



Ghana  
Meteorological  
Agency

# SUMMARY OF GHANA CLIMATE ATLAS

March 2026

## Acknowledgement

The development and successful launch of the Ghana Climate Atlas have been made possible through the collective dedication of numerous individuals and institutional partners. We extend our deepest gratitude to all who contributed to this milestone for climate resilience in Ghana.

Our sincere appreciation goes to the Royal Danish Embassy in Accra and the Danish Meteorological Institute (DMI) for their unwavering technical and financial support. This partnership has been the cornerstone of our ability to deliver high-resolution climate projections for the nation.

We are grateful to the World Meteorological Organization (WMO) for providing the Content Management System that allows us to effectively visualize and share this critical data with the global community. Special thanks also go to Sibus Geospatial (ESRI) for providing the interactive platform that brings our climate story to life through dynamic mapping and digital innovation.

Finally, we commend the GMet Climate Atlas Team for their dedication, technical excellence, and unwavering commitment in bringing this vision to life. This milestone reflects your strong contribution to safeguarding Ghana's future through science-driven service and innovation.



*Group photo of the GMet and DMI teams during a training program in Denmark.*

## 1. Introduction

Climate change poses a growing threat to Ghana’s socio-economic stability, as rising temperatures, erratic rainfall, floods, droughts, and coastal erosion increasingly disrupt livelihoods and key sectors such as agriculture, energy, transport, and fisheries. Without strengthened adaptation measures, the World Bank estimates that up to one million additional Ghanaians could fall into poverty by 2050. Observed data from the Ghana Meteorological Agency shows a clear warming trend, with the 1991–2020 average temperature (27.6°C) already 0.5°C higher than the previous climatological baseline. These changes align with global concerns highlighted under the Paris Agreement, which emphasizes limiting warming to 1.5–2°C, as every incremental increase intensifies extreme weather risks. This underscores the urgent need for proactive, climate-resilient policies and investments to safeguard national development.

### Ghana’s Observed Climate

Ghana, located between latitudes 4°N–12°N and longitudes 1.5°E–3.5°W, has a tropical climate modulated by the movement of the Intertropical Discontinuity (ITD), which drives distinct wet and dry seasons. The wet season is influenced by moist South westerly (SW) winds and exhibits a bimodal rainfall pattern in southern Ghana and a unimodal pattern in the north. In contrast, the dry season is dominated by North easterly (NE) winds, bringing dry and dusty conditions across the country. Temperature patterns are also seasonal, with peak temperatures typically occurring in March and the lowest in August as shown in Figure 1.

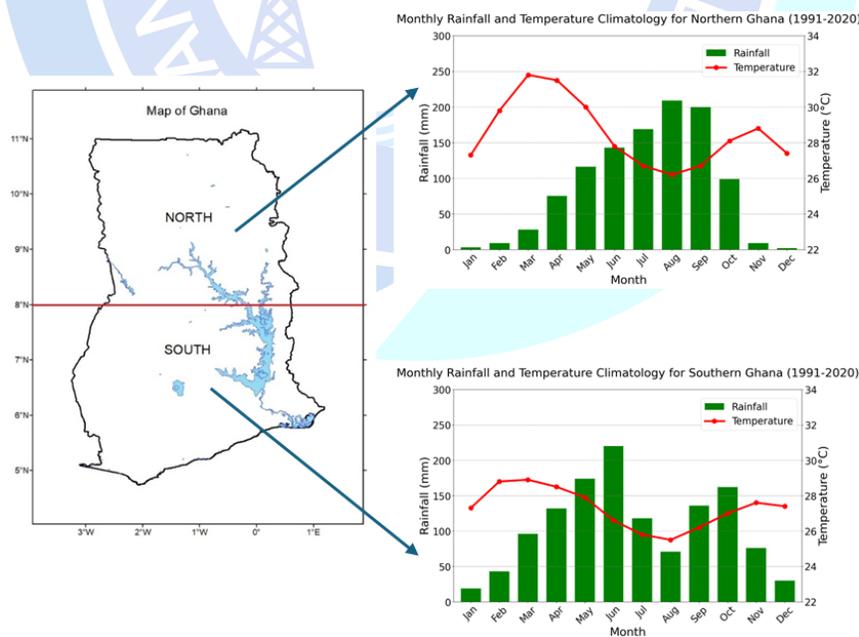


Figure 1 illustrates Monthly Rainfall and Temperature climatology of Ghana (1991 -2020)

### Temperature and Rainfall Trend in Observations

The annual average temperature in Ghana has shown an increasing trend since 1981 (Figure 2). The current climatological baseline (1991-2020) of **27.6°C** is warmer than the previous climatology (1981-2010) of **27.1°C**. The 2024 annual temperature of **28.5°C** is the highest on record and is **0.9°C** warmer than the current climatological average (1991-2020).

Annual total rainfall has shown a marginal increase over time. The year 2023 recorded the highest annual total rainfall of 1526mm, which is 291mm above the 1991-2020 climatological average of 1235mm. In contrast, 2024 recorded a total of 1129mm, representing a deficit of 106 mm compared to the climatology. The prolonged dry spell experienced in 2024 significantly affected several sectors, particularly agriculture, resulting in an estimated financial loss of GHC3.5 billion, according to the Ministry of Food and Agriculture.

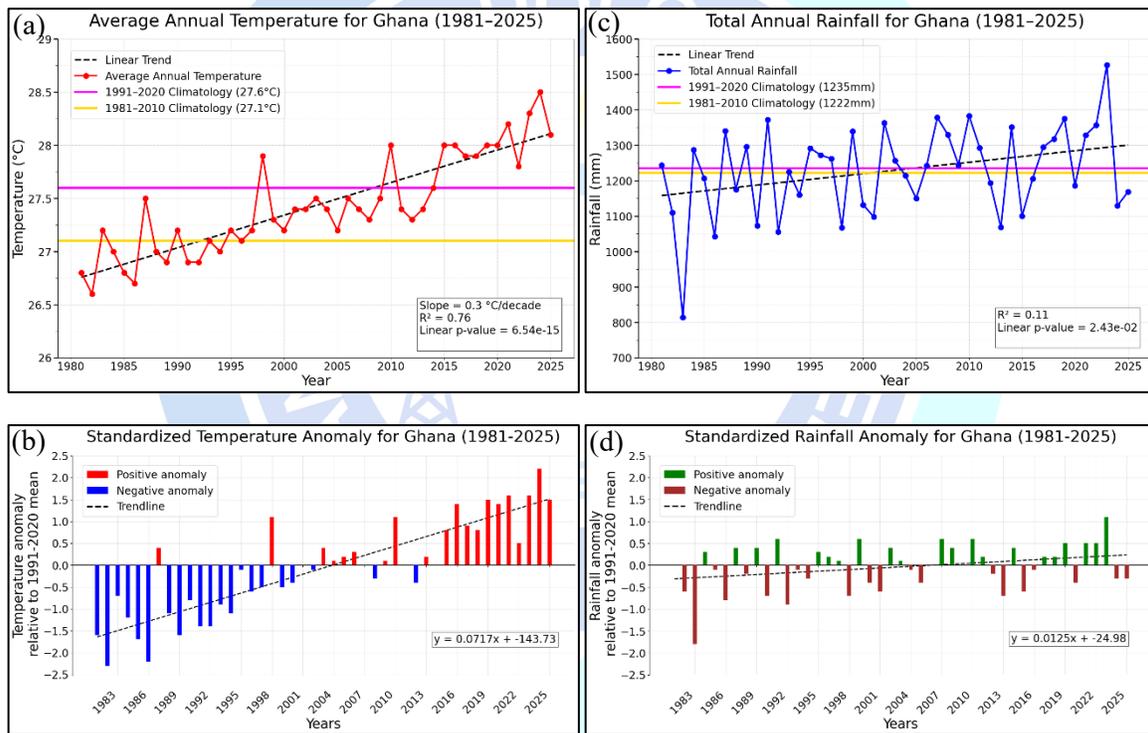


Figure 2 illustrates (a) Average Annual Temperature, (b) Standardized Temperature Anomaly (c) Annual total Rainfall and (d) Standardized Rainfall Anomaly for Ghana (1981 - 2025)

## Ghana Climate Atlas

The Ghana Climate Atlas is a user-friendly and interactive tool that illustrates how Ghana's climate is expected to change over the coming years, up to the end of century and its impact on the country's socio-economic development. The Atlas serves a wide range of stakeholders across government, private, Non-Governmental Organizations, Civil Society Organizations and research communities.

### What Key Features can you find on the Ghana Climate Atlas?

The Atlas is designed as a multi-functional digital platform to support climate resilience. Based on the system architecture, its key features include:

#### Core Platform Features

- **Interactive Map Viewer:** A dynamic online tool that allows users to explore localized climate data across various geographic locations in Ghana.
- **Climate Projections:** Provides scenario-based insights into future climate trends, essential for long-term planning and risk assessment.
- **Story Map:** Offers a guided, visual narrative that combines maps and multimedia to explain complex climate impacts in a relatable way.
- **Ghana Climate Atlas Reports:** These are downloadable technical reports and official documentation for offline use and research.
- **Frequently Asked Questions (FAQ):** A dedicated section providing quick help for data interpretation and platform navigation.

### Who Developed the Ghana Climate Atlas?

The Ghana Climate Atlas is coordinated and developed by Ghana Meteorological Agency (GMet) in collaboration with the Danish Meteorological Institute (DMI) and support from the Danish Embassy in Ghana. The visualization platforms are developed in collaboration with support from the World Meteorological Organization and Sambus Geospatial-ESRI.

## 2. Data Inputs and Analytical Approach

**Data Sources:** The Ghana Climate Atlas is based on a GMet-developed gridded dataset that merges ground observations with reanalysis data (for temperature) and satellite-derived rainfall estimates. This integration enhances spatial coverage and data reliability, producing a refined dataset at ~4 km resolution. Future climate projections are derived from CORDEX-Africa regional climate models, which downscale global models to ~25–50 km. An ensemble of ~39 model combinations is used to represent a wide range of possible climate futures for Ghana, with outputs further processed to ~4 km resolution.

**Climate Model Calibration:** To address biases in climate models, Quantile Delta Mapping (QDM) is applied. This method aligns model outputs with observed historical data while preserving projected climate signals. Calibration is based on the 1991–2020 WMO climatological normal, resulting in bias-corrected and statistically downscaled datasets at 4 km resolution.

**Handling Uncertainty:** Uncertainty from model differences, natural variability, and emission assumptions is addressed using probabilistic outputs from the ensemble. The Atlas presents projections using the 10th, 50th (median), and 90th percentiles, enabling users to assess both likely outcomes and extreme scenarios for risk-informed planning.

**Emission Scenarios:** The Ghana Climate Atlas evaluates climate futures under three primary emission scenarios as;

Scenario	Description	Policy Implications
<b>Low emission scenario,</b> RCP2.6/SSP1-2.6	<b>Strong Global Mitigation:</b> pathway consistent with the goals of the Paris Agreement, where greenhouse gas emissions decline rapidly	global warming is limited to approximately 1.5°C
<b>Medium emission scenario,</b> RCP4.5/SSP3- 4.5	<b>Moderate Mitigation:</b> an intermediate stabilization pathway in which emissions peak around the middle of the century before declining	a steady warming trajectory of 2°C
<b>High emission scenario,</b> RCP8.5/SSP5-8.5	<b>Business as Usual:</b> a fossil-fuel-intensive development pathway characterized by continued emission growth throughout the century	to substantial global warming higher than 3°C and more severe climate impacts by 2100

**Time Periods:** Climate projections are analyzed across three periods: near-term (2021–2040), mid-century (2041–2060), and end-century (2081–2100), relative to the 1991–2020 baseline.

### 3. Key Findings

The findings presented here consider the Medium Emission Scenario for the End of Century (2081-2100) for the national and agroclimatic zones. The climate variables used include temperature, rainfall and sea-level rise at annual and seasonal scales.

#### Temperature Projections

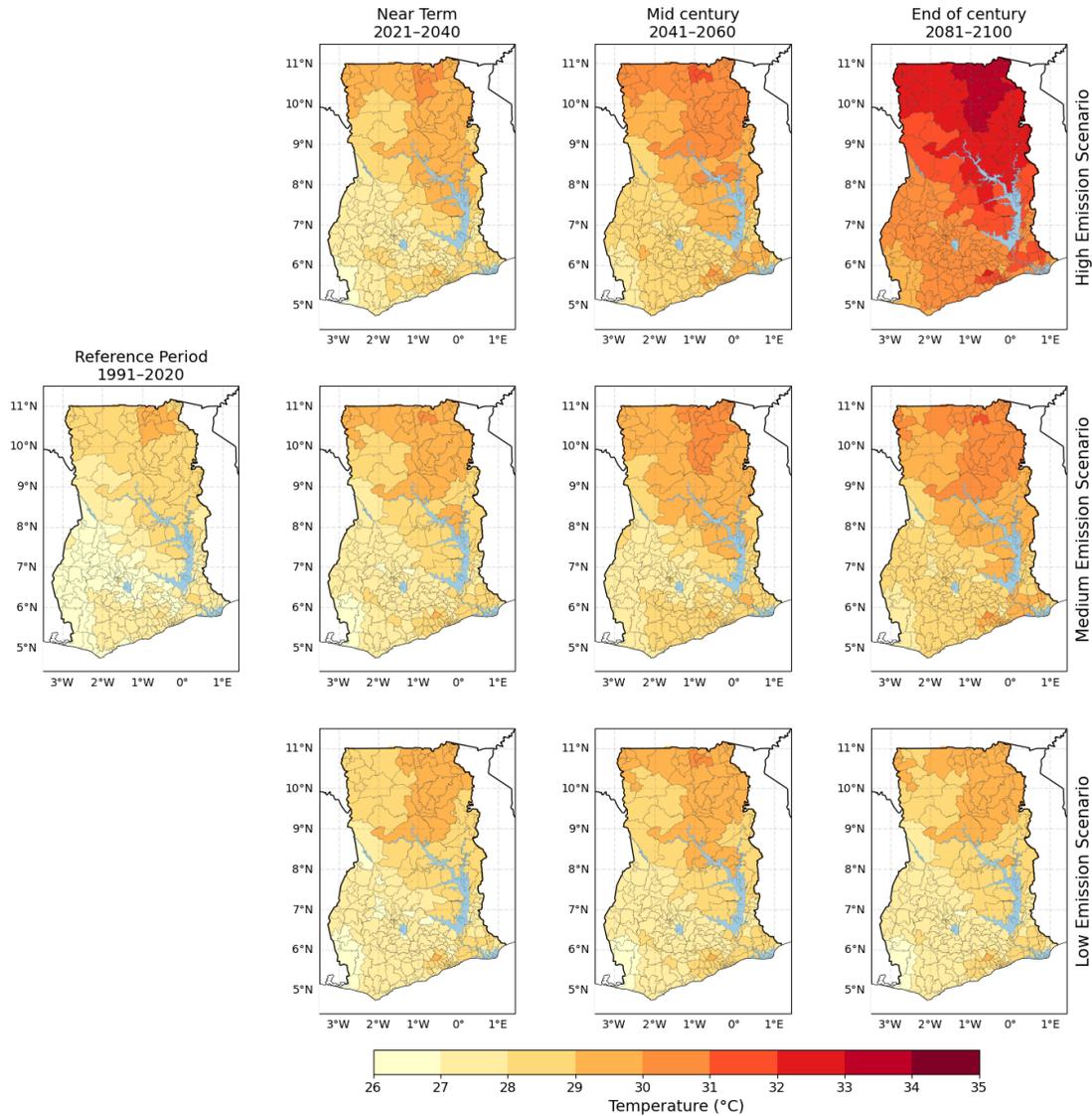


Figure 3. illustrate variations in average annual temperature (50th percentile) in Ghana under low, medium and high emission scenarios for the near term (2021-2040), mid century (2041-2060) and end of century (2081-2100). The stand-alone plot on the far left shows the reference period (1991-2020).

By the end of the century (2081-2100), under the medium emission scenario (RCP4.5), Ghana’s climate is projected to become significantly warmer by 1.4°C relative to the reference period (27.8°C.) as shown in Figure 3. The average annual temperature is projected to reach 29.2°C. Seasonal warming is expected to be highest during the December-January-February (DJF) season, with an increase of 1.6°C, while the season with the coolest month will increase by 1.3°C as projected for the July-August-September (JAS) season.

### Rainfall Projections

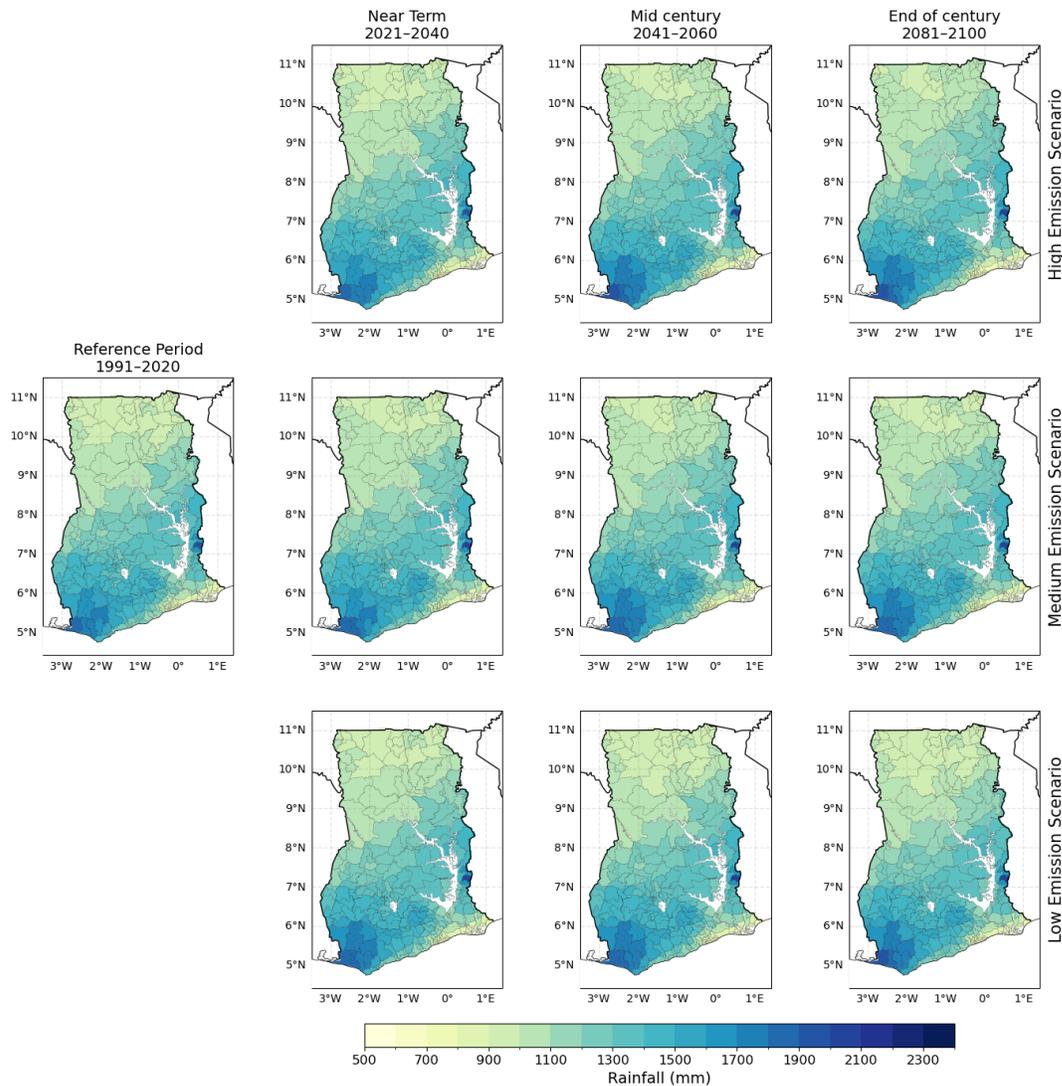


Figure 4. illustrates variations in total annual rainfall (50th percentile) in Ghana under low, medium and high emission scenarios for the near term (2021-2040), mid-century (2041-2060) and end of century (2081-2100). The stand-alone plot on the far-left shows for the reference period (1991-2020).

Annual rainfall as shown in Figure 4 is projected to marginally increase by 22mm, corresponding to a 1.8% increase relative to the reference value of 1221mm. Among the seasons, JAS is expected

to experience the highest increase in rainfall of 18mm (3.9%), whereas DJF may see the most decline of 3mm (5.2%). However, these projected rainfall changes are small and vary for the seasons; an indication that JAS season is becoming wetter while the DJF becomes drier.

## Sea Level Rise Projections

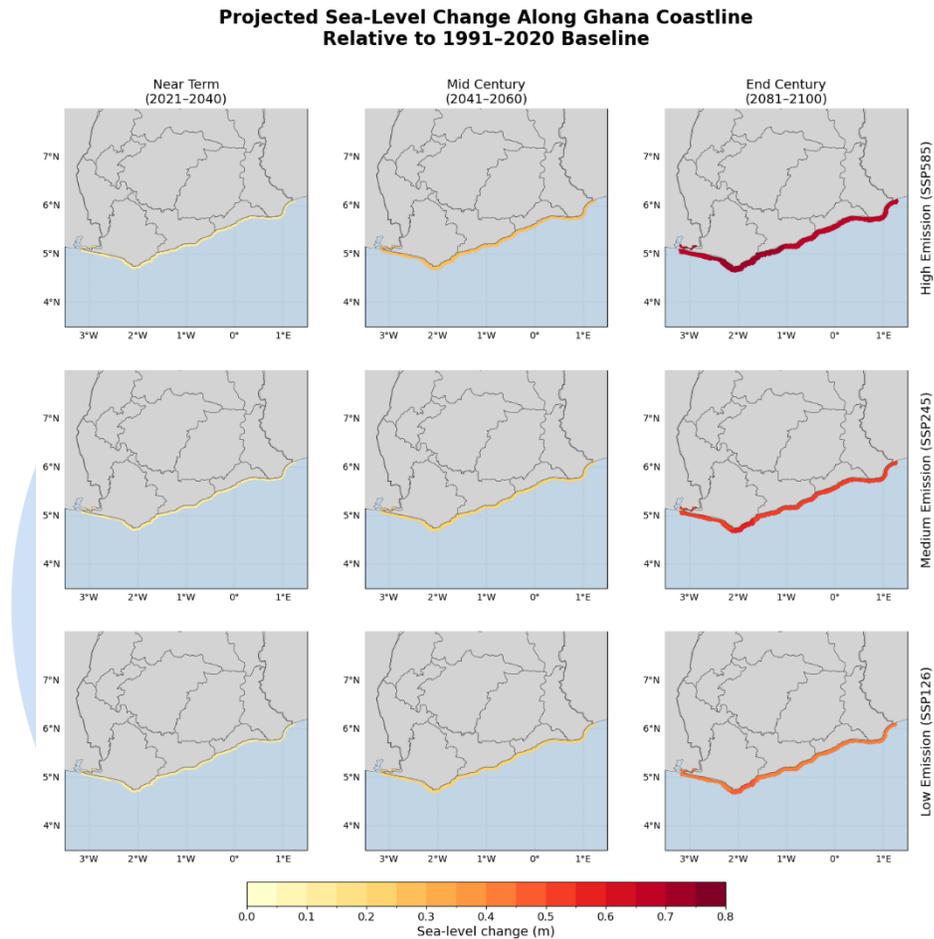


Figure 5. Projections of mean sea level rise over the period 2021 to 2100 relative to the 1991–2020 baseline (a period used for the Intergovernmental Panel on Climate Change Sixth Assessment Report (IPCC, 2021) from a combination of the CMIP6 model ensemble for a high emission, medium emission and low emissions scenarios.

The sea level projections over Ghana show a continuous rise through the near term to the end of century along the coastline under the three emission scenarios as shown in Figure 5 above. By end of century, mean sea level rise of approximately 0.4m is projected under a low emission scenario, 0.6m under a medium emission scenario and 0.7m under a high emission scenario.

## Agroclimatic Zone Projections

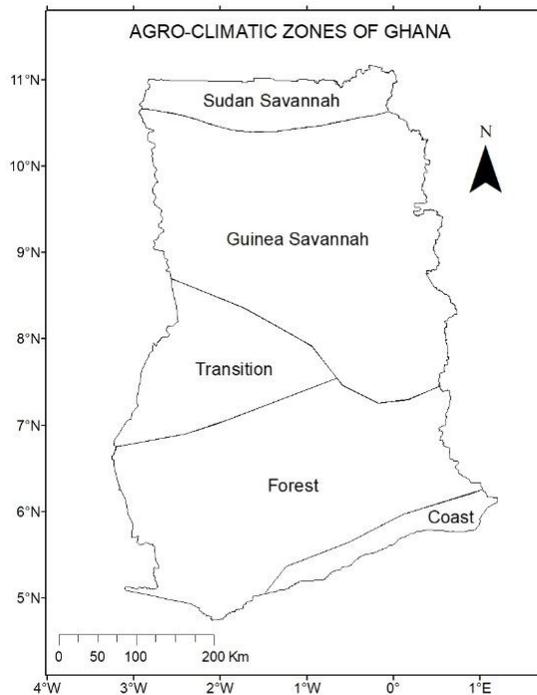


Figure 6 The Agro-Climatic Zones of Ghana

Ghana’s climate and natural environment vary across the country, resulting in different agro-climatic zones that reflect variations in rainfall, temperature, vegetation, and land use. For analysis in the Ghana Climate Atlas, the country is broadly divided into five major agro-climatic zones: the Coastal Zone, Forest Zone, Transition Zone, Guinea Savannah Zone, and Sudan Savannah Zone.

The Coastal, Forest and Transition zones experience bimodal rainfall pattern whiles the Guinea Savannah and the Sudan Savannah zones experience unimodal rainfall pattern. The Sudan Savannah Zone, found in the far north, is the driest and hottest part of the country, with shorter rainy seasons and higher vulnerability to drought and heat stress.

### Summary of Temperature Projections by Zone

Agro-Climatic Zone	Baseline Temp	Projected Temp	Total Increase	Peak Warming Season
Sudan Savannah	28.8°C	30.4°C	+1.6°C	AMJ & DJF (+1.8°C)
Guinea Savannah	28.4°C	29.9°C	+1.5°C	AMJ & DJF (+1.6°C)
Transition	27.0°C	28.4°C	+1.4°C	DJF (+1.5°C)
Forest	27.1°C	28.5°C	+1.4°C	AMJ & DJF (+1.5°C)
Coastal	27.5°C	28.9°C	+1.4°C	Stable (+1.3°C to +1.4°C)

### Key Policy Takeaways

- North-South Gradient:** The Sudan Savannah is the warming hotspot of the country, facing the highest overall increase (+1.6°C). This necessitates prioritized heat-resilience strategies for northern agricultural systems.
- Critical Warming Windows:** Across almost all zones, the April-May-June (AMJ) and December-January-February (DJF) periods show the most significant temperature spikes. This coincides with the end of the dry season and the start of the primary planting season, posing a direct threat to soil moisture and early crop establishment.

- **Consistent Coastal Rise:** While the **Coastal Zone** has the lowest peak increases, its warming is consistent throughout the year, which can have long-term impacts on humidity levels and coastal health.
- **Minimal Variation in JAS:** The **July-August-September (JAS)** period consistently shows the smallest temperature increases (averaging +1.3°C), likely due to the cooling effect of peak monsoon cloud cover and rainfall.

### Summary of Rainfall Projections by Zone

Agro-Climatic Zone	Annual Change	% Change	Primary Increase Season	Primary Decrease Season
<b>Coastal</b>	-6 mm	-0.6%	JAS (+23 mm / 11.8%)	AMJ (-16 mm / 3.5%)
<b>Forest</b>	+20 mm	+1.4%	JAS (+24 mm / 6.2%)	AMJ (-9 mm / 1.7%)
<b>Transition</b>	+15 mm	+1.3%	JAS (+20 mm / 5.2%)	AMJ (-8 mm / 1.7%)
<b>Guinea Savannah</b>	+26 mm	+2.3%	SON (+9 mm / 2.7%)	AMJ (-6 mm / 1.6%)
<b>Sudan Savannah</b>	+31 mm	+3.2%	SON (+10 mm / 4.1%)	AMJ (-6 mm / 2.2%)

### Strategic Policy Takeaways

- **Critical Risk to Coastal Agriculture:** The Coastal Zone faces the most shift. A 3.5% drop in rainfall during the April-May-June (AMJ) season directly threatens the major cropping cycle. Policy interventions should prioritize drought-resistant crop varieties and irrigation support in these areas.
- **Wetting of the Late Season:** Across the Sudan and Guinea Savannah zones, the September-October-November (SON) period is becoming wetter. This may offer opportunities for expanding farming season but also increases the risk of harvest-time flooding and post-harvest losses.
- **Increased Rainfall During the JAS Season:** The Coastal, Forest, and Transition zones are projected to experience the greatest increases in rainfall during the July-August-September (JAS) period. This suggests a strengthening of rainfall during this season, with the potential for more intense rainfall events.
- **Drier Harmattan Periods:** The December-January-February (DJF) season is projected to become even drier across all zones. This increases the risk of wildfires and puts additional stress on perennial crops like cocoa that require baseline moisture during the dry months.

- Infrastructure Adaptation:** The slight increases in annual rainfall in the northern Savannahs, combined with more intense seasonal peaks, will likely lead to higher runoff. Drainage and dam infrastructure must be audited to handle these shifting volumes to prevent flash flooding.

#### 4. Implications for Key Sectors

The climate projections presented in this summary report provide important insights into how Ghana’s climate may evolve in the future up to the end of century. These changes have the potential to influence multiple sectors of the economy and society. Figure 7 highlights the possible implications of these climate trends for key sectors in Ghana. There is the need for climate risk assessment based on these climate projections to inform adaptation measures for climate resilience.

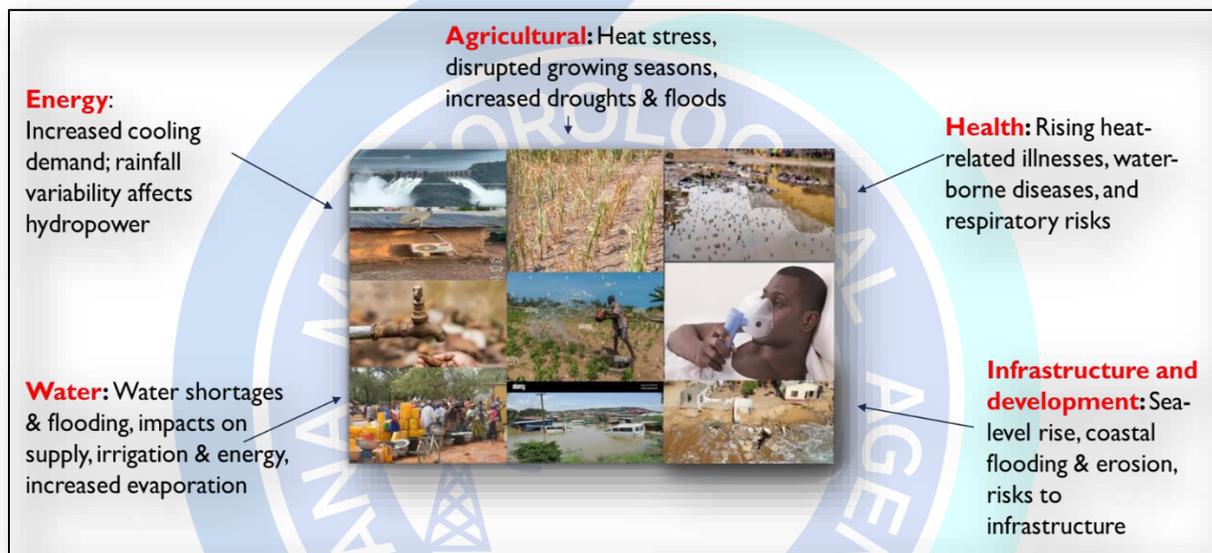


Figure 7 Climate change implication on key sectors

#### 5. Conclusion

In summary, the Ghana Climate Atlas demonstrates that climate change is a structural threat to Ghana’s national stability. Without proactive adaptation, these climatic shifts could push an additional one million Ghanaians into poverty by 2050 (World Bank, 2022). The Atlas provides the necessary high resolution data for stakeholders to move from reactive crisis management to climate informed development. It is imperative that these findings are integrated into national policy to protect the livelihoods, infrastructure, and economic productivity of all Ghanaians.

*"The cost of adaptation today is far lower than the cost of a disaster tomorrow." -- GMet*