AFRICA KNOWLEDGE PLATFORM

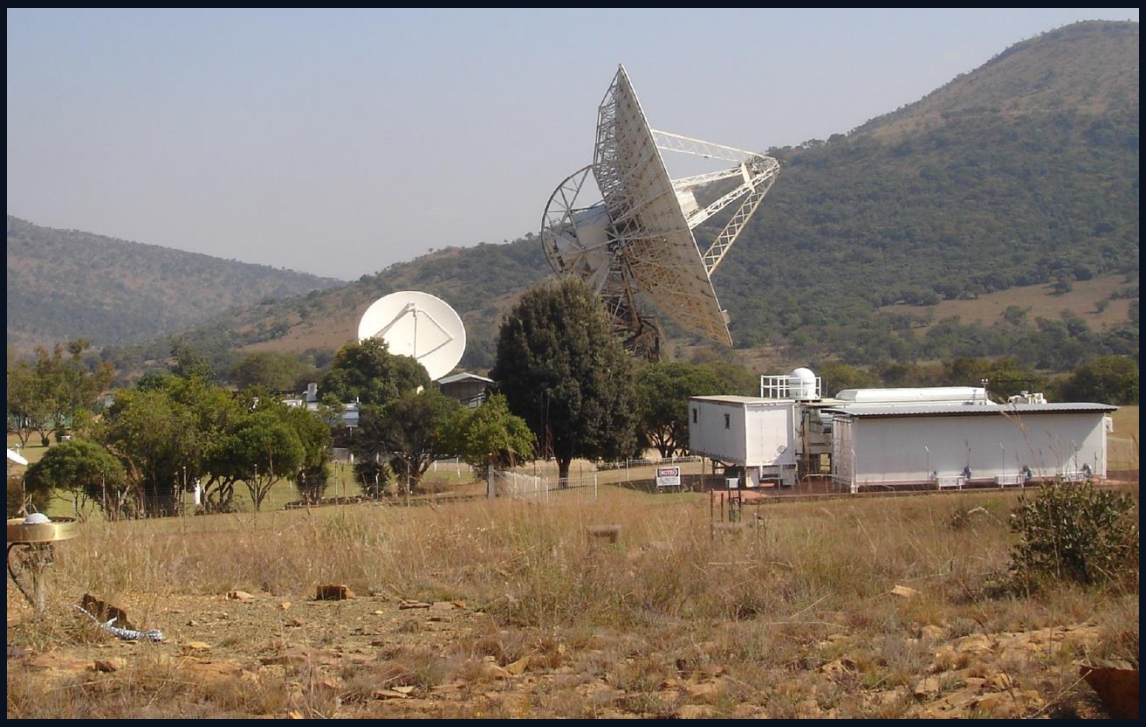
Unlocking the Potential of Satellite Imagery for Local Communities

From Farming to Fishing and Beyond

European Commission

Remote sensing means observing and analysing objects without being in direct contact with them. Earth Observation (EO) is arobust, flexible and cost-effective technique to gather information about our planetfrom remote sensing satellites carrying imaging devices.

In 2007, the African and European Commissions have agreed to jointly develop and implement EO-based services to foster sustainable developmentand improve decision-making, particularly on climate adaptation. Building from existing infrastructure and capacities (established by PUMA, AMESD and MESA programmes), the ongoing GMES & Africa programme (Global Monitoring for Environment and Security & Africa) promotes the development of local capacities, and institutional, human and technical resources for an operational access to and exploitation of EO-based services. In the frame of those EO programmes, the Joint Research Centre (JRC) of the European Commission has developed the eStation for the African Union Commission: a software and data station to ingest, process and analyse EO datasets rendering easy and operational their uptake in many professional sectors.



Today, the eStation is implemented in all African regions by 12 consortia comprising more than 130 institutions (mandated regional organization, national ministries, research centres and universities). The JRC maintains a constant dialogue with the African partners, offers training to the users and develops new tailored products and indices to answer their needs.

The eStation2 has been distributed in all 48 sub-Saharan African countries to institutions involved in the MESA project (Monitoring of Environment and Security in Africa, 2013-2017) and 12 additional stations have been procured under GMES & Africa, mainly for Northern African institutions

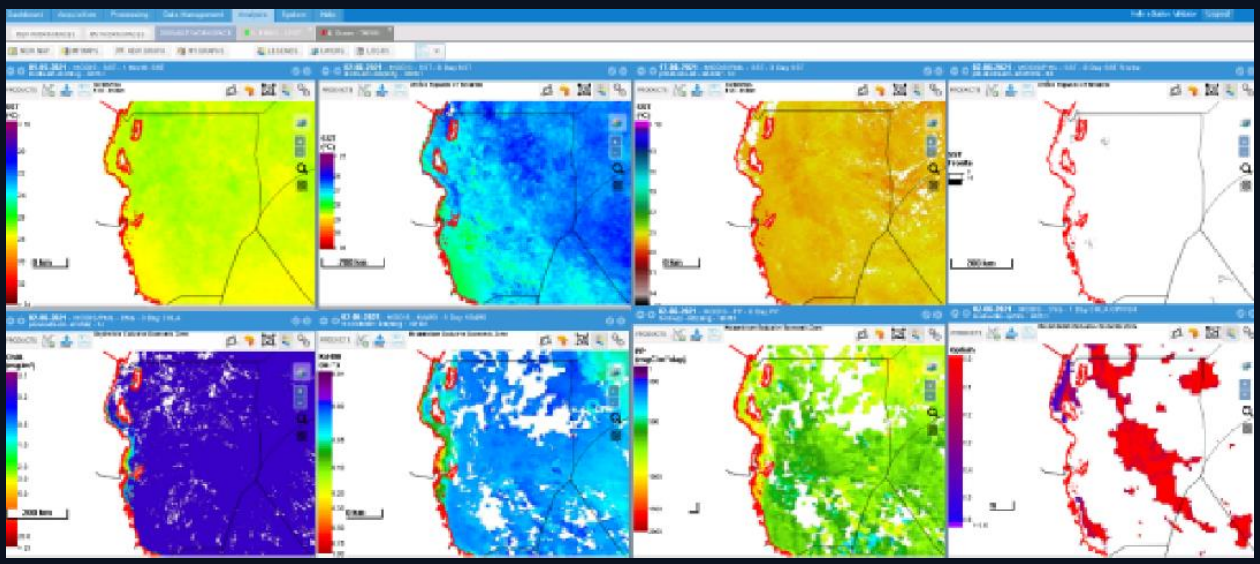
eStation

THE TECHNOLOGY BEHIND THE TOOL

The eStation is a web-processing system designed to automatically acquire and process key environmental indicators derived from Earth observation (EO) data. Highly customisable, it allows users to build tailored workspaces to analyse and visualise those indicators. It is entirely built upon open-source technologies. The eStation – the software component – can be hosted and executed on a MESA station – the physical component – which comprises a satellite dish (reception antenna) and three interconnected personal computers that receive, process and analyse the data. The eStation automatically retrieves data from the EUMETCast broadcasting system through the receiving antenna, and establishes a systematic

access to the data published by the data providers when an internet connection is available.

The acquired datasets are typically low and medium spatial resolution measurements from SPOT/PROBAV, SEVIRI/MSG, TERRA-AQUA/MODIS and Copernicus Sentinel 2 and 3 Earth Observation systems. They are grouped under thematic categories like vegetation, rainfall, precipitations, fire, inland water and oceanographic products, among others. The software then derives selected indicators like climatological anomalies, standardised indices like the Normalised Difference Vegetation Index (NDVI) or tailored products like potential fishing zones (PFZs). Based on these indices, the eStation users can perform analyses and generate information fit-for purpose for end users (decision makers, locals and private sector). In a few simple steps, the users can have the eStation and its services activated and customised, and be ensured a continuous and reliable acquisition and processing of EO data.



An eStation workspace showing visualisations of EO-based ocean data and products over the Tanzanian Exclusive Economic Zone.

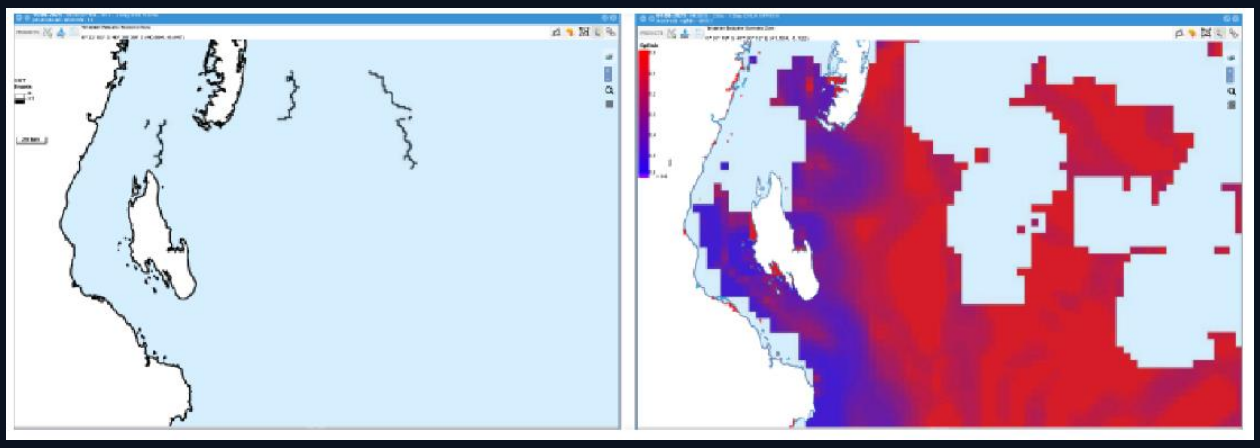
What could be the concrete uses and benefits of the eStation for local communities?

 # Fishing Activities: How the eStation Can Support Fishers by Identifying Prime Fishing Grounds and Mitigating Coastal Strain in Tanzania

In Tanzania, coastal fishing directly supports more than 54,000 fishers and contributes significantly to the country's economy and food security. Fish catches along the coast started to decline in the recent years. The decline in fish catches is attributed to multiple factors, including rising sea temperatures and overfishing in shallow waters, both of which are significant contributors. This is worrying, not only because local communities depend on fish for daily food and income, but also because it threatens the food security of the growing African population.

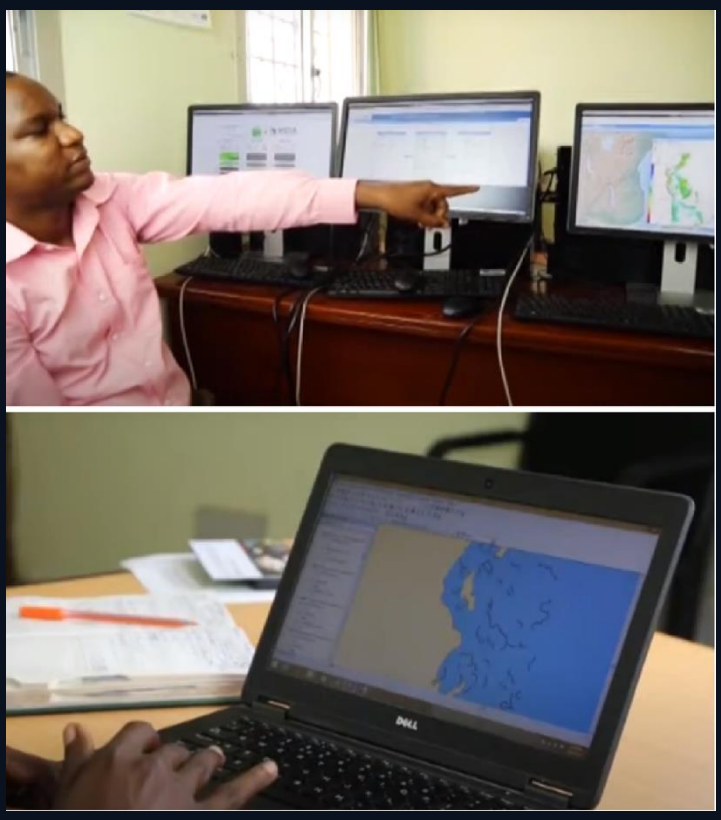
Oceanic pelagic fish live in the water surface layers (not near the seabed nor the shore). They aggregate where and when feeding and environmental conditions are favourable, depending on (1) oceanic (currents, density) and atmospheric (wind, precipitation, air pressure, temperature) processes over tens of kilometres, and (2) the presence of phytoplankton, the basis of the marine food chain (it is eaten by zooplankton, which is food for fish). As all plants, phytoplankton requires light and nutrients and thrives when rich deeper waters rise near the sea surface. Climate change events render those favourable conditions unpredictable and pose serious threats to plankton populations. Remote sensing represents an interesting source of observation in real time and greatly helps identify favourable fishing areas for pelagic fish species.

Within the framework of the GMES & Africa project, the Tanzania Fisheries Research Institute(TAFIRI) has been a pioneer user of Earth Observation data in the East African region. Satellite based information from the eStation provides the Potential Fishing Zones (PFZs) and the Ocean Productivity available to Fish (OPFish). Those two indices help identify hotspots of plankton productivity towards which large predators actively aggregate, namely favourable fishing grounds. If fishers with suitable vessels were provided with information from the eStation on where to find and be encouraged to venture further out at sea to catch large pelagic species like tunas, it could help reduce fishing pressure in coastal waters



Left: The Sea Surface Temperature (SST) fronts —where colder waters meet warmer waters, black lines— are used to locate Potential Fishing Zones (PFZ).

This innovative support to fishing, in the long term, it could also help identify priority areas to control and fight Illegal, Unreported and Unregulated (IUU) fishing, that continues being reported.



Innocent Sailale, analyst at TAFIRI, demonstrates the eStation

Thanks to TAFIRI, both the fishers and the fisheries authorities are aware of the direct benefits of EO-based services to reduce the fishing pressure on coastal waters and to promote a sustainable use of natural resources. Moreover, the government can use this information to improve fisheries management plans in the Tanzanian waters, not only for large pelagic fish (large tuna and tuna like) but also for small and medium fish (sardines and skipjack tuna).

Farming Activities: How the eStation Could Be Used to Monitor the Agropastoral Season in the Sahel

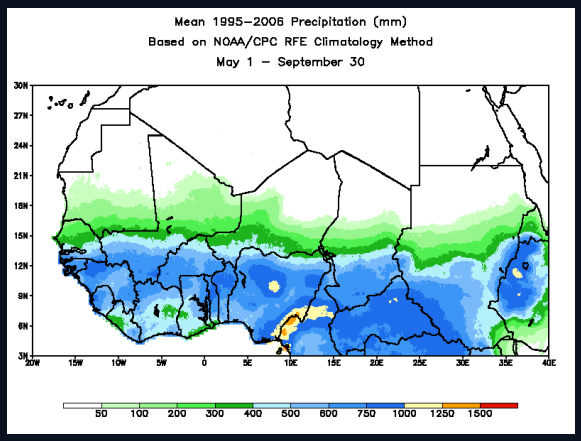
The Sahel is a region characterized by its agropastoral activities, where the dynamics are increasingly complex due to multiple interrelated factors. Extreme climate events, such as prolonged droughts and unpredictable rainfall, are becoming more frequent, exacerbating the strain on already limited natural resources. This climatic variability impacts both crop yields and grazing conditions, heightening competition for land and water between herders and farmers. Additionally, the intensification of land use and the pressures of population growth contribute to escalating tensions. The interplay of these factors creates a volatile environment where conflicts over resources are more likely, and the challenges faced by both agricultural and pastoral communities are deeply intertwined and multifaceted.

Livestock production accounts for at least 25% of the GDP of countries like Burkina Faso, Mali, Mauritania, Niger and Chad. The sector provides employment to 80% of the population, produces meat and other commodities, and provides draught power. (Data source:FAO- Photo: Andreas Brink).

Pastoralism is a cornerstone of local food security and income in the Sahel, providing approximately 65% of the meat and 70% of the milk sold in local markets.

Nomadic and semi-nomadic herders constitute about 13% of West Africa's population. Traditionally, they migrated south during the dry season to find resources for their livestock. In recent decades, conflicts between herders and farmers have escalated due to environmental, economic, and social factors. Climate change has disrupted traditional migration routes and diminished water sources, increasing competition for land and water. Economic pressures and rising populations exacerbate these tensions, leading to disputes over resources.

Farmers in Western Africa depend on rainfed subsistence farming systems, making them highly vulnerable to precipitation variability for their crop production. Similarly, herders adjust their livestock movements based on rainfall patterns. Prolonged grazing on a single pasture can lead to over-grazing and land degradation, which in turn exacerbates conflicts with farmers. This dynamic underscores the critical interplay between climatic conditions and land use practices, highlighting the challenges both groups face in managing their resources sustainable



Map showing mean rainfall amount (mm) for the monsoon season (May 1-September 30) in West Africa. Period 1995-2006. Based on NOAA/CPC Climatology Method Rainfall Estimates. Africa Rainfall Climatology (CPC ARC) Serie . By NOAA/ National Weather Service - NOAA, US Govt http://www.cpc.ncep.noaa.gov/products/fews/AFR_CLIM/afr_clim_season.shtml, Public Domain, https://commons.wikimedia.org/w/index.php?curid=4438274

In the Sahel, the rainy season is short (3-4 months). The rain intensity and its spatial distribution directly impacts the availability of the vegetation and the forage stock during the long dry season (8-9 months).

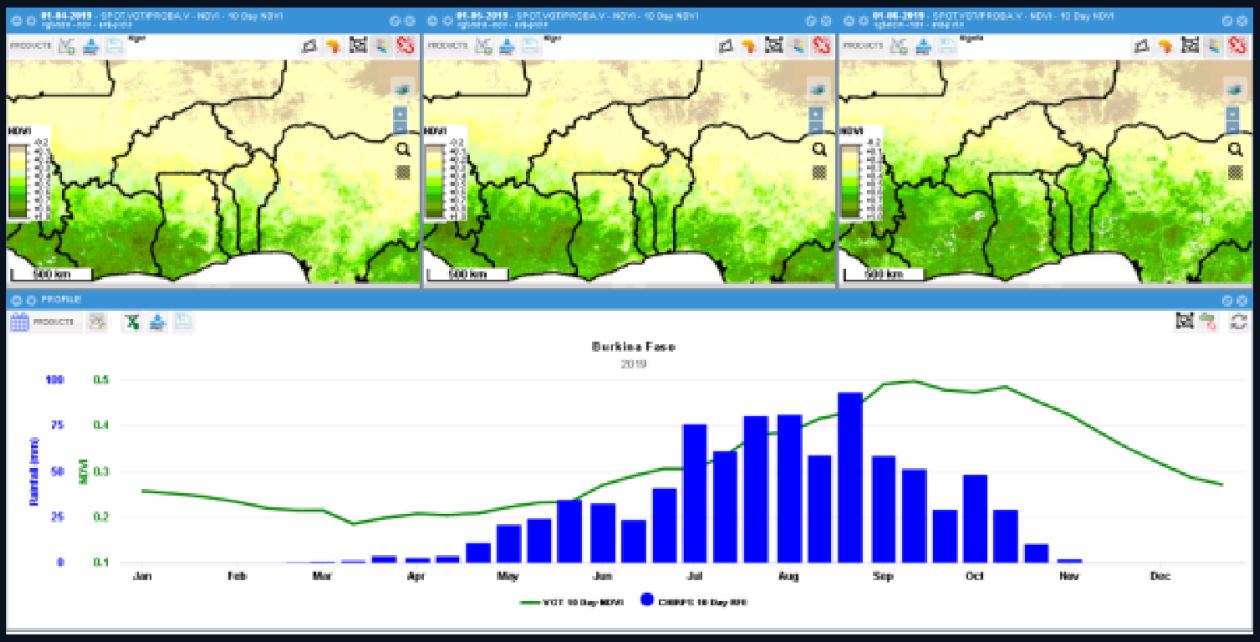
Rainfall patterns vary a lot between years, and between decades. The 1950s were wet, the 1980s excessively dry. Since the 1990s, yearly cumulative precipitations are partially recovering. But this is due to a major change in the sub-seasonal variability: there are more intense precipitations, more frequent and intense floods, more late or interrupted rainfalls, more severe droughts and fires... By rendering the planning of their activities difficult, these climate fluctuations make farmers and herders highly vulnerable and poorly resilient.

AGRHYMET is an institution of the Comité Permanent Inter-Etats de Lutte contre la Sécheresse dans le Sahel (CILSS) specialised in education and information on food security, water management, climate change and desertification. Their Pastoralism Service monitors the status of rangelands in West Africa. Thanks to the eStation, they map and monitor the vegetation, the surface water bodies (ponds and streams), the weather patterns as well as fires, floods and droughts to support decision-making in the livestock sector . During the agropastoral season (May-October), they produce monthly geospatially explicit bulletins to inform users – ranging from farmers and herders to decision makers – on local conditions. They include:

- Weather patterns (predictions of seasonal rainfall, start and end of the season, etc.);
- Hydrological, crop and phytosanitary (e.g. locust) conditions;
- Pastoral movements;
- Forage biomass production;
- Etc..

Acacia trees in the Sahel sub-Saharan savanna ecoregion. Sahel Acacia species include: Acacia laeta, Acacia nilotica, Acacia seyal, and Acacia tortilis. @ Annabel Symington - The road to Timbuktu, Mali, CC BY 2.0, https://commons.wikimedia.org/w/index.php?curid=11950762

AGRHYMET evaluates the potential impacts of these factors on livestock and local populations, offering recommendations to all stakeholders. Developing and validating effective, customized tools and indices for the eStation necessitates a strong partnership and ongoing dialogue with regional actors.



NDVI (Normalised Difference Vegetation Index) data available on the eStation are used to follow the evolution of the vegetation growth from south to north (visualised here for April, May and June 2019). By analysing the vegetation and rain dynamics, one can predict the mobility patterns of the herds and their late or early return towards the north, i.e., away from cropped areas

Earth Observation (EO), combined with digitalization, is a transformative tool for enhancing decision-making. It benefits policymakers at global and regional levels by providing timely, actionable, reliable, and targeted geospatial information.

The eStation is flexible: its services can be customised to answer the specific needs of local African partners and the characteristics of the region (e.g.access to EO without internet). By developing a strong and strategic partnership and maintaining a constant dialogue with regional and local actors, the eStation project contributes to the renewed focus of the Africa-EU partnership where African actors play a key active role towards shaping the rural transformation of Africa.

https://estation.jrc.ec.europa.eu/

https://africa-knowledge-platform.ec.europa.eu/

This StoryMap was compiled for the Africa Knowledge Platform, a project of the European Commission's Joint Research Centre

.

Authors
Emilie Weynants & Christine Estreguil

Contributors
Christophe Lavaysse, Marco Clerici & Jean-Noël Druon. With the support of AGRHYMET and TAFIRI

Related publications
On the Use of the eStation Developed in the GMES & Africa EU Project: Results from the User Survey (Lavaysse et al, 2021)

Image credits

Cover: Marco Clerici