# HYDRO-METEOROLOGICAL CONDITIONS AND FLOOD DYNAMICS IN GHANA

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# Outline

1. Geography of Ghana
   - Climate
   - Hydrology
2. Different types of flooding
3. Flood dynamics in Ghana

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# Geography of Ghana

- Ghana is a country in West Africa situated between latitudes 4°30'N and 11°N and longitudes 3°11'W and 1°14’E
- In June 2023, the population of Ghana was estimated to be approximately 32 million
- The relief Ghana is generally low, with the highest elevation of not above 900 m. Many places along the coast have elevations below 50 m (e.g., Accra, Keta, etc.)
- The highest peak in Ghana is Mount Afadja (885 m) in the Volta Region, near Togo
- The country is a blend of coastal plains, rainforests, savannas, highlands, and river systems. This diverse landscape plays a critical role in agriculture, tourism, economy, and culture
- Ghana is endowed with various natural resources, including gold, bauxite, diamond, cocoa, coffee, timber, crude oil, etc.


Figure1. Map of Ghana showing the topography and tourist attractions areas
Source: https://www.worldatlas.com/maps/ghana


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# Climate of Ghana – Temperature

- tropical climate with a mean annual temperature ranging between 22 °C and 36 °C, which increases from south to north (https://gadm.org/maps/GHA.html)
- is influenced by its proximity to the equator and the movement of Inter-Tropical Convergence Zone (ITCZ)
- Climate change projections: the average annual temperature is reported to have increased over the entire West Africa Sub-region by 1.0 °C since 1960 with an average rate of 0.21 °C per decade (Mcsweeney et al., 2023)

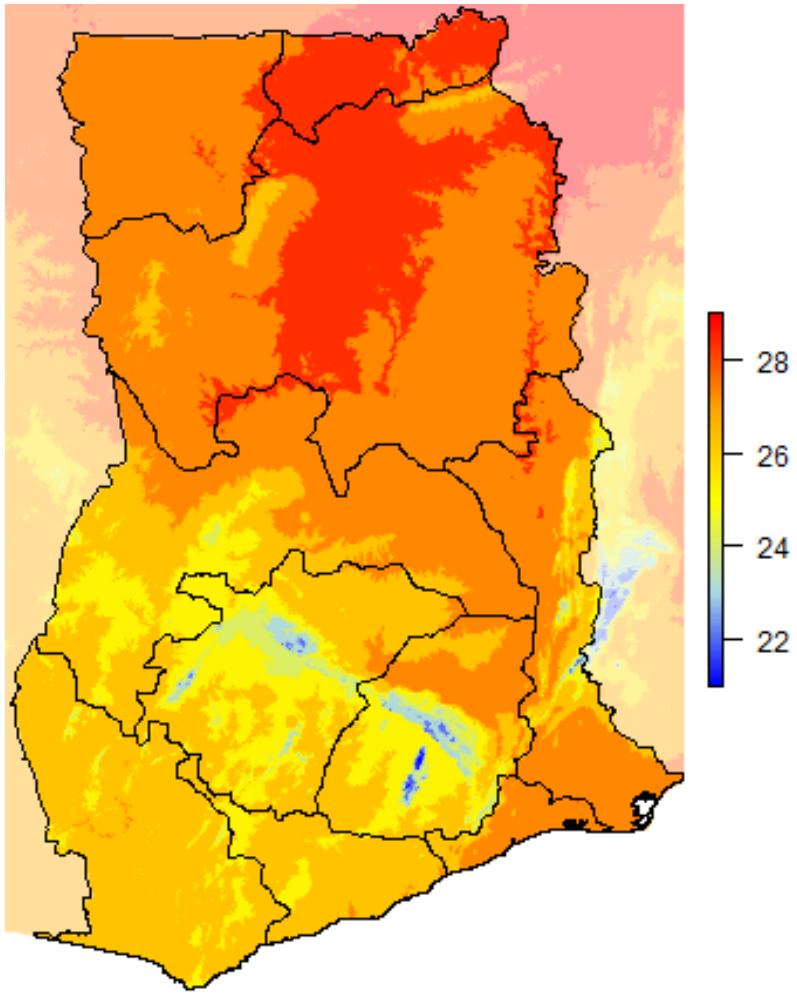


Figure: 2. Map of Ghana showing spatial temperature variation
Source: https://gadm.org/maps/GHA.html

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# Climate of Ghana - Rainfall

- Ghana experiences two distinct seasons in a year: wet and dry seasons
- The southern part experiences a tropical wet and dry climate, but the northern part has a tropical savannah climate, characterized by Harmattan (dry and dusty winds) (Awotwi et al., 2021)
- The rainfall decreases spatially from south-western to north and eastwards. In the south-eastern coastal areas, annual total rainfall ranges from 750 mm to 800 mm (Agodzo et al. 2023, Kabo-Bah et al., 2016 )
- The south-western part and forest zone of the country records the highest annual rainfall (approx. 2000 mm)
- Rainfall patterns are highly variable with extreme events, contributing to floods and droughts (Awotwi et al., 2021)

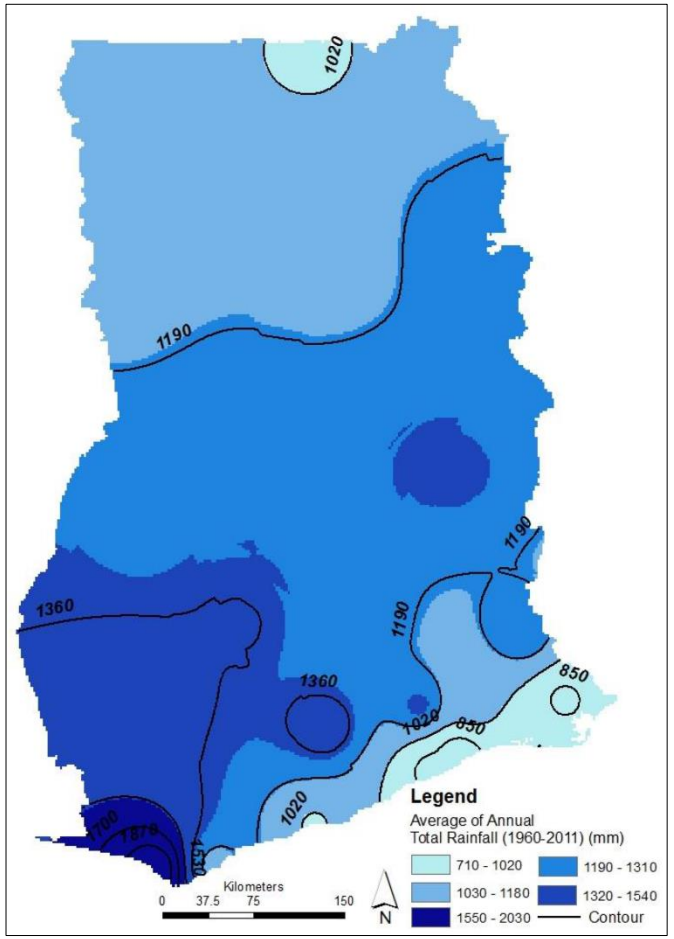


Figure 3. Map of Ghana showing annual total rainfall distribution
Source: Kabo-Bah et al. (2016)

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# Hydrology of Ghana

- The hydrology of Ghana is defined by its surface water systems (rivers, lakes, etc.), groundwater systems, wetlands, and floodplains
- Ghana is home to several major river systems generally classified as the Volta River system, the South-western, and the coastal river systems
- The Volta River system occupies nearly 68% of the country with freshwater supply (Agodzo et al., 2023)
- The Volta and the Coastal River basins experience the frequent and most devastating floods in Ghana, partly to due low elevation
- Water pollution in river systems is a major challenge in Ghana, due to mineral mining activities

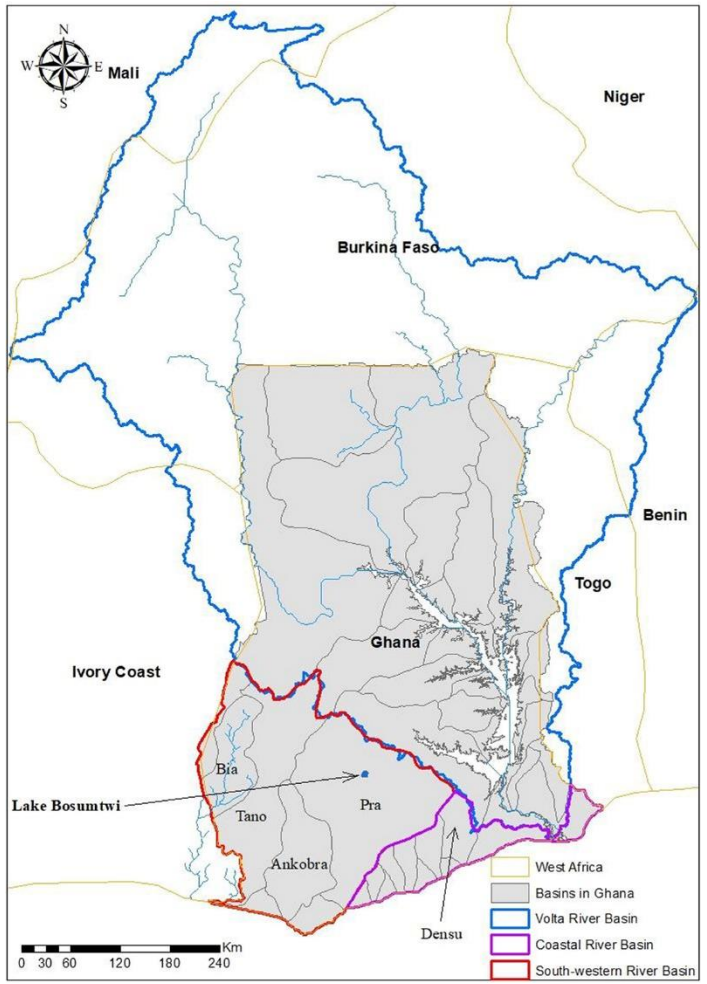


Figure 4. Major River systems in Ghana
Source: Agodzo et al. (2023)

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# Types of floods in Ghana

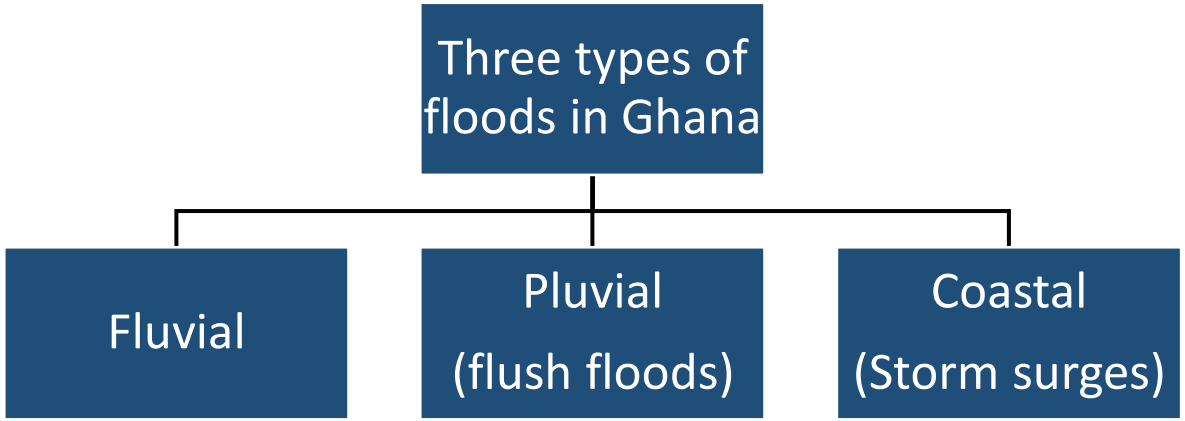


Figure 5. Types of floods in Ghana

- The types of floods are defined based on the causes and origin
- Fluvial (river) floods are common in the river catchment such as the Volta, Odaw, Densu, etc.
- occur when the river overflows its original banks
- Dam spillage also causes fluvial floods in Ghana
- Pluvial or flash floods are common in low-lying areas with poor drainage systems in Accra, Cape Coast, etc.
- This is usually due to extreme high rainfall, blockage of drainage, etc.


Figure 6. Flash floods in Keta, Volta Region, Ghana in July 2023
Source: https://newsghana.com.gh/hundreds-displased-schools-homes-flooded-after-heavy-downpour-in-keta/

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# Flood dynamics in Ghana

- Coastal floods, caused by storm surges are experienced in the south-eastern part of the country. E.g., Keta and the surrounding communities in the Volta Delta (Brempong et al., 2023)
- For example, floods due to storm surges and tidal waves in Keta District displaced over 1,500 people in 2018, and over 4,000 displaced in November 2021 (CitiNews, 2022)


Figure 7. Coastal floods in Keta, Volta Region, Ghana in July 2023
Source: https://citinewsroom.com/2018/04/tidal-waves-displace-residents-of-fuveme-photos/

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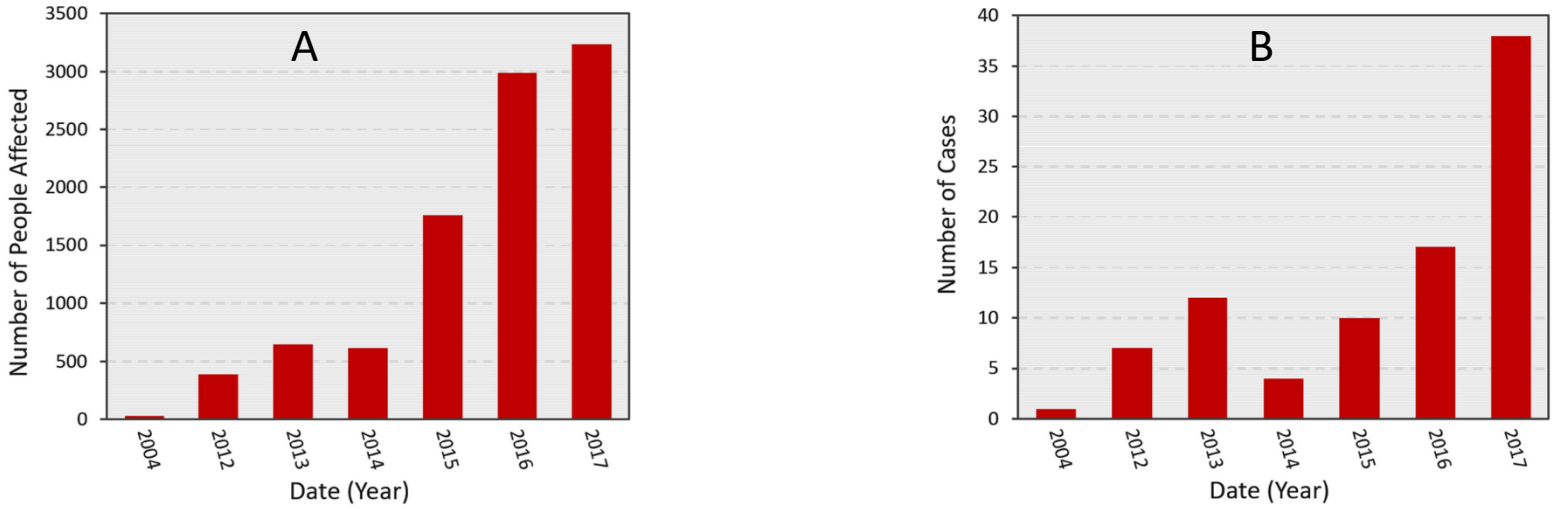
# Flood dynamics in Ghana

- Floods have been one of the major disasters in Ghana since 1995 and their frequency has increased over the past decade, due increase in population in vulnerable areas (Ansah et al., 2020)
- Major cities such as Accra, Cape Coast, Kumasi, etc., experience flash and pluvial floods annually (Abass et al., 2023)
- The frequency of fluvial and flash floods in Kumasi has increased over the past years, due to human activities such as building in waterways (Abass et al., 2022)




*The trend in flood cases and their effects in Kumasi is not different from the cases in Accra, which even records more frequent events*

Figure 8 ( A and B). Trends in flood cases and the number of people affected in Kumasi from 2004 to 2017
Source: Abass (2022)

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# Flood dynamics in Ghana

- The Communities in the Odaw River catchment in Accra are major flood hotspots in Accra, which experience floods at least twice a year
- New flood hotspots are emerging in many parts of Ghana, partly due to poor land use planning, and high variability in rainfall patterns – climate change (Agodzo et al. 2023)
- Increasing levels of  vulnerability in poor communities will likely increase and further affect their coping capacities (Abass et al., 2022)
- The impacts of floods in Ghana cut across multiple sectors of the economy and the communities.
- Sustainable and innovative solutions are required for mitigation in Ghana

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# Flood hotspots in Ghana

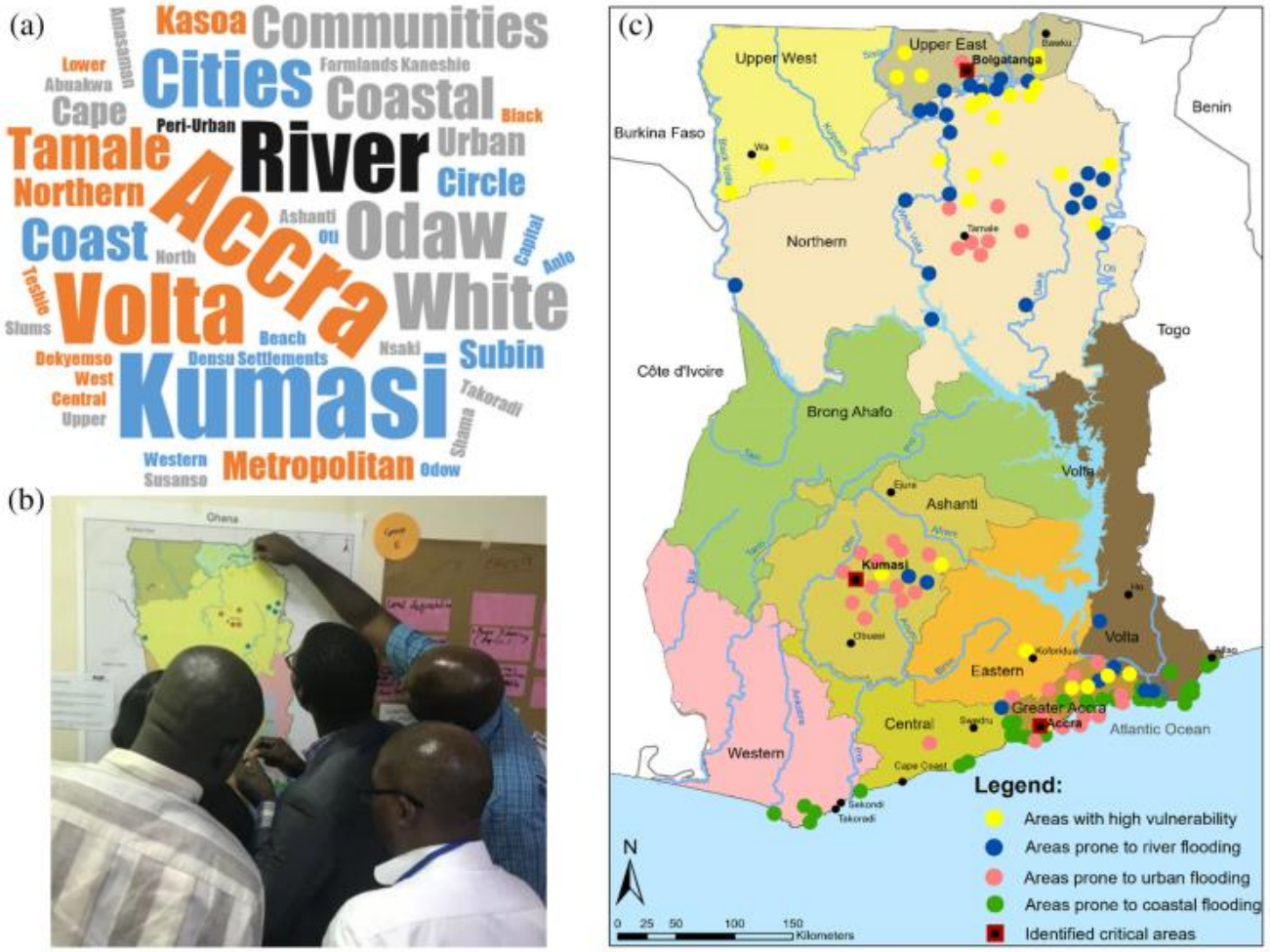


Figure 8. Flood hotspot map of Ghana
Source: Almoradie et al. (2020)


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# PARADeS

Participatory assessment of flood-related disaster prevention and development of an adapted coping system in Ghana

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