Global Development Assistance

Public Health Brochure

May 2025

powered by esa in partnership with ADB

Contents

List of Abbreviations

ADB - Asian Development Bank

AID - Agile EO Information Development

BC - Brockmann Consult

BSC - Barcelona Supercomputing Center

DN - Diginove

EO - Earth Observation

EOID - EO Information Development

ESA - European Space Agency

IFI - International Financial Institution

GDA - Global Development Assistance

WB - World Bank

WHO - World Health Organisation

What is the ESA's Global Development Assistance (GDA) programme?

The European Space Agency's (ESA's) **Global Development Assistance (GDA)** programme is an international partnership designed to integrate Earth Observation (EO) into development operations. Implemented in cooperation with major International Financial Institutions (IFIs), ESA's GDA develops targeted Agile Information Developments (AID) to address the needs of key thematic activity. The programme focuses on delivering operational EO services tailored to user requirements, supporting the mainstreaming of EO into IFI activities and client government processes. Those EO Information Development (EOIDs) or case studies are real-world implementations of EO services produced by one or more of ESA's GDA Public Health consortium members addressing an IFI team's need in a specific country with a client state and local stakeholder.

With twelve thematic activities underway, including Public Health, ESA's GDA AID is accelerating the operational use of EO to foster sustainable development outcomes.

What does the ESA's GDA Thematic Activity on Public Health do?

ESA's GDA Public Health focuses on activities to improve health infrastructure accessibility and vulnerability, to assess risk of environmentally sensitive infectious diseases, airborne and waterborne health hazards, and emerging diseases in the One Health context, while supporting efforts in improving nutrition and reducing food insecurity.

Public health around the world faces several challenges, from inaccessibility to health infrastructure, to nutrition and food insecurity, to increasing health risks due to climate change and environmentally sensitive infectious diseases. IFIs have introduced agendas that target these challenges, e.g., by strengthening health systems, increasing disease preparedness and resilience to climate-induced health risks, while improving nutrition (World Bank) and providing sustainable solutions to strengthen health infrastructure, governance, and financing (Asian Development Bank). Pivotal to the work financed by IFIs is access to relevant data and synoptic information on health and their background environmental or socioeconomical triggers. EO is increasingly seen as an essential source of information which can complement national data and support countries in the monitoring of key indicators related to health risks or factors of vulnerability. When combined with public health and other sources of information, EO can provide vital knowledge about risks to public health and opportunities for improvement.

➔ For further information please visit: https://gda.esa.int/thematic-area/health/

Who is working on ESA's GDA Public Health?

The ESA's GDA Public Health thematic activity is implemented by a consortium of five European companies and institutions leading in the fields of EO, remote sensing, risk assessment, data analytics, health, and the integration of technology into international development contexts.

The ESA's GDA Public Health consortium is led by Brockmann Consult.

The team members are:

- Brockmann Consult (Germany),
- GMV (Spain),
- Barcelona Supercomputing Center (Spain),
- Diginove (France), and
- mundialis (Germany).

What are the use cases of EO for ESA's GDA Public Health?

Health infrastructure accessibility

Health infrastructure accessibility plays a critical role in shaping public well-being, particularly during natural disasters or crises. The central concern underscores the necessity to quantify and analyse population accessibility to health centres, emphasising the need for adequacy and responsiveness to the ever-evolving dynamics of population density and urban development. This analysis tackles the pressing issue of limited access to essential healthcare facilities, highlighting the urgent requirement for a solution capable of thoroughly assessing the sufficiency of healthcare infrastructure in alignment with population distribution.

Examples EOIDs for health infrastructure accessibility

Population Accessibility to Health Care

Use

Assess and monitor the spatial accessibility of health care services in relation to population distribution. Population estimates are derived from building characteristics extracted from Sentinel-1 and Sentinel-2.

By integrating population distribution data with demographic density, existing health centre locations, and road network information, accessibility to healthcare infrastructure can be quantified and used to inform the strategic planning.

Benefits

Identify underserved populations to help optimise health service coverage.

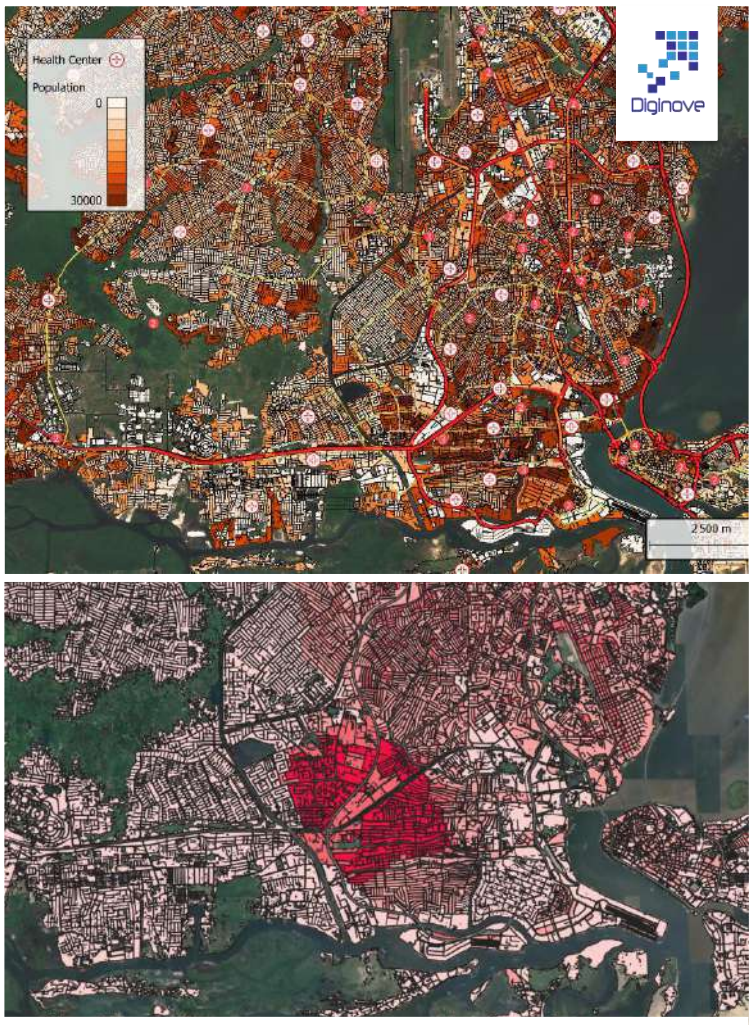
Monitor transportation access to health infrastructure.

Spatial resolution and coverage

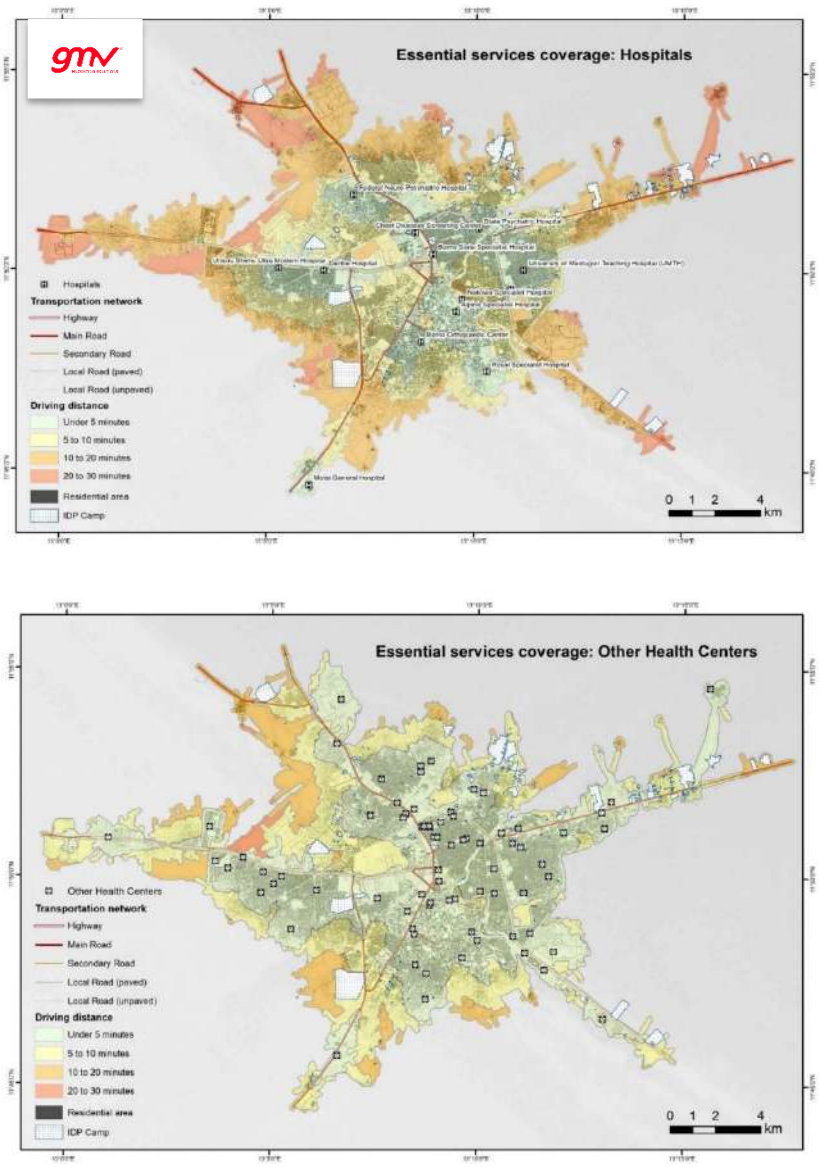
10m, global

Frequency

Annual



Population density and health centres in Lagos, Nigeria © Diginove.



Access to health services and educational facilities in Maiduguri, Nigeria © GMV.

Health Facilities Coverage Analysis

Use

Conduct a comprehensive analysis of health facility coverage to assess accessibility and identify gaps in health infrastructure.

The accessibility is measured by the distance from each street point to relevant health care facility. The analysis incorporated key road network attributes, including traffic flow direction, average speed, and segment length. These parameters were used to estimate driving time along each segment of the network.

Benefits

Identifies areas with insufficient health facilities, enabling targeted improvements.

Provides data for policymakers to allocate resources effectively.

Spatial resolution and coverage

<1m, global

Frequency

Ad-hoc

Health infrastructure vulnerability

Healthcare infrastructure is at risk from a variety of threats, both natural and human made. Natural disasters include earthquakes, volcanic eruptions, hurricanes, floods, fires, and pandemics. Human-made disasters encompass war, pollution, nuclear and other explosions, fires, hazardous materials exposures, transportation accidents, and pandemics. These events can lead to a mass exodus of people, disease outbreaks, and destruction of property.

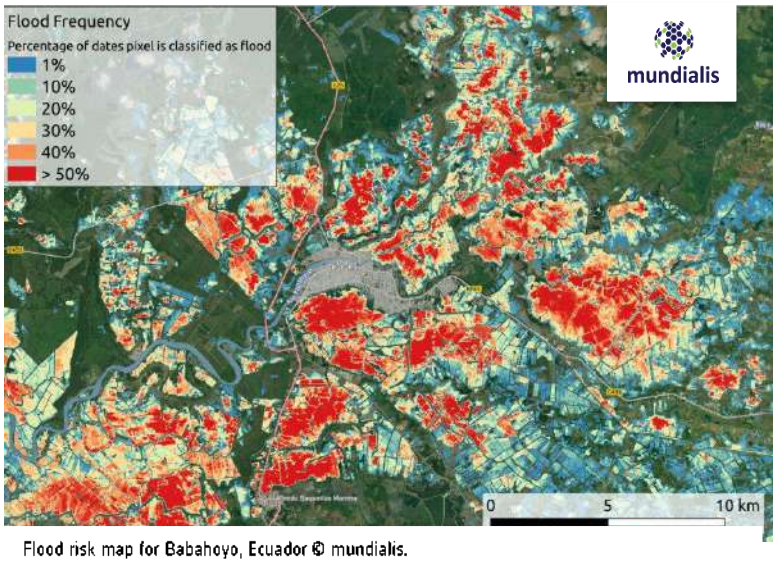
Examples EOIDs for health infrastructure vulnerability

Health Facilities Vulnerability Analysis

Use

Combine EO and health infrastructure data to identify critical health infrastructure at risk. For example, mapping flood prone areas based on Sentinel-1 time series.

Assess exposure of health facilities towards natural or man-made disasters. The spatial intersection of hazard maps with local assets (i.e. health infrastructure data) yields infrastructure at risk.



Flood risk map for Babahoyo, Ecuador © mundialis.

Benefits

Identifies critical health infrastructure at risk.

Provides information basis for adaptive measures to reduce risk.

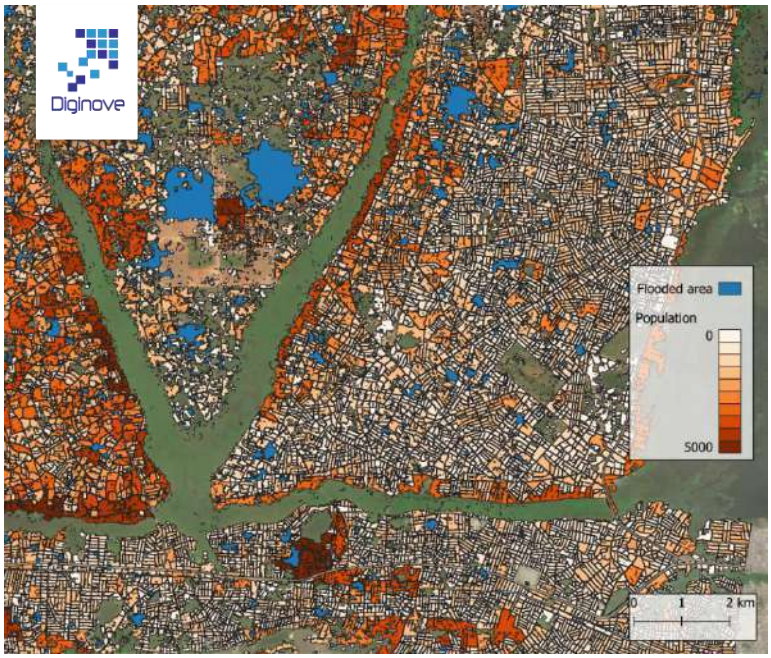
Helps to effectively allocate aid in case of a disaster.

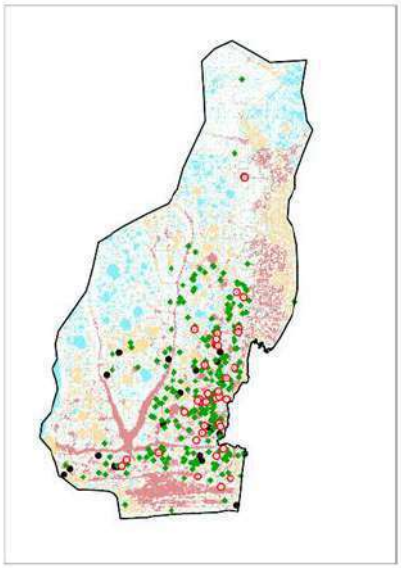
Spatial resolution and coverage

10m, global

Frequency

Status quo analysis





Population and flooded areas in Abomey-Calavi, Benin © Diginove.

Flood and Coastal Erosion Impact on Population

Use

Assess the impact of flooding and erosion on critical infrastructure and population.

Risk maps are generated using simulated water elevation and event frequency data, with risk categorised into four levels: No Risk, Low, Moderate, and High.

Risk maps support planning by identifying protective measures for at-risk health centres and guiding the planning of future facilities away from high-risk areas.

Benefits

Evaluate the vulnerability of the population and critical infrastructure such as health centres.

Manage the population and the health accessibility according to these risks.

Spatial resolution and coverage

10m, global

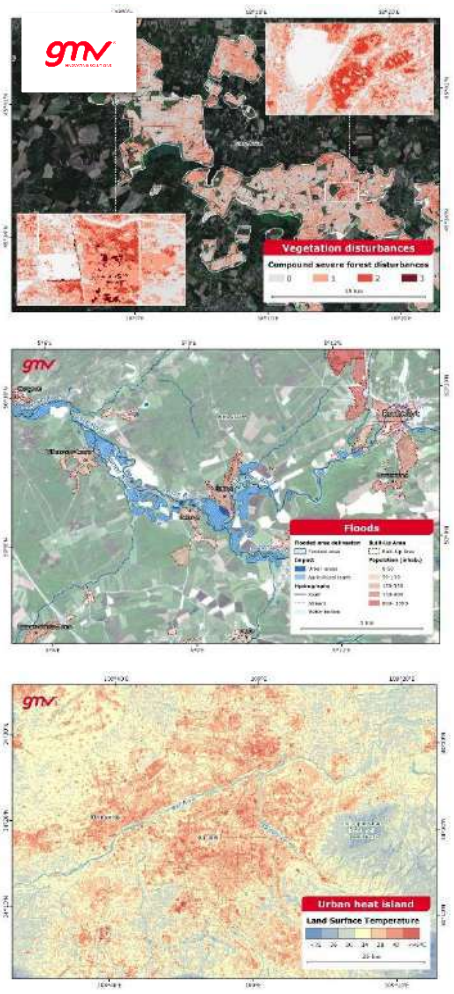
Frequency

Annual

Climate-related health risks

Health is a transversal topic in climate-driven risk assessment as it assumes the negative impact of climate change in critical domains like agriculture, water, and landscape management. Climate directly affects the spreading patterns of infectious diseases by making them more intense, persistent and broader. Such pattern dynamics can put health resources in pressure due to lack of prevention and/or economic resources to admit and manage an increasing number of ill people and/or disease outbreaks. Indirectly, climate affects food and water access through more severe extreme events like droughts, flooding, storms, strong wind, or sea level rise. The result, according to new World Bank data, is that a warmer climate could lead to at least 21 million additional deaths by 2050 (link).

Example EOIDs for climate-related health risks



Vegetation disturbances in Našice Lowland Forest, Croatia; flooding in Belgium and Urban heat islands in Xi'an City, China © GMV.

Wildfires, Floods and Heatwaves

Use

Use satellite data to evaluate health risks from climate extremes for adaptive infrastructure planning.

Vegetation disturbances monitor natural disturbances affecting vegetation dynamics, including deforestation, fire, vegetation stress, and biotic damage.

Flood extent is extracted from optical and SAR imagery using supervised classification, enhanced with expert interpretation and refined with elevation data.

Urban heat islands (UHI) are assessed by measuring land surface temperatures from satellite thermal observations and deriving air temperatures using meteorological and ancillary data.

Benefits

Helps in identifying and mitigating health risks associated with climate extremes.

Supports the development of climate resilient infrastructures.

Enables prompt responses to emerging health climate threats.

Spatial resolution and coverage

10-100m, global

Frequency

Weekly – Monthly

Urban Green Analysis

Use

Use satellite and population data to model the impact of urban green spaces on public health.

Urban green spaces are mapped using Copernicus Sentinel and Landsat data and evaluated in relation to population distribution through proximity analysis to assess potential public health impacts. Where fine-scale population data is unavailable, it can be disaggregated from administrative units using EO-derived building and urban footprints.

Benefits

Assess the status quo of urban green spaces.

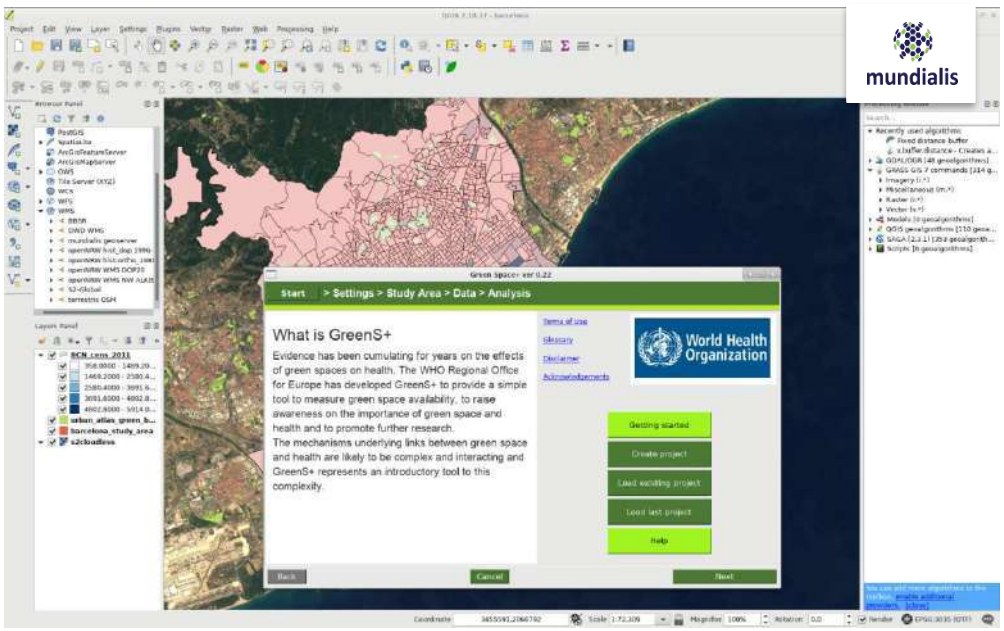
Model impacts of new green spaces on public health (statistics of mortality, hazards of developing cardiovascular diseases, air pollutants, etc.).

Spatial resolution and coverage

10m, global

Frequency

Ad-hoc

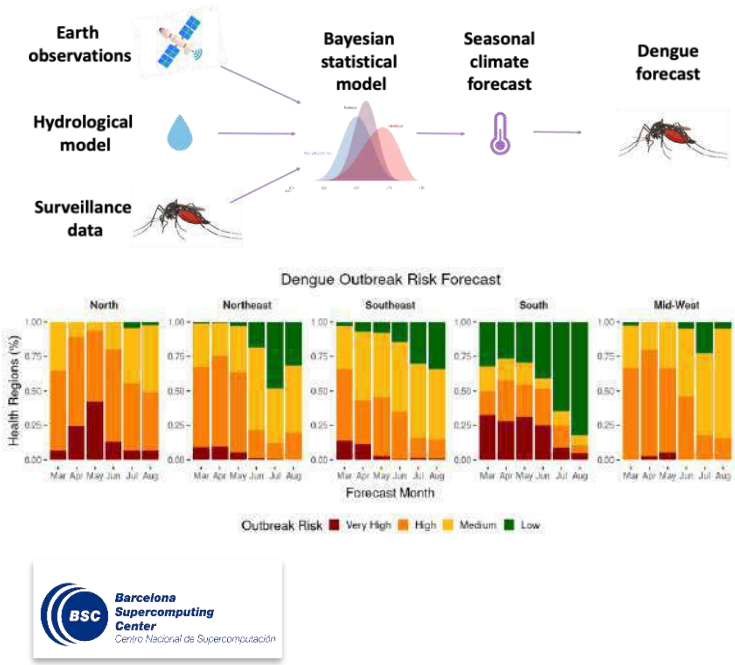


QGIS Plugin developed for WHO for urban green analysis © mundialis.

Environmentally sensitive infectious diseases

Mosquito-borne diseases such as dengue, malaria and yellow fever account for a large share of the overall burden of vector-borne diseases, which place 80% of the world's population at risk of infection and take 700,000 lives each year [link]. They are increasing in prevalence, geographical distribution, and severity, representing an increasing threat for humans and animals worldwide. Leptospirosis is another neglected public health threat, which affects roughly 1.03 million people per year across the globe [link]. Vulnerable populations are particularly affected, and the disease is especially prevalent in tropical and subtropical regions, with the highest burden among low- and middle-income countries. These zoonotic diseases often depend on complex interactions between vector and host species which are influenced by changes in temperature, rainfall, land use, and other environmental factors.

Example EOIDs for environmentally sensitive infectious diseases



Dengue outbreak risk forecasts across five macro-regions in Brazil over the next six months © BSC.

Modelling and forecasting disease risk

Use

EO data and other predictors are combined with surveillance data in a modelling framework, which is then linked to climate forecasts to predict disease outbreaks.

These models support public health decision-making by identifying transmission risk across space and time.

Benefits

Allow public health stakeholders to take initial action to prevent disease burden.

Enhance disease surveillance with automatic epidemiological bulletins.

Spatial resolution and coverage

Municipality

Frequency

Monthly

Disease Spreading

Use

Health assessments: modelling the spread of diseases such as malaria, COVID-19, etc., and identifying populations at risk.

Demographic modelling provides insights into population distribution and density. These estimations are then used to model disease propagation and assess population-level health risks.

Benefits

Assess the risk of contagion across the population based on its density and distribution.

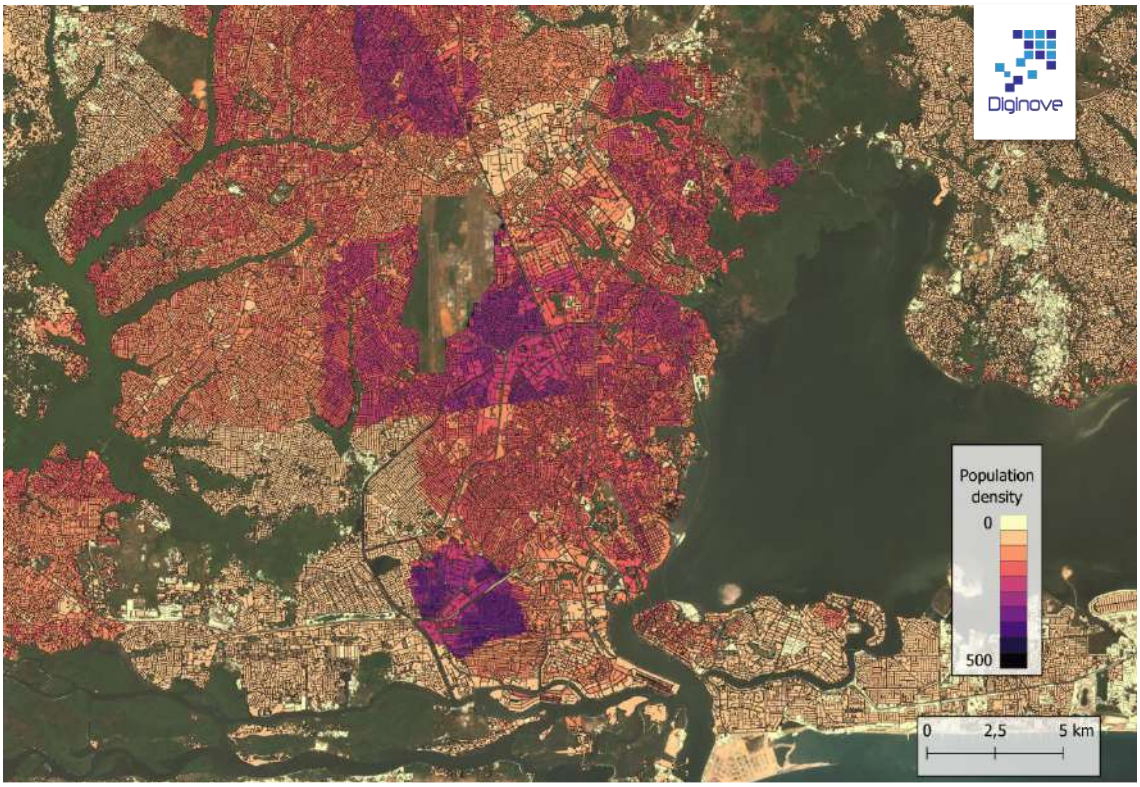
Identify populations at risk of disease exposure.

Spatial resolution and coverage

10m, global

Frequency

Annual



Population density in Lagos, Nigeria © Diginove.

Insect-borne Diseases: Environmental Factors

Use

Monitors environmental factors that affect the spread of insect-borne diseases like malaria and dengue.

Water availability is assessed through time-series data on the occurrence, frequency, and extent of water bodies, as well as anomalies in total water storage. Indicators such as water occurrence, change intensity, surface persistence, seasonality, and annual recurrence help describe water dynamics.

Soil moisture indicates areas with sufficient surface moisture to support the development of mosquito larvae.

Wetlands serve as critical habitats for numerous disease vector species, supporting their breeding and survival.

Time-series analysis can provide insights into precipitation and evapotranspiration patterns, soil moisture anomalies, reductions in water body extent, total water storage anomalies, and climate drought indices.

Other EO derived indicators for insect-borne diseases are deforestation, floods, vegetation and land surface temperatures, snow cover and growing degree days.

Benefits

Supports efforts to control and reduce the spread of insect-borne diseases.

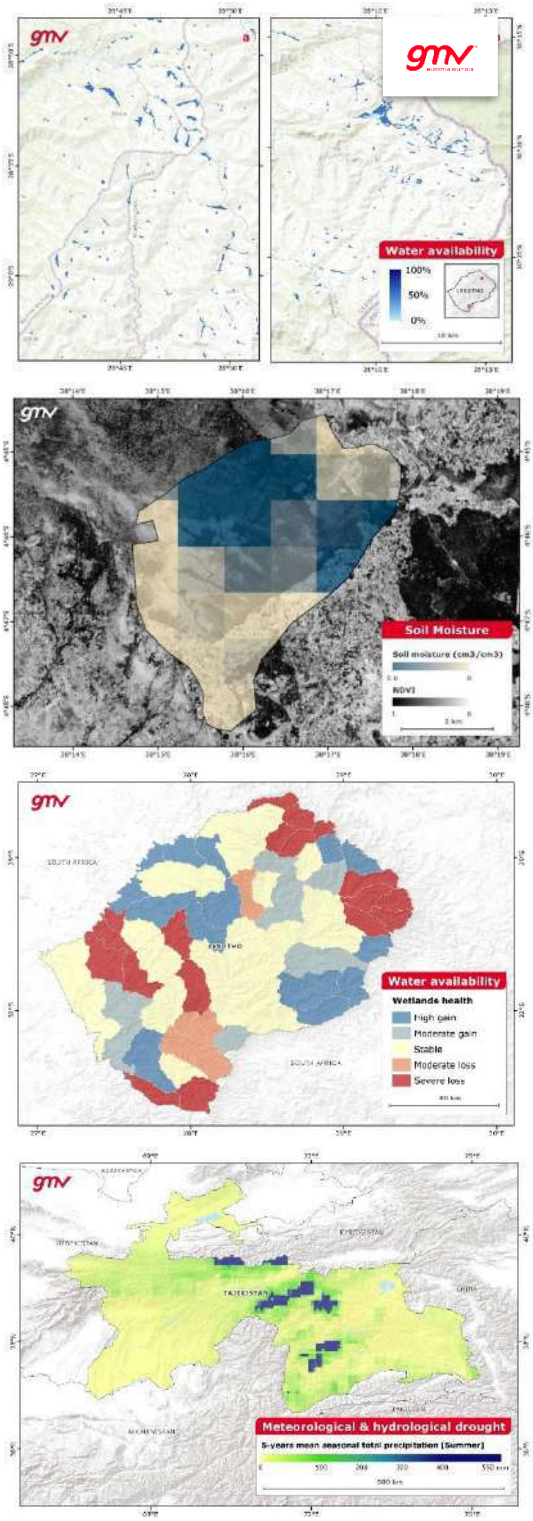
Provides data to predict outbreaks based on environmental conditions

Spatial resolution and coverage

10-100m, global

Frequency

Weekly – Monthly



Water availability in Lesotho; soil moisture in Tanzania; wetland detection in Lesotho and precipitation in Tajikistan © GMV.

Airborne and waterborne health hazards

Air pollution, wildfires, dust storms, and algae blooms are some of the health hazards that affect large populations around the world. As the frequency and severity of these events have been increasing with climate change, so does the associated health risk.

Example EOIDs for airborne and waterborne health hazards

Detection of Cyanobacteria in Water

Use

Satellite data can be used to detect the presence or absence of cyanobacteria blooms in water, enabling alerts to be sent to affected users. Detection is possible daily (weather permitting) for water bodies of approximately 0.25 km² or larger, with higher reliability in larger or more regularly shaped lakes and ponds.

Combined Sentinel-2 and Sentinel-3 data in a fully automated processing and available through mobile App, web-based analysis tool, dashboard.

Benefits

High concentration Cyanobacteria blooms can be detected.

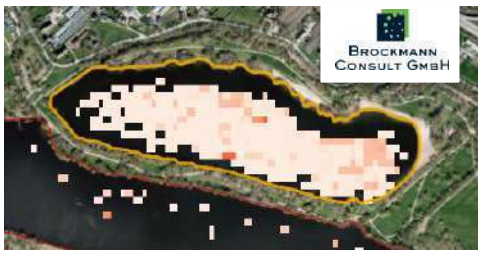
Warnings are provided to administrations to aid in public health protection.

Spatial resolution and coverage

20 – 300m, global

Frequency

5 days to daily



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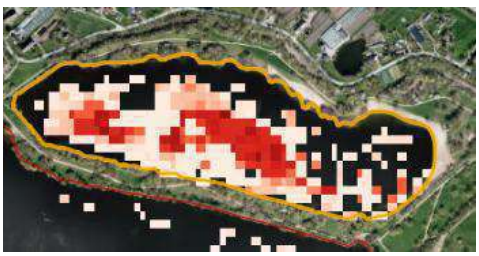

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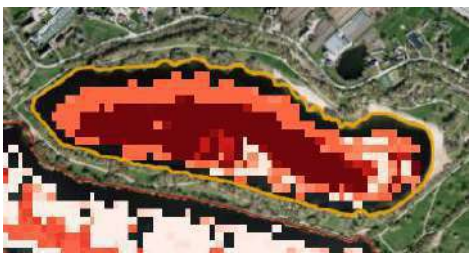

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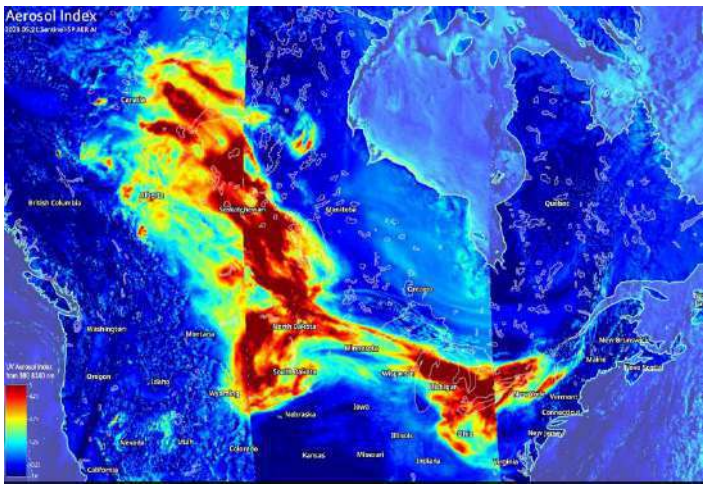
Cyanobacteria in a lake in Germany © Brockmann Consult.



Aerosol index over Northern America © Brockmann Consult.

Detection of Wildfires and Plumes

Use

Combined use of multiple satellite sources. Sentinel-2 to identify wildfires and their plumes. Sentinel-5P for Aerosol index, thermal sensors for detecting fires and plumes are used in combination.

Active fires can be detected using satellite data by identifying areas with elevated temperatures or visible fire plumes, based on a combination of satellite sensors. Global datasets and operational services, such as ESA's Fire CCI project and the Copernicus Climate Change Service, support this detection, though success depends on the timing of the fire relative to satellite overpasses.

Benefits

Plume detection and warning to protect people's health.

Aids in public health protection.

Spatial resolution and coverage

30m – km, global

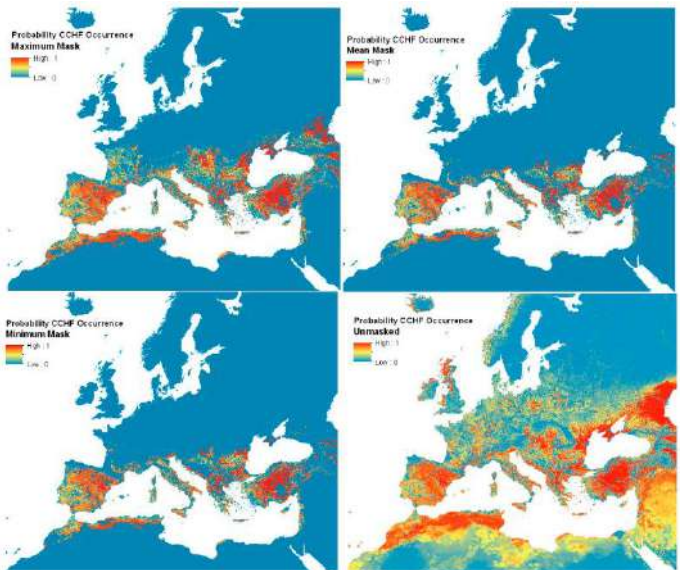
Frequency

Daily to weekly

Emerging diseases in the One Health context

'One Health' is a collaborative, multisectoral and transdisciplinary approach to balance and optimise the health of humans, animals, and the environment by recognising the interconnectivity between people, flora, fauna, and their shared environment. It is particularly important to prevent, predict, detect, and respond to global health threats such as the COVID-19 pandemic. The approach mobilises multiple sectors and involves the public health, veterinary and environmental sectors, making it relevant for food and water security, nutrition, and the control of zoonoses (diseases that can spread between animals and humans, such as flu, rabies, and Rift Valley fever).

Example EOIDs for emerging diseases in the One Health context



Predicted human CCHF suitability maps (Messina & Wint 2023).

Risk Mapping of Emerging Diseases with Exposures among Multiple Species

Use

Combine EO, livestock, and environmental data to model spatial patterns of Crimean-Congo haemorrhagic fever (CCHF) or Rift Valley Fever (RVF) outbreaks.

CCHF and RVF are examples of diseases transmitted between humans and livestock, either through direct contact with infected animals or more commonly via vectors such as ticks or mosquitoes. Their analysis involves environmental factors affecting vector survival and, where available, data on livestock numbers and movements.

Benefits

Enhances early warning systems.

Supports vector control.

Spatial resolution and coverage

1km, global

Frequency

Annual

Nutrition and food insecurity

Food security has different dimensions, namely, food availability (enough food of appropriate quality), food access (access by individuals to adequate resources for acquiring appropriate foods for nutritious diet), utilisation (through adequate diet, clean water, sanitation and health care to reach a state of nutritional well-being where all physiological needs are met) and stability (access to adequate food at all times). Chronic and acute hunger are on the rise due to various factors including civil conflicts, socio-economic conditions, natural hazards, climate change and pests. From the health perspective, people affected by food insecurity are more prone to experience infectious diseases, chronic conditions (heart diseases, hypertension, *etc.*), or mental illness.

Example EOIDs for nutrition and food insecurity

Climate indicators for livestock in Argentina © GMV.

Livestock Stress

Use

Provide information about historical, current, and future environmental stress affecting livestock.

Heat and cold stress charts for livestock species are essential for accurately assessing climate-related impacts. These indices are derived from climate data provided by meteorological, regional, and global climate models.

Benefits

Helps in managing and improving livestock health by monitoring stress factors.

Supports sustainable livestock farming practices through environmental monitoring.

Spatial resolution and coverage

9 – 25km, global

Frequency

Monthly – Annual

Droughts and Land abandonment

Use

Monitor crop changes to assess agriculture and food security in conflict-affected and drought-prone areas.

Supports the analysis of crop changes by monitoring crop area, identifying crop types, and assessing productivity and health using SAR and optical satellite imagery.

Benefits

Ensures food security by monitoring and responding to agricultural changes.

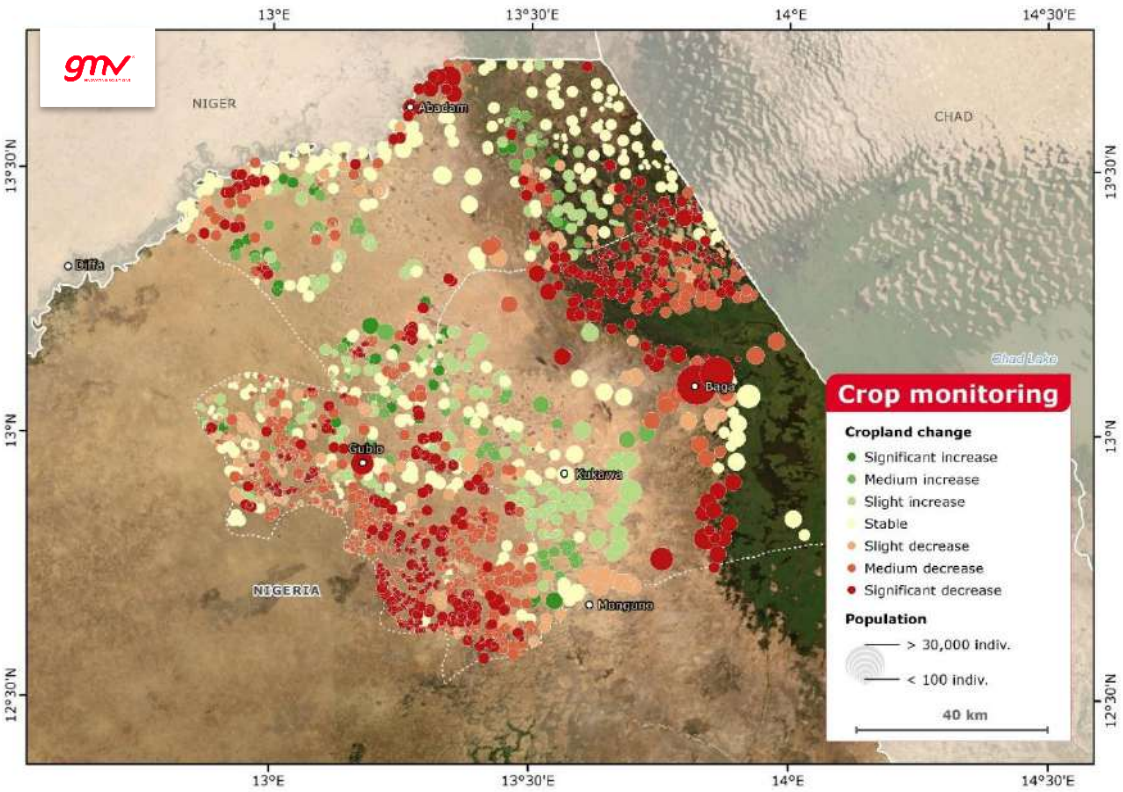
Aids in managing agricultural crises in conflict and drought-affected regions.

Spatial resolution and coverage

10m, global

Frequency

Monthly



Crop monitoring in Nigeria © GMV.

Burned Area Mapping

Use

Satellite data enables the mapping of burned areas at both full and reduced resolution through initiatives like ESA's Fire CCI and the Copernicus Climate Change Service (C3S). These products provide detailed information such as burn date, confidence level, and land cover type at the pixel level, with additional aggregated statistics and a dedicated Small Fires Database available for Sub-Saharan Africa using Sentinel-2.

Benefits

Develop strategies to mitigate the impact of fires on agriculture.

Targeted crop rotation strategies based on fire risk assessments.

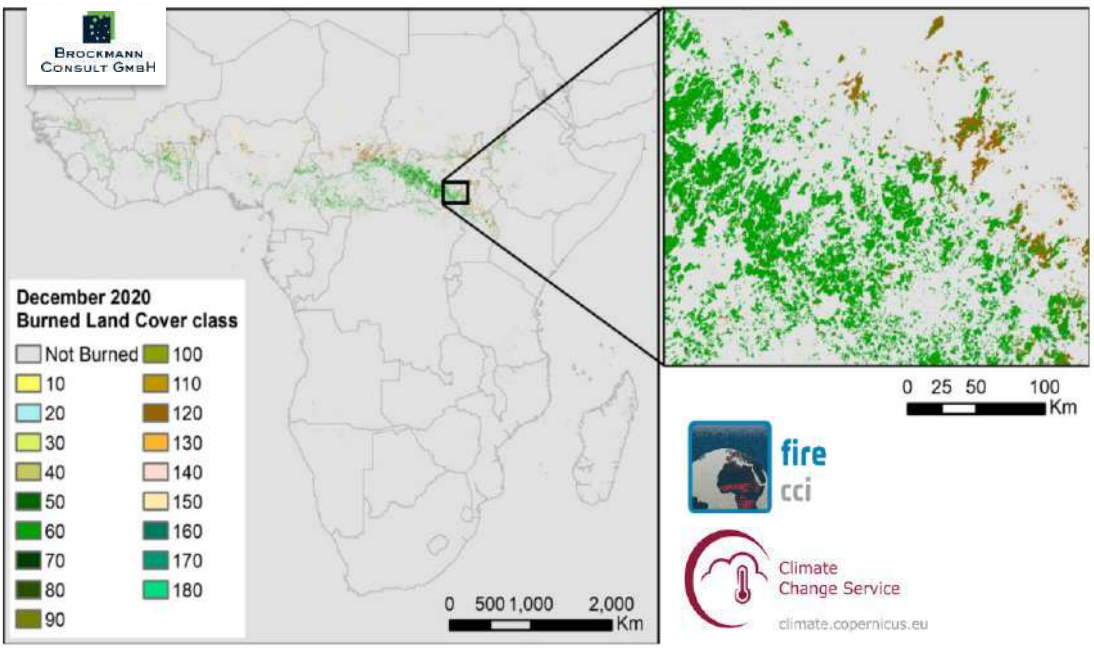
Supports planning of fire-resistant crop selection and soil management

Spatial resolution and coverage

10m and 300m, global

Frequency

15 days, month



Burned Land Cover Classes Sub-Saharan Africa © Brockmann Consult.

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