Volta Flood and Drought Management

ADAPTATION FUND

INTEGRATING FLOOD AND DROUGHT MANAGEMENT AND EARLY WARNING FOR CLIMATE CHANGE ADAPTATION IN THE VOLTA BASIN PROJET (VFDM)

STAKEHOLDERS CONSULATION IN THE DISSEMINATION OF FLOOD AND DROUGHT EARLY WARNING INFORMATION IN THE PILOT SITES OF GHANA

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EXECUTING PARTNERS

WORLD METEOROLOGICAL ORGANIZATION

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Global Water Partnership West Africa

Volta Flood and Drought Management

Table of Contents

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1 Introduction

The World Meteorological Organization - WMO (a specialized agency of the United Nations), the Volta Basin Authority (VBA), and the Global Water Partnership in West Africa (GWP-WA) have been implementing the Project entitled ***"Integrating Flood and Drought Management and Early Warning for Climate Change Adaptation in the Volta Basin."*** The activities of the project began in June 2019 and will end in mid-2023. As part of the implementation of this project, the three implementing partners have developed the VOLTALARM platform with the technical support of the CIMA Foundation. This platform is an early warning system on flood and drought.

In the Volta Basin, ten (10) pilot sites were selected to test the application and effectiveness of the VOLTALARM early warning system in areas highly exposed to hydro-meteorological hazards such as flood and drought. To properly evaluate dissemination of early warning information at these sites, a consultative process was undertaken at these sites. In Ghana, the chosen sites were the Upper East Region and Akosombo Dam. Figure 1 below displays the selected sites in all the member states of the Volta Basin.

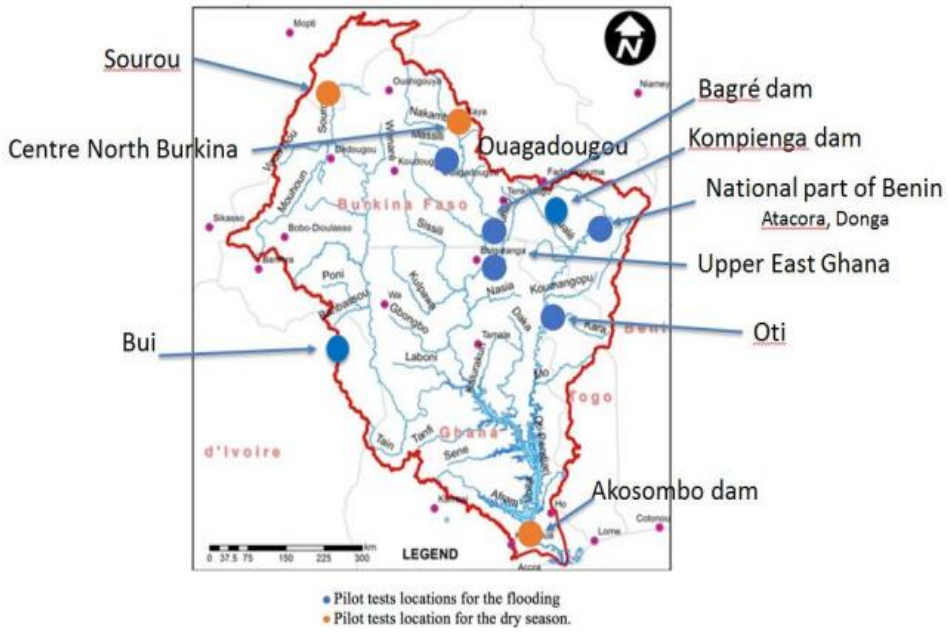

Figure 1: Geographic location of the selected pilot sites

1.1 Objectives of the consultation

Consultations were undertaken in the selected pilot sites of Ghana. The objectives of the consultation were the following;

a) To identify stakeholders at the national, regional, and community level involved in the early warning services;

b) To identify the institutional arrangements and stakeholders responsible for disseminating early warning information to the selected sites and population;
c) To Identify gaps, challenges, and needs in effective dissemination of early warning information and examine the feedback from to the impacted people;
d) To propose recommendations taking into account the existing and the improvements to be made for effective dissemination of the early warnings.

2 Methodology

The consultative process to understand the systems in place with dissemination of early warning information and chain of actions undertaken had three approaches. The first was a national consultative engagement with representatives from identified stakeholder institutions such as the Hydrological Service Department (HSD), Ghana Meteorological Agency (GMet), National Disaster Management Organisation (NADMO), Water Resources Commission (WRC), Water Research Institute (WRI), Local Government Service, and Volta River Authority (VRA).

The next level of approach was with the regional and district stakeholders such as NADMO, District Assemblies, Media and NGOs. This engagement took place in the Upper East Region at the Learning Centre of the Water Resources Commission in Bolgatanga. The districts engaged were Bawku Municipal, Bawku West, Binduri, Talensi, and Nabdam Districts. These districts were chosen because they are the most severely affected by flood in the Upper East Region.

The final engagement was with two selected communities situated in the districts of the Upper East Region. Communities at Talensi District (Pwalugu) and Binduri District (Azum-Sapelliga) were engaged to assess the level of dissemination of early warning information and the actions undertaken.

Figure 2 : Stakeholder engagement at the regional and district level

3 Selected Pilot Sites

The Volta River Basin System in Ghana is made up of the White Volta, Black Volta, Oti, and Lower Volta Basins. Rainfall-runoff from these basins contribute to the water storage in the Volta Lake. Amongst these basins, the White Volta River and Lower Volta River Basins were selected for testing the application, and effectiveness of the VOLTALARM early warning system in areas highly exposed to different hydro-meteorological hazards such as flood and drought.

The selected pilot areas were the Bawku Municipal, Bawku West, Binduri, Talensi, and Nabdam Districts (Upper East Region) in the White Volta River Basin and Akosombo Dam. Assessment of the early warning system in the Upper East Region concentrated on flood and that of Akosombo Dam on hydrological drought.

3.1 White River Basin and river network

The drainage area of the White Volta Basin within Ghana is about 50,000 km^2 (20% of Ghana's total land area), and constitutes about 44% of the total area of the White Volta River Basin (named Nakanbé River in Burkina Faso). The Red Volta (Nazinon) and the Kulpawn/Sissili rivers, which are the main tributaries of the White Volta River in the northern part have their sources in the central and north-eastern portions of Burkina Faso.

The river first flows south on entering Ghana, turns west to be joined by the Red Volta River, continues westwards through the Upper East Region and then turns south, where it is joined by several tributaries, including the Kulpawn/Sissili, Nabogo and Nasia rivers. It continues southwards to Nawuni, flows westwards to Daboya and then southwards again where it is joined by the Mole River before entering the Volta Lake (WRC, 2008).

3.2 Volta Lake

The Volta Lake is a man-made lake and it was formed from the creation of the Akosombo Dam along the course of the Volta River. The main tributaries of the lake are the Black Volta, White Volta and Oti River. The major use of the lake is for the production of hydroelectric power at Akosombo (1,020 MW) and Kpong (160 MW) by the Volta River Authority. The electricity produced is used by the populace of Ghana for household and economic activities such as mining, manufacturing, textile making, etc.

The VRA also supplies to neighbouring countries through the Ghana Grid Company's (GRIDCo) transmission system, which links up with the national electricity grids of Cote d'Ivoire-Compagnie Ivoirienne d'Électricité (CIE), Togo-Communauté Electrique du Benin (CEB), and Burkina Faso (SONABEL). These interconnections serve as part of the transmission network under the West Africa Power Pool (WAPP) (VRA, 2022).

The reservoir also has other water use activities such as domestic/municipal water supply, irrigation, fishing, aquaculture, navigation, recreation, and industrial. Hence, it is a major

concern whenever the water level drops to the minimum level of 240ft. The climatic conditions of the area within certain periods over the years had resulted in hydrological drought of the lake. In the years, 1983-84, 1997-98, 2003, and 2006-2007 Ghana experienced power crisis as a result of drought leading to power rationing in different parts of the country (Bekoe & Logah, 2013).

3.3 Administrative setting and population of the Upper East

The Upper East Region has fifteen (15) districts/municipals (4 municipals and 11 districts) within the White Volta River Basin (see table 1). Ghana's 2021 Population and Housing Census indicated that the region has a population of 1,301,226 with the female and male distributions as 669,963 and 631,263 respectively. The population growth rate from 2010 to 2021 is about 2.0%. Percentage of the urban and rural populations are 25.4% (330,258) and 74.6% (970,968) respectively. Table 1 below presents the rural and urban population distribution in the various districts.

Table 1 : Population by district and type of locality

District/Municipal	Urban Pop.	Rural Pop.	Total Pop.
Builsa South	5,815	30,760	36,575
Builsa North Municipal	5,729	50,842	56,571
Kassena Nankana East Municipal	28,736	71,159	99,895
Kassena Nankana West	18,530	72,205	90,735
Bolgatanga Municipal	89,255	50,609	139,864
Bolgatanga East	11,758	27,066	38,824
Bongo	7,270	112,984	120,254
Garu	11,907	59,867	71,774
Tempane	12,861	74,132	86,993
Pusiga	25,794	54,739	80,533
Talensi	10,242	76,779	87,021
Nabdam	-	51,861	51,861
Bawku West	21,731	122,458	144,189
Binduri	-	76,679	76,679
Bawku Municipal	80,630	38,828	119,458

(Ghana Statistical Service, 2021 Ghana Population and Housing Census)

In assessing the districts in the Upper East Region to test the application and effectiveness of early warning, past experience gathered from WRC with regards to flooding indicated that Bawku Municipal, Bawku West, Binduri, Talensi, and Nabdam Districts were the most severely impacted areas. Therefore, in the consultative process representatives from these districts were engaged to understand the dissemination process and its associated challenges.

3.4 Socio-economic activities in the Upper East

The water resources of the White Volta River Basin contribute substantially to the economic livelihood of the people living in the basin. Water is used for a variety of purposes in the domestic, agriculture and industrial sectors.

Agriculture (including animal husbandry), fishery, hunting and forestry together constitute the main economic activity in the basin, particularly in the rural areas and provide occupation and employment for a vast majority of the people. In the 2021 Ghana Population and Housing Census, the economic activities of the district were assessed but that data is yet to be made available to public. In the absence of this data, 2000 Census data is presented noting that there had been changes over the past 10 years. The figures presented in Table 2 is derived from the 2000 Census data[1], and are given as percentages of the economically active population (above 15 years of age) in the Upper East Region.

Table 2 : Occupation (in %) of the economically active population in the Upper East

District	Economic activity							
	Professional and technical	Administrative and managerial	Clerical and related workers	Sales workers	Service workers	Agriculture, incl. animal husbandry, fishery, and forestry	Production, transport and equipment	Other activities
Builsa (Builsa North and Builsa South)	2.6	0.1	0.8	8.5	2.7	75.2	9.1	0.8
Kasina-Nankana (Kasina-Nankana East and Kasina-Nankana West)	3.5	0.1	1.4	9.2	5.6	68.7	10.4	0.9
Bongo	2.6	0.1	0.5	6.8	2.3	57.9	29.3	0.3
Bolgatanga (Bolgatanga East, Bolgatanga Municipal, Talensi and Nabdam)	4.3	0.2	2.8	10.6	5.7	50.6	24.8	1.0
Bawku West	1.9	~ 0	0.5	5.1	2.0	84.7	5.4	0.2
Bawku East (Bawku Municipal, Garu, Tempane, Binduri, Pusiga)	2.2	0.1	1.3	11.3	3.2	71.9	9.4	0.5

[1] *Ghana Statistical Service: 2000 Population and Housing Census: Analysis of District Data and Implications for Planning (August 2005)*

4 Roles and responsibilities of stakeholders engaged

The stakeholders in Ghana have different mandates and responsibilities. This largely influences their role in the dissemination of early warning information. Assessment of stakeholder's function ensures the right allocation of resources, logistics, technical assistance, and capacity building. Below are the responsibilities of some major stakeholders engaged.

4.1 Hydrological Service Department

HSD is mandated to undertake programs and coordinate activities related to coastal protection works, construction and maintenance of storm drains, and the monitoring and evaluation of surface water bodies in respect to floods. As part of its roles, it undertakes flood forecast of river flows on the White Volta and Oti Rivers in the wet season when there are high river flows resulting from high amounts of rains or water spillage from the Bagre Dam. The flood forecasts are normally disseminated to stakeholders such as NADMO, GMET, WRC, VRA for any necessary action to be undertaken. Currently, the SERVER used for data processing to forecast is not functioning due to a fault developed from consistent power outages. However, efforts are being made to restore it. Due to this challenge, HSD is presently using FANFAR to forecast for hydrological stations along the course of the White Volta and Oti Rivers.

4.2 Ghana Meteorological Agency

The Agency is mandated to collect, process, store and disseminate meteorological information and also provide weather forecast on daily basis (national weather) on radio and television to the public. In view of these responsibilities, it provides a 24-hour weather forecast for selected cities, and impact-based forecast map for the regions of Ghana. The two products are disseminated to stakeholders such as the Media, Civil Aviation, Military Aviation, Volta River Authority, Ghana Ports and Harbour Authority, Fisheries Commission, NADMO, HSD, Agricultural institutions, Public etc.

Presently, the agency is unable to undertake drought seasonal forecast to determine short and long dry spell (drought). In view of this, the agency expressed the need for more capacity building in drought forecasting. It also largely wants to promote the dissemination of weather information in all media house. As a result, it has trained some media personnel and it is planning to build the capacity of others to ensure that daily weather forecast reach the public at all levels. Other needs required by GMet include the proper functioning of their audio-visual studio to broadcast weather information, the procurement of SERVERS to run models and resolving internet challenges since majority of their data are accessed online.

4.3 National Disaster Management Organisation

NADMO is mandated to manage disasters and similar emergencies, and to develop the capacity of communities to respond effectively to disasters and emergencies. The functions presented below are some of the roles being performed by NADMO (NADMO Act 927, 2016);

- To implement government policy on disaster prevention, disaster risk reduction, and climate risk management; and of international, national, regional and district management plans;
- To prepare, co-ordinate, monitor and update management plans;
- To collaborate with communities and relevant institutions through the dissemination of information to educate the public on hazards and natural disasters likely to affect the various of Ghana, actions to be taken in the event of any degree of disaster, disaster prevention rules and regulations etc;
- To analyse and disseminate relevant information on disaster to the public;
- To ensure the effective flow of information on disasters between the national, regional and district levels of Ghana

In view of these roles, NADMO receives information related to flood and drought risks for actions to avert or minimize its impact on the populace. For example, the GMet and HSD respectively send daily weather forecast and seasonal hydrological forecast to NADMO for onward dissemination to relevant stakeholder and to educate the public to undertake actions that will reduce the impact of disasters. NADMO manages disasters with other institution such as Ministry of Health, Ministry of Gender, Children and Social Protection, Ministry of Information, Ministry of Education, Ghana Fire Service, Ghana Police Service, District Assemblies, and Disaster Volunteer Groups. Information related to disaster (flood or drought) is normally disseminated from the head office of NADMO to regional, district and zonal offices.

4.4 Water Resources Commission

Water Resources Commission is mandated to manage and regulate the utilization of Ghana's water resources and all policies in relation to it. Amongst the responsibilities include (a) the development of comprehensive plans for the utilization, conservation, development and improvement of water resources; (b) collect, collate, store and disseminate data or information on water resources in Ghana, (c) initiate, control and co-ordinate activities connected with the development and utilization of water resources etc.

The Commission is also the coordinating body in matters relating to international and transboundary water resources management on behalf of Ghana. Therefore, the Commission coordinates international water management issues with the United Nations Economic Commission for Europe (UNECE) and Volta Basin Authority (VBA). The

Commission receives water level data of the Bagre dam in Burkina Faso (SONABEL) annually and most especially in the rainy period (Aug. – Sept.) of the northern part of Ghana for dissemination to all relevant stakeholders in Ghana to minimise the impact in the event of water spillage from the Bagre Dam.

4.5 Volta River Authority

The Volta River Authority (VRA) was established with the mandate to generate, transmit and distribute electricity to the population of Ghana. It achieves this responsibility through the power generated from the Akosombo and Kpong Hydropower Dams. The reservoir known as the Volta Lake is the main source of water for these hydropower generation. VRA also produces electric power from solar, gas and thermal plants established in various parts of Ghana. It disseminates information to communities and Ghana's populace in the event of water spillage from the Akosombo and Kpong Dams, and when the upstream level of the Akosombo Dam is at the minimum level of 240 ft (73.15 m). VRA generally uses its Public Relation Department to disseminate such information through Press Releases, and community engagement.

4.6 Media

The Media is a major stakeholder in educating and disseminating information to the public. In this wise, the traditional media platform such as Radio, Television, and Print are largely used in Ghana. In present times, Social Media have been adopted as one of the major mediums to quickly disseminate information to the public at all levels.

5 Institutional mechanism for processing and dissemination of forecast and early warning at the national and local level

In Ghana, hydrological and meteorological forecasts are two main information that are disseminated in in relation to flood and drought. The hydrological forecasts are mainly for the White Volta and Oti River during the rainy season (August-September). These flood forecasts are done by HSD. It uses the Sobek Model developed by HKV. This model SERVER has developed a fault. However, FANFAR is being used currently for the flood forecasting. The hydrological station on the White Volta River being assessed are Pwalugu, Kpasenkpe, Nawuni, Daboya, Yapei, Nasia and Nabogo. Their assessments are presented in Hydrograph Forecasts and Flood Hazard Maps with symbologies and forecast interpretation. The hydrograph forecasts are categorized into level of severity (level 1-3) and the degree of flood hazard (categorized into moderate, high, and very high). The forecast and its impact assessments in pdf format are mainly disseminated through an email system to stakeholders such as the NADMO, GMET, WRC, VRA, WRI, University of Ghana, Legon and Volta Basin Authority.

GMet provides meteorological forecast with respect to the weather conditions in Ghana. Daily forecasts are normally generated for a period of 24 hours in a 6-hour interval. The 24

hours forecast is disseminated daily and this is segregated into morning (0600UTC), afternoon (1200UTC), and evening (1800UTC) for the major cities of Ghana. This has information such as temperature, cloudiness, the nature of expected rain (slight, thunderstorm etc). A 24-hour impact-based forecast map with indication of the potential areas of Ghana to be affected is also produced and shared to the media and the general public. The impact forecast is categorized into No Risk, Low Risk, Be Aware, Be Prepared, and Take Action. GMet distributes and disseminates this information via platforms such as Email, Facebook, Twitter, WhatsApp, Telegram, official website, and Media houses (radio, television, print).

NADMO is the recipient of flood and weather forecast from HSD, GMet and WRC. The information received are normally analysed at the National Office prior to its dissemination to the regional, district, zonal and community levels. NADMO uses the traditional media houses, information vans and centers, and social media platform in communicating, disseminating and receiving feedbacks.

6 Assessment of dissemination at communities in Talensi and Binduri Districts

Community engagement was undertaken in both the Talensi and Binduri Districts. The Pwalugu community had notification of the flood gate opening on September 1, 2022 and experienced the flood within 7 to 10 days. Unfortunately, the farmers lost their crops because the crops were not matured for harvesting. The community has noticed the variability in the climatic conditions in their area. The farmers used to plant in April and harvest by July before the spillage of the Bagre Dam in August or September. However, the delay in rains currently leads to planting in July which results in the farmers inability to harvest before the spillage of the dam and/or excess water from the rains. In view of these observations, community proposed that water released from the Bagre dam should commence when the water level in the dam begins increasing and not until it reaches the maximum level. Others also proposed that they will move their farming activities from the riverbank if they are provided with irrigation facilities.

The Azum-Sapelliga community in the Binduri District received their information from a radio station. Subsequently, NADMO officials visited and informed the community of the dam spillage on September 1, 2022. Prior to the spillage, they received constant update of the water level via radio stations. Part of their farming areas were flooded within 2-3 days after the opening of the dam. They stated that their planting period has changed from April to July due to changes in the time they receive rains to commence the planting season. The farmers also stated that they would prefer to farm along the riverbanks and within floodplains though their farms could be flooded and destroyed from annual water spill from the Bagre Dam. They explained that (a) their large number in those areas protect

them against nomadic herdsmen and their cattle, (b) access to water for irrigation is addressed (c) less fertilizer is used in their farming resulting in high profits.

Figure 3 : Community engagement

7 Techniques, media and channels for disseminating early warning at the local level.

Dissemination of information at the local level largely involve stakeholders and departments at the district and zonal level. For NADMO, the district and zonal coordinators are the first hand receivers and transmitters of early warning information.

7.1 NADMO

- NADMO takes the lead in the dissemination of early warning information in collaboration with other relevant stakeholders at the community level. For example, in the event that flooding affects drinking water, Ghana Health Service play a role.
- Traditional and religious bodies such as Chiefs, Churches, Mosque and radio stations assist with information dissemination.
- NADMO has Disaster Volunteer Groups (DVGs) at the community level that play a critical role by disseminating information from the district to the community and vice versa.
- NADMO have Emergency Operation Centers (EOCs) at the district level to receive and disseminate early warning information. However, EOCs are not in all district. The first center established was in Bawku West.
- NADMO also have Rapid Response Teams made up of several stakeholders such as DAs, NGOs (e.g. Ghana Red Cross Society), Ghana Fire Service and others that perform rescue role and assess the impacts of flood and other disasters.
- The use of social media platforms is also used for dissemination of early warning information (e.g. flows from Bagre dam) among DVGs and other groups in NADMO.

7.2 District Assembly & NGOs

- The Municipal/District Assemblies (DA) through the Information Services Department (ISD) disseminates early warning information to the communities through a Public Announcement Van.
- The District Assembly also make use of Assembly members in the communities to disseminate information.
- Information Centers within the communities and Community durbars are also means of sharing information to farmers, fishermen, traditional leaders and the entire community.
- Agriculture Extension Officers (AEAs) from the Agriculture Department at the District level oversee a number of communities in the district. Therefore, they assist in dissemination of early warning information.
- Community Development and Environmental Health Officers also assist in dissemination of early warning information due to their presence at the community level.
- NGOs such as Red Cross, and FONAR who engage in climate change issues also play a role in the dissemination of early warning information at the community level.

8 Challenges in the dissemination of the early warning at national and local levels

Several gaps and challenges were identified during the consultation with the stakeholders. Below are some of the issues identified;

1. Dissemination of early warning information in remote areas or hinterlands does not reach all the communities since their settlements are scattered.
2. Information disseminated are at times distorted leading to low confidence in subsequent information. In certain cases, reports on early warning and weather information by stakeholders such as the media is not accurate.
3. Some of the institution such as GMet that depends on the internet to download data, run models and forecast have internet connectivity issues.
4. Institutions such as GMet and HSD do not have a functioning SERVER to run models tailored to the Ghanaian context.
5. Some communities do not have Information Centers due to the nature of the settlements.
6. Some of the sub-structure departments of the District Assemblies are not adequately resourced in disseminating information at the community level.
7. Inadequate resources to furnish audiovisual studio of GMet to consistently broadcast weather information to the public.
8. Early warning information on drought is barely disseminated.
9. Inadequate resources for the implementation of Disaster Management Plans developed by Disaster Management Committee.

9 Recommendations to improve early warning dissemination at national and local levels

In view of the assessment of the stakeholder's responsibilities and challenges identified, these are some recommendations that must be considered to improve the dissemination of early warning information.

1. Establishment of information centers and the provision of public address system in affected remote areas.
2. Regular sensitization in communities on flood and drought management
3. Strengthening of EOCs, DVGs, District Assembly sub-structures like zonal councils and other groups to deal with flood issues at the community level.
4. Progressive and consistent dissemination of early warning information in spite of doubt created from misconstrued information.
5. Capacity building for stakeholders who are in charge of the management of flood and drought in the districts. Also, provision of logistics and resources to manage flood and drought at the district and local level.
6. Capacity building for stakeholders such as GMet in seasonal forecasting of drought.
7. Capacity building for the media in appropriate and accurate dissemination of early warning information and interpretation of forecasts.
8. Consistent provision of information to target groups such as farmers, fishermen and others whose livelihoods depend on nature-based activities is key in the dealing with disaster management.
9. Flood management including relief items should be part of District Assemblies plans since the flooding has become an annual event instead of using ad-hoc measures.
10. Effective implementation of laws regarding settlement patterns, physical development and demolition of structures on waterways or floodplains.
11. NADMO should be given the authority through Legislative Instrument to demolish illegal structures in waterways.
12. NADMO should add to its responsibilities by the introduction of pro-active measures than reactive measures.
13. There should be an advocacy to involve NGOs/CSOs in flood and drought management.
14. Capacity building in flood and drought management should be centered on both indigenous and scientific knowledge.
15. There should be the establishment of other Emergency Operation Centers in the districts/municipal

Reference

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Appendix

GHANA METEOROLOGICAL AGENCY

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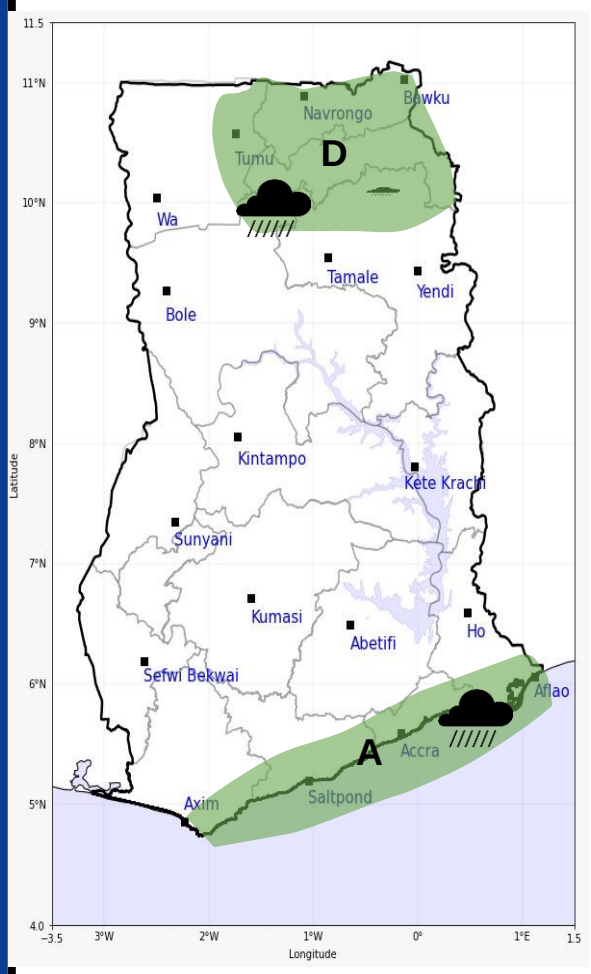
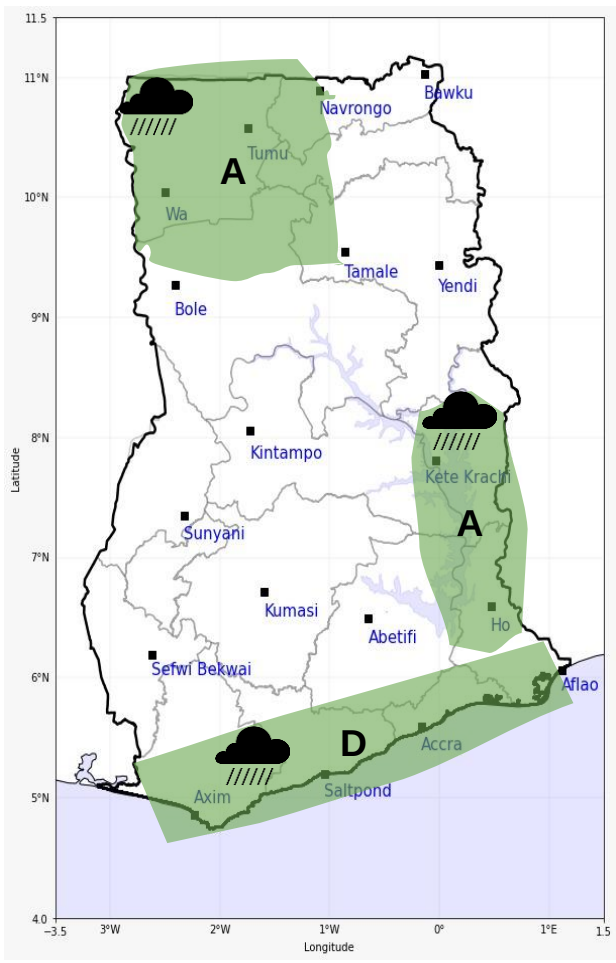
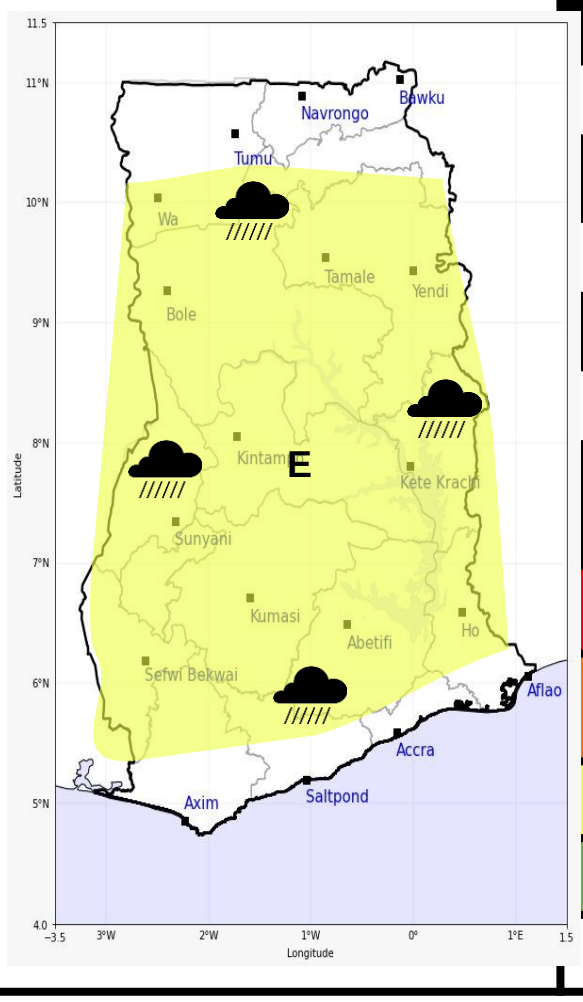
24-HOUR IMPACT-BASED FORECAST FOR GHANAD

MORNING (27/09/2022)	AFTERNOON (27/09/2022)	EVENING (27/09/2022)
		

CAFO
Date
27/09/2022
Time Issued
0500 UTC
Valid From
0600 UTC
Nowcasting Risk
Take Action
Be Prepared
Be aware
Low risk
No risk

Weather Forecasting Risk Table

Likelihood \ Impact	Low	Medium	High
High (>60%)	G	H	I
Medium (40% - 60%)	D	E	F
Low (<40%)	A	B	C

Weather Icons

Rain Wind Dust Hail

Sector	Minimum Temperature (°C)	Maximum Temperature (°C)
Coast	22	30
Forest	22	32
Transition	22	32
Northern	21	34

SUMMARY

Cloudy conditions along with mist and fog patches are expected across the country this morning with chances of slight to moderate rains over the coastal and few places in the northern sector.
Thunderstorms or rains will be experienced over the coastal and upper western regions during the afternoon giving way to cloudy weather in the evening. Variably Cloudy weather is expected over the middle and transition sectors in the afternoon, with chances of thunderstorms or rains in the evening.

SIGNED: Central Analysis and Forecasting Office (CAFO)

HYDROLOGICAL SERVICES DEPARTMENT (HSD)

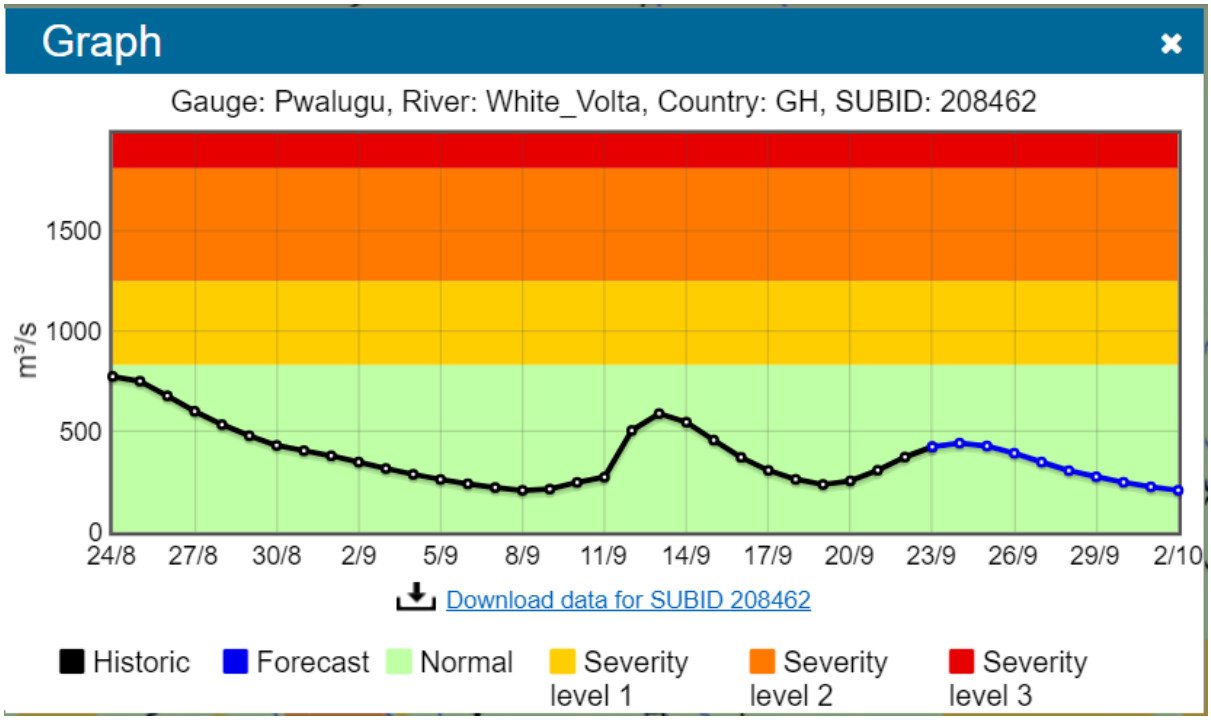
WHITE VOLTA RIVER BASIN FORECAST REPORT

Note: Recommendations on the content and format are welcome. Field observations including pictures and videos for verifications will be therefore very much appreciated.

Although the forecast period shows a 10-day forecast, the forecast is reviewed every five days.

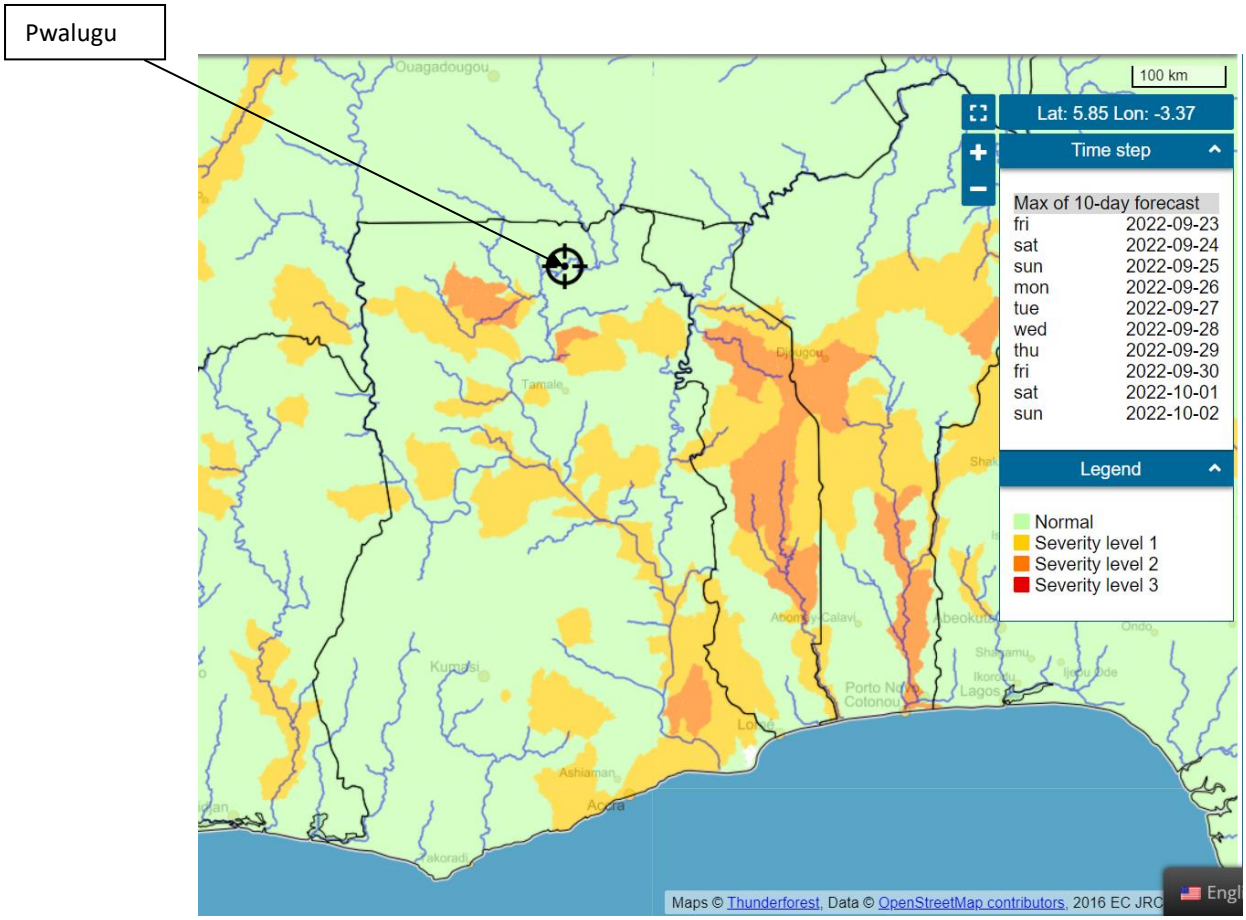
Below are discharge forecast flood hazard maps for the White Volta River basin valid from today, 23/09/2022 to 02/10/2022 @ midnight.

Forecast Hydrograph for Pwalugu

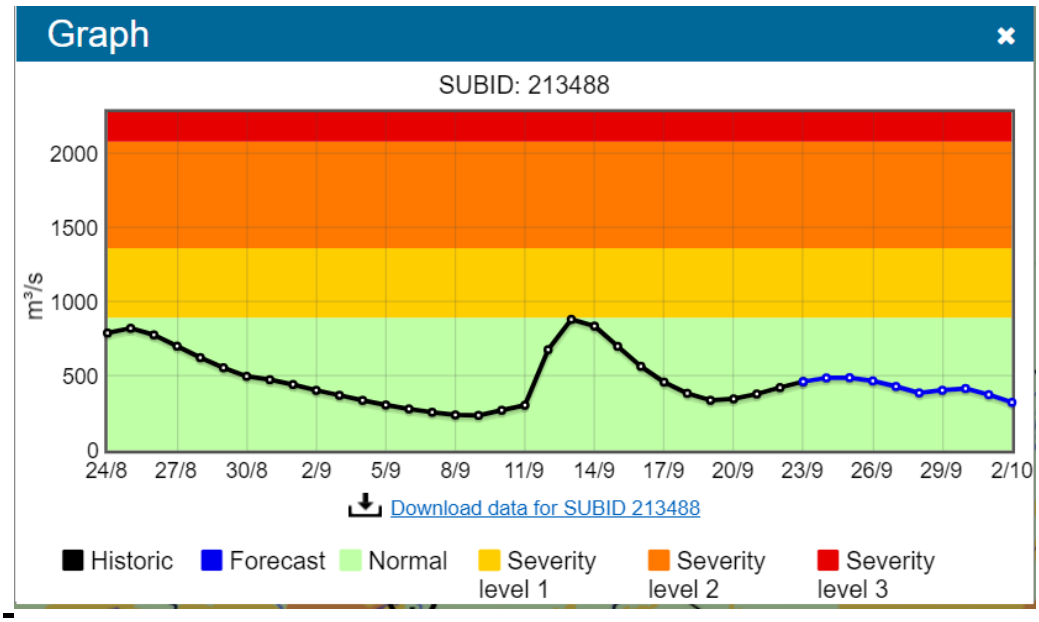


NB : It is expected that the discharge of the White Volta River at Pwalugu will decrease from the current 425 m^3/s to approximatley 209 m^3/s over the 10-day forecast period (23-09-2022 to 02-10-2022). Beneath is the expected flood hazard map which indicate normal level for Pwalugu and its surrounding areas.

FLOOD HAZARD MAP FOR PWALUGU –23/09/22



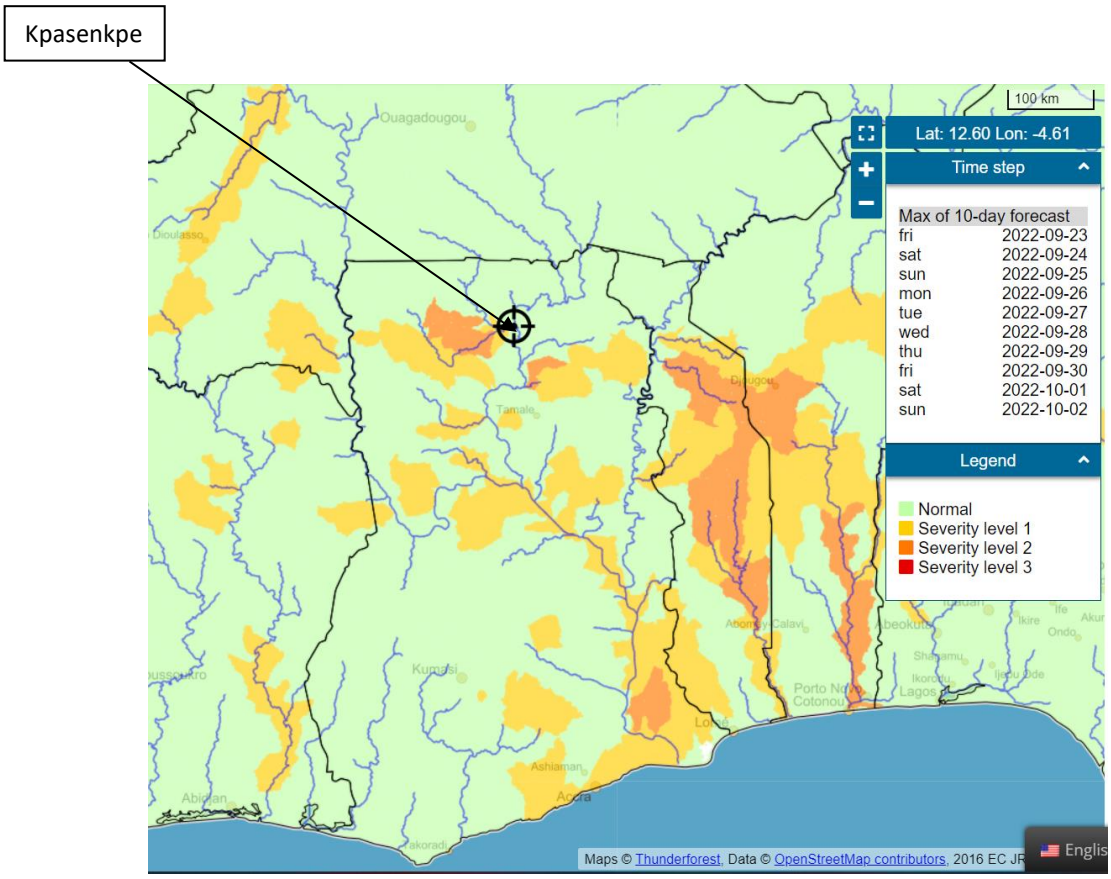
Forecast Hydrograph for Kpasenkpe



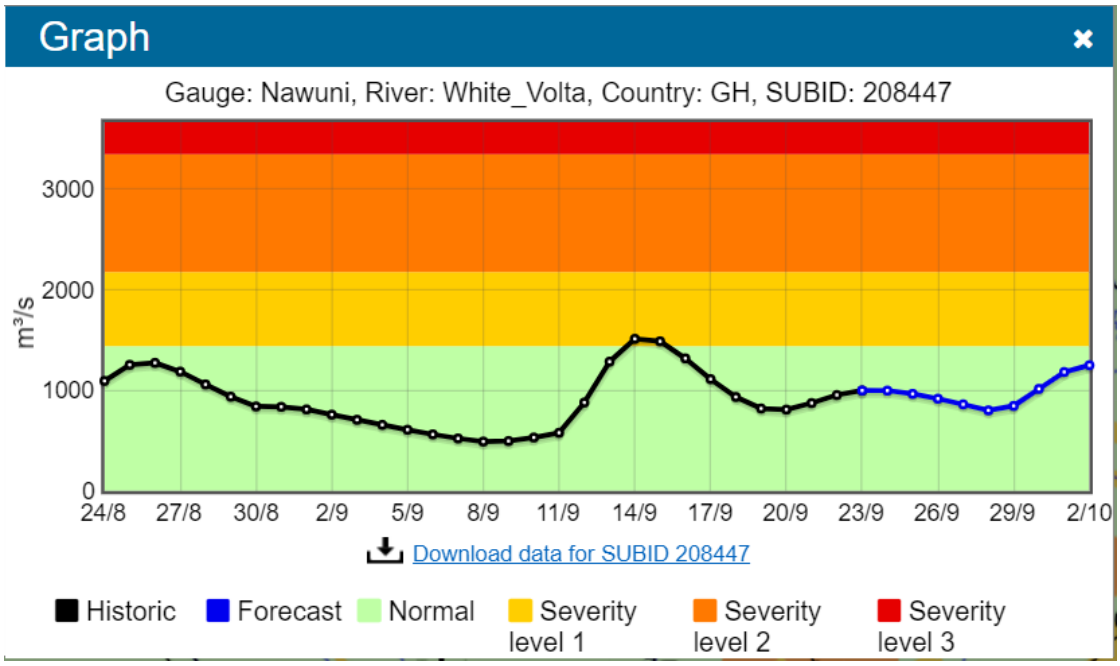
NB : It is expected that the discharge of the White Volta River at Kpasenkpe will decrease from the current 464 m^3/s to 325 m^3/s over the 10-day forecast period (23-09-2022 to 02-10-2022). Beneath is the expected flood

hazard map which indicate Normal level for Kpasenkpe and its surrounding areas.

FLOOD HAZARD MAP FOR KPASENKPE –23/09/22

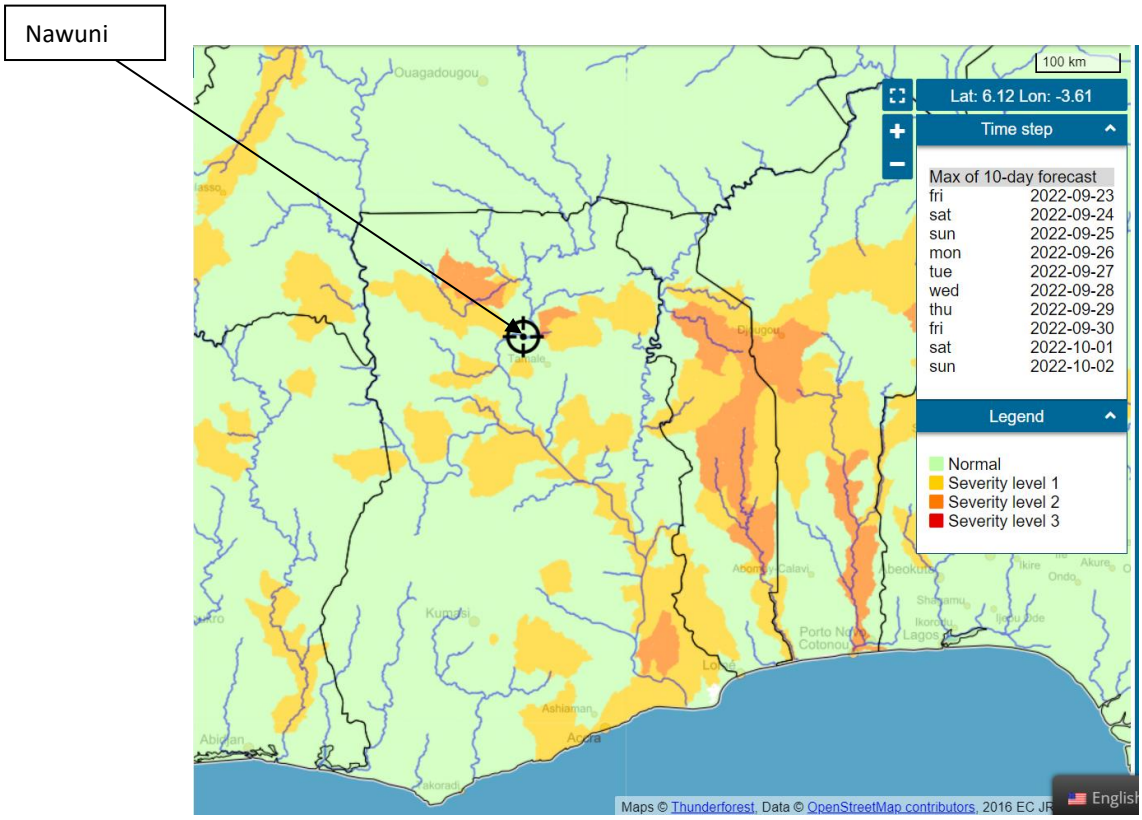


Forecast Hydrograph for Nawuni

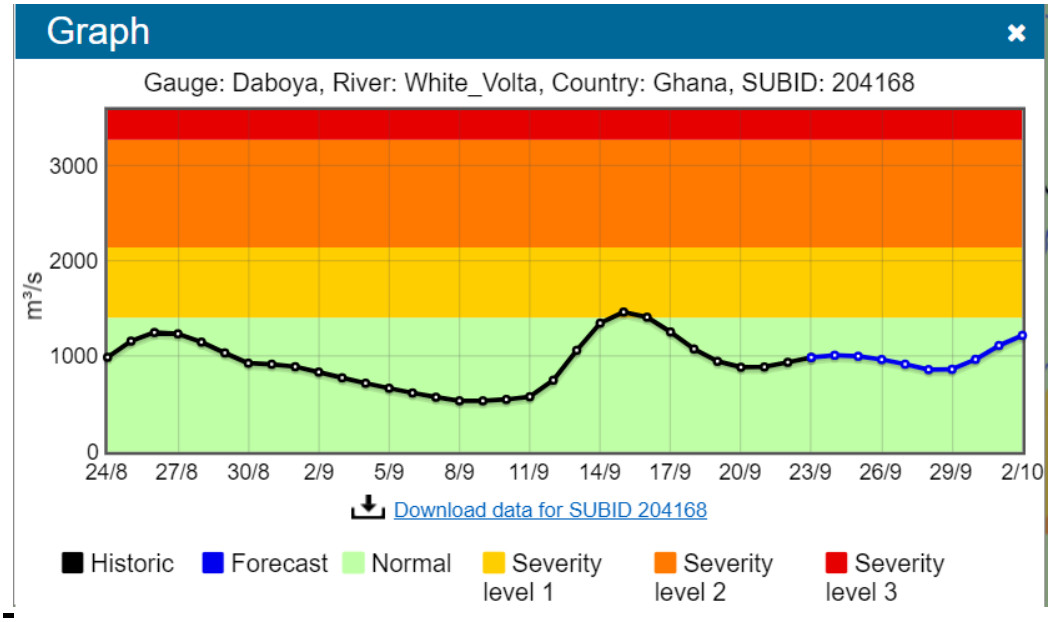


NB : It is expected that the discharge of the White Volta River at Nawuni will increase from the current 999 m^3/s to 1250 m^3/s over the 10-day forecast period (23-09-2022 to 02-10-2022). Beneath is the expected flood hazard map which indicate Normal level for Nawuni and its surrounding areas.

FLOOD HAZARD MAP FOR NAWUNI –23/09/22

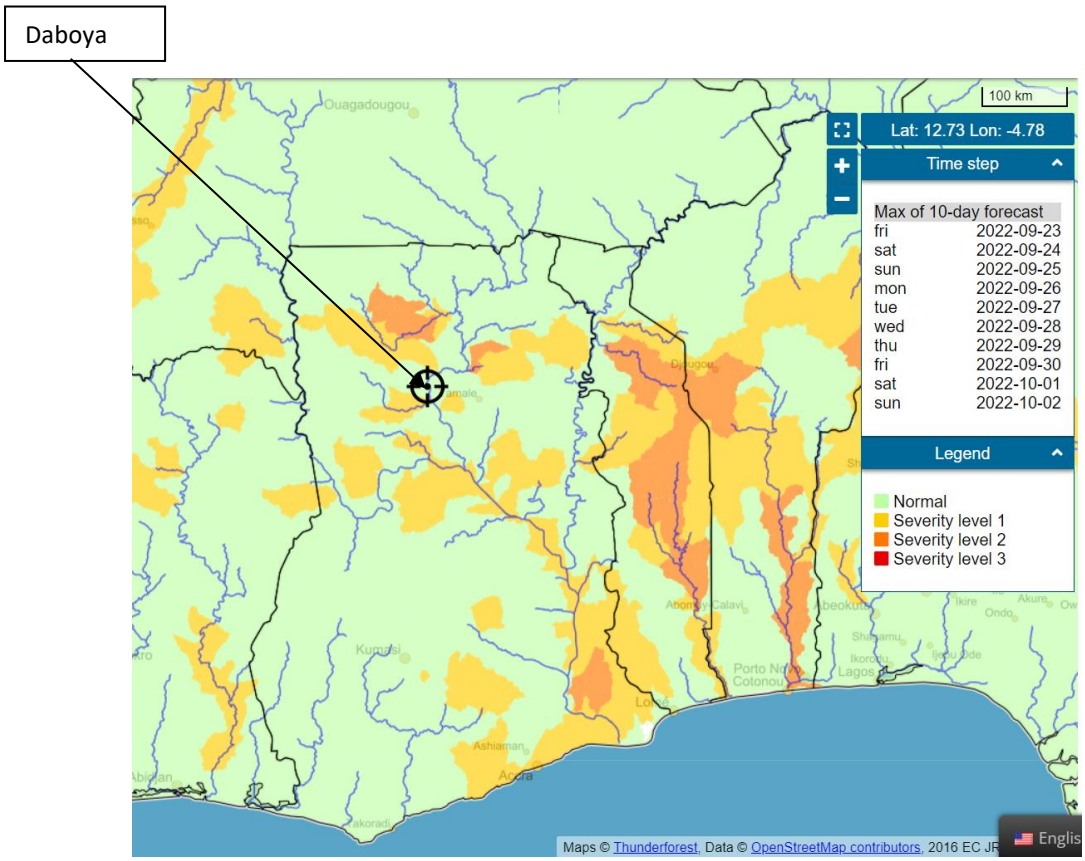


Forecast Hydrograph for Daboya

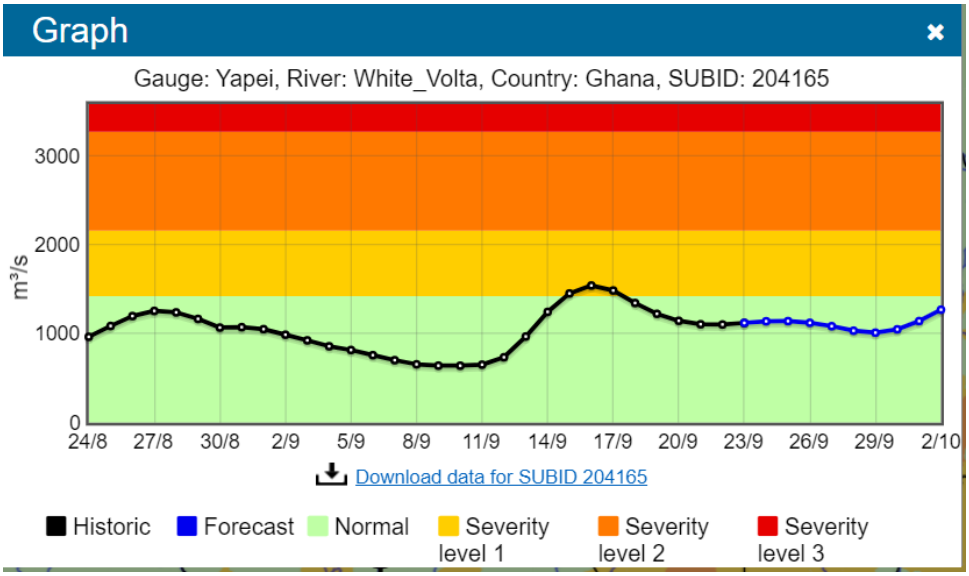


NB : It is expected that the discharge of the White Volta River at Daboya will increase from the current 990 m^3/s to 1221 m^3/s over the 10-day forecast period (23-09-2022 to 02-10-2022). Beneath is the expected flood hazard map which indicate Normal level for Daboya and its surrounding areas.

FLOOD HAZARD MAP FOR DABOYA –23/09/22

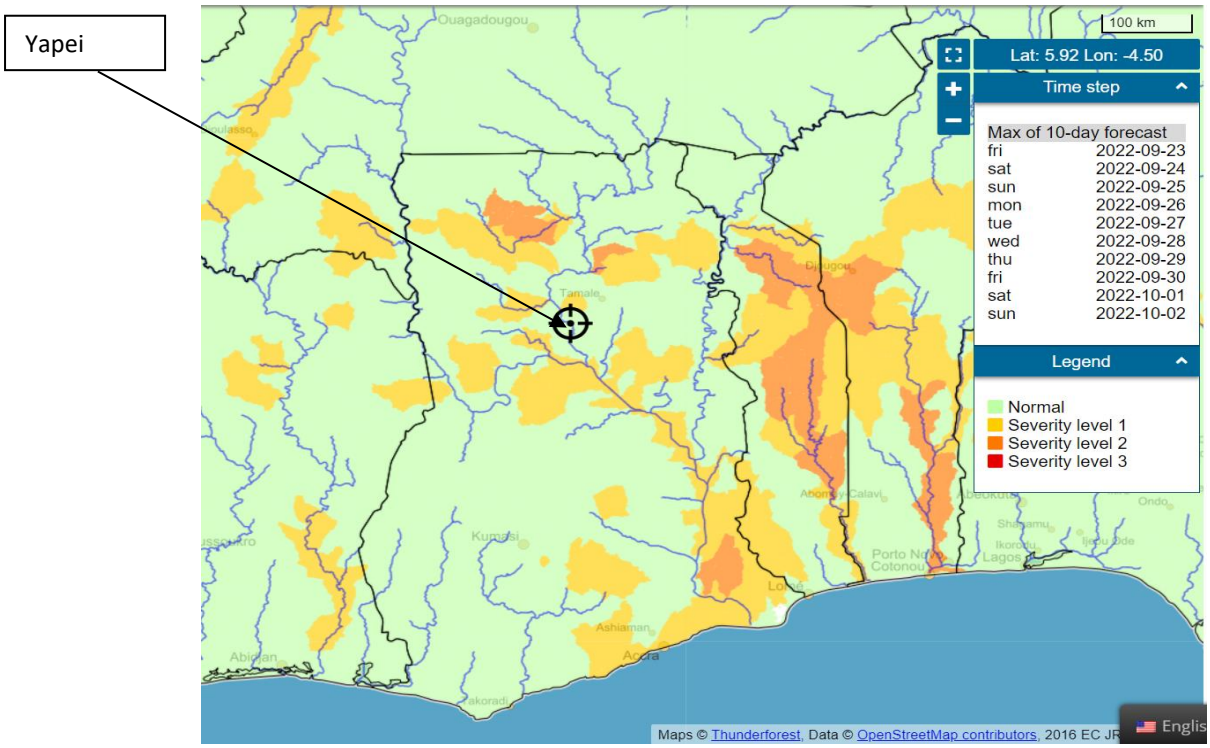


Forecast Hydrograph for Yapei

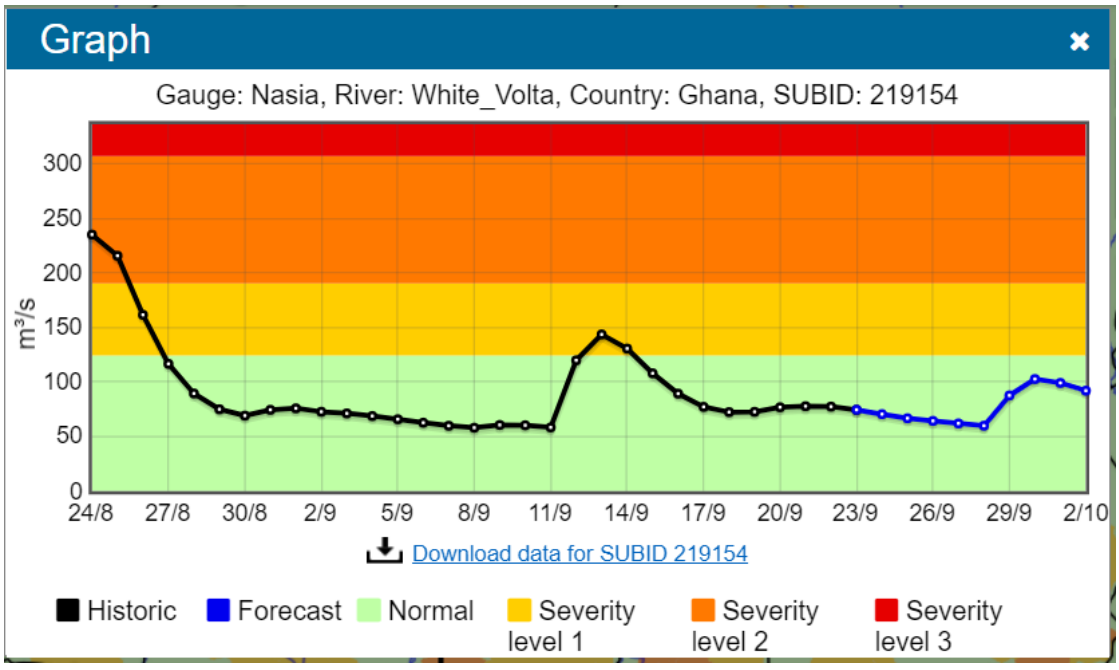


NB : It is expected that the discharge of the White Volta River at Yapei will increase from the current 1124 m^3/s to 1274 m^3/s over the 10-day forecast period (23-09-2022 to 02-10-2022). Beneath is the expected flood hazard map which indicate Normal level for Yapei and its surrounding areas.

FLOOD HAZARD MAP FOR YAPEI –23/09/22

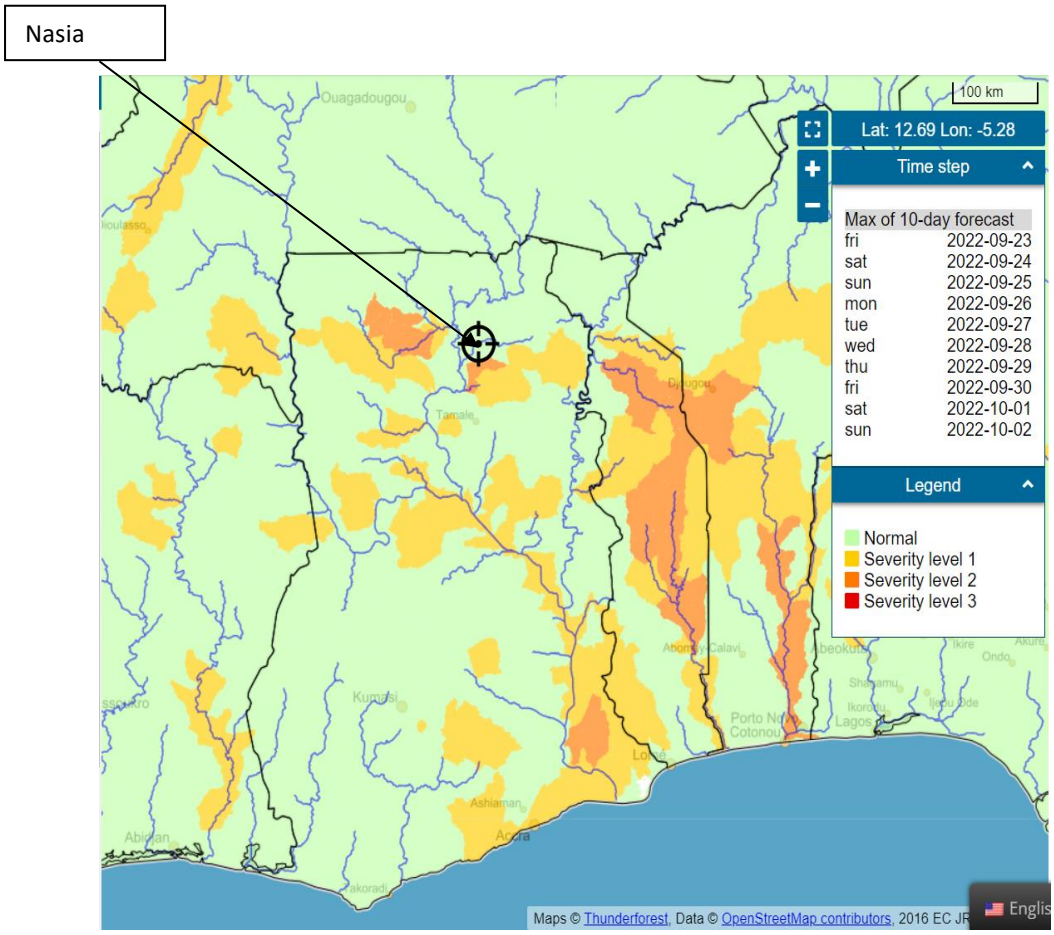


Forecast Hydrograph for Nasia

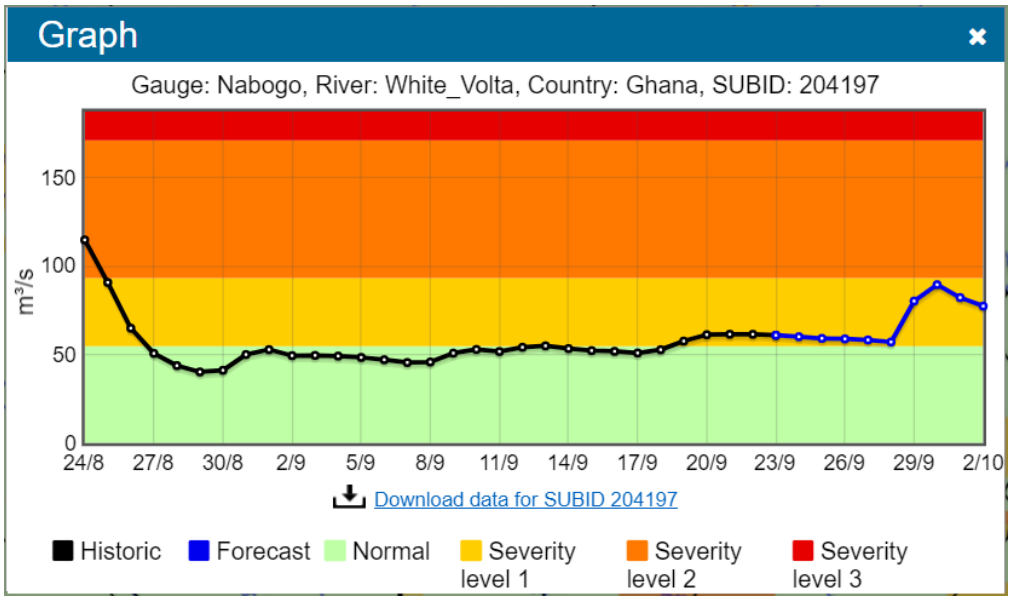


NB : It is expected that the discharge of the White Volta River at Nasia will increase from the current 75 m^3/s to 92 m^3/s over the 10-day forecast period (23-09-2022 to 02-10-2022). Beneath is the expected flood hazard map which indicate Normal level for Nasia and its surrounding areas.

FLOOD HAZARD MAP FOR NASIA –23/09/22

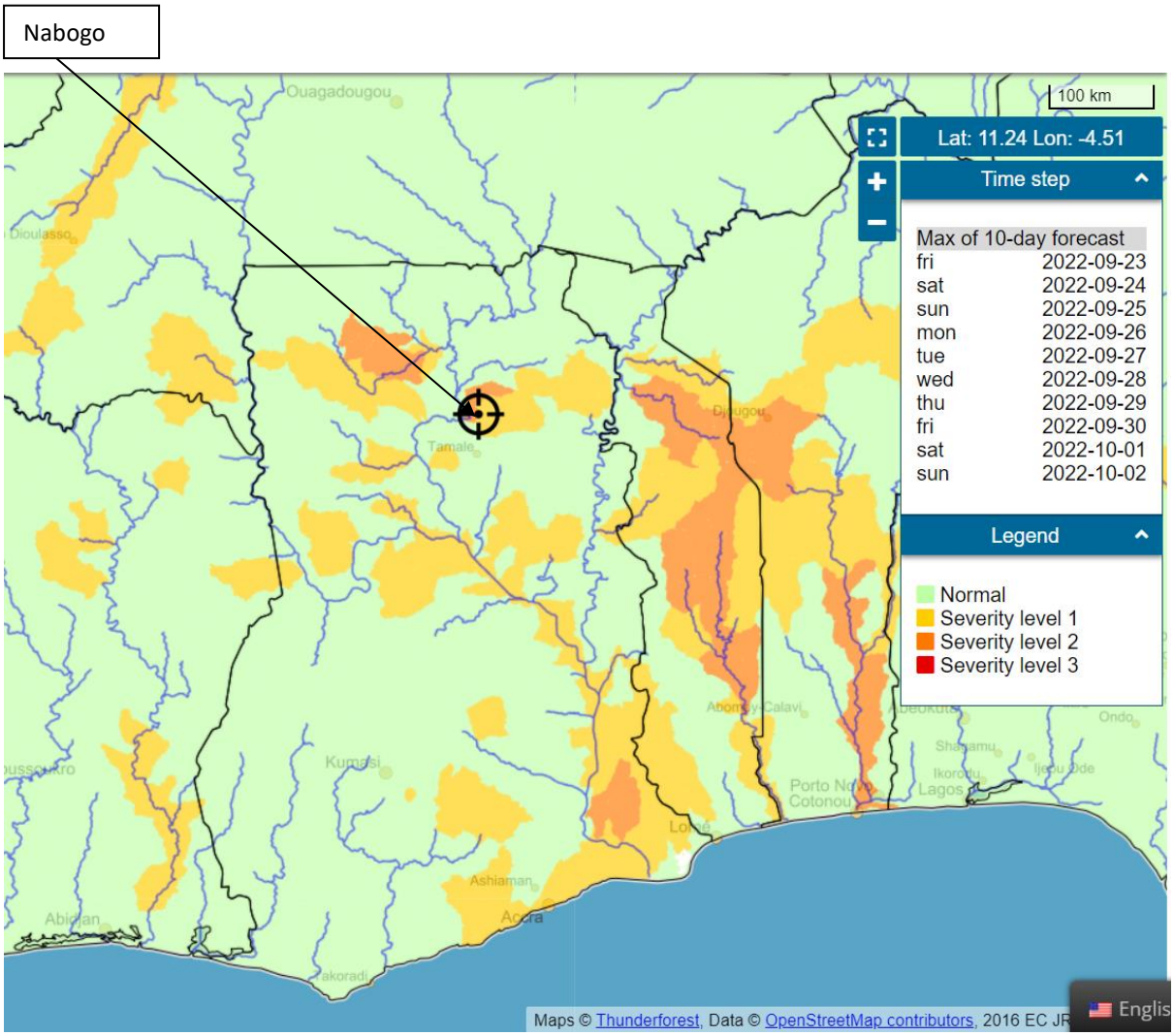


Forecast Hydrograph for Nabogo



NB : It is expected that the discharge of the White Volta River at Nabogo will increase from the current 61 m^3/s to 77 m^3/s over the 10-day forecast period (23-09-2022 to 02-10-2022). Beneath is the expected flood hazard map which indicate Severity level 1 for Nabogo and its surrounding areas.

FLOOD HAZARD MAP FOR NABOGO –23/09/22

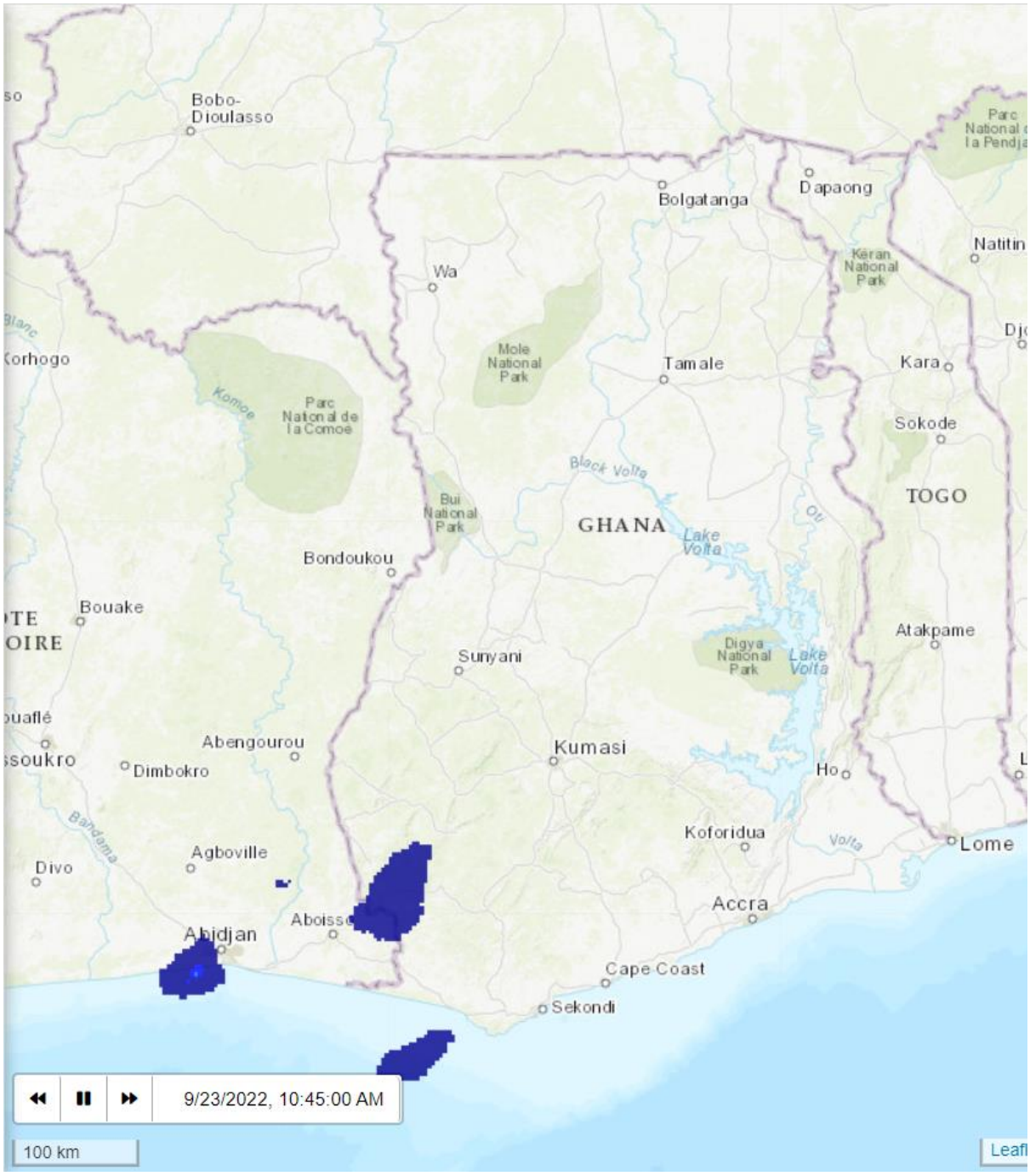


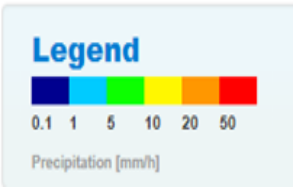
NOTE: The colours on the flood hazard map correspond to the following return periods.

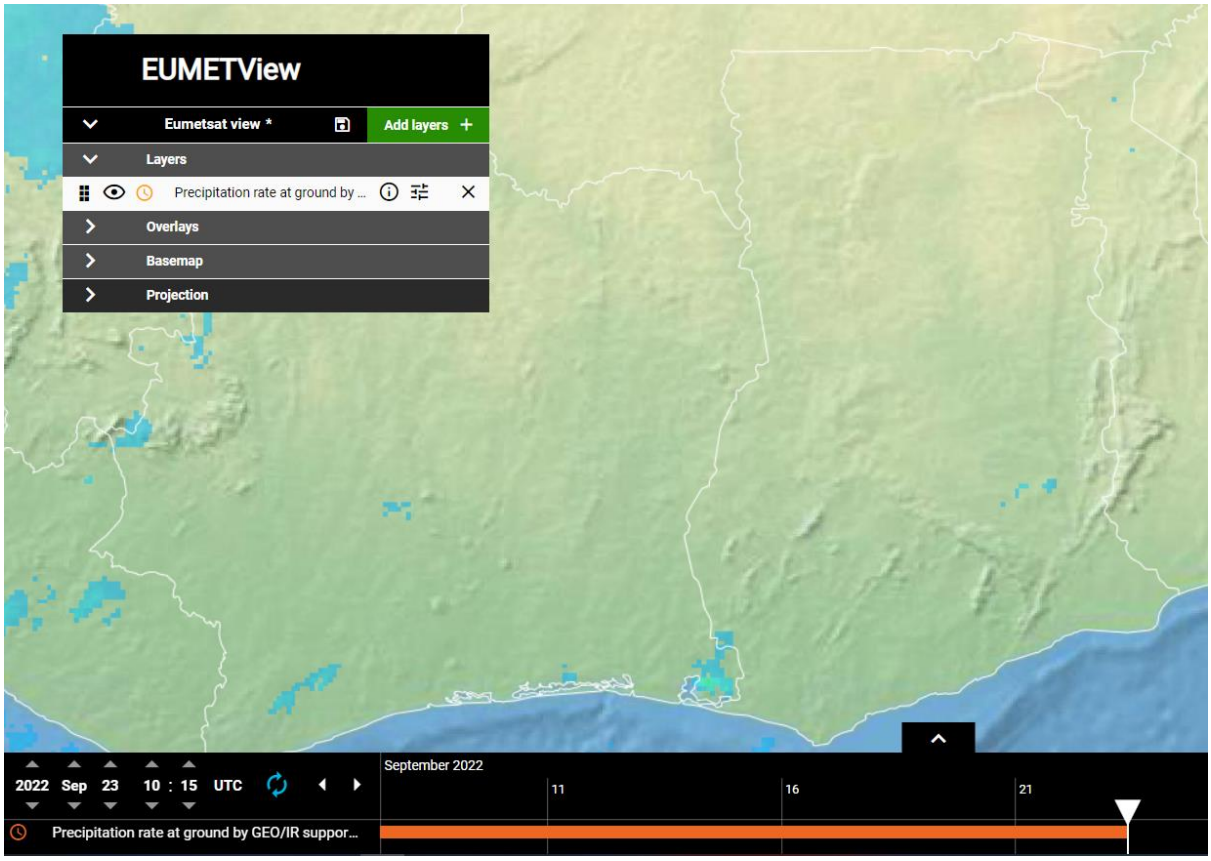
Forecast layer

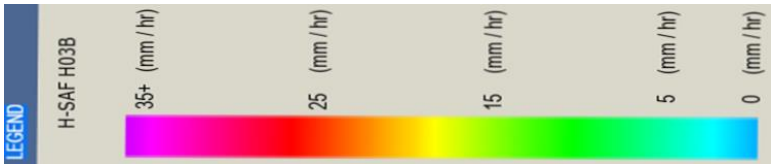
- ☑ Severity level
  - ☑ 3 Very high (>30-year return period)
  - ☑ 2 High (>5-year return period)
  - ☑ 1 Moderate (>2-year return period)

RAINFALL MAP – 23/09/22









Recommended action: The forecasted discharge level at all the stations are within the normal level currently except Nabogo which is within severity level 1, hence inundations are not likely to occur in most places during the forecast period. Discharge levels are expected to increase for all the stations over the forecasted period. Extra caution should be exhibited by the inhabitants of towns/communities such as Kobore, Zebilla, Bawku, Wiasi,Nasia, Nabogo,Yagaba, Nawuni, Daboya, Yapei and Nakpanduri, all within the White Volta River Basin.

NADMO regional, district and zonal officers/offices are advised to continue monitoring in the field and possibly alert and sensitize inhabitants of the local communities within the White Volta River Basin in the North-East, Northern, Savannah and Upper East Regions.

DISSEMINATION OF THE WATER LEVELS OF BAGRE AND KOMPIENGA DAMS

Water levels of the Bagre and Kompienga as of Sunday 28 August 2022

Comments:
Bagre Dam:
The upstream level is 234.42 m. The water level is rising. The filling rate is 92.24% compared to 90.64% on the same date in 2021.

Kompienga Dam:
The upstream level is 175.31m and is rising. The filling rate is 58.29% compared to 53.93% on the same date in 2021.

NOTE: If the current rise in the level of the Bagre continues, the flood gates of the Bagre dam will be opened in about 10 days.

Water levels of the Bagre and Kompienga as of Tuesday 30 August 2022.

Comments:
Bagre Dam:
The upstream level is 234.71 m. The water level is rising. The filling rate is 96.17% compared to 91.37% on the same date in 2021.

Kompienga Dam:
The upstream level is 175.53m and is rising. The filling rate is 59.86% compared to 54.86% on the same date in 2021.

NOTE: If the current rise in the level of the Bagre continues, the flood gates of the Bagre dam will be opened in about 10 days.

Water levels of the Bagre and Kompienga as of Wednesday 31 August 2022.

Comments:
Bagre Dam:
The upstream level is 234.88 m. The water level is rising. The filling rate is 98.40% compared to 92.10% on the same date in 2021.

Kompienga Dam:
The upstream level is 175.53m and is rising. The filling rate is 59.86% compared to 55.24% on the same date in 2021.

NOTE: If the current rise in the level of the Bagre continues, the flood gates of the Bagre dam will be opened from September 1, 2022

Water levels of the Bagre and Kompienga as of Thursday 1 September 2022.

Comments:
Bagre Dam:
The upstream level is 235.06 m. The water level is rising. The filling rate is 100.98% compared to 93.05% on the same date in 2021.

Kompienga Dam:
The upstream level is 175.70m and is rising. The filling rate is 56.15% compared to 55.71% on the same date in 2021.

NOTE: The valves of the Bagre Dam were opened this morning September 1, 2022, at 9 a.m. with a flow of 355 m3/s

Water levels of the Bagre and Kompienga as of Friday 30 September 2022.

Comments:
Bagre Dam:
The upstream level is 235.06m. The water level has decreased. The filling rate is 100.98% compared to 88.69% on the same date in 2021.

Kompienga Dam:
The upstream level is 178.69m and is rising. The filling rate is 86.50% compared to 57.16% on the same date in 2021.

NOTE:
The valves of the Bagre Dam were opened on September 1, 2022, at 9 a.m. The average flow for the 29th day (Sept 29) was 430 m3/s.

Water levels of the Bagre and Kompienga as of Friday 07 October 2022.

Comments:
Bagre Dam:
The upstream level is 235.08m. The water level is stable. The filling rate is 101.30% compared to 86.14% on the same date in 2021.

Kompienga Dam:
The upstream level is 179.03m and is rising. The filling rate is 90.01% compared to 56.59% on the same date in 2021.

NOTE:
The valves of the Bagre Dam were opened on September 1, 2022, at 9 a.m. The average flow for the 36th day (Oct 06) was 342.18 m3/s

Water levels of the Bagre and Kompienga as of Tuesday 11 October 2022.

Comments:
Bagre Dam:
The upstream level is 235.07m. The water level is stable. The filling rate is 101.14% compared to 84.67% on the same date in 2021.

Kompienga Dam:
The upstream level is 179.11m and is rising. The filling rate is 90.68% compared to 56.10% on the same date in 2021.

NOTE: The valves of the Bagre Dam were opened on September 1, 2022, at 9 a.m. The average flow for the 40th day (Oct 10) was 2.70 m3/s.

The dam spillways/valves were closed at 9:19 am yesterday Monday, October 10, 2022.

List of Stakeholders consulted

No.	Full Name	Institution	Designation
1	Dorcas Adwoa Paintsil	Water Resources Commission	Acting Executive Secretary
2	Matilda Owusuaa Ndaa	Hydrological Services Department	Assistant Scientific Officer
3	Brian Tsikpor	Office of The Head of The Local Government Service	Principal Development Planning Officer
4	Jesse Pwayivi Kazapoe	WRC - White Volta Basin Secretariat	Principal Basin Offiicer
5	Eric Muala	Water Resources Commission	Principal Officer (Monitoring)
6	Andrew Asaviansa	Water Resources Commission, White Volta Basin	Assistant Basin Officer
7	Godfred Asamoah	Water Resources Commission	Water Quality Officer
8	Emmanuel Mualah	Volta River Authority	
9	Charlotte Nana Norman	National Disaster Management Organization	Director for Climate Change Adaptation
10	Emmanuel Obuobie	CSIR-Water Research Institute	Senior Research Scientist
11	Eric Asuman	Ghana Meteorological Agency	Director-General
12	Haruna Tia Alhassan	Nabdam District Assembly	District Planning Officer
13	Fatima A. Astanga	Ghana News Agency	Reporter
14	Mustapha Abdulai	NADMO, Bawku Municipal	Director
15	Daniel Azimbe	NADMO, Binduri District	Director
16	Anania Daniel Atampuba	NADMO, Bwaku West District	Director
17	Robert Abeero Alpha	NADMO, Talensi District	Director
18	Joseph A. Azuntaba	Bawku Municipal Assembly	Municipal Planning Officer
19	Diana Asabia	Talensi District Assembly	District Planning Officer
20	Bismark Adongo Ayorogo	Northern Patriots in Research & Advocacy (NORPRA)	
21	Selina Awuni	Regional NADMO	Admin. Assistant
22	Edward Ndanbon	NADMO, Nabdam District	Director
23	Yenli Reuben K.	Bwaku West District Assembly	District Planning Officer
24	Nuodio Benjamin B.	Binduri District Assembly	District Planning Officer
25	Comfort A. Atia	WRC, WVB	Admin. Assistant