

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



EO - Flood Watch

GMES - CSSTE Consortium Newsletter



Volume 2, No 1. August, 2021

Message from the Consortium Lead



Welcome to this edition of the CSSTE Consortium Newsletter – EO-Flood Watch. A resource for regional efforts on Flood Monitoring, Management and Assessment. This edition is dedicated to providing in-depth information on some of our Product and Services as promised in the maiden edition. Under the Action of Multiscale

Flood Monitoring and Assessment Services for West Africa (MiFMASS), there are five (5) Products and Services namely; Capacity Building, Flood Forecast, Damage Assessment, Updatable Flood Event database and Flood Mitigation & Management. The Consortium which is made up of seven (7) Partners spread across five (5) West African Countries - Nigeria, Benin, Ghana, Burkina Faso, and Cote d'Ivoire worked together as a team to deliver on the aforementioned Services. Despite the challenges and restrictions that the Covid-19 Pandemic has inflicted on our World today, the Consortium found ways to rise above these issues to ensure it contributes its quota to the regional efforts of combating the menace of Flooding. CSSTE Consortium is one of the 12 Consortia of the Global Monitoring for Environment and Security and Africa (GMES & Africa)

support programme - a joint initiative of the African Union (AU) and the European Union (EU) targeted at using Earth Observation data (Satellite data) to tackle existing challenges in Africa, by Africans and for Africa.

One of the areas in which there was notable positive impact despite the pandemic is the area of Capacity building. The restrictions of Covid necessitated the development of an E-learning platform to conduct the trainings and it resulted in training more people across more countries than earlier planned.

Through the joint generosity of the African Union (AU) and European Union (EU), an e-station was donated to CSSTE to give free and direct access to Earth Observation data from a number of satellites as part of the GMES & Africa Support programme. Recently, the Ground-station (Antennae) was installed and the e-Station set up, all thanks to the following organisations; EU Joint Research Centre (JRC), EUMETSAT, Telespazio and the EU Commission. This means easy access to a range of data that can be used for Environment, Crop monitoring, Agriculture, Health and so much more.

So sit back and enjoy this copy of the newsletter and we would love to have your feedback.

Happy Reading!

CAPACITY BUILDING: Empowering National Experts for More

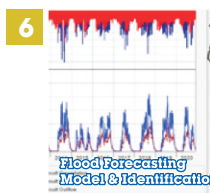
by: Ms. Funmi Shonubi (CSSTE)

Training is one of the four (4) pillars that the GMES & Africa Support programme is built upon with the aim of enhancing the capacity of a critical mass of experts in Africa on the use of Earth Observation (EO) data to improve the realization of institutional mandates and targets. In the case of the CSSTE Consortium, Capacity development is a major component of the Multi-scale Flood Monitoring and Assessment Services for West Africa (MiFMASS) project. The focus is on building and enhancing capacity for Flood Monitoring, Management and Assessment in West Africa through tailored and specialized trainings. This is to ensure the capacity development of both Partners and Stakeholders involved in the project and to deliver on the proposed improvements on how Flooding



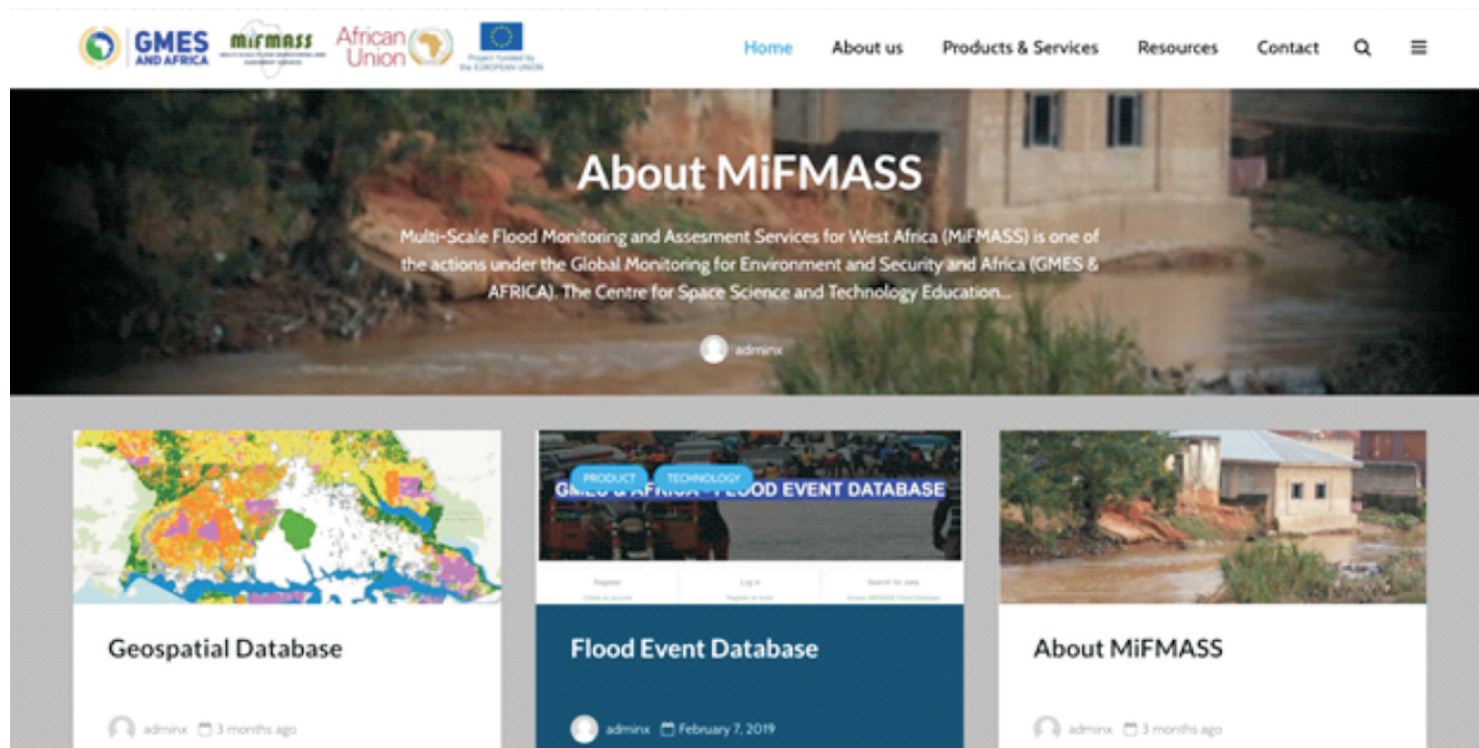
Fig. 1: E-Learning Platform developed for online trainings
- <https://elearn.arcsstee.org.ng/>

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UPDATABLE REGIONAL FLOOD EVENT DATABASE - A NOVEL PRODUCT OF THE CSSTE CONSORTIUM

by: Ms. Funmi Shonubi (CSSTE), Dr Jean Danumah (CURAT) & Ms. Sylviah Amponsah (CSIR)

The Updatable Flood Event Database developed under MIFMASS is one of the Products delivered by the CSSTE Consortium for West Africa through the GMES & Africa Support Programme. This database will enable mitigation of effects of flood disasters as well as enhance the capacity of relevant Disaster Management Organizations (DMOs) in fulfilling their mandates using Earth Observation data. This product is a novel tool that will be very useful for Decision making, Research and

range from the geographical location, the type of disaster (e.g., riverine or flash flood), casualties and the damage in physical and economic terms. This database can aid in the identification of hotspots and implementation of targeted interventions across the countries of interest. It can also assist in developing flood vulnerability maps using spatial layers of factors that may contribute to the occurrence of floods. This product will be handed over to the National Disaster Management organizations (DMOs) across West Africa by the end of the GMES & Africa programme to ensure sustainability.

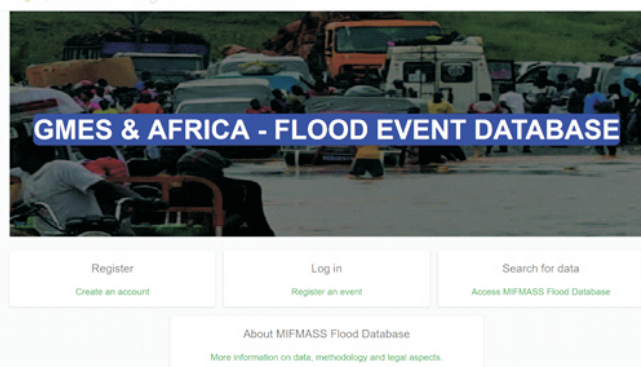


Figure 1: Landing page of the database interface

Disaster management in the West Africa sub-region. It is designed to be a one-stop shop for regional data on flood events. As we know, the attendant losses that follow from disasters does not stop at the socio-economic and infrastructural level but also has very huge impact on human lives. Therefore, the existence of a record database that captures the quantitative and qualitative extent of a flood event is a great tool for DMOs, governments and international organizations in providing impactful support to affected areas in the event of a disaster. The records

The Database was developed by three (3) Partner organizations of the Consortium- Council for Scientific and Industrial Research (CSIR), Ghana; Centre for Space Science and Technology Education (CSSTE), Nigeria and; Centre Universitaire de Recherche et d'Application en Teledetection (CURAT). CSIR handled 'Overview of existing Database'. CSSTE developed the Database Architecture while CURAT finalized the Database development. In this article, Flood Event data refers to data on flood disasters such as those recorded in disaster databases which include number of people killed/ injured/ rendered homeless; properties damaged; estimated damage costs; etc.

The Overview of Existing Database carried out by CSIR was done through desk study and interviews with the DMOs in the Partner countries (Benin, Ghana, Nigeria, Burkina Faso and Cote D'Ivoire). The desk study included online search of global disaster databases and literature related to flood/disaster events.

This resulted in the collection of available flood event data for the five countries from three global databases (Emergency Disasters Database - EM-DAT, Disaster Inventory System - DesInventar, and Global Disaster Identifier Number - GLIDE). A review of existing data collection and archiving methods amongst DMOs was carried out by visiting the various organisations in Partner countries to get a first-hand feel of how things are being done. Interviews of relevant DMO's

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CAPACITY BUILDING: Empowering National Experts for More

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events are managed and monitored. It will also create a new breed of experts adept at using Earth Observation (EO) data to create products and services to meet peculiar needs of the region. That is using EO for the "Africa We Want" by Africans.

At the onset of the GMES & Africa programme, an EO Training Needs Assessment exercise was carried out involving relevant institutions in order to identify the areas of knowledge and skills gap. The Consortium designed its training programme under two categories; Long and Short term trainings.

The Long term training is at the Postgraduate level (MSc.). A total of six (6) Students across five (5) ECOWAS countries were awarded scholarship by the Consortium under the GMES & Africa Programme. The scholarships were based on the quality of proposal submitted in relevance to the MiFMASS project. The names of the students sponsored for MSc. from the participating countries are:

1. Fofie Kouadio Maizan Guy Laurent – CURAT, Cote D'Ivoire
2. Ms. Yeboah felicia - University of Ghana, Ghana
3. Pelagie YAMEOGO – ISESTEL, Burkina Faso
4. Ebijuworih, Etari Joy- CSSTE, Nigeria
5. Aderunboye, Kehinde – CSSTE, Nigeria
6. Houinato Marjoël – INE, Benin Republic



Fig. 2: Meet the CSSTE Consortium Msc. Scholars.

Five (5) tailored Short term trainings were initially identified by the Consortium, two more were requested by Partners to bring it to a total of seven (7) as respectively shown in table below.

Table: List of Short Term Trainings by the Consortium

SN	DATE/VENUE	TITLE (STATUS)	NO. OF TRAINEES
1	26 th -28 th November, 2019 (Benin Republic)	Flood Database Management (Completed)	26
2	18 th – 19 th August, 2020 (Online)	Acquisition and Use of Sentinel 1, 2, 3 Data: Processing and Application (Completed)	62
3	23 rd – 25 th February, 2021 (Online)	API Development and Usage for Dissemination of Data-Products and Services (Interfacing services into Information on Mobile Applications, Mail and SMS Diffusion Systems) (Completed)	112
4	9 th – 11 th February, 2021 (Online)	Flood Monitoring and Forecasting Modelling (Completed)	97
5	20 th – 22 nd April, 2021 (Online)	Acquisition and Processing of Drone Data and Application (Completed)	86
6	Yet to be determined	Training on E-Station Installation, Operations and Troubleshooting (Outstanding)	
7	Yet to be determined	Training on Technique for Sharing, Validating and Dissemination of Products (Outstanding)	

Due to the Global pandemic, the trainings had to be redesigned and moved online as opposed to delivering them across Partner countries in the normal face-to-face classroom style. The Consortium developed a customized e-learning platform as shown in fig.1.

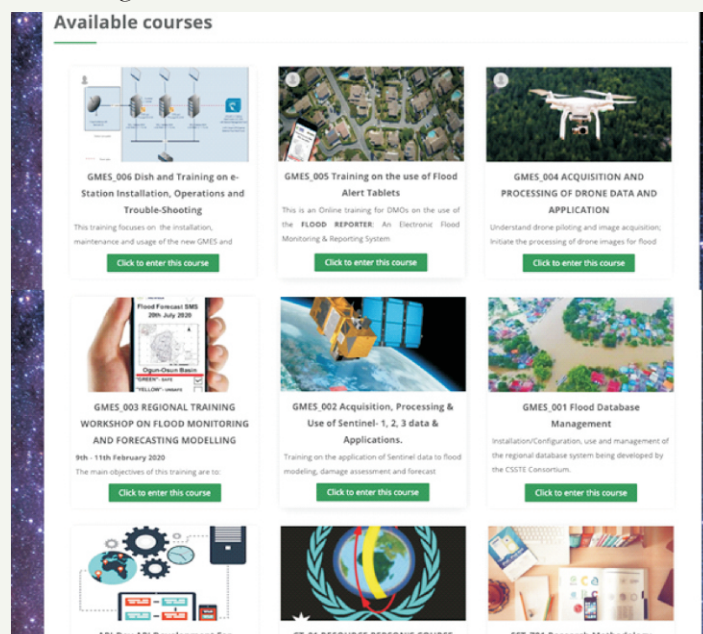


Fig. 3: Some of the Courses already onboarded on the E-learning Platform

Despite the difficulties the Covid-19 pandemic has caused many lives, the Consortium was able to use it positively by impacting more people across more countries through the online training. The trainings were held across the 5 partner countries concurrently. From Table 1, you would observe that the training with the lowest number of participants was the on-site one, all others are higher.

Members of the Consortium have also benefitted from specialized trainings organized by AUC such as:

- I. Monitoring and Evaluation Training, Tunis, 19-21 Feb., 2019
- II. Land Services Design Workshop, Ispra, Italy 18-29 Mar., 2019
- III. Grants Management training, Dakar, Senegal, 6-10 May, 2019
- IV. Cloud computing training, Morocco, 11-15 Nov., 2019
- V. Communication Training, Addis Ababa, 9-12 Mar., 2020

See below distribution of participants at some of the trainings across countries and by gender.

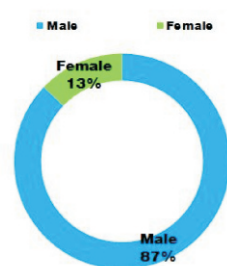


Fig. 4: Gender Distribution of Participants at the Regional training on Acquisition and use of Sentinel 1,2,3 Data

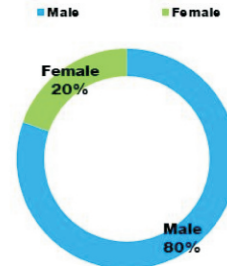


Fig. 5: Gender Distribution of Participants at the Regional training on Flood Monitoring and Forecast Modelling

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Geospatial Database Development

by: Ms. Funmi Shonubi (CSSTE) & Dr Jean Danumah (CURAT)

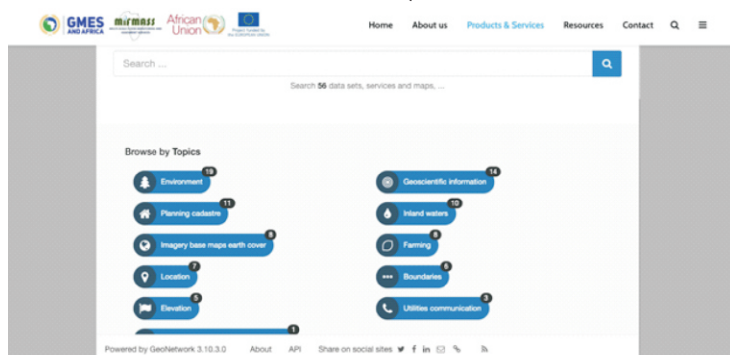


Fig 1: Landing page of the MIFMASS Geospatial Database where you can browse by Topics

A Geospatial Database (GD) is a goldmine resource of information that can be harnessed by the government, industry and private organizations across various sectors for the purpose of making informed decisions. Geospatial Data is information about an event, object or feature with location attached to it. That is why the MIFMASS Geospatial Database developed by the CSSTE Consortium under the GMES & Africa Programme for Flood Monitoring and Assessment is of great usefulness to Disaster Management Organizations (DMOs) and Governments in West Africa. The Consortium has developed a complete online database for all the spatial layers downloaded, pre-processed and generated in the framework of the MIFMASS project which covers certain river basins in - Ghana, Benin, Nigeria, Cote D'Ivoire and Burkina Faso and can be assessed on www.gmes-mifmass.net. The GD was developed by four (4) Partners of the Consortium namely; Centre for Space Science and Technology Education (CSSTE)-Nigeria, Volta Basin Authority (VBA)- Burkina Faso, University of Ghana (UG), Ghana and Centre Universitaire de Recherche et d'Application en Teledection (CURAT), Cote D'ivoire.

The Geospatial Database will enable speedy and efficient decisions during a disaster emergency response. Beyond that, it is useful for Disaster risk mapping and the whole Disaster management cycle. It has different spatial layers like basin boundaries, Geology, Drainage networks, Transportation/Road Network, Soil, Topography, Land use/Land cover and so on.

The development of the MIFMASS Geospatial database for Flood Damage Assessment includes development of identified and relevant but readily unavailable geospatial layers, data and metadata collection, Vector data analysis. It also involves the preparation of the technological environment, customization of the Geonetwork interface, charging data in PostgreSQL/PostGIS, Styling layers in Geoserver and creation of data presentation sheets.

For the purpose of the countries and study sites covered, relevant and useful sources of satellite were identified. They are Radar Radar Images Sentinel 1A, 1B, Optical Image Sentinel 2A, 2B and ALOS DEM with 12.5m resolution. Copernicus and USGS glovis were used to identify all satellite images needed for the Partner countries: Cote d'Ivoire, Benin, Ghana and Burkina and Nigeria. In order to ensure that all EO data identified are downloaded from portals that grant open access to EO data, an automated data download and pre-processing routines were developed of EO related datasets. The satellite image database was thus created and made available for generation of relevant Geospatial layers.

a) **Catchment or Basin Boundary Delineation:**

b) **Landcover/Landuse:**

i. **Road Network**

ii. **Hydrography** (stream/stream order, rivers, surface water body). This is fundamental as the work is entirely a riverine flood mapping and assessment.

iii. **Settlement Layer** (cities, localities, settlements, towns, etc.).

c) **Geomorphology/Pedology Layers:** These include majorly GIS shapefiles of Soil and Geological formations.

d) **Terrain features:**

e) **Rainfall Layer.**

f) **Optional layer like Critical infrastructure**

The geospatial layers collated for the five basins were processed using ArcGIS 10.4.1 to assess quality and degree of completeness.

Having generated the Geospatial layers, a cloud-based Linux server was provisioned to host the system which comprises of different open access Technologies (Fig. 2).

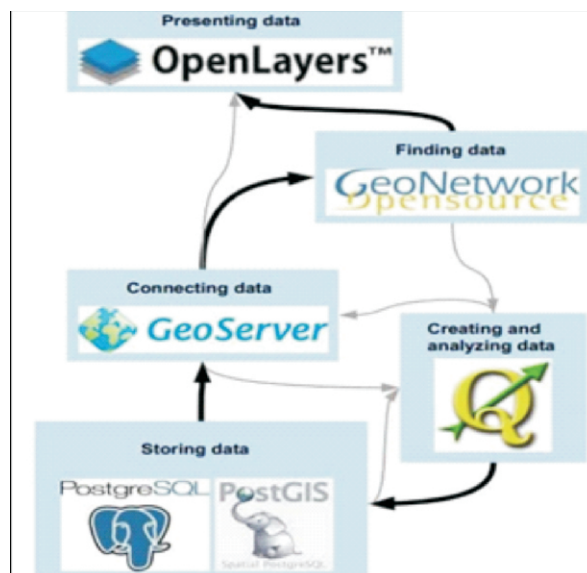


Fig. 2: The Cloud-based Geo-database comprises of different Technologies

The following technologies were employed:

- QGIS: GIS software
- Geoserver: Map server for sharing, modifying and publishing geographic data;
- PostGIS/PostgreSQL: A PostgreSQL database server for the storage of geographical data; it also supports updating the database.
- Geonetwork: a catalog application for the management of spatially referenced resources. It offers powerful metadata editing and search functions, as well as an integrated interactive web map viewer.

For data visualization, end users have possibilities to create a free account and have access to database. In addition to visualization, there is the ability to edit maps and export to png and pdf formats. As a result, the database created in PostgreSQL/PostGIS gives the possibility of updating, this will enable the DMOs and other relevant government agencies who will take over the management of this service to continue to update the database. Some organizations have been trained across the five (5) West African Partner countries on the development of this service to ensure continuity.



Fig. 3: Topic Search view of the Geospatial Database Catalogue

Recently, a EUMETSAT e-station (EUMETCSAT) was installed at CSSTE, thanks to EUMETSAT, African Union, European Union, Joint Research Centre (JRC) and Telespazio, additional range of EO products have been available in different categories - vegetation, rainfall, inland water and miscellaneous to make MIFMASS more robust.

In conclusion, it is our hope that Governments and organizations in the ECOWAS region will rise up to the occasion and make good use of this tool that has been developed for the ease of governance and decision making on Disasters.

UPDATABLE REGIONAL FLOOD EVENT DATABASE - A NOVEL PRODUCT OF THE CSSTE CONSORTIUM Contd.

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officers were conducted at the National level of the five countries, via country visits for the purposes of validating country specific online data/information gathered and for collecting additional data. This was followed by collation of all available historical data from these National institutions which were obtained in a traditional way - Newspaper clippings and manual excel sheet entries. In addition, the templates for flood data collection by the DMOs were obtained for all the project countries. The collated historic data as well as the templates for flood data collection were shared with Partners responsible for the development of the database architectural design and the database system, respectively.

The Database Architecture design by CSSTE utilized open source tools and libraries for all the development; PostgreSQL/POSTGIS for database engine, Geoserver for web mapping, Geonetwork, open-layers and their dependencies. A three (3) tier architecture was adopted for this database while an entity relationship (ER) modeling was adopted for data modeling. The 3-tier architecture (see Fig. 2) for enterprise systems supports easy maintenance, improves security and efficiency. The templates obtained by CSIR during the Overview were analyzed to arrive

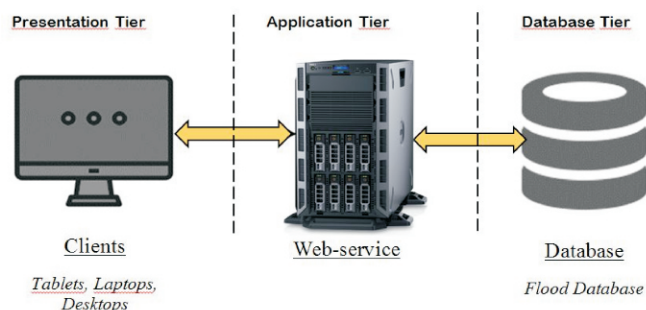


Fig 2: A Typical Three Tier Architecture

at a set of entities and attributes (data-items) for the purpose of capturing flood events into the database.

CURAT was responsible for the installation of software and infrastructure necessary for database development, recovery of prerequisites and implementation of the database that has created a system that integrates together respective national databases of Partner countries into a regional database. The recovery of prerequisites was done by GPS Data collection from field campaign, extracting information from sentinel images and digitizing existing paper documents. The database has been designed as an online system that mirrors the national databases and permit population, basin authorities and other cross-border agencies to have regional overviews of flood events over the years and proffer regional scale solutions. The flood event database Geoportal is a fully functional updatable online system that provides past and present information on flood events in the five Partner countries of the CSSTE consortium.

The updatable database allows for continuous update of information on the platform via various means: crowd-sourced data and data professionally collected by the National mandated organizations that the service will eventually be domiciled with. The database captures the timing, location, characteristics and assessment of damages caused by a particular flood event. The web interface also allows for visualization and downloads of the flood events (See Figure 2). The Consortium has already trained personnel from these organizations to build the capacity needed to maintain and operate the database. The database which is currently undergoing quality assessments will be one of the products accessible through the GMES-MIFMASS geoportal of the CSSTE Consortium.

The five (5) participating countries have DMOs that are responsible for the collection and management of flood disaster data among other

responsibilities. However, none of the countries have a flood event database or a database system. The availability of data and human capacity, the strong interest of national DMOs to establish national flood database system, the responsibility of regional institutions to support countries with flood management including support for flood data management, among others, provide strong incentive to establish a regional flood event database system for West Africa. To ensure continuity and also create a sense of ownership is why the Consortium

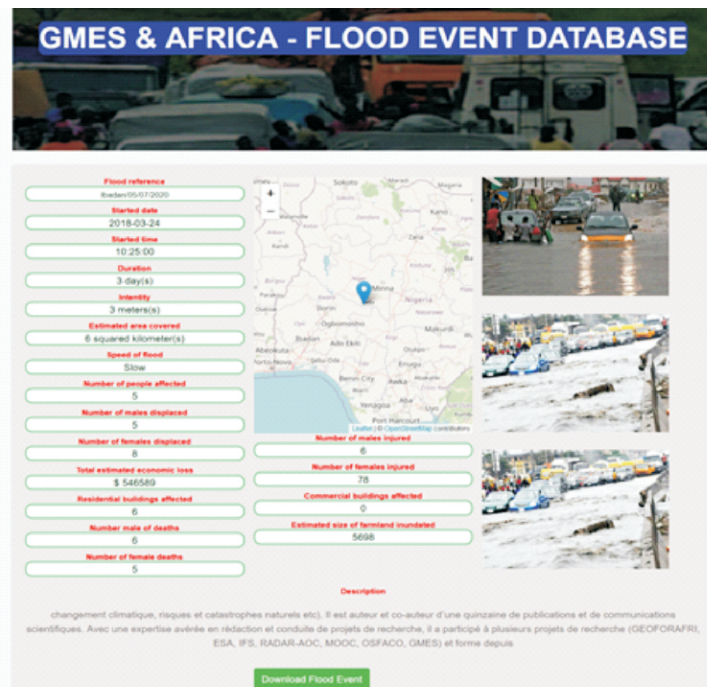


Figure 3: Sample search result for a Flood Event from the Database

has been working with National Disaster Management organizations (DMOs) across the West Africa region to keep the Updatable Flood Event Database platform relevant even after the GMES & Africa programme life span.

In conclusion, the benefits of having a Regional Updatable Flood Event Database for the ECOWAS region is priceless as its usefulness ranges from aiding disaster risk reduction policies at national level, mitigating socio-economic problems that arise from flood disasters to planning and putting in place mitigation strategies functional for a particular city or country. It also engenders cross- agency or country collaboration and ease of data sharing within the region. In the words of Petra Nemcova (Year?) *"We cannot stop natural disasters but we can arm ourselves with knowledge: so many lives wouldn't have to be lost if there was enough disaster preparedness"*



Figure 4: Location of MiFMASS project countries (shaded in green) in West Africa

Set up of Flood Forecasting Model and Identification of Flood Hotspots

by: Dr. Djigbo Felicien Badou (INE)

If extreme flood events cannot be prevented, a better understanding of the risks posed by such events is the first stage in building the resilience of the community. The analysis of the flood-prone area associated with flooding produces knowledge about the hazard and the vulnerability of the population at risk. This passes through the identification and mapping of vulnerable areas which in turn requires food extent modeling.

As part of the MifMASS project, the National Institute of Water (INE) set up the HEC-HMS (hydrological model) and HEC-RAS (hydraulic model) for selected basins of the five countries. These are the Ouémé River basin (49,256 km² Benin), Bagré dam basin (Burkina-Faso), Rivera basin (Côte d'Ivoire), the Black Volta basin (156,798 km², Ghana) and the Ogun-Ona River Basin (23,000 km², Nigeria). Satellite and ground data (CLIMATESERV, Sentinel 2, etc.) were used for the task. The outputs of the HEC-HMS were used as inputs of the HEC-RAS model to derive flood extent and flood hotspots for the five basins.

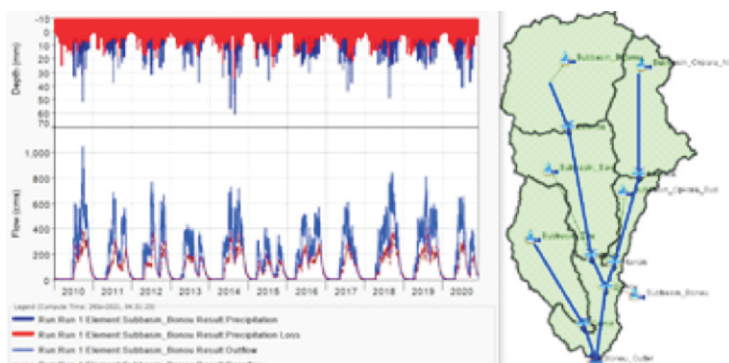


Fig.: Hydrological process of Oueme river basin (Benin)

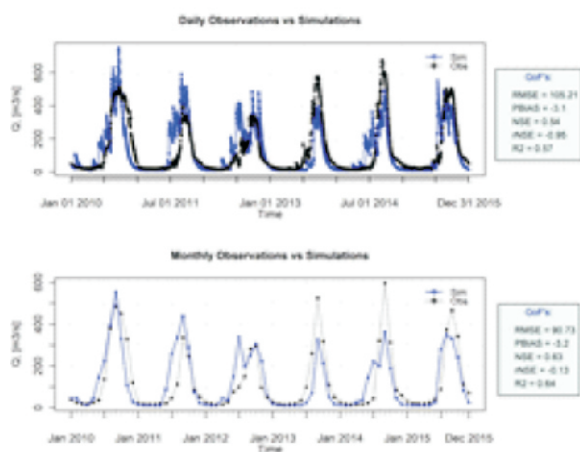


Fig. 2: Flows calibration at Lawra in Black Volta basin (Ghana)

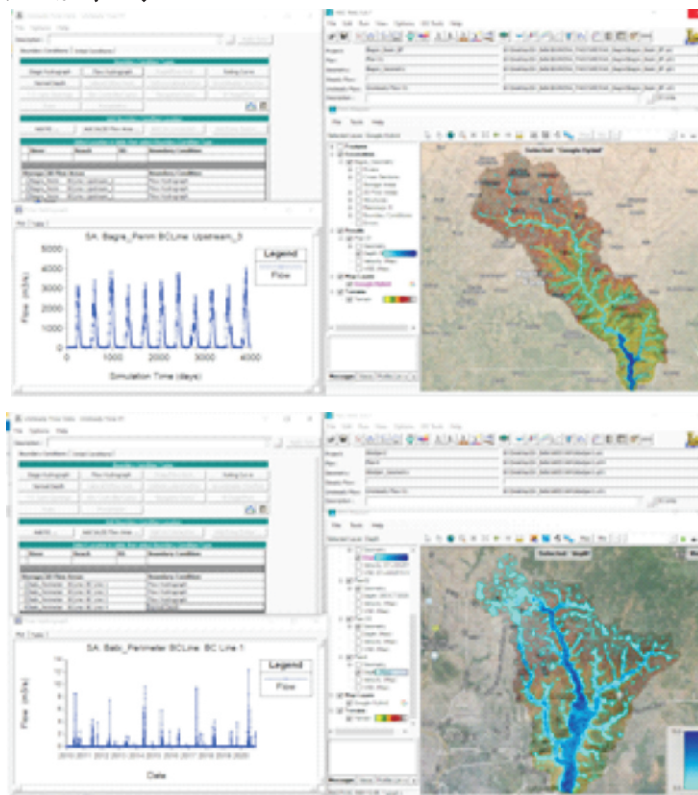


Fig. 3: HEC-RAS Model setup for Bagre Basin in Burkina-Faso (left) and Rivera Basin in Abidjan, Côte-d'Ivoire (right)

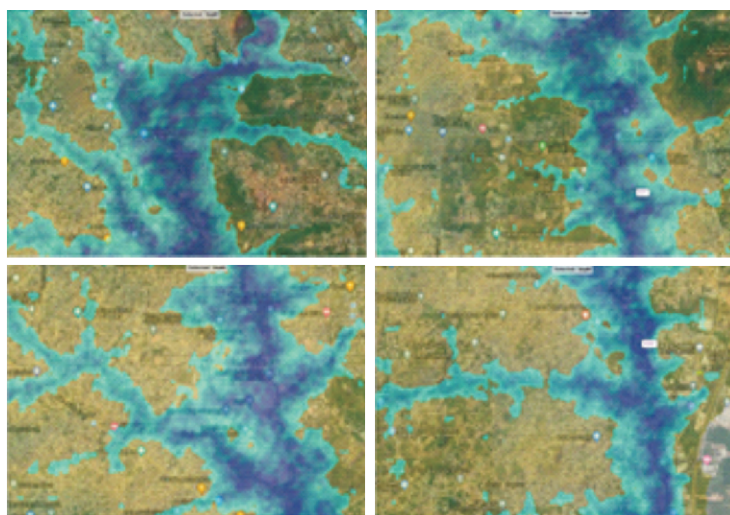
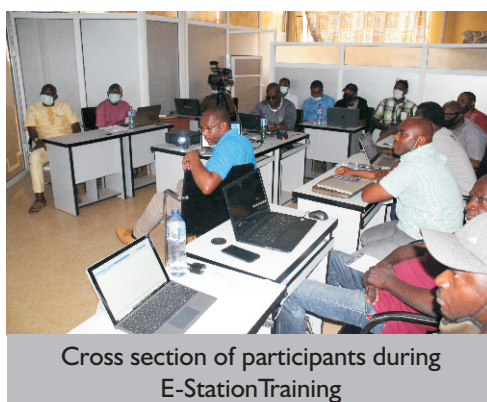


Fig. 4: Flood extent map in Ogun-Ona River Basin (project site in Nigeria)

Photo Speak



Newly installed 2.4m VSAT Antenna



Cross section of participants during E-Station Training



A group photograph of the Director, CSSTE with some participants during the VSAT Installation

CAPACITY BUILDING: Empowering National Experts for More

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Fig. 6: Distribution of Participants by Country and Gender for Flood Database Management training, 26 - 28 November, 2019

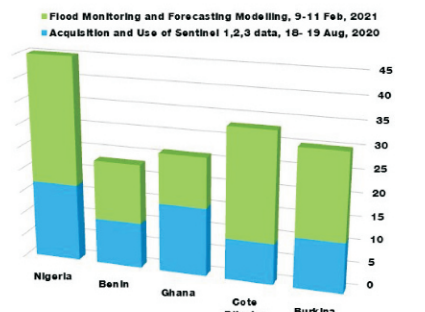


Fig. 7: Participation by Country for Flood Monitoring training and Acquisition & Use of Sentinel Data Training

For the trainings that have held, the set objectives achieved are as follows:

1. Flood Database Management

- Enhance the capability of stakeholders and CSSTE-Consortium technical personnel on the regional flood database Management System within the West Africa sub-region, and;
- Stimulate sense of ownership, amongst the stakeholders.

2. Acquisition and Use of Sentinel 1, 2 & 3 Data: Processing and Application

- Understand and undergo detailed Hands-on training on Copernicus data
- Understand the use of Sentinel data product for Flood Monitoring and Management
- Understand the use of SNAP platform in Flood Monitoring

3. API Development and Usage for Dissemination of Data-products and Services

- Understand the concept and application of APIs for disseminating online data products and services.
- Master the development of APIs for web-based software systems and databases through a hands-on training.
- Master the process of consuming data products and online services with third-party applications through APIs.

4. Flood Monitoring and Forecasting Modelling

- Introduce the participants into hydrological and hydraulic modeling;
- Identify flood-hotspot areas in order to make a quick flood damage assessment;
- Develop a flood monitoring and forecast model.

5. Acquisition and Processing of Drone Data and Application:

- Understand drone piloting and image acquisition;
- Initiate the processing of drone images for flood monitoring and management;
- Use the products resulting from the processing of drone images for flood monitoring and management.

Through these trainings, participants from the following organizations in ECOWAS have benefitted:

Benin

- DGEau (Benin Water Directorate)
- Agence Nationale de la Protection Civile (ANPC) - Benin Civil Protection Agency, Cotonou, Bénin
- Institut de Géographie, de l'Aménagement du Territoire et Environnement (IGATE)/ Institute of Geography, Regional Planning and Environment.

Cote d'Ivoire

- Ministry of Environment and Sustainable Development (MINEDD)
- Disaster Risk Reduction (DRR)
- SODEXAM
- Ministry of Sanitation and Healthiness
- National Office of Civil Protection (ONPC)
- Cocody Municipality or town hall
- National Office of Sanitation and Drainage (ONAD)

Nigeria

- NIHSA: Nigeria Hydrological Services Agency
- NEMA: National Emergency Management Agency
- NIMET: Nigerian Meteorological Agency
- Federal Ministry of Environment

Burkina Faso

- National Observatory of Sustainable Development / ONDD (SP-CNDD)
- Ministry of Agriculture (MAAH)
- National Society of Electricity SONABEL

Ghana

- Water Resources Commission (WRC)
- Hydrological Services Department (HSD)
- University of Ghana
- National Disaster Management Organisation (NADMO)
- Ghana Meteorological Agency
- Community Water and Sanitation Agency

The statistics depicted earlier above shows to an extent the impact of the capacity building efforts of the Consortium on Flood Monitoring, Management and its Assessment. It is hoped that the beneficiaries of these trainings will continue carrying the torch of this newly acquired skills and fan the flames of knowledge sharing.

Photo Speak



Participants during the Flood Monitoring and Forecasting Online Training, CURAT



Cross section of participants during the Flood Monitoring and Forecasting Training, Abidjan



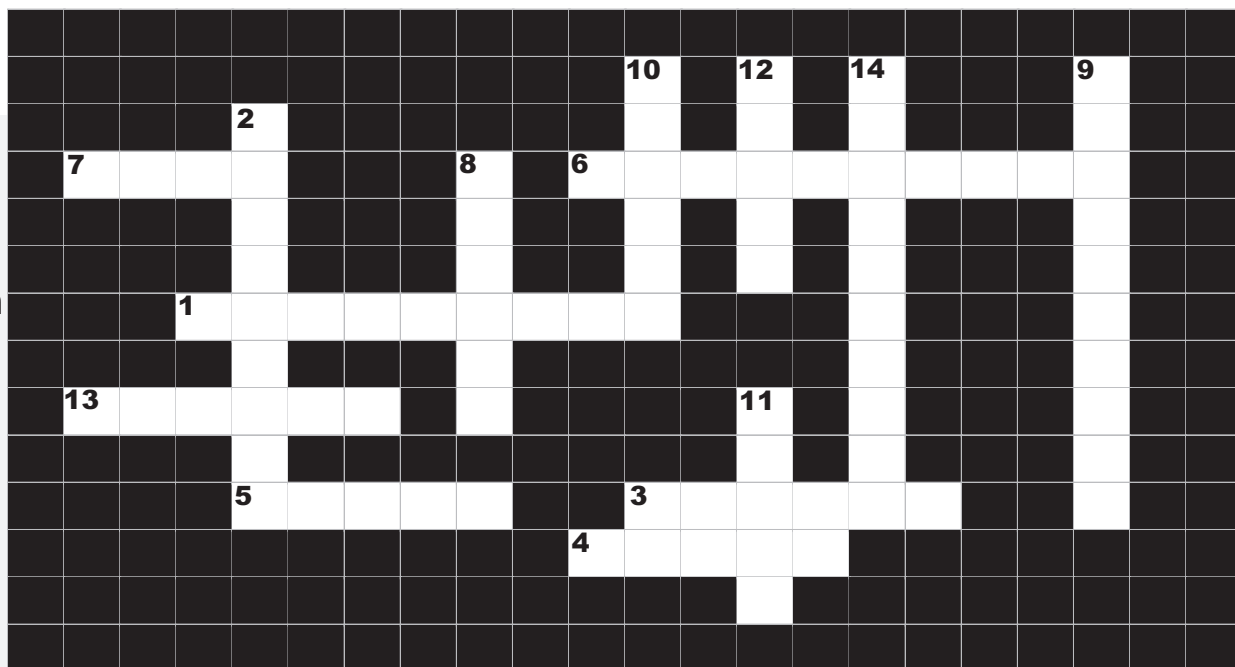
Participants during the Flood Monitoring and Forecasting Online Training, INE, Benin.



Cross section of participants during the Flood Monitoring and Forecasting Training, INE, Benin

Last Puzzle Answers

1. Orbit
2. Moon
3. Gravity
4. Mars
5. Constellation
6. Astronaut
7. Mercury
8. Orbiter
9. Horizon
10. Axis
11. Solar
12. Spectrum



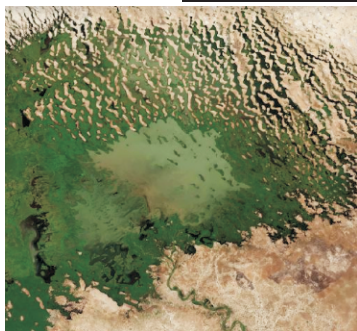
ACROSS

1. What is the study of stars called?
3. A dwarf planet with two moons
4. Which is the only planet not named after a Greek god or goddess?
5. How many minutes does it take the sun's ray to reach the earth?
6. What are asteroids also referred to?
7. What color is Mars' sunset?
13. What is the sun's outermost atmosphere called?

DOWN

2. An instrument used for seeing stars and planets clearly.
8. Which is the planet that rotates on its side?
9. The coldest layer of the atmosphere.
10. What do you call a large group of stars, dust and gas?
11. What planet is no longer on our solar system?
12. Which is the hottest planet in our solar system?
14. A person who loves stars

Do you know that



The objective of Sentinel-2 is land monitoring, which is composed of two polar-orbiting satellites providing high-resolution optical imagery. Vegetation, soil and coastal areas are among the monitoring objectives. The Sentinel-2A satellite was launched on 23rd June 2015, while Sentinel-2B satellite was launched on March 7th 2017. (Ref. Missions - Sentinel Online - Sentinel (esa.int)).

"Satellite image of Lake Chad on 31 October 2018 by the Copernicus Sentinel-2A satellite"
(Ref. https://www.esa.int/ESA_Multimedia/Images/2019/03/Lake_Chad_s_shrinking_waters#.YJqAoYqsm84.link)

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Useful Links of Partners

COPERNICUS: www.copernicus.eu

GMES blog: www.gmes4africa.blogspot.com

CSIR WRI: www.wri.csir.org.gh

UG: www.ug.edu.gh

CURAT: www.curat-edu.org

https://web.facebook.com/GMES_MIFMASS_C%3CB4te-dIvoire-107852551169484

<https://www.linkedin.com/company/curatciv/>

Useful Links of Stakeholders

WRC: www.wrc-gh.org

ONPC: www.onpc-ci.org

NEMA: <https://nema.gov.ng/>

HSD: www.mwh.gov.gh

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