

GHANA

Climate-Health-Agriculture Maps

CHOICE Quantitative Analysis Results

June 2025

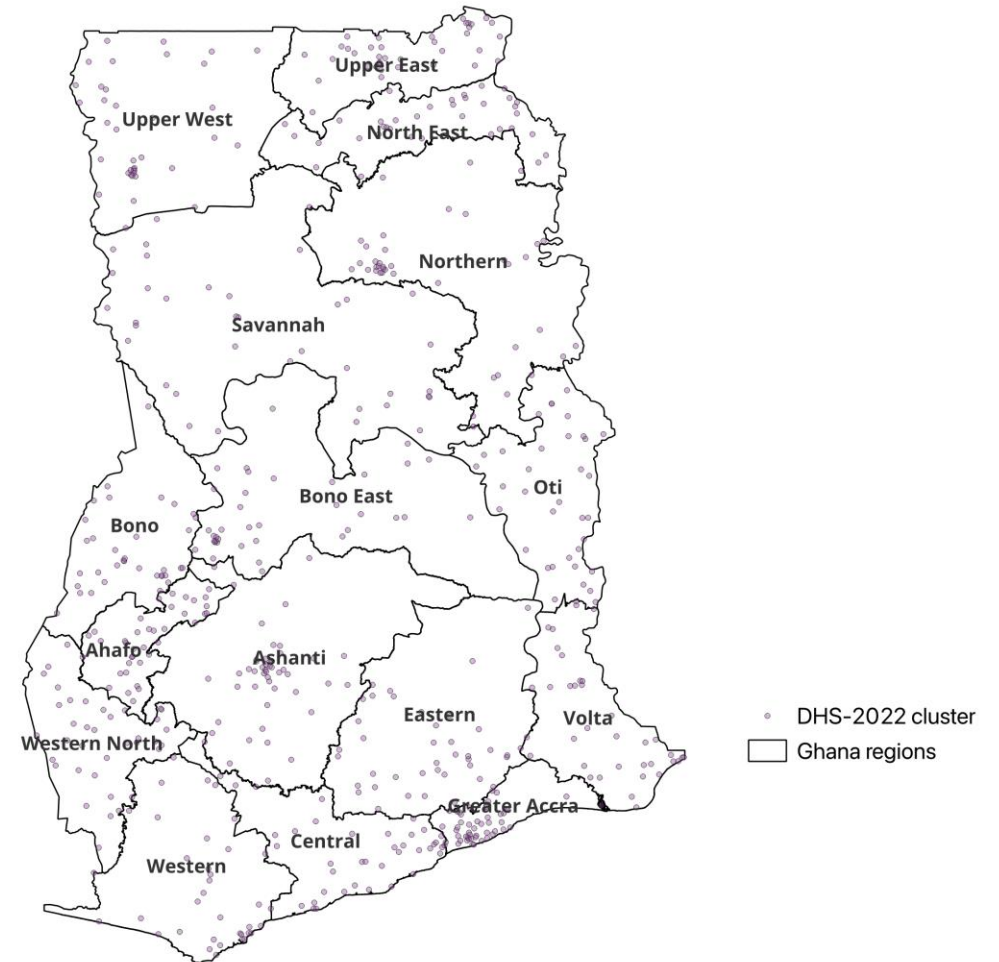
SickKids CGCH Team

Purpose

- A set of national level quantitative analyses for the (5) CHOICE countries – Kenya, Tanzania, Ghana, Kyrgyzstan, and Pakistan – was conducted, mapping climate and health variables both geographically and over time.
- Further exploration of these associations was made, where relevant/applicable. CHOICE teams may want to further explore these associations in their work.

Methodology - Climate

- Clusters rolled up into one of 16 (current) regions (using DHS clusters for GPS coordinates)
- Maps generated for each indicator at 5-year intervals from 2000 to 2020
- Daily values averaged per year
- Generated maps for the AARC (average annual rate of change) for each indicator from 2000 to 2020
- Scale is based on 10 equal intervals



List of 16 Regions

Ahafo
Ashanti
Bono
Bono East
Central
Eastern
Greater Accra
North East
Northern
Oti
Savannah
Upper East
Upper West
Volta
Western
Western North



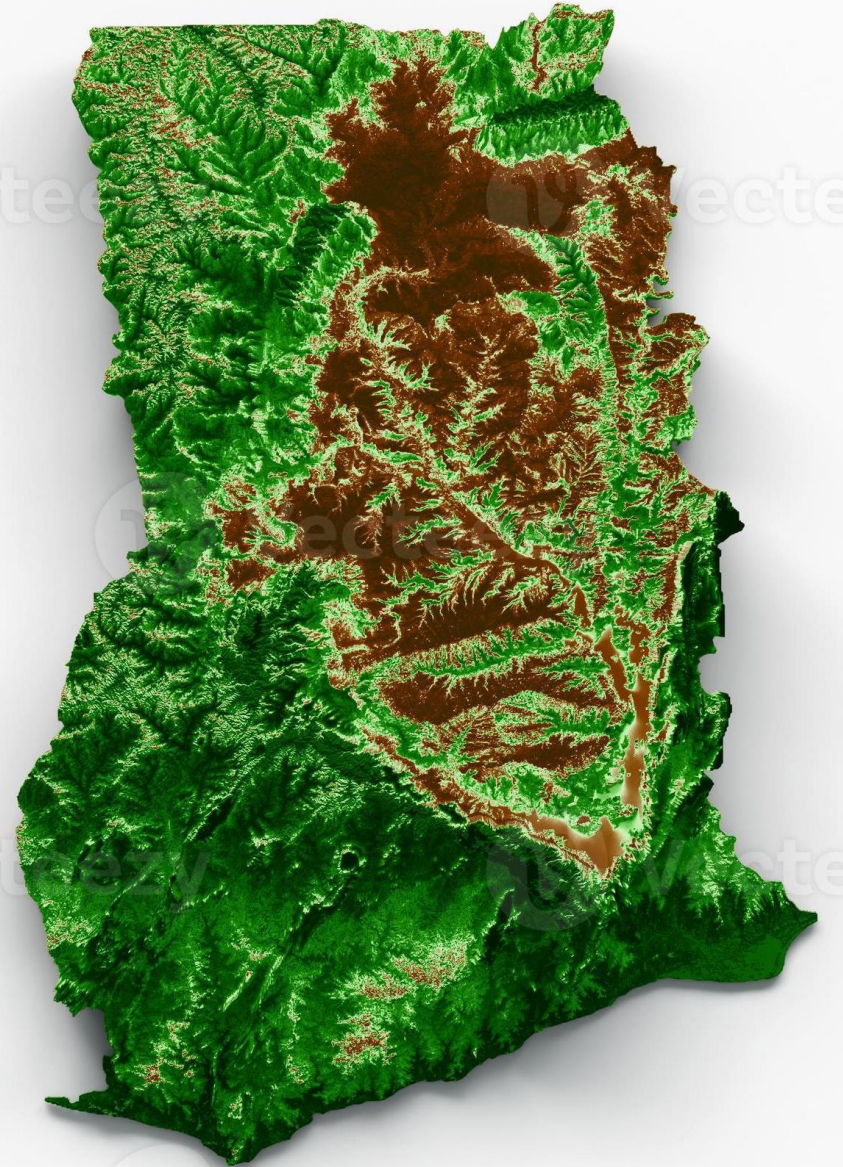
Methodology implemented to address changing boundaries over time:
[Demystifying Spatially Harmonized Geography in IPUMS DHS – IPUMS
DHS Spatial Analysis and Health Research Hub](#)

Ghana

Time points: 2000, 2005, 2010,
2015, 2020

Climate Indicators (7)

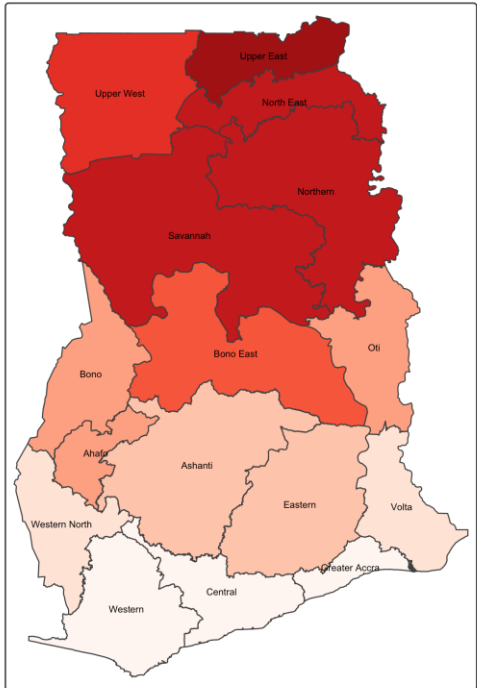
- Maximum temperature
- Minimum temperature
- Diurnal temperature
- Precipitation
- Soil moisture
- Relative humidity
- Wet bulb



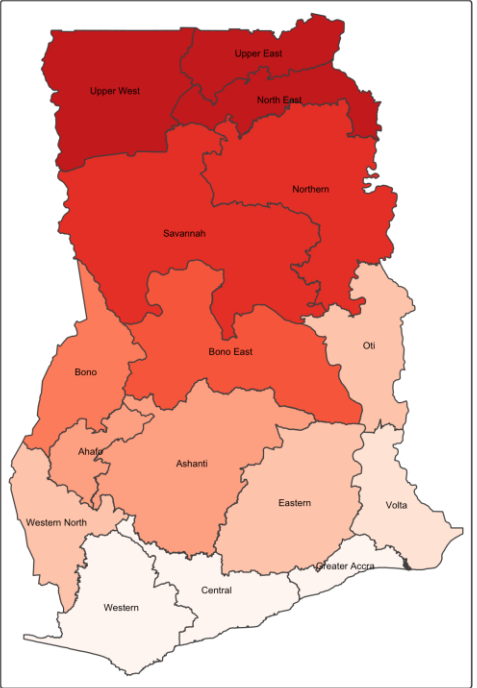
Maximum Temperature

- Derived Data Set: ERA-5
- Year: 2000, 2005, 2010, 2015, 2020
- Horizontal resolution: 25 kms
- Units: Degrees Celsius (daily)

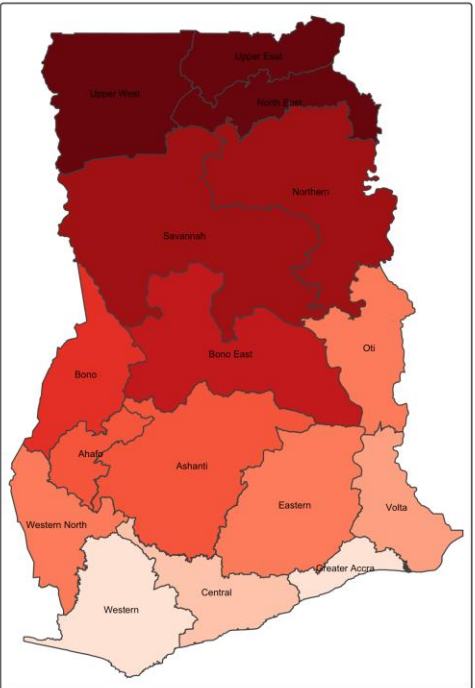
Description: This parameter is the highest temperature of air at 2m above the surface of land, sea or inland water since the parameter was last archived in a particular forecast. 2m temperature is calculated by interpolating between the lowest model level and the Earth's surface, taking account of the atmospheric conditions. This parameter has units of kelvin (K). Temperature measured in kelvin was converted to degrees Celsius (°C) by subtracting 273.15.



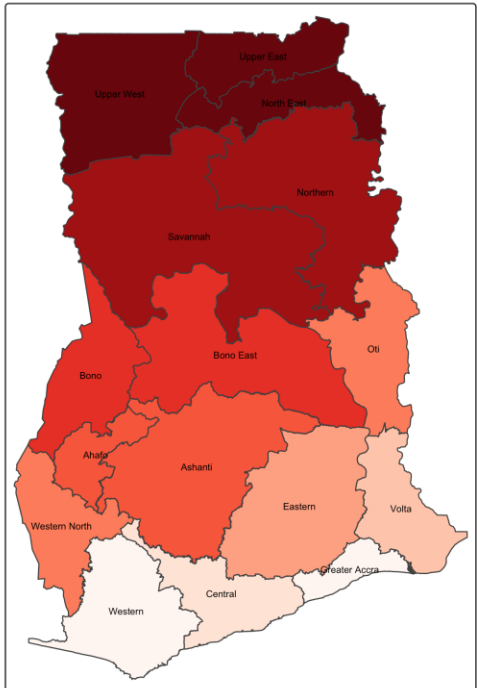
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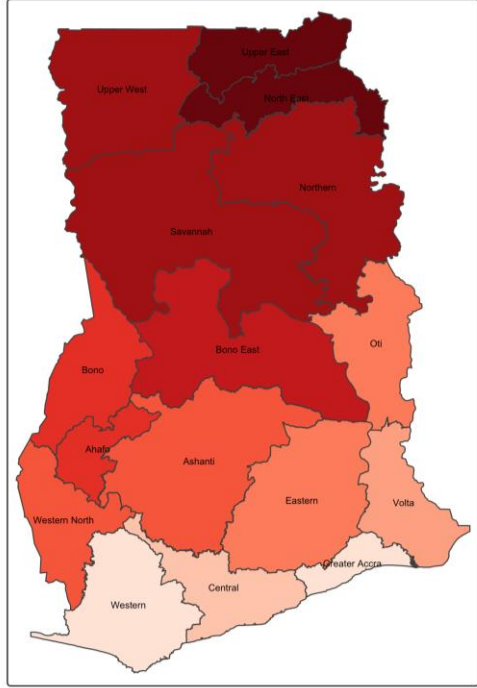
2005



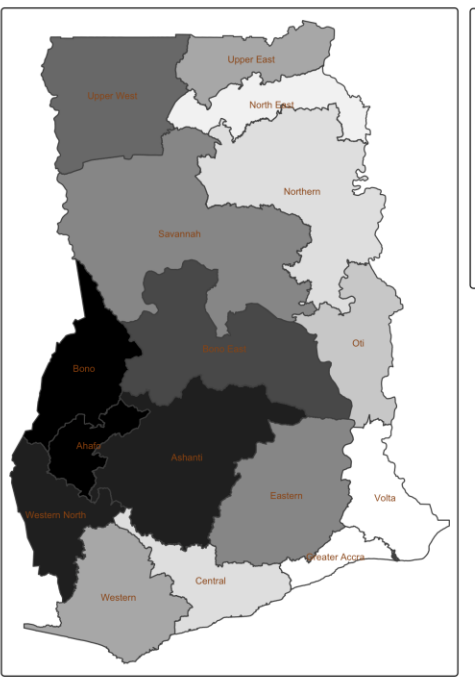
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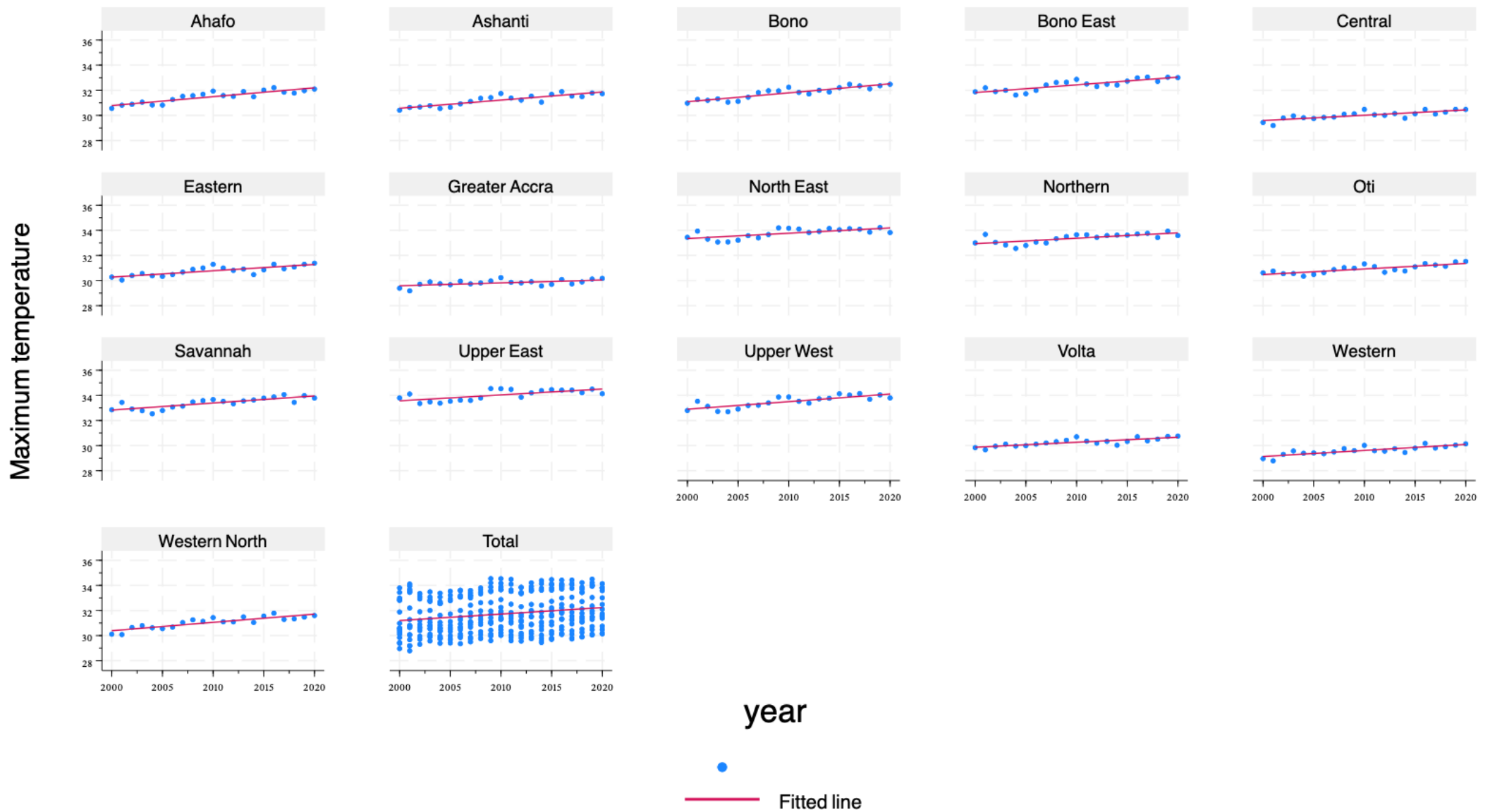
2015



2020



AARC

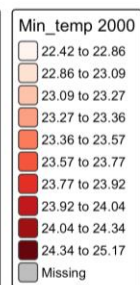
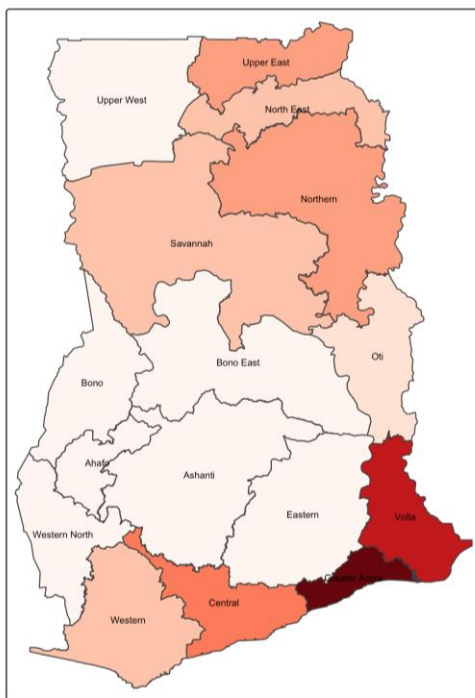


Maximum Temperature Trends over Time by Region

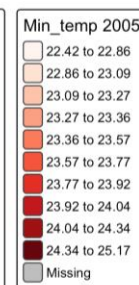
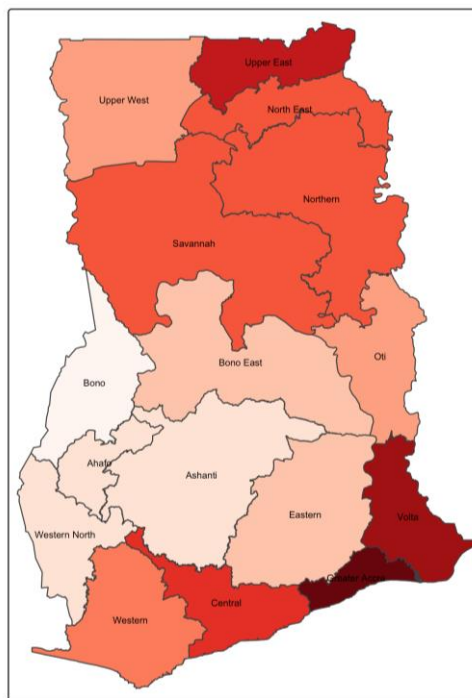
Minimum Temperature

- Derived Data Set: ERA-5
- Year: 2000, 2005, 2010, 2015, 2020
- Horizontal resolution: 25 kms
- Units: Degrees Celsius (daily)

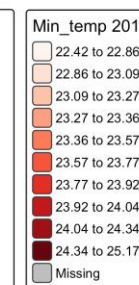
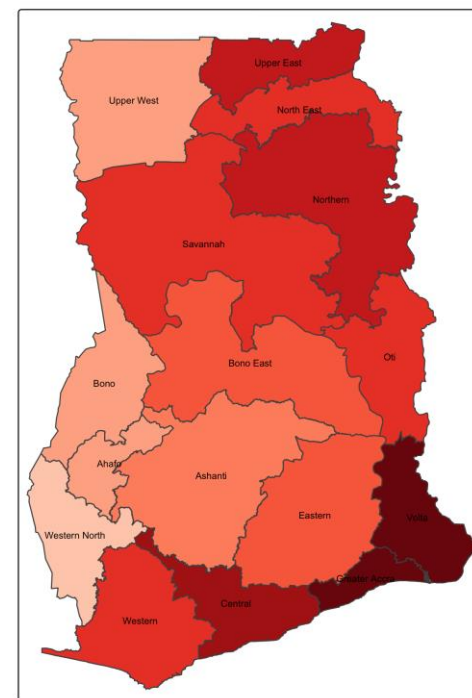
Description: This parameter is the lowest temperature of air at 2m above the surface of land, sea or inland waters since the parameter was last archived in a particular forecast. 2m temperature is calculated by interpolating between the lowest model level and the Earth's surface, taking account of the atmospheric conditions. This parameter has units of kelvin (K). Temperature measured in kelvin was converted to degrees Celsius (°C) by subtracting 273.15.



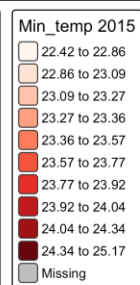
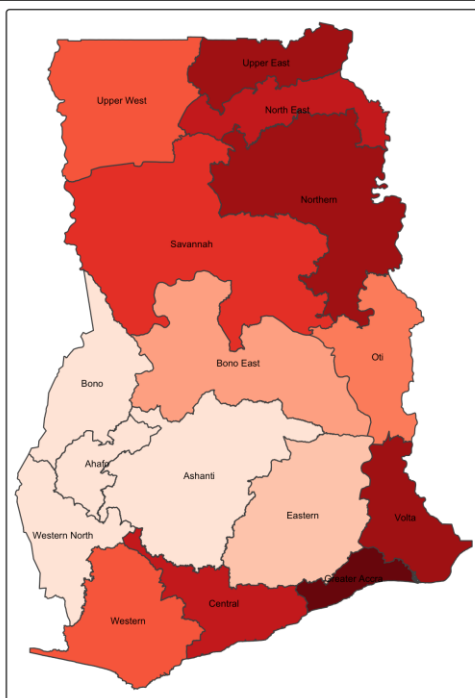
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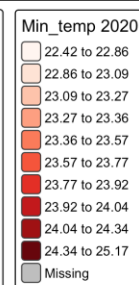
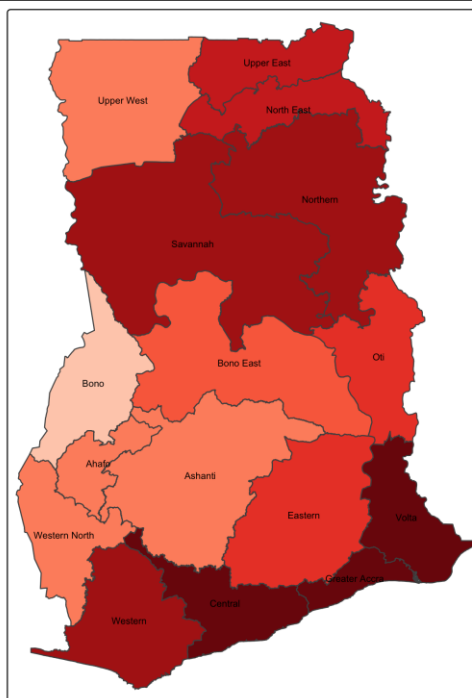
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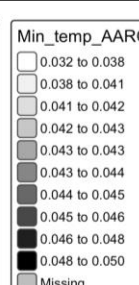
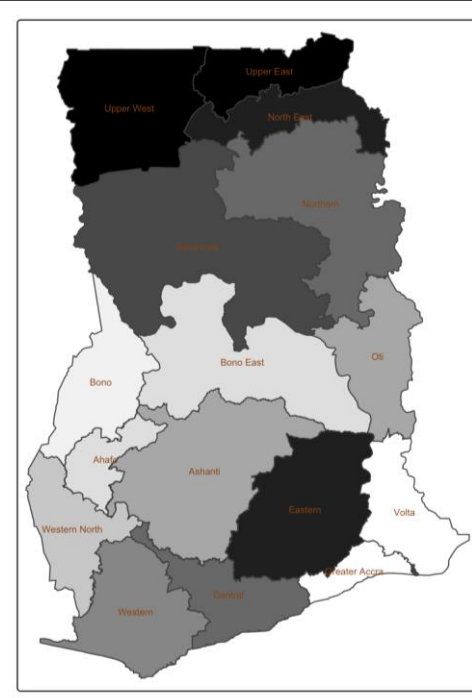
2010



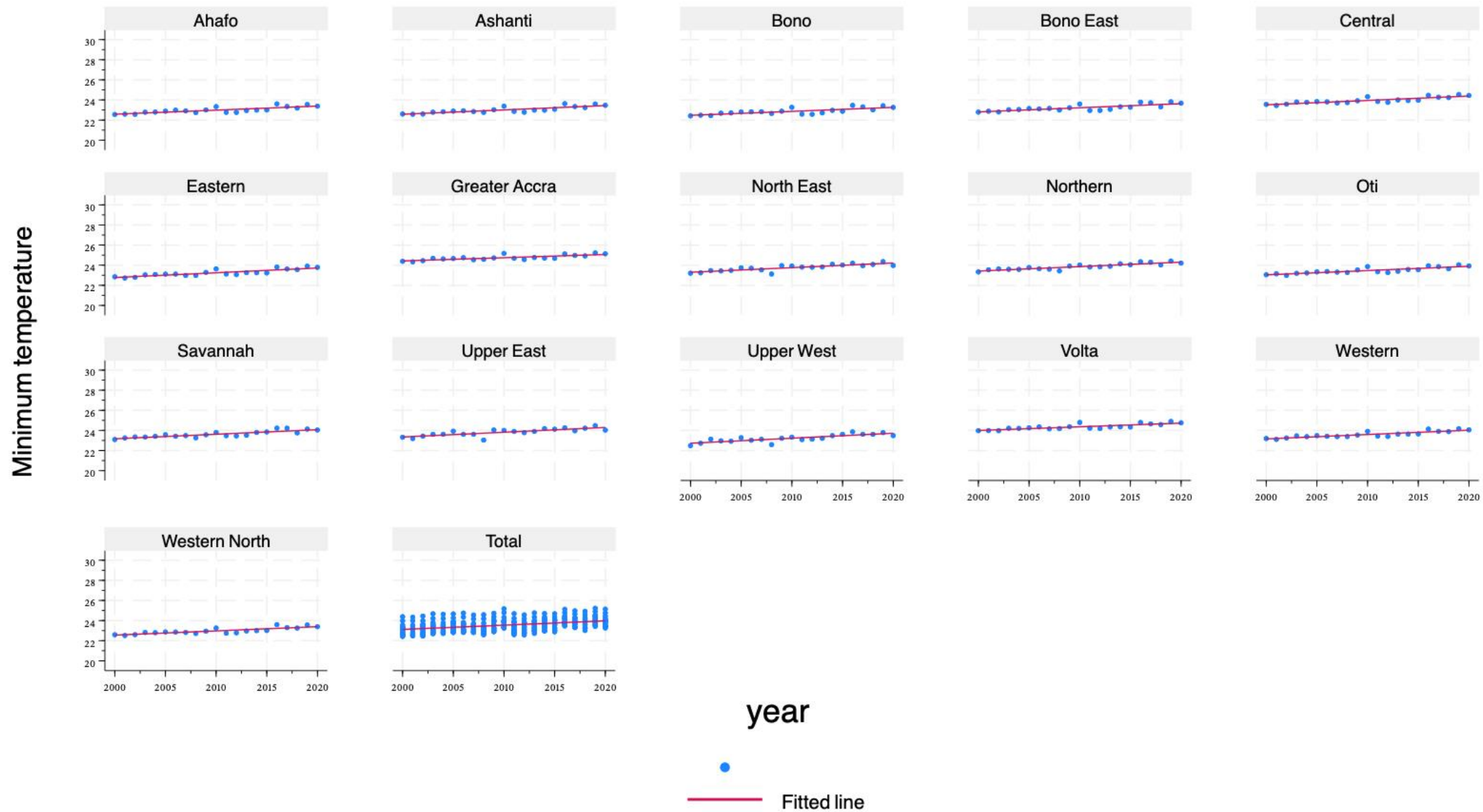
2015



2020



AARC

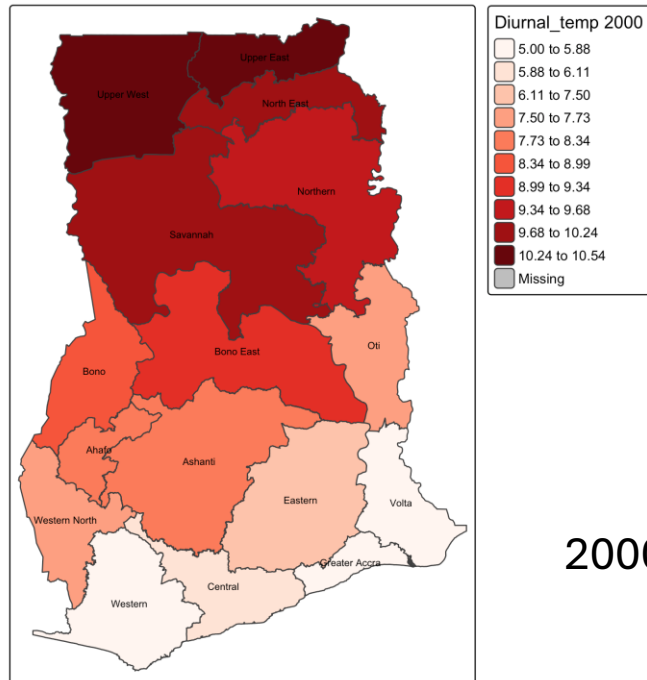


Minimum Temperature Trends over Time by Region

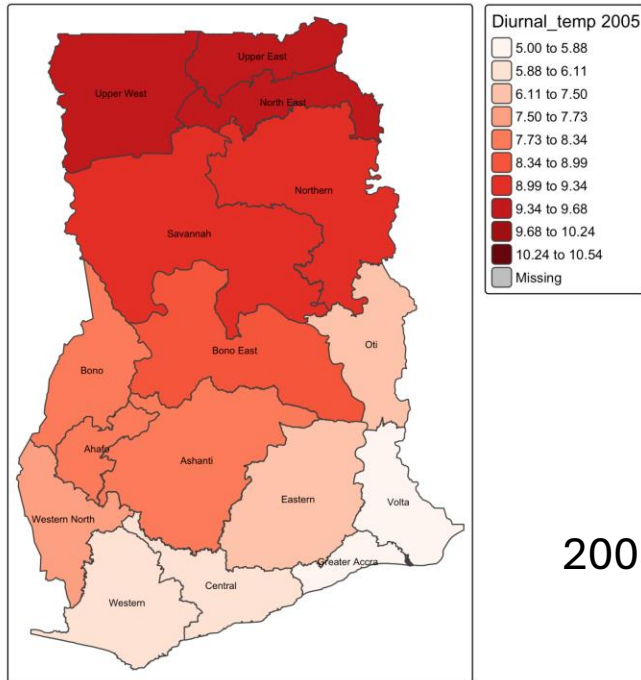
Diurnal Temperature Range

- Derived Data Set: ERA-5 (calculated)
- Year: 2000, 2005, 2010, 2015, 2020
- Horizontal resolution: 25 kms
- Units: Degrees Celsius (daily)

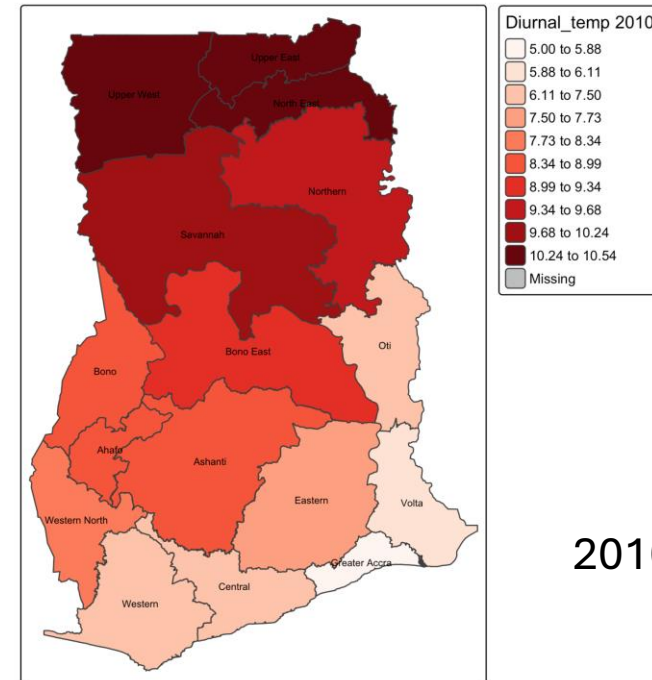
Description: Diurnal temperature range is the difference between the maximum and minimum temperatures.



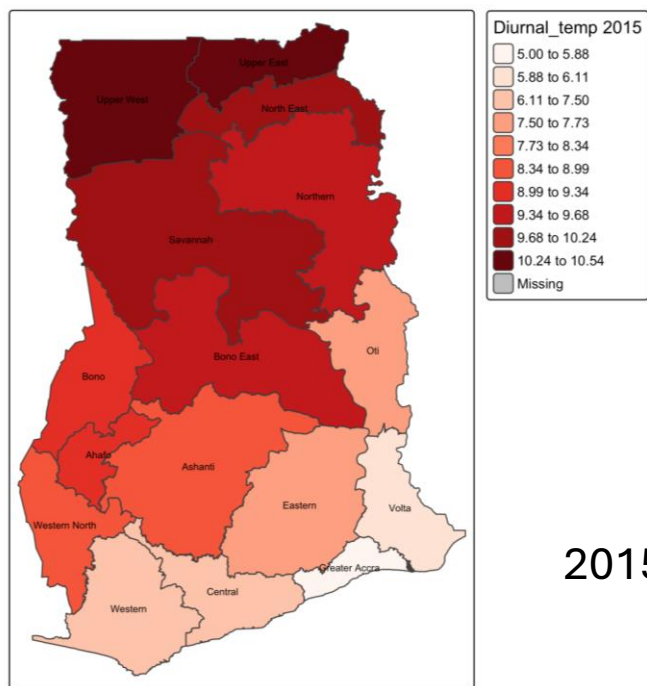
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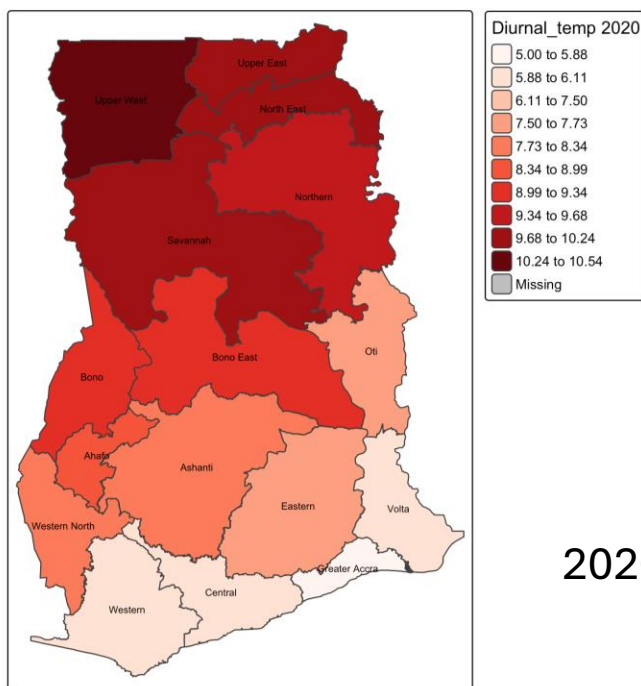
2005



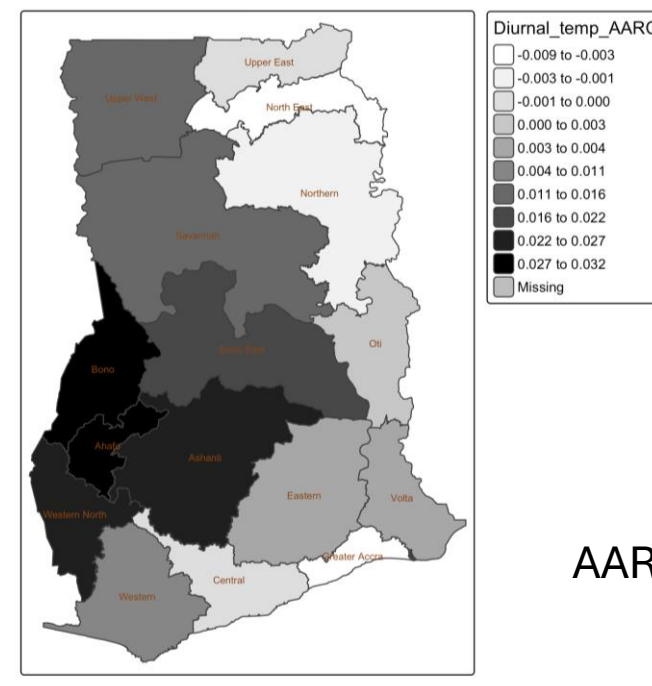
2010



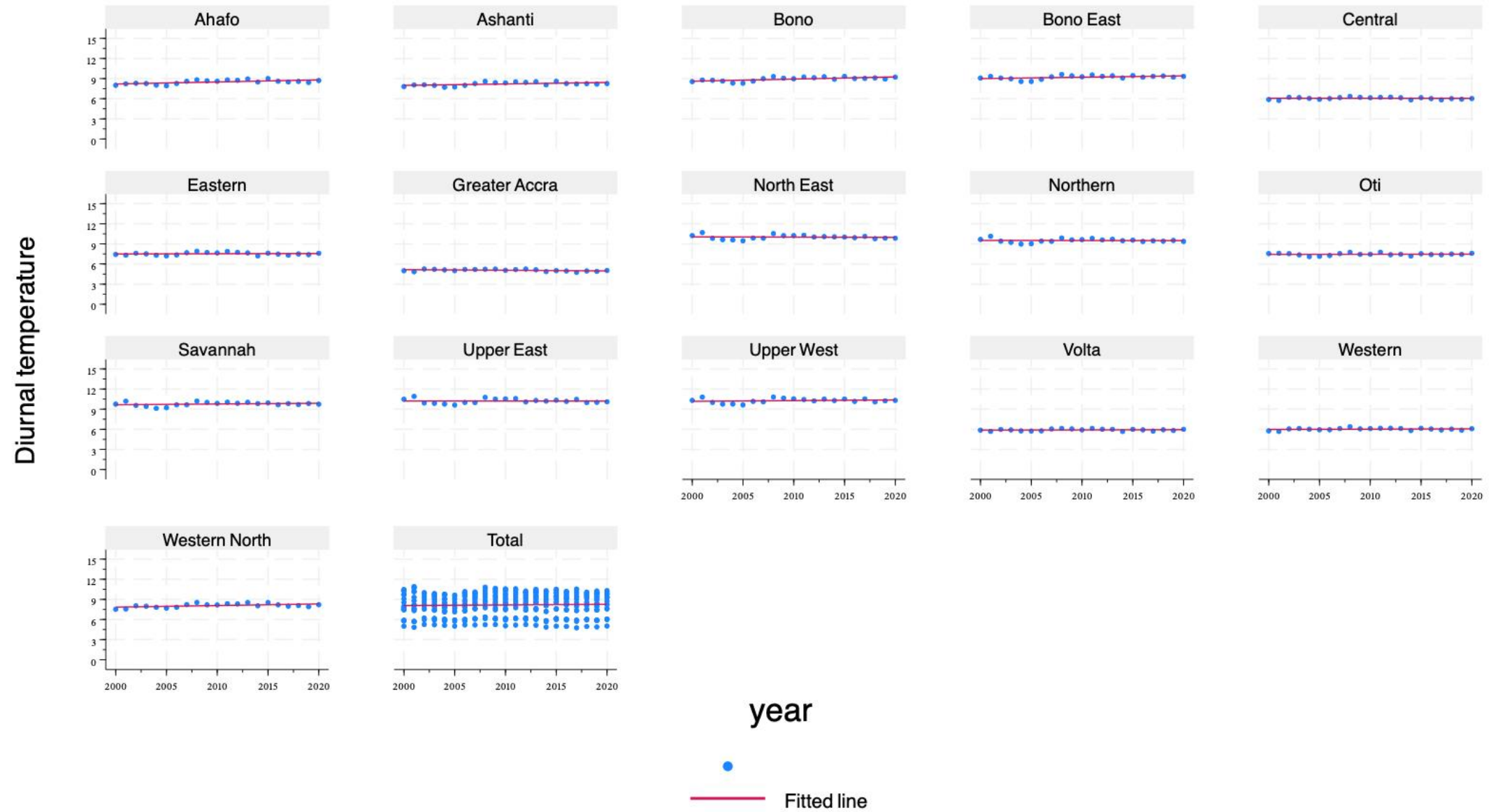
2015



2020



AARC



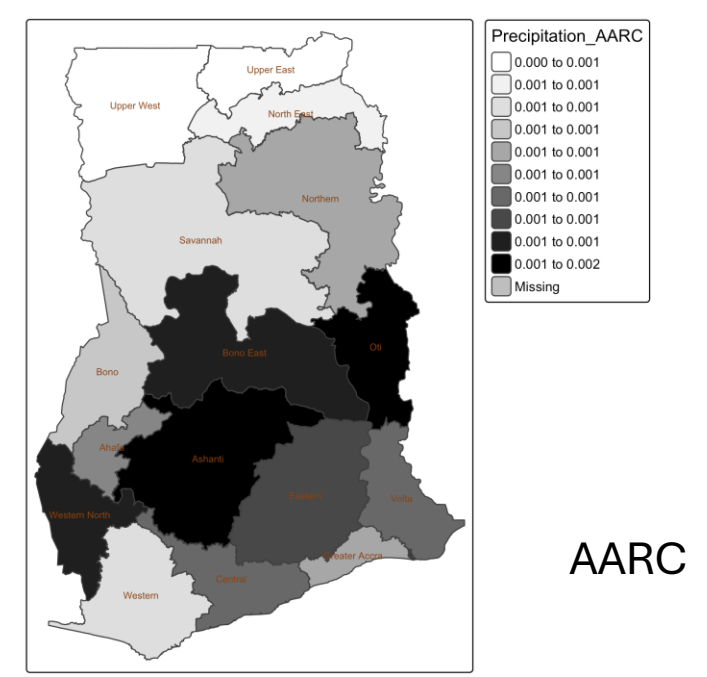
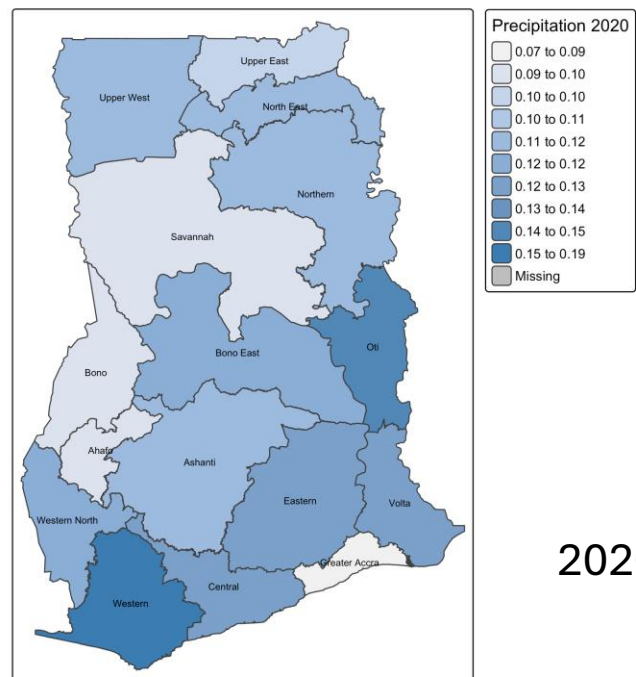
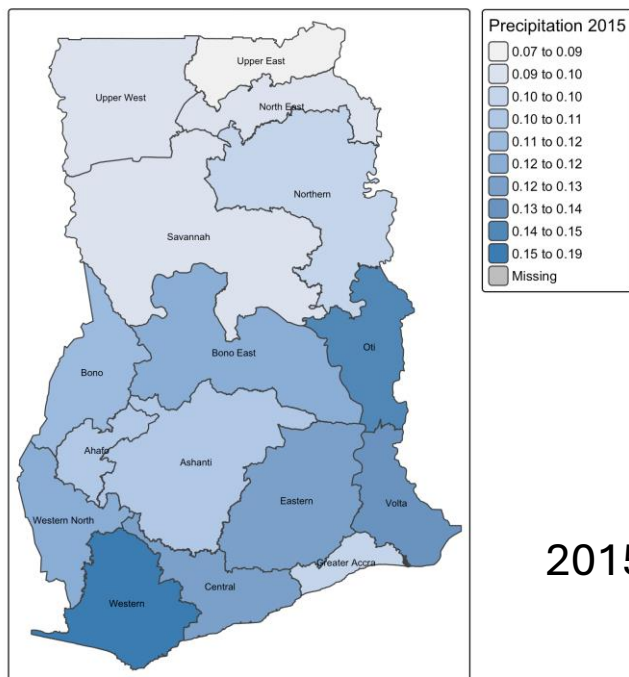
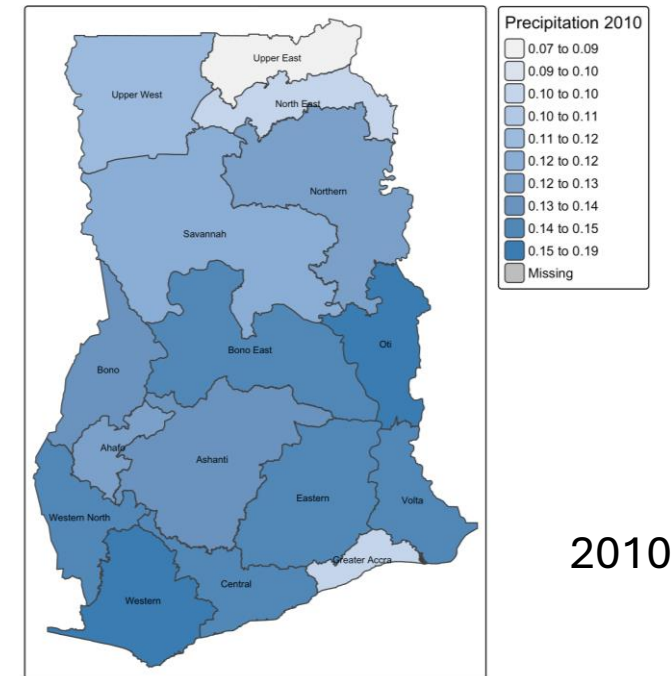
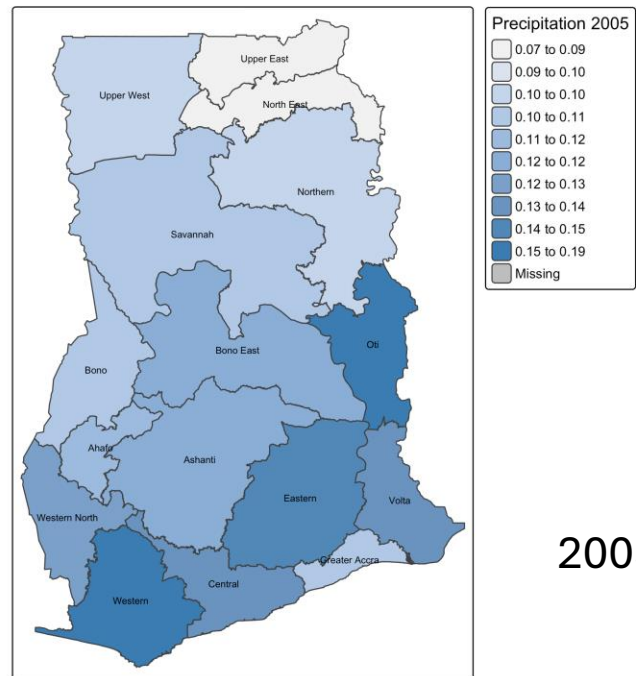
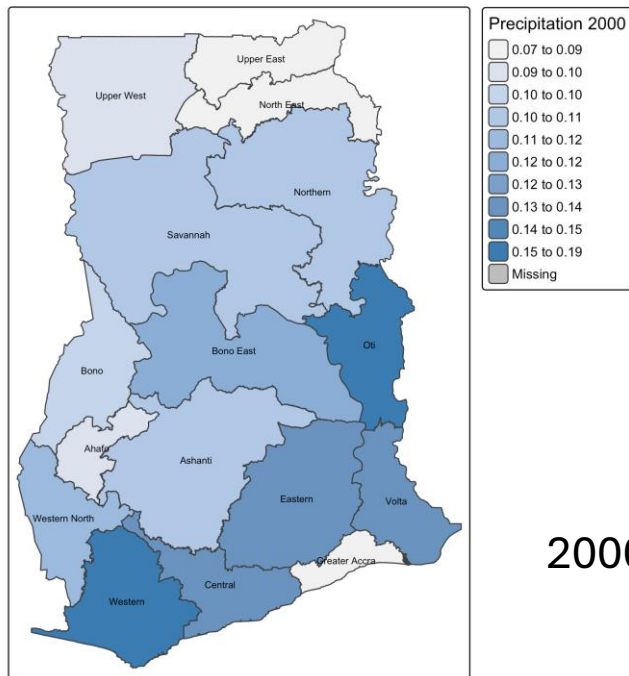
Graphs by regions

Diurnal Temperature Trends over Time by Region

Precipitation

- Derived Data Set: ERA-5
- Year: 2000, 2005, 2010, 2015, 2020
- Horizontal resolution: 25 kms
- Units: Millimeters per day

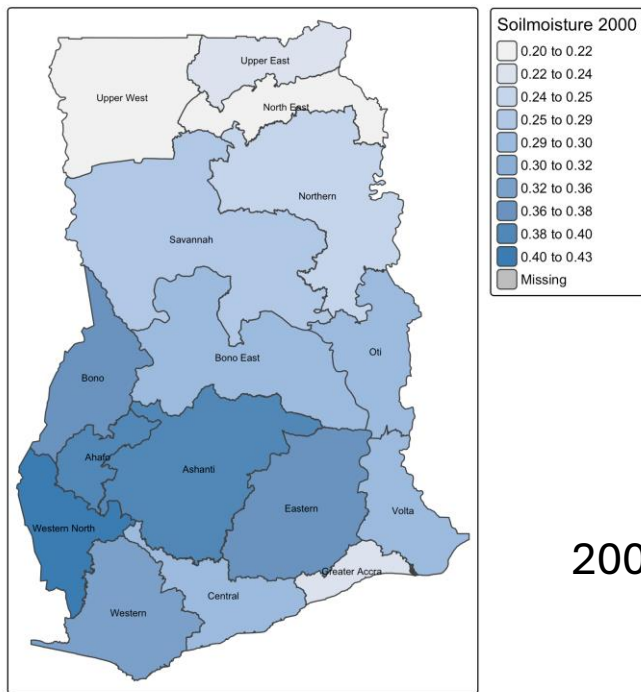
Description: Standard way of measuring rainfall or snowfall. The total precipitation is calculated from the combined large-scale and convective rainfall and snowfall rates every time step and the maximum is kept since the last postprocessing.



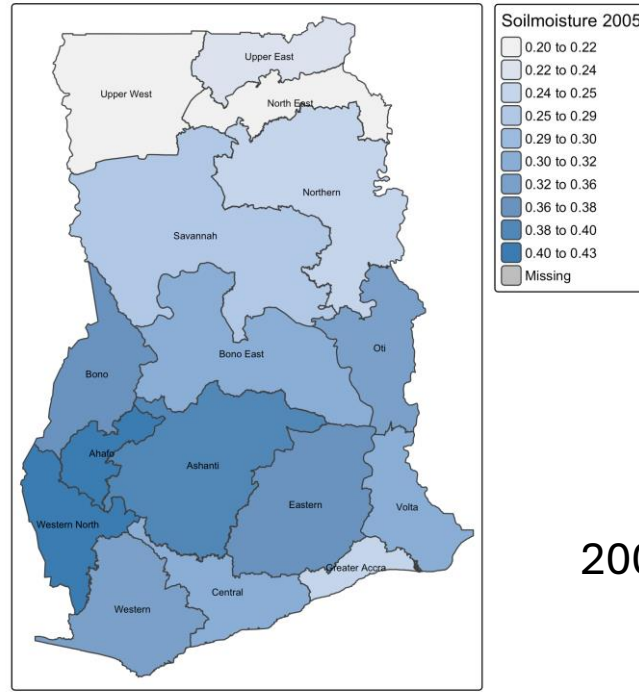
Soil Moisture

- Derived Data Set: ERA-5
- Year: 2000, 2005, 2010, 2015, 2020
- Horizontal resolution: 25 kms
- Units: m^3 water/ m^3 soil (daily)

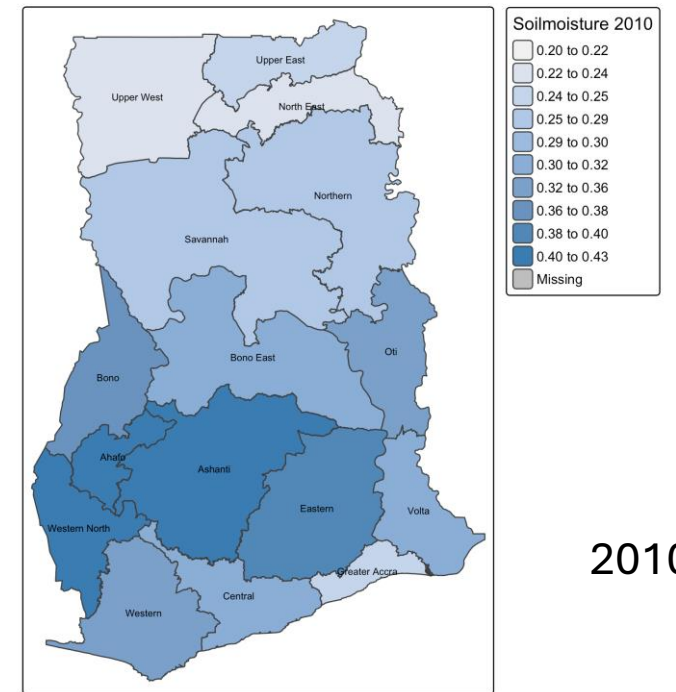
Description: Soil moisture in ERA5 refers to the volume of water contained in the first soil layer, which spans from the surface (0 cm) down to 7 cm depth. It is expressed as a volumetric quantity (m^3 water/ m^3 soil).



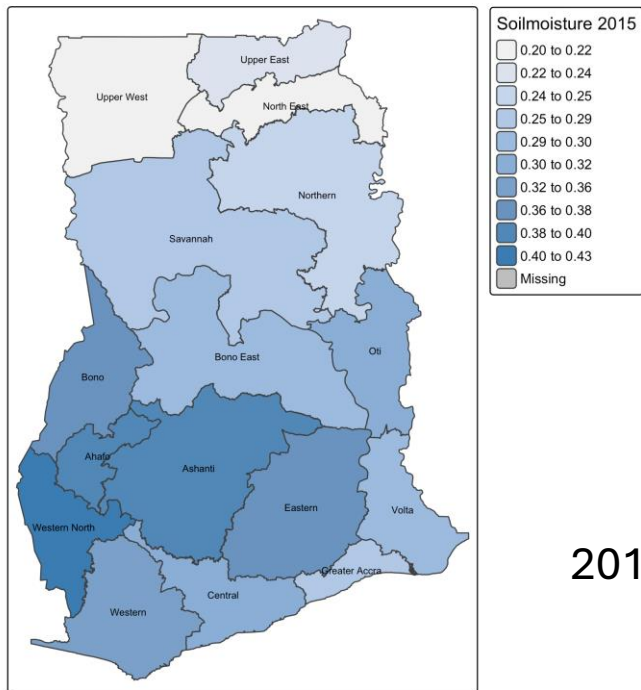
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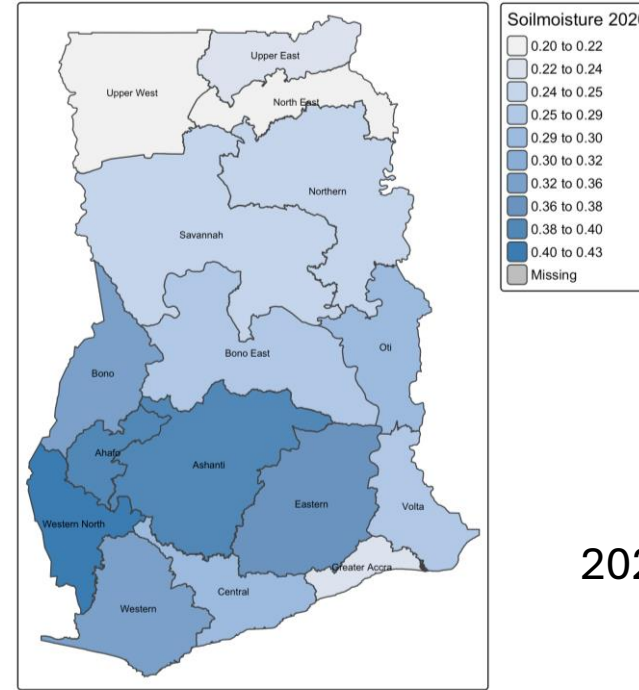
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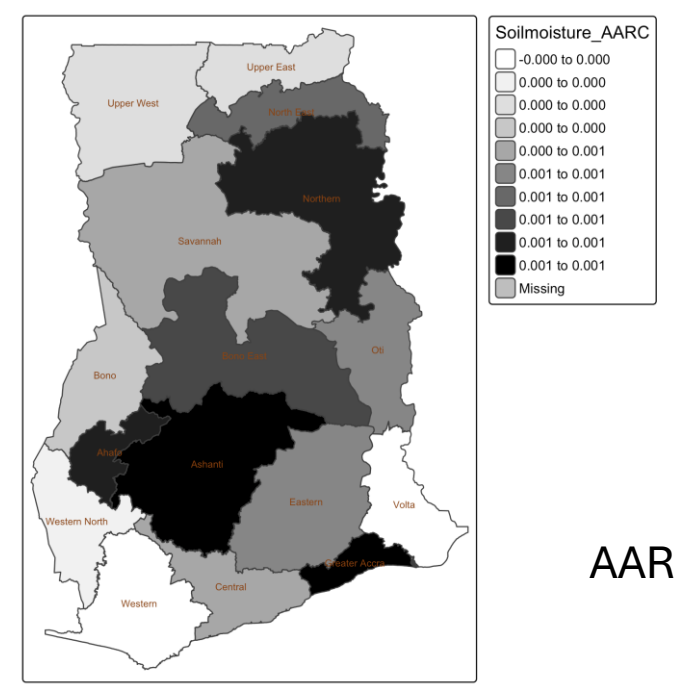
2010



2015



2020

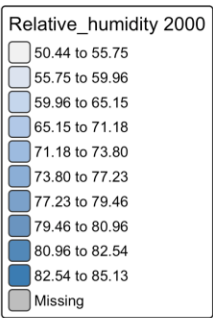
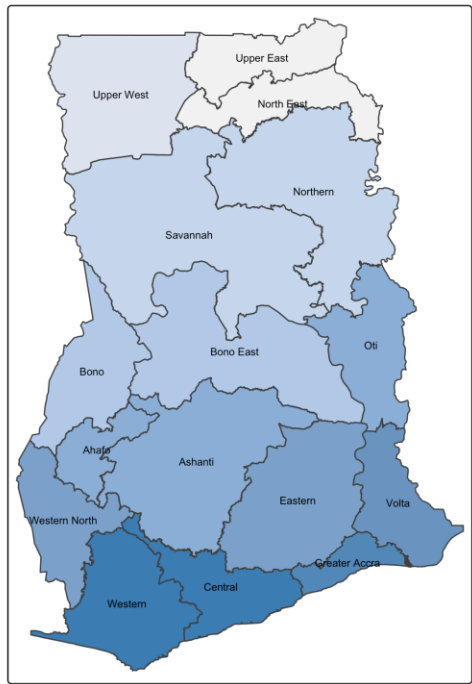


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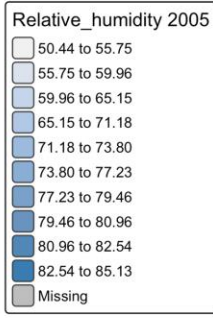
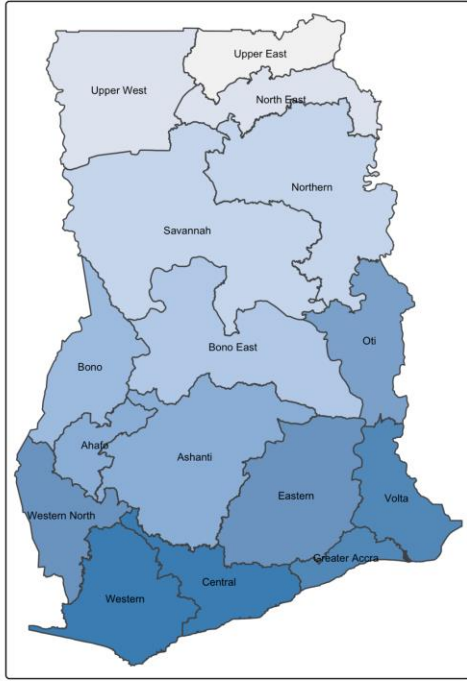
Relative Humidity

- Derived Data Set: ERA-5
- Year: 2000, 2005, 2010, 2015, 2020
- Horizontal resolution: 25 kms
- Units: % (daily)

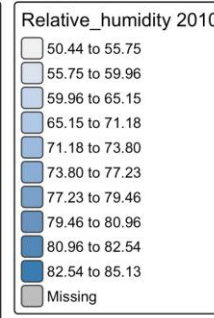
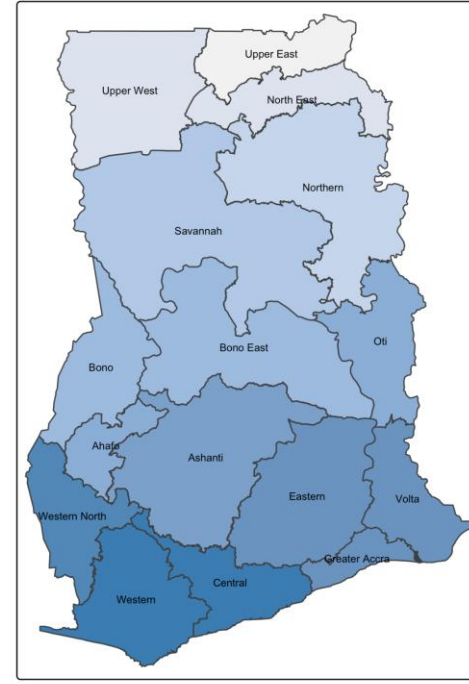
Description: Relative Humidity (RH) is the ratio of the current water vapor pressure to the maximum possible water vapor pressure at a given temperature. It is a measure of how much moisture is in the air compared to the maximum moisture the air can hold at a specific temperature.



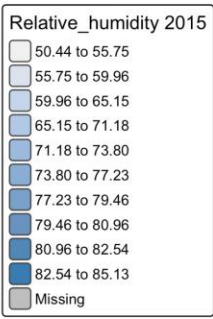
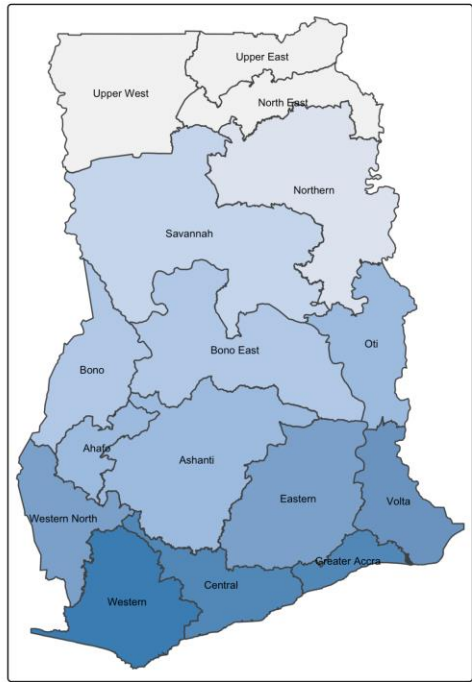
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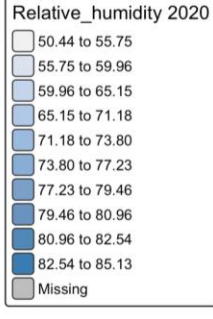
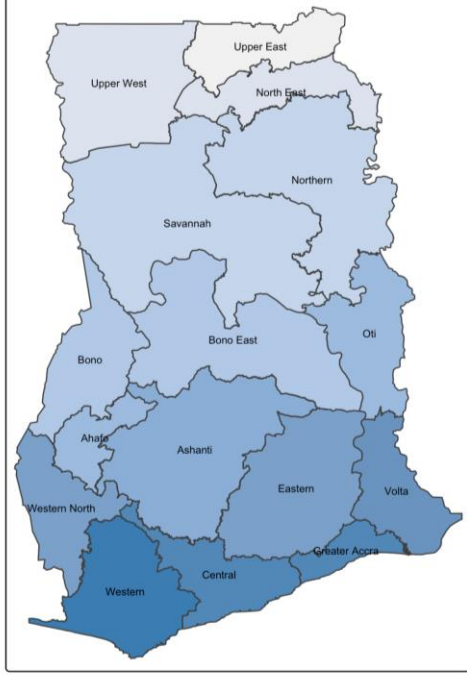
2005



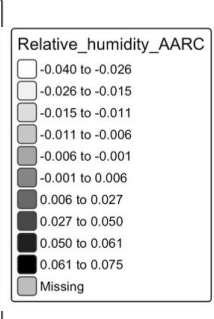
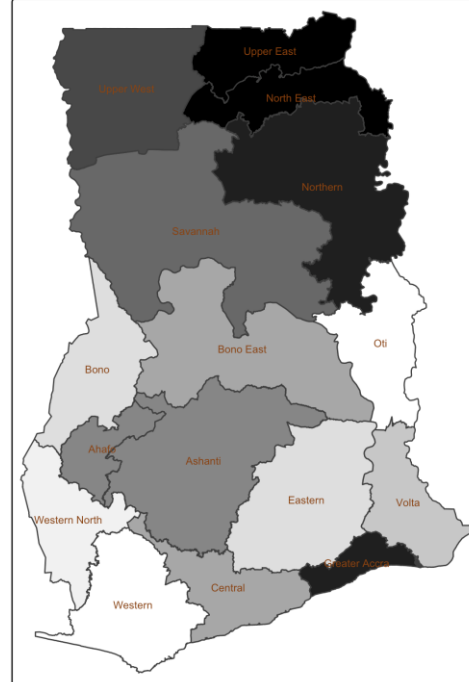
2010



2015



2020



AARC

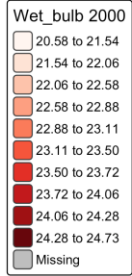
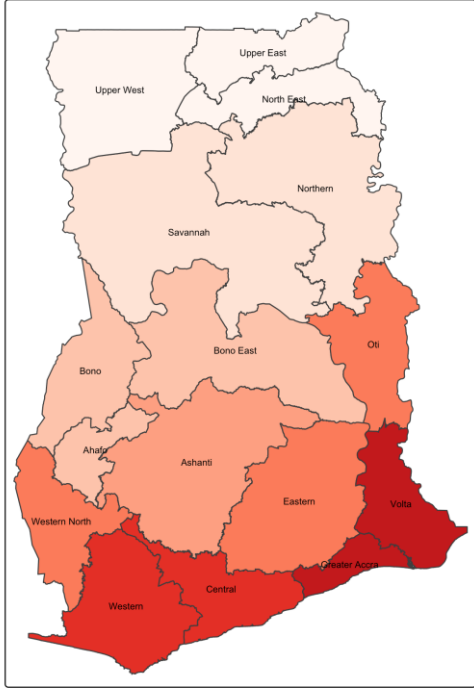
Wet Bulb Temperature

- Derived Data Set: ERA-5 (calculated)
- Year: 2000, 2005, 2010, 2015, 2020
- Horizontal resolution: 25 kms
- Units: Degrees Celsius (daily)

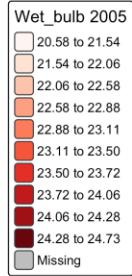
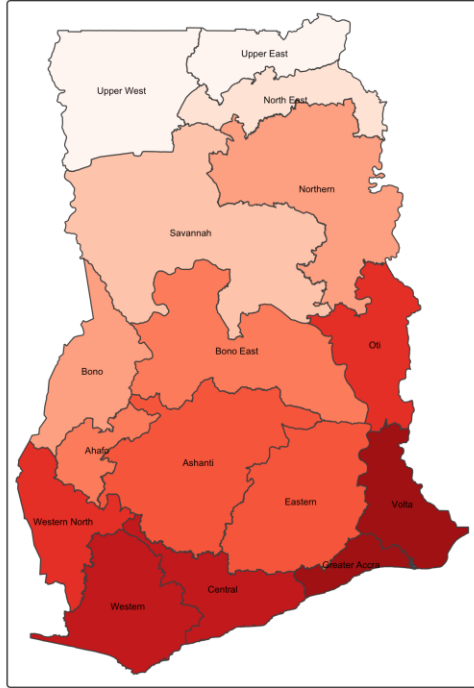
Description: The wet-bulb temperature represents the lowest temperature that air can attain through the process of evaporative cooling. It reflects the temperature at which air becomes fully saturated with moisture (relative humidity of 100%) when water evaporates into it. This measure combines the effects of temperature and humidity in a way that directly influences human temperature, indicating the physical limit at which the human body can effectively cool itself by sweating (less than 35°C).

References: Hersbach, H., Bell, B., Berrisford, P., Hirahara, S., Horányi, A., Muñoz-Sabater, J., ... & Thépaut, J. N. (2020). The ERA5 global reanalysis. Quarterly journal of the royal meteorological society, 146(730), 1999-2049.

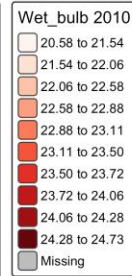
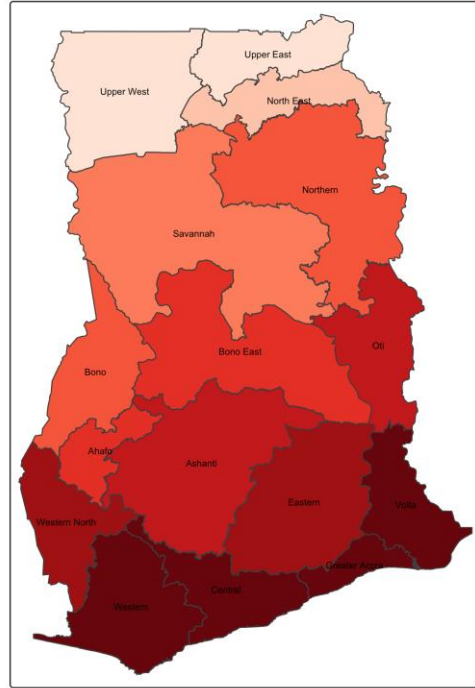
Stull, R. (2011). Wet-bulb temperature from relative humidity and air temperature. Journal of applied meteorology and climatology, 50(11), 2267-2269.



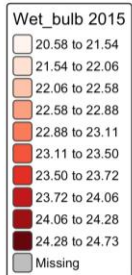
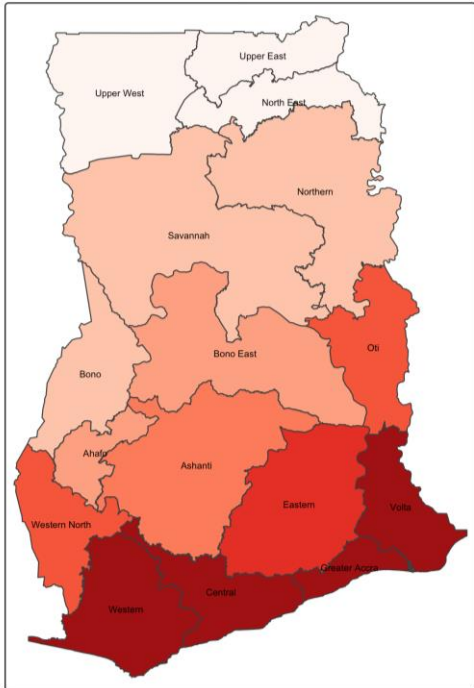
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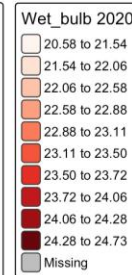
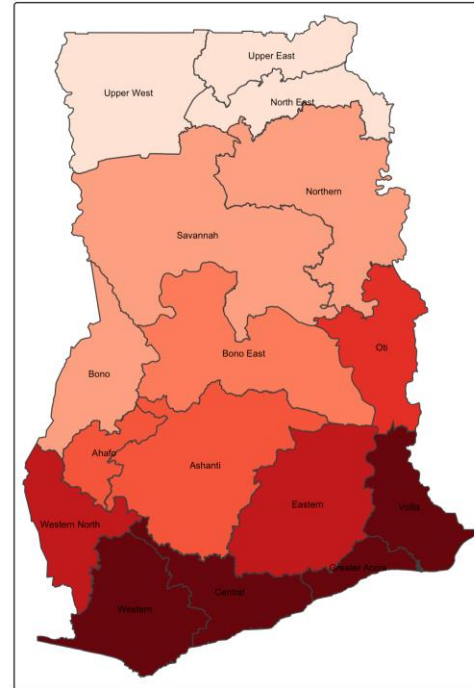
2005



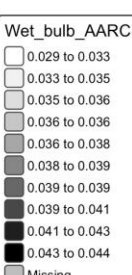
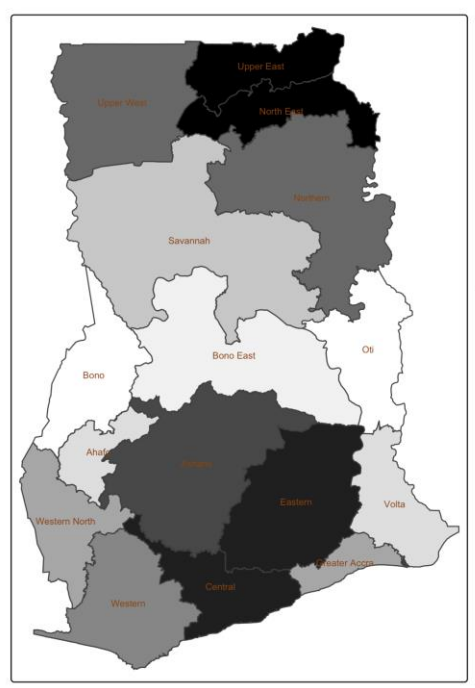
2010



2015



2020



AARC

Ghana

Time points: 2000, 2005, 2010, 2015, 2020

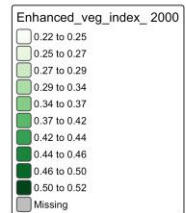
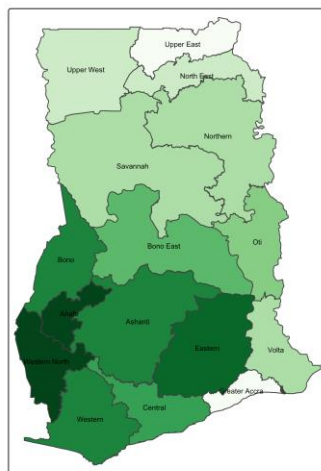
Agriculture (3)

- Enhanced vegetation index
- Crops – maize & rice (within the top 20 list of commodities noted in FAO for 2020)

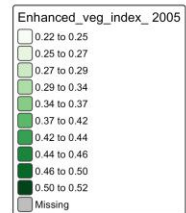
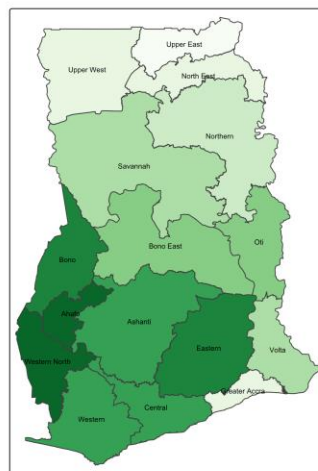
Enhanced Vegetation Index

- Derived Data Set: Vegetation Index and Phenology (VIP) Phenology EVI-2 Yearly Global 0.05Deg CMG V004
- Derived Data Set Cell Size: 0.05 decimal degrees (~5 km)
- Summary Statistic: Mean
- Year: 2000, 2005, 2010, 2015, 2020 Units:
- Vegetation index value between -1 (least vegetation) and 1 (most vegetation).

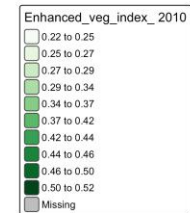
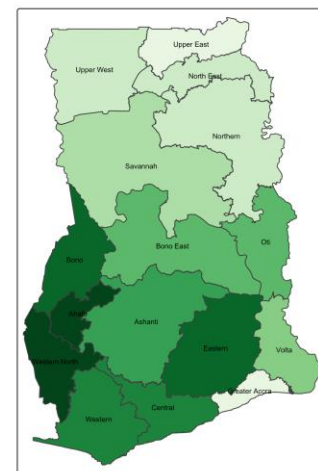
Description: The average vegetation index value at the DHS survey cluster at the time of measurement (year). EVI composites are produced globally from data collected by the MODIS sensor on the Terra satellite (MOD13A3). The MODIS EVI products are computed from atmospherically corrected bi-directional surface reflectance data that have been masked for water, clouds, heavy aerosols, and cloud shadows. These data are used for global monitoring of vegetation condition.



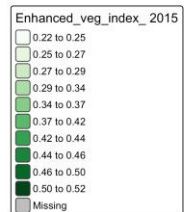
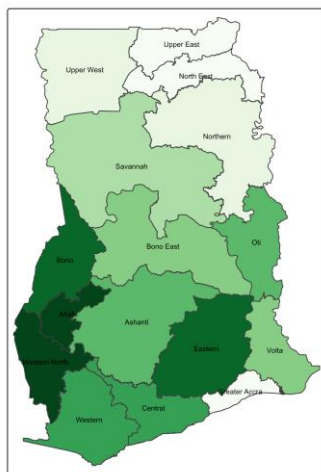
2000



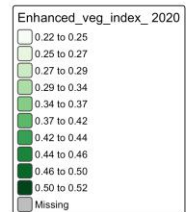
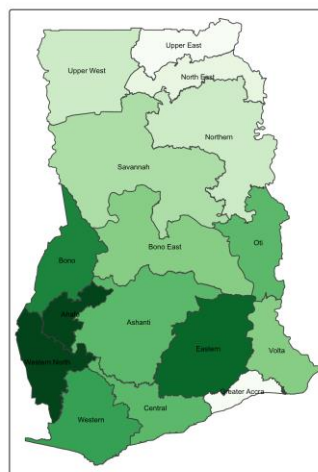
2005



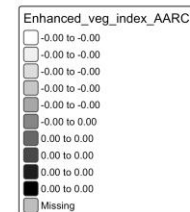
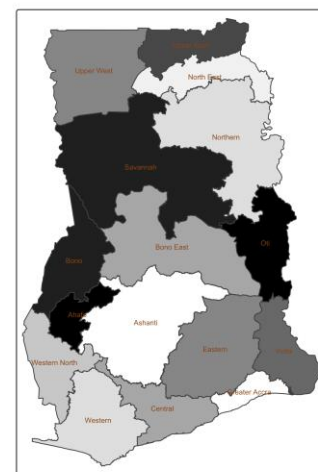
2010



2015



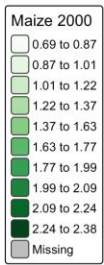
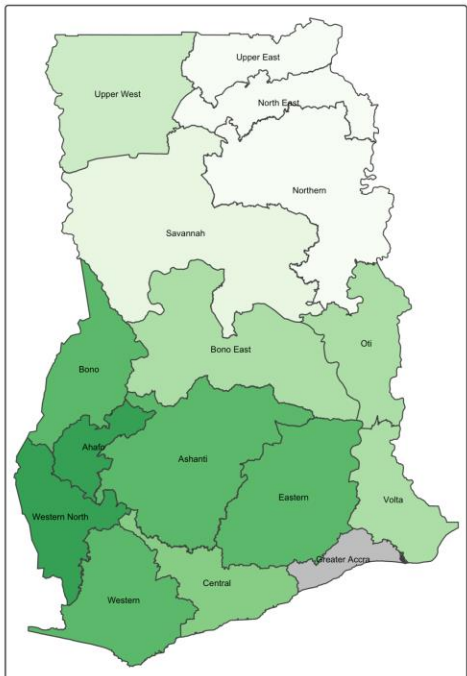
2020



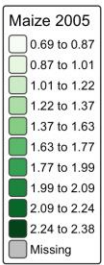
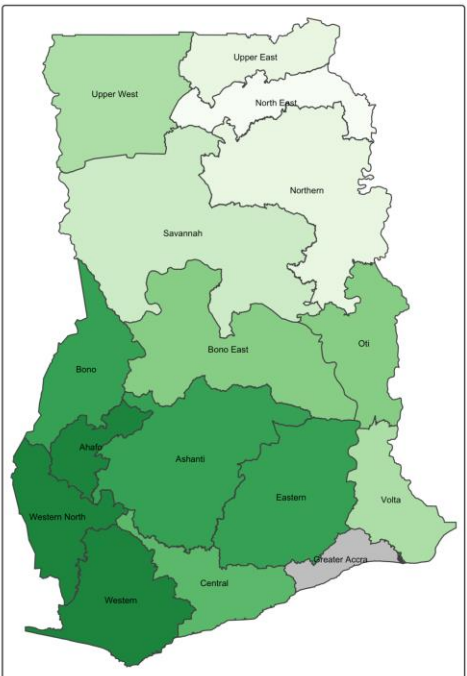
AARC

Maize

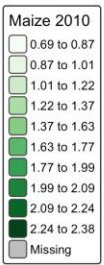
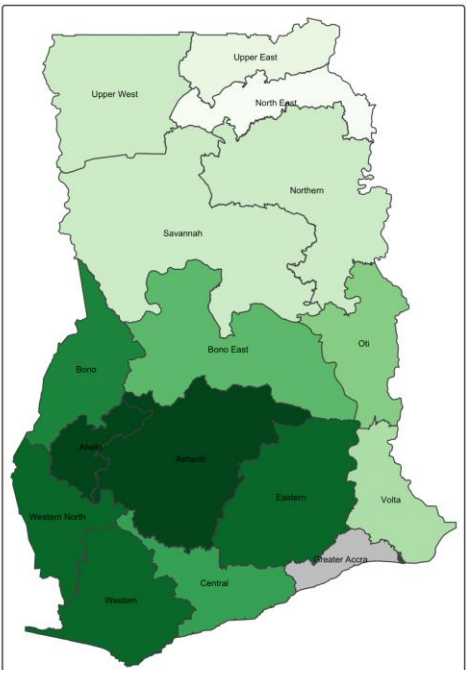
- The Gridded Yields data provides grid-cell yield estimates for wheat, maize, and rice over the period 1981–2020 at 0.5° spatial resolution.
- Maize: Yield data are provided separately for major and second cropping seasons (where maize is grown twice a year).



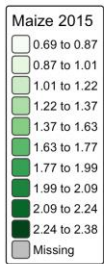
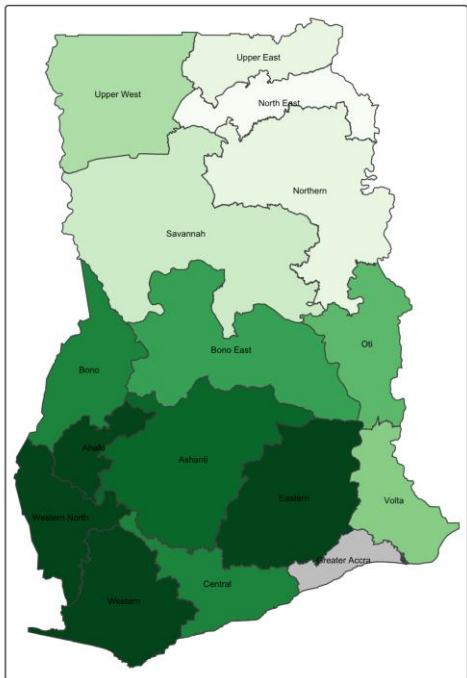
2000



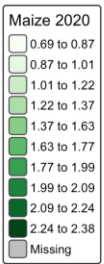
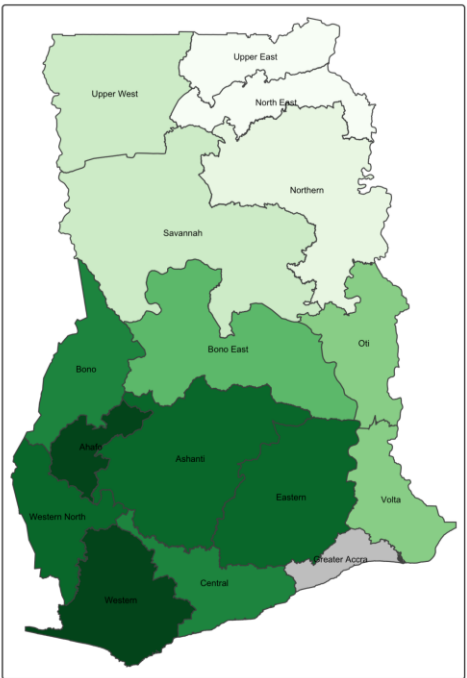
2005



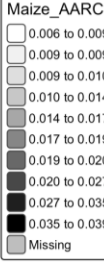
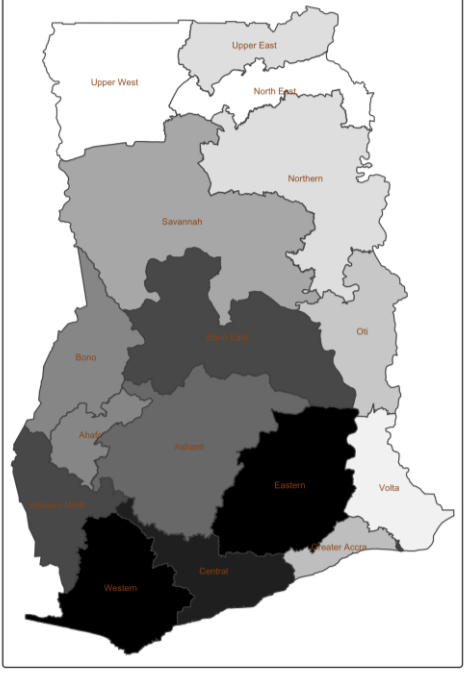
2010



2015



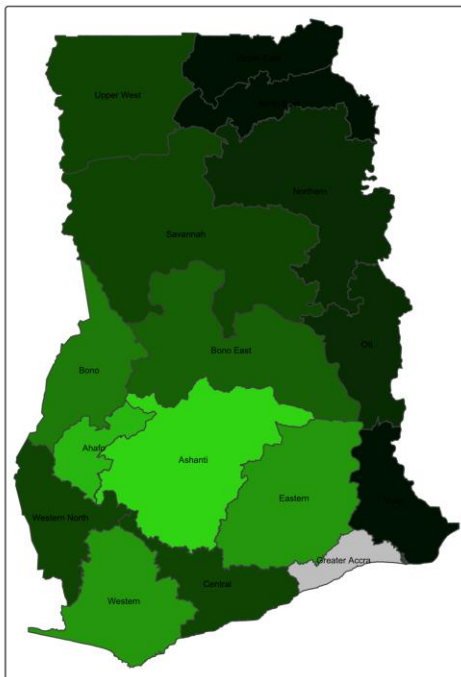
2020



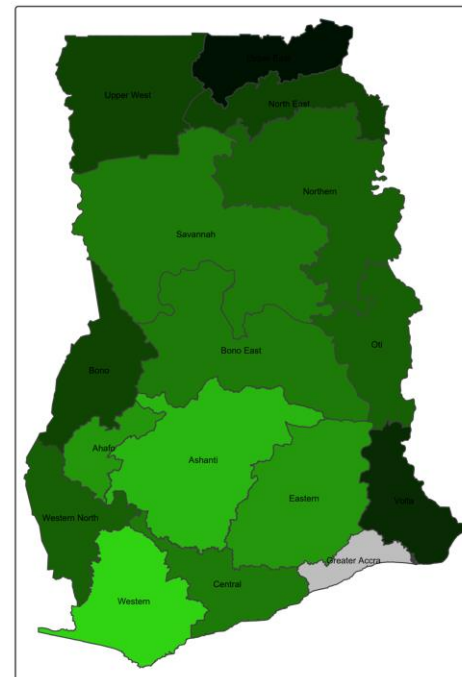
AARC

Rice

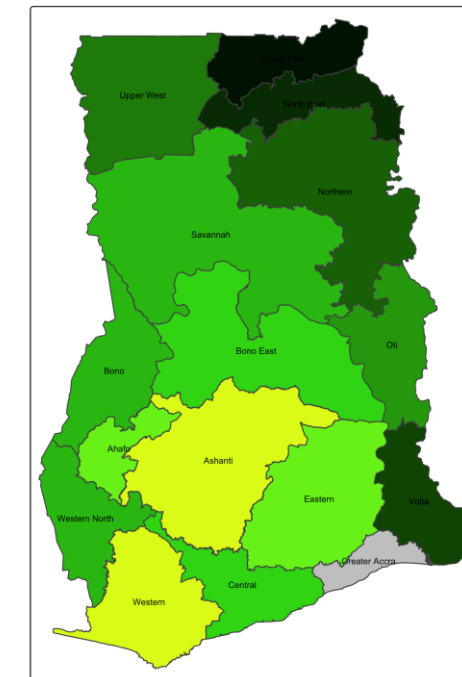
- The Gridded Yields data provides grid-cell yield estimates for wheat, maize, and rice over the period 1981–2020 at 0.5° spatial resolution.
- Rice: Yield data are separated into major and second cropping seasons as well, reflecting different planting and harvesting cycles typical in tropical and subtropical regions.



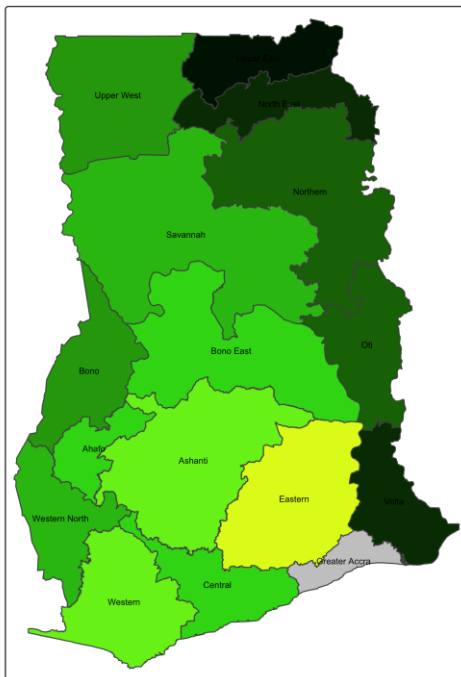
2000



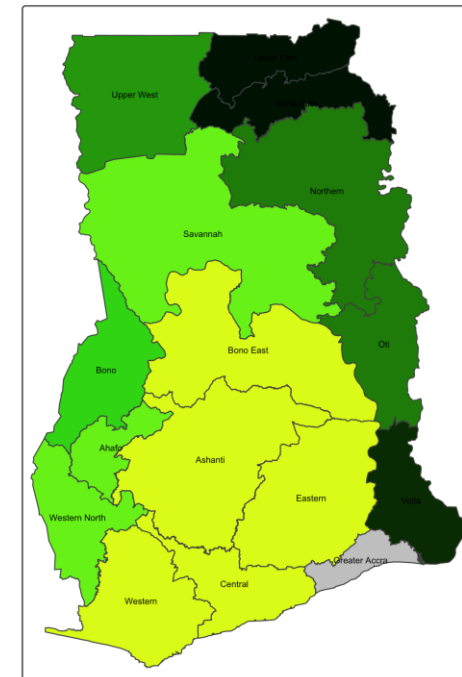
2005



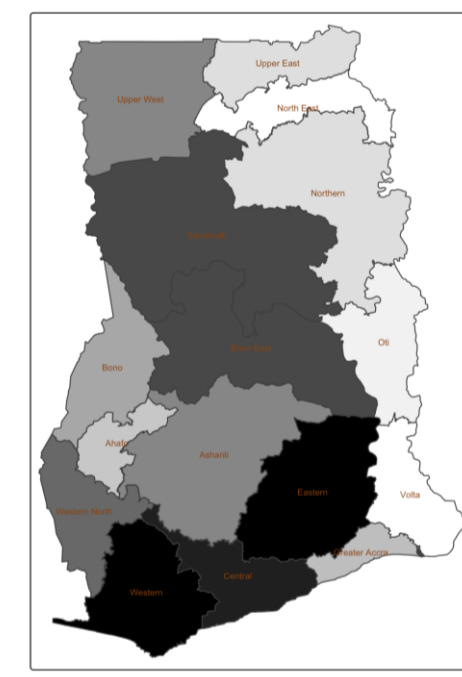
2010



2015



2020



AARC

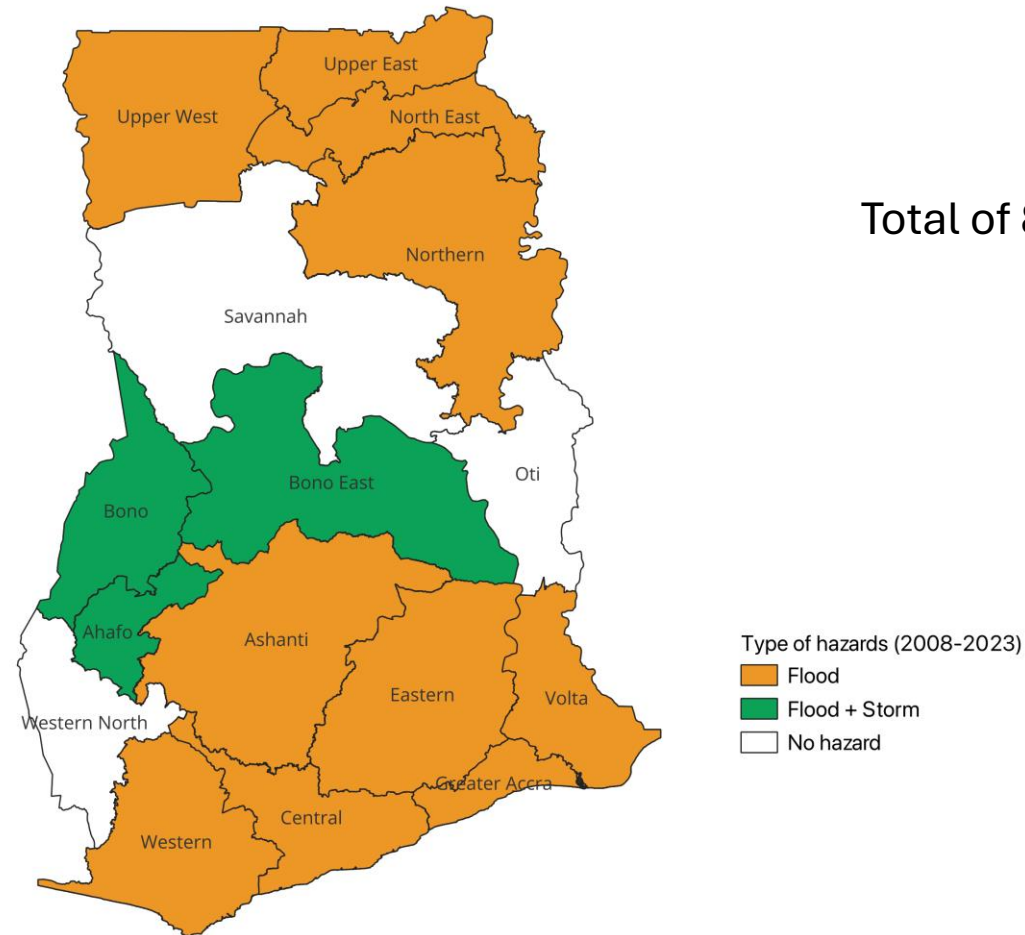
Ghana

Time points: 2000, 2005, 2010, 2015, 2020

Disaster and Migration/Displacement (4)

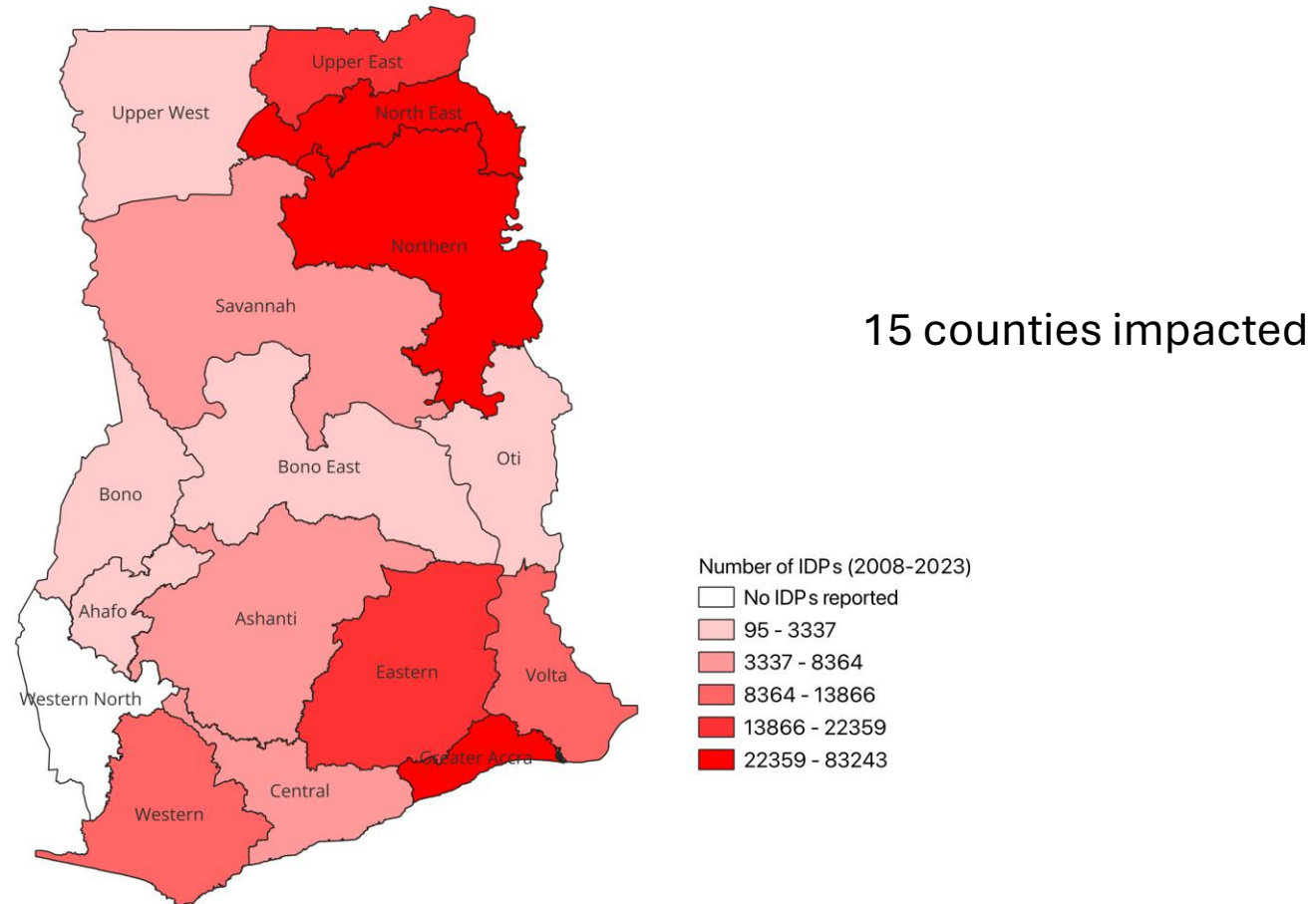
- Counties affected by disasters between 2008-2023
 - Resource: Em-dat database
- Counties with IDPs due to Disaster(s) between 2008-2023
 - Resource: IDMC (Internal Displacement Monitoring Centre)
- Number of IDPs by disaster over time
 - Resource: IDMC (Internal Displacement Monitoring Centre)
- UN-adjusted population density

Counties affected by Disasters between 2008-2023



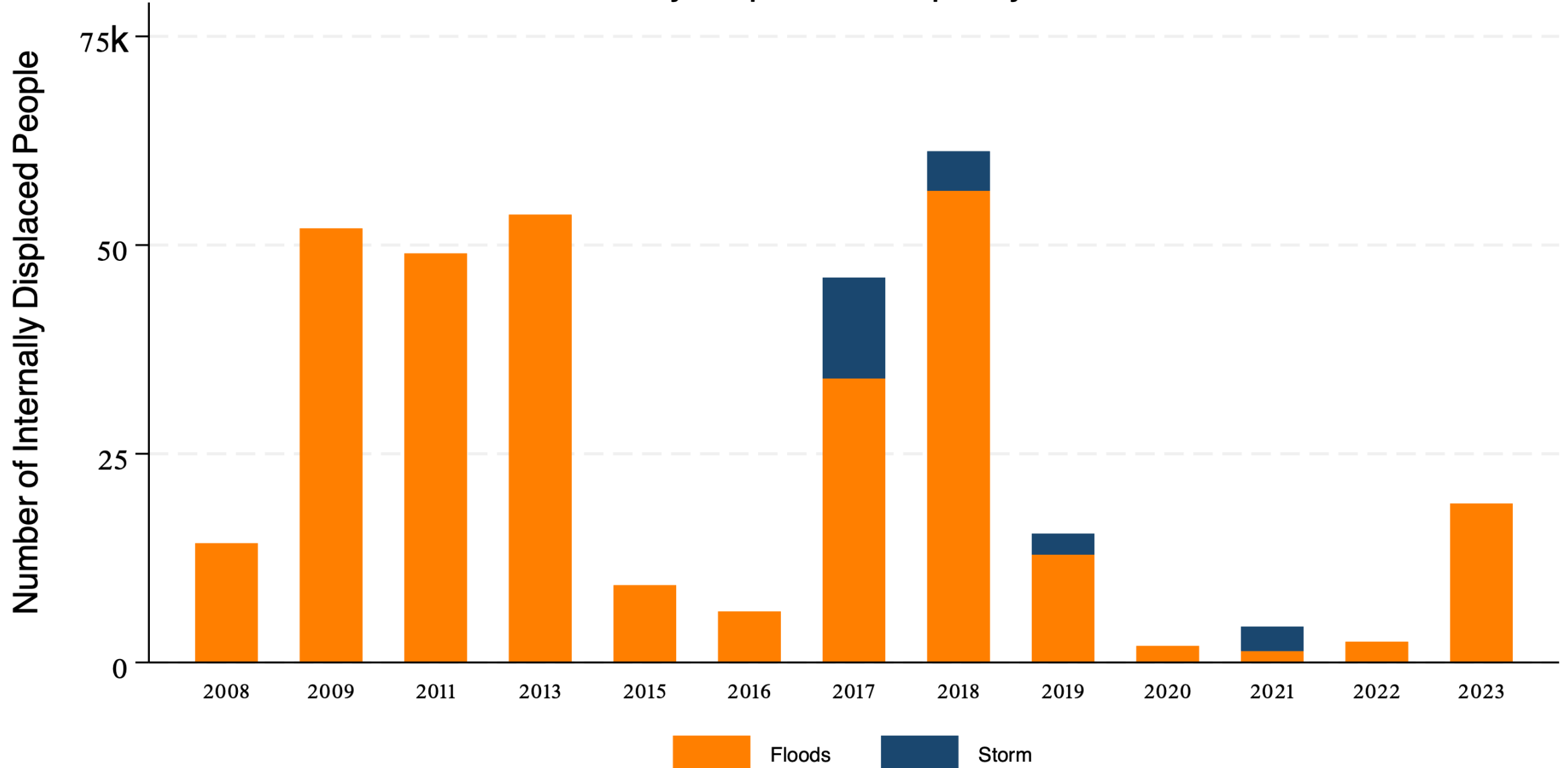
Total of 83 disasters affecting 13 regions

Counties with IDPs due to Disaster(s) between 2008-2023



Ghana

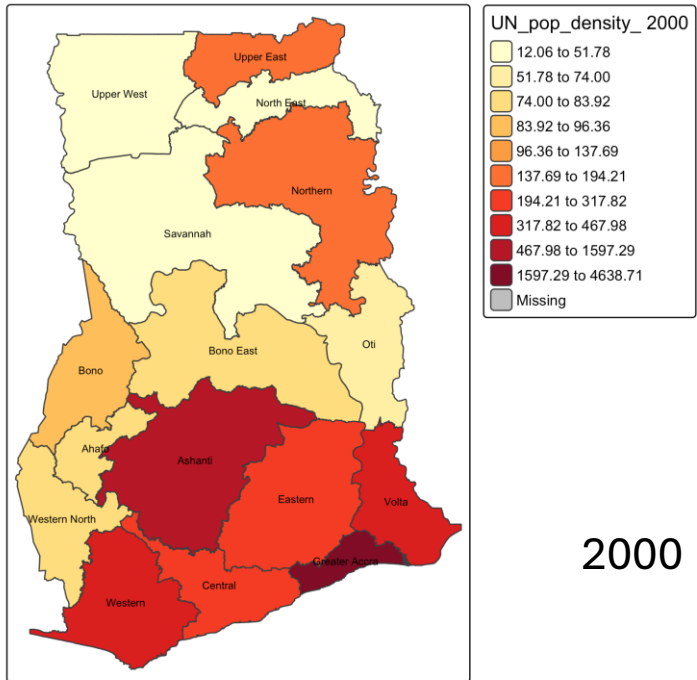
Number of Internally Displaced People by Disaster Over Time



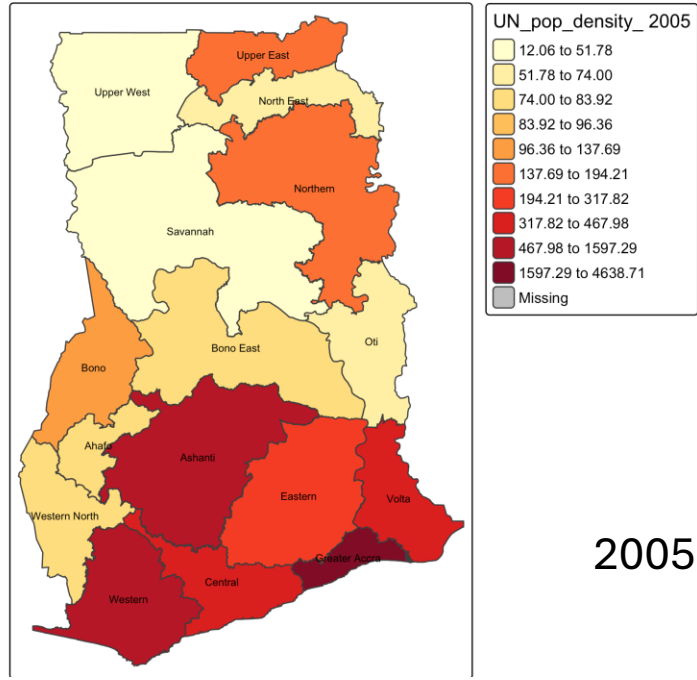
UN-adjusted Population Density

- Derived Data Set: UN-Adjusted Population Density, v4.11 (2000, 2005, 2010, 2015, 2020)
- Derived Data Set Cell Size: 30 arc seconds (~0.00833333 decimal degrees; ~1 km)
- Summary Statistic: Mean
- Year: 2000, 2005, 2010, 2015, 2020
- Units: Number of people per square kilometer

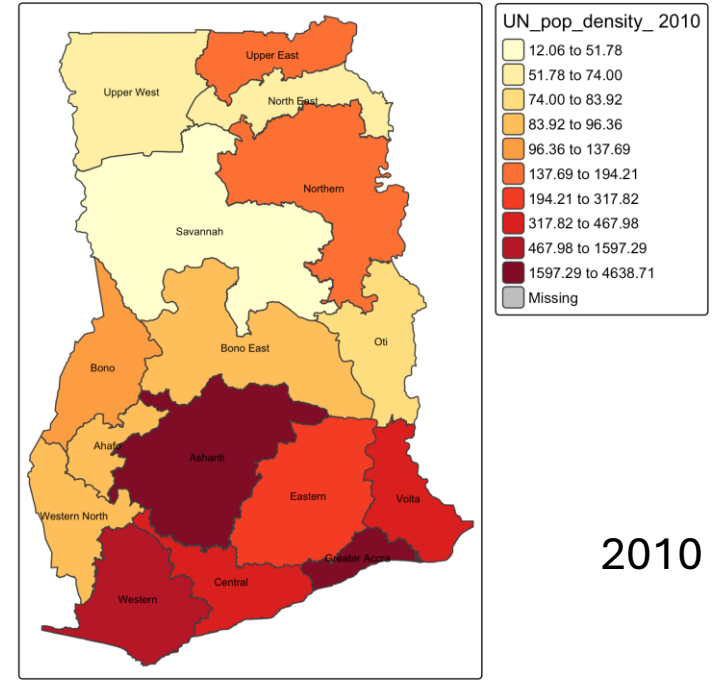
Description: The average UN-adjusted population density of the area at the DHS survey cluster location. Gridded Population of the World, Version 4 (GPWv4) consists of high resolution estimates of human population density (number of persons per square kilometer) based on counts consistent with national censuses and population registers, for the years 2000, 2005, 2010, and 2015. A proportional allocation gridding algorithm, utilizing approximately 13.5 million national and subnational administrative units, was used to assign population counts to ~1 km grid cells. The population density rasters were created by dividing the population count raster for a given target year by the land area raster.



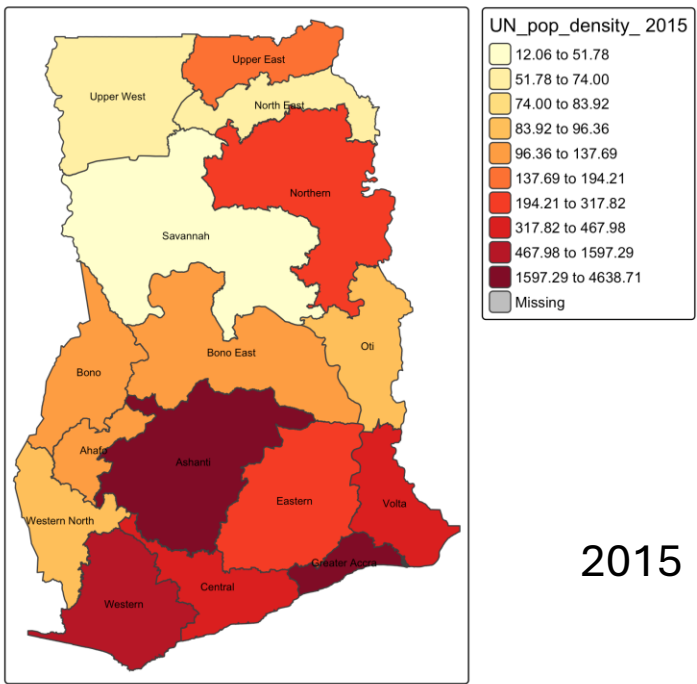
2000



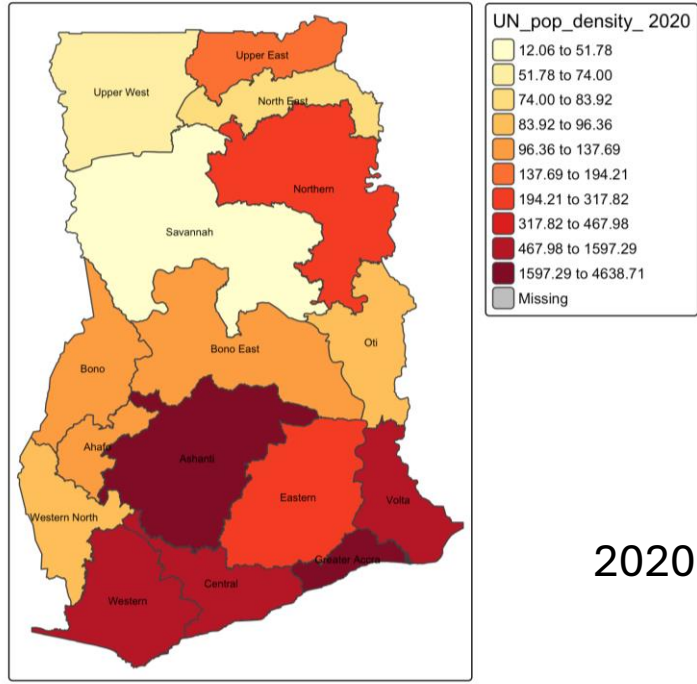
2005



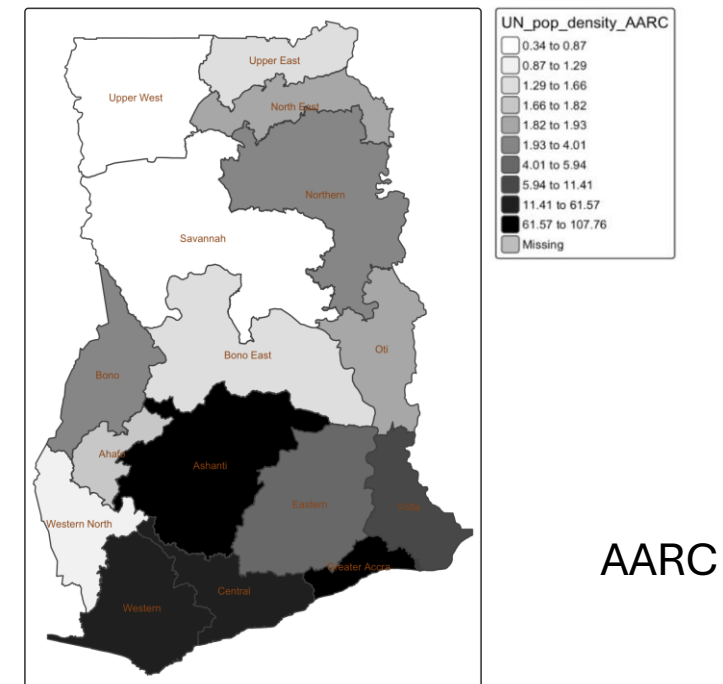
2010



2015



2020



AARC

Ghana

Time points: 2003, 2008, 2014, 2022

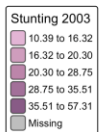
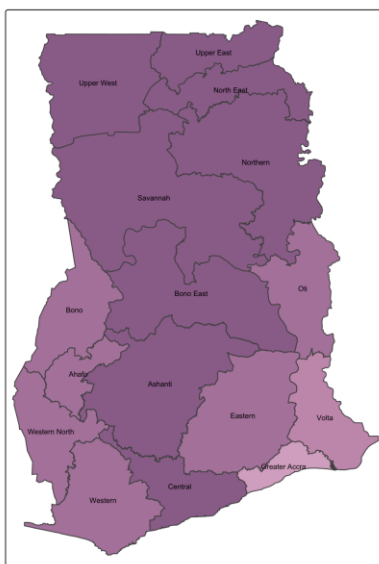
Health & Nutrition Indicators (3)

DHS surveys for year the survey conducted for following indicators:

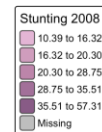
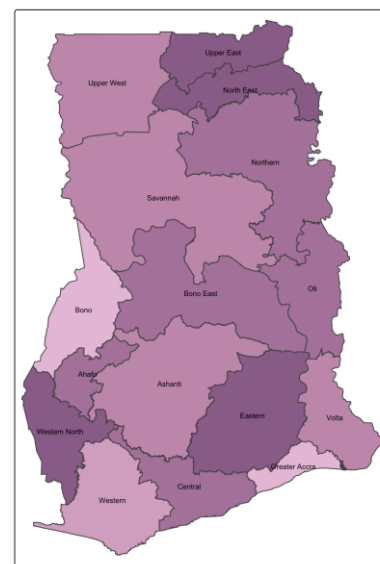
- Stunting
- Wasting
- Underweight

Stunting

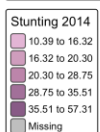
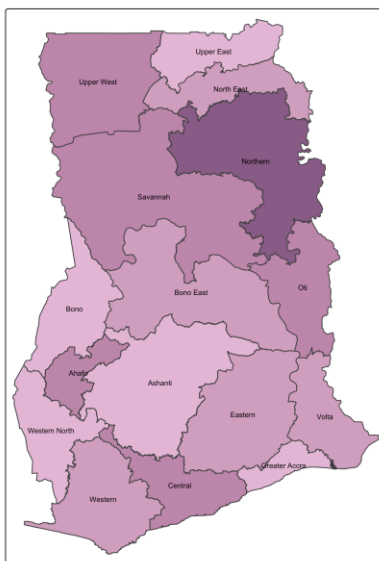
- Number of children aged 0-59 months whose height-for-age z-score is below minus 2 (-2.0) standard deviations (SD) below the median on the WHO Child Growth Standards



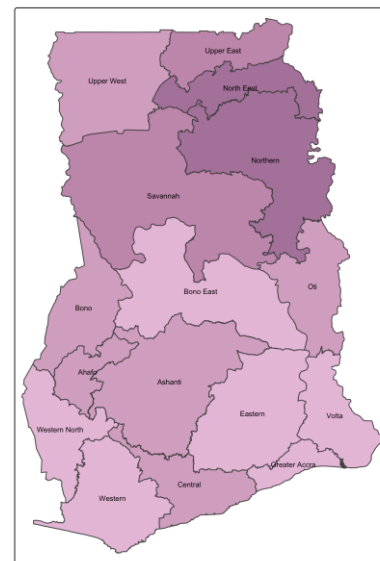
2003



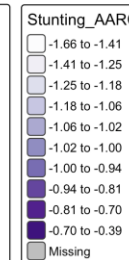
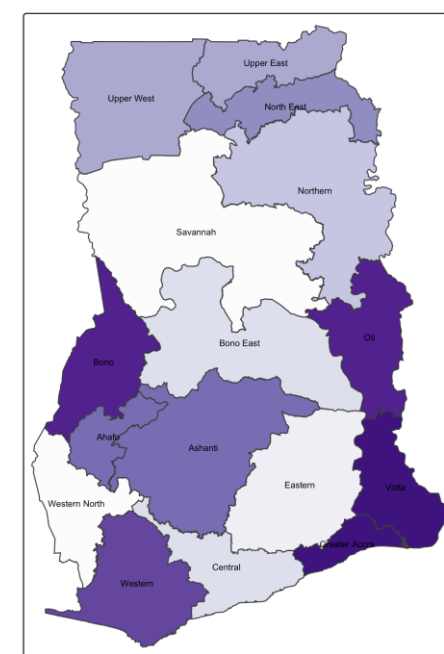
2008



2014



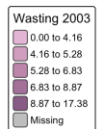
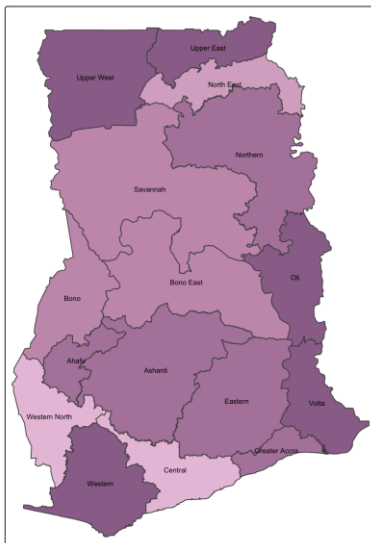
2022



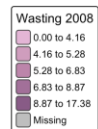
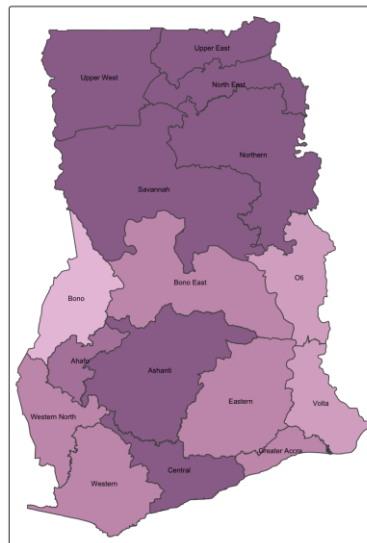
AARC

Wasting

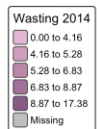
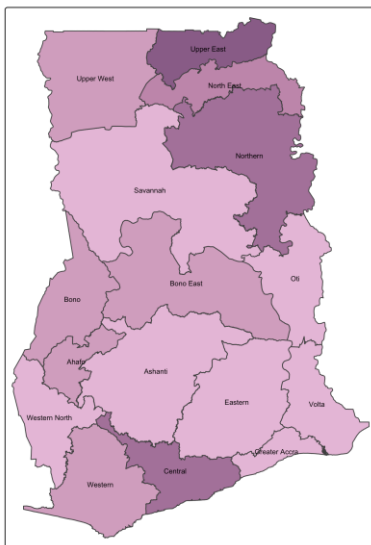
- Number of children age 0-59 months whose weight-for-height z-score is below minus 2 (-2.0) standard deviations (SD) below the median on the WHO Child Growth Standards



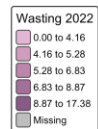
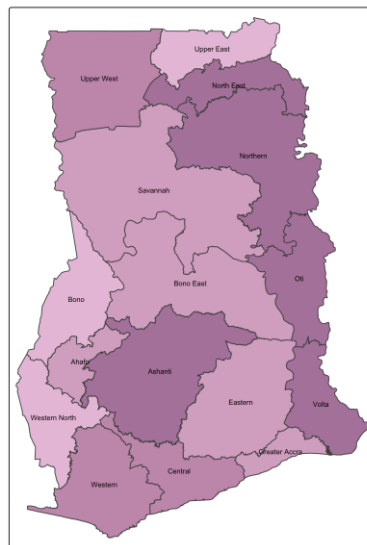
2003



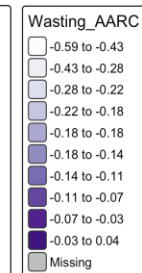
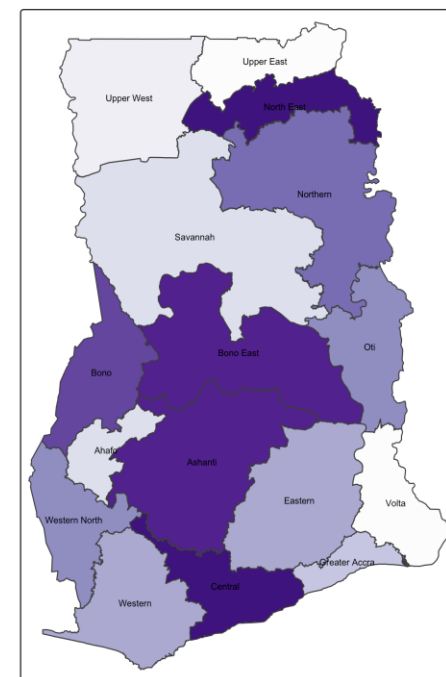
2008



2014



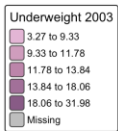
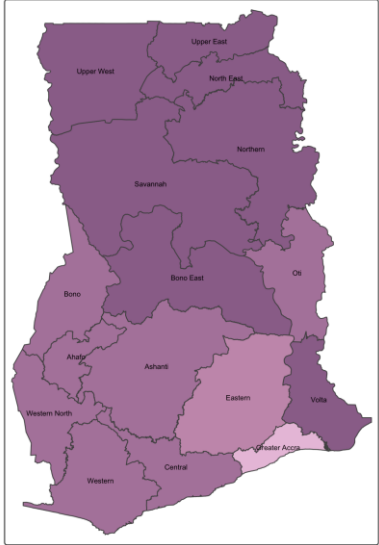
2022



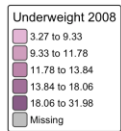
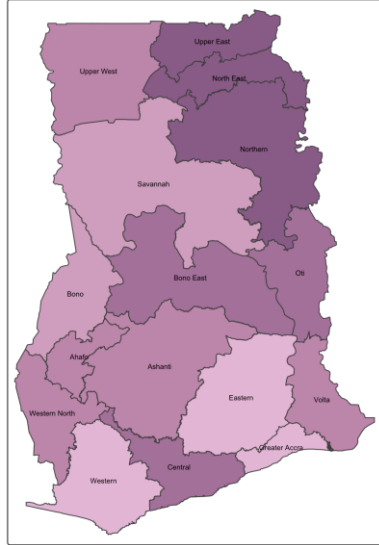
AARC

Underweight

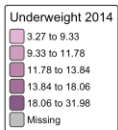
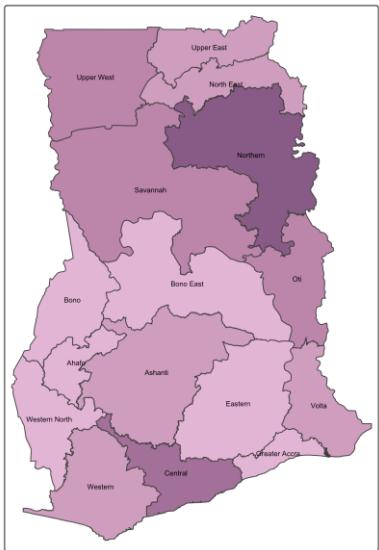
- Number of children age 0-59 months whose weight-for-age z-score is below minus 2 (-2.0) standard deviations (SD) below the median on the WHO Child Growth Standards



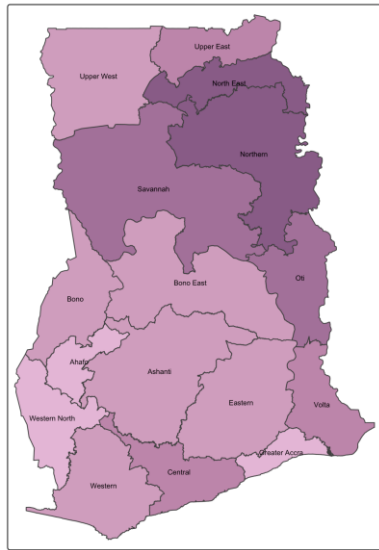
2003



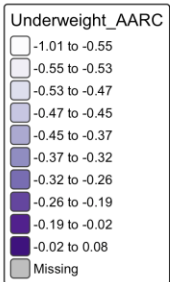
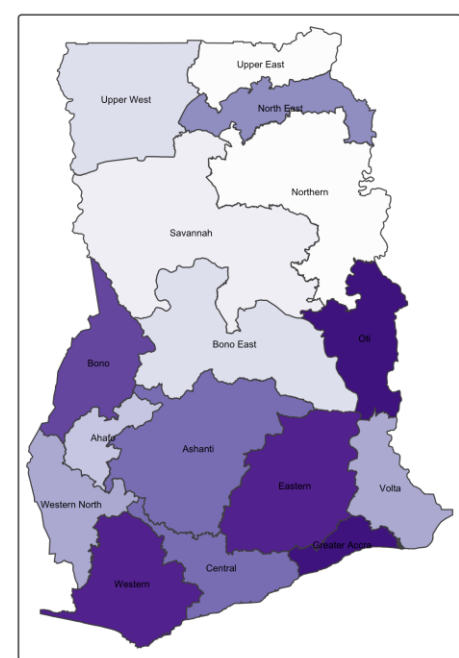
2008



2014

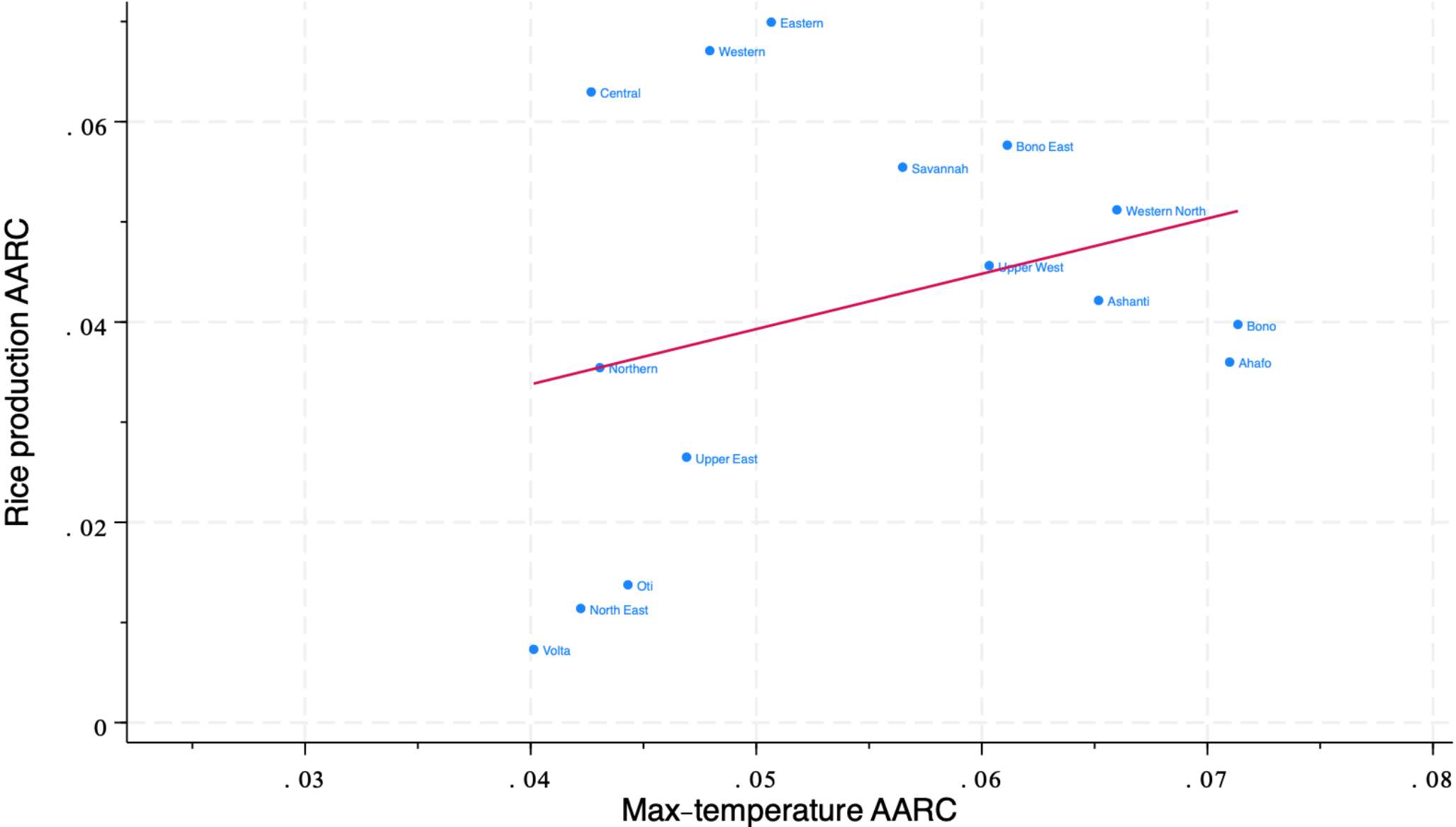


2022

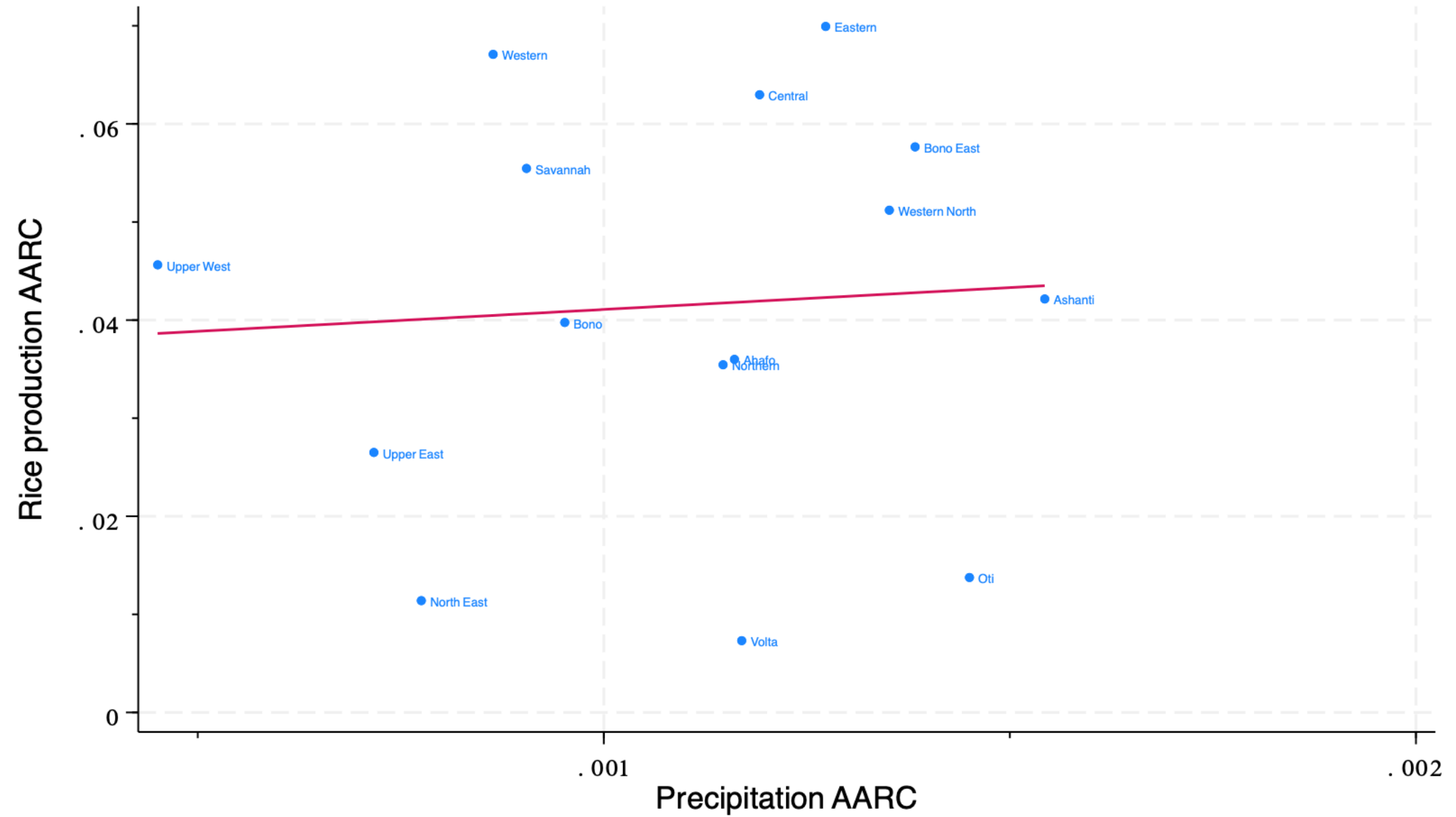


AARC

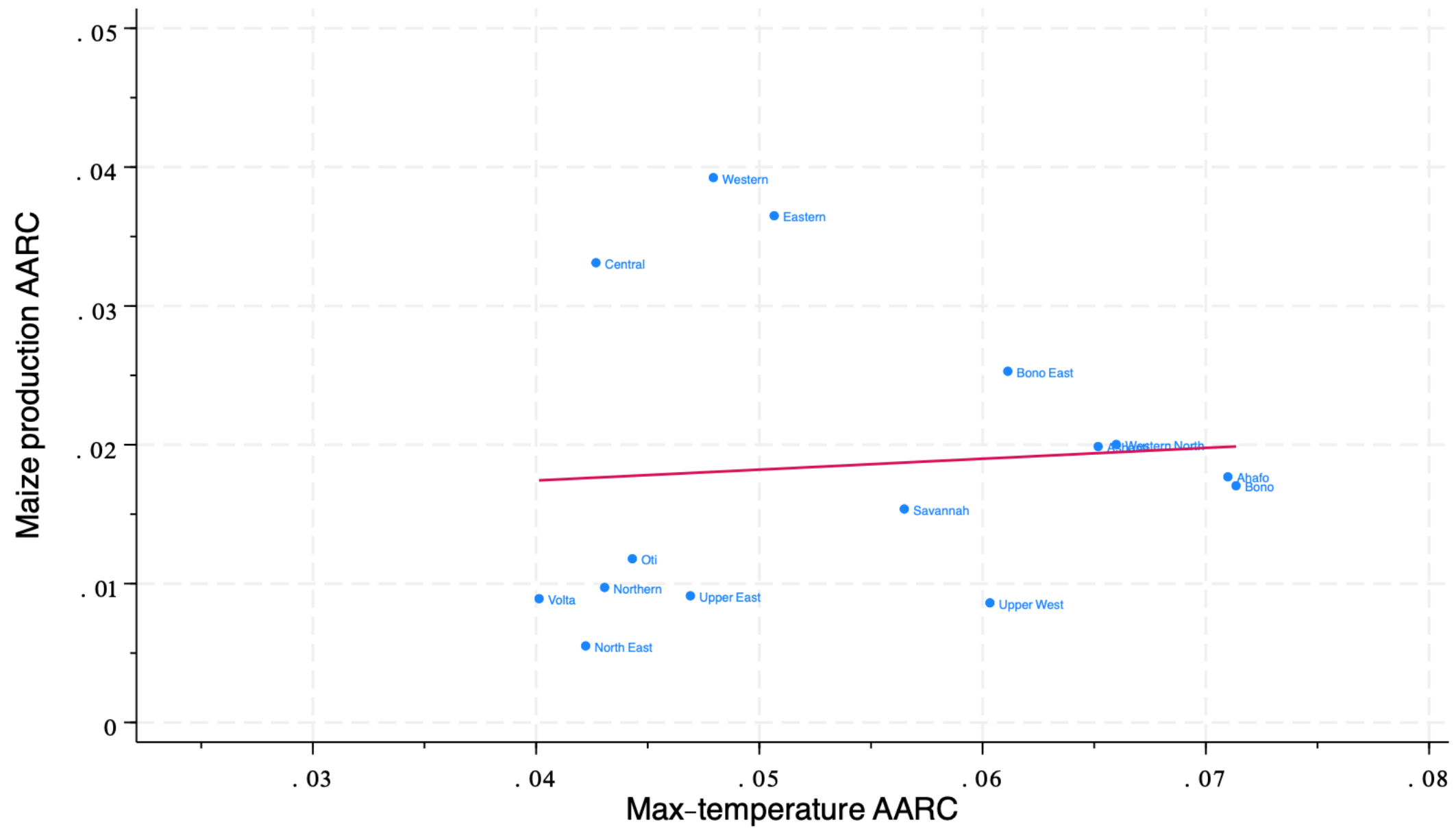
Rice Production AARC vs Max Temperature AARC from 2000-2020 by Region in Ghana



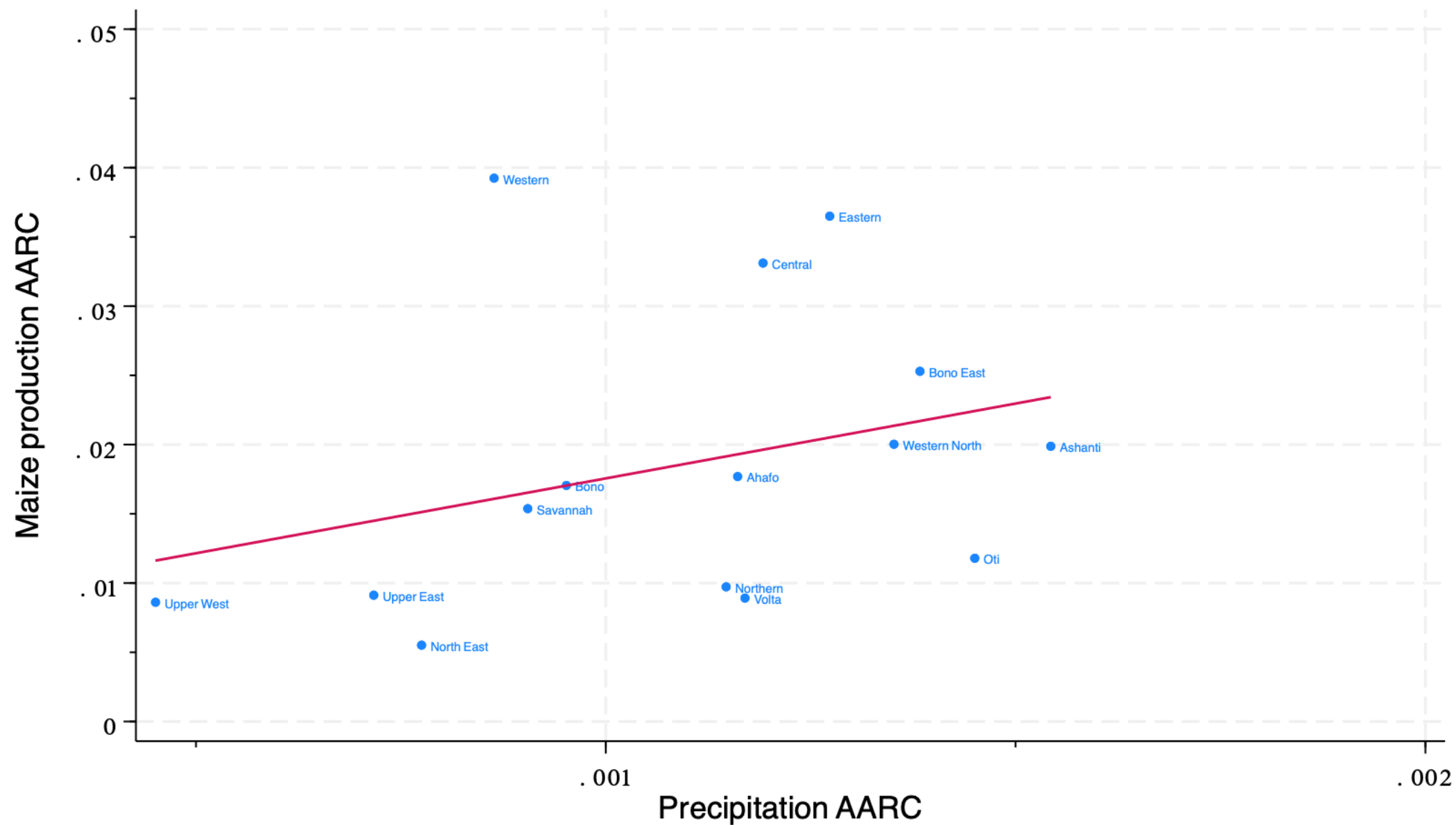
Rice Production AARC vs Precipitation AARC from 2000-2020 by Region in Ghana



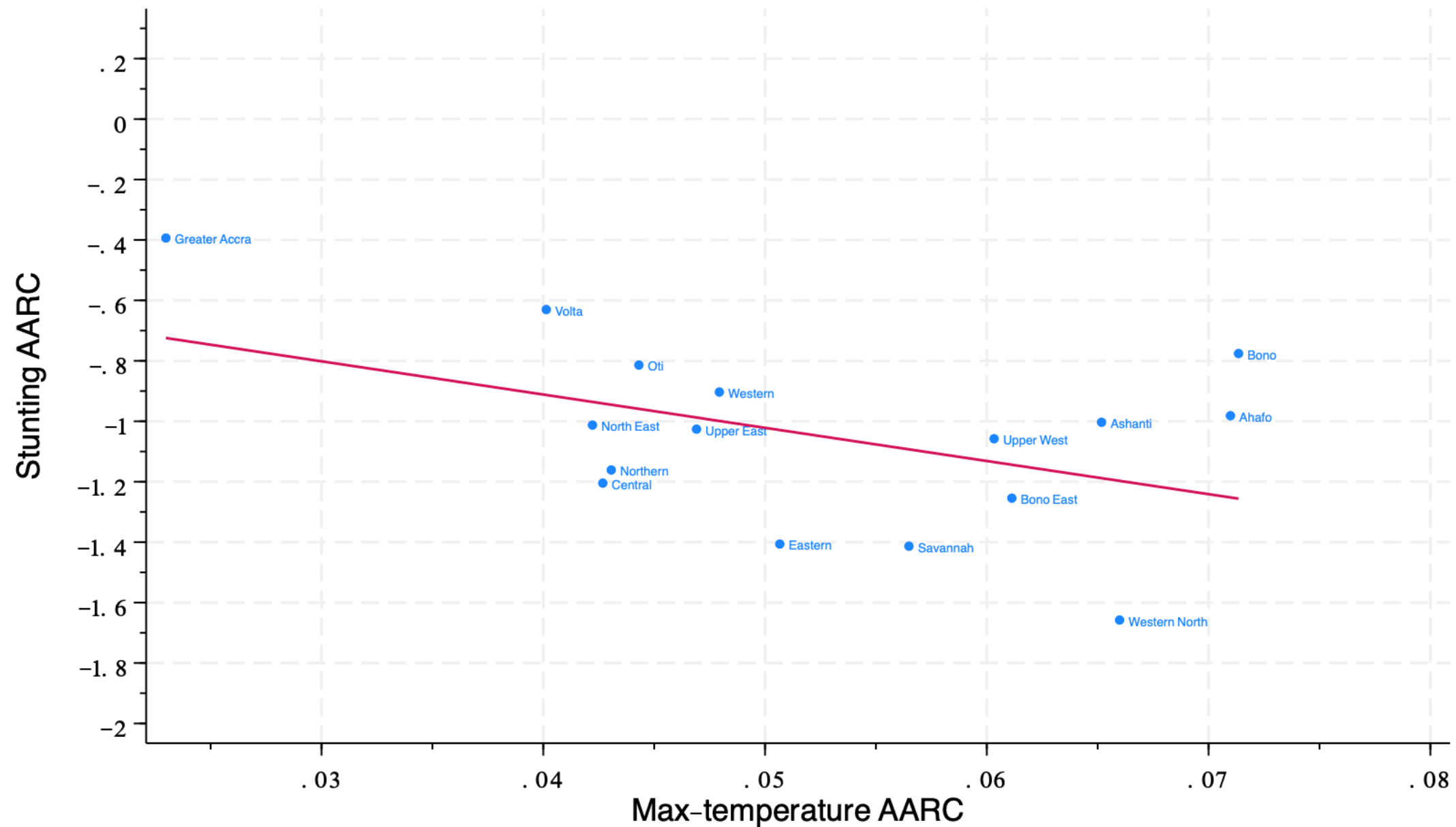
Maize Production AARC vs Max Temperature AARC from 2000-2020 by Region in Ghana



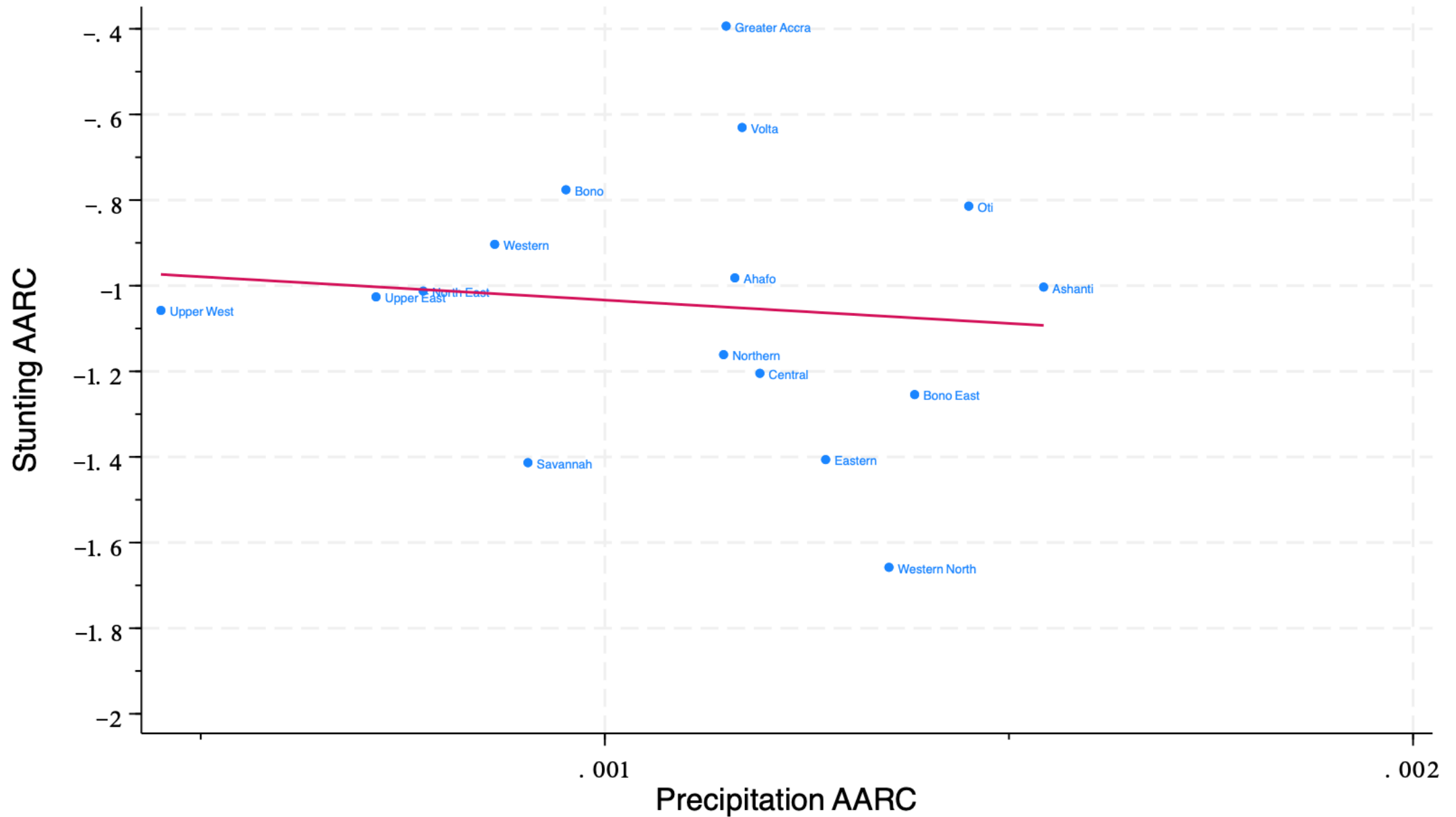
Maize Production AARC vs Precipitation AARC from 2000-2020 by Region in Ghana



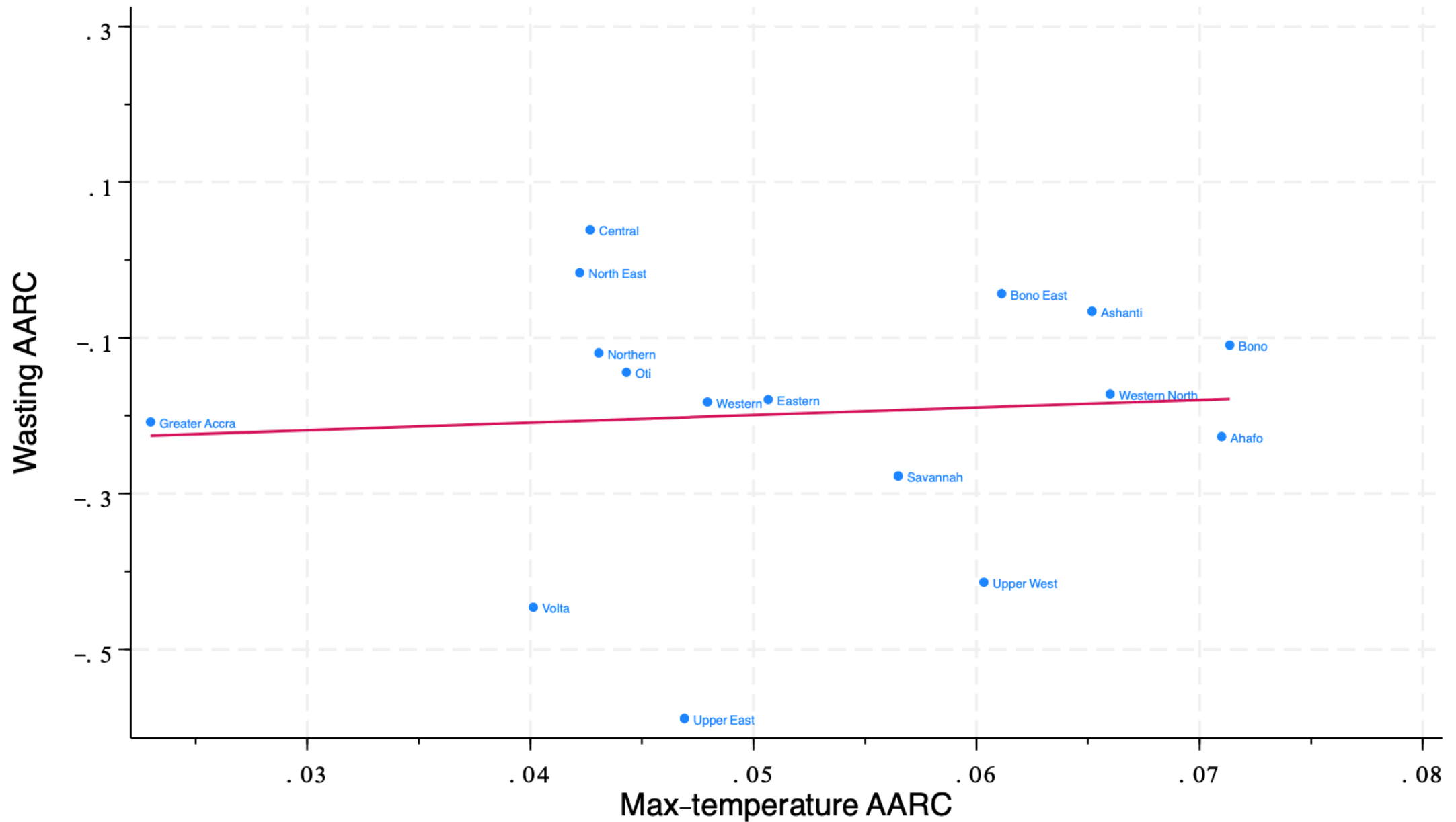
Stunting AARC vs Max Temperature AARC from 2000-2020 by Region in Ghana



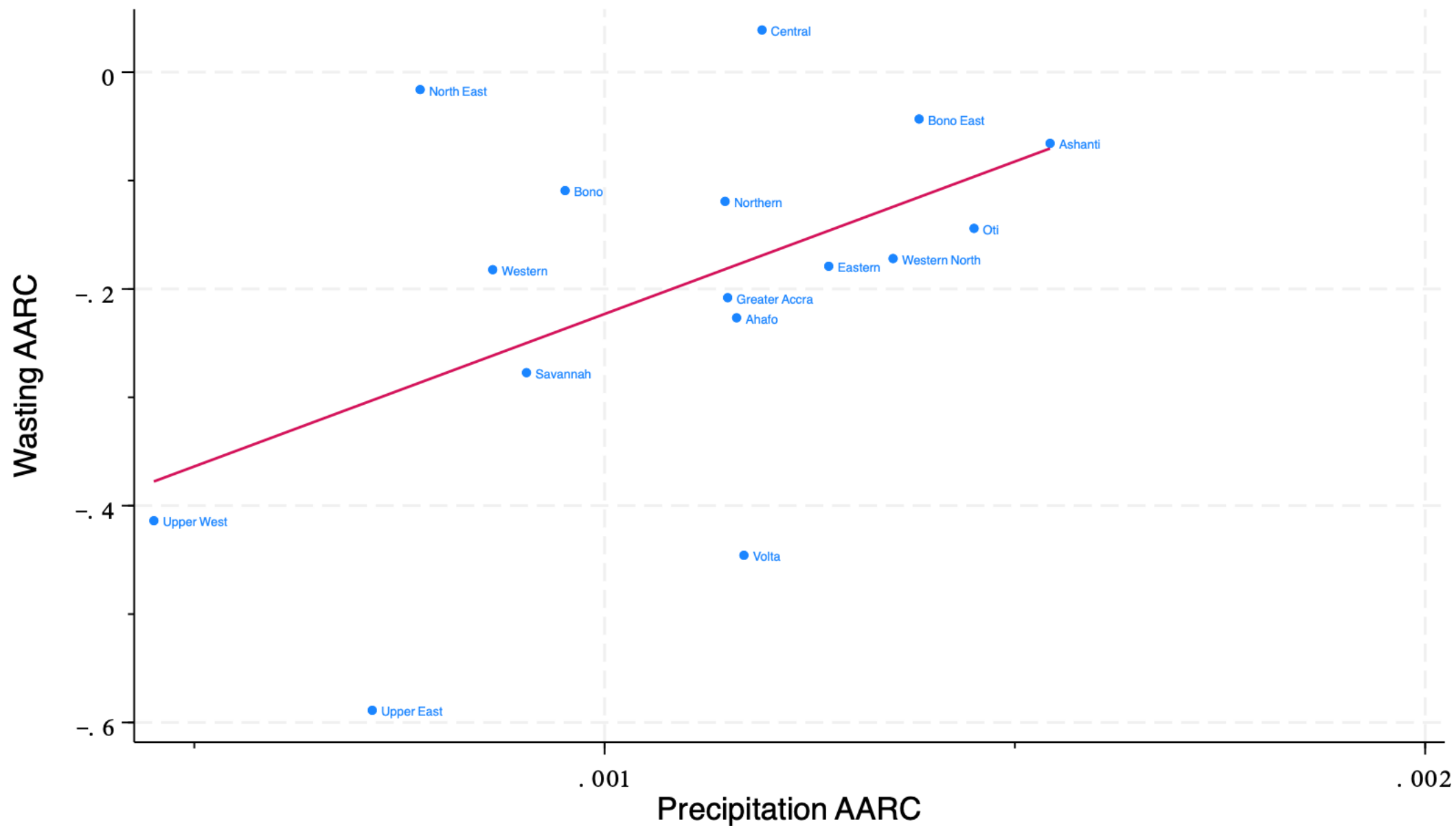
Stunting AARC vs Precipitation AARC from 2000-2020 by Region in Ghana



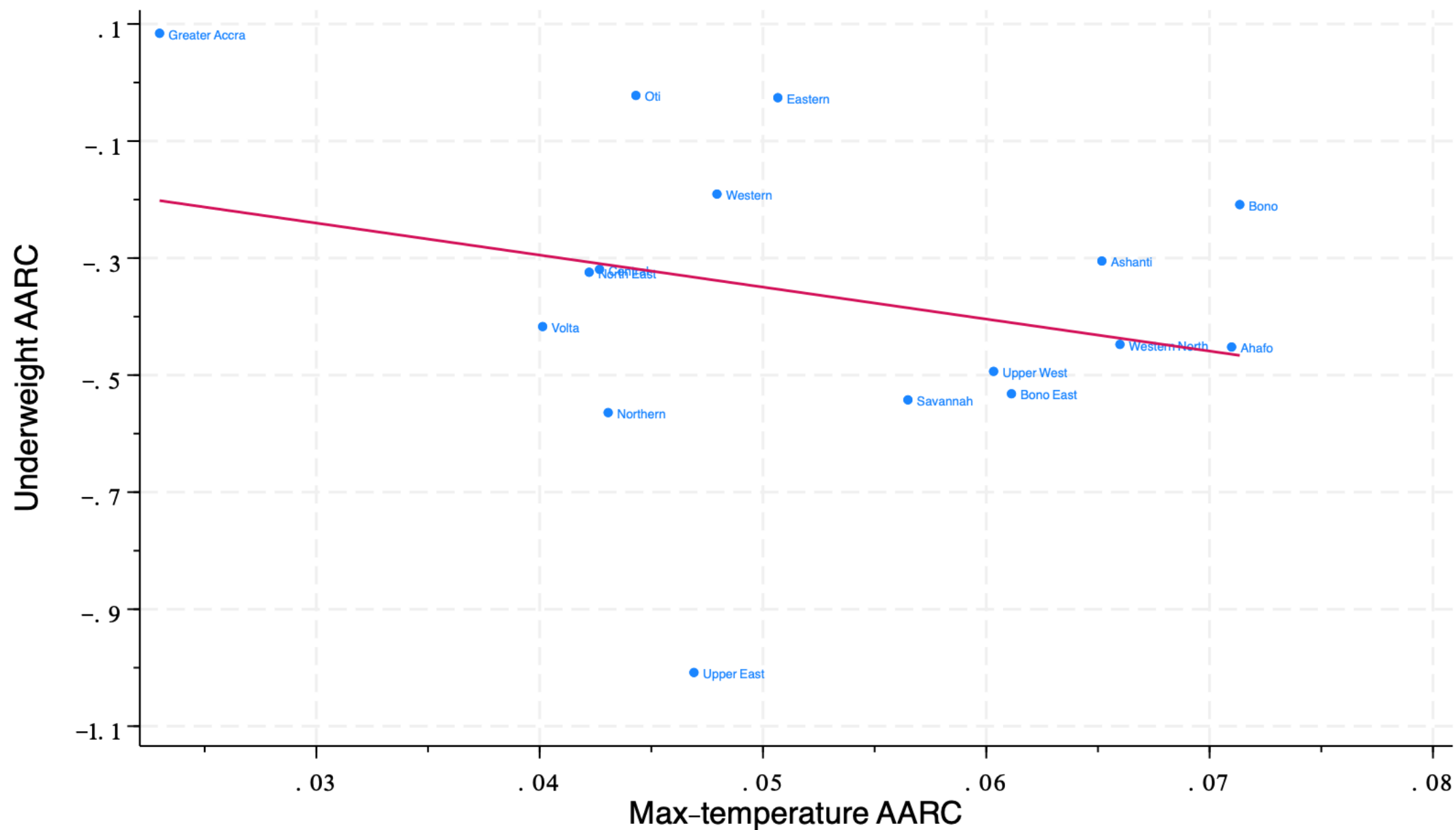
Wasting AARC vs Max Temperature AARC from 2000-2020 by Region in Ghana



Wasting AARC vs Precipitation AARC from 2000-2020 by Region in Ghana



Underweight AARC vs Max Temperature AARC from 2000-2020 by Region in Ghana



Underweight AARC vs Precipitation AARC from 2000-2020 by Region in Ghana

