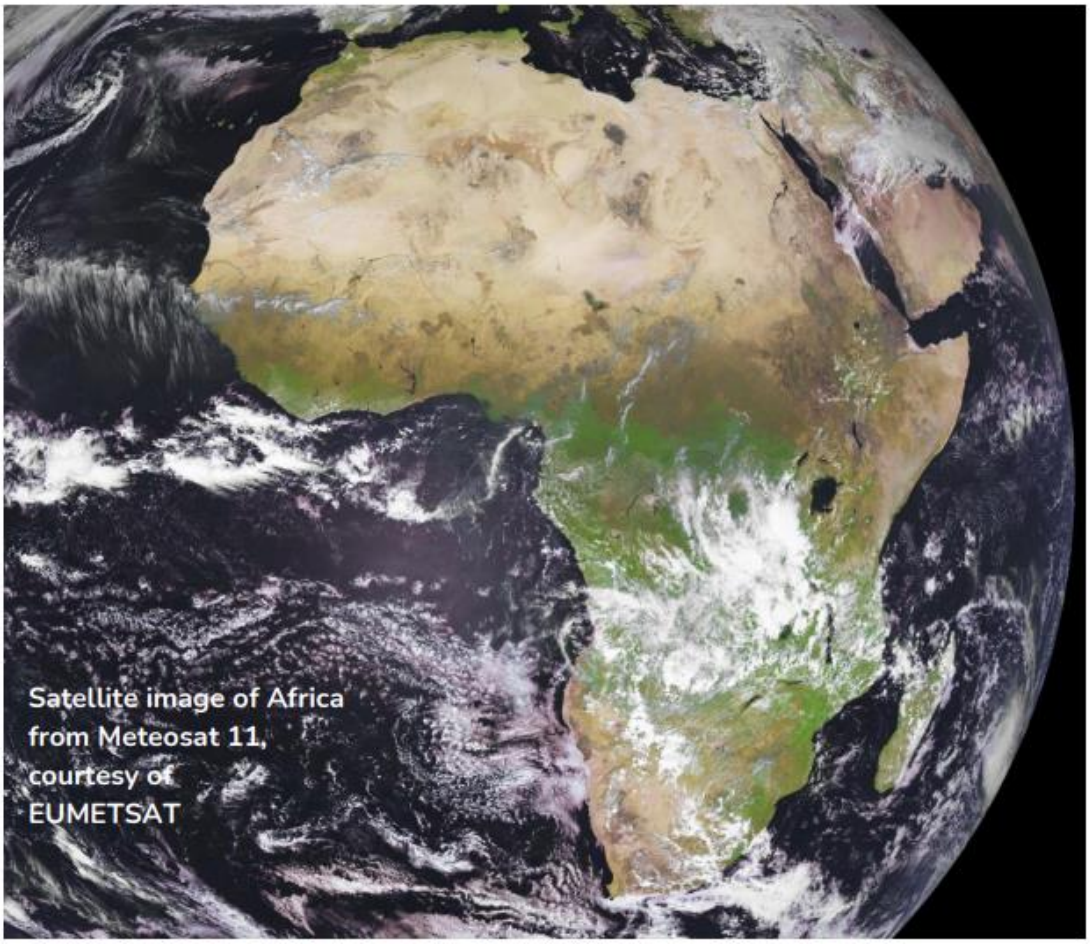
UNITED NATIONS
Office for Outer Space Affairs

UNIVERSITÄT BONN

UN-SPIDER Bonn International Conference (virtual)

"Space-based Solutions for Disaster Management in Africa: Networks and Information Technologies in times of crisis."



BACKGROUND INFORMATION

16 to 18 November 2021

Contents

Setting the stage

In recent years communities around the world began to experience foreseen and unforeseen impacts of the combination of climate change, improperly planned development processes, uncontrolled urban expansion, population growth, political crises, rising inequalities within and among countries, and an improper management of the environment.

Several delegations and stakeholders attending the Climate Change Conference of Parties in Glasgow are highlighting the need to address the challenges posed by climate change with a particular focus on developing countries and vulnerable communities that do not contribute to the problem, but rather suffer the consequences.

Recognizing the need to increase their ambition, parties to the United Nations Climate Change Convention (UNFCCC) concluded the recent 26th Conference of Parties adopting the Glasgow Climate Pact[1]. This pact recognizes the fact that climate change is a common concern for humankind, it reiterates the need to increase efforts related to mitigation and emphasized the need to scale up action to enhance adaptive capacity, strengthen resilience and reduce vulnerability to climate change using the best available science and technology.

This year, countries in Southern Africa including Madagascar and South Africa continued to suffer the impacts of droughts. In contrast, Morocco, Mozambique, Somalia, Sudan, and Togo experienced floods. Large forest fires occurred in Algeria and Tunisia, and the Democratic Republic of Congo experienced the impacts of the eruption of the Nyiragongo volcano.

At the more global level, regions in Western Canada and the United States experienced a severe heat wave in the spring, and massive forest fires impacted areas in Greece, Turkey, the United States and the Russian Federation. In addition, the Cumbre Vieja volcano continues to impact the island of La Palma in Spain, and earthquakes impacted several countries around the world including China, Haiti and Indonesia. Furthermore, several countries continue to suffer the impacts of floods triggered by tropical cyclones and monsoons. Furthermore, Germany, the Netherlands and Belgium experienced unprecedented floods and debris flows that triggered damages and losses of many kinds.

Satellite technologies have been used in recent decades to track the status of our natural resources, the climate, our oceans and polar caps, land use patterns, the spatial expansion of cities, agricultural and mining activities, the expansion of the agricultural frontier, and other features of our planet. When incorporated in routine monitoring activities, Earth observation supports informed decision making at the local, national, regional and global level; helping us to finding ways to reduce disaster risks; identify different alternatives to plan our adaptation to climate change, prepare better for inevitable losses and damages triggered by disasters, and contribute to monitor how well our efforts are leading to sustainable development; providing relevant information to align targets and indicators included in these global agreements; and can be used to develop harmonised national reporting systems.

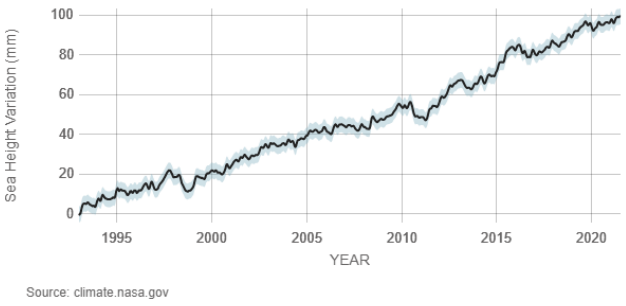


Figure 1: Sea-level rise tracked with satellites. (Courtesy of NASA.)

The integrated use of satellite telecommunications, Earth observation, and global navigation satellite systems is allowing researchers engaged in climate change to

[1] UNFCCC (2021). Glasgow Climate Pact. Decision =/CP.26. Advanced unedited version. Available at <https://unfccc.int/sites/default/files/resource/cop26_auv_2f_cover_decision.pdf>

track changes in the extent of sea ice and glaciers, the physical properties of the ocean including temperature and salinity, and sea-level rise.

Figure 2: Sentinel 1a of the COPERNICUS programme of the European Commission (Courtesy of COPERNICUS).

During the last decade, the space community has made extremely relevant advances that are contributing to achieve the Sustainable Development Goals (SDG) and targets, as well as those stipulated in the Sendai Framework for Disaster Risk Reduction and those included in the Paris Climate Agreement. Furthermore, new satellites have been launched that provide continuity to existing satellite observations, and the open data policies implemented by several space agencies are facilitating access to such satellite imagery. In a complementary fashion, the space community is developing open services and products that facilitate access to ready-to-use geospatial information with a focus on floods, droughts, forest fires, atmospheric contamination, and weather.

At the more international level, the United Nations General Assembly adopted last month the **Space2030 Agenda: space as a driver of sustainable development**[2]. This agenda refers to four overarching objectives wrapped around four pillars: space economy, space society, space accessibility and space diplomacy. This agenda emphasizes that space tools are highly relevant for the attainment of the goals and targets included in the 2030 Agenda for Sustainable Development, the Sendai Framework for Disaster Risk Reduction 2015–2030 and the Paris Agreement.

More recently, faster processing capacities, cloud-based computing, artificial intelligence, and machine learning are allowing the space community, international and regional organizations, national institutions, and private companies to launch services or platforms that allow users to access pre-processed satellite imagery in combination with other sources of data in the format of "analysis-ready-data". For example, the Copernicus programme has set up dedicated services like the Global Flood Awareness Systems (GLOFAS), the Global Drought Observatory (GDO) and the Global Wildfire Information System (GWIS). In addition, efforts are underway to facilitate access to a variety of data through "Data Cubes".

Several companies and organizations are facilitating access to some cloud-processing tools and cloud-based platforms. Among them the Data and Information Access Services (DIAS)[3] launched by Copernicus, the Google Earth Engine[4] of Google, and the Planetary Computer of Microsoft[5].

All these developments are contributing to an improved understanding of risks, to an enhanced visualization of geospatial trends regarding the exposure of vulnerable elements, to track the spatial and temporal evolution of hazards, to improve early warning systems, and towards a more efficient response in case of disasters.

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[2] United Nations General Assembly (2021): **Space2030 Agenda: space as a driver of sustainable development**. The text of the Space2030 Agenda is available in this link: https://undocs.org/en/A/RES/76/3

[3] More information on DIAS is available in this link: https://www.copernicus.eu/en/access-data/dias

[4] More information on Google Earth Engine is available in this link: https://earthengine.google.com/

[5] More information on Microsoft's Planetary Computers is available in this link: https://planetarycomputer.microsoft.com/

To enhance the use of all these opportunities, UN-SPIDER and its network of Regional Support Offices, as well as several universities and centres of excellence, are carrying out training activities. Other institutions carrying out training activities include the Applied Remote Sensing Training (ARSET) programme of the National Aeronautics and Space Administration of the United States (NASA), the EO College of the University of Jena, the Working Group on Capacity Building and Data Democracy of the Committee on Earth Observing Satellites (CEOS). In the case of Africa, the Global Monitoring for Environment and Security and Africa (GMES & Africa) programme has a dedicated segment for capacity building.

SPEAR: An UN-SPIDER and ZFL initiative to enhance the use of space technologies in Africa

In June 2019, ZFL and UN-SPIDER began to implement the project entitled *Spaceborne Earth Observation Applications for Emergency Response and Disaster Risk Reduction* (SPEAR). SPEAR includes the organization of awareness and outreach efforts including conferences and expert meetings, the provision of technical advisory support to African countries, the implementation of knowledge management efforts, applied scientific research to enhance the use of space technologies in disaster management and to contribute to UN-SPIDER networking activities.

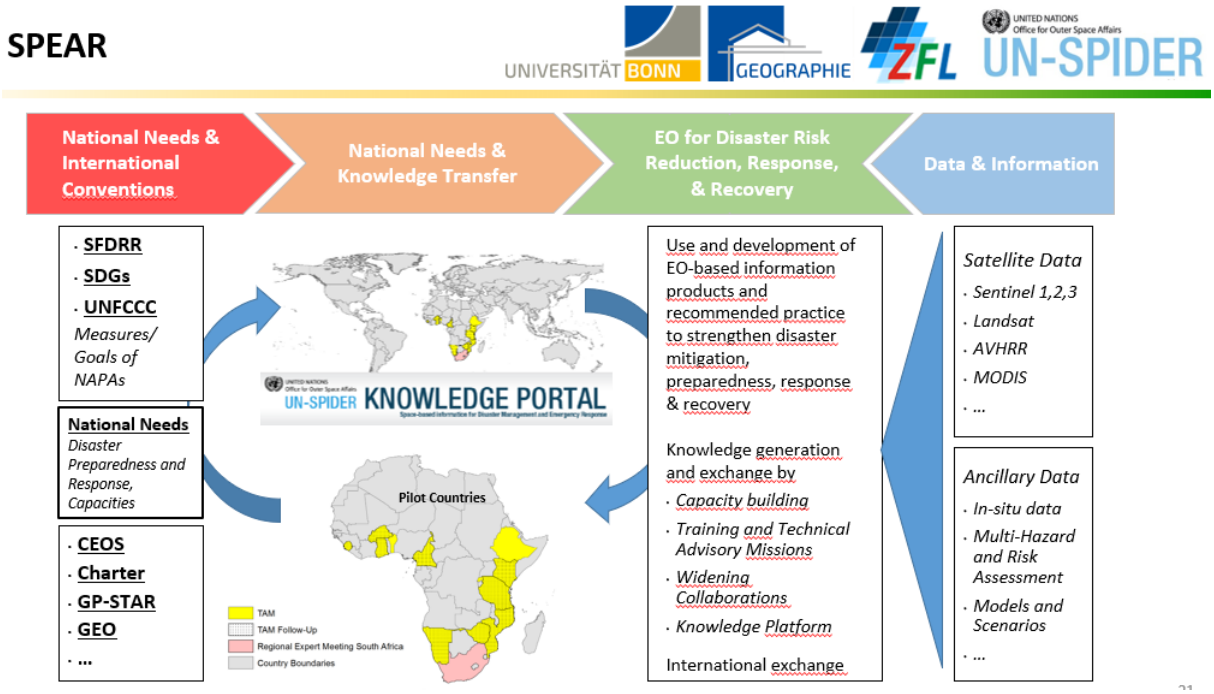


Figure 2: Conceptual design of the SPEAR project implemented by ZFL and UN-SPIDER.

More information on the SPEAR project is available in these links:

https://un-spider.org/projects/spear

https://www.zfl.uni-bonn.de/research/projects/spear/spear

The Conference

The **UN-SPIDER Bonn International Conference: "Space-based Solutions for Disaster Management in Africa: Networks and Information Technologies in times of crisis."**, to be carried out virtually from 16 to 18 November, will allow participants to take note of recent advances developed by the space community, UN-SPIDER and other relevant institutions. In addition, the conference will allow several national disaster management agencies and regional and international organizations to present their work. The conference will include an opening segment and five technical sessions:

Opening segment, 16 November, 10:00 am to 12:30 pm Central European Time (CET)

The opening segment will be used to set the setting for the conference. It will include:

- Opening remarks by the Director of the Office for Outer Space Affairs.
- A presentation by the German Aerospace Centre (DLR) on the **Space2030 Agenda: space as a driver of sustainable development**[6]**.**
- A presentation by the Coordinator of the GMES & Africa on the status of this initiative of the African Union Commission.
- A presentation by the National Disaster Management Centre of South Africa on its efforts in South Africa.
- A presentation by the Rwandan Space Agency on its efforts on disaster management in Rwanda.

More information on the topics of this opening segment is available in Annex A.

Session 1: Confronting the challenges of Floods, 16 November, 14:00 pm to 16:30 pm Central European Time

This technical session will allow participants to take note of recent advances on the use of space technologies to contribute to flood management. The session will include:

- A presentation by the National Meteorological Institute of Mozambique (INAM) on its efforts in Mozambique.
- A presentation by the Joint Research Centre of the European Commission (JRC) on the Copernicus Global Flood Awareness System (GLOFAS).
- A presentation by the Nigeria Hydrological Services Agency (NIHSA) on its efforts on flood management in Nigeria.
- A presentation by the Gambia National Disaster Management Agency (NDMA) on disaster management efforts in Gambia.
- A joint presentation by the Centre for Remote Sensing of Land Surfaces of the University of Bonn (ZFL) and DLR on strengthening the use of Copernicus data and services for flood prediction and monitoring in African countries.
- A presentation by DLR on the use of artificial intelligence to map the recent floods that impacted Germany earlier this summer

Additional information on efforts carried out by NIHSA, GLOFAS, and DLR is available in Annex B.

[6] United Nations General Assembly (2021): **Space 2030 Agenda: space as a driver of sustainable development**. Available at: < https://www.undocs.org/en/A/76/L.3>

Session 2: Confronting the challenges of Forest Fires, 17 November, 10:00 am to 12:30 pm Central European Time

This technical session will allow participants to take note of recent advances on the use of space technologies to address the challenges posed by forest fires. The session will include:

- A presentation by Beyond Centre of Excellence of the National Observatory of Athens on the use of space technologies for forest fires risk prediction and monitoring in Greece.
- A presentation by the Algerian Space Agency on the use of space technologies in the recent forest fires that impacted Algeria this summer.
- A presentation by JRC on the Copernicus Wildfire Information System (GWIS).
- A presentation by the European Centre for Medium-Range Weather Forecasts (ECMWF) on Monitoring fire emissions and air quality using the Copernicus Atmosphere Monitoring Service (CAMS).
- A joint presentation by the Fraunhofer Institute for Technological Trend Analysis (INT) on the FIRELOGUE project: addressing forest fires through supporting and coordinating Innovation Actions.
- A presentation by UN-SPIDER on the use of GWIS for the Sendai Indicator on impacts of forest fires.

Additional information on these topics is available in Annex C.

Session 3: Capacity building and Emergency Response Mechanisms, 17 November, 14:00 pm to 16:30 pm Central European Time

This session starts with a panel on the topic of capacity building is continues with two presentations on emergency mechanisms set up by the space community to contribute to disaster response efforts. The panel on capacity building will benefit from experts from:

- The United Nations University Institute for Environment and Human Security (UNU-EHS).
- Ruhr Bochum University of Germany.
- The EO College at the University of Jena in Germany.
- The African Centre for Space Science and Technology Education in English Language (ARCSSTE-E).

This session is followed by two key presentations on emergency mechanisms set up by the space community to support disaster response efforts:

- The International Charter Space and Major Disasters.
- The Copernicus Emergency Management Service.

Additional information on these emergency mechanisms is available in Annex D.

Session 4: Confronting the challenges of droughts, 18 November, 10:00 am to 12:30 pm Central European Time

This technical session will allow participants to take note of recent advances on the use of space technologies to address the challenges posed by droughts. The session will include:

- A presentation by the United Nations Convention to Combat Drought (UNCCD).

- A presentation by the United Nations Food and Agriculture Organization (FAO) on its Agricultural Stress Index System (ASIS).
- A presentation by Airbus Defense & Space on its activities in disaster management.
- A presentation by the International Water Management Institute (IWMI) on its efforts on droughts.
- A presentation by JRC on the Copernicus Global Drought Observatory (GDO).
- A presentation by ZFL and UNU-EHS on the results of the Globe Drought project that focuses on agricultural droughts.

Additional information on these topics is available in Annex E.

Session 5: Innovative Tools, 18 November, 14:00 pm to 16:30 pm Central European Time

This session will allow several institutions to present innovative tools used in case of floods, forest fires, as well as other hazards and related risks:

- The Center for Space Science and Technology Education of Nigeria (CSSTE) will present its Multi-Scale Flood Monitoring and Assessment Services for West Africa (MiFMASS) initiative.
- The private company Maydai AI will present information on its real time & near-real time information services for disaster management.
- UN-SPIDER will present its prototype of a decision support system for forest fires.
- UNU-EHS will make a presentation on the CLIMADA tool for the estimation of economic losses due to disasters.
- Microsoft´s AI for Good Research Laboratory will present on contributions to disaster response efforts from Microsoft

Additional information on these topics is available in Annex F.

Summary, Outlook and closing remarks

The conference will end with a summary of the different sessions, a short question and answer segment and suggestions regarding future activities. The conference will conclude with closing remarks by UN-SPIDER and ZFL.

Annex A

International Cooperation - the United Nations Committee on the Peaceful Uses of Outer Space.

Figure 1: COPUOS in session at the Vienna International Centre.

In the context of international cooperation, the United Nations Committee on the Peaceful Uses of Outer Space[7] (COPUOS) has reiterated the usefulness of space technologies to address the challenges posed by climate change and natural hazards and consistently calls for the use of space technologies to generate useful information to confront these challenges. In the year 2006, the Committee elevated to the General Assembly the usefulness of implementing a programme within the United Nations to enhance the use of space technologies in disaster risk reduction. Based on this recommendation, the General Assembly of the United Nations adopted its Resolution 61/110 establishing the United Nations Platform for Space-based Information for Disaster Management and Emergency Response (UN-SPIDER).[8]

Taking into consideration the fact that more countries are launching satellites, the increased presence of the private sector in outer space activities, the aims of the Sendai Framework for Disaster Risk Reduction 2015-2030, the Paris Agreement and the 2030 Agenda for Sustainable Development; the Committee deliberated during the past three years on ways to enhance the use of space technologies and elevated to the United Nations General Assembly the **Space 2030 Agenda: space as a driver of sustainable development**. [9]

In its seventy sixth session in October 2021, the United Nations General Assembly (UNGA) adopted the Space 2030 Agenda noting that "space tools are highly relevant for the attainment of the global development agendas, in particular the 2030 Agenda for Sustainable Development and its goals and targets, either directly, as enablers and drivers of sustainable development, or indirectly, by providing essential data for the indicators used to monitor the progress towards achieving the 2030 Agenda and the Sendai Framework for Disaster Risk Reduction 2015–2030 and the commitments by States parties to the Paris Agreement."

The Space2030 Agenda

As stated by the UNGA, the Space2030 agenda and its implementation plan, submitted by the Committee to the General Assembly is "a forward-looking strategy for reaffirming and strengthening

[7] More information on COPUOS is available at < http://www.unoosa.org/oosa/en/ourwork/copuos/index.html>

[8] United Nations General Assembly (2006**): Resolution adopted by the General Assembly on the United Nations Platform for Space-based Information for Disaster Management and Emergency Response 61/110**. Available at <http://www.unoosa.org/pdf/gares/ARES_61_110E.pdf>

[9] United Nations General Assembly (2021): **Space 2030 Agenda: space as a driver of sustainable development**. Available at: < https://www.undocs.org/en/A/76/L.3>

the contribution of space activities and space tools to the achievement of global agendas addressing long-term sustainable development concerns of humankind. It also contributes to charting the future contribution of the Committee to the framework for the global governance of outer space activities, consistent with international law".

The Space2030 Agenda includes four overarching objectives:

1. Enhance space-derived economic benefits and strengthen the role of the space sector as a major driver of sustainable development
2. Harness the potential of space to solve everyday challenges and leverage space-related innovation to improve the quality of life
3. Improve access to space for all and ensure that all countries can benefit socioeconomically from space science and technology applications and space-based data, information and products, thereby supporting the achievement of the Sustainable Development Goals
4. Build partnerships and strengthen international cooperation in the peaceful uses of outer space and in the global governance of outer space activities

For its implementation, the Space2030 Agenda calls on Member States of the United Nations to contribute via partnerships, tools and resources. Among the tools included, the UN General Assembly mentioned UN-SPIDER.

Efforts by the African Union Commission

In recent decades, communities in Africa have experienced disasters triggered by floods, droughts, landslides, volcanic eruptions, locust plagues, Ebola, and most recently the COVID-19 pandemic. These have eroded hard-won development gains. Taking note of advances in space technologies and other technological innovations, the African Union indicated in its 2017 **African Space Policy**[10] that space represented a unique opportunity for cooperation in using and sharing enabling infrastructure and data towards the proactive management of, inter alia, responses to natural hazards and disasters. In that respect, the African Union aims to promote the use of space applications to improve weather forecasts and to develop a range of early warning systems, as Africa is subject to various extreme weather, climate, ecosystem and geological events.

The African Space Policy aims to address the challenges faced by African nations. It is aligned with the **Agenda 2063: The Africa We Want**[11] of the African Union. One of its goals is to implement an African space programme that is responsive to the social, political, economic and environmental needs of the continent.

The Global Monitoring for Environment and Security and Africa Support Programme, which is coordinated by the African Union Commission, includes efforts in four key areas:

- Data and infrastructure
- Products and services
- Communication and awareness-raising
- Training and capacity-building

[10] African Union Commission (2017): **African Space Policy: Towards Social, political and Economic Integration**. Available at: < https://au.int/sites/default/files/documents/37433-doc-african_space_policy_isbn_electronic_.pdf>

[11] African Union Commission (2017): **Agenda 2063: The Africa We Want**. Available at: < https://au.int/en/agenda2063/overview>

The Programme has been implemented through 13 regional consortia that bring together 122 institutions in 45 African countries, and benefits from the engagement of several European countries.

Contributions to development in Southern Africa: national and regional institutions

Every country in Africa has a government agency that addresses disaster risk reduction, preparedness and response and recovery efforts. The conference benefits from the participation of staff from these government agencies, as well as from other ministries, NGOs, universities, and private companies. The virtual expert meeting will include a presentation by the National Disaster Management Center of South Africa (NDMC)[12] on how it coordinated efforts with the South African National Space Agency (SANSA) and other government agencies, and at the provincial and local levels through its hierarchical structure. The National Disaster Management Agency of Gambia (NDMA)[13] will also provide information on its mandate and on how it is confronting the challenges posed by floods, droughts, windstorms and other hazards.

In addition, several countries have established national space agencies that actively contribute to disaster risk reduction efforts. The Rwanda Space Agency (RSA) will be making a presentation on its contributions to disaster management efforts carried out in Rwanda by the Ministry of Emergency Management.

[12] More information on the NDMC is available at: <http://www.ndmc.gov.za/Pages/Home-Page.aspx>
[13] More information on the NDMA of Gambia is available at: < https://ndma.gm/>

Annex B: Confronting the challenges of floods

Flood are impacting most countries of the world and African countries are no exception. Floods are triggered by severe weather, and in the case of Southern Africa by cyclones.

Global Flood Awareness System (GLOFAS)

The Global Flood Awareness System (GloFAS) is aimed at providing global information on flood and flood-related environmental parameters. Through its "web viewer" online, a large selection of parameters can be visualized to assess flood potential. Provided data include rainfall, hydrological model outputs as well as hydrological measurements from stations across the globe. Users can select parameters to visualize interactively, which allows for an assessment of active floods. Furthermore, forecast data are provided which can be used to assess future flood-potentials.

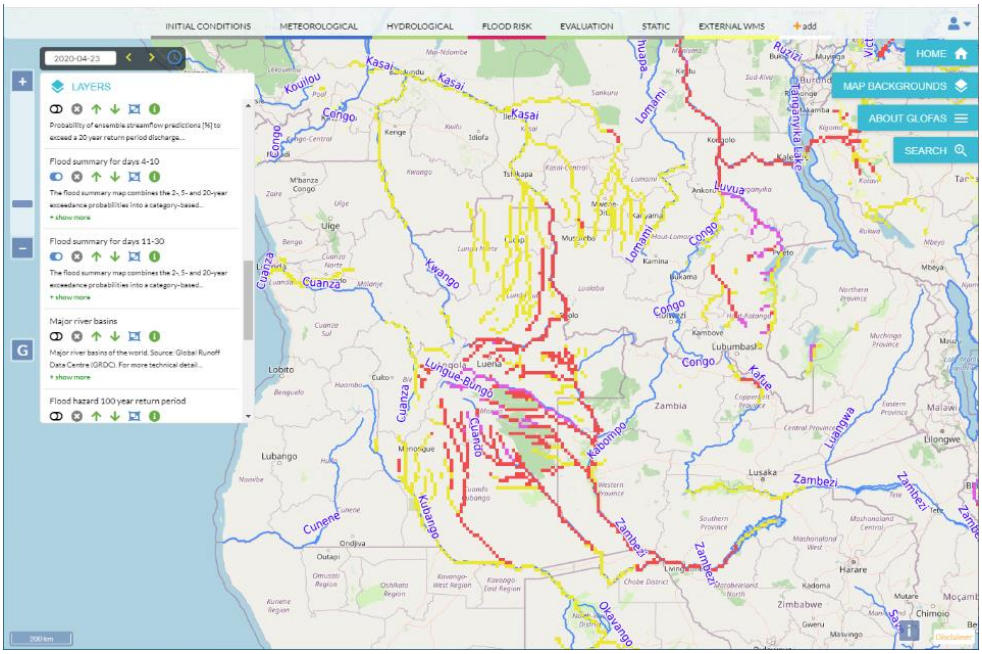


Figure B.1: Example of potential floods in several tributaries of the Zambezi River as generated by the Global Flood Awareness System (GloFAS) Portal for the period at end of April of the year 2020. Image courtesy of GLOFAS.

More information on GLOFAS is available at: https://www.globalfloods.eu/glofas-forecasting/

Forecasting cyclones in Mozambique

Mozambique is one of the countries exposed to cyclones which can trigger massive floods. In January of this year, tropical cyclone Eloise impacted Eswatini, Mozambique, and South Africa. In the case Mozambique, the National Meteorological Institute (INAM) monitors the weather, operates the Cyclone Early Warning System and issues warnings in case of cyclones and severe weather. In addition, INAM also monitors other weather events such as droughts.

Figure B.2: Warning levels for the Cyclone Early Warning operated by INAM in Mozambique.

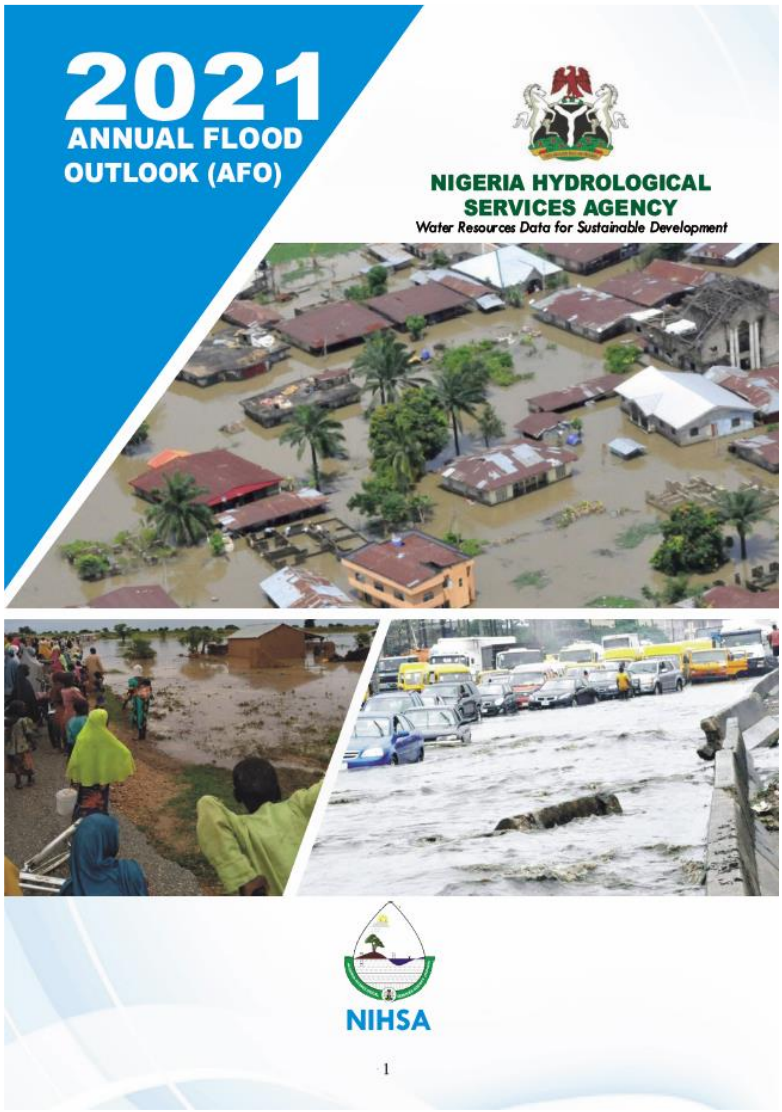
More information on INAM is available at: https://www.inam.gov.mz/index.php/pt/

NIHSA: Addressing floods in Nigeria

Several regions in Nigeria are exposed to floods triggered by the Niger, the Benue and other rivers. Early warning efforts have been implemented by the Nigerian Meteorological Agency (NIMET), the Nigeria Hydrological Services Agency (NIHSA), the National Emergency Management Agency (NEMA), and more recently by the Center for Space Science and Technology Education of Nigeria (CSSTE) and other partners. Through its weather monitoring efforts, NIMET can foresee and predict areas which may experience intense precipitation that can trigger floods.

NIHSA produces flood vulnerability maps for areas on floodplains and additionally conducts periodic observations of water level fluctuations in rivers and reservoirs. The Agency also operates and maintains a data collection platform that provides real time hydrological data for flood forecasting. NIHSA initiated the installation of Automated Weather Observing System (AWOS) in eight hydrological areas of the country to provide meteorological/hydrological data required for flood mitigation.

A policy-relevant publication elaborated by NIHSA is the Annual Flood Outlook (AFO). This Outlook provides information to decision makers and to NEMA regarding geographic areas and towns that may experience floods. The information is generated by using statistical procedures applied to historic data on floods and flood modelling. With this publication, NIHSA contributes to disaster risk reduction and disaster preparedness efforts in Nigeria.



NIHSA has established real-time flood warning systems near every major waterway or body of water in Nigeria to reduce flood risks. In January of this year, NIHSA launched an application that can be used to visualize the potential extent of floods. This app uses the Soil and Water Assessment Tool (SWAT) and Geospatial Stream Flow Model (Geo- SFM) for flood prediction.

Figure B.3: Cover of the 2021 Annual Flood Outlook elaborated and published by NIHSA.

The Flood App will contribute to improve the performance of early warning systems. The Flood App was developed by NIHSA as part of its efforts as a member of the Committee on Flood Emergency Preparedness and Response Plan. More information on NIHSA is available at: https://nihsa.gov.ng/

DLR's Research Institutes and its Space Agency

Through its 55 Research Institutes, DLR carries out research in aeronautics, space, energy, transport, security and digitalisation to develop technologies for a sustainable future. Several of these institutes contribute to UN-SPIDER, the World Food Programme and other UN agencies. Since 2006, DLR established its Crisis Situation Centre (ZKI) to contribute to disaster response efforts in Germany and worldwide. Furthermore, experts from ZKI and from the Earth Observation Centre actively contribute to the International Charter as project managers analysing satellite imagery to generate maps and other policy-relevant information to be used in disaster response efforts.

In a complementary fashion, the Space Agency at DLR implements the space strategy of the Federal Government of Germany, develops and manages the national space programme, and represents Germany in space-related international bodies. The Space Agency represents DLR in the Executive

Board of the International Charter Space and Major Disasters. Recently, the Space Agency and ZFL launched a project to enhance the use of Copernicus services in Africa.

More information on DLR is available in this link: https://www.dlr.de/EN/Home/home_node.html

DLR's Artificial intelligence for Humanitarian Action project

During a crisis event, humanitarian aid organisations often do not have the appropriate spatial information at the required scale, which they would urgently need for many decision-making assessments. In the project Data4Human being implemented by the DLR, remote sensing data and other data sources are processed and implemented in a user-adapted way and developed for specific case studies.

One major case study is the flooding in Mozambique triggered by Cyclone Idai in 2019. Many humanitarian organisations were involved, which offered the possibility to retrospectively explore potential humanitarian relief support. Scientists at DLR applied different data sources for this purpose, like remote sensing or web data and used innovative methods to explore the sourcing data all the way from satellites to the internet and employed innovative techniques such as artificial intelligence and web-harvesting methods.

More recently, several towns in Western Germany experienced massive floods and debris flows that triggered damages and losses. Scientists at DLR used their artificial intelligence tools to identify the geographical extent of floods and the impacts to infrastructure.

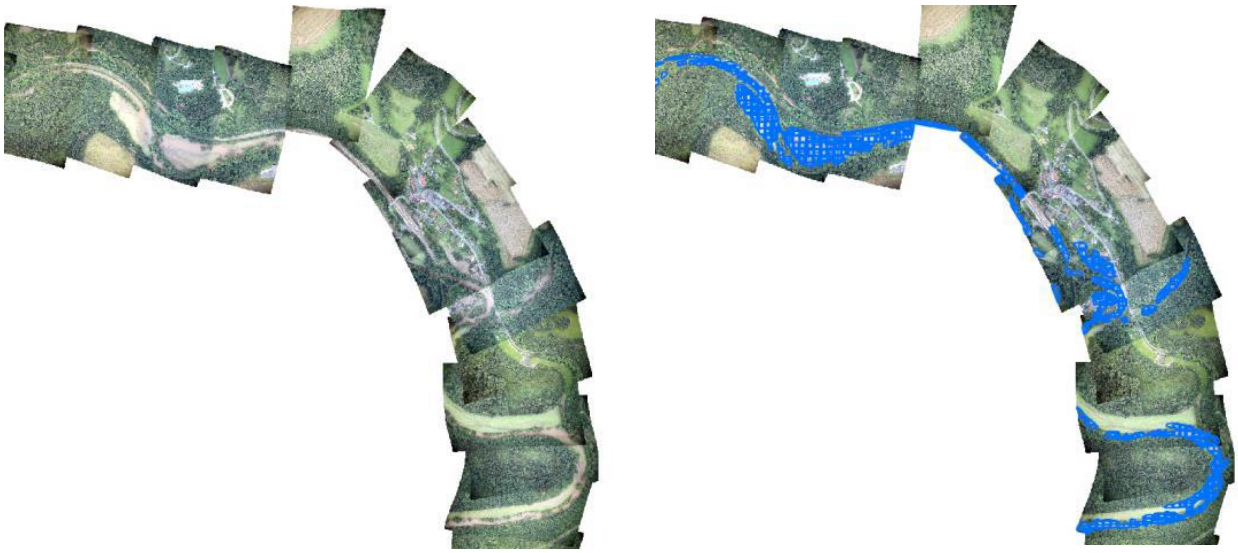


Figure B.4: Extraction of information on buildings that experienced different types of damages in the City of Philippsheim in Germany. The area impacted by floods is shown in the right side. Image course of DLR.

Annex C: Confronting the challenges of forest fires

Forest fires have been impacting several developed and developing countries around the world in recent years, including Algeria, Argentina, Brazil, Chile, Greece, Turkey, Tunisia, the Russian Federation, and the United States. Efforts to monitor forest fires are carried out at the national, regional and international levels. At the international level there are several services available including the the Global Wildland Fire Information System (GWIS) and the Fire Information for Resources Management System (FIRMS) operated by NASA of the United States to name a few. More recently, the European Centre for Medium Weather Forecasts (ECMWF) has implemented the Copernicus Atmosphere Monitoring Service (CAMS) that also tracks emissions triggered by forest fires.

Prediction and monitoring of forest fires in Greece

The Beyond Centre of Excellence of the National Observatory of Athens uses space technologies to predict and monitor forest fires in Greece. FireHub, developed by this Centre of Excellence, is a real-time 24/7 active fire detection service for effectively monitoring forest fires all over Greece. It is continuously ingesting real time satellite acquisitions every 5 minutes from the Meteosat-SEVIRI geostationary satellite series (EUMETSAT). Enhanced processing allows improving the quality, reliability, and spatial resolution for detecting active fires over time. The system accounts for wind, ground morphology and altitudinal data, and integrates together with the satellite observations fuel and fire proneness data for deriving active fire predictions in the spatial resolution of 500 m, which is 50 times better compared to the raw resolution of the ingested observations of the MSG SEVIRI sensor (3.5km).

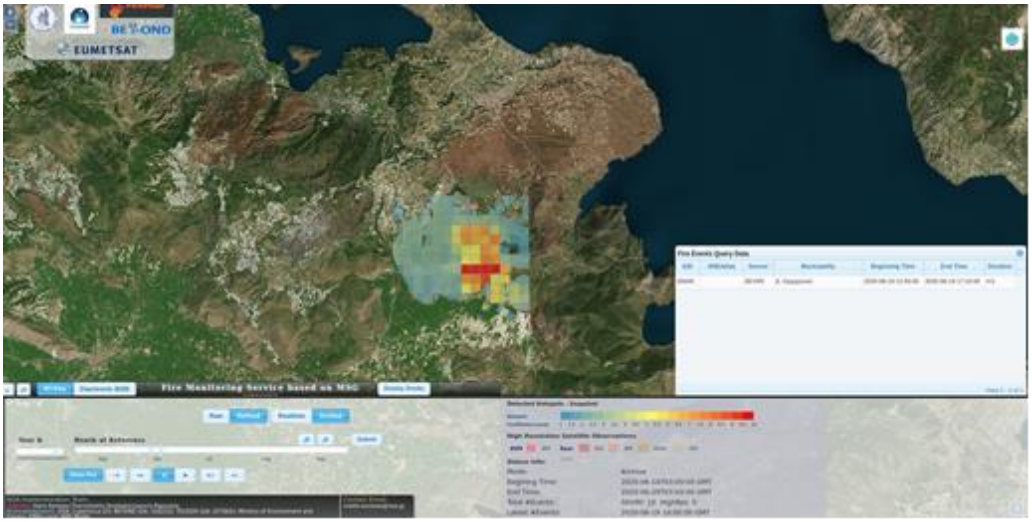
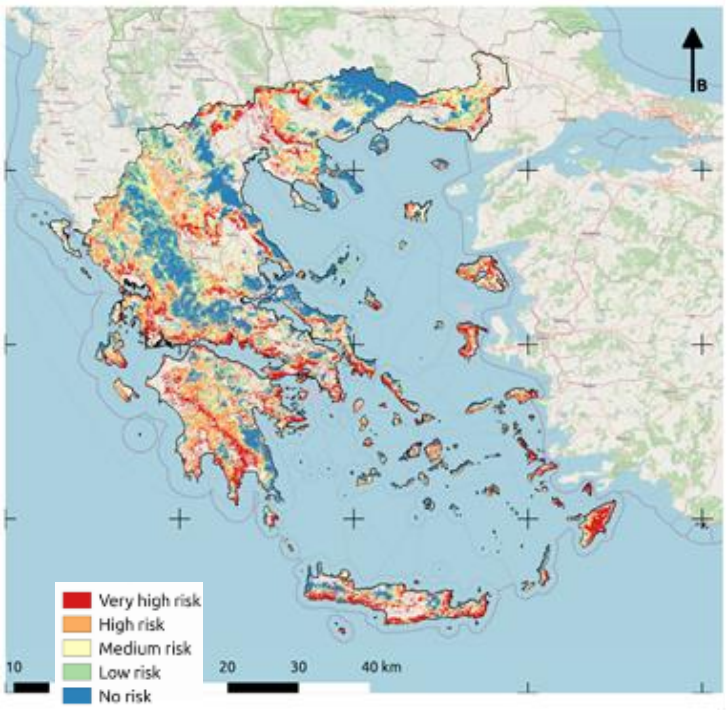


Figure C.1: FireHub detects a forest fire. Image courtesy of the Beyond Centre of Excellence of NOA.

More information on FireHub is available in this link: http://beyond-eocenter.eu/index.php/web-services/firehub

Like many other Mediterranean countries, Greece is exposed to forest fires that are becoming worse in frequency and severity. Since summer 2020, the Beyond Centre of Excellence of the National Observatory of Athens has implemented a pilot fire risk forecasting system to predict the next day wildfire risk in the enhanced spatial resolution of 500m. The system exploits solely information obtained up to the previous day and is based on machine/deep learning technologies.



The methodology developed by the Beyond Centre of Excellence has been proven efficient and effective for next day fire predictions in the model assessment process and it was used during the recent forest fires that impacted several areas of Greece this past summer.

Figure C.2: Example of a next day's fire risk prediction map. Image courtesy of the Beyond Centre of NOA.

Monitoring forest fires in Algeria

The Algerian Space Agency (ASAL) uses optical satellite imagery from the Alsat-1 and Alsat-2 satellites to map the geographic extent of forest fires on an annual basis. The typical procedure uses satellite imagery acquired before and after the fire and complementary data on the location of forests to identify burnt areas using inputs from the National Forest Inventory and exclude those recorded from the previous years. Supervised classification is conducted in ENVI software using the red, green and near-infrared (NIR) spectral bands and the Normalized Difference Vegetation Index (NDVI) for the delineation of burnt areas. Results are validated in the field.

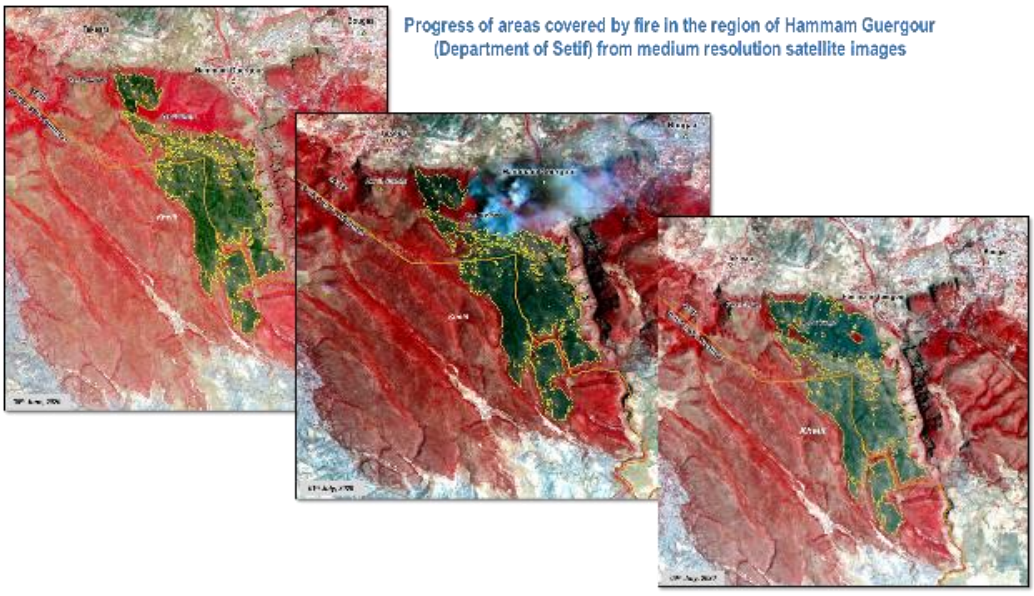


Figure C.3: Extraction of information on the geographic location of forest fires in Algeria. Image courtesy of ASAL.

Global Wildfire Information System (GWIS)

The Global Wildfire Information System (GWIS) provides information on active fires on a regional as well as national scale. It is made up of three main tools. The Current Situation Viewer offers an online map view of near-real time active fire information. Additionally, 24-hour lightning forecasts, as well as fire danger forecasts for up to 10 days in advance, are provided. Fire-emission estimations can also be accessed. The Country Profile tool provides national-level statistics and historical data on fires for the years 2002 to 2019. The data include burnt area, fire frequencies and seasonality. Charts are created dynamically, and the data is free to download. Finally, the Data & Services platforms provides download links for each dataset used throughout GWIS.

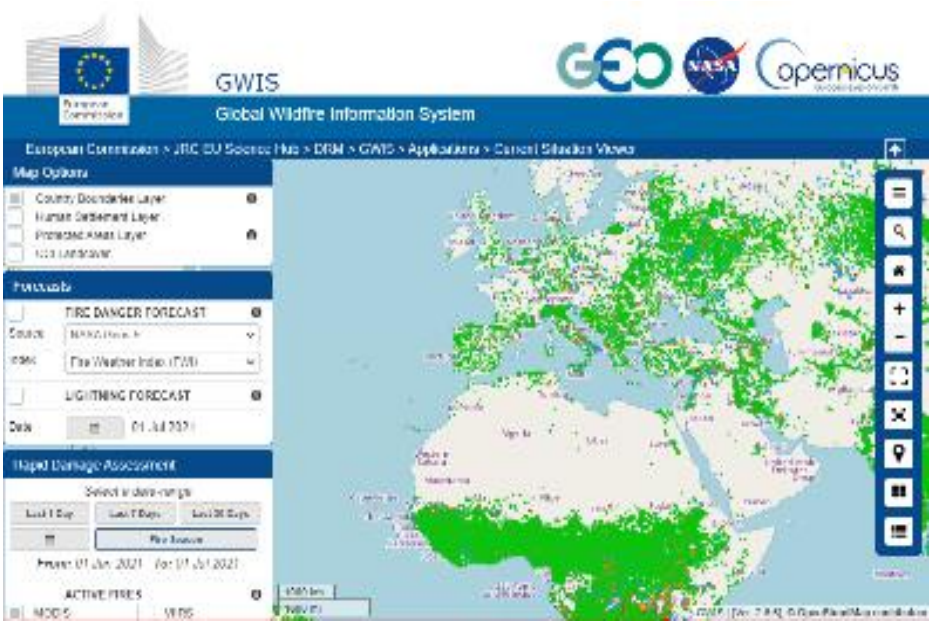


Figure C.4: The Global Wildfire Information System (GWIS) Portal. Image courtesy of GWIS.

More information on GWIS is available in this link: https://gwis.jrc.ec.europa.eu/apps/gwis_current_situation

Copernicus Atmosphere Monitoring Service (CAMS)

CAMS was launched in July 2015 and is implemented by ECMWF[14]. Its aim is to provide "consistent and quality-controlled information related to air pollution and health, solar energy, greenhouse gases and climate forcing, everywhere in the world."

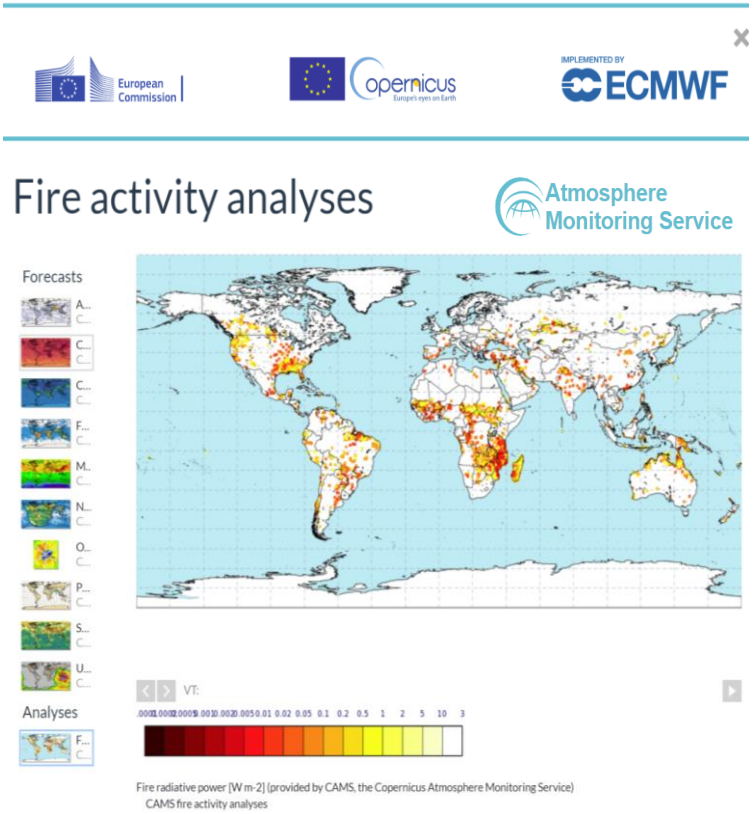
It is one of six services under the umbrella of Copernicus and offers information generated using models that employ Earth observation data from satellites in combination with in-situ data.

Initially developed within Europe, CAMS now offers worldwide five-day forecast plots of aerosol pollutants, greenhouse gases, stratospheric ozone and the UV-index. In the case of forest fires, CAMS offers information on fire activity generated using the fire radiative power.

[14] More information on ECMWF is available in this link: < https://www.ecmwf.int/>

Figure C.5: Five-day forecast of aerosols based on the Aerosol Optical Depth within the atmosphere. Courtesy of CAMS – Copernicus.

For general information on CAMS, see this link: https://atmosphere.copernicus.eu/about-us



Sendai Framework Monitor: Reporting on the impacts of forest fires

UNITED NATIONS Office for Outer Space Affairs
UN-SPIDER
www.un-spider.org

The **Sendai Framework for Disaster Risk Reduction 2015-2030** was adopted at the Third UN World Conference in Sendai, Japan, on March 18, 2015. The framework aims to achieve the substantial reduction of disaster risk and losses in lives, livelihoods and health and in the economic, physical, social, cultural and environmental assets of persons, businesses, communities and countries over the 15 years leading to 2030.

The framework sets four priorities for action and seven global targets to reduce the risk of disasters and to avoid the increase in the level of existing risks. The seven targets are assessed through a set of 38 indicators. Government officials and relevant stakeholders involved in monitoring national progress have been designated to report on their advances using the Sendai Framework Monitor (SFM). This web-based tool has been developed by the United Nations Office for Disaster Risk Reduction (UNDRR) to support the assessment of global progress in the reduction of risk and losses. Country coordinators also have the option to add custom indicators and targets, which are nationally defined instruments to measure the implementation of the Sendai Priorities to support states in reporting the relevant data they have.

One specific sub-indicator of target C of the Sendai Framework addresses the physical damage due to hazards such as forest fires. This sub-indicator C-2FOa measures the number of hectares of forests damaged/destroyed by disasters such as forest fires.

Taking into consideration the incorporation of historic and recent data on impacts of forest fires in GWIS, UN-SPIDER developed an ad-hoc procedure for C-2FOa. This procedure provides a comparison of the number of hectares burnt by forest fires in a country or in an area within a country in comparison to a decade-long benchmark that represents the annual average of the number of hectares burnt by forest fires between 2005 and 2014.

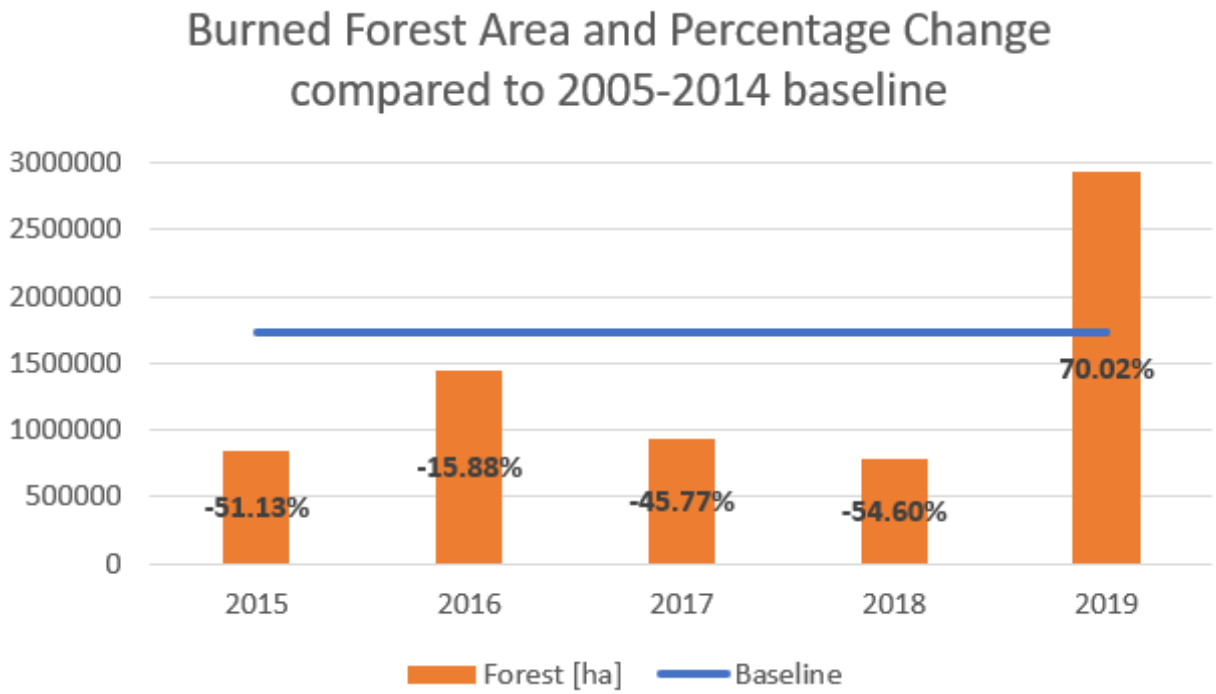


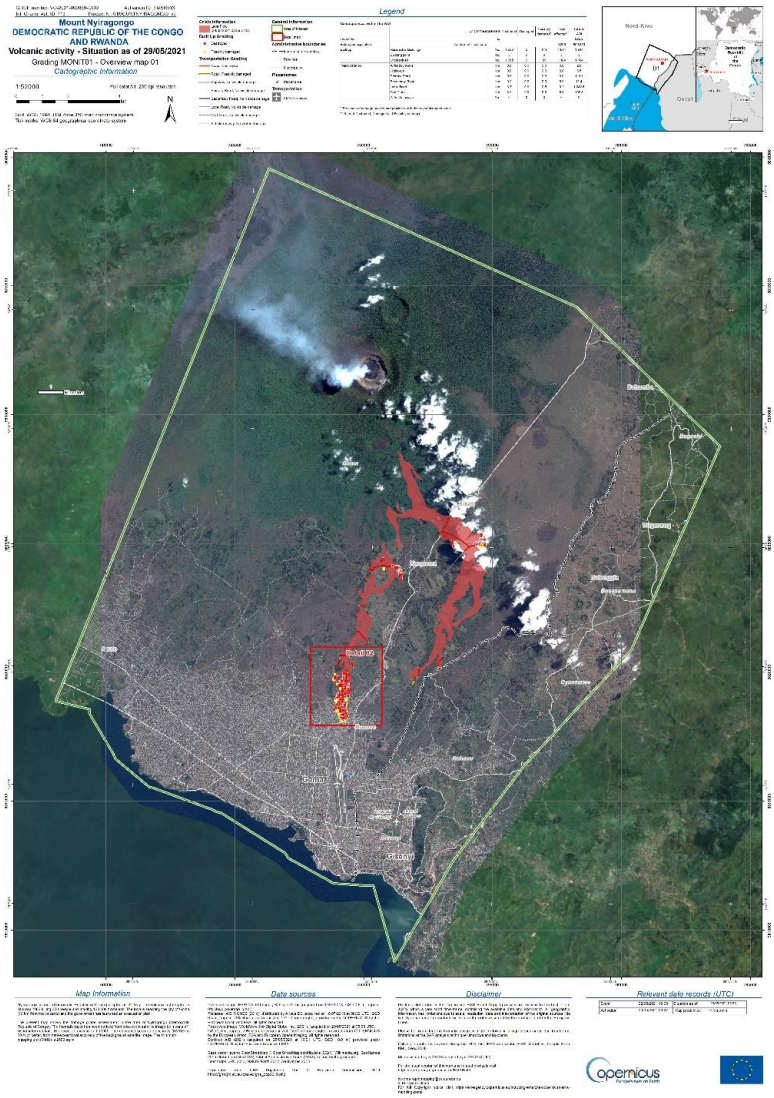
Figure C.6: Example of the C-2FOa data generated with GWIS using the UN-SPIDER suggested procedure.

Annex D: Emergency Mechanisms set up by the Space Community

The Space community has launched several mechanisms to support national disaster management agencies and organizations of the United Nations in their disaster response efforts. These include the International Charter Space and Major Disasters, Copernicus Emergency Management Service, and Sentinel Asia.

Copernicus Emergency Management Service

The Copernicus Management Service has been established by the European Commission as part of the Copernicus programme to contribute to sustainable development. The Emergency Management Service (EMS) provides an on-demand mapping service that consists of two components. The service needs to be initiated through service requests in case of an emergency or a disaster. Active and recent events are presented in an interactive map and on as a list, allowing for quick assessment of the situation and thus decision-support.



For all events, products showing the extent and in-depth information can be viewed and downloaded. Secondly, a similar service supporting disaster Management (Risk and Recovery Mapping) focuses more on the preparatory and recovery stages of events.

Figure D.1: Example of a map generated as part of the activation of the Copernicus Emergency Management Service due to the eruption of Nyiragongo volcano in the Democratic Republic of Congo and Rwanda in May 2021. Image courtesy of Copernicus EMS.

More information on the Copernicus Emergency Mapping Service is available in these links:

https://emergency.copernicus.eu/

https://un-spider.org/space-application/emergency-mechanisms/copernicus-gio-emergency-mapping-service

The International Charter Space and Major Disasters

The International Charter Space and Major Disasters provides information derived from satellite imagery provided by member space agencies free of charge to disaster management agencies and organizations of the United Nations which respond to or coordinate the response in case of disasters. The Charter has been activated more than 730 times since it was established. This year it has been activated due to disasters in Angola, Madagascar, Malawi, Mozambique, Namibia, South Africa, Zambia, and Zimbabwe.

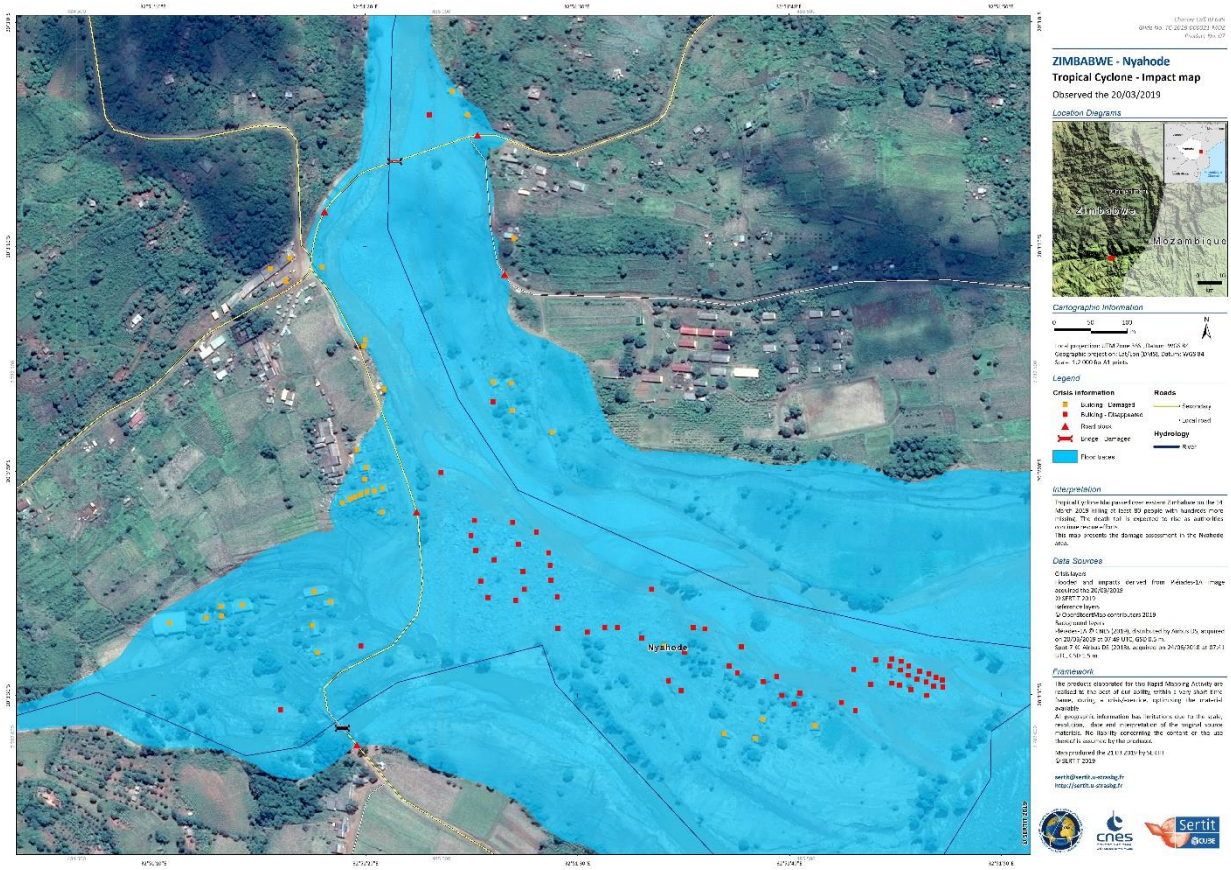


Figure D.2: Example of a map generated as part of the activation of the International Charter to support disaster response efforts due to floods in the region of Nyahode in Zimbabwe triggered by Cyclone Idai in March 2019. Image courtesy of the International Charter Space and Major Disasters.

The National Space Research Institute of Brazil (INPE), which is a members of the member of the International Charter, will make the presentation on this mechanism.

More information on the International Charter is available in these links:

https://disasterscharter.org/web/guest/home

https://un-spider.org/space-application/emergency-mechanisms/international-charter-space-and-major-disasters

Annex E: Confronting the challenges of droughts

Droughts continue to impact several countries in Africa and in other countries of the world, disrupting livelihoods and in extreme cases, forcing farmers to seek other types of livelihoods or to migrate to urban areas to escape from poverty. According to UNCCD, "drought is considered one of the most far-reaching natural disasters, bringing short and long-term economic and social losses to millions of people worldwide. Many countries across the globe that soon may face the impacts of intense drought still lack a comprehensive plan of action at the first signs of drought. Drought and water scarcity – interconnected phenomena that often aggravate each other's effects – can trigger major setbacks for the most disadvantaged populations: from famine to migration and displacement. A single year of drought can undermine years of social development, in particular for vulnerable members of society. Water scarcity alone could cost some regions up to six percent of their GDP by 2050, in turn triggering mass migration and conflict over diminishing resources."

United Nations
Convention to Combat Desertification

The United Nations Convention to Combat Desertification (UNCCD)

The UNCCD secretariat has been supporting countries in designing national drought plans since several years ago. To date, more than 70 countries are engaged in the process of designing national-level plans of action. 31 countries have validated national drought plans. In Africa, these are: Algeria, Benin, Burundi, Ivory Coast, Eswatini, Ghana, Liberia, Mali, Nigeria, Sierra Leone, Somalia, Sudan, Togo, Tunisia, Zambia and Zimbabwe.

On 17 June 2021, UNCCD celebrated the Desertification and Drought Day 2021. The event was used by the United Nations Office for Disaster Risk Reduction (UNDRR) and UNCCD to launch the Special Report on Drought 2021. The report examines the systemic character of droughts, its effects and consequences for human lives, health, and ecosystems. The report calls for urgent action to reduce drought risks, as advanced and preventive action carry far fewer costs than reaction and response to post-drought consequences. This special report is available in this link: https://www.un-spider.org/sites/default/files/screenshot-2021-06-18-at-13.55.35.png

UNCCD also launched a few years ago its Drought Toolbox that contains easy to access resources to address the challenges of droughts. The toolbox includes tools that are useful in monitoring and early warning, vulnerability and risk assessment, and risk mitigation.

More information on this Drought Toolbox is available in this link: https://knowledge.unccd.int/drought-toolbox

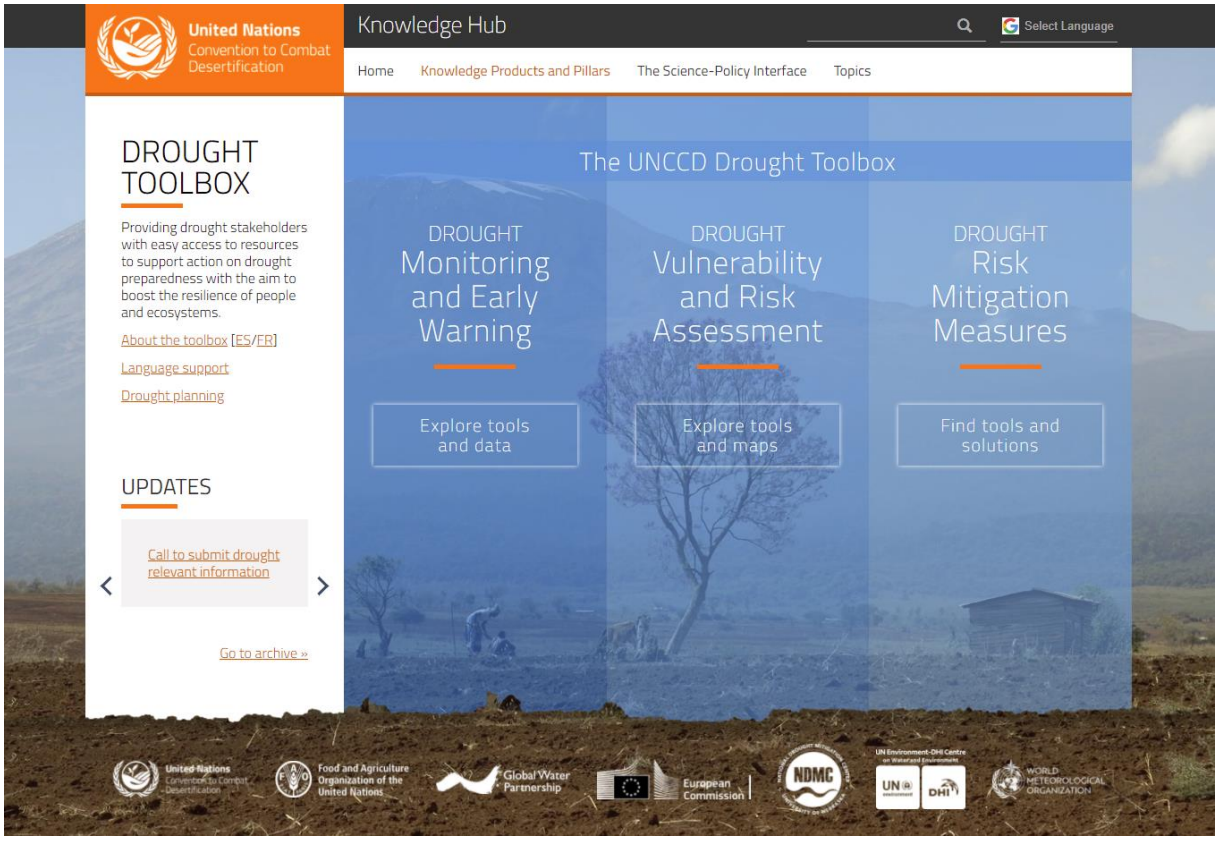


Figure E.1: UNCCD´s Drought Toolbox.

FAO's Agricultural Stress Index System (ASIS)

Recognizing the need to address the challenges posed by droughts, the Food and Agriculture Organization of the United Nations (FAO) launched nearly a decade ago its Agricultural Stress System Index (ASIS) to allow countries to become better aware of the manifestation and impact of droughts. ASIS is based on the Vegetation Health Index (VHI), derived from the Normalized Difference Vegetation Index (NDVI). The NDVI is one of several indicators that can be extracted from optical satellite imagery.

The VHI can detect drought conditions at any time of the year. For agriculture, the analysis is performed only between the start (SOS) and end (EOS) of the crop season (temporal integration) and restricted to crop areas (spatial integration). ASIS allows the user to assess the severity (intensity, duration and spatial extent) of the agricultural drought and expresses the final results at administrative level, giving the possibility to compare it with the agricultural statistics of the country.

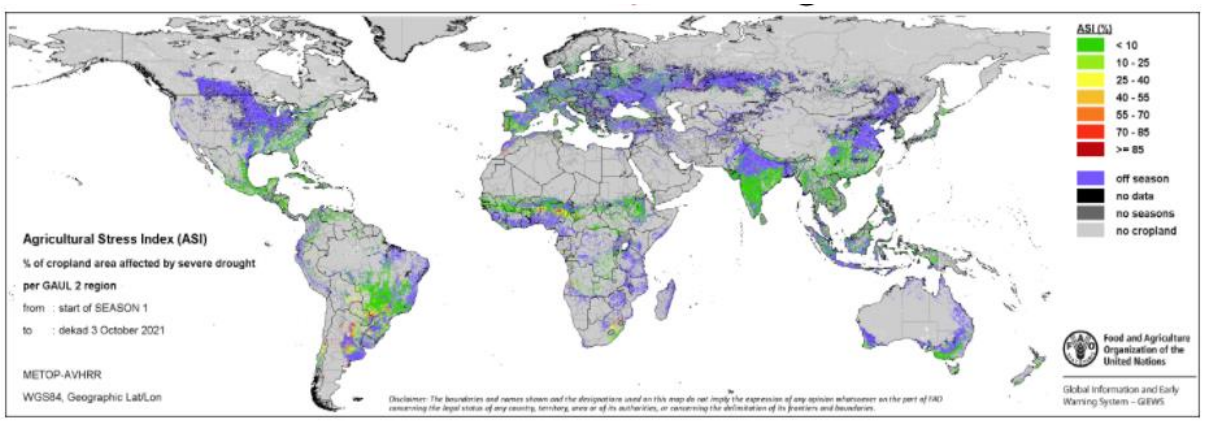


Figure E.2: A global view of the Agricultural Stress Index presented by FAO.

More information on ASIS is available at: https://www.fao.org/resilience/news-events/detail/en/c/296089/

International Water Management Institute (IWMI)

IWMI is a research-for-development (R4D) organization, with offices in 13 countries and a global network of scientists operating in more than 30 countries. It has been supporting the UN-SPIDER programme for nearly a decade as a Regional Support Office. IWMI's research is geared to contribute to a transformative agenda developing innovative water solutions for sustainable development. It addresses three key water-related challenges: Improving Food Security; adaptation to climate change and growth. IWMI has been implementing Earth-observation-based solutions in Asia and Africa and contributes actively to disaster response efforts with a focus on floods.

More information on IWMI is available in this link: https://www.iwmi.cgiar.org/

The Global Drought Observatory (GDO)

The Global Drought Observatory (GDO) provides information on current and past drought events on regional and national scales. Its most central part is an online map view that provides easily accessible information on the estimated effects of drought on agriculture. Additional information such as precipitation, vegetation condition, mitigation measures and the effect on wetlands are available. Both the current and past situation from 2013 onwards can be accessed. Furthermore, a forecast for the next 3 months shows regions where extremely dry or wet conditions are expected. The second tool consists of in-depth reports on selected past drought events in Europe since 2011 and worldwide since 2017. The third tool is an overview on drought events worldwide since 1951, provided as a map and a table. All reports and data sets are free to download.

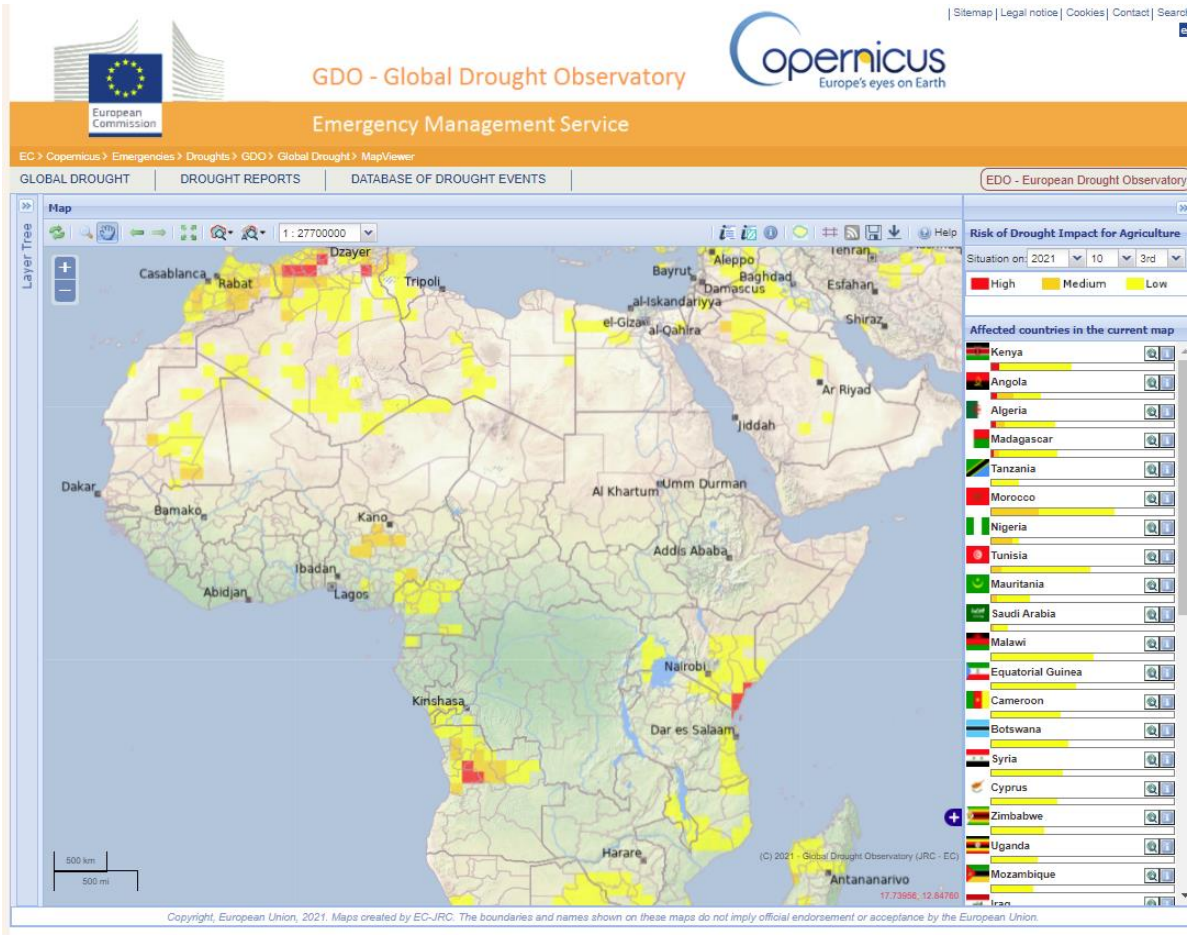


Figure E.3: Global Drought Observatory (GDO) Portal. Image courtesy of the Global Drought Observatory.

More information on GDO is available in this link:

https://edo.jrc.ec.europa.eu/gdo/php/index.php?id=2001

Globe Drought project

The Globe Drought project has been implemented by researchers and staff from the University of Bonn (UNU/EHS), the NGO Welthungerhilfe (German Agro Action) and the private company Remote Sensing Solutions GmbH of Germany. The aim of the project has been to develop a web-based information system for comprehensively characterising drought events. The project has produced a spatially explicit description of drought risks by considering three components: drought hazard, exposure and vulnerability. Researchers engaged in this project investigated how droughts impact water resources, crop productivity, trade in food products and the need for international food aid. More information on this project is available in this link: https://grow-globedrought.net/about/

Annex F: Innovative Tools

Recognizing the need to contribute to sustainable development, climate change and disaster management; the space community continues to develop novel types of solutions and tools to be used for this purpose.

Multi-scale Flood Monitoring and Assessment Services for West Africa (MiFMASS).

The Multi-scale Flood Monitoring and Assessment Services for West Africa (MiFMASS) project is implemented in five West Africa countries: Ghana, Benin, Cote D'Ivoire, Burkina Faso and Nigeria by a consortium on seven institutions as a regional activity under the umbrella of the GMES & Africa programme of the African Union and the European Commission. The aim of the project is to enhance the efficiency of flood monitoring, assessment and management in West Africa by providing Earth-observation-based services in near real time basis to disaster management organizations and boosting their human capacity to adapt to these services. Specific objectives include:

- The establishment of a flood event database to be regularly updated
- The provision of timely information before, during and after flood events to Disaster Management Organizations (DMOs)
- The strengthening of the capacities of DMOs and other target groups (farmers, Local residents along flood plains) in the use of Earth observation data for flood monitoring, assessment and management

Flood modelling will be carried out using the Hydrologic Engineering Center-Hydrologic Modelling System (HEC-HMS) and the Hydrologic Engineering Center-River Analysis System (HEC-RAS). The two models are used to simulate and model relations between rainfall and runoff in MifMASS Project sites (Benin, Burkina-Faso, Côte-d'Ivoire, Ghana and Nigeria).

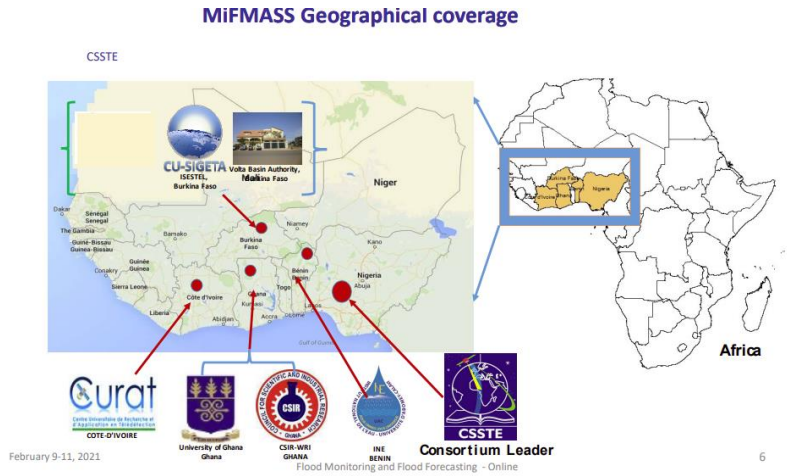


Figure F.1: Geographical coverage of the MiFMASS project.

The project envisions the implementation of several products and services including:

- An application to inform end-users about potential floods, targeted for users in Nigeria, Benin, Ghana and Burkina Faso
- A flood event database that includes maps of areas which could be flooded (forecasts), for users in Nigeria, Cote D'Ivoire, Benin and Ghana
- Capacity building efforts in topics such as downloading of Earth observation data, processing, and flood modelling

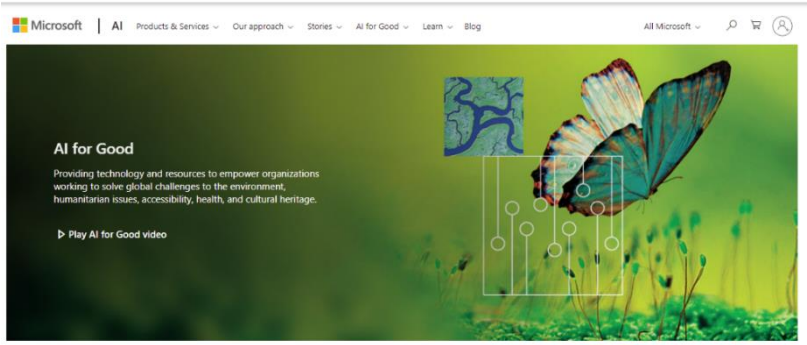
- Policy-relevant advice to decision makers and water resources commissions in several countries on flood mitigation management and regarding damage assessments

More information on this project can be found on its website: http://gmes-mifmass.net/mifmass/

Microsoft's AI for Good initiative

As part of its corporate efforts to contribute to sustainable development, Microsoft has launched several initiatives including AI for Good, AI for Earth, and AI for Humanitarian Action.

The AI for Good Research Laboratory is a philanthropic team of data scientists and researchers dedicated to using artificial intelligence, machine learning and statistical modelling to tackle some of humanity's greatest challenges. Staff engaged in this laboratory partner with leading non-profits, research institutions, NGOs, and governments to accelerate work across the AI for Good programmme portfolio — Earth, accessibility, humanitarian action, cultural heritage, health — as well as other pressing issues such as affordable housing, broadband access, digital skills, justice reform, legal compliance, etc.



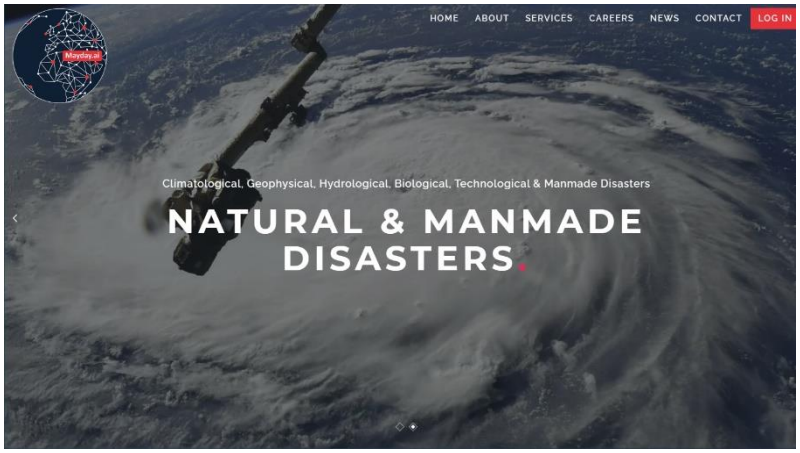
The AI for Humanitarian Action supports disaster response efforts, refugees, displaced people, human rights and the need of women and children.

Figure F.2: Microsoft's AI for Good initiative.

More information on these initiatives of Microsoft can be found in this link: https://www.microsoft.com/en-us/ai/ai-for-good

Maydai AI: Real Time & Near-real time information services for disaster management.

Mayday AI is developing an artificial intelligence platform designed to provide real time and near-real time information to disaster managers regarding risks of potential events and disasters. The platform leverages satellite imagery, in-situ camera imagery, social media data, and other data sources to generate policy-relevant and actionable information for decision makers and end-users at different levels.



The platform makes use of proprietary algorithms that pinpoint with high accuracy the geospatial extent of events such as forest fires in a very quick fashion. It also offers a two way communication service and a dynamic risk score that can be used for insurance purposes.

Figure F.3: Microsoft's AI for Good initiative.

More information on Mayday AI is available at: https://mayday.ai/

From Climate Data to Risk finance:

Modelling drought in Ethiopia

Climate change creates cascading risks in physical systems, ecosystems, the economy and societies with disproportional impacts on the vulnerable populations. Addressing climate risks across domains, and in a manner meaningful to decision-makers, is a major challenge. Shifting to a proactive approach in managing climate change risks requests an increasing level of objectivity in the analysis of risks for multiple sectors. Such evidence base fosters transparency and enables consensus in developing climate adaptation measures. The quantification of climate risk is paramount in defining the balance between risk reduction, risk retention, adaptation pathways and risk transfer solutions.

UNU-EHS is already using open data for its projects and research, as well as open-source software such as CLIMADA for the studies of the economics of climate adaptation. UNU-EHS will present the distribution of damages associated to drought risk in the Afar and Somali regions. It will also present a detailed cost benefit analysis of possible measures to be implemented. Furthermore, it will discuss the limitation of the approach in ungauged basins, and the potential for enhanced remote sensing datasets

More information on this initiative of UNU-EHS can be found in this link: https://ehs.unu.edu/news/news/economics-of-climate-adaptation-eca-the-tool-to-support-countries-and-communities-to-develop-more-ambitious-climate-adaptation-and-mitigation-plans.html

Decision Support System for Forest Fire Management

The UN-SPIDER programme will be presenting information on its prototype of a decision support system being developed to contribute to address the challenges posed by forest fires. The prototype has been developed using Google Earth Engine and builds on existing data and information sources generated by the space community and other national, regional, and international organizations. It includes information on weather conditions and susceptibility of vegetation to inform decision makers about the potential conditions for the spreading of forest fires; information on forest fire hotspots on a near real time basis, and information on the geographic extension and burn severity of forest fires.

The decision support system will be developed to present geospatial information to decision makers in three terminals simultaneously to convey information that is useful before, during and after forest fires. The first screen will provide information on current weather conditions and the susceptibility of vegetation to forest fires. The second screen will provide information on fire hotspots and will display near real time imagery of the area of interest. The third screen will provide information on the geographical extent of forest fires and their burn severity.

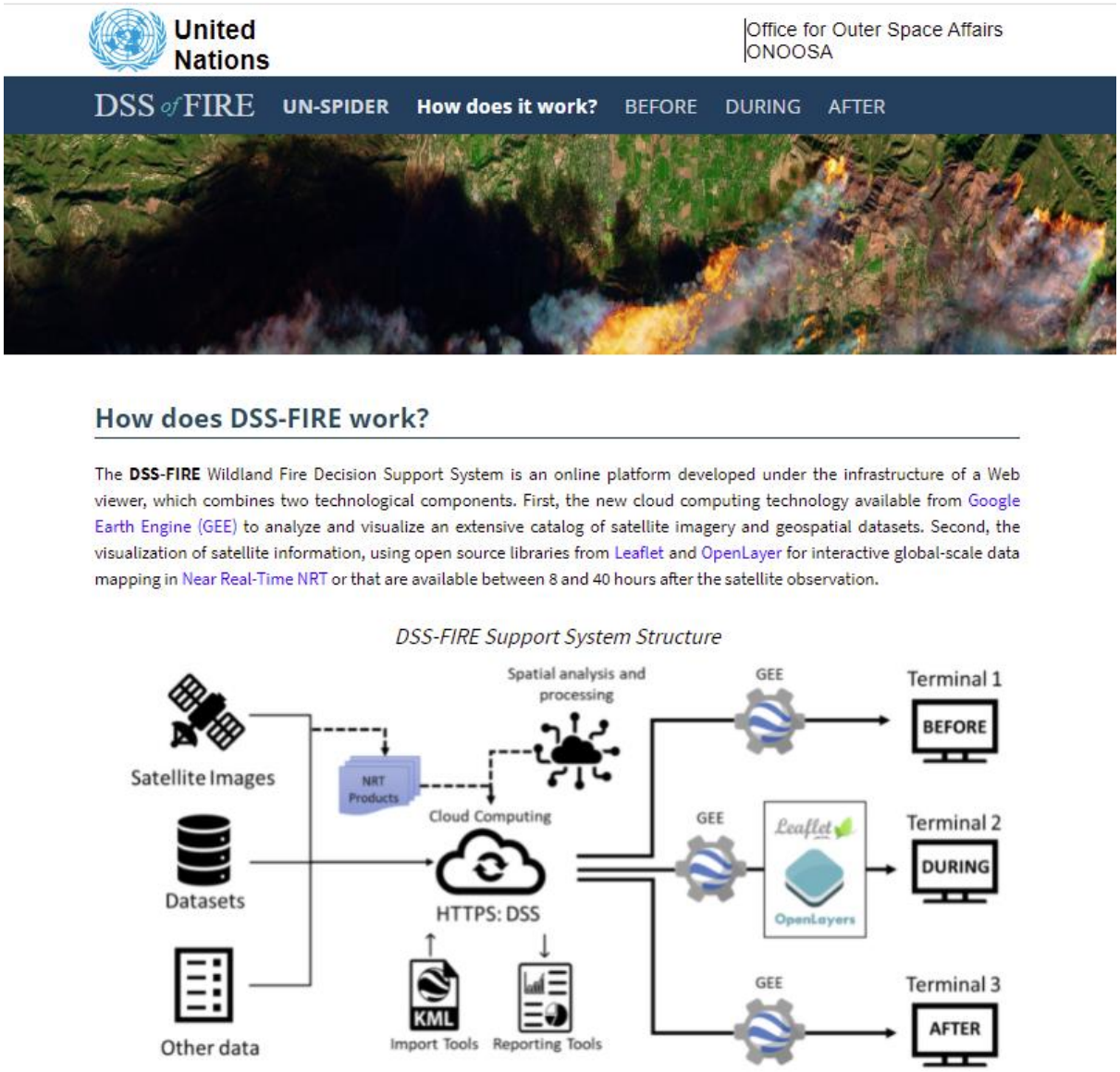


Figure F.4: Operational scheme of the prototype of the decision support system for forest fire management being developed by UN-SPIDER.