TANZANIA
Climate-Health-Agriculture Maps

CHOICE Quantitative Analysis Results

May 2025

SickKids CGCH Team

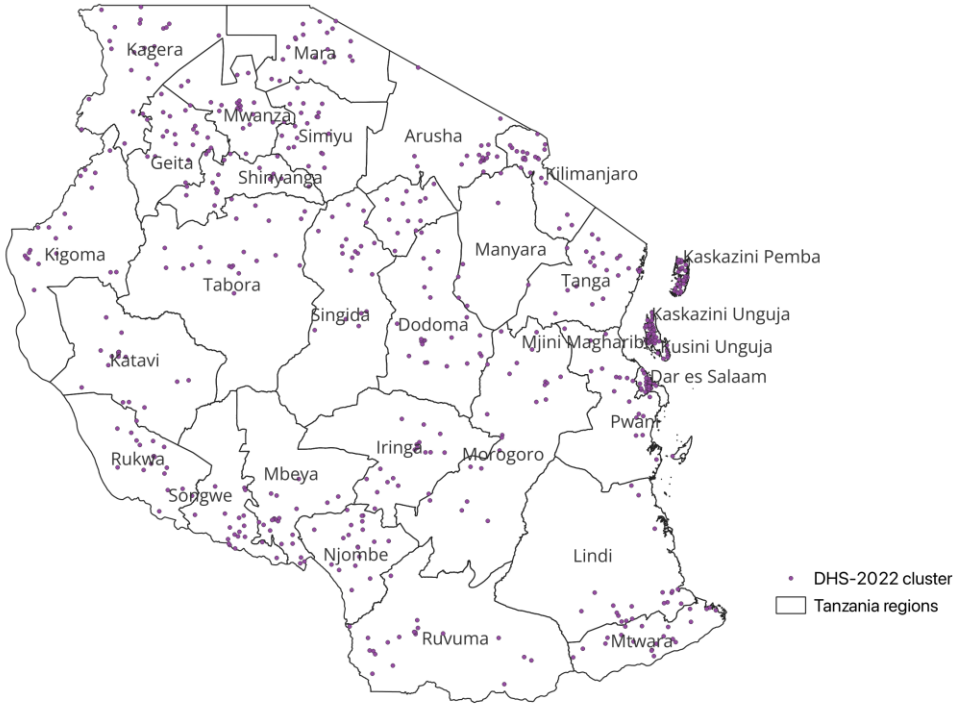
Purpose

- 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 31 (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 31 Counties

Arusha	Mbeya
Dar Es Salaam	Mjini Magharibi
Dodoma	Morogoro
Geita	Mtwara
Iringa	Mwanza
Kagera	Njombe
Kaskazini Pemba	Pwani
Kaskazini Unguja	Rukwa
Katavi	Ruvuma
Kigoma	Shinyanga
Kilimanjaro	Simiyu
Kusini Pemba	Singida
Kusini Unguja	Songwe
Lindi	Tabora
Manyara	Tanga
Mara	

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

Tanzania

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

Climate Indicators (7)

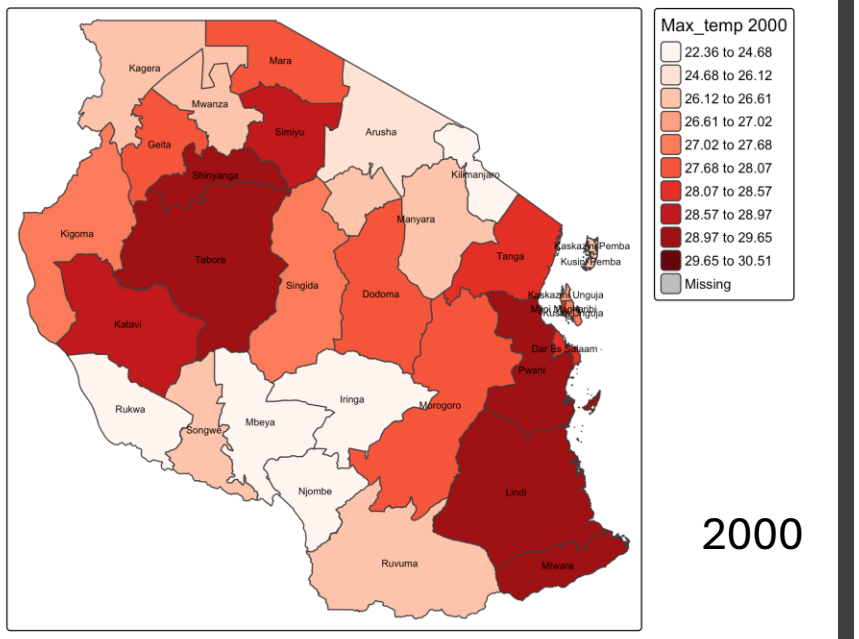
- Maximum temperature
- Minimum temperature
- Diurnal temperature
- Precipitation
- Soil moisture
- Relative humidity
- Wet bulb

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.

Reference: 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.



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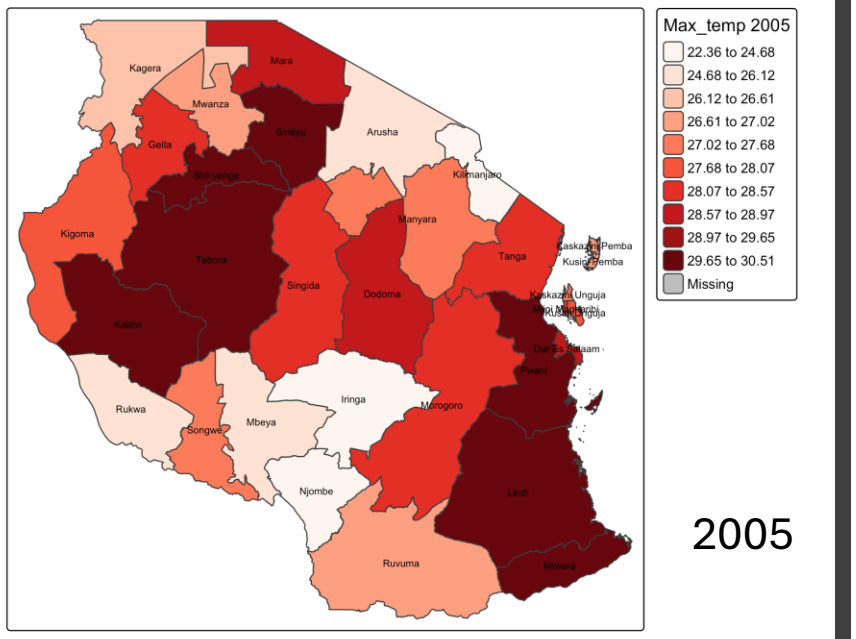

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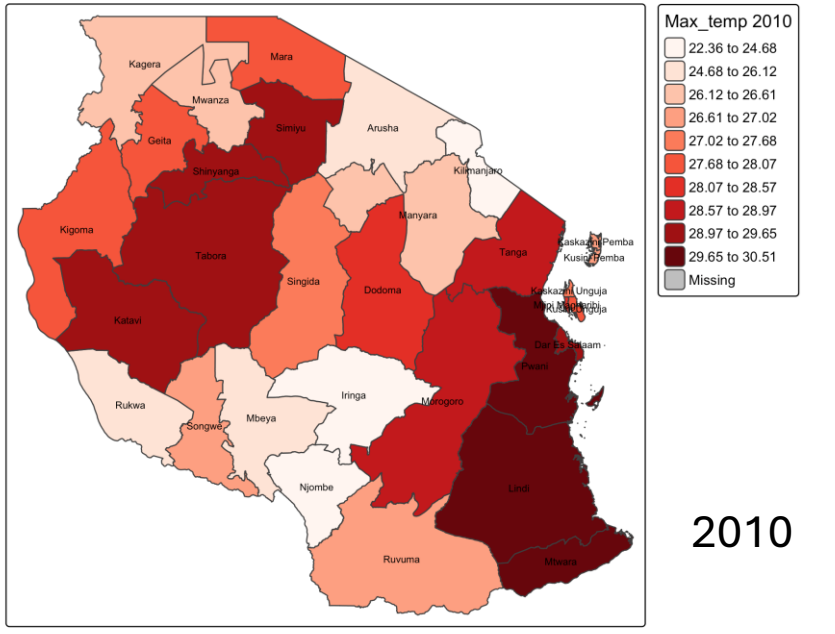

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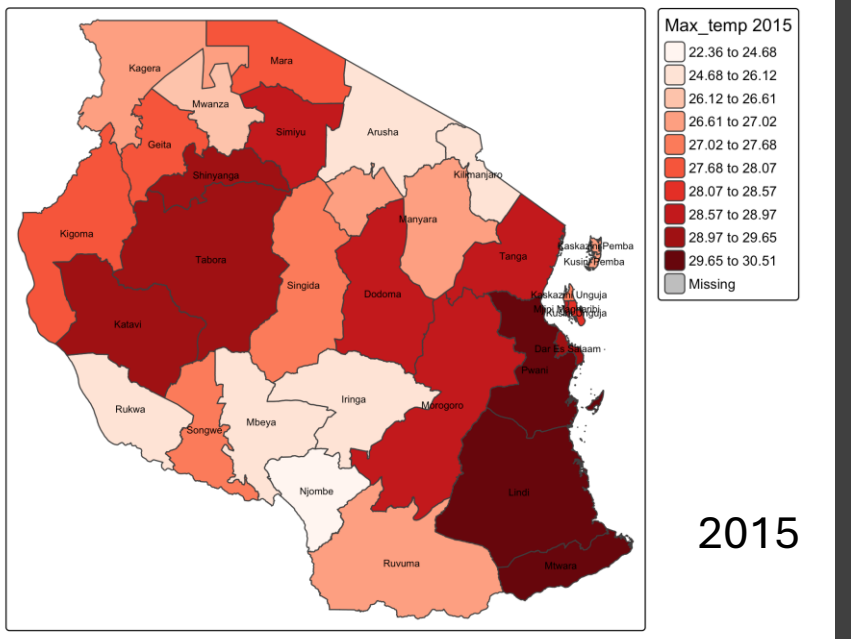

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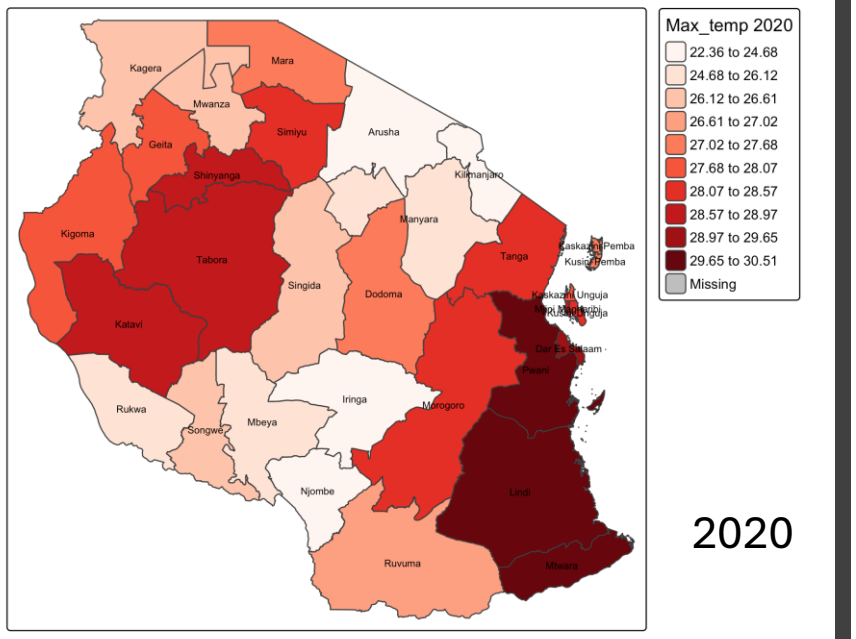

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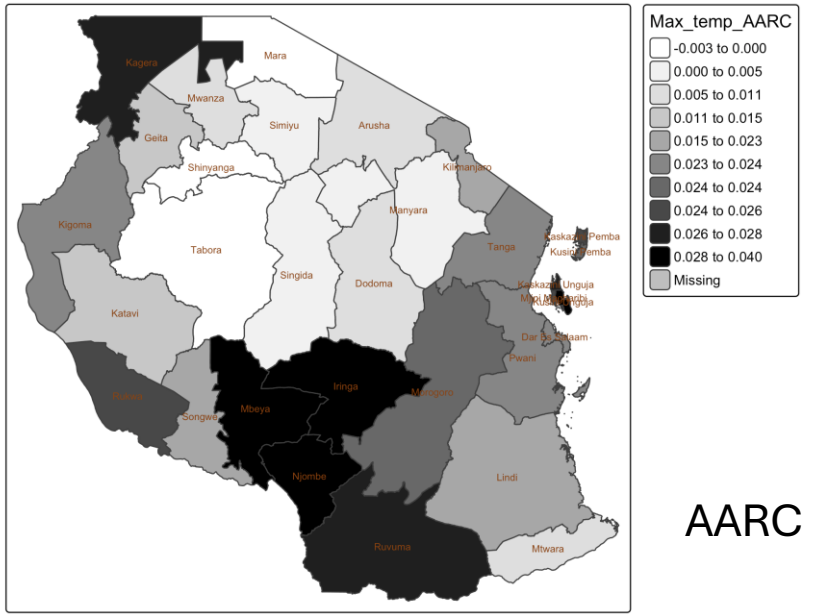
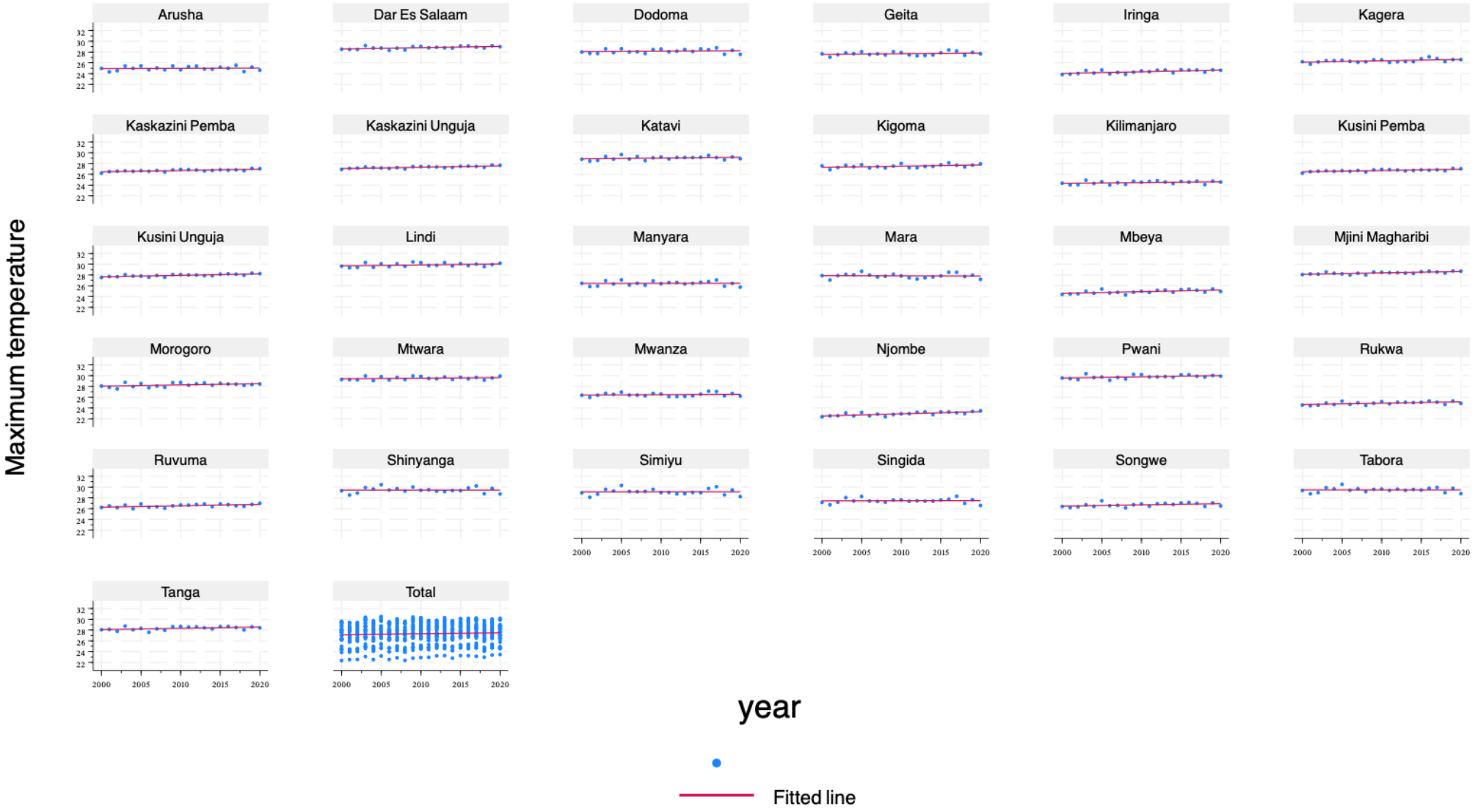


AARC



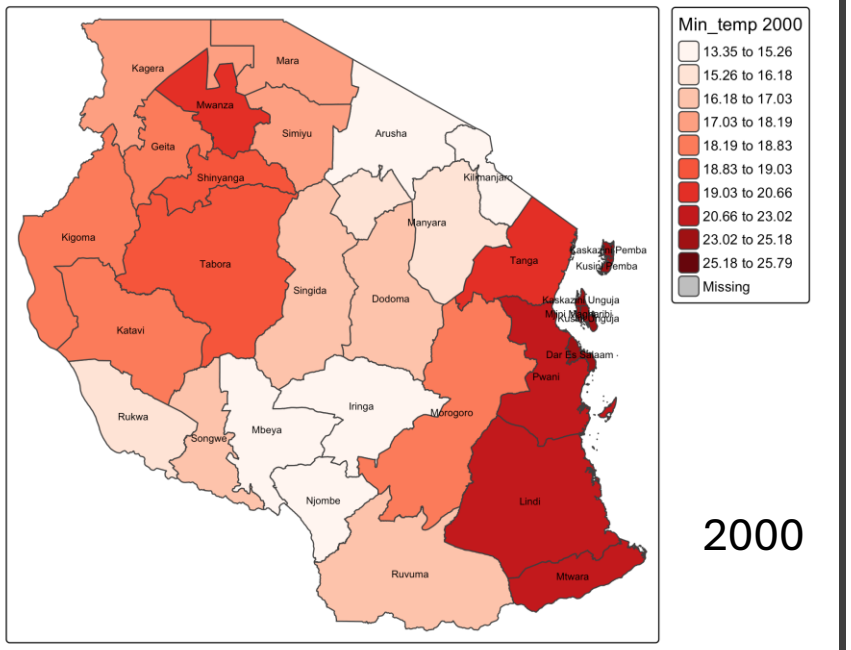
Maximum Temperature Trends over Time by Region

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.

Reference: 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.



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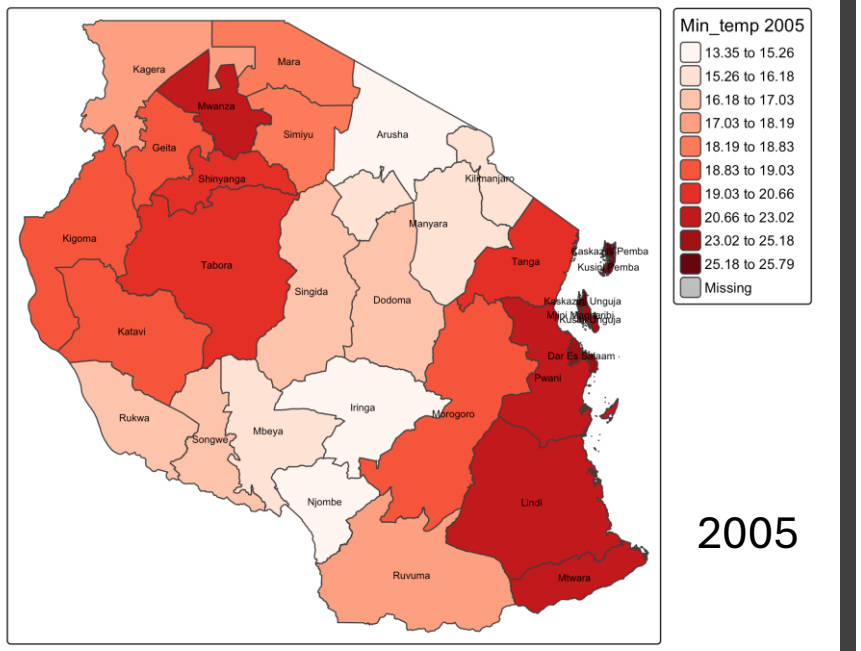

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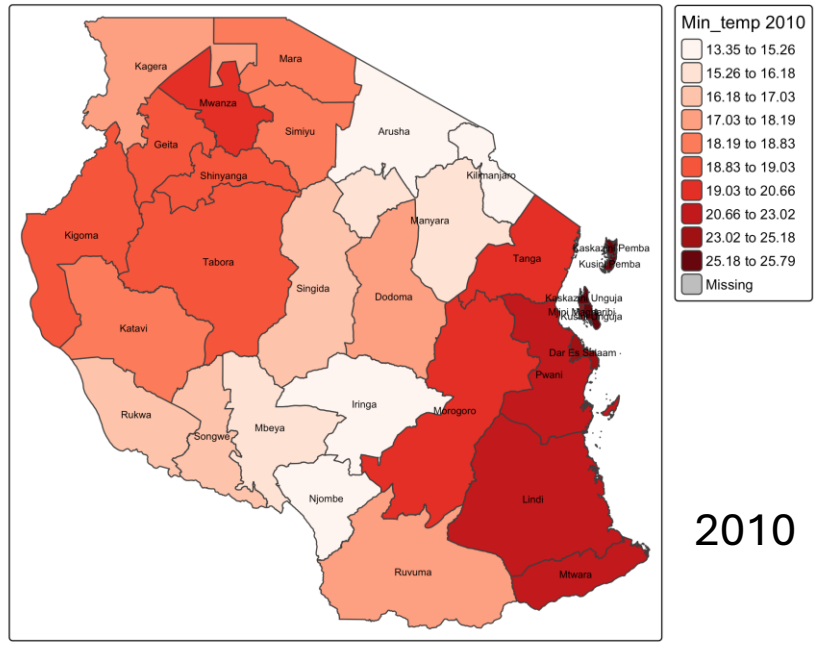

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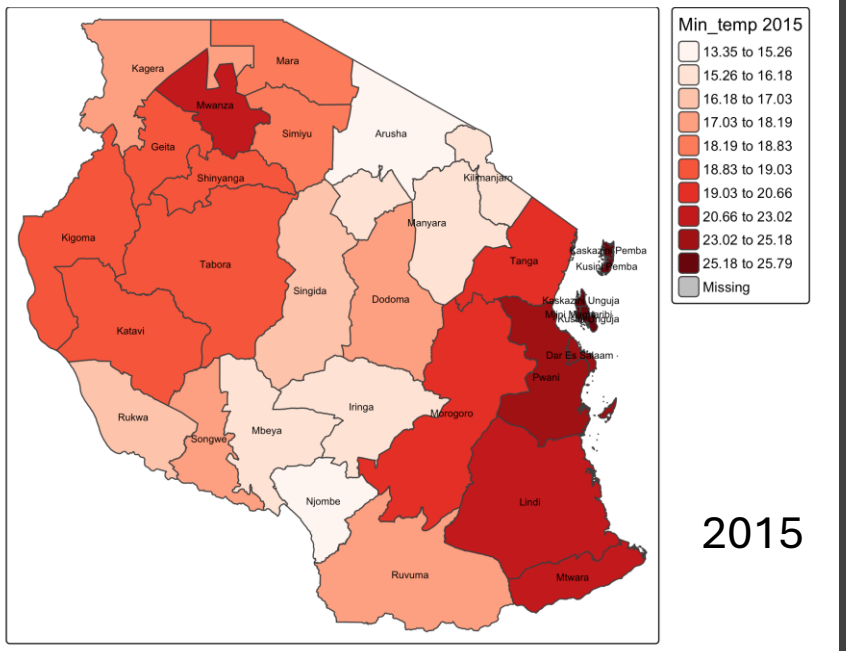

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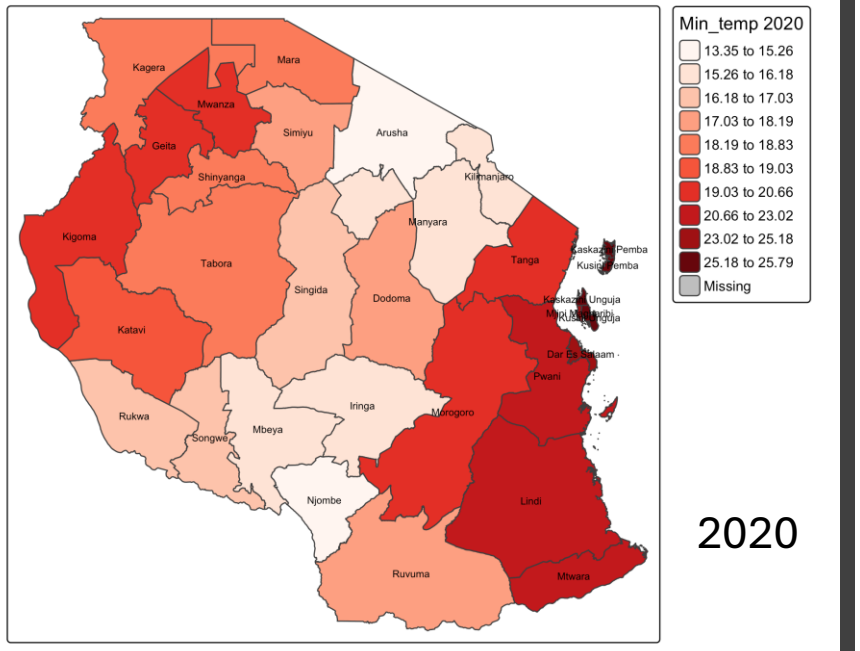

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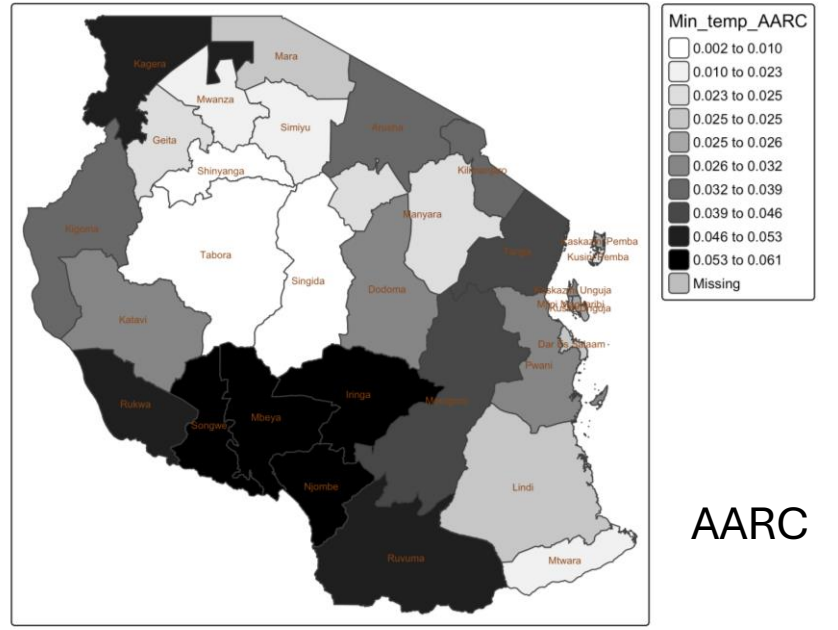

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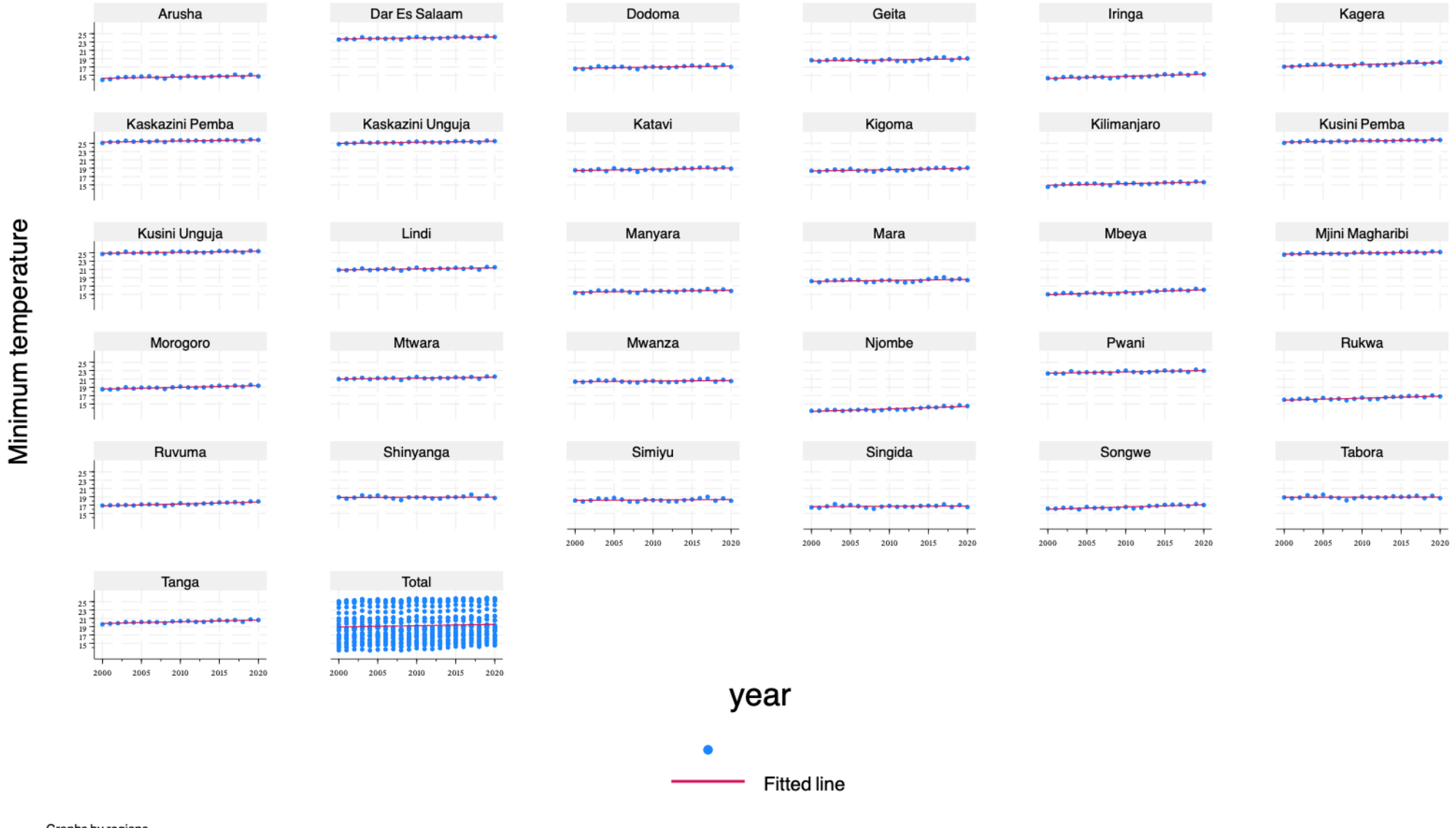


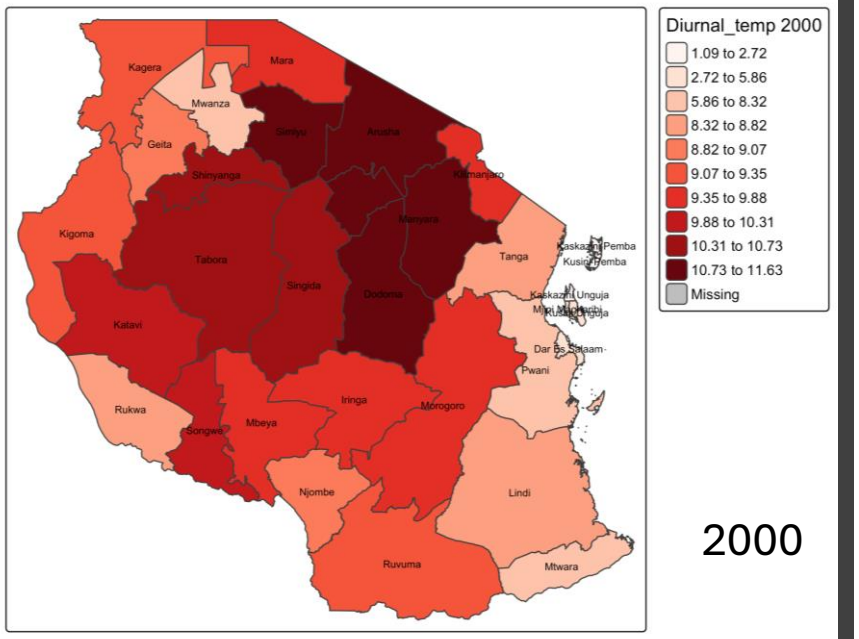
Minimum Temperature Trends over Time by Region

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.

Reference: 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.



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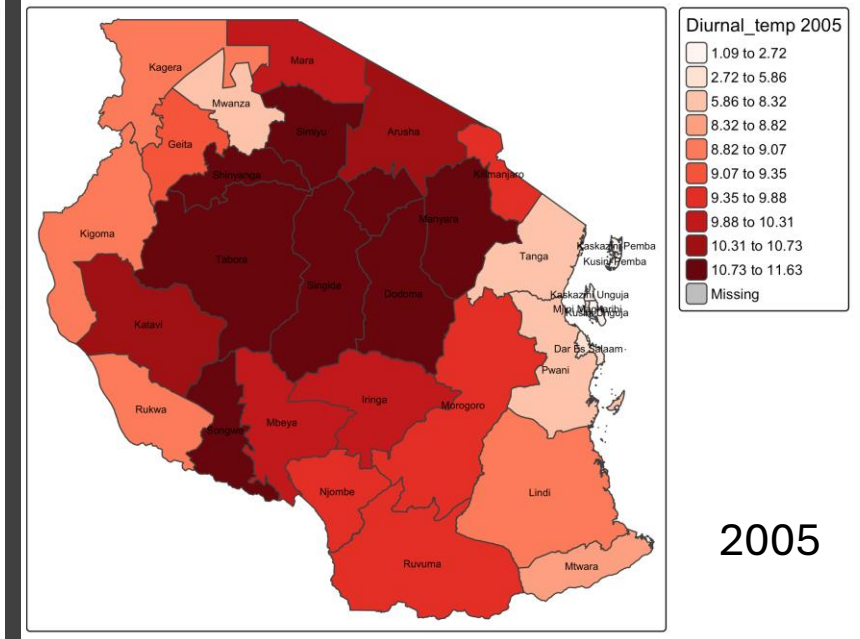

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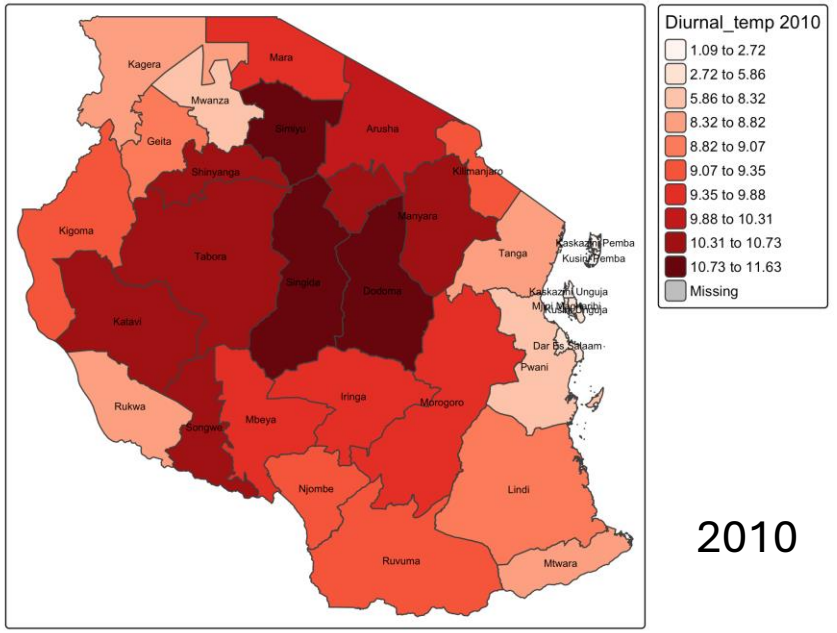

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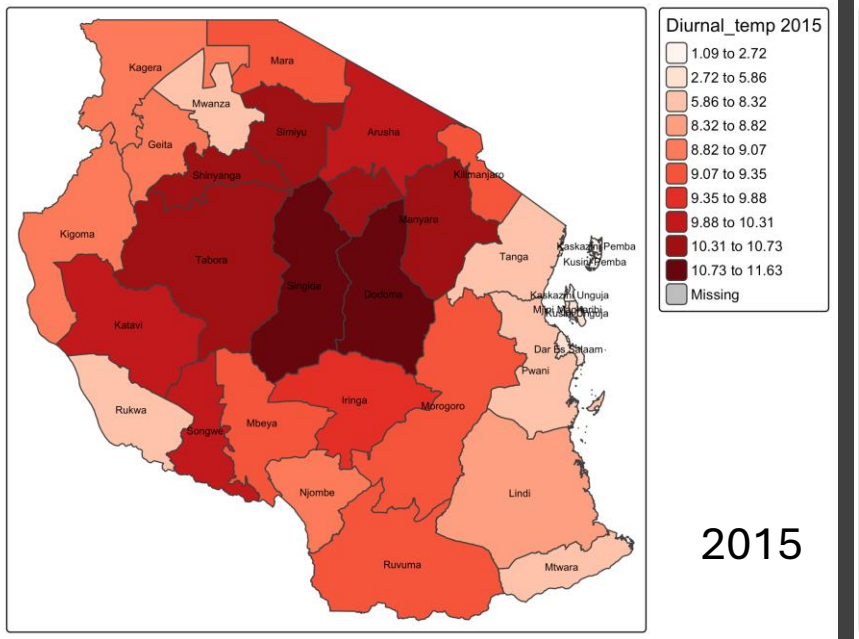

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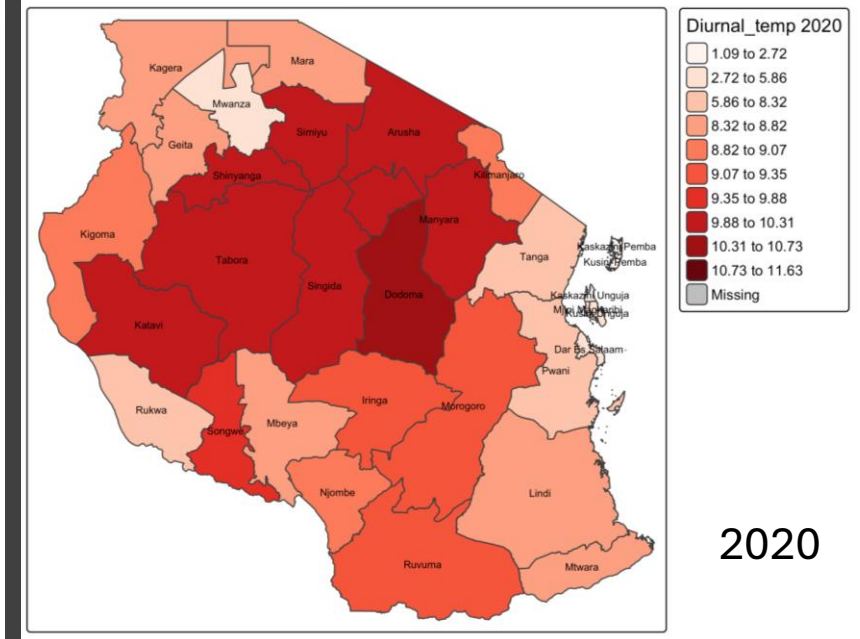

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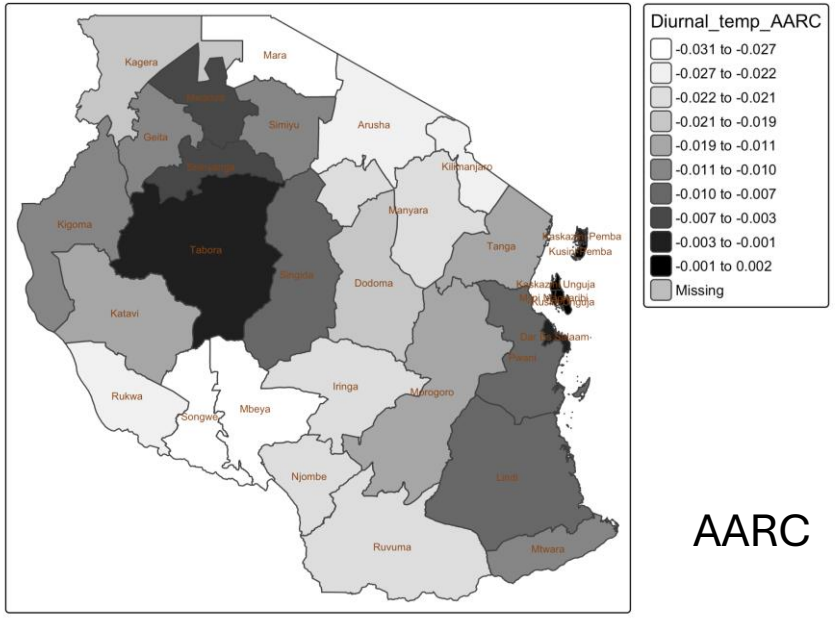

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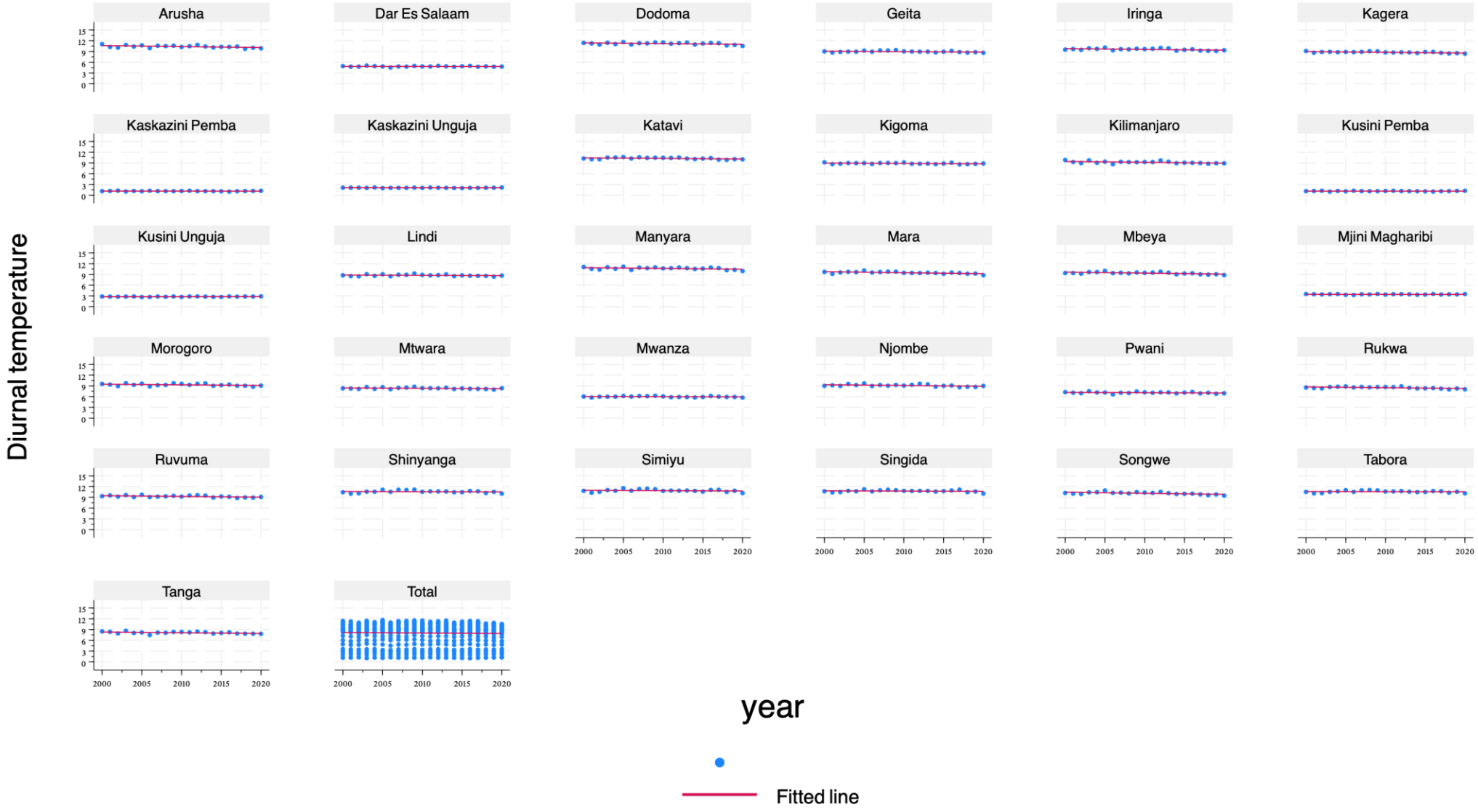


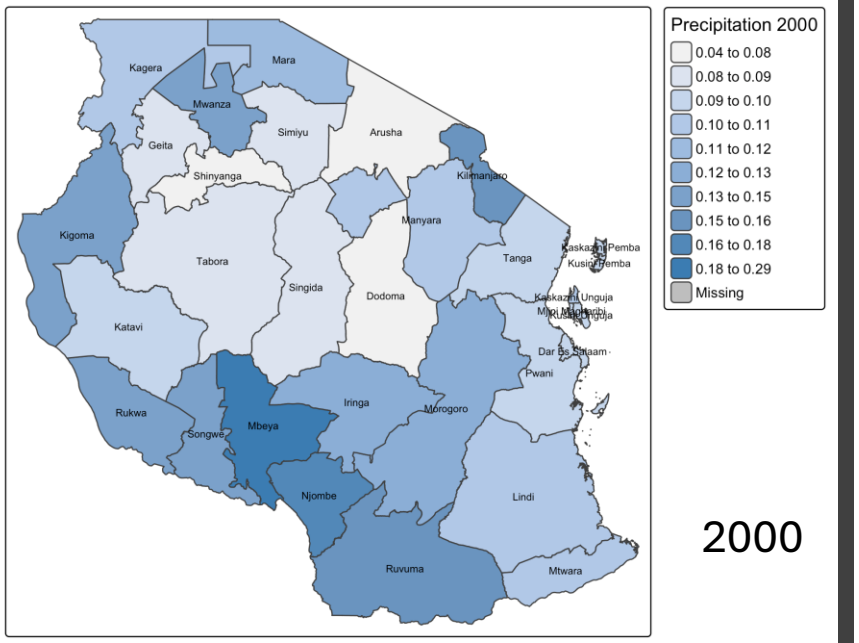
Diurnal Temperature Trends over Time by Region

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.

Reference: 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.



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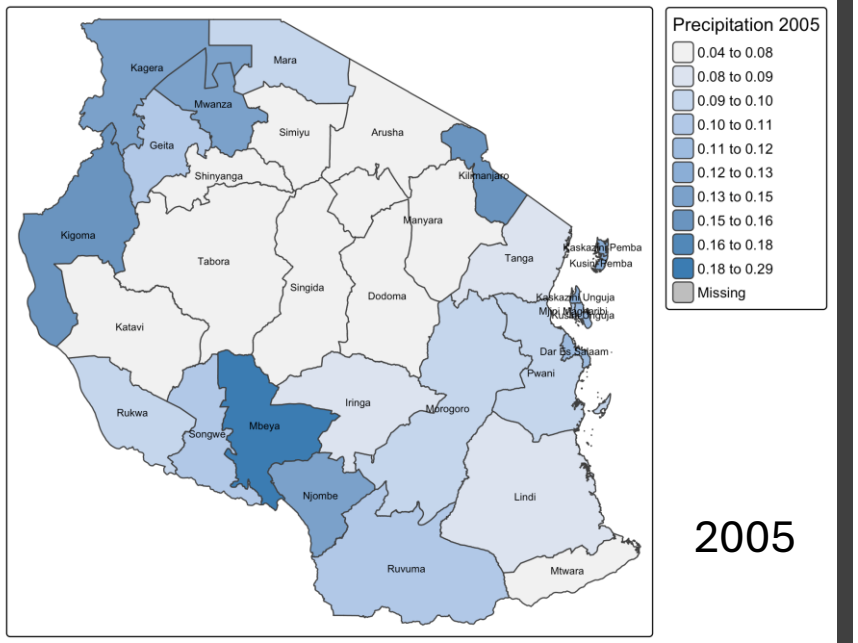

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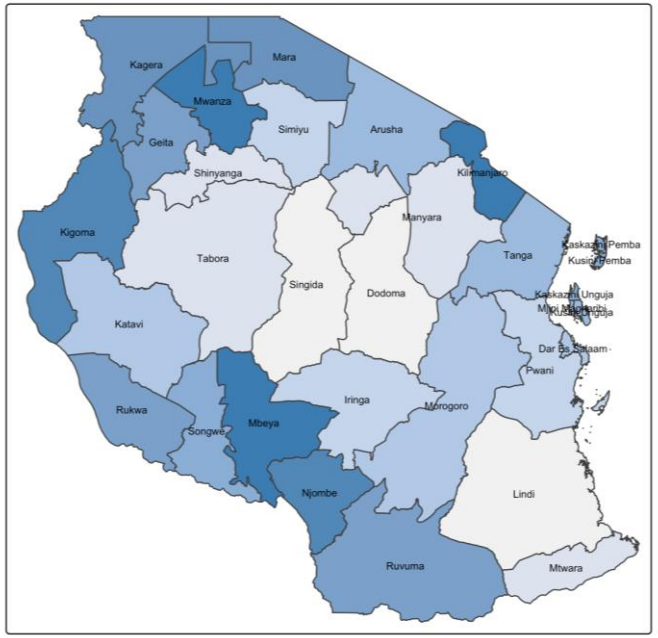

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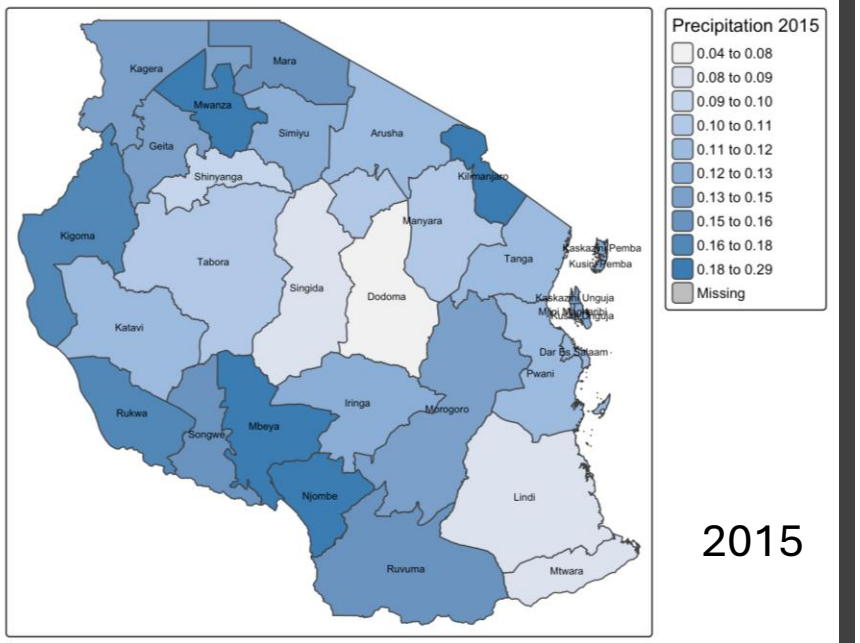

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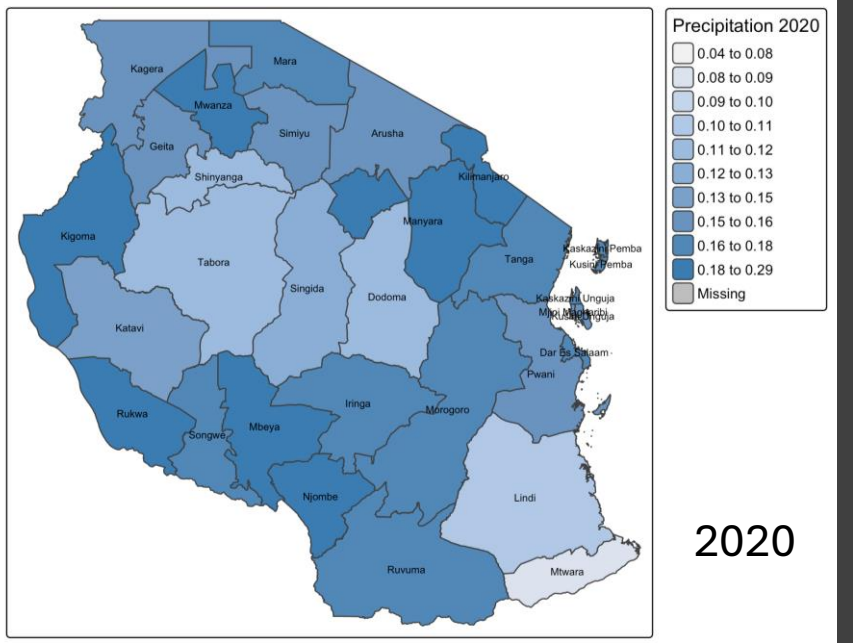

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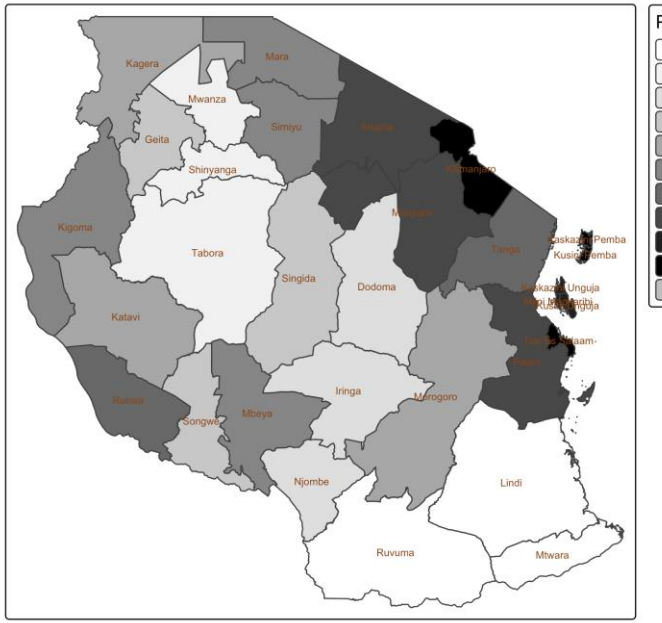


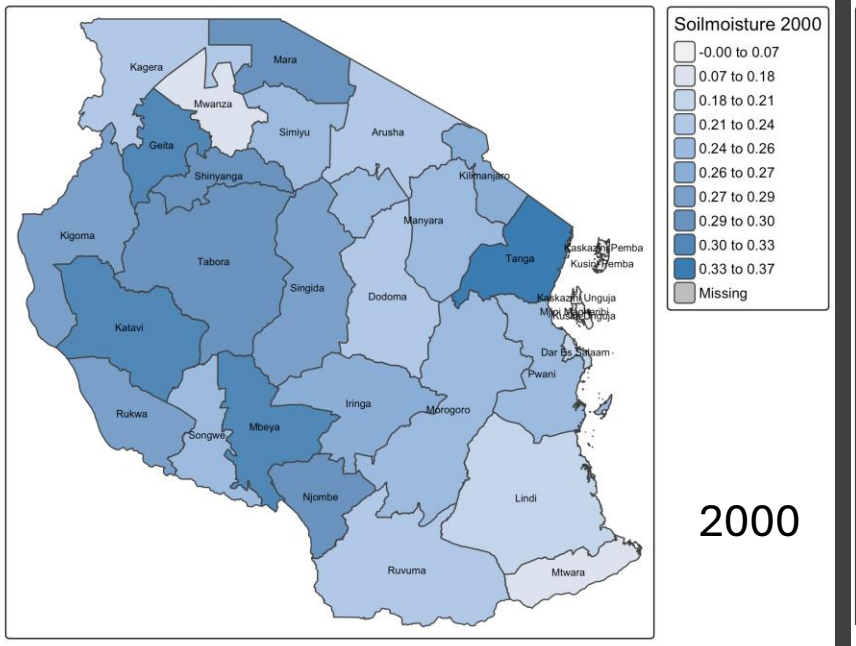
AARC

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).

Reference: 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.



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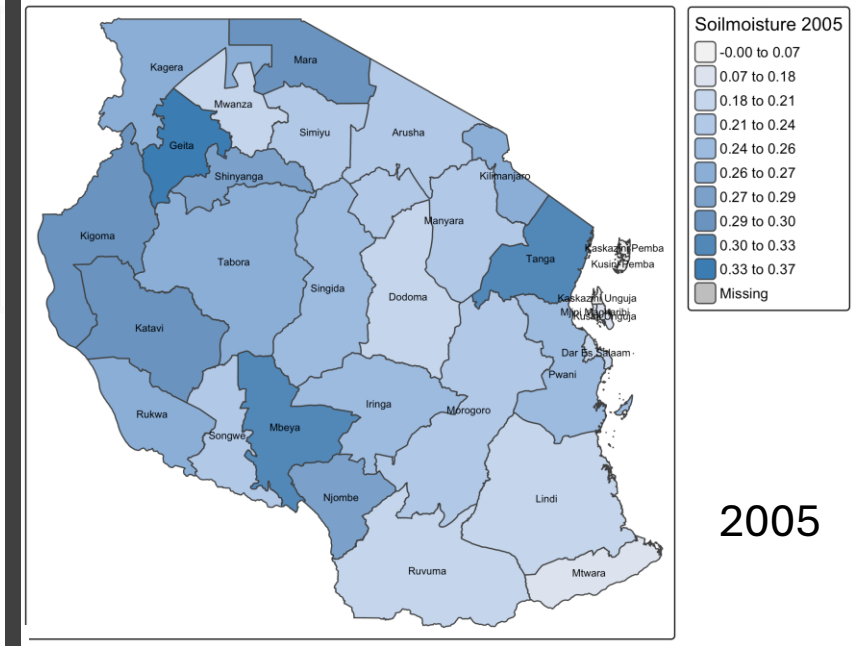

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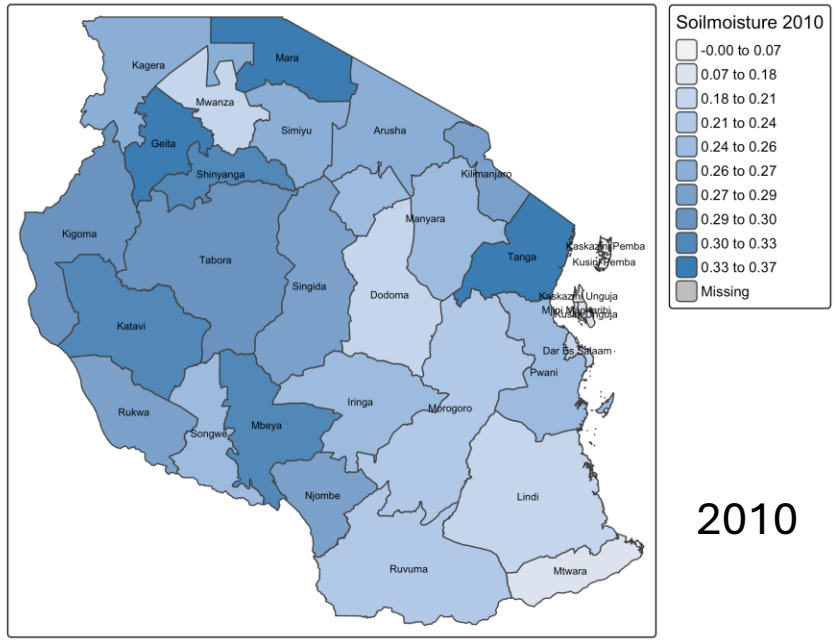

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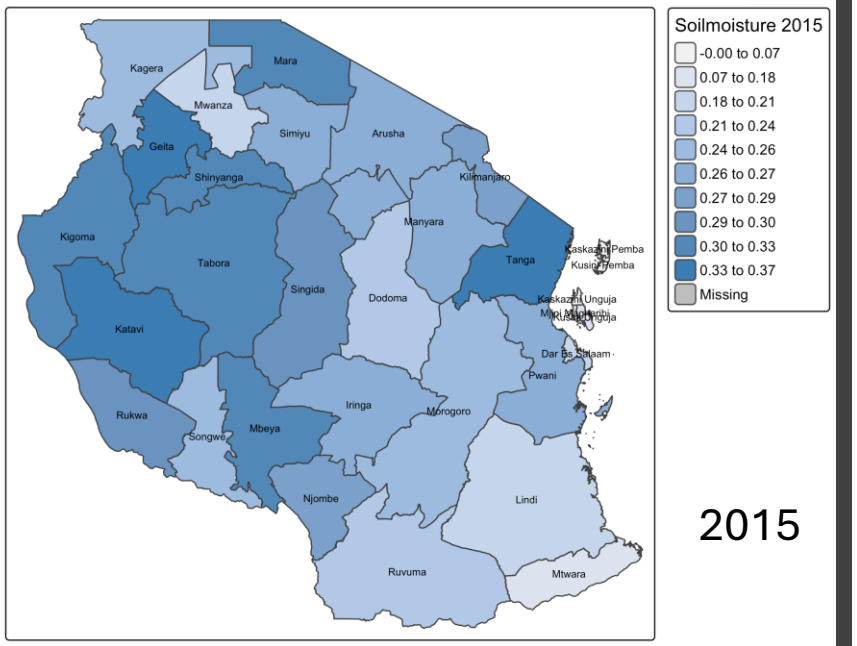

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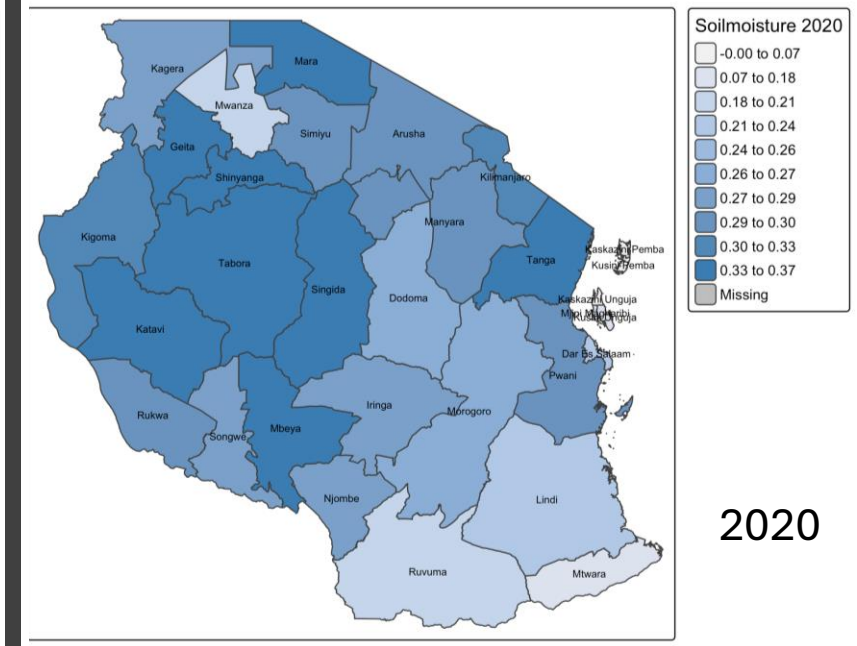
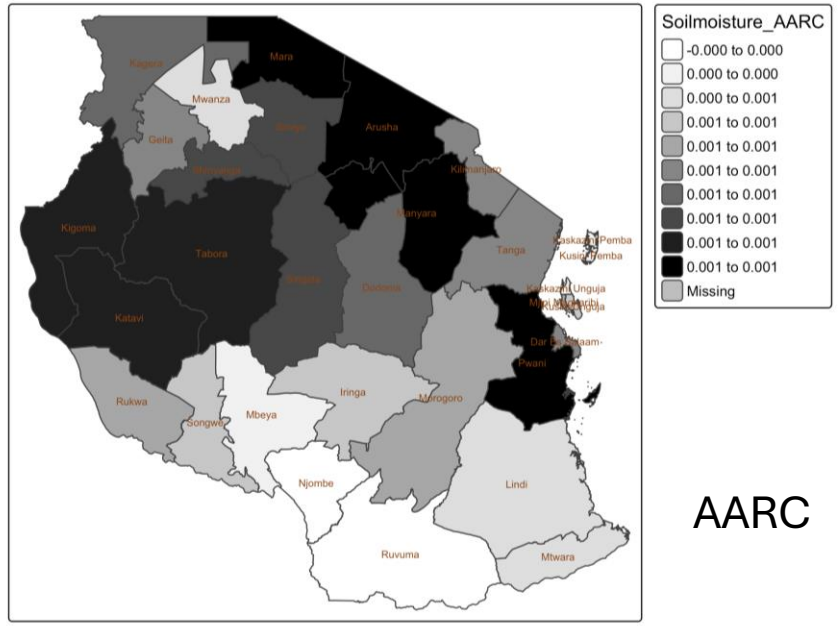


2020



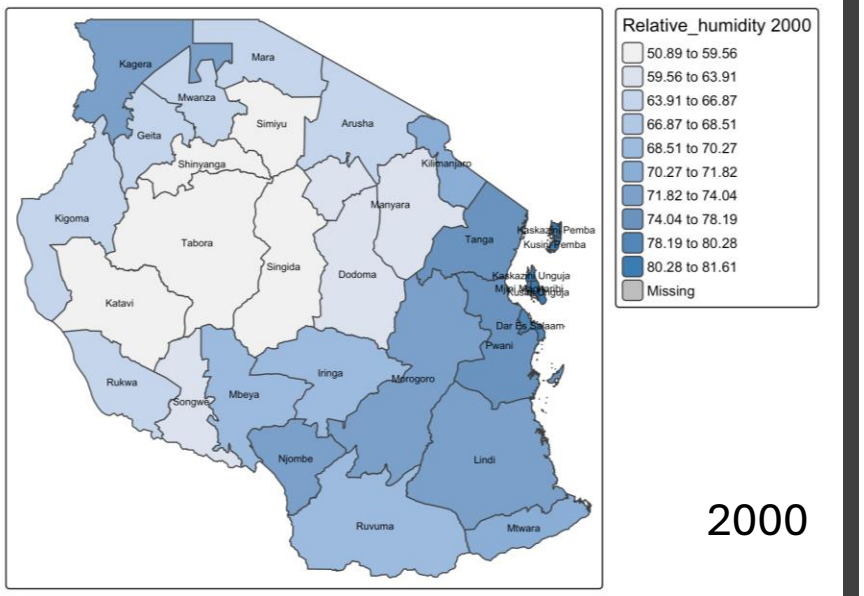
AARC

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.

Reference: 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.



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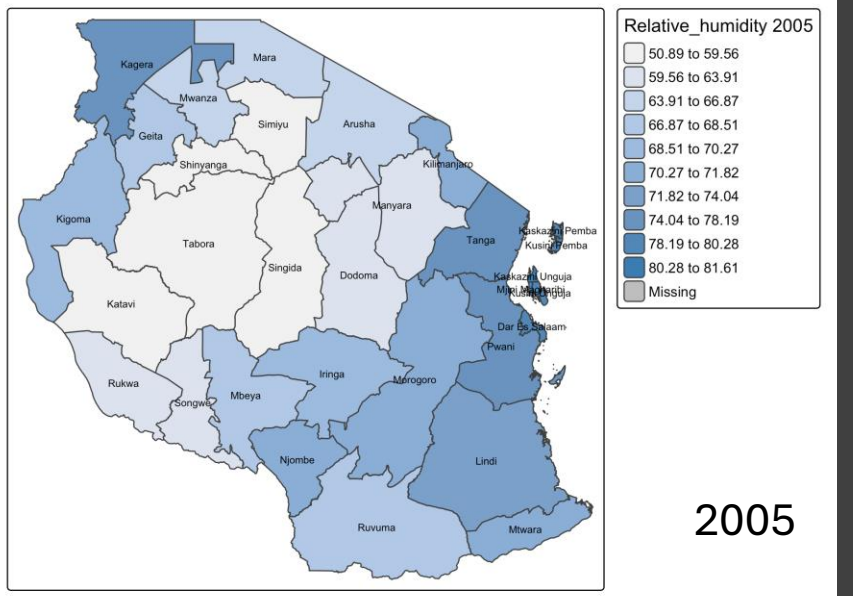

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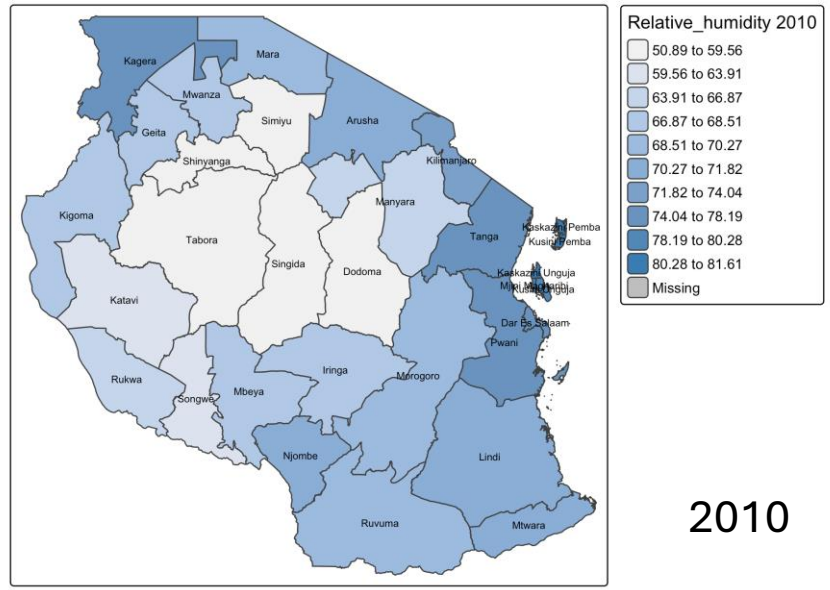

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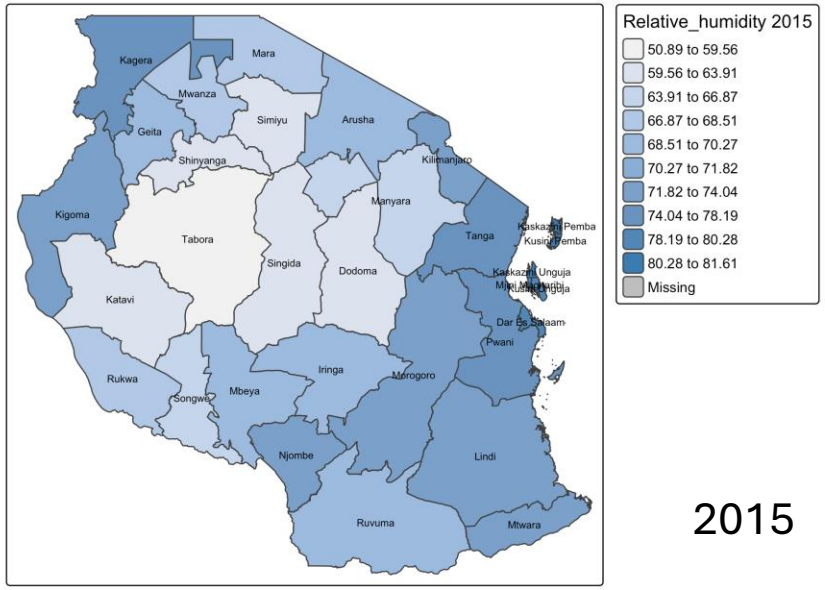

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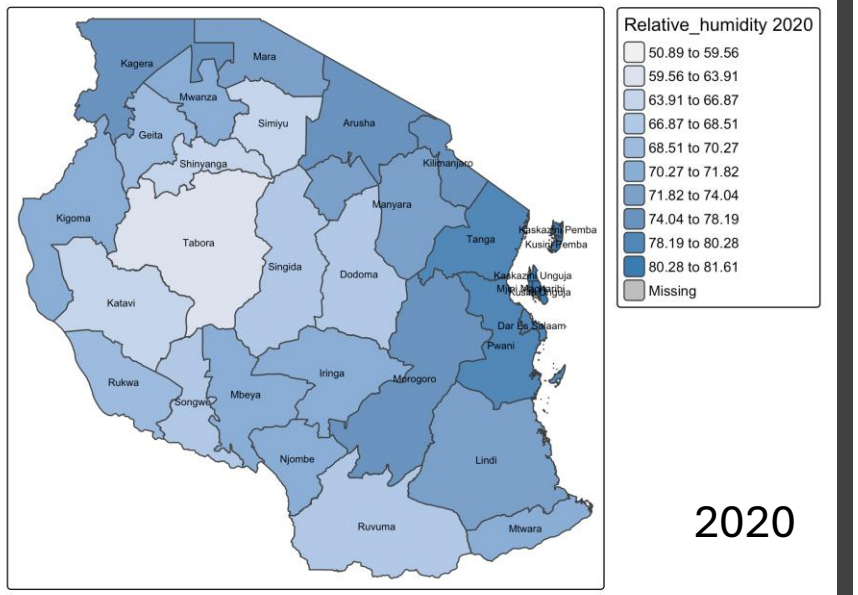
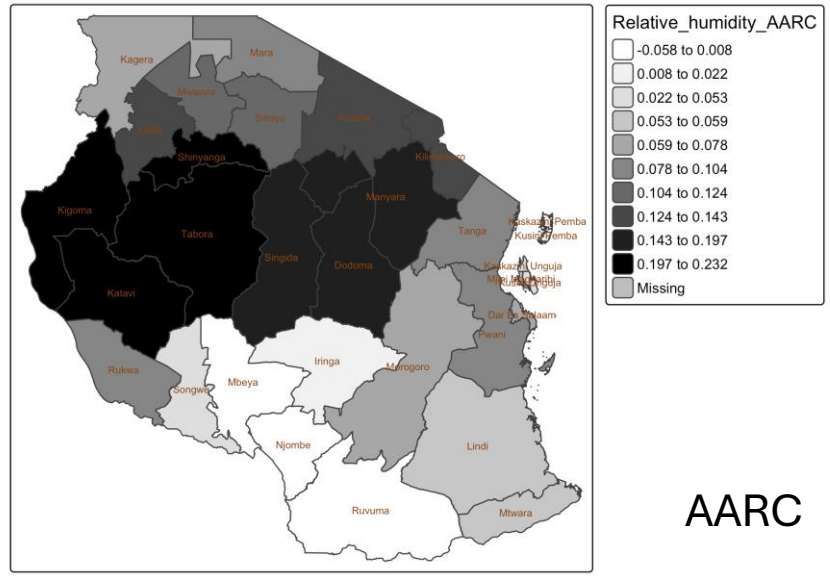


2020



AARC

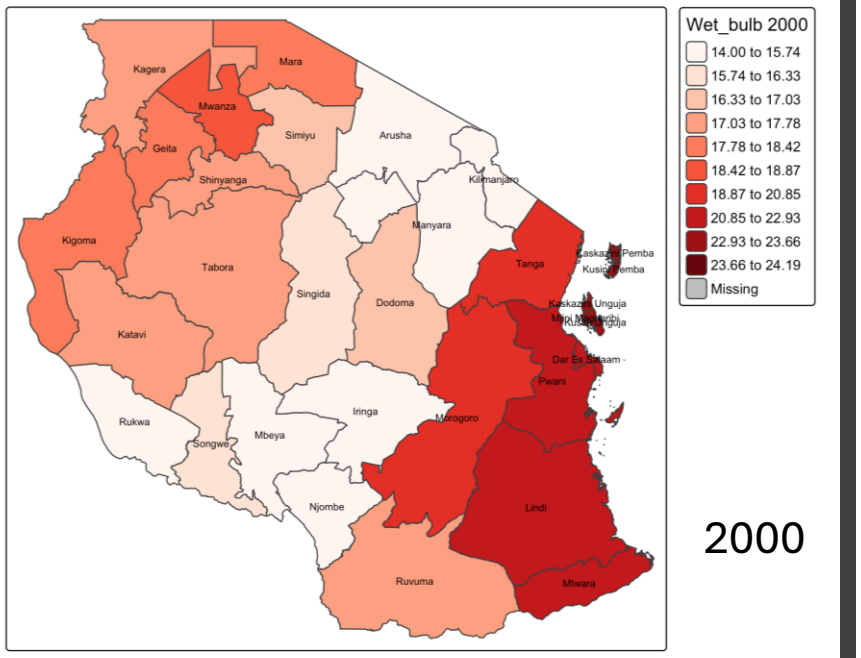
Wet Bulb Temperature

- 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.


Wet_bulb 2000
14.00 to 15.74
15.74 to 16.33
16.33 to 17.03
17.03 to 17.78
17.78 to 18.42
18.42 to 18.87
18.87 to 20.85
20.85 to 22.93
22.93 to 23.66
23.66 to 24.19
Missing
Kagera
Mara
Mwanza
Simiyu
Arusha
Geita
Shinyanga
Kilimanjaro
Kigoma
Manyara
Tabora
Tanga
Singida
Dodoma
Katavi
Rukwa
Songwe
Mbeya
Iringa
Njombe
Lindi
Ruvuma
Mtwara
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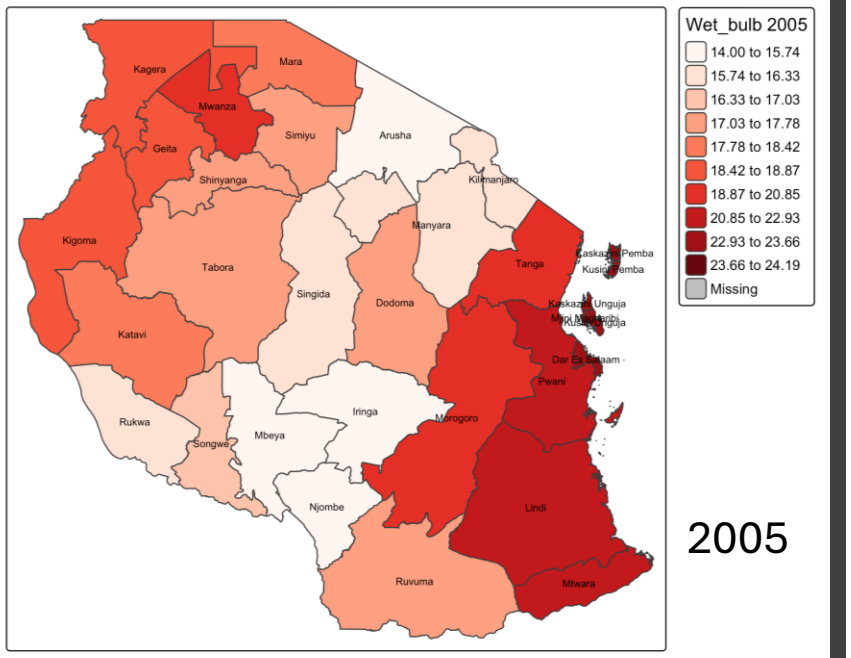
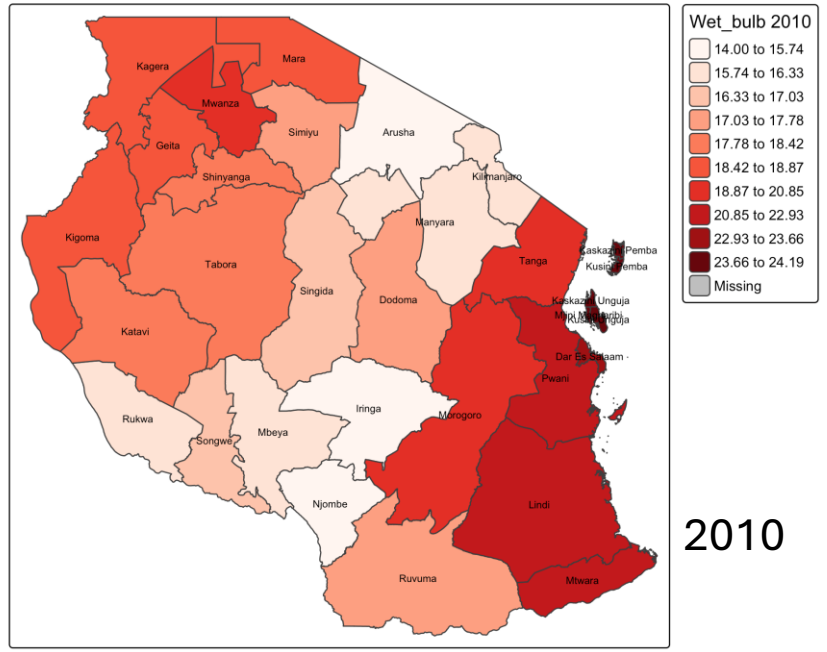
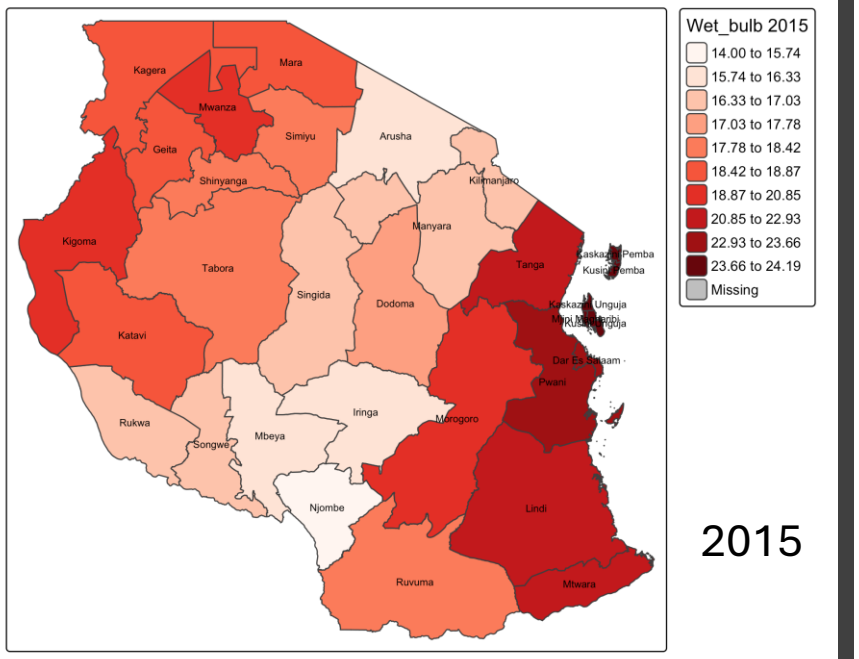
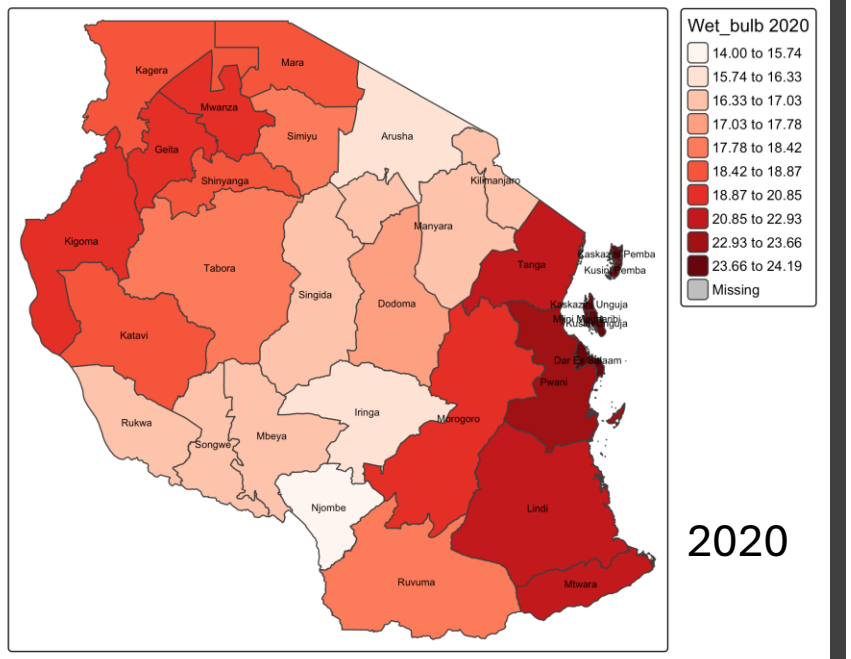
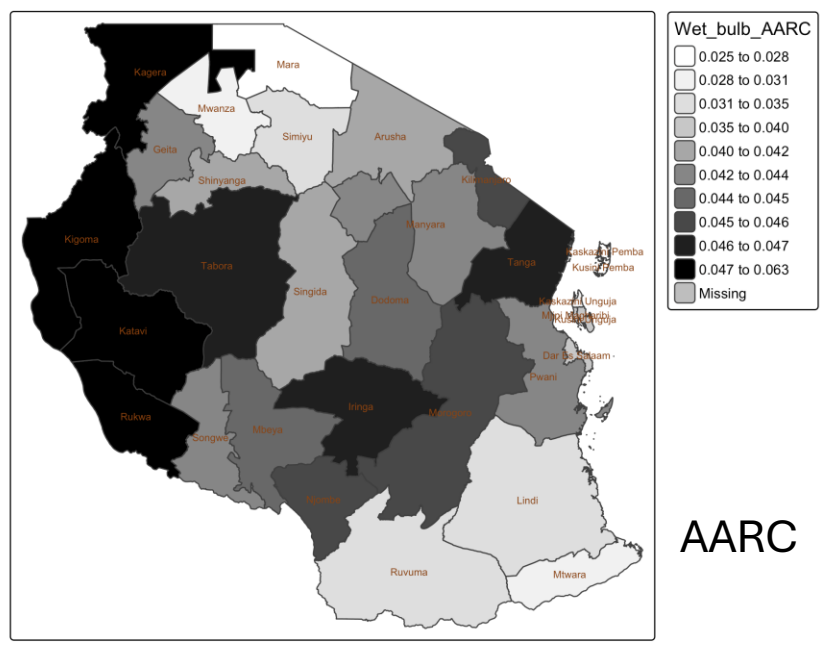

Wet_bulb 2005
14.00 to 15.74
15.74 to 16.33
16.33 to 17.03
17.03 to 17.78
17.78 to 18.42
18.42 to 18.87
18.87 to 20.85
20.85 to 22.93
22.93 to 23.66
23.66 to 24.19
Missing
2005


Wet_bulb 2010
14.00 to 15.74
15.74 to 16.33
16.33 to 17.03
17.03 to 17.78
17.78 to 18.42
18.42 to 18.87
18.87 to 20.85
20.85 to 22.93
22.93 to 23.66
23.66 to 24.19
Missing
2010


Wet_bulb 2015
14.00 to 15.74
15.74 to 16.33
16.33 to 17.03
17.03 to 17.78
17.78 to 18.42
18.42 to 18.87
18.87 to 20.85
20.85 to 22.93
22.93 to 23.66
23.66 to 24.19
Missing
2015


Wet_bulb 2020
14.00 to 15.74
15.74 to 16.33
16.33 to 17.03
17.03 to 17.78
17.78 to 18.42
18.42 to 18.87
18.87 to 20.85
20.85 to 22.93
22.93 to 23.66
23.66 to 24.19
Missing
2020


Wet_bulb_AARC
0.025 to 0.028
0.028 to 0.031
0.031 to 0.035
0.035 to 0.040
0.040 to 0.042
0.042 to 0.044
0.044 to 0.045
0.045 to 0.046
0.046 to 0.047
0.047 to 0.063
Missing
AARC

Tanzania

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)

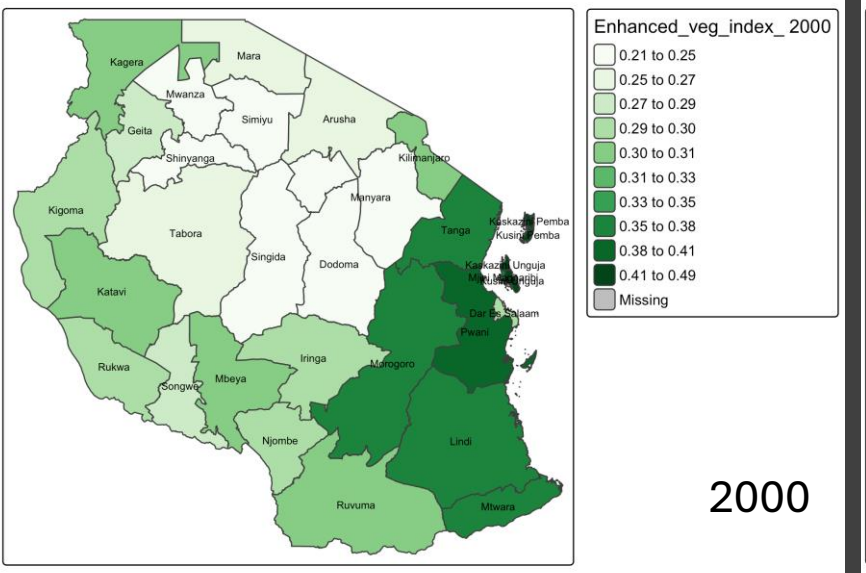
Reference: FAOSTAT

Enhanced Vegetation Index

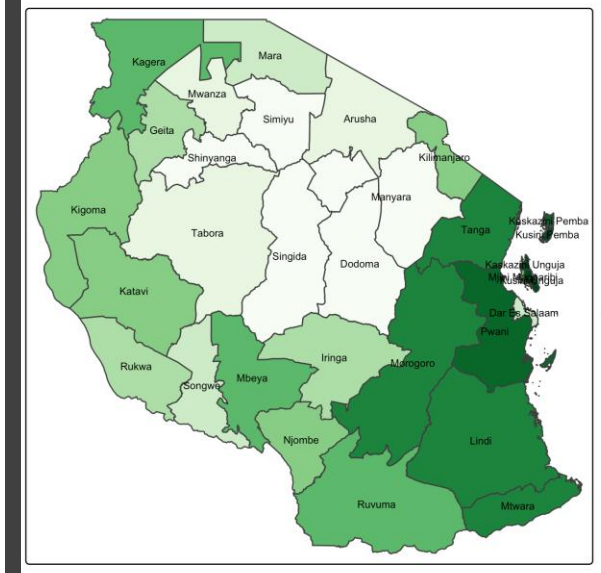
- Derived Data Set: Vegetation Index and Phenology (VIP) Phenology EVI-2 Yearly Global 0.05Deg CMG V004
- Derived Data Set Cell Size: 0.05 decimal degrees (~5 km)
- Summary Statistic: Mean
- Year: 2000, 2005, 2010, 2015, 2020 Units:
- Vegetation index value between -1 (least vegetation) and 1 (most vegetation).

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.

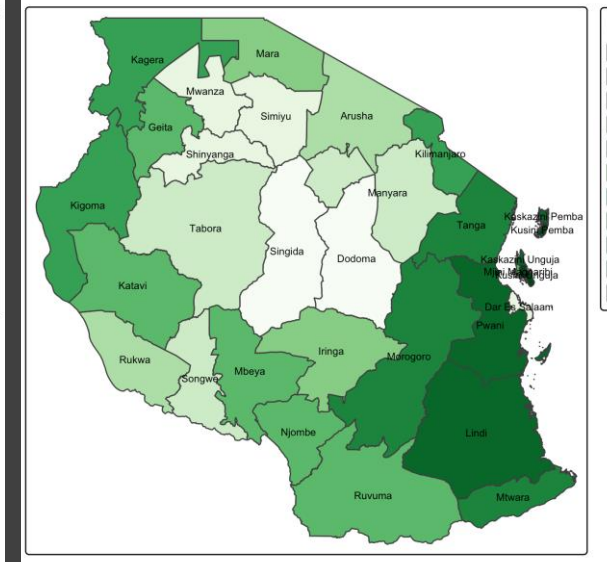
Reference: The Geospatial Covariate Datasets Manual - The Demographic and Health Surveys Program



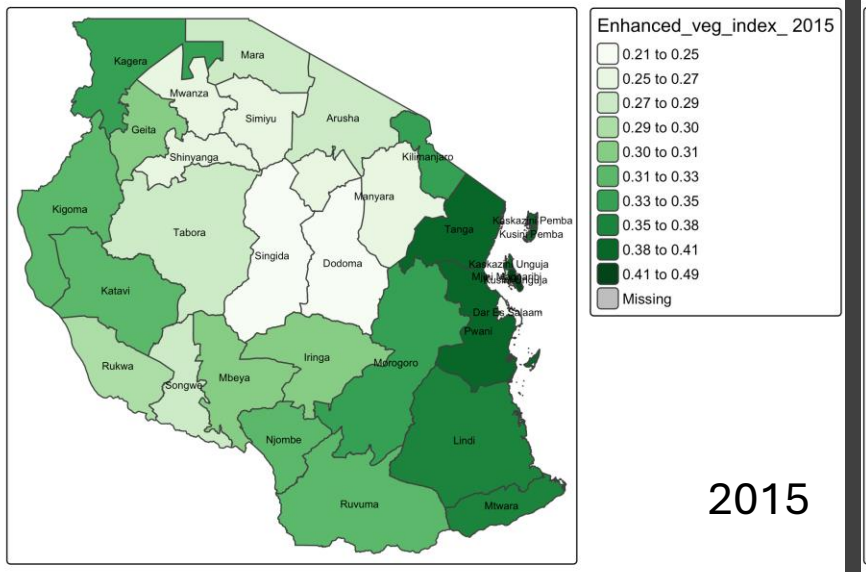
2000



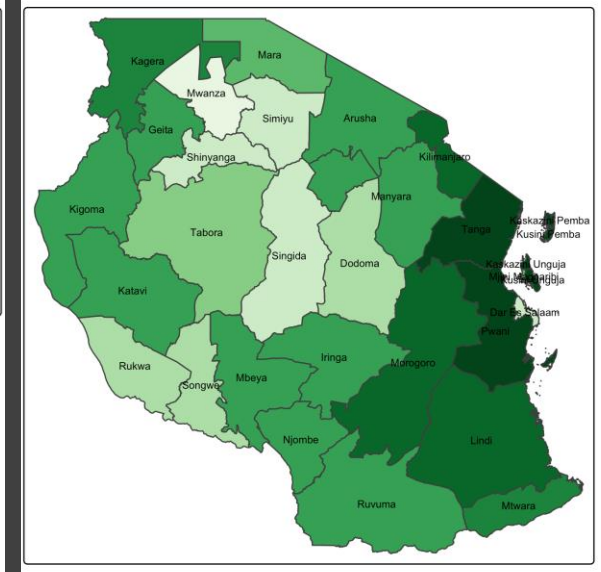
2005



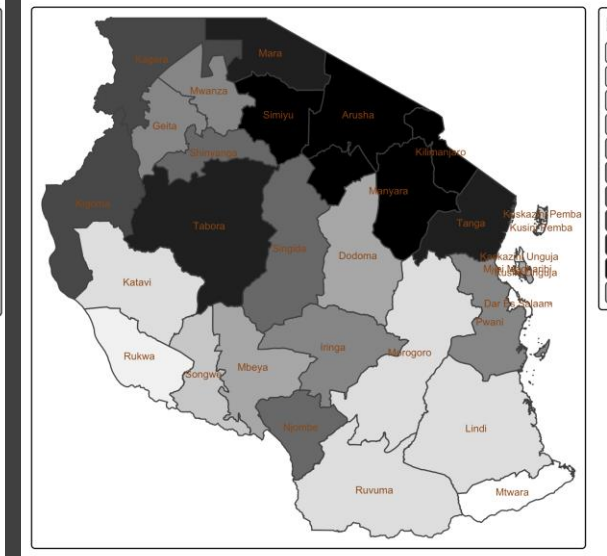
2010



2015



2020

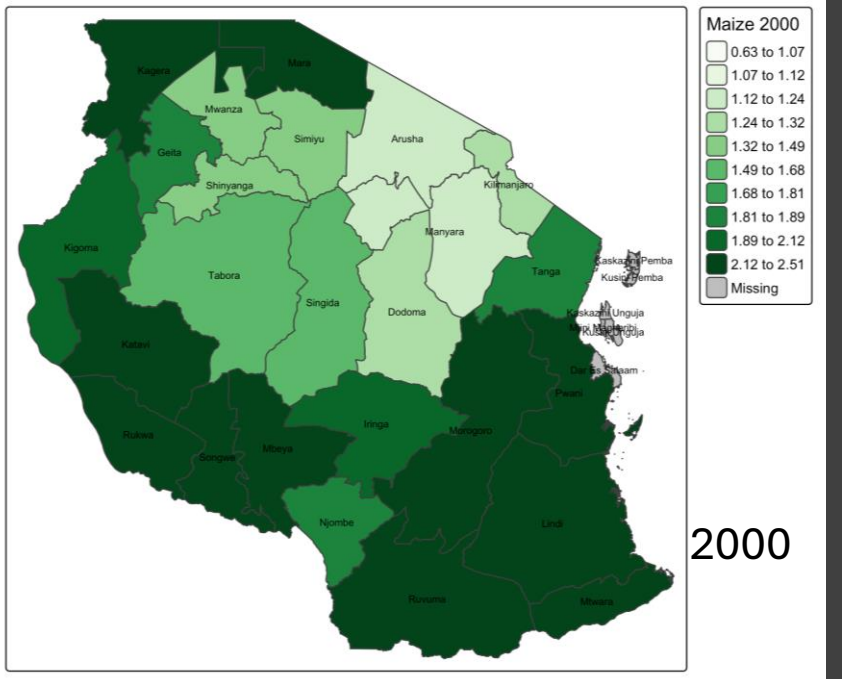


AARC

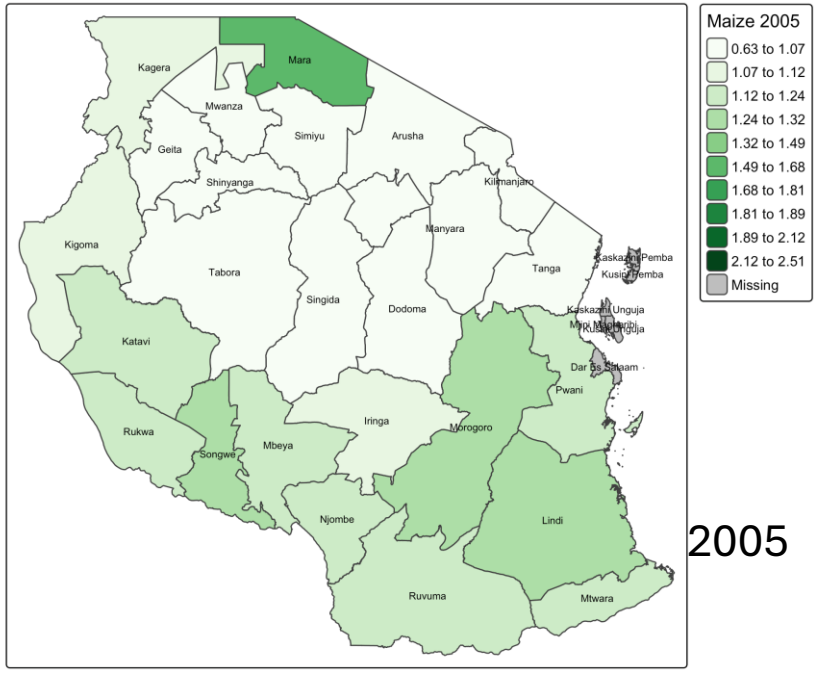
Maize

- 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).

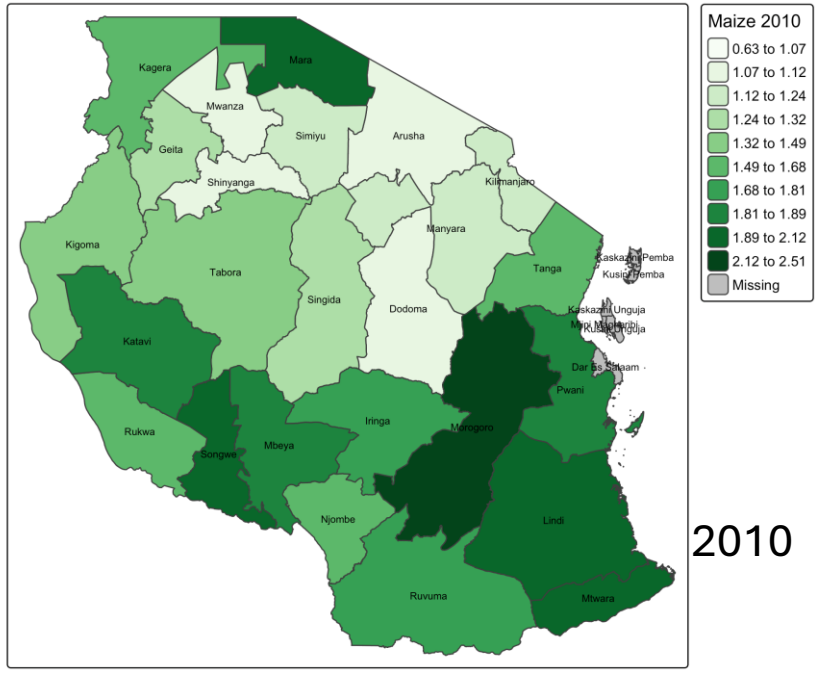
Reference: Iizumi, T., & Sakai, T. (2020). The global dataset of historical yields for major crops 1981–2016. Scientific Data, 7(1), 97.



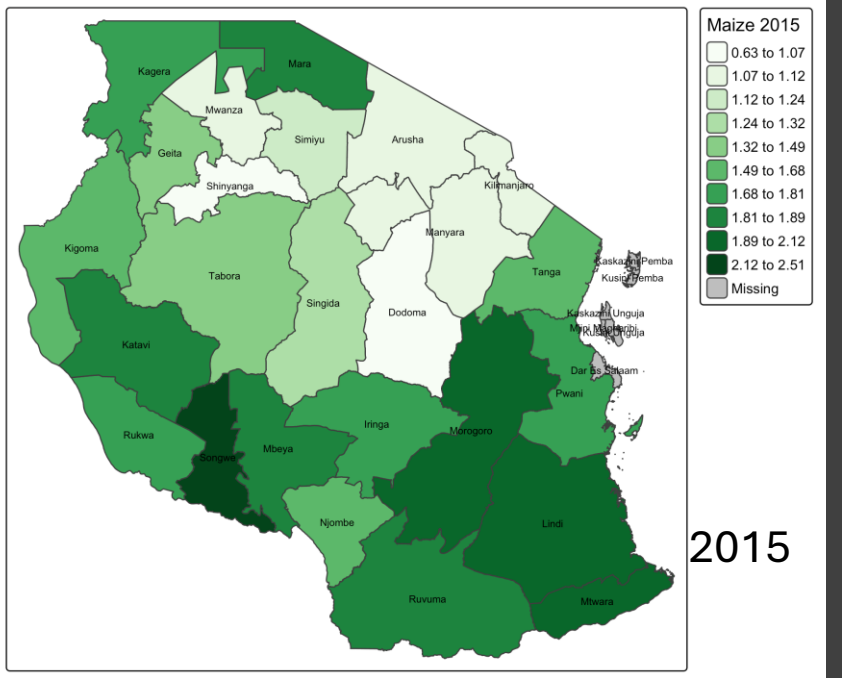
2000



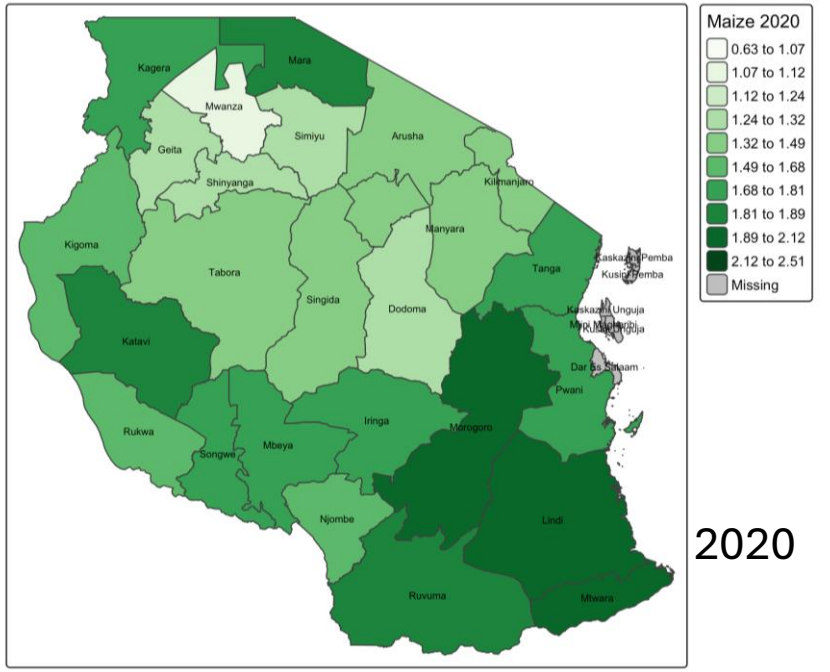
2005



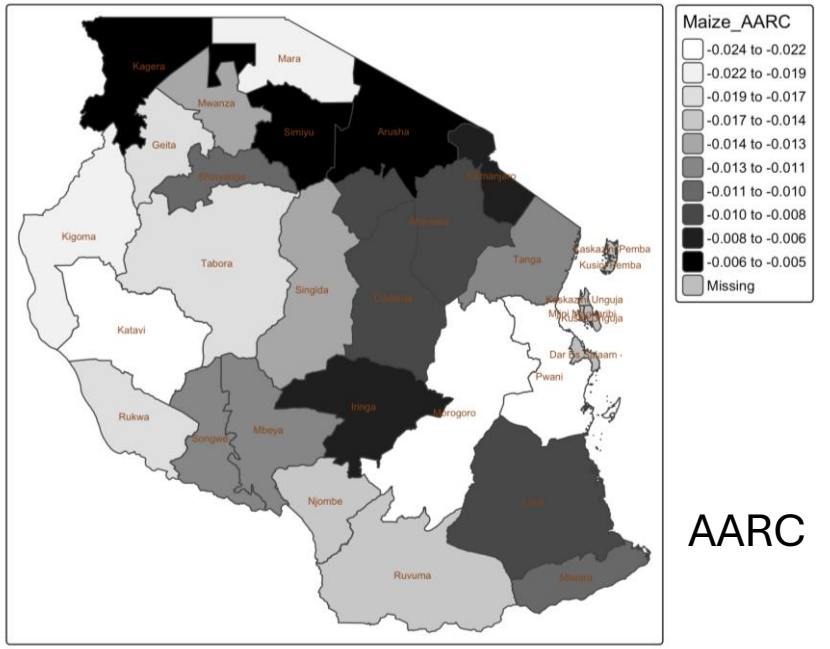
2010



2015



2020

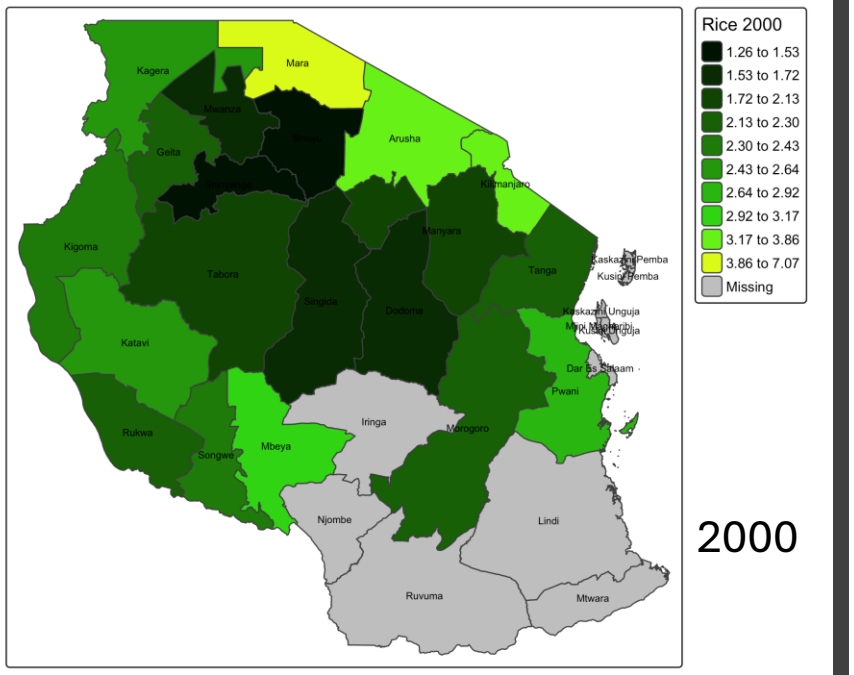


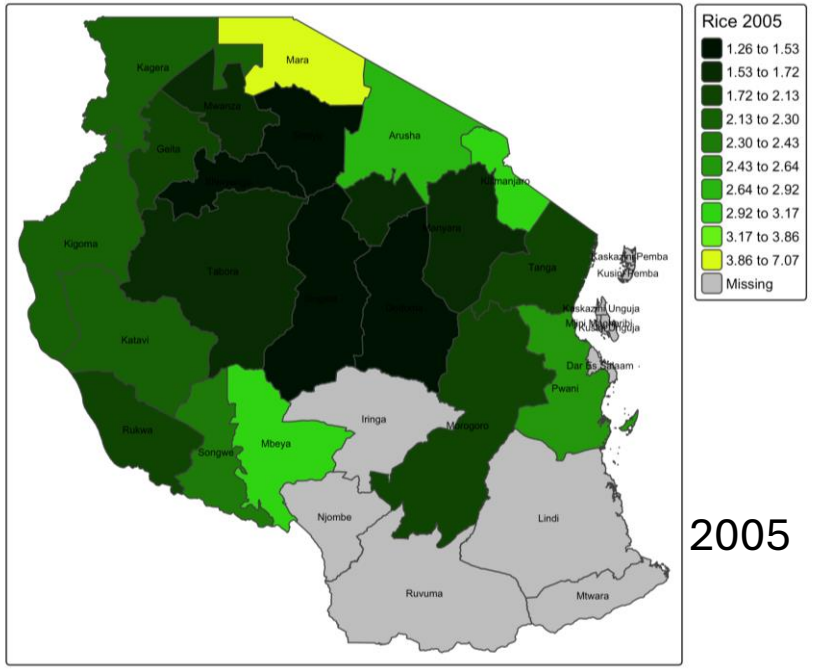
AARC

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.

Reference: Iizumi, T., & Sakai, T. (2020). The global dataset of historical yields for major crops 1981–2016. Scientific Data, 7(1), 97.


Rice 2000
1.26 to 1.53
1.53 to 1.72
1.72 to 2.13
2.13 to 2.30
2.30 to 2.43
2.43 to 2.64
2.64 to 2.92
2.92 to 3.17
3.17 to 3.86
3.86 to 7.07
Missing
Kagera
Mara
Mwanza
Geita
Simiyu
Arusha
Kilimanjaro
Shinyanga
Manyara
Kigoma
Tabora
Tanga
Singida
Dodoma
Kaskazini Pemba
Kusini Pemba
Kaskazini Unguja
Mjini Magharibi
Kusini Unguja
Dar Es Salaam
Katavi
Pwani
Iringa
Morogoro
Rukwa
Songwe
Mbeya
Njombe
Lindi
Ruvuma
Mtwara
2000


Rice 2005
1.26 to 1.53
1.53 to 1.72
1.72 to 2.13
2.13 to 2.30
2.30 to 2.43
2.43 to 2.64
2.64 to 2.92
2.92 to 3.17
3.17 to 3.86
3.86 to 7.07
Missing
Kagera
Mara
Mwanza
Geita
Simiyu
Arusha
Kilimanjaro
Shinyanga
Manyara
Kigoma
Tabora
Tanga
Singida
Dodoma
Kaskazini Pemba
Kusini Pemba
Kaskazini Unguja
Mjini Magharibi
Kusini Unguja
Dar Es Salaam
Katavi
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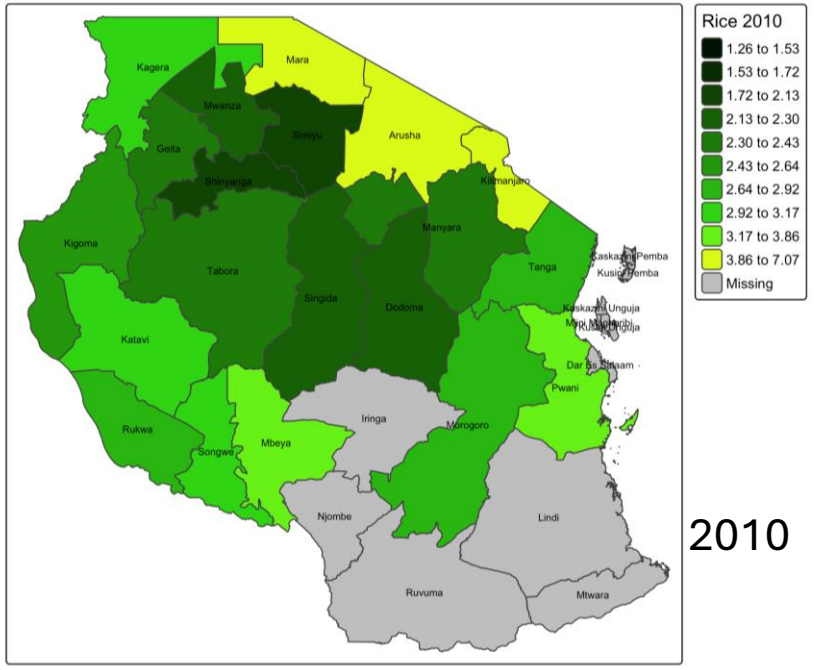
Iringa
Morogoro
Rukwa
Songwe
Mbeya
Njombe
Lindi
Ruvuma
Mtwara
2005


Rice 2010
1.26 to 1.53
1.53 to 1.72
1.72 to 2.13
2.13 to 2.30
2.30 to 2.43
2.43 to 2.64
2.64 to 2.92
2.92 to 3.17
3.17 to 3.86
3.86 to 7.07
Missing
Kagera
Mara
Mwanza
Geita
Simiyu
Arusha
Kilimanjaro
Shinyanga
Manyara
Kigoma
Tabora
Tanga
Singida
Dodoma
Kaskazini Pemba
Kusini Pemba
Kaskazini Unguja
Mjini Magharibi
Kusini Unguja
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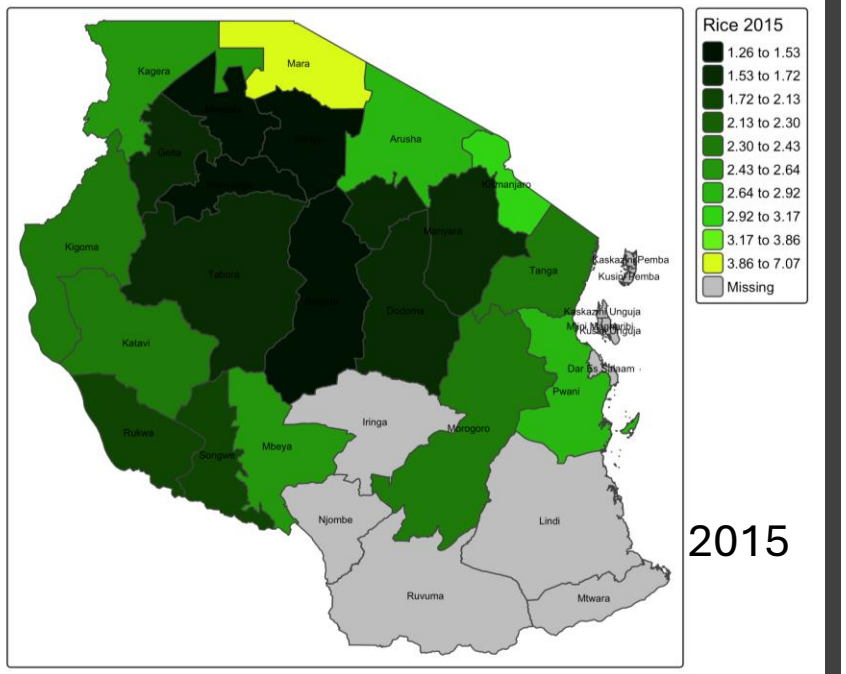
Songwe
Mbeya
Njombe
Lindi
Ruvuma
Mtwara
2010


Rice 2015
1.26 to 1.53
1.53 to 1.72
1.72 to 2.13
2.13 to 2.30
2.30 to 2.43
2.43 to 2.64
2.64 to 2.92
2.92 to 3.17
3.17 to 3.86
3.86 to 7.07
Missing
Kagera
Mara
Mwanza
Geita
Simiyu
Arusha
Kilimanjaro
Shinyanga
Manyara
Kigoma
Tabora
Tanga
Singida
Dodoma
Kaskazini Pemba
Kusini Pemba
Kaskazini Unguja
Mjini Magharibi
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Songwe
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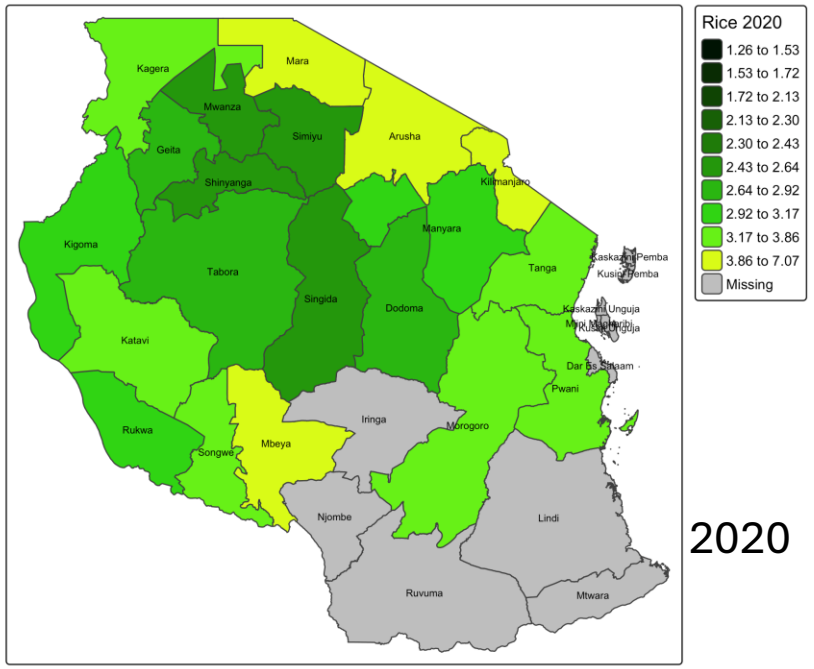
Njombe
Lindi
Ruvuma
Mtwara
2015


Rice 2020
1.26 to 1.53
1.53 to 1.72
1.72 to 2.13
2.13 to 2.30
2.30 to 2.43
2.43 to 2.64
2.64 to 2.92
2.92 to 3.17
3.17 to 3.86
3.86 to 7.07
Missing
Kagera
Mara
Mwanza
Geita
Simiyu
Arusha
Kilimanjaro
Shinyanga
Manyara
Kigoma
Tabora
Tanga
Singida
Dodoma
Kaskazini Pemba
Kusini Pemba
Kaskazini Unguja
Mjini Magharibi
Kusini Unguja
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Iringa
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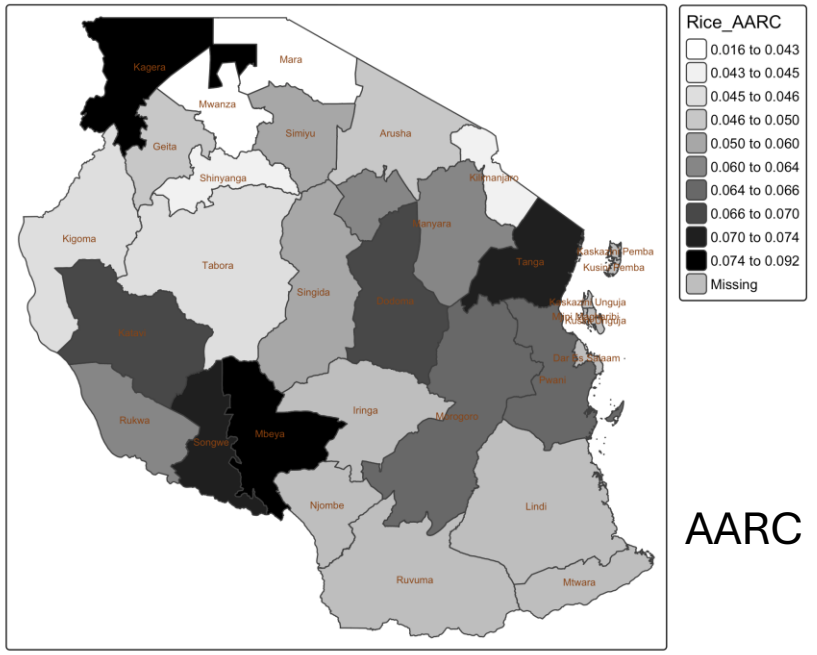
Rukwa
Songwe
Mbeya
Njombe
Lindi
Ruvuma
Mtwara
2020


Rice_AARC
0.016 to 0.043
0.043 to 0.045
0.045 to 0.046
0.046 to 0.050
0.050 to 0.060
0.060 to 0.064
0.064 to 0.066
0.066 to 0.070
0.070 to 0.074
0.074 to 0.092
Missing
Kagera
Mara
Mwanza
Geita
Simiyu
Arusha
Kilimanjaro
Shinyanga
Manyara
Kigoma
Tabora
Tanga
Singida
Dodoma
Kaskazini Pemba
Kusini Pemba
Kaskazini Unguja
Mjini Magharibi
Kusini Unguja
Dar Es Salaam
Katavi
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Iringa
Morogoro
Rukwa
Songwe
Mbeya
Njombe
Lindi
Ruvuma
Mtwara
AARC

Tanzania

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

Disaster and Migration/Displacement (4)

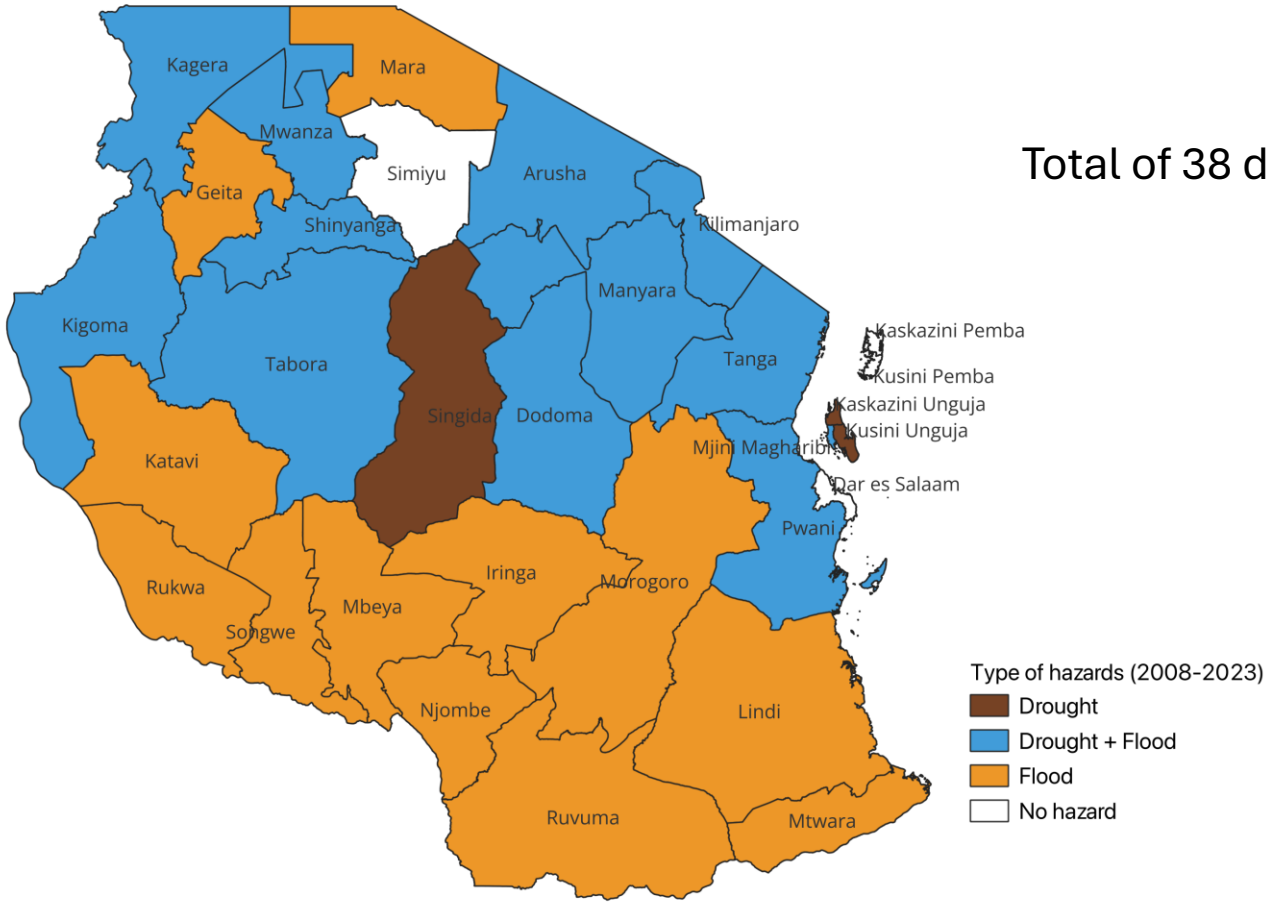
- Counties affected by disasters between 2008-2023
  - Resource: Em-dat database

- 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

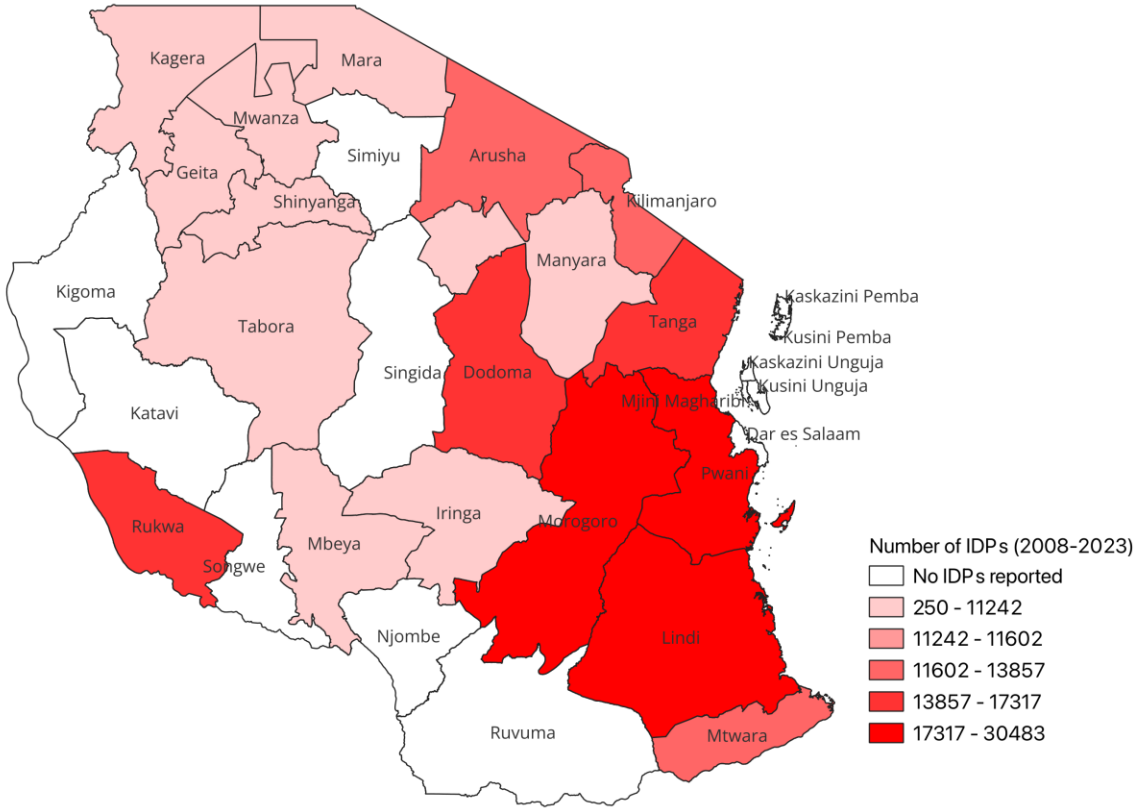
Counties affected by Disasters between 2008-2023



Total of 38 disasters affecting 31 regions

Reference: Em-Dat database

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

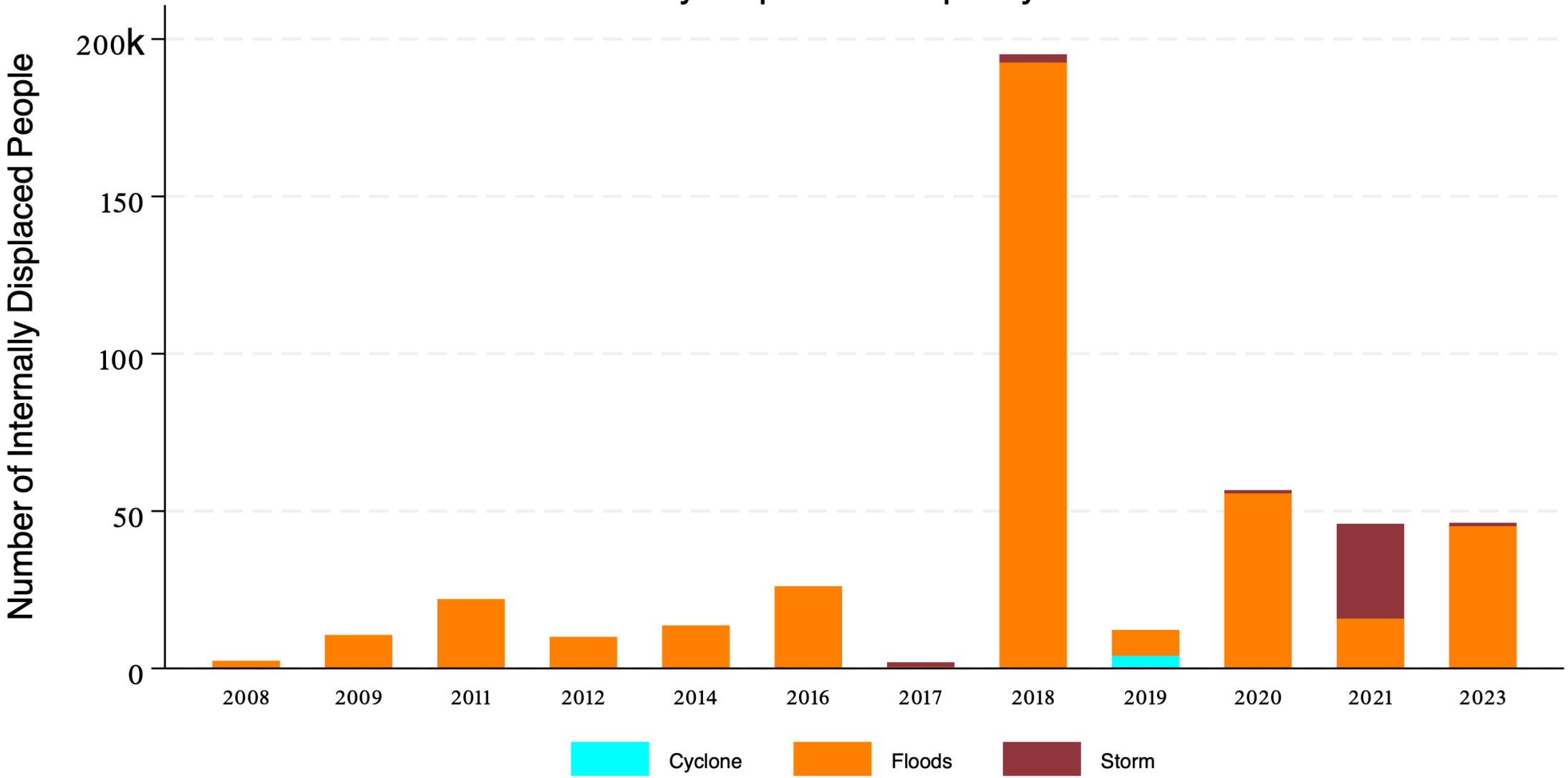


19 counties impacted

Reference: IDMC - Internal Displacement Monitoring Centre

Tanzania

Number of Internally Displaced People by Disaster Over Time



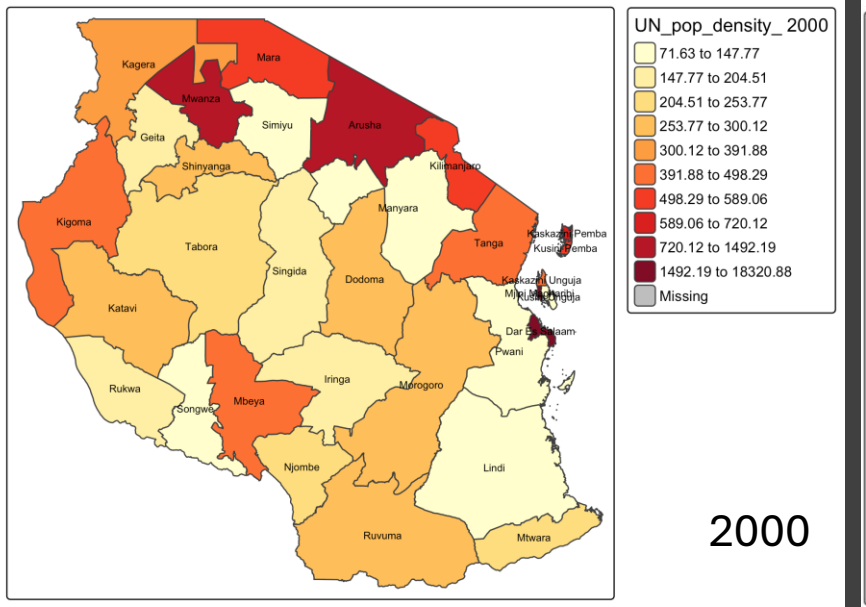
Reference: IDMC - Internal Displacement Monitoring Centre

UN-adjusted Population Density

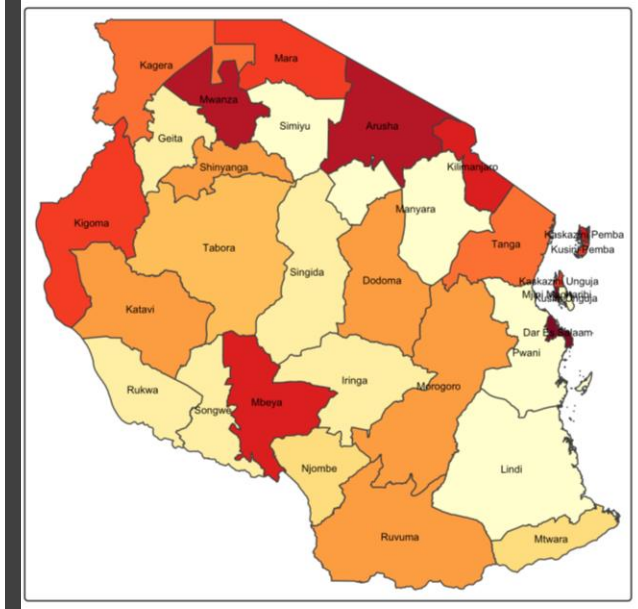
- Derived Data Set: UN-Adjusted Population Density, v4.11 (2000, 2005, 2010, 2015, 2020)
- Derived Data Set Cell Size: 30 arc seconds (~0.00833333 decimal degrees; ~1 km)
- Summary Statistic: Mean
- Year: 2000, 2005, 2010, 2015, 2020
- Units: Number of people per square kilometer

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.

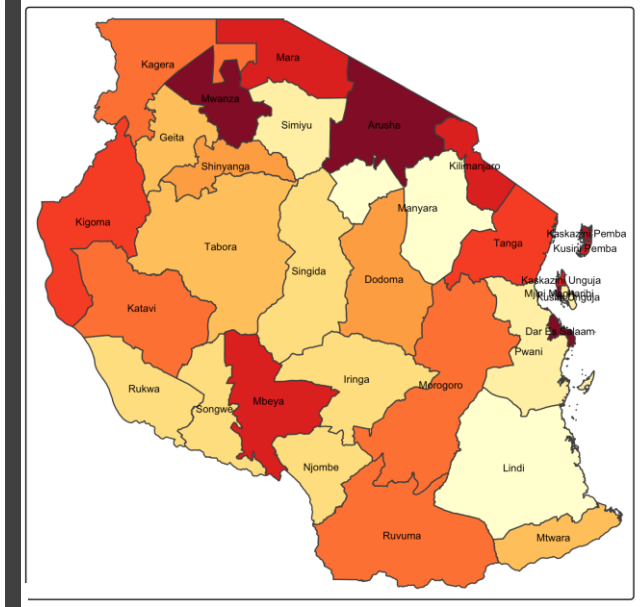
Reference: The Geospatial Covariate Datasets Manual - The Demographic and Health Surveys Program



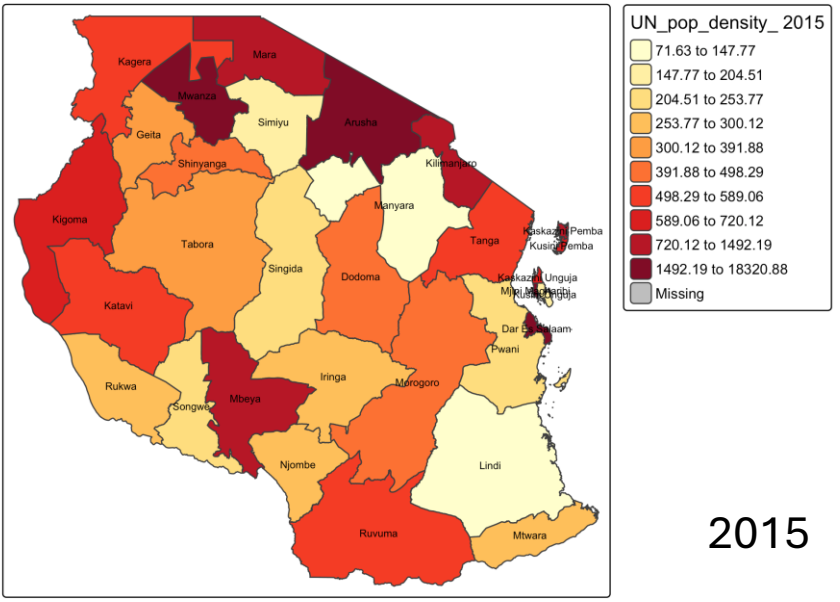
2000



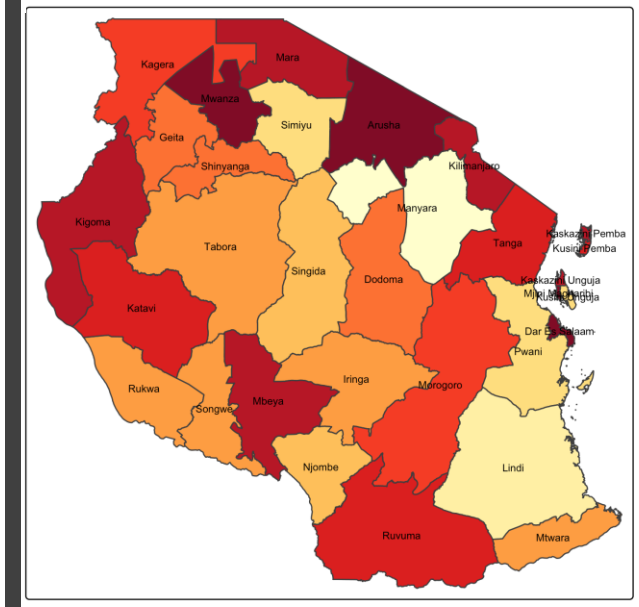
2005



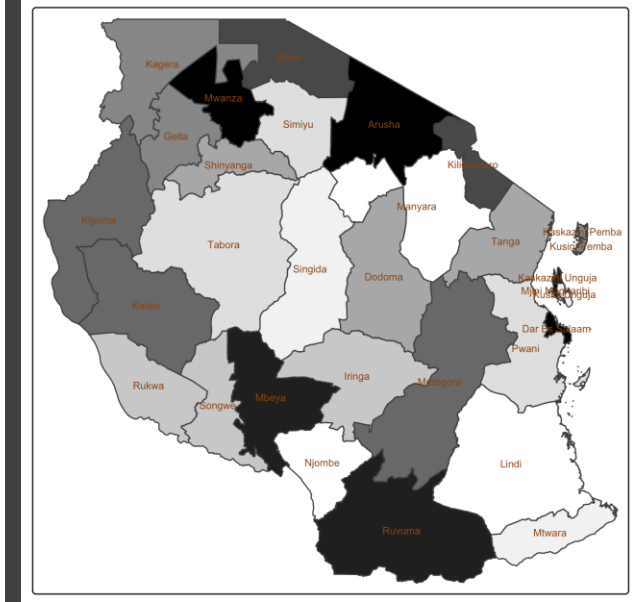
2010



2015



2020



AARC

Tanzania

Time points: 1999, 2010, 2015, 2022

Health & Nutrition Indicators (3)

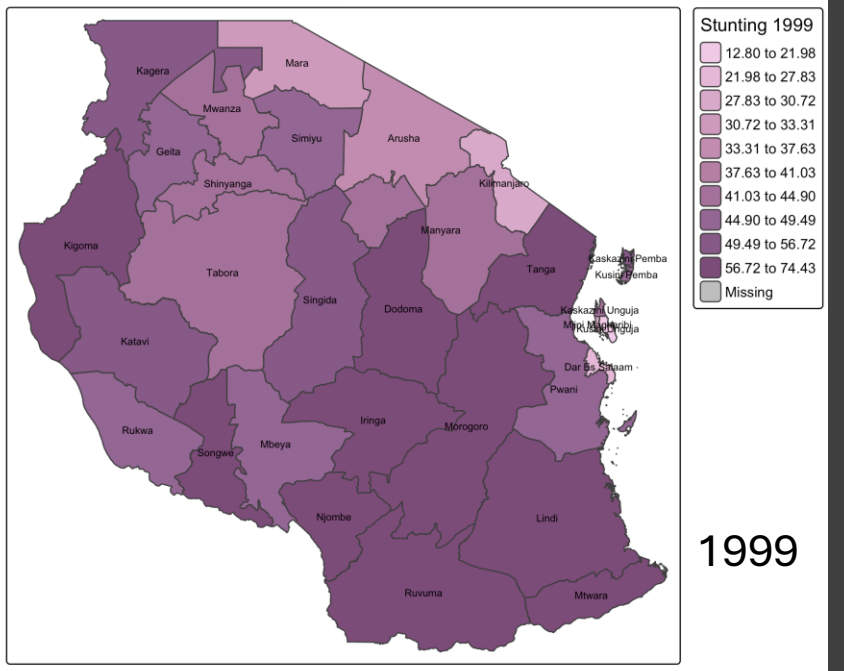
DHS surveys for year the survey conducted for following indicators:

- Stunting
- Wasting
- Underweight

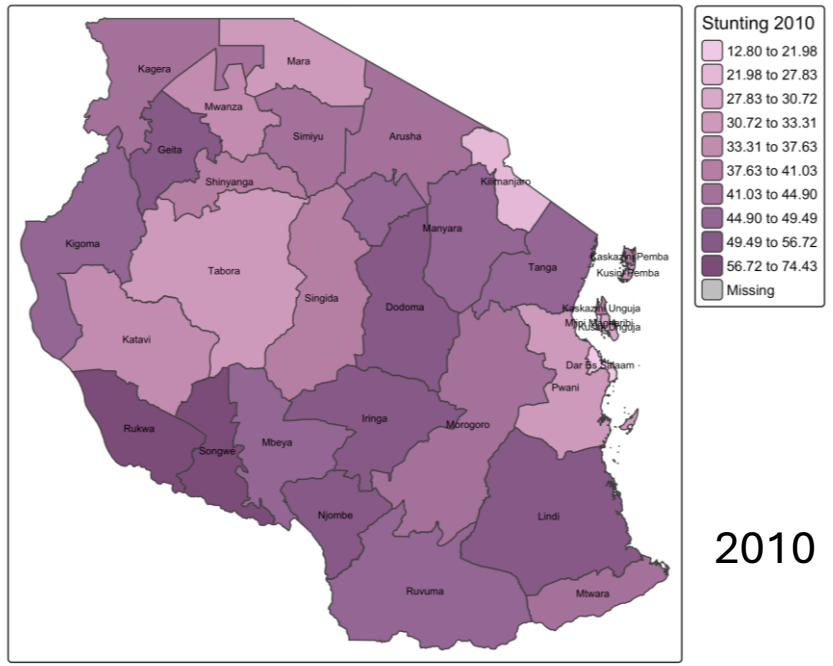
Stunting

- 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

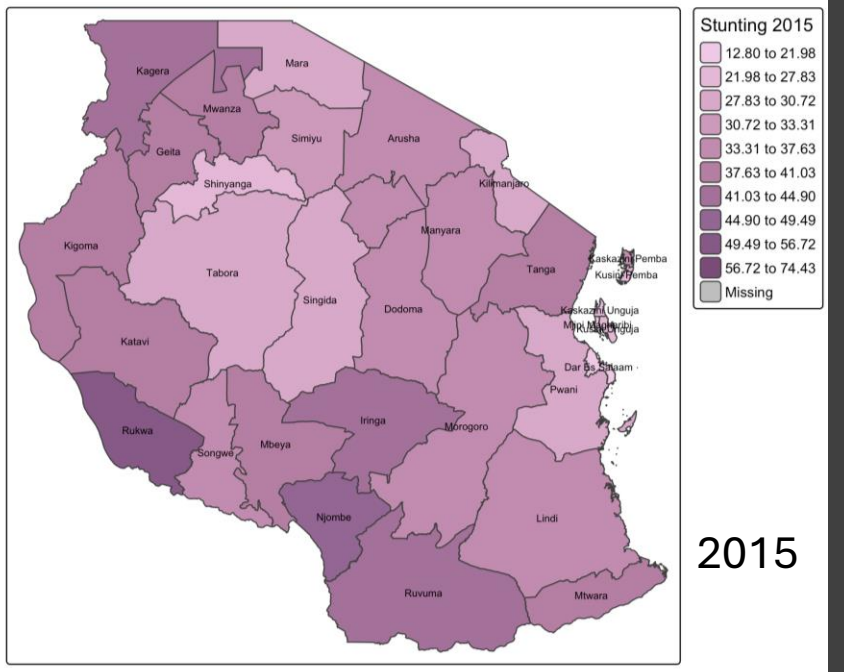
Reference: The Geospatial Covariate Datasets Manual - The Demographic and Health Surveys Program



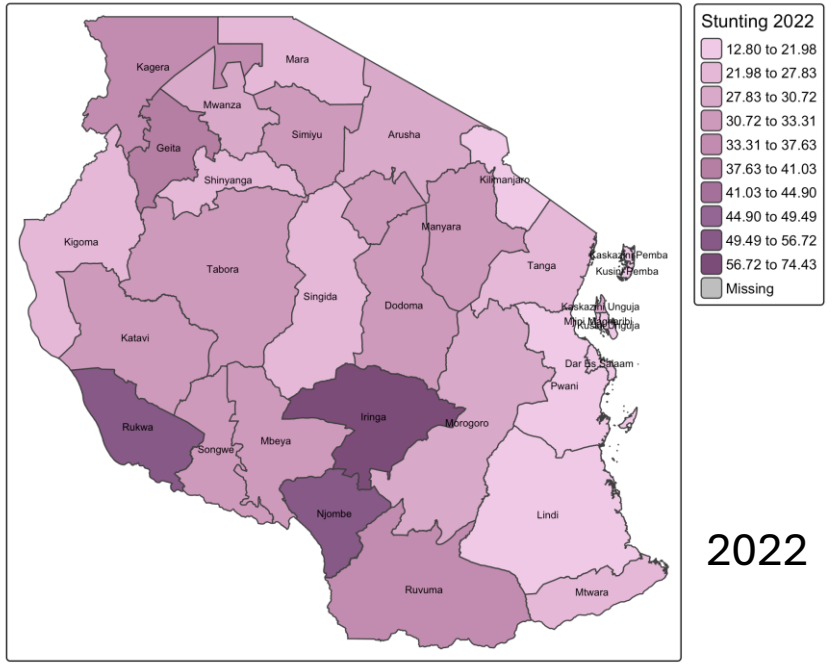
1999



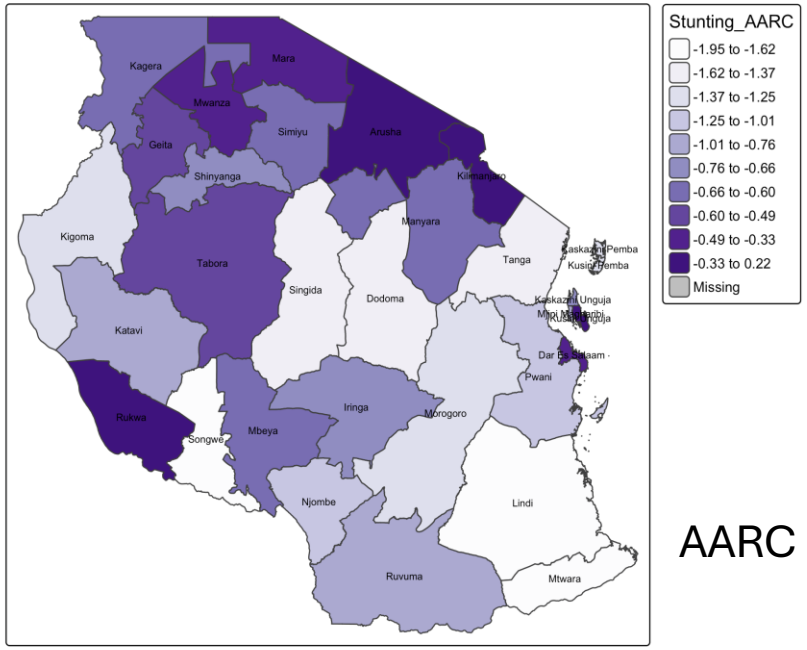
2010



2015



2022

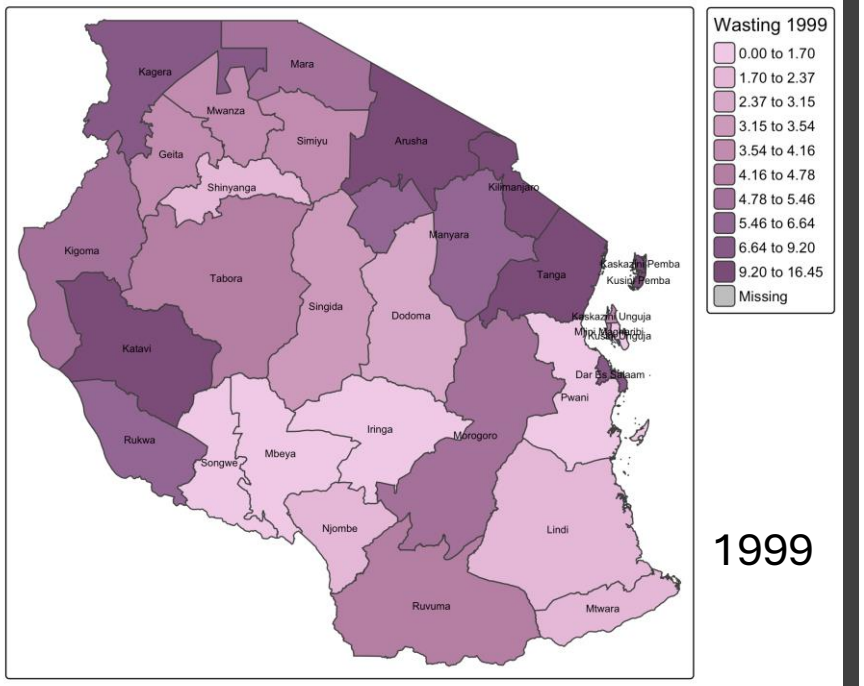


AARC

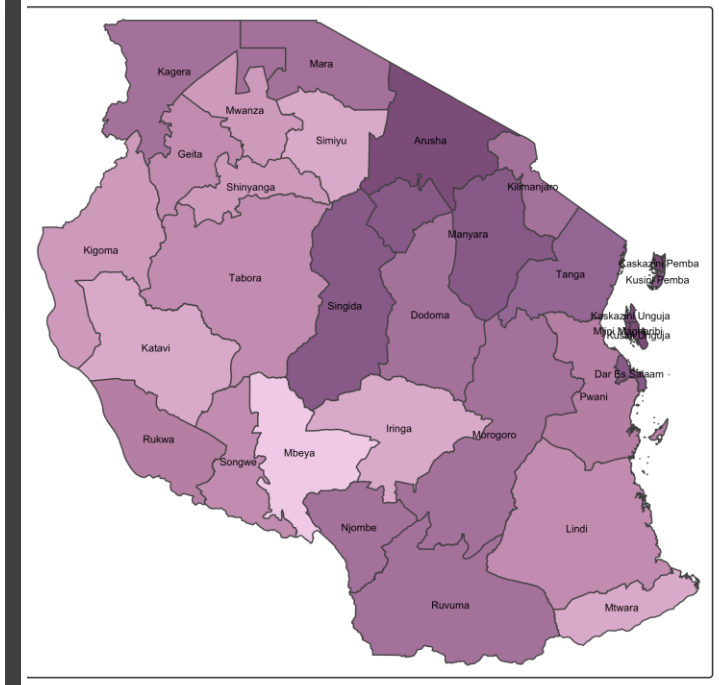
Wasting

- 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

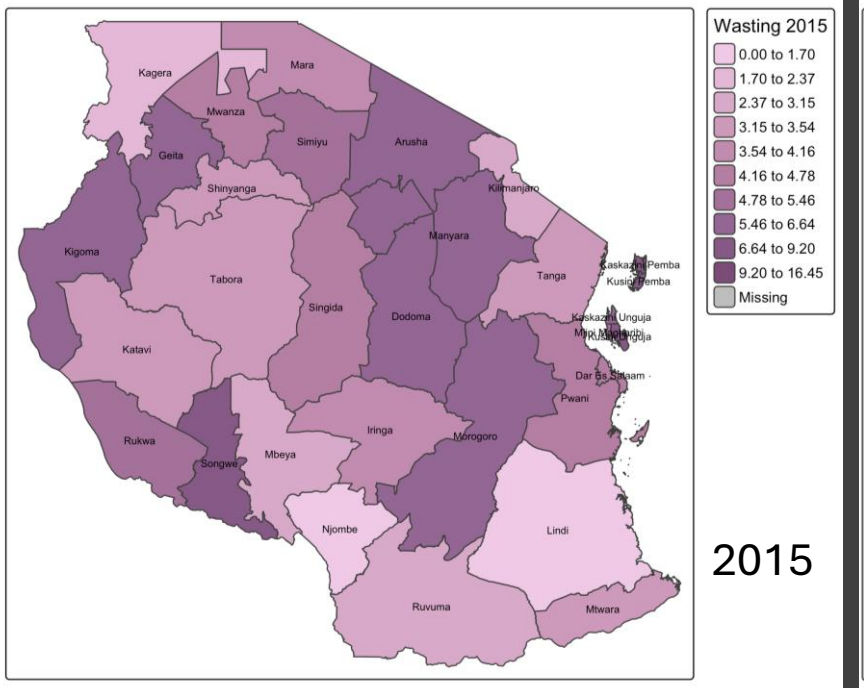
Reference: The Geospatial Covariate Datasets Manual - The Demographic and Health Surveys Program



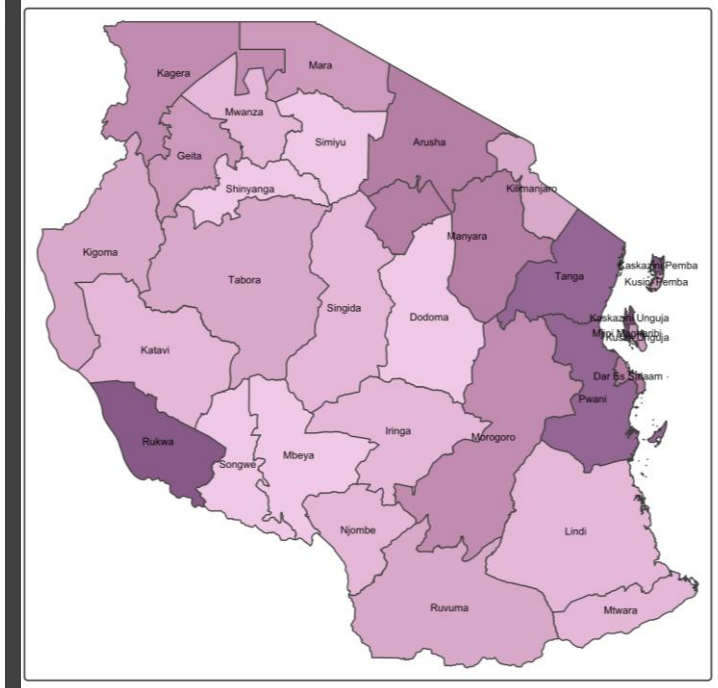
1999



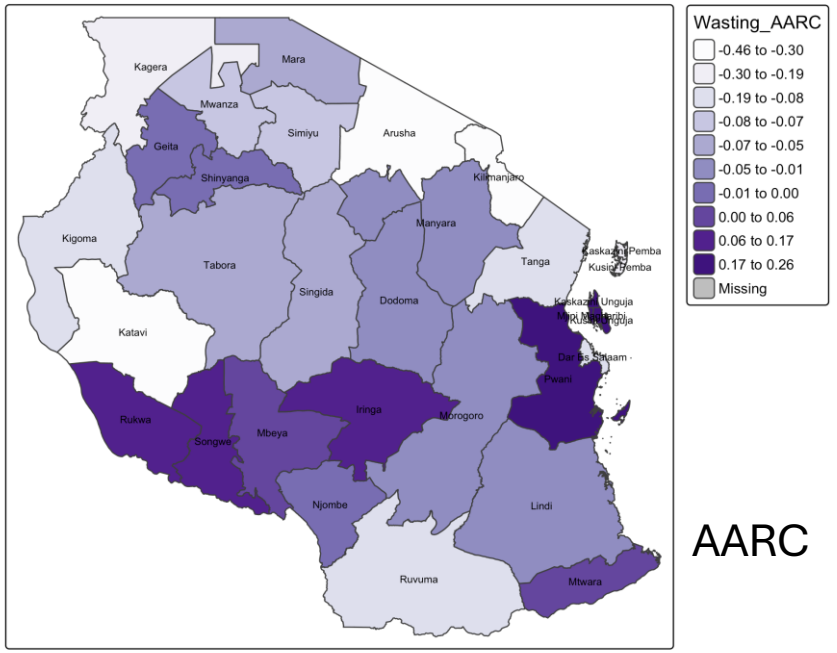
2010



2015



2022

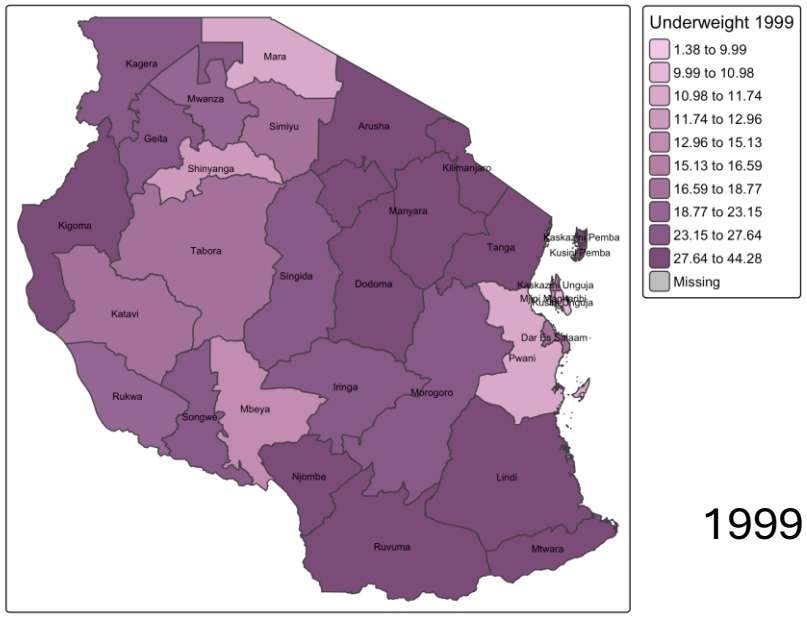


AARC

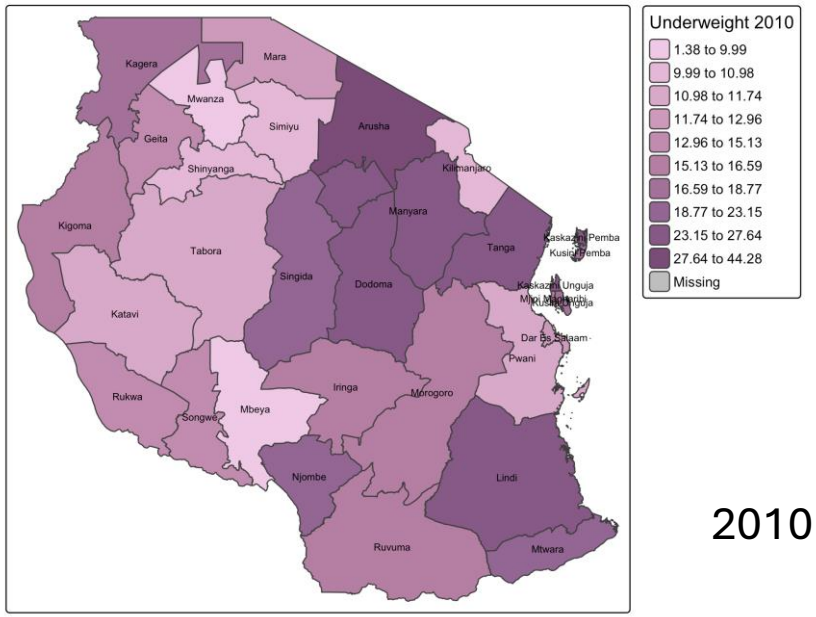
Underweight

- 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

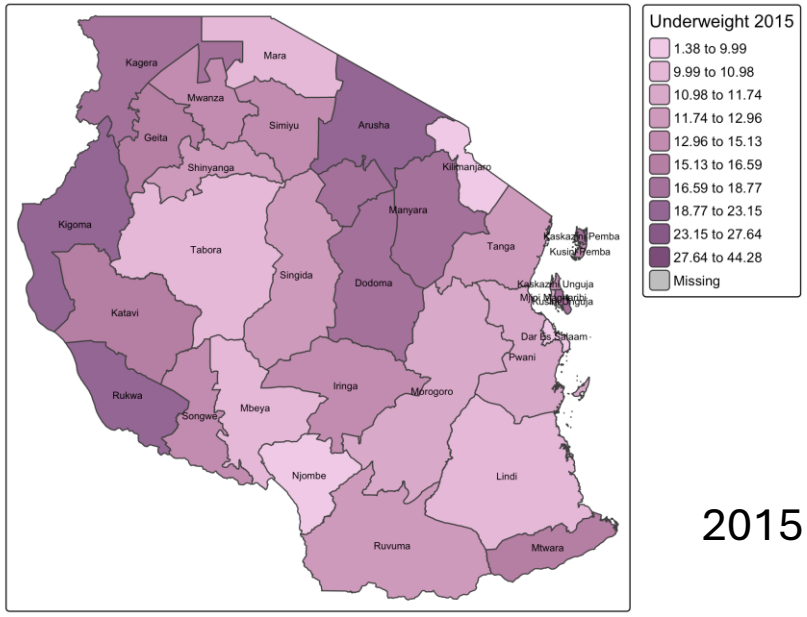
Reference: The Geospatial Covariate Datasets Manual - The Demographic and Health Surveys Program



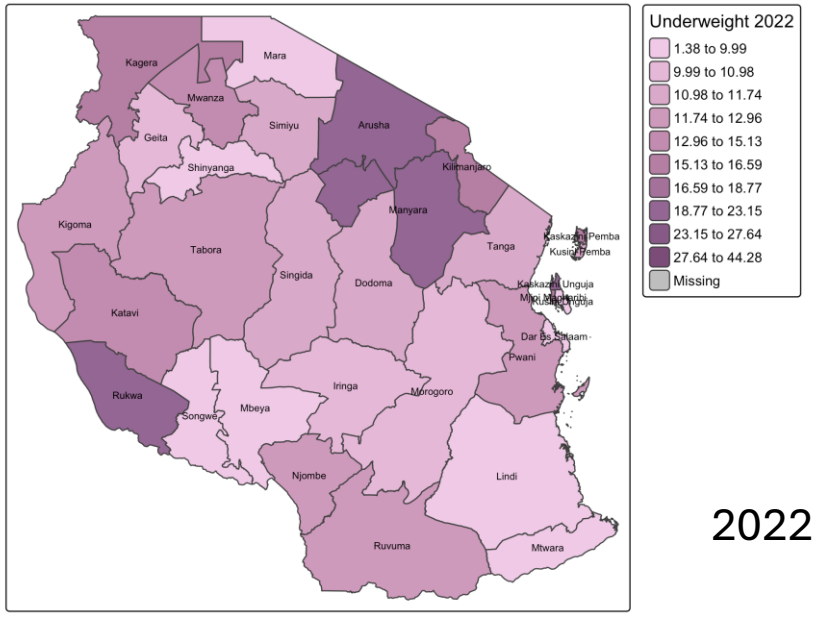
1999



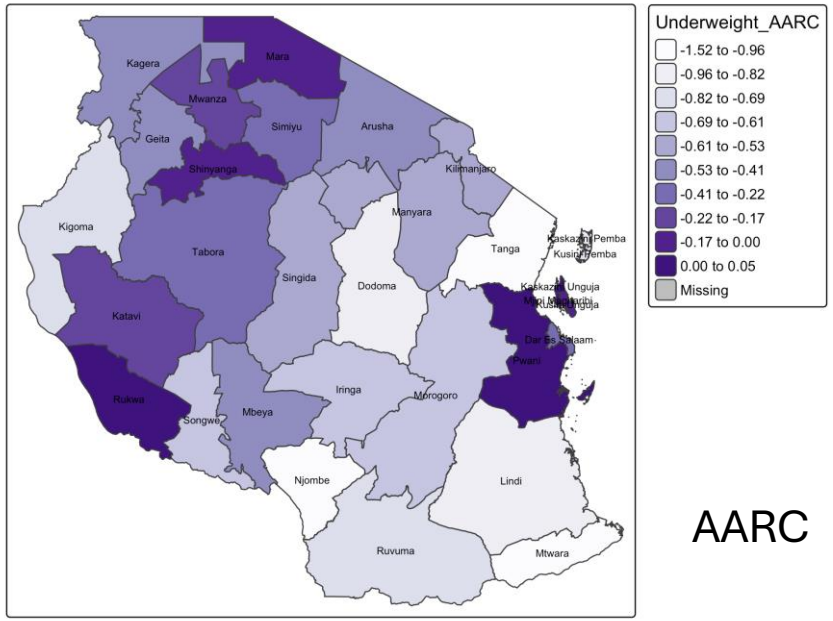
2010



2015

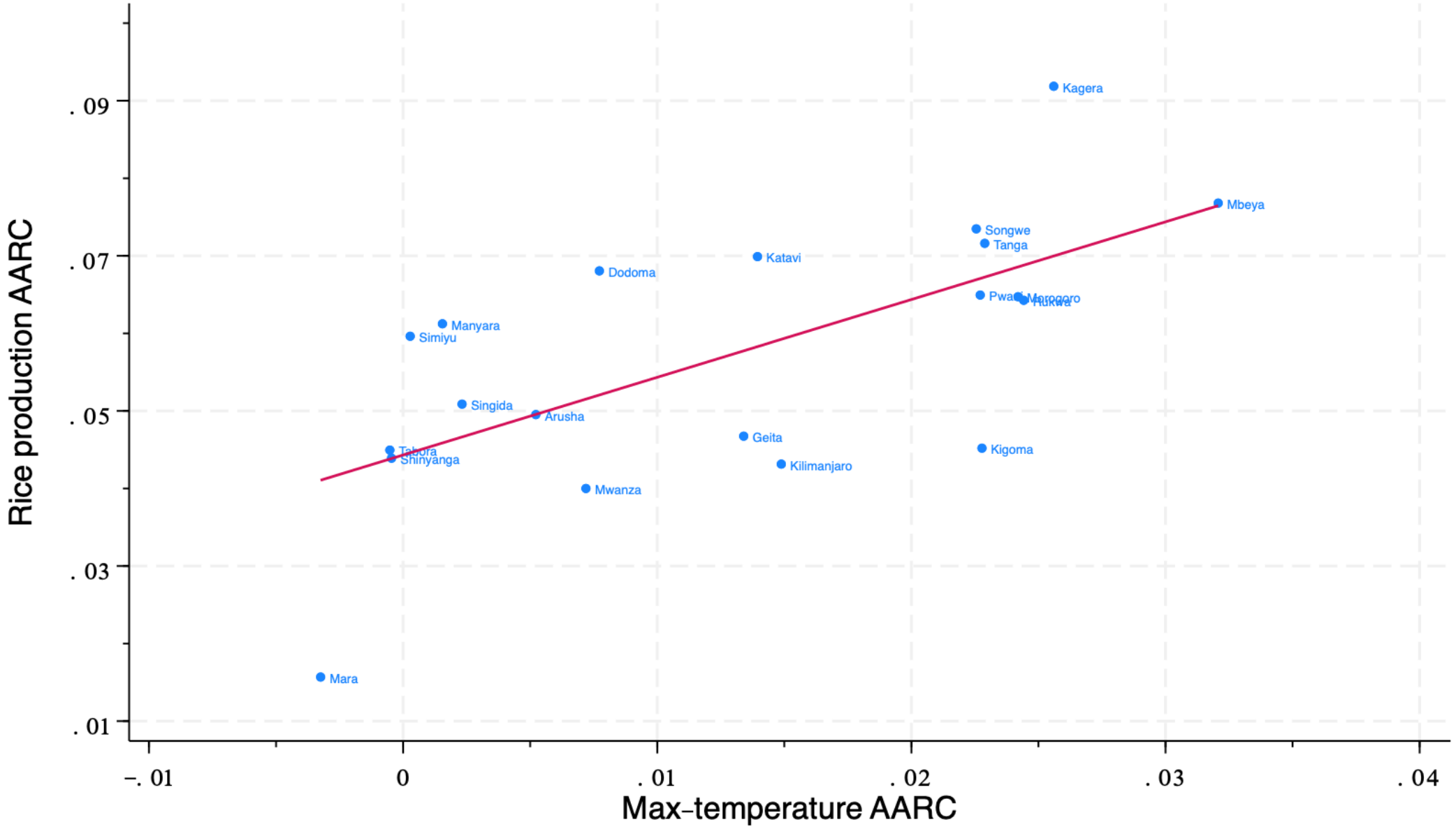


2022

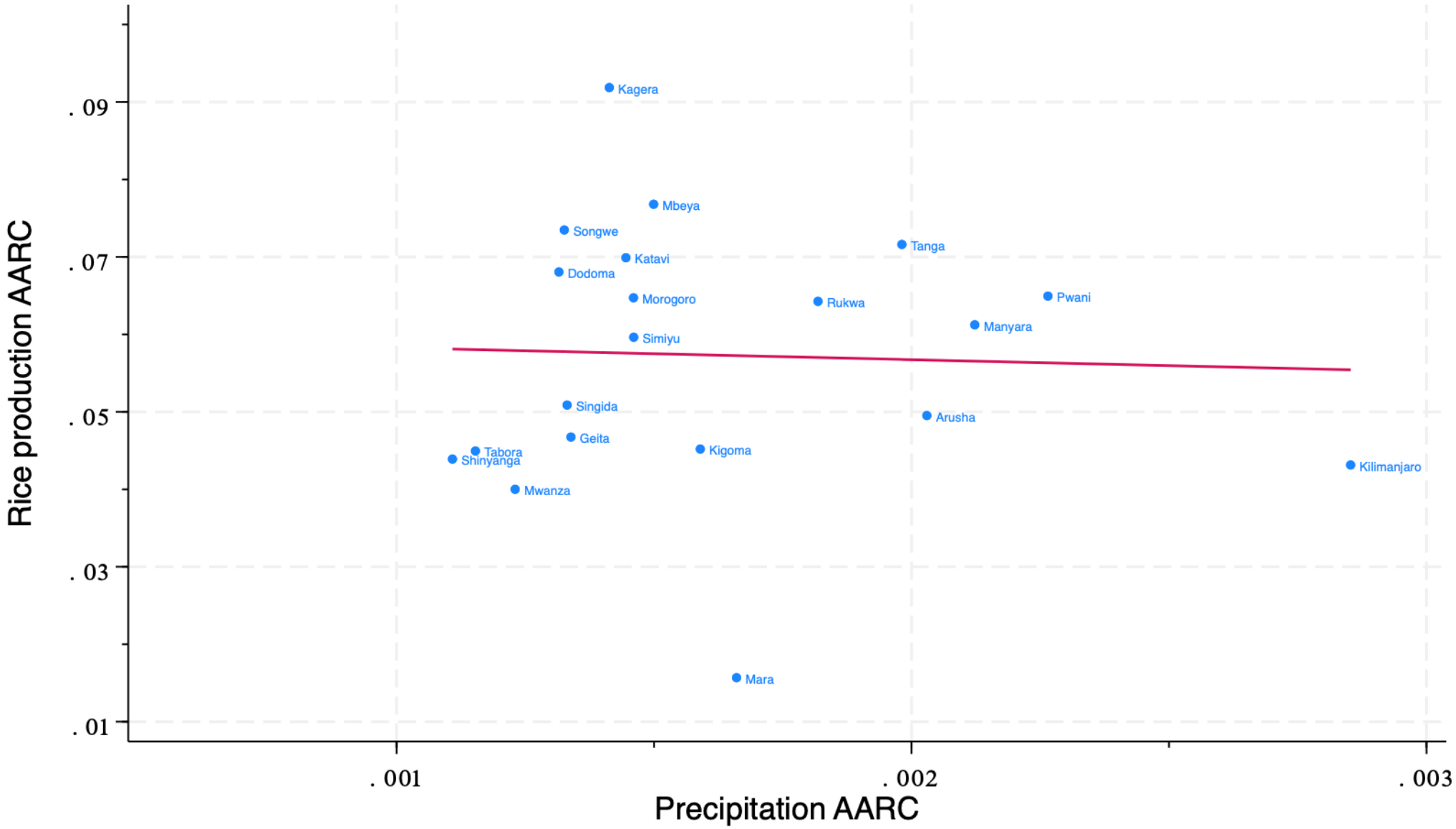


AARC

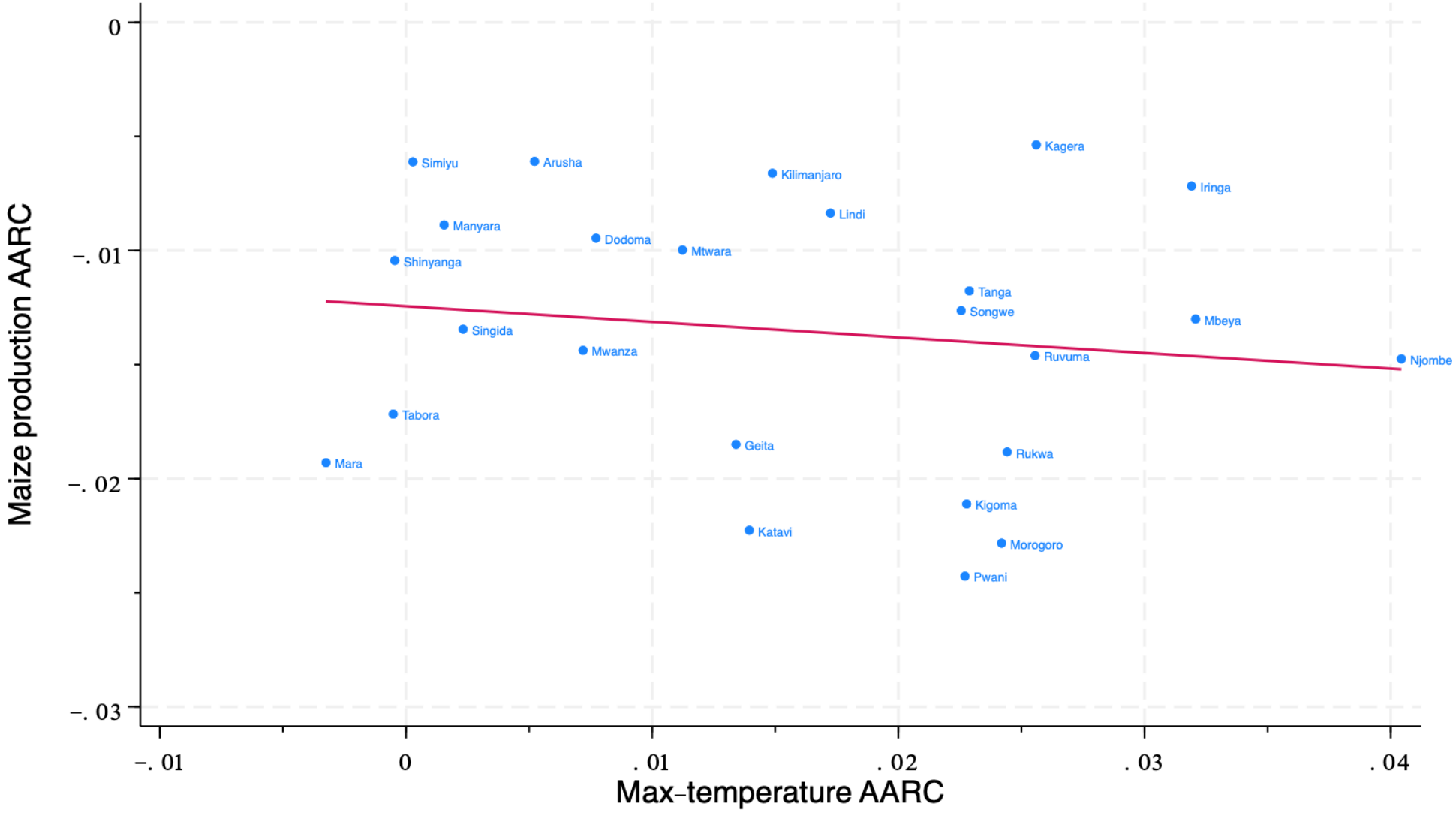
Rice Production AARC vs Max Temperature AARC from 2000-2020 by Region in Tanzania



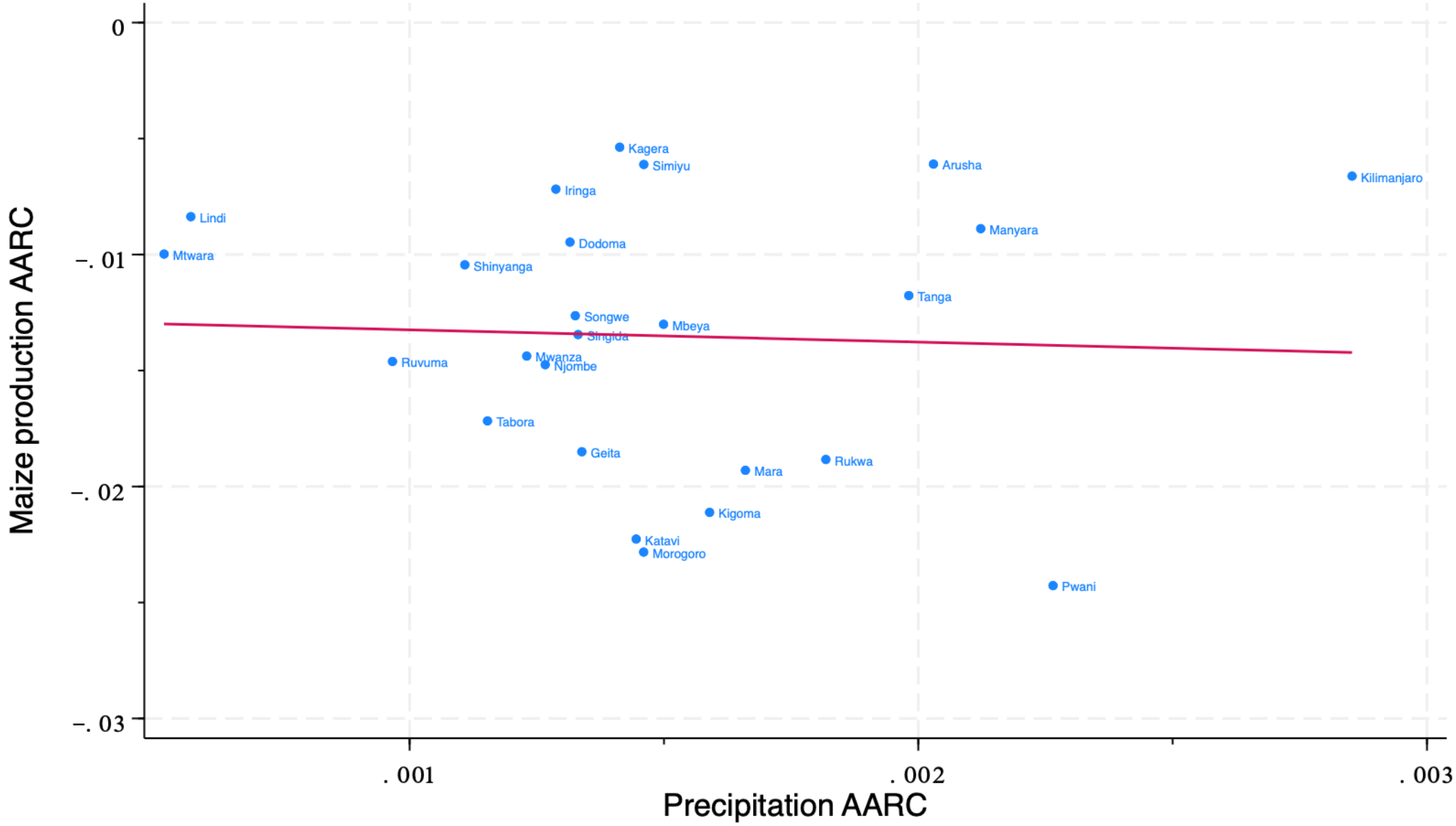
Rice Production AARC vs Precipitation AARC from 2000-2020 by Region in Tanzania



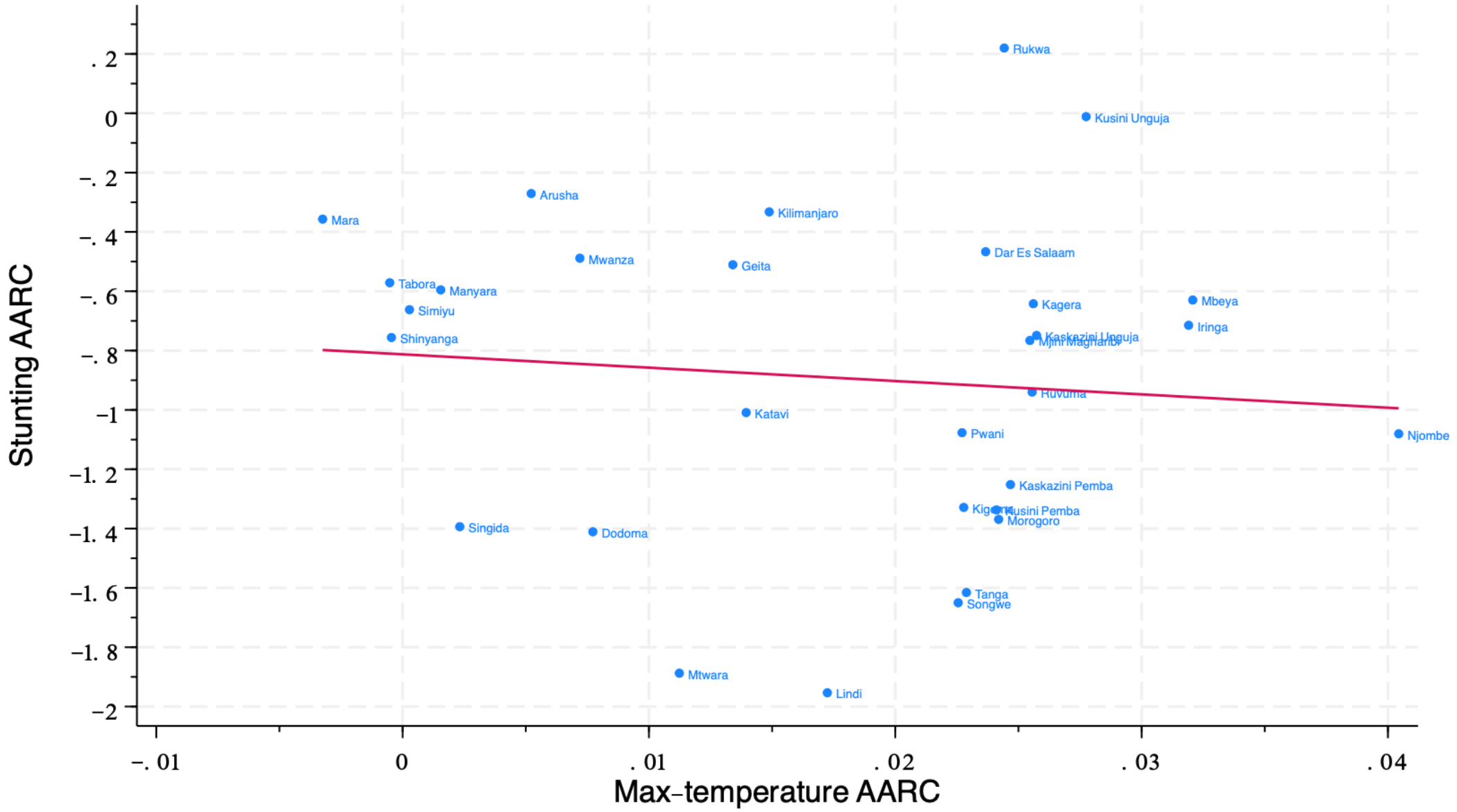
Maize Production AARC vs Max Temperature AARC from 2000-2020 by Region in Tanzania



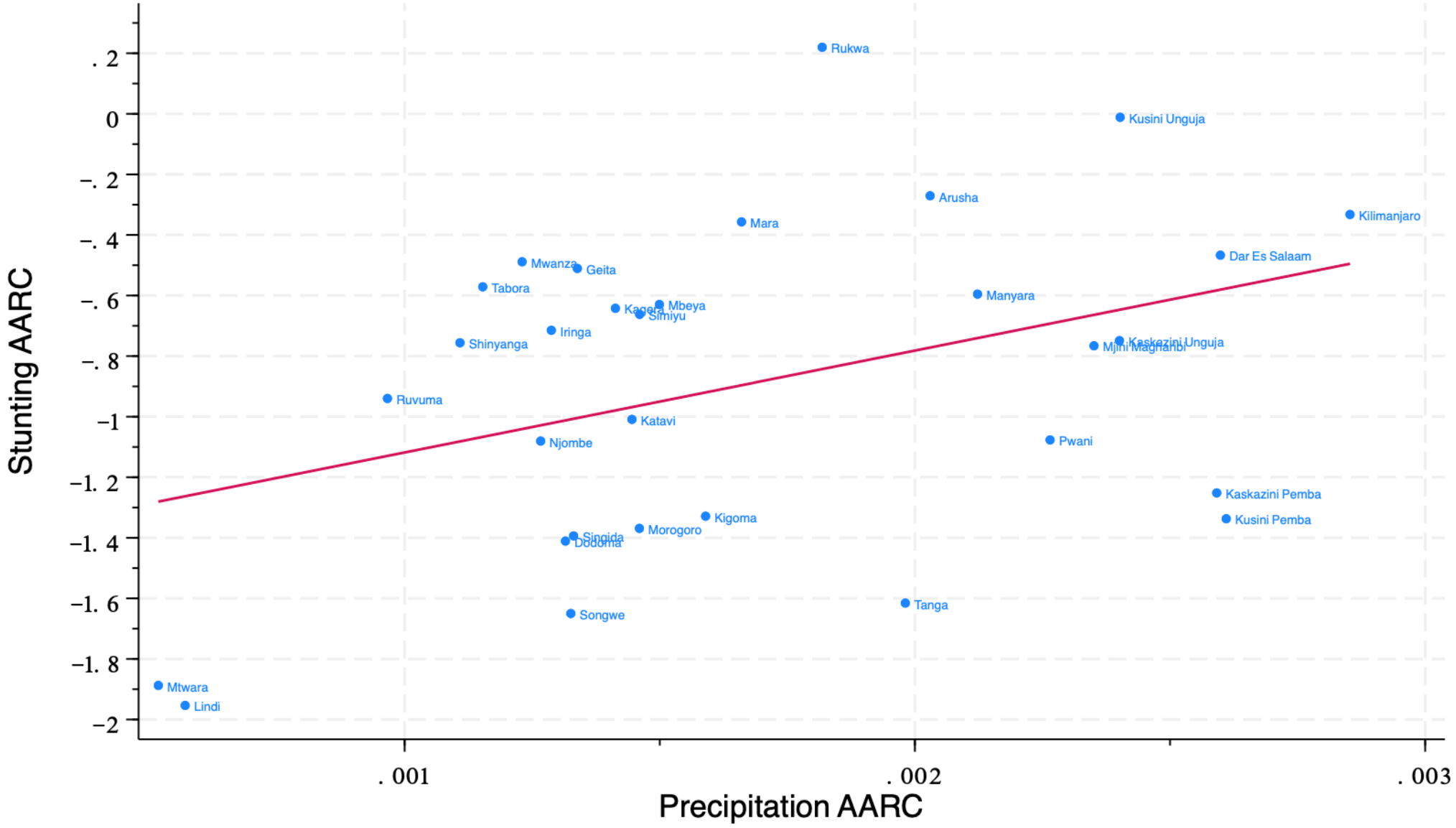
Maize Production AARC vs Precipitation AARC from 2000-2020 by Region in Tanzania



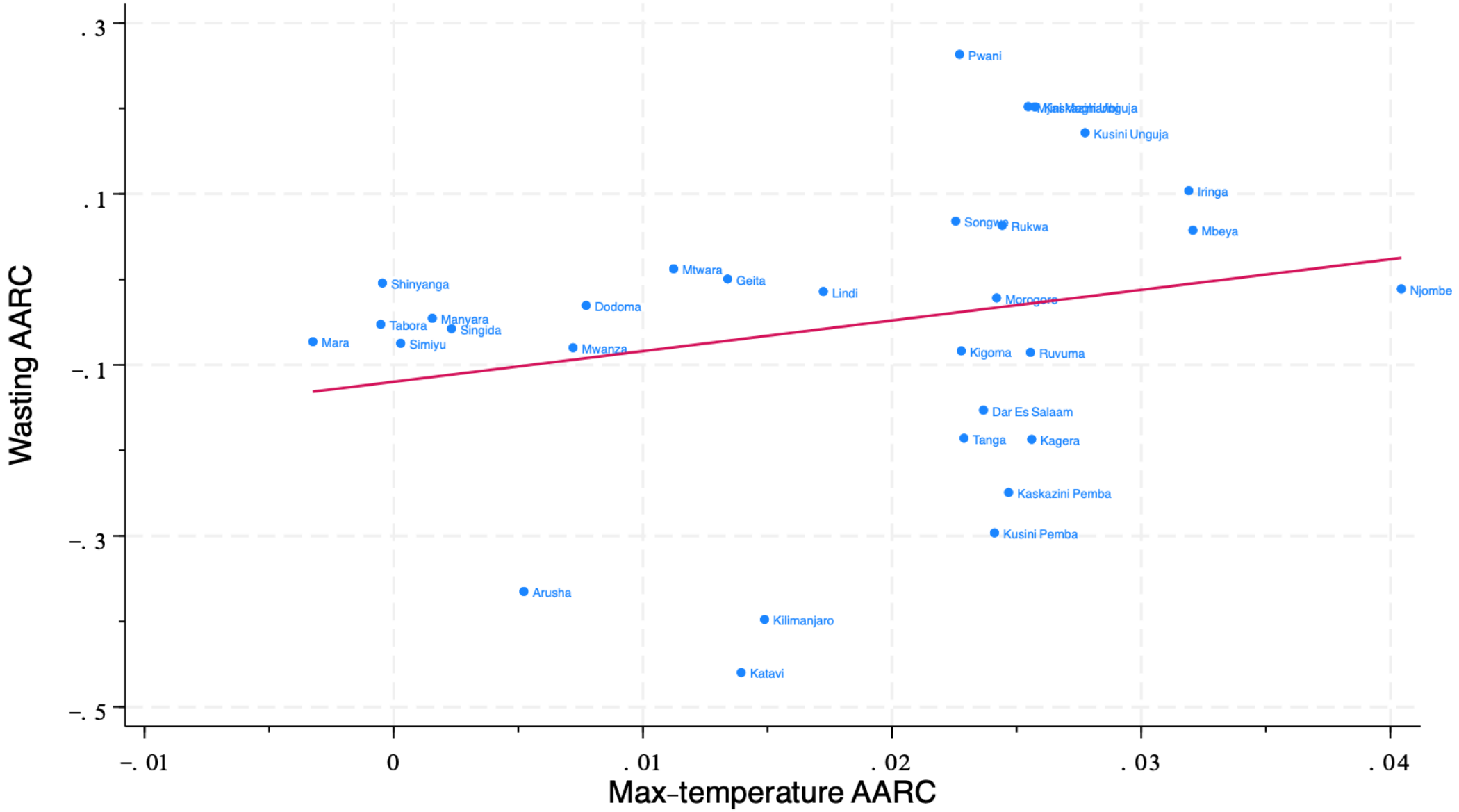
Stunting AARC vs Max Temperature AARC from 2000-2020 by Region in Tanzania



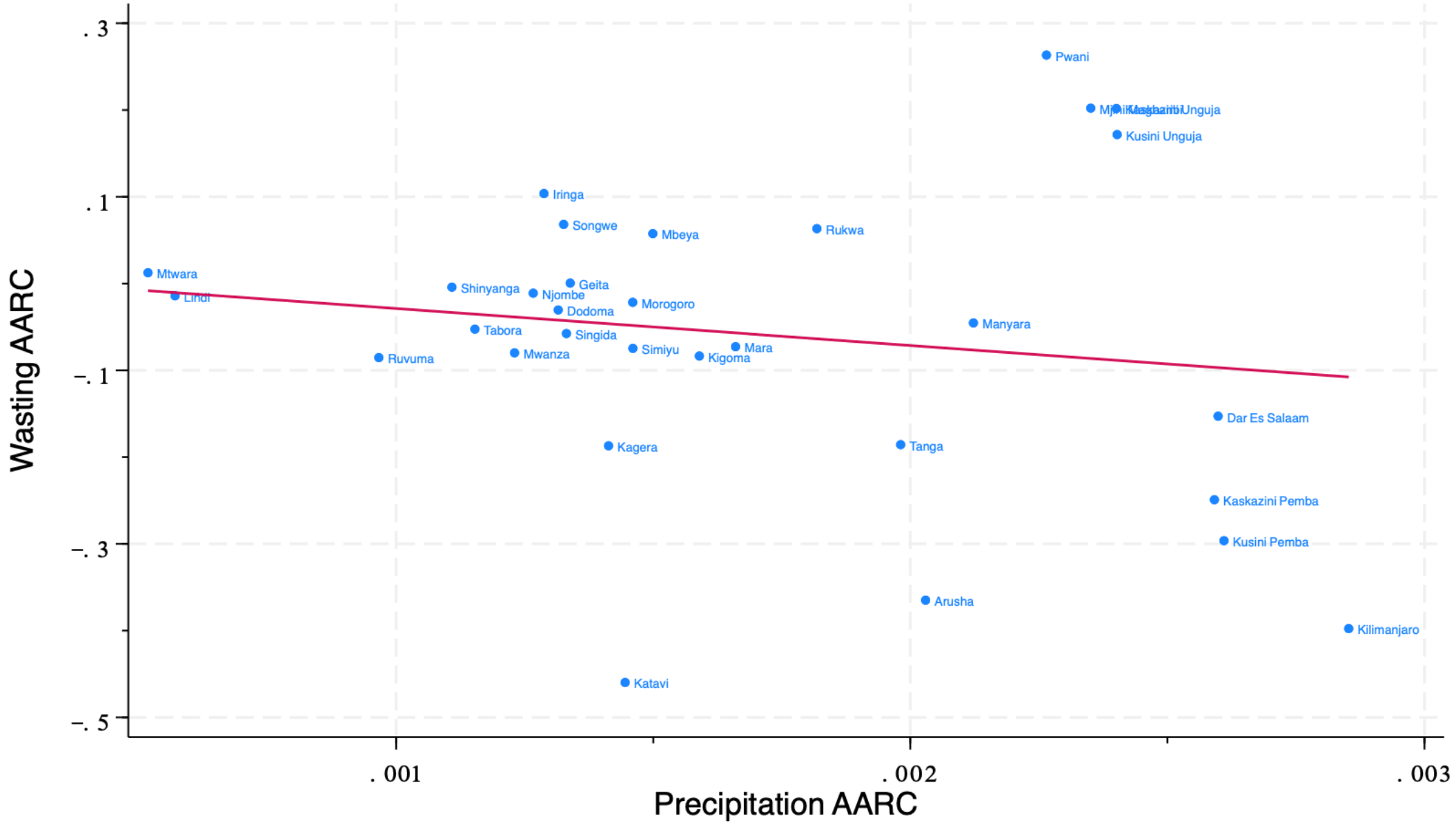
Stunting AARC vs Precipitation AARC from 2000-2020 by Region in Tanzania



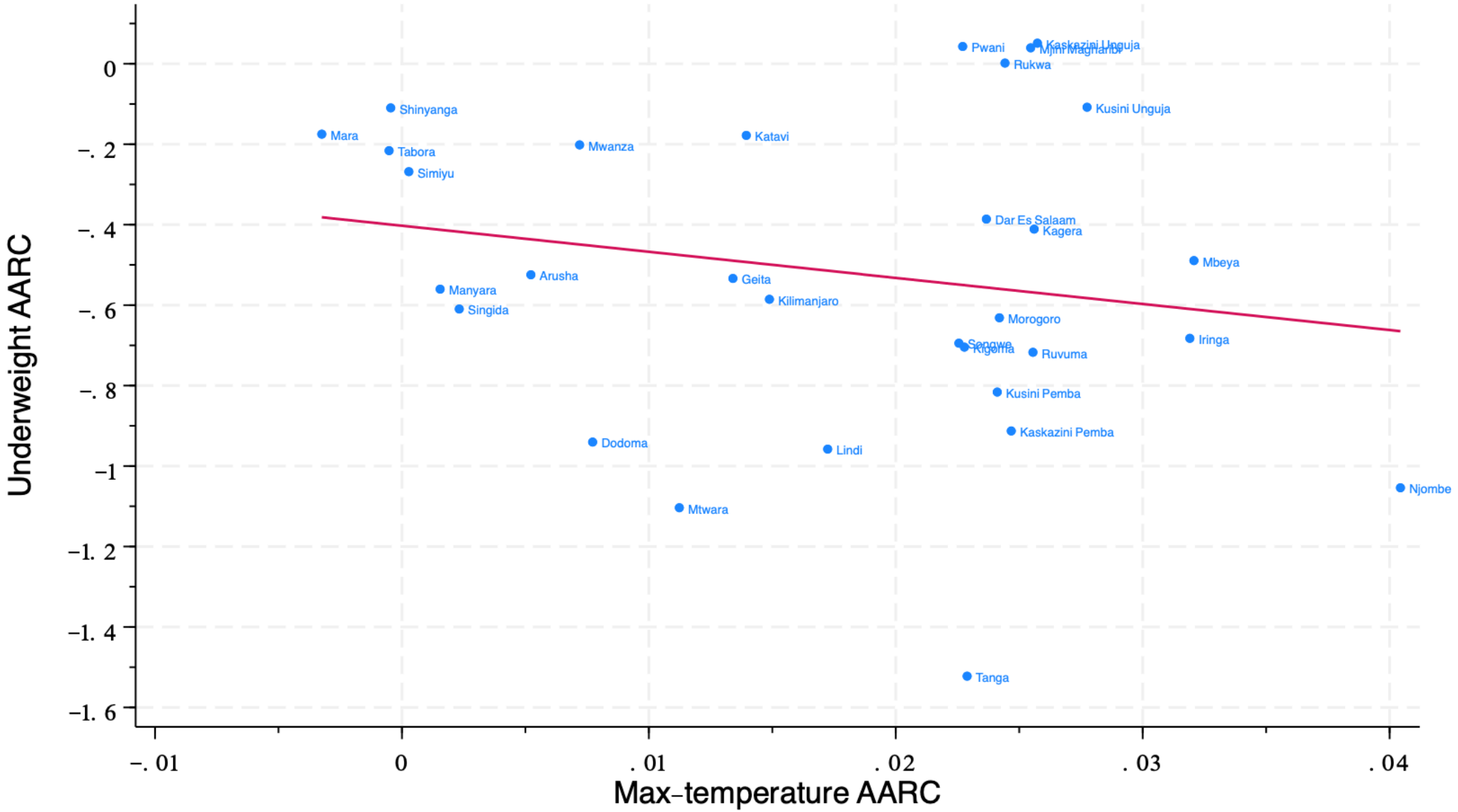
Wasting AARC vs Max Temperature AARC from 2000-2020 by Region in Tanzania



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



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



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