→EO4SD - EARTH OBSERVATION FOR SUSTAINABLE DEVELOPMENT

Climate Resilience | West Africa

Earth Observation Data for West Africa Climate Resilience
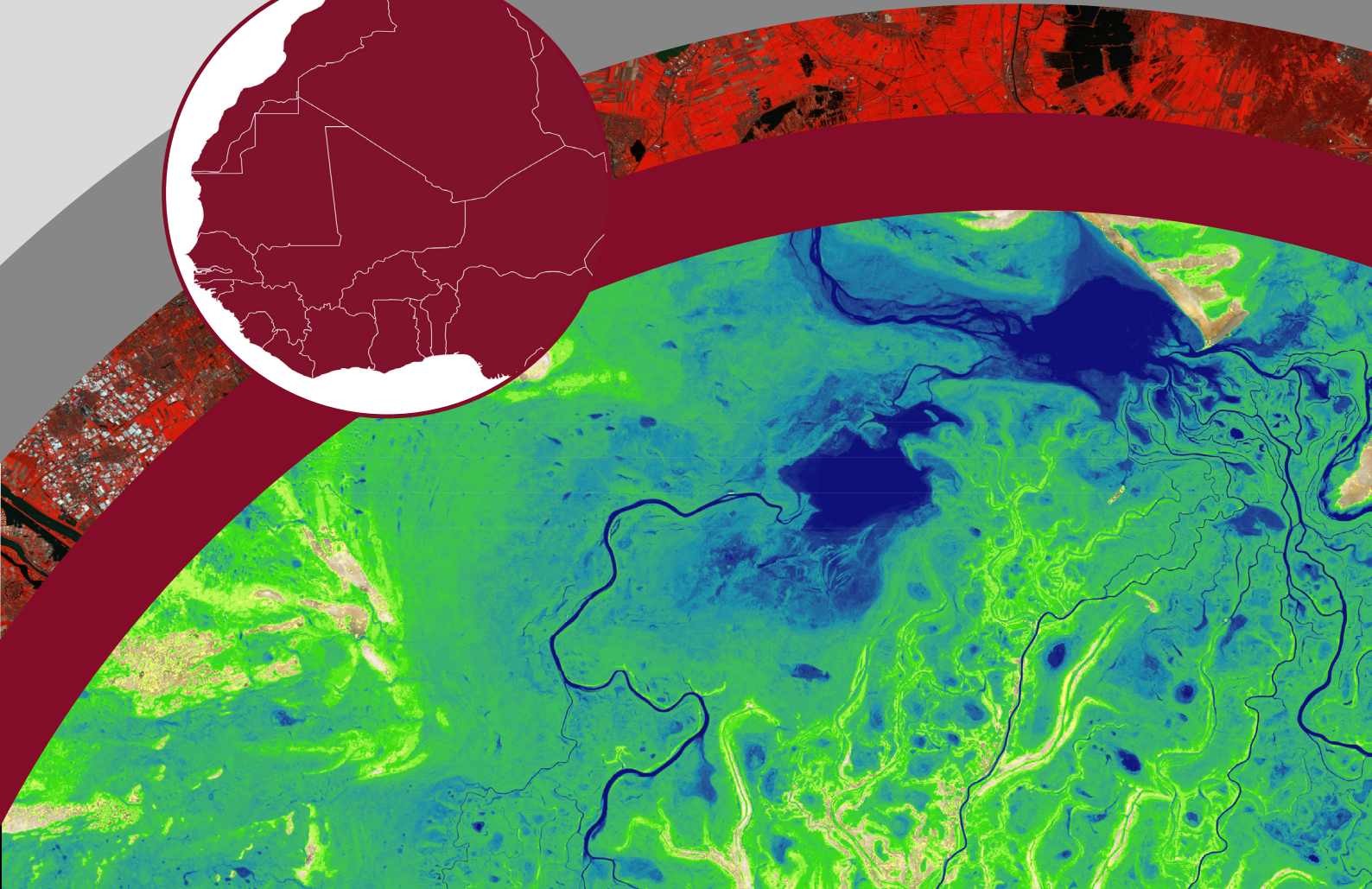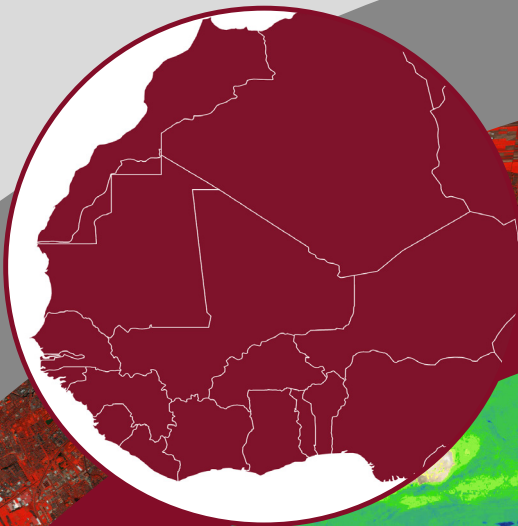
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1. INTRODUCTION

In regions where high resolution data is scarce, Earth Observation (EO) data has the potential to give valuable insights into climate indicators and the impacts of extreme events. West Africa is particularly vulnerable to these emerging threats, with increasing temperatures and changing rainfall patterns threatening food security.

The European Space Agency's (ESA) Earth Observation for Sustainable Development Climate Resilience (EO4SD CR) cluster is working with AGRHYMET to refine and improve its drought monitoring and forecasting. Since 1974, the AGRHYMET Regional Center, a specialized institution of the Permanent Interstates Committee for Drought Control in the Sahel (CILSS), has provided training, equipment for a meteorological and hydrological stations networks, and set up regional and national multidisciplinary working groups to monitor the meteorological, hydrological, crops and pastures conditions during the rainy season. Today it is considered West Africa's leading drought monitoring centre.

The World Bank's Africa Risk Reduction Management team, in partnership with AGRYHMET, is working on the definition of an ambitious investment project in West Africa designed to improve food security. The West Africa Hydromet Project will be operated by Agriculture Global Practice and executed by AGRHYMET. In support of the project preparation, the EO4SD CR cluster provided a range of EO datasets and services that inform resilient drought assessments covering climate indicators including rainfall, soil moisture, and water availability.

About ESA's EO4SD Climate Resilience Cluster

Since 2008, the European Space Agency (ESA) has worked closely with International Financing Institutions (IFIs) and their client countries to harness the benefits of EO in their operations and resources management. Earth Observation for Sustainable Development (EO4SD) is a new ESA initiative which aims at increasing the uptake of EO-based information in regular development operations at national and international level.

The ESA EO4SD Climate Resilience Cluster aims to provide insight about the potential of EO to support of climate-resilient decision making at the regional and national scale. In collaboration with several IFIs, the EO4SD CR cluster has developed EO-based integrated climate screening and risk management products and services to help manage climate-related risks and capitalise on the opportunities that climate resilience can create. The EO4SD CR cluster is also working to build the capacity of IFI staff and IFI client states, allowing stakeholders to autonomously use EO-based information for climate resilience decision making.

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2. SUPPORTING AGRHYMET'S DROUGHT MONITORING WITH EO DATA

West Africa is one of most vulnerable regions to climate variability and change in the world. Increasing temperatures and changing rainfall patterns already impact people's livelihoods, with threats to food security, negative effects on economic performance and governance issues. Since the 1970s, climate variability has resulted in large agricultural losses, food crises, water scarcity and extreme flooding, and environmental degradation. Warming across the region exceeds the global average, and this trend is expected to continue, with the greatest warming in the Sahel[1].

People in the region are especially vulnerable to climate-related shocks and stresses, thanks to socioeconomic challenges such as high rates of extreme poverty, unemployment rates, high population density, and under-developed infrastructure. These impacts are then also more severely felt due to the low adaptive capacity of the local population and compounded further by a lack of reliable and pertinent information on climate change.[2]

AGRHYMET has developed models and methodologies based on ground and satellite observations to monitor rainfall, food-crop water requirements, prospective yields, and vegetation cover and its seasonal and interannual variations. It has also trained around 1200 experts in agrometeorology, hydrology, equipment maintenance, and plant protection, and more than 6000 professionals on topics related to food security, climate change, and sustainable natural resource management.

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1 USAID (2018). Climate Risks in West Africa: Regional Risk Profile. Available at https://reliefweb.int/sites/reliefweb.int/files/resources/West_Africa_CRP_Final.pdf
2 Mohamed Yahya Ould Mahmoud (2013). The New CILSS Climate Change and Sustainable Land Management Platform. Published on IISD SDG Knowledge Hub. Available at: http://sdg.iisd.org/commentary/guest-articles/the-new-cilss-climate-change-and-sustainable-land-management-platform/

AGRHYMET's service rely on accurate information about drought indicators being delivered in a timely manner, in order to be able to provide early warnings to farmers and governments about impending water and food scarcity issues. The EO4SD CR cluster has worked with AGRHYMET and the World Bank to identify how EO data can increase the accuracy and timeliness of their drought monitoring and forecasts to build climate resilience in the region.

The services provided by the EO4SD CR cluster enhances AGRHYMET's ability to have a comprehensive view of climate risk as a function of hazard, exposure and vulnerability. Combining EO-derived information and socioeconomic data can better equip AGRHMET to understand and improve Sahelian food security, desertification control, and water control and management.

EO4SD CR cluster's priority was to increase the accuracy, resolution and timeliness of AGRHYMET's products, so that it could provide more accurate forecasts, at better resolutions and at more regular intervals. The EO4SD CR cluster identified products and services that could usefully support AGRHYMET's work (Table 1). The EO4SD CR Cluster was able to make most of these products available to AGRHYMET as on demand products served through the EO4SD CR Platform[3] (Image 1).

Table 1 Products and services identified by the EO4SD CR Cluster and AGRHYMET as being useful to support their services.

| EO service or product	Description
Historical and operational rainfall estimation.	EO data can monitor monthly and annual observed rainfall and anomalies with reference to a baseline time period. For example, projected changes compared to the 1980-2010 average for each month.
Historical and operational soil moisture estimation.	EO data can monitor monthly and annual observed rainfall and anomalies with reference to a baseline time period. For example, projected changes compared to the 1980-2010 average for each month.
Surface water, wetlands and surface soil moisture monitoring.	EO data can support the mapping, monitoring and assessment of dynamics of surface water bodies, wetlands and surface soil moisture. The prototype product covered a region of the Inner Niger Delta. This service is extended in a modified version to cover two sub-basin areas in Burkina Faso/Niger and Ghana (Sirba and Pra sub-basins).
High resolution land use and land cover mapping.	EO data can provide detail of the land use and land cover changes in the last decades. This includes the 300m ESA's Climate Change Initiative Land Cover products from 1992 to 2015.

3 EO4SD CR Cluster Platform: https://explorer-eo4sdcr.adamplatform.eu/
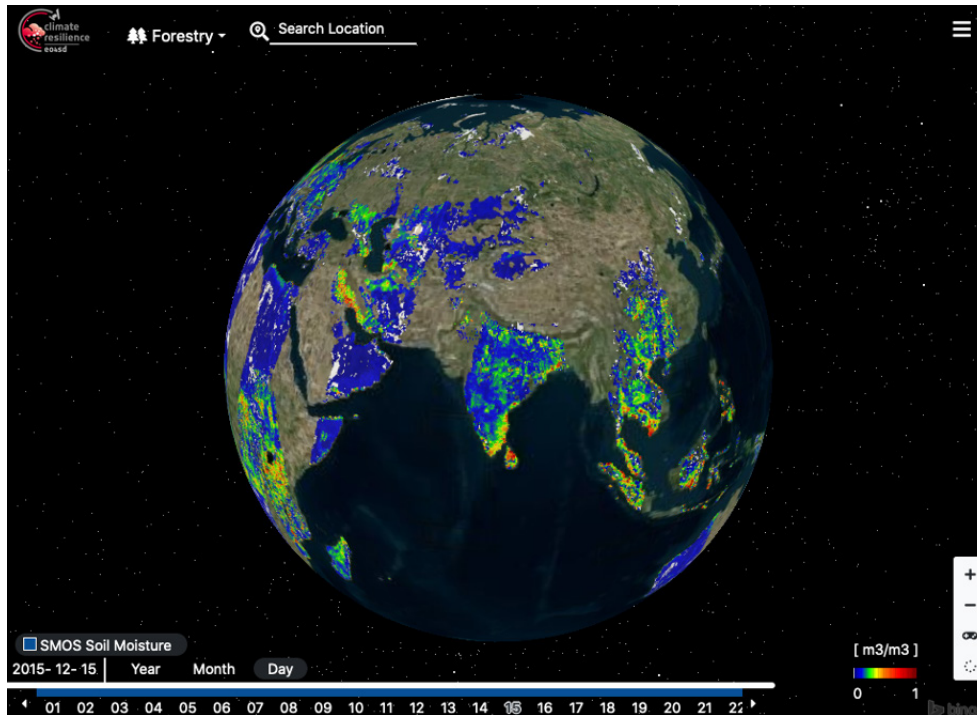
Image 1 A screenshot of the EO4SD Climate Resilience Cluster Platform. Source: EO4SD CR cluster

3. WETLANDS MONITORING PROTOTYPE FOR THE INNER NIGER DELTA

To demonstrate that EO services could be successfully integrated in AGRHYMET's existing processes, the EO4SD CR cluster developed a surface water and wetlands monitoring service and applied it in a pilot region in Mali. The pilot showed that EO information could accurately classify permanent and temporary water bodies and wetlands in the region.

The service is able to detect surface water by automatically assessing high resolution EO images. Mapping monthly water for the observation period, allowed monthly datasets to be combined in order to distinguish between permanent and temporary water bodies (Image 2).
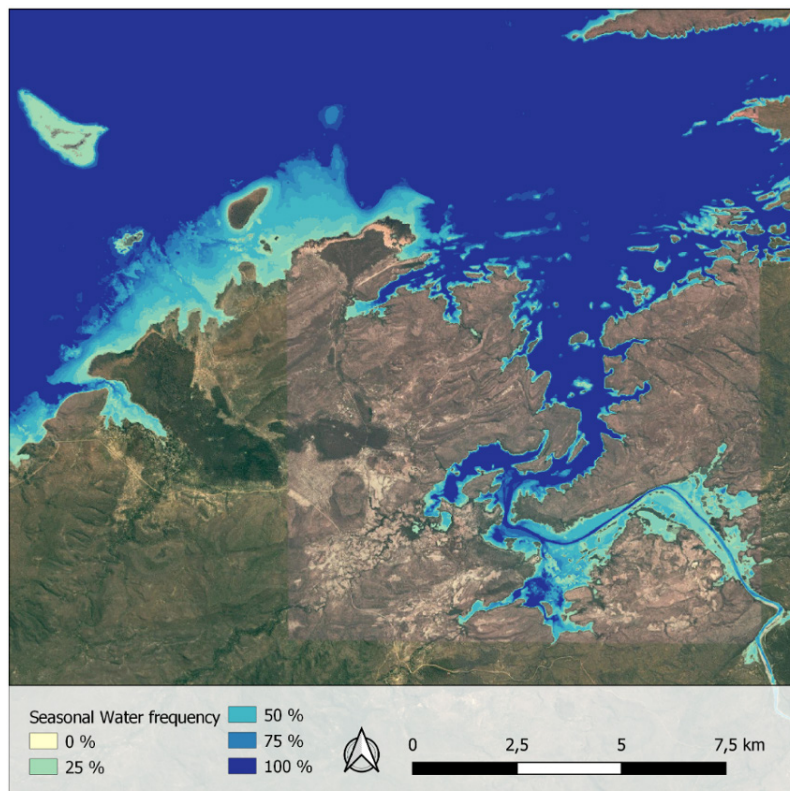

Image 2 Water Frequency map of water body – seasonal changes in surface extent. Source: GeoVille

The data was also used to establish a water and wetness probability index, which indicated the likelihood of wetland conditions occurring and the frequency that particular areas of ground would be wet.

4. SURFACE WATER AND SURFACE SOIL MOISTURE MONITORING IN GHANA AND BURKINA FASO/NIGER

The EO4SD CR Cluster is also working with AGRHYMET to provide surface water and soil moisture monitoring in catchments in Ghana and Burkina Faso. Spatial and temporal distribution of surface water and surface soil moisture will be provided across the areas of interest for a five-year period (May 2016 – May 2021). This supports AGRHYMET's work to undertake a detailed evaluation of water resource availability based on high resolution EO data.

Due to high cloud cover for certain months, the service for the two areas of interest in Ghana and Burkina Faso/Niger is to be modified to be a radar-based surface water and surface soil moisture monitoring service. Mapping and monitoring water resources over an extended time period and at high spatial resolution and frequency, allows AGRHYMET to complete detailed trend analyses of changes to water bodies on seasonal, annual and longer time intervals. The soil moisture datasets are especially important to detect of droughts.

EO information of this sort is of importance to the region as it can inform decision making relating to local agriculture, water supply management, and food security among other things. It also allows AGRHYMET to identify focus areas for intervention in order to achieve sustainable management of precious water resources.
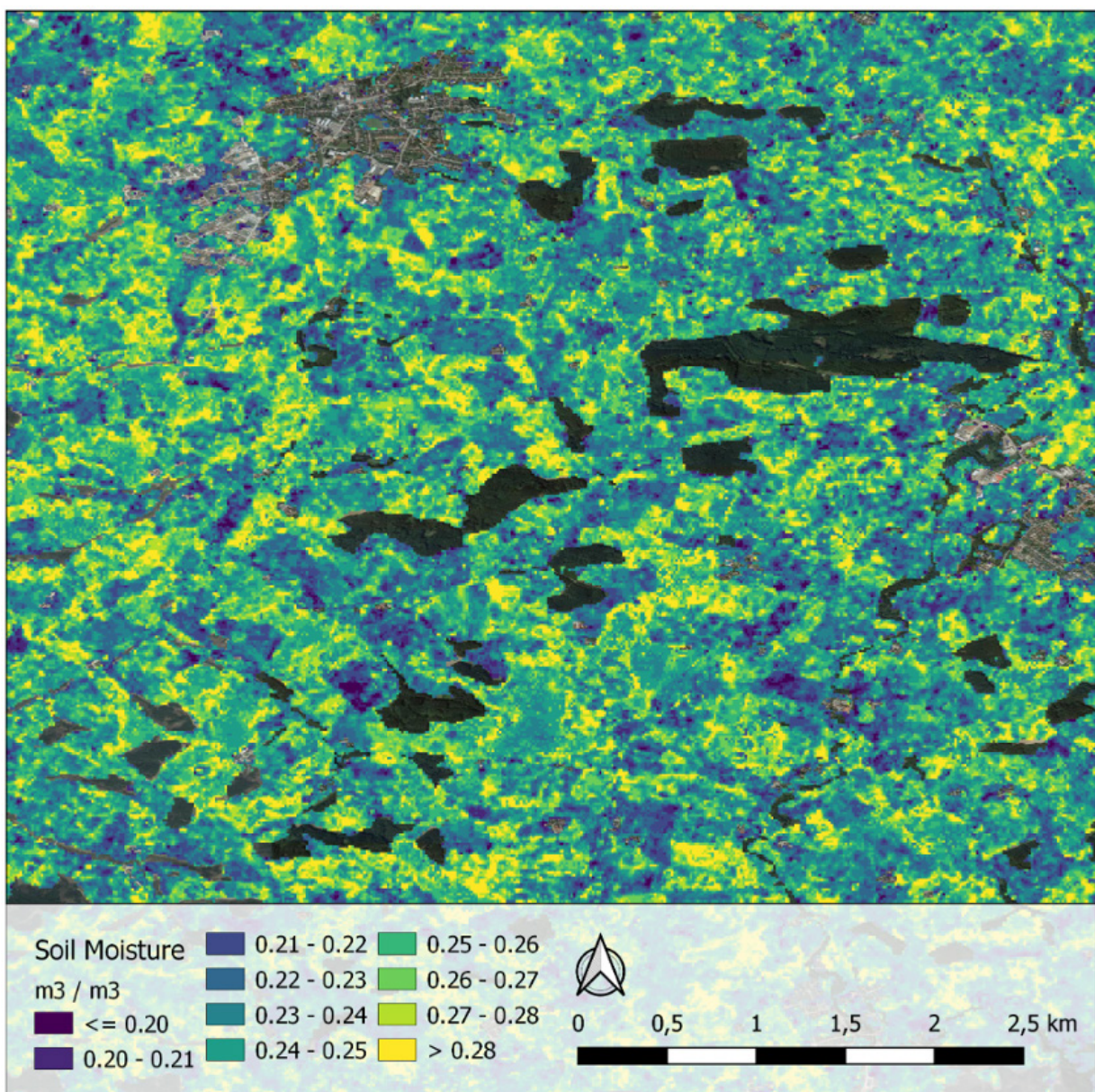

Image 3 High resolution surface soil moisture map based on Sentinel-1. Source: GeoVille

5. CAPACITY BUILDING

Alongside the EO service provision, the EO4SD Climate Resilience Cluster delivers capacity building support to foster the sustained uptake of EO-based data and services by IFIs and Client States to support climate change resilience. The goal of the capacity building is to enable the sustainable and autonomous application and use of the provided services and data.

Led by the National Observatory of Athens' Centre of Excellence BEYOND with support from EO4SD Climate Resilience Cluster partners GMV, Acclimatise, Telespazio VEGA UK and GeoVille, the capacity building activities provide both targeted support through practical training, and awareness raising and knowledge transfer through online courses and webinars.

AGRHYMET already has strong competence in GIS and using remotely sensed data, but faces challenges in executing optimised data processing chains for extracting required EO data layers and processing optical and radar imagery. The EO4SD CR cluster is therefore providing targeted capacity building activities to increase the capability of the AGRHYMET GIS and remote sensing teams to process EO data.

In addition to targeted support and training, the EO4SD Climate Resilience Cluster has also delivered a webinar series to raise awareness, acceptance and understanding of EO-based information services and the associated benefits, impacts and usefulness with regard to the specific priorities of the stakeholders.

The seven-part webinar series, delivered in June and July 2020, is aimed at all those interested in developing a foundational knowledge of EO and how it can be applied practically in the context of climate-resilience projects and programmes.

The series draws on the EO4SD Climate Resilience Cluster's experience working with IFIs including the Asian Development Bank, The World Bank, the International Finance Corporation, Africa Risk Capacity and the European Bank for Reconstruction and Development, to provide 'hands-on' sessions and guided tutorials for existing climate resilience platforms.

Over the course of the series, participants learned the basics of EO data in the context of climate resilience; how, why and when to use EO data to inform decision making,; how to applying EO data to manage key climate risks including flooding and drought; and practical skills about accessing and using EO data tools and platforms.

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Cover image: Map of the Water and Wetness Probability Index for the
Inner Niger Delta (2017-2019)