive solutions that address the many dynamics a community, state, or country may face for greater outcomes at scale
- **Service Provider:** Satellogic

-Target 11.3: By 2030, enhance inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management in all countries. Indicator 11.3.1: Land consumption.

-Target 11.5: By 2030, significantly reduce the number of deaths and the number of people affected and substantially decrease the direct economic losses relative to global gross domestic product caused by disasters, including water-related disasters, with a focus on protecting the poor and people in vulnerable situations.

-Target 13.1: Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries.

-Target 15.1: By 2020, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements.

-Target 15.2: By 2020, promote the implementation of sustainable management of all types of forests, halt deforestation, restore degraded forests and substantially increase afforestation and reforestation globally.



An urban settlement next to a forest. Earth Observation data can help plan urban development and react to disasters such as wildfires.

