



Ghana
Meteorological
Agency

THE DEVELOPING VERY STRONG EL NIÑO EVENT (2026-27)

Implications for Ghana and Recommended National Preparedness Measures

Technical Brief

Ghana Meteorological Agency (GMet)
October 2026





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Revised following the GMet Governing Board Scientific Review of 27 October 2026

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EXECUTIVE SUMMARY

The tropical Pacific Ocean is experiencing a very strong and still intensifying El Niño event, with potential implications for weather and climate conditions in Ghana. NOAA's Climate Prediction Center (CPC), which adopted the Relative Oceanic Niño Index (RONI) as its official ENSO index on 1 February 2026, reported a July–September 2026 RONI of +1.7°C (traditional ONI +2.2°C). The weekly Niño 3.4 anomaly of about +3.4°C (week centred on 21 October 2026) shows that the event is still strengthening. CPC's outlook of 8 October 2026 gives about a 96 percent chance that the November 2026 to January 2027 RONI reaches very strong intensity (+2.0°C or more), and it is very likely that El Niño will persist into early 2027.

Ghana's experience of past El Niño episodes, particularly the very strong events of 1982/83, 1997/98 and 2015/16 and the moderate 2023/24 event, shows the country's vulnerability to rainfall variability and associated impacts on agriculture, water resources, hydroelectric power generation and public health. The nature and severity of these impacts have varied considerably between events and across the country, and some of the most damaging Ghanaian climate shocks have occurred outside El Niño years. El Niño increases the likelihood of certain climate anomalies but does not produce uniform conditions across Ghana, and its influence depends strongly on the state of the tropical Atlantic Ocean.

GMet's observations and seasonal forecasts for 2026 have already highlighted these differences. Exceptionally heavy rainfall caused widespread flooding in parts of southern Ghana in June, while prolonged dry spells subsequently affected farming activities in parts of northern Ghana. The updated September–November (SON) and October–December (OND) seasonal outlooks indicate predominantly normal-to-below-normal rainfall across much of the country, with above-normal rainfall expected in some areas. Warmer-than-average temperatures are also projected for most locations, with regional variations.

Looking ahead, the principal concerns fall into three periods. From November 2026 to April 2027, the main risks are a hotter and drier dry season in many areas, bushfires, water stress and dust, with heat stress likely to peak between February and April 2027, especially in the north. The 2027 rainy seasons are uncertain in both directions: late and weak rains are possible if El Niño decays slowly or the Gulf of Guinea stays cool, while above-normal northern rainfall, flooding and Volta spillage become more likely if La Niña develops by mid-2027. For hydropower, generation through the 2026/27 dry season depends mainly on water already stored in Lake Volta; the El Niño-sensitive period is the 2027 inflow season, which will determine generation in 2028. Localised heavy rainfall and flooding remain possible throughout, even where seasonal rainfall is expected to be below normal.

This technical brief reviews the scientific evidence, historical impacts and emerging risks associated with the ongoing event and identifies priority measures for national preparedness. GMet emphasises the need for continuous climate monitoring, regular forecast updates, strengthened impact-based early warning and coordinated sectoral preparedness. Particular attention should be given to translating forecasts into timely, location-specific advisories to support agriculture, water-resource management, energy, disaster risk reduction and public health through 2027.

Interpretation: This document draws on established climate science, historical observations and probabilistic climate predictions. While confidence is high in the underlying scientific mechanisms and historical impacts of El Niño, uncertainties remain regarding the timing, magnitude and spatial distribution of future impacts in Ghana. The findings should therefore be interpreted as probabilistic assessments of climate risk rather than deterministic predictions. Likelihood terms follow the IPCC calibrated scale (Mastrandrea et al., 2010): very likely means 90 to 100 percent, likely 66 to 100 percent, about as likely as not 33 to 66 percent, and unlikely 0 to 33 percent.

1. PURPOSE AND SCOPE

This outlook monitors the development of the very strong El Niño event (CPC strength category) and its implications for Ghana, in preparation for consolidation into a policy document on national disaster preparedness. It draws on the latest advisories of NOAA/CPC and IRI, the WMO Global Seasonal Climate Update, GMet's 2026 seasonal forecasts and outlook updates for Northern and Southern Ghana, the regional consensus outlooks for the Sahel (PRESASS) and the Gulf of Guinea countries (PRESAGG), and available peer-reviewed and institutional literature on the impacts of previous El Niño events on Ghana and West Africa.

2. CURRENT STATE OF ENSO AND LATEST PROJECTIONS

2.1 Current oceanic and atmospheric conditions

The El Niño–Southern Oscillation (ENSO) is a naturally recurring pattern of warming and cooling of sea-surface temperatures in the central and eastern equatorial Pacific Ocean, coupled with corresponding shifts in tropical atmospheric circulation. NOAA's Climate Prediction Center upgraded its ENSO status to “El Niño Advisory” in June 2026, confirming that El Niño conditions were observed, not merely forecast, with the atmosphere already responding through increased thunderstorm activity over the central and eastern Pacific and suppressed convection over the Indonesian region, the classic atmospheric signature of an established event. Since 1 February 2026, CPC has classified ENSO using the Relative Oceanic Niño Index (RONI): the three-month mean Niño 3.4 anomaly minus the tropical mean (20°N–20°S) anomaly, rescaled and referenced to 1991–2020 (L'Heureux et al., 2024). RONI reached +1.7°C in July–September 2026, up from +1.4°C in June–August; the traditional ONI for July–September was +2.2°C.

Monitoring note (weekly values). The weekly Niño 3.4 anomaly (OISST) rose from about +2.1°C in mid-July to about +3.4°C in the week centred on 21 October 2026, indicating that the event is still intensifying (Figure 1). Weekly values are noisy and are not used to classify events; they are given here for monitoring only.

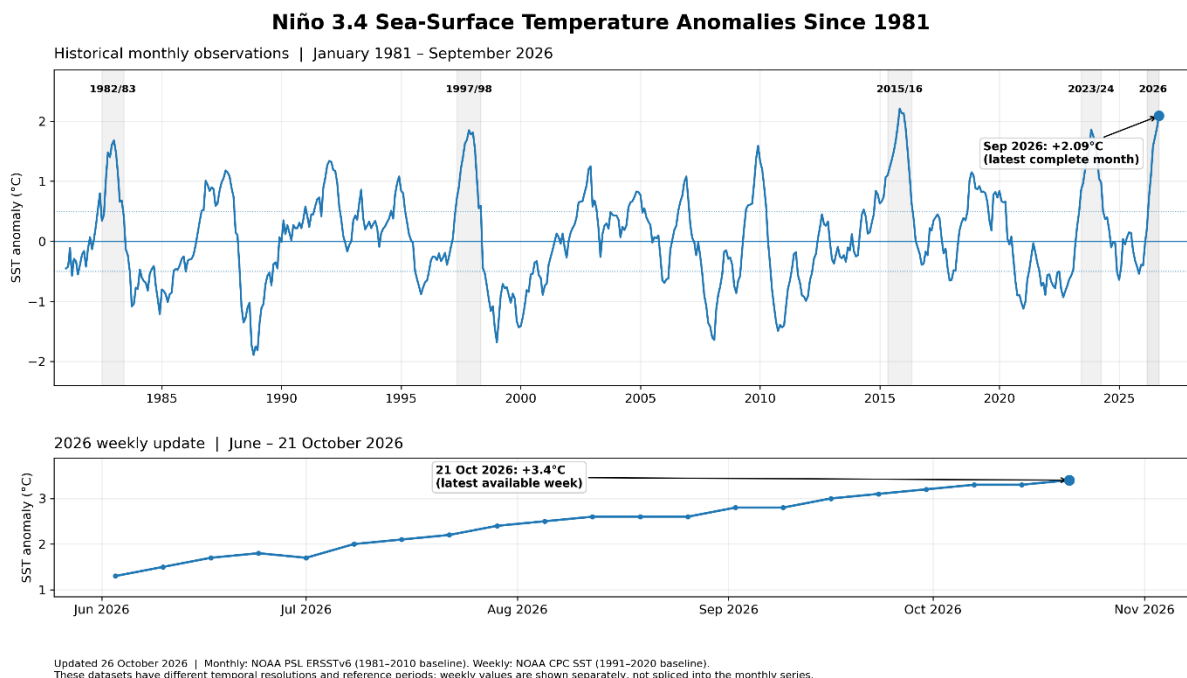


Figure 1: Monthly Niño 3.4 SST anomaly, January 1981 to September 2026 ($^{\circ}\text{C}$), ERSSTv6, 1991–2020 base, with the three month RONI overlaid. Source: NOAA CPC, accessed 27 October 2026.

2.2 ENSO strength categories

El Niño Conditions:

- Weak: $+0.5^{\circ}\text{C}$ to $+0.9^{\circ}\text{C}$
- Moderate: $+1.0^{\circ}\text{C}$ to $+1.4^{\circ}\text{C}$
- Strong: $+1.5^{\circ}\text{C}$ to $+1.9^{\circ}\text{C}$
- Very strong: $+2.0^{\circ}\text{C}$ and above

La Niña Conditions:

- Weak: -0.5°C to -0.9°C
- Moderate: -1.0°C to -1.4°C
- Strong: -1.5°C to -1.9°C
- Very strong: -2.0°C and below

Categories follow the Official NOAA CPC ENSO Strength Probabilities, which are verified against the three-month RONI in 0.5°C steps relative to 1991–2020. They apply to the three-month RONI only, not to weekly or monthly values. As CPC notes, the strength of an event does not necessarily correspond to the strength of its impacts. “Extreme” is not a CPC category; this brief uses the term only in the research sense described in Section 2.1.

2.3 Forecast development, intensity and duration

The IRI/CCSR multi-model plume of 19 October 2026 shows strong model agreement that El Niño will persist and strengthen through the remainder of 2026, with peak conditions most likely between October 2026 and January 2027. The ensemble of 27 models (16 dynamical and 11 statistical) projects a mean Niño 3.4

anomaly of about +3.5°C for October–December and November–January. CPC's strength outlook of 8 October 2026 gives about a 96 percent chance that the November–January RONI reaches very strong intensity (+2.0°C or more) and about a 70 percent chance that it reaches +2.5°C or more. On current readings the event is among the strongest on record; a ranking against past events will be made only when a full season of RONI values is available. It is very likely that El Niño will persist through the Northern Hemisphere winter and into early 2027.

On duration, ENSO events of this magnitude typically evolve over 12 to 18 months from onset to full decay. On current guidance, El Niño conditions have been present continuously since around mid-2026, are expected to peak between October 2026 and January 2027, and will gradually weaken through the first half of 2027. CPC gives about an 85 percent chance of El Niño in March–May 2027, falling to 45 percent in April–June 2027, so a transition towards ENSO-neutral or La Niña conditions later in 2027 is increasingly likely, though not yet established. The timing of that transition matters for Ghana's 2027 rainy seasons (Section 4.1).

Table 1: Current El Niño Conditions and Forecast Outlook

Indicator	Status / Forecast	Source	
ENSO alert status	El Niño Advisory. El Niño conditions are established and continuing to intensify, supported by oceanic and atmospheric observations.	NOAA/CPC, October 2026	8
Niño 3.4 sea-surface temperature (SST) anomaly	RONI +1.7°C (July–September 2026; ERSSTv6, 1991–2020 base; official classification index). Traditional ONI +2.2°C (same season). Weekly Niño 3.4 anomaly about +3.4°C (OISST, week centred on 21 October 2026; monitoring only).	NOAA/CPC RONI and ONI tables; NOAA weekly SST indices	
Probability of El Niño persisting through Northern Hemisphere winter 2026/27	Near 100% through January–March 2027, with greater than 83% probability of strong-to-very-strong conditions during this period.	NOAA/CPC, October 2026	
Probability of historically exceptional intensity, October–December 2026	83% probability of the three-month Relative Oceanic Niño Index (RONI) reaching or exceeding +2.5°C.	NOAA/CPC, October 2026	8
Probability of historically exceptional intensity, November 2026–January 2027	70% probability of RONI reaching or exceeding +2.5°C; approximately 96% probability of reaching very strong intensity (RONI ≥ +2.0°C).	NOAA/CPC, October 2026	
Model ensemble and projected intensity	The IRI ensemble comprises 27 models (16 dynamical and 11 statistical), with a mean projected Niño 3.4 anomaly of approximately +3.5°C during October–December 2026 and November 2026–January 2027.	IRI/CCSR, October 2026	19
Expected peak timing	Further intensification is projected, with peak conditions most likely between October 2026 and January 2027.	NOAA/CPC; IRI	

Indicator	Status / Forecast	Source
Expected weakening / possible transition	Gradual weakening is anticipated during the first half of 2027. The probability of El Niño is approximately 85% during March–May 2027, declining to 45% during April–June 2027. The timing of transition to ENSO-neutral or La Niña conditions remains uncertain.	NOAA/CPC, October 2026

Source: Compiled from NOAA Climate Prediction Center (CPC), ENSO Diagnostic Discussion (8 October 2026), RONI and ONI tables (ERSSTv6, accessed 27 October 2026) and Official ENSO Strength Probabilities; NOAA weekly SST indices (21 October 2026); and the IRI/CCSR ENSO Forecast Update (19 October 2026).

2.4 Tropical Atlantic conditions and outlook to May 2027

Ghana's rainfall is governed by the tropical Atlantic as much as by the Pacific. Gulf of Guinea sea-surface temperatures control moisture supply and the timing of the monsoon onset along the Guinea Coast, including southern Ghana, and the relationship between ENSO and West African rainfall has varied in strength and sign over recent decades (Losada et al., 2012; Rodríguez-Fonseca et al., 2015; Nnamchi & Li, 2011). Whether an El Niño year is wet or dry in West Africa depends on the state of the other ocean basins (Pomposi et al., 2020).

El Niño typically warms the tropical North Atlantic with a lag of a few months, the warming peaking in boreal spring of the decay year (Enfield & Mayer, 1997; Chiang & Sobel, 2002). This does not translate directly into wetter conditions on the Guinea Coast. Coastal rainfall responds mainly to equatorial and South Atlantic temperatures, and a North Atlantic that is warm relative to the south tends to shift the rain belt northwards, favouring the Sahel over the coast (Polo et al., 2008). The link between Pacific and Atlantic Niño events is also inconsistent from one event to the next (Lübbecke & McPhaden, 2012).

3. HISTORICAL EL NIÑO EVENTS AND OBSERVED IMPACTS ON GHANA

Table 2a gives the peak intensities of past El Niño events on CPC's official index (RONI) and on the traditional ONI, both from ERSSTv6. On RONI, four events since 1980 reached very strong intensity: 1982/83, 1991/92, 1997/98 and 2015/16. The 2023/24 event peaked at +2.0°C on the traditional ONI but only +1.4°C on RONI, making it a moderate event on the official index; it remains a useful recent reference for Ghana's vulnerability to rainfall extremes, agricultural losses and dam operations. The 1991/92 event is not yet documented in Table 2 and will be included in the composite analysis described in Section 3.1. The 2026/27 event reached a RONI of +1.7°C in July–September 2026 and is still intensifying; its eventual peak and ranking remain to be established. Past events provide a basis for examining potential risks, but the timing, magnitude and geographical distribution of impacts in Ghana differ considerably between episodes.

Table 2a: Peak three-month intensity of selected El Niño events (°C)

Event	Peak RONI, official index (season)	Peak traditional ONI (season)
1982/83	+2.4 (NDJ 1982, DJF 1983)	+2.1 (NDJ 1982, DJF 1983)
1991/92	+2.1 (DJF, JFM 1992)	+1.5 (DJF, JFM 1992)
1997/98	+2.3 (OND, NDJ 1997)	+2.4 (NDJ 1997)
2015/16	+2.3 (NDJ 2015)	+2.6 (NDJ 2015)

Event	Peak RONI, official index (season)	Peak traditional ONI (season)
2023/24	+1.4 (OND, NDJ 2023)	+2.0 (NDJ 2023)
2026/27 (to date)	+1.7 (JAS 2026)	+2.2 (JAS 2026)

Source: NOAA CPC RONI and ONI (ERSSTv6) tables, accessed 27 October 2026. RONI uses the 1991–2020 base period; ONI uses centred 30-year base periods updated every five years. Seasons: JAS, July–September; OND, October–December; NDJ, November–January; DJF, December–February; JFM, January–March.

3.1 Summary of observed effects on Ghana in past El Niño years

Table 3. Documented effects of major El Niño events on Ghana

Event	Peak intensity (RONI; ONI)	Observed effects and notable events in Ghana
1982/83	Very strong (+2.4°C; +2.1°C)	<p>Drought and agriculture: Severe drought during 1981–1983 (Ofori-Sarpong, 1986), accompanied by widespread bushfires, destruction of vegetation and crops, food shortages and substantial livelihood losses. The drought began before El Niño onset (around April–June 1982) and sat within the multidecadal Sahel drought (Giannini et al., 2003); it was most severe in 1983, a decay year.</p> <p>Hydropower: Reduced inflows caused a major decline in Lake Volta levels, constraining electricity generation at Akosombo and leading to power rationing from late 1983 into subsequent years. National electricity supply fell from approximately 5,180 GWh in 1981 to 1,670 GWh in 1984.</p> <p>Health: Food insecurity and water scarcity increased household vulnerability, although reliable event-specific disease or mortality figures remain limited.</p>
1997/98	Very strong (+2.3°C; +2.4°C)	<p>Rainfall: Variable rainfall conditions across West Africa, with drought in parts of the region but no uniformly severe drought response.</p> <p>Hydropower: Reduced rainfall and inflows into Lake Volta contributed to the 1998 national electricity crisis, with restrictions on Akosombo/Kpong hydroelectric generation and widespread electricity rationing affecting households, industries and economic activities.</p> <p>Health: A major meningitis epidemic in northern Ghana during November 1996–May 1997 recorded 18,703 cases and 1,356 deaths. The outbreak largely preceded the El Niño and has not been established as an ENSO-related impact.</p>
2015/16	Very strong (+2.3°C; +2.6°C)	<p>Agriculture: Reduced rainfall, delayed onset and prolonged dry spells affected maize production in Ghana's transition zone, particularly Techiman, Wenchi and Ejura, with associated livelihood and food-security pressures. Cocoa farmers also experienced drought-related stresses.</p> <p>Hydropower: Low inflows and declining Lake Volta levels constrained Akosombo's hydroelectric generation. Reservoir levels fell below the reported minimum operating threshold in June 2015, compounding Ghana's existing electricity supply difficulties. This preceded the mature phase of the 2015 El Niño and most likely reflected low inflows in earlier seasons, since Lake Volta stores several years of inflow.</p> <p>Flooding: The 3 June 2015 Accra flood and associated fire disaster claimed more than 152 lives.</p>

Event	Peak intensity (RONI; ONI)	Observed effects and notable events in Ghana
		<p>Health: A meningitis outbreak between December 2015 and February 2016 resulted in 432 suspected cases in three northern regions, caused mainly by <i>Streptococcus pneumoniae</i> and <i>Neisseria meningitidis</i> serogroup W (Aku et al., 2017). Neither the Accra flood nor the outbreak has been attributed to ENSO.</p>
2023/24	Moderate on RONI (+1.4°C); +2.0°C on ONI	<p>Agriculture: Significant cocoa production losses occurred amid rainfall extremes: heavy rain from April to June 2023 followed by a harsh dry spell from November 2023 to February 2024. A peer-reviewed study estimated a 20% year-on-year decline in Ghana's 2023/24 cocoa production (Albright et al., 2026); losses also reflected cocoa swollen shoot virus disease, ageing trees and illegal mining on cocoa land. Prolonged dry spells caused crop wilting, poor germination and losses in maize and other staple crops across northern and transitional Ghana.</p> <p>Dam operations and flooding: Exceptionally high inflows into Lake Volta necessitated controlled spillage from the Akosombo and Kpong dams during September–October 2023, causing extensive flooding in downstream communities, particularly Mepe, Battor, Sogakope, Mafi and Adidome. Homes, farmlands and public infrastructure were damaged, and thousands of residents were displaced. A direct ENSO attribution for the spillage has not been established.</p> <p>Health: Flooding disrupted healthcare services, sanitation and drinking-water infrastructure, increasing risks of waterborne disease and psychological distress. Subsequent water-quality research identified potentially pathogenic bacteria in affected downstream communities.</p>
2026/27 (ongoing)	RONI +1.7°C to date (JAS 2026); ONI +2.2°C	<p>Flooding (June 2026): Heavy rainfall on 28–29 June caused severe flooding in Greater Accra. Accra recorded 593.2 mm for June, with 169.2 mm reported in 24 hours during the major event. Authorities reported 12 deaths and extensive damage. Farmland was also inundated in parts of Anloga in June. Dam spillage: Controlled spillage was reported at Weiija Dam in May, with further spillage announced for September. Burkina Faso's Bagré Dam was scheduled for controlled spillage from 28 August 2026, prompting downstream flood-risk precautions in Ghana. These events are not attributed to El Niño.</p>

3.2 Key lessons for the current event

- El Niño raises the probability of hotter and drier conditions in parts of Ghana, particularly during the dry season, but the relationship has varied in strength and sign over recent decades and depends strongly on the tropical Atlantic (Section 2.4). El Niño does not preclude, and has in some years coincided with, intense short-duration rainfall and flood events in the south, so drought and flood contingencies must be planned for concurrently.
- The distribution of rainfall is as important as the total amount received. Our assessment indicates that agricultural losses during previous El Niño events were not necessarily associated with low seasonal rainfall totals alone. Delayed onset, prolonged dry spells and poorly distributed rainfall contributed significantly to crop losses. GMet will therefore continue to monitor rainfall distribution, dry-spell

duration, onset and cessation dates, alongside seasonal rainfall totals, to provide more targeted agricultural advisories.

- Impacts compound across sectors rather than occurring in isolation: the same event has historically produced simultaneous stress on food crops, food prices, hydropower reliability, and public health.
- Cocoa output is sensitive to rainfall extremes in both directions. Heavy rainfall during flowering and early pod development, together with dry-season drought, explains most year-to-year variation in Ghana's cocoa yields (Albright et al., 2026). El Niño in West Africa has tended to lower the risk of the heaviest wet-season rain but raise the risk of dry-season drought, so its net effect on cocoa differs between events. Non-climatic factors, including swollen shoot disease and illegal mining, also contributed to the 2023/24 losses.
- The Volta dams (Akosombo and Kpong) are a recurring point of vulnerability in both directions: too little inflow threatens power generation, while sudden heavy inflow can force spillage and downstream flooding, as in 2023. Because Lake Volta stores several years of inflow, generation responds to wet-season inflows with a lag (Section 5.2).

4. LIKELY IMPLICATIONS FOR GHANA'S CLIMATE

4.1 Rainfall: timing and distribution of the major and minor seasons

GMet's 2026 seasonal forecasts, issued in February (Southern Sector) and May (Northern Sector) 2026 before the event intensified, already signalled several of the risk patterns historically associated with El Niño years:

- Northern Ghana (single rainy season, May–October): onset generally forecasted as normal to late across most areas (with a few localised exceptions such as areas in and around Bole and Salaga); May–September rainfall forecasted as below-normal to near-normal across much of the north and parts of the middle belt; peak-season totals of roughly 450–700 mm; dry spells of 10–18 days expected in parts of the Upper East, Upper West and Transition zones; cessation expected early to normal in most areas.
- Southern Ghana (major rainfall season: March–July; minor rainfall season: September–November): The forecast indicated a risk of dry spells during March–April, potentially affecting early-season crop establishment and reservoir inflows. This was expected to be followed by above-normal rainfall during April–June, particularly along the eastern coastal belt and adjoining inland areas, including Accra, Tema, Cape Coast, Saltpond, Asamankese, Akim Oda, Koforidua and Kade.

As the El Niño event intensified between June and October 2026, conditions evolved beyond those considered in GMet's initial seasonal forecasts. For the remainder of 2026 the balance of risk has shifted towards conditions often associated with El Niño in Ghana: reduced or more erratically distributed rainfall during the southern minor season (September–November 2026) in many areas, and a hotter, drier dry season beginning around November 2026.

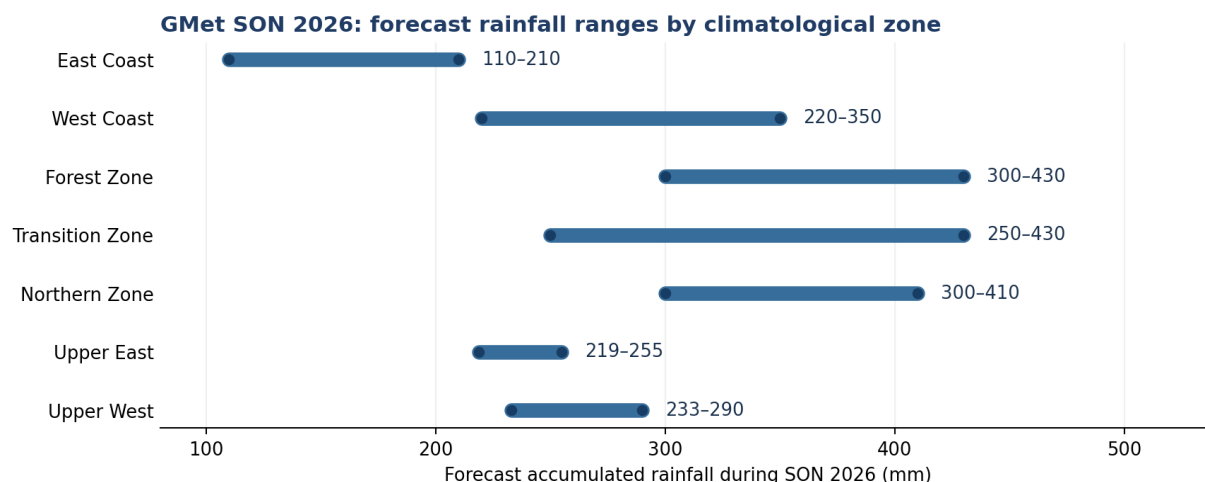


Figure 2: Forecast accumulated rainfall for September–November 2026 (mm), GMet September 2026 update.

GMet’s updated October–December (OND) 2026 seasonal outlook, which incorporates the latest available global climate assessments from CPC, IRI and WMO alongside updated national analyses, projects below-normal rainfall across much of Ghana. However, above-normal rainfall is anticipated in some inland areas of the Greater Accra and Central Regions, southwestern portions of the Volta and Eastern Regions, and parts of the Bono and Savannah Regions, as well as northwestern areas of the Upper West Region. These regional differences highlight the spatial variability of the expected rainfall response and the importance of considering location-specific risks rather than assuming uniform drying conditions across the country.

While these projections are consistent with some historical El Niño-related rainfall patterns, they do not establish that all the anticipated impacts will occur. Continued monitoring of evolving ocean and atmosphere conditions and regular updates to seasonal forecasts will therefore be essential for assessing risks through the remainder of 2026 and into 2027.

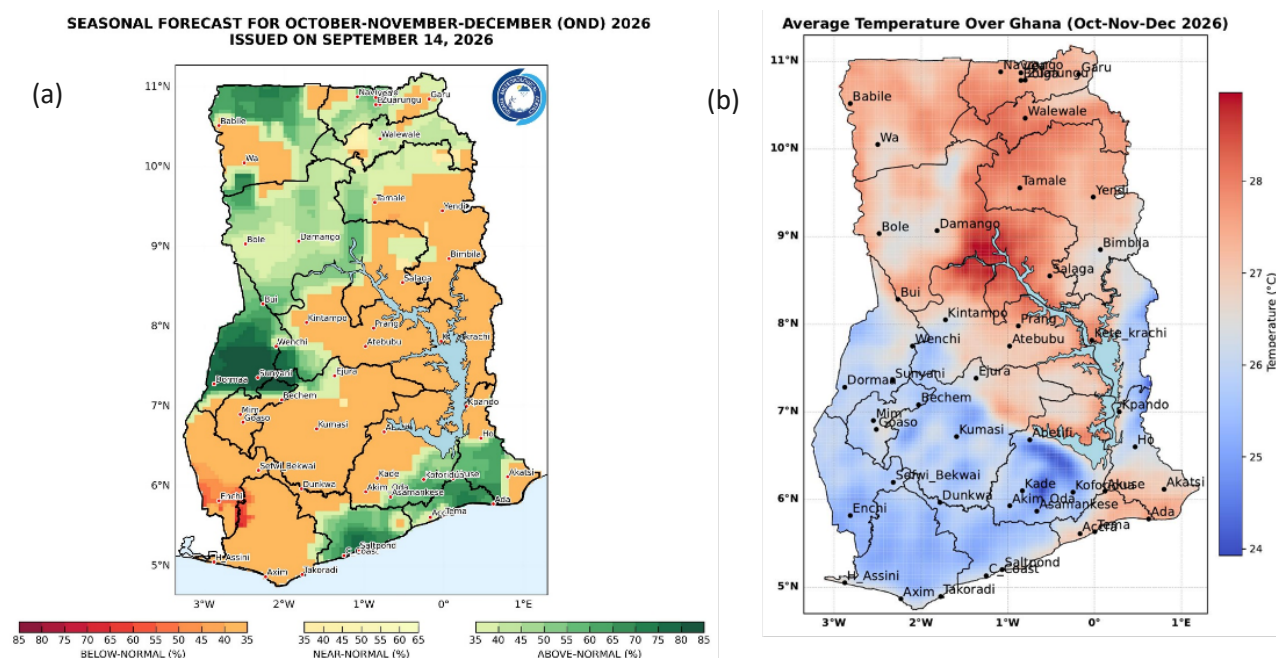


Figure 3: (a) OND 2026 rainfall forecast and (b) OND 2026 average temperature forecast for Ghana, GMet October 2026 update, which supersedes Figure 2 for October and November.

4.2 Temperature

El Niño years are often associated with above-average temperatures across Ghana's cocoa belt and more widely, both through broad tropical atmospheric warming linked to the Pacific event and because reduced cloud cover and rainfall increase surface heating. Peer-reviewed analysis of Ghana's cocoa-growing zone finds that recent El Niño conditions are associated with statistically significant increases in temperature across all seasons, together with reduced rainfall in most seasons, particularly the major wet season, relative to La Niña years. GMet's October–December 2026 forecast indicates warmer-than-average conditions across most of the country. The exceptions are much of the south-west and a corridor in the east from Ho to Kete Krachi, where cooler-than-average conditions are forecast. These areas coincide with forecast near-normal or above-normal rainfall, and more cloud and wetter soils lower daytime maximum temperatures; because this part of the forecast runs against the national tendency, it is issued with low confidence. A global seasonal outlook for 2026 flags a substantial probability of heat-stress conditions for Ghana's cocoa-growing areas.

4.3 Dry-season (Harmattan) conditions

The Harmattan season, typically extending from late November to March, is characterised by dry north-easterly winds, reduced humidity and periodic dust haze across Ghana, particularly in the northern and middle belts. Because below-normal rainfall is projected for much of the country during October–December 2026, existing moisture deficits and drying vegetation could increase the risk of bushfires, water stress and agricultural disruption during the 2026/27 dry season.

The intensity and duration of Harmattan conditions depend mainly on the Saharan pressure systems, the North Atlantic Oscillation, the position of the Inter-Tropical Discontinuity and dust emission (Moulin et al.,

1997; Lyngsie et al., 2013); a direct ENSO influence on Harmattan intensity is weakly established. Dust exposure and prolonged dry conditions affect air quality, visibility and respiratory health, and the usual dry-season meningitis risk in northern Ghana may be compounded by heat and dryness (Section 5.4). GMet will continue to monitor these conditions and provide updates to support preparedness across affected sectors.

4.4 Heat and health, February to April 2027

February to April is the hottest period of the year in northern Ghana. Tropical mean temperatures typically peak a few months after an El Niño peak (Yulaeva & Wallace, 1994; Trenberth et al., 2002), so early 2027 is likely to be unusually hot. Background warming is, however, the main driver of recent West African heat extremes: El Niño contributed only about 0.2°C to the March–April 2024 Sahel heatwave, far less than human-induced warming (World Weather Attribution, 2024a), and humid heat in southern West Africa in early 2024 was about 4°C hotter because of climate change (World Weather Attribution, 2024b). The heat risk for February to April 2027 is therefore high, with El Niño a modest added factor.

GMet and the Ghana Health Service will issue heat advisories against agreed maximum temperature and heat-index thresholds, with particular attention to older people, young children, outdoor workers, people with chronic illness and crowded urban households. Night-time temperatures, which limit the body's recovery from daytime heat, will be included in advisories for northern towns.

5. SECTORAL IMPACTS AND IMPLICATIONS

5.1 Agriculture and food security

Ghana's agriculture remains predominantly rain-fed, making it the sector most directly exposed to rainfall deficits, rainfall extremes and heat stress. Cocoa, the country's principal agricultural export, is sensitive to rainfall extremes in both directions: heavy rainfall during flowering and early pod development, together with dry-season drought, explains most year-to-year variation in Ghana's yields (Albright et al., 2026). Black pod disease increases with the frequency of rain events rather than with heat, so it is mainly a wet-season risk. In 2023/24, heavy rain from April to June 2023 was followed by a harsh dry spell from November 2023 to February 2024; Ghana's output fell by an estimated 20 percent (Albright et al., 2026), and the International Cocoa Organization reported a global decline of about 11 percent, which drove prices to record highs (ICCO, 2024). Those losses also reflected cocoa swollen shoot virus disease, ageing trees and illegal mining on cocoa land (Dzahini-Obiatey et al., 2010; Wessel & Quist-Wessel, 2015). Current seasonal outlooks assign Ghana's cocoa belt a substantial probability of medium heat stress during the 2026 growing cycle. Staple food crops (maize, millet, sorghum, rice, groundnuts) grown under rain-fed conditions in the north are exposed to late onset, shortened growing windows and mid-season dry spells, with knock-on risks to household food security, farm incomes and food-price inflation nationally.

5.2 Water resources and the Volta system

Inflows to Lake Volta, Ghana's principal freshwater and hydropower reservoir, are concentrated in roughly August to October, much of them from the basin's northern zones in Burkina Faso and northern Ghana; the basin also spans Côte d'Ivoire, Togo, Benin and Mali. Dry-season rainfall contributes little, and the lake stores several years of inflow (Gyau-Boakye, 2001; Boadi & Owusu, 2017). Generation through the 2026/27 dry season is therefore determined mainly by current storage and by the 2026 wet-season inflows, which are now essentially complete. Above-normal rainfall in Burkina Faso and the controlled spillage of the Bagré Dam from 28 August 2026 point to good inflows from the upper basin. A hotter, drier dry season will raise

open-water evaporation from the lake, a large term in its water balance, but this effect is secondary to storage.

The El Niño-sensitive risk to the Volta system lies in the 2027 wet season. A late or weak 2027 season would lower inflows and constrain generation in 2028; a developing La Niña would instead raise the risk of heavy inflows and downstream spillage. The basin's history shows both. In October 2023, the Volta River Authority opened the Akosombo and Kpong spillways after unusually heavy inflows, displacing an estimated 35,857 people in North, Central and South Tongu and Asuogyaman districts. Generation shortfalls and flood-control spillage should therefore both be treated as live risks for the 2027 inflow season, not as mutually exclusive scenarios.

5.3 Hydropower and energy

Hydropower remains a significant component of Ghana's electricity supply, accounting for approximately 26.6% of total installed generation capacity, excluding embedded generation, at the end of 2025. The country's hydropower capacity is provided primarily by three major facilities: Akosombo (1,020 MW), Kpong (160 MW) and Bui (404 MW), with a combined installed capacity of 1,584 MW. In 2025, these facilities generated approximately 8,752 GWh of electricity, representing 32.4% of Ghana's total electricity generation. However, hydropower production is sensitive to rainfall variability, reservoir inflows and water availability, highlighting the importance of climate-informed water-resource management for maintaining reliable electricity generation. Because dry-season generation depends mainly on stored water, El Niño is not expected to constrain hydropower through the 2026/27 dry season unless current lake levels are already low. The El Niño-sensitive period is the 2027 inflow season. Contingency planning for 2027 and 2028 by the Volta River Authority, GRIDCo and the Energy Commission should consider greater reliance on thermal generation if 2027 inflows are poor, with the associated fuel-cost and foreign-exchange implications.

5.4 Health

Northern Ghana lies within the African meningitis belt, where cerebrospinal meningitis cases rise each dry season with low humidity and dust (Sultan et al., 2005; Agier et al., 2013). A hot, dry 2026/27 season may add to this seasonal risk, but it should not be described as an El Niño effect. The epidemiology has changed since the 1996–97 serogroup A epidemic, which began before the 1997/98 El Niño developed. Ghana introduced the serogroup A conjugate vaccine (MenAfriVac) in a 2012 mass campaign in the northern regions, and the 2015–16 northern outbreak was caused by *Streptococcus pneumoniae* and *Neisseria meningitidis* serogroup W (Aku et al., 2017; Trotter et al., 2017). Laboratory confirmation of the causative organism therefore remains essential to target vaccination. Other plausible health pressures include heat-related illness, particularly from February to April 2027, malnutrition risk linked to food insecurity, and cholera and other water-borne disease in communities affected by heavy rainfall or flooding.

5.5 Infrastructure, fisheries and other climate-sensitive sectors

- Infrastructure: increased wildfire risk to rural infrastructure and forest reserves during an intensified dry season; localised flood damage to roads, bridges and housing in the event of heavy short-duration rainfall or Volta spillage, as in 2023.

- Fisheries: reduced Volta Lake levels affect lake-based fisheries and inland aquaculture livelihoods. Ghana's marine fisheries depend on seasonal coastal upwelling, mainly from July to September, which is driven by equatorial Atlantic dynamics and local winds along the Guinea Current (Bakun, 1978; Djakouré et al., 2017); the ENSO influence on it is indirect and weak.
- Disaster risk more broadly: compound risk of drought, wildfire, food-price shocks and flash flooding occurring within the same 12 to 18 month window, straining NADMO, Ghana Health Service, Ghana National Fire Service and district-level emergency response capacity simultaneously.
- Macroeconomy and trade: cocoa export revenue and hydropower reliability are both significant to the national fiscal and current-account position; simultaneous stress on both carries broader macro-fiscal implications beyond the immediate humanitarian and sectoral impacts described above.

6. REGIONS AND DISTRICTS OF PARTICULAR VULNERABILITY

Table 4. Illustrative regional and district-level vulnerability profile.

Region / Area	Primary exposure	Key vulnerable districts / zones (illustrative)
Upper East, Upper West, Northern (meningitis belt / far north)	Rainfall deficit, shortened growing season, heat stress (February–April), seasonal meningitis risk	Districts with recurrent dry-season meningitis cases; single-season rain-fed farming districts
Savannah, North East, Bono East (middle belt/transition zone)	Dry spells (10–18 days), delayed cessation risk, food security	Transition-zone rain-fed farming districts flagged in GMet's 2026 northern forecast
Eastern Region: Asuogyaman and Volta Lake shoreline	Reservoir level volatility; controlled-spillage flood risk, especially in the 2027 inflow season	Communities directly downstream of Akosombo/Kpong
Volta Region: North, Central and South Tongu	Downstream flooding from Volta spillage; also, drought stress in dry years	Mepe, Battor, Sogakope, Mafi, Adidome, Ada and other riverbank communities (2023 precedent)
Cocoa belt: Western, Western North, Ashanti, Bono, Ahafo, Eastern	Rainfall extremes and dry-season drought; black pod disease in wet spells; livelihood and export exposure	Major cocoa-growing districts across these regions
Eastern coastal belt: Greater Accra, Central (parts)	Localised heavy-rainfall and flash-flood risk even amid an overall drier national pattern	Accra, Tema, Cape Coast, Saltpond and adjoining low-lying urban areas

7. SCENARIOS: TIMING AND SEVERITY OF ANTICIPATED IMPACTS

Table 5. Indicative scenario timeline.

Period	Most likely conditions	Principal risks
Now to November 2026	El Niño continuing to intensify; southern minor season ending; northern rainy season over in most areas; dry season beginning	Early food-security stress where 2026 harvests were poor; bushfire and water stress; localised flash flooding in the south still possible; GMet will update its guidance regularly

December 2026 to January 2027 (event peak)	Very strong El Niño most likely at or near peak intensity; dry, dusty Harmattan conditions	Bushfires; water stress; the usual dry-season meningitis risk in the north (surveillance window open); continued food-price pressure
February to April 2027	Peak heat, especially in the north; El Niño weakening but still active; onset of the southern major season due from March	Heat stress and heat-related illness (highest-risk period); wildfire; meningitis season continues; uncertain southern onset; monitor Volta storage, though no El Niño effect on supply is expected before the 2027 inflow season
May to July 2027	El Niño decaying (CPC: about 45 percent chance of El Niño in April–June 2027); ENSO-neutral or La Niña increasingly likely	Two-sided: late, weak rains if decay is slow or the Gulf of Guinea is cool; above-normal northern rainfall and flooding if La Niña develops; planting guided by GMet onset forecasts
August to October 2027	Volta basin inflow season; ENSO state uncertain	Inflows decide 2028 hydropower generation; downstream spillage preparedness if rainfall is above normal

Severity for Ghana is best framed as a range rather than a single outcome, and it is defined here by impact on Ghana, not by Pacific intensity; as CPC notes, the strength of an event does not necessarily match its impacts. A lower-severity scenario involves significant but manageable stress on rain-fed farming, water and health services, met largely through existing institutional mechanisms. A higher-severity scenario combines a late or failed 2027 rainy season with dry-season heat and food-price pressure, and would require sustained cross-government coordination, especially in health and food security. Present evidence does not allow GMet to say which is more likely; the scenarios will be updated with each seasonal forecast.

8. RECOMMENDED PREPAREDNESS, EARLY-WARNING, MONITORING, MITIGATION AND RESPONSE MEASURES

8.1 Institutional coordination

1. Activate or reconvene, with technical support from GMet, a National El Niño / Dry-Season Preparedness Task Force bringing together the Ministries responsible for Food and Agriculture, Health, Energy, Water Resources, Local Government, Finance, and the Volta River Authority, reporting to Government/Cabinet at a fixed cadence (e.g. monthly) through the peak risk period.
2. GMet will issue updated seasonal forecasts for the 2027 major and northern seasons early in 2027, incorporating the June–October 2026 intensification not reflected in the February and May 2026 forecasts and conditioned on both the Pacific and the tropical Atlantic, and will brief Government and Cabinet directly on any material revisions.
3. The National Development Planning Commission (NDPC) and NADMO should produce a formal district-level vulnerability and hazard-overlay map (building on Table 3) to guide targeted resource allocation.

8.2 Early warning and monitoring

- Government's technical agencies should act on the monthly NOAA/CPC ENSO Diagnostic Discussion and the IRI/CPC seasonal ENSO plume forecast, alongside GMet's own dekadal and seasonal bulletins, when received.
- Strengthen real-time monitoring of Volta Lake levels and inflows, with pre-agreed trigger levels for (a) hydropower contingency measures and (b) flood-control spillage communication protocols, developed jointly by VRA, BUI Authority, GRIDCo, NADMO and downstream district assemblies.
- Reinforce dry-season meningitis surveillance in the northern regions in coordination with the Ghana Health Service, WHO AFRO and regional meningitis-belt monitoring networks, with laboratory confirmation of serogroups and pre-positioned vaccine and treatment stocks.
- Expand agromet advisory services (onset/cessation forecasts, dry-spell alerts) to rain-fed farming districts identified as most vulnerable, delivered through existing extension and mobile-advisory channels.
- Tie each sectoral action to a pre-agreed early-action trigger that GMet or a partner can monitor, following the forecast-based financing approach (Coughlan de Perez et al., 2015). Illustrative triggers, with values to be agreed with partners: a dry spell of 15 days or more by a stated dekad in a district (agromet advisories and seed support); forecast maximum temperatures at or above an agreed threshold for three consecutive days (heat advisories by the Ghana Health Service); Volta lake elevation below an agreed level on a stated date (VRA contingency measures); and an above-normal rainfall forecast with La Niña developing (downstream spillage preparedness).
- Issue warnings in the Common Alerting Protocol (CAP) format, so that broadcasters, mobile networks and district assemblies relay alerts consistently.

8.3 Sectoral mitigation measures

- Agriculture and food security: pre-position drought-tolerant and early-maturing seed varieties; expand access to irrigation and water harvesting in the most exposed northern and transition-zone districts; strengthen national food and seed reserves; monitor cocoa belt conditions jointly with COCOBOD and consider targeted extension support (shade management, disease control) to affected farmers.
- Water and energy: plan energy-mix and demand-management contingencies at the Energy Commission and GRIDCo for 2027 and 2028, when El Niño-related inflow risk applies; review reservoir operating rules to balance drought and flood-control objectives; ensure downstream communities have updated flood evacuation and communication plans in case spillage becomes necessary in 2027.
- Health: pre-position meningitis vaccines and treatment supplies in the northern regions, with laboratory capacity to confirm serogroups; prepare heat-health action plans and advisories for February to April 2027; strengthen malnutrition surveillance; maintain cholera and water-borne disease preparedness for any heavy-rainfall or flood episodes.
- Disaster risk management: replenish and pre-position NADMO relief stocks; identify and prepare flood-prone Volta-basin and coastal communities; integrate wildfire risk-reduction messaging into dry-season public communication; rehearse cross-agency response protocols before the peak risk period (November 2026 to April 2027).

- Public communication: launch a coordinated national public-awareness campaign, possibly led by the National Commission for Civic Education together with GMet and NADMO, to explain the event in plain language, manage public expectations and direct citizens to authoritative sources of information and early-warning alerts, following GMet's communication guidance for the media and political leaders.

8.4 Financing and contingency planning

- Assess the adequacy of the National Disaster Management Fund and related contingency budget lines against the range of scenarios in Section 7, and identify any need for supplementary allocation or contingent financing (including regional and international mechanisms) ahead of the peak risk period.
- Engage development partners and regional bodies (ECOWAS, WMO Regional Climate Centres, ACMAD) early, given that El Niño impacts on the Volta basin and West African food systems are inherently transboundary.

9. Documents and Literature Consulted

The preparation of this document was informed by a review of peer-reviewed scientific literature, historical climate records, seasonal forecasts, operational climate bulletins and technical assessments covering El Niño events and their impacts on Ghana. Particular consideration was given to publications and analyses produced by the Ghana Meteorological Agency (GMet), including historical rainfall and dry-spell observations, seasonal climate outlooks and forecast updates issued during 2026

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ANNEX A: SUMMARY TABLE FOR POLICY DEVELOPMENT

Question	Current answer
Is El Niño happening now?	Yes. Confirmed and intensifying (El Niño Advisory since June 2026; RONI +1.7°C in July–September 2026).
How strong will it become?	Very likely very strong (CPC, 8 October 2026: about 96 percent chance of a November–January RONI of +2.0°C or more). Whether it meets the research definition of an “extreme” event is not yet known.
When will it peak?	October 2026 to January 2027.
When will it end?	Gradual weakening through the first half of 2027; El Niño is about as likely as not to persist into April–June 2027 (45 percent).
What does this mean for Ghana's rains?	Drier conditions likely in many areas for the rest of 2026, with localised heavy rain and flooding still possible. The 2027 rainy seasons are uncertain in both directions: late, weak rains, or above-normal rains with flood and Volta spillage risk if La Niña develops.
What does this mean for the dry season?	A hotter, drier dry season is likely from late November 2026, starting in the north, with heat stress highest from February to April 2027. Harmattan intensity depends mainly on factors other than El Niño.
Which sectors are most exposed?	Rain-fed agriculture and food security, cocoa, dry-season public health (heat and seasonal meningitis), Volta basin water management and flood risk, and hydropower in the 2027 inflow season.
What about electricity?	Generation through the 2026/27 dry season depends mainly on water already stored in Lake Volta. The El Niño-sensitive period is the 2027 inflow season. Refer questions to VRA, GRIDCo and the Energy Commission.
What should Government do now?	Activate coordinated preparedness (Section 8): early warning with pre-agreed triggers, sectoral mitigation, contingency financing and public communication, ahead of the November 2026 to April 2027 peak risk window.

ANNEX B: GLOSSARY OF TECHNICAL TERMS, EXPRESSIONS AND ABBREVIATIONS

Table B1. ENSO and Climate-System Terminology

Term	Definition
El Niño	The warm phase of the El Niño–Southern Oscillation (ENSO), characterised by unusually warm sea-surface temperatures in the central and eastern equatorial Pacific Ocean and associated changes in atmospheric circulation.
La Niña	The cool phase of ENSO, characterised by unusually cool sea-surface temperatures in the central and eastern equatorial Pacific Ocean and associated atmospheric changes.
El Niño–Southern Oscillation (ENSO)	A naturally occurring, coupled ocean–atmosphere climate phenomenon involving fluctuations in tropical Pacific sea-surface temperatures, atmospheric pressure, circulation and rainfall patterns.
ENSO-neutral	Conditions in which the tropical Pacific does not meet the operational criteria for either El Niño or La Niña.
Niño 3.4 Region	An area of the equatorial Pacific extending from 5°N to 5°S and 170°W to 120°W, used to monitor ENSO conditions and intensity.
Sea-Surface Temperature (SST)	The temperature of seawater near the ocean surface, which influences atmospheric circulation, evaporation and rainfall formation.
Sea-Surface Temperature Anomaly	The difference between an observed or forecast sea-surface temperature and its climatological average for the corresponding period.
Oceanic Niño Index (ONI)	The traditional ENSO index: three-month running mean SST anomalies in the Niño 3.4 region, calculated relative to centred 30-year base periods updated every five years. Replaced by RONI as CPC's official index on 1 February 2026.
Relative Oceanic Niño Index (RONI)	An ENSO index that subtracts the tropical mean (20°N–20°S) SST anomaly from the Niño 3.4 anomaly and rescales the result, separating ENSO warming from general tropical ocean warming. CPC's official ENSO index since 1 February 2026 (L'Heureux et al., 2024).
ENSO strength category	CPC's classification of an event as weak, moderate, strong or very strong from its three-month RONI, in 0.5°C steps. Strength describes the ocean state, not the size of impacts.
Extreme El Niño (research sense)	An El Niño in which deep convection moves into the normally dry eastern equatorial Pacific, as in 1982/83 and 1997/98 (Cai et al., 2014). Not a CPC strength category.
Southern Oscillation Index (SOI)	An atmospheric index based on differences in sea-level pressure between Tahiti and Darwin, used to assess the atmospheric component of ENSO.
Ocean–Atmosphere Coupling	The interaction between ocean temperatures and atmospheric circulation through which ENSO conditions develop, intensify and influence climate patterns.
Walker Circulation	The large-scale east–west tropical atmospheric circulation, particularly over the Pacific Ocean, which changes during El Niño and La Niña events.
Atmospheric Convection	The vertical movement of air associated with heating and atmospheric instability, often producing cloud development, thunderstorms and rainfall.
Climate Teleconnection	A relationship through which climate variability in one geographical region influences weather or climate conditions in distant regions.

Term	Definition
Indian Ocean Dipole (IOD)	A climate pattern involving differences in sea-surface temperatures between the western and eastern tropical Indian Ocean, which can influence atmospheric circulation and regional rainfall.
Tropical Atlantic SST Variability	Changes in sea-surface temperatures across the tropical Atlantic Ocean that influence moisture transport, atmospheric circulation and rainfall patterns over West Africa.
Atlantic Niño (ATL3 index)	Year-to-year warming or cooling of the eastern equatorial Atlantic, measured over 3°N–3°S, 20°W–0°, which influences rainfall along the Guinea Coast.
West African Monsoon (WAM)	The seasonal atmospheric circulation that transports moist air from the Atlantic Ocean into West Africa, producing much of the region's rainfall.
Inter-Tropical Discontinuity (ITD)	The boundary separating moist southwesterly monsoon air from dry northeasterly continental air over West Africa.
Intertropical Convergence Zone (ITCZ)	A broad tropical zone of converging winds and rising air, associated with cloud development and rainfall, whose position shifts seasonally.
Harmattan	A seasonal period characterised by dry, often dust-laden northeasterly winds originating from the Sahara and affecting Ghana during the dry season.

Table B2. Seasonal Forecasting, Climate Data and Statistical Terminology

Term	Definition
Seasonal Forecast	A probabilistic prediction of average climate conditions over a period of several months, including rainfall and temperature tendencies.
Climatological Normal	The average climatic condition calculated over a defined reference period, commonly 30 years. GMet's seasonal assessments generally use 1991–2020.
Long-Term Mean (LTM)	The average value of a meteorological variable calculated over a specified historical period and used as a reference for comparing observed or forecast conditions.
Below-Normal Rainfall	Rainfall falling within the lower category of the historical seasonal distribution, commonly the lowest third when tercile categories are used.
Near-Normal Rainfall	Rainfall falling within the middle category of the historical seasonal distribution.
Above-Normal Rainfall	Rainfall falling within the upper category of the historical seasonal distribution.
Tercile Probabilities	Probabilities assigned to below-normal, near-normal and above-normal categories in a seasonal forecast.
Multi-Model Ensemble (MME)	A combination of forecasts from several climate models used to assess likely climate outcomes and forecast uncertainty.
Forecast Plume	A graphical presentation of projections from multiple climate models, showing their expected evolution and differences in forecast outcomes.
Dynamical Climate Model	A numerical model that simulates climate processes using physical equations governing the atmosphere, oceans and related components of the climate system.
Statistical Climate Model	A forecasting model that uses relationships between historical climate observations and predictor variables to estimate future conditions.
Forecast Confidence	The degree of trust in a forecast assessment, informed by observational evidence, model agreement, historical forecast skill and other relevant information.

Term	Definition
Probabilistic Forecast	A forecast that expresses the likelihood of different outcomes rather than specifying one outcome as certain.
Deterministic Forecast	A forecast presenting a specific predicted outcome rather than a probability distribution of possible outcomes.
Forecast Onset	The anticipated beginning of a rainy season, determined using specified rainfall criteria.
Forecast Cessation	The anticipated end of a rainy season, determined using specified rainfall or water-balance criteria.
Dry Spell	A consecutive period with little or no effective rainfall, defined using an established rainfall threshold and duration.
Dekadal Forecast	A forecast covering approximately ten days, corresponding to one of the three reporting periods within a calendar month.
Rainfall Anomaly	The difference between observed or forecast rainfall and the corresponding climatological average, expressed in millimetres or as a percentage.
Temperature Anomaly	The difference between an observed or forecast temperature and its climatological average for the corresponding period.
Standardised Precipitation Index (SPI)	A statistical index used to assess unusually dry or wet conditions by comparing precipitation totals with their historical distribution over a specified accumulation period.
Unimodal Rainfall Regime	A climate regime characterised by one principal rainy season annually, typical of northern Ghana.
Bimodal Rainfall Regime	A climate regime characterised by two principal rainfall peaks or rainy seasons annually, typical of southern Ghana.
Length of Growing Season (LOS)	The duration of the period during which rainfall and moisture conditions, according to specified criteria, are suitable for crop growth.
Climate Projection	An estimate of future climate conditions derived from climate models under specified assumptions, such as greenhouse-gas emissions or concentration pathways.

Table B3. Climate Hazards, Sectoral Impacts and Preparedness Terminology

Term	Definition
Drought	A sustained period of deficient water availability relative to normal conditions, potentially affecting rainfall, soil moisture, rivers, reservoirs and agricultural production.
Flash Flood	Rapid flooding caused by intense rainfall or sudden water accumulation, often developing within a relatively short period.
Hydrological Inflow	Water entering a river, reservoir or lake from rainfall, surface runoff, tributaries or other contributing sources.
Catchment or River Basin	The geographical area from which precipitation and surface or subsurface water drain into a common river, lake or other water body.
Reservoir Spillage	The controlled or uncontrolled release of water from a reservoir, generally undertaken or occurring to manage reservoir levels and dam safety.
Heat Stress	Physiological or biological stress resulting from excessive heat, potentially affecting people, livestock, crops and ecosystems.
Evapotranspiration	The combined transfer of water to the atmosphere through evaporation from surfaces and transpiration from plants.

Term	Definition
Rain-Fed Agriculture	Agricultural production that depends primarily on natural rainfall rather than irrigation.
Agrometeorological Advisory	Weather- and climate-based guidance supporting agricultural decisions, including planting dates, crop selection, irrigation and dry-spell management.
Climate Hazard	A potentially damaging climate-related event or condition, such as drought, extreme rainfall, excessive heat or flooding.
Exposure	The presence of people, infrastructure, livelihoods, economic assets or ecosystems in locations where climate hazards may occur.
Vulnerability	The susceptibility of individuals, communities, systems or assets to harm, influenced by their sensitivity and capacity to cope or adapt.
Climate Risk	The potential for adverse consequences arising from the interaction of climate hazards, exposure and vulnerability.
Compound Climate Risk	Risk arising when multiple climate hazards or their impacts interact or occur together, potentially increasing the severity of consequences.
Climate Attribution	Scientific analysis used to assess the contribution of particular climate drivers or human-induced climate change to observed climate events or trends.
Impact-Based Warning	A warning that communicates the likely consequences of anticipated weather or climate hazards, rather than describing meteorological conditions alone.
Early-Action Trigger	A predetermined forecast, monitoring or impact threshold used to initiate preparedness or response measures.
Climate Resilience	The capacity of individuals, communities, institutions or systems to anticipate, withstand, respond to and recover from climate-related disturbances.
Hydropower Generation Deficit	A reduction in electricity generation from hydropower facilities relative to expected or required output, potentially resulting from inadequate reservoir inflows or water availability.
Contingency Planning	The development of predefined arrangements, responsibilities and resources for responding to potential adverse events or emergency scenarios.

Table B4. List of Acronyms

Acronym	Full name or meaning
GMet	Ghana Meteorological Agency
NOAA	National Oceanic and Atmospheric Administration
CPC	Climate Prediction Center
IRI	International Research Institute for Climate and Society
CCSR	Center for Climate Systems Research
WMO	World Meteorological Organization
ACMAD	African Centre of Meteorological Applications for Development
AGRHYMET RCC-WAS	AGRHYMET Regional Climate Centre for West Africa and the Sahel
OISST	Optimum Interpolation Sea Surface Temperature
PRESASS	Regional forum on seasonal forecasts for the Sudanian and Sahelian zones of West Africa and the Sahel
NADMO	National Disaster Management Organisation
NDPC	National Development Planning Commission
VRA	Volta River Authority
GRIDCo	Ghana Grid Company Limited
ICCO	International Cocoa Organization

GHS	Ghana Health Service
COCOBOD	Ghana Cocoa Board
WHO	World Health Organization
RONI	Relative Oceanic Niño Index
CAP	Common Alerting Protocol
ATL3	Atlantic Niño index
ERSST	Extended Reconstructed Sea Surface Temperature (NOAA)
ONI	Oceanic Niño Index
PRESAGG	Regional forum on seasonal forecasts for the Gulf of Guinea countries