# Impact of Climate Change on One Health Surveillance of Vector-Borne Diseases in West Africa (Senegal and Nigeria)

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## ❑ Current and Future Climate Regime Analysis for Senegal and Nigeria

## ❑ Data Collection and Analysis:

•Collecting and analyzing baseline climate data from 1985 to 2014.
•Calculating trends in temperature and rainfall indices.
•Identifying signals of changes in other relevant climatic variables.

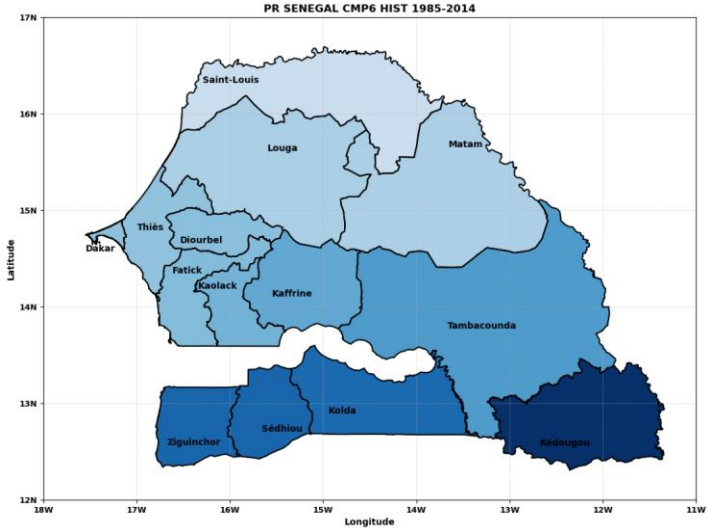
## ❑ Climate Change Impact:

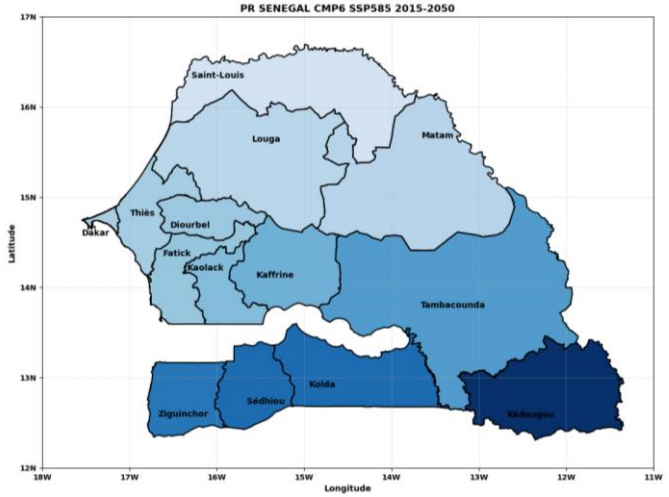
•Illustrating the influence of climate trends on vector-borne diseases, with a focus on malaria by use of Climate Models.
•Testing various models including the Decision Trees (DT), Artificial Neural Networks (ANN) etc. These models are used to evaluate and predict the evolution of various diseases using respective climate driver variables.

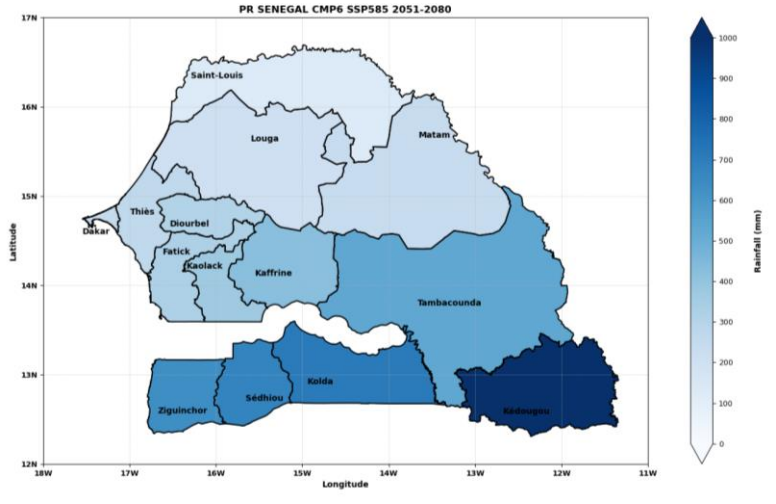
## ❑ Collaboration with Other Experts:

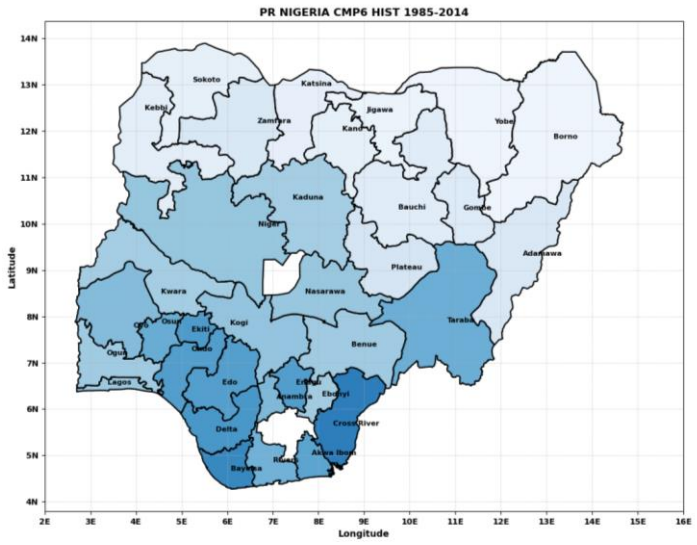
•Providing climate data and analyses tailored to their specific needs.

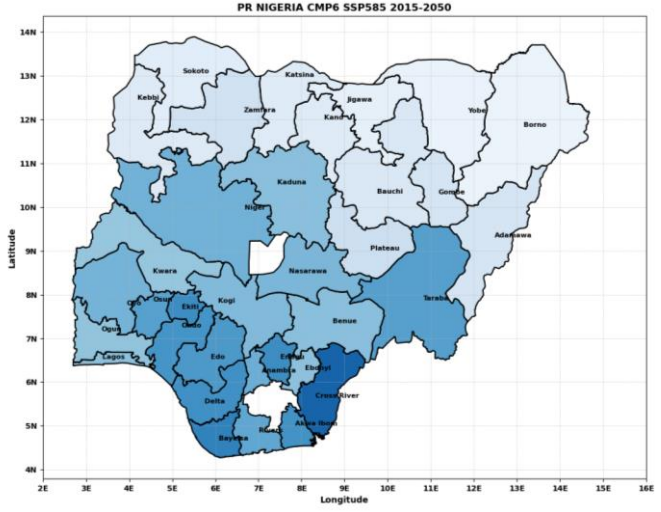
# Current and Projected Changes in Rainfall Patterns in Senegal and Nigeria

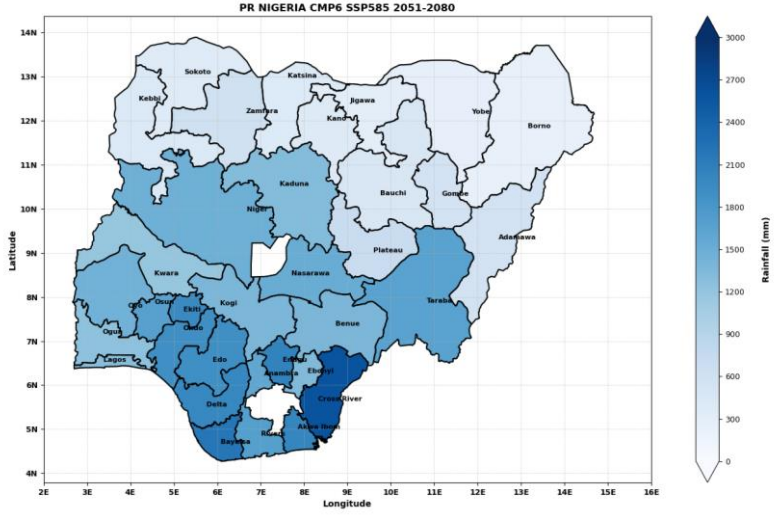



For **Senegal**:

•**Historical Period (1985-2014)**: Analysis reveals significant regional variability in rainfall, with distinct patterns across different areas.

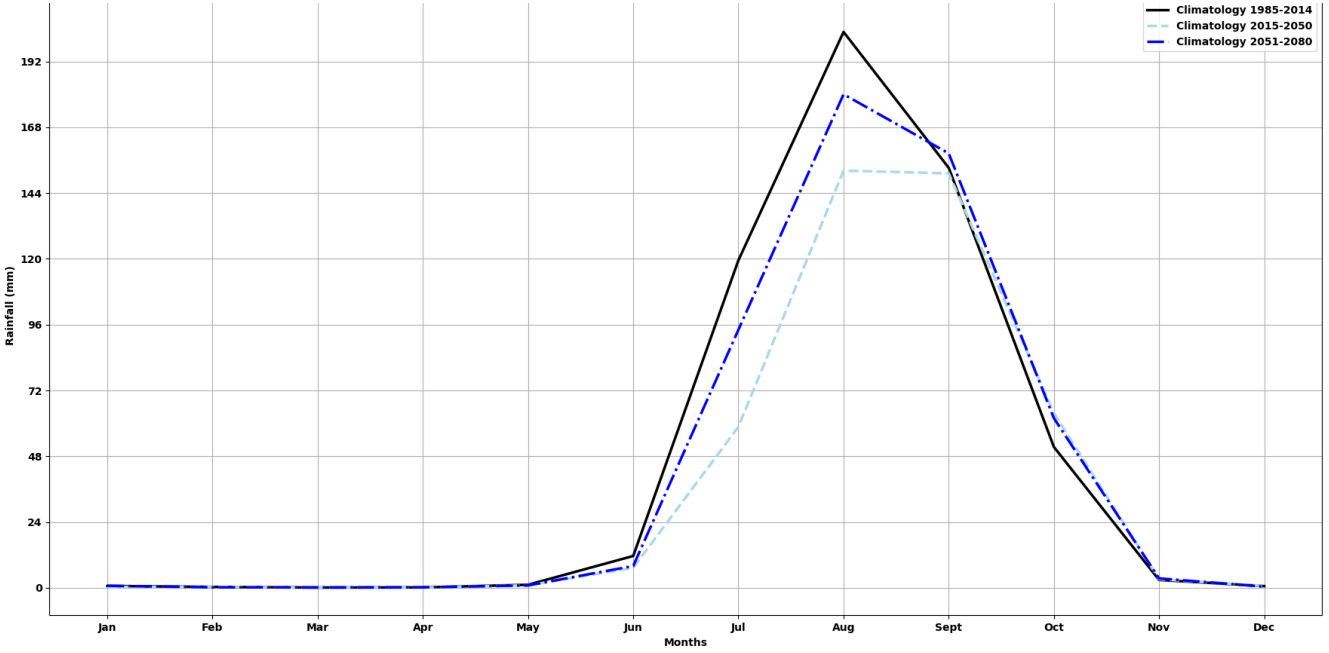
•**Future Projections (SSP5 2015-2050)**: Projections indicate an increase in rainfall, particularly in the southern regions of the country, intensifying the existing north-south disparities.

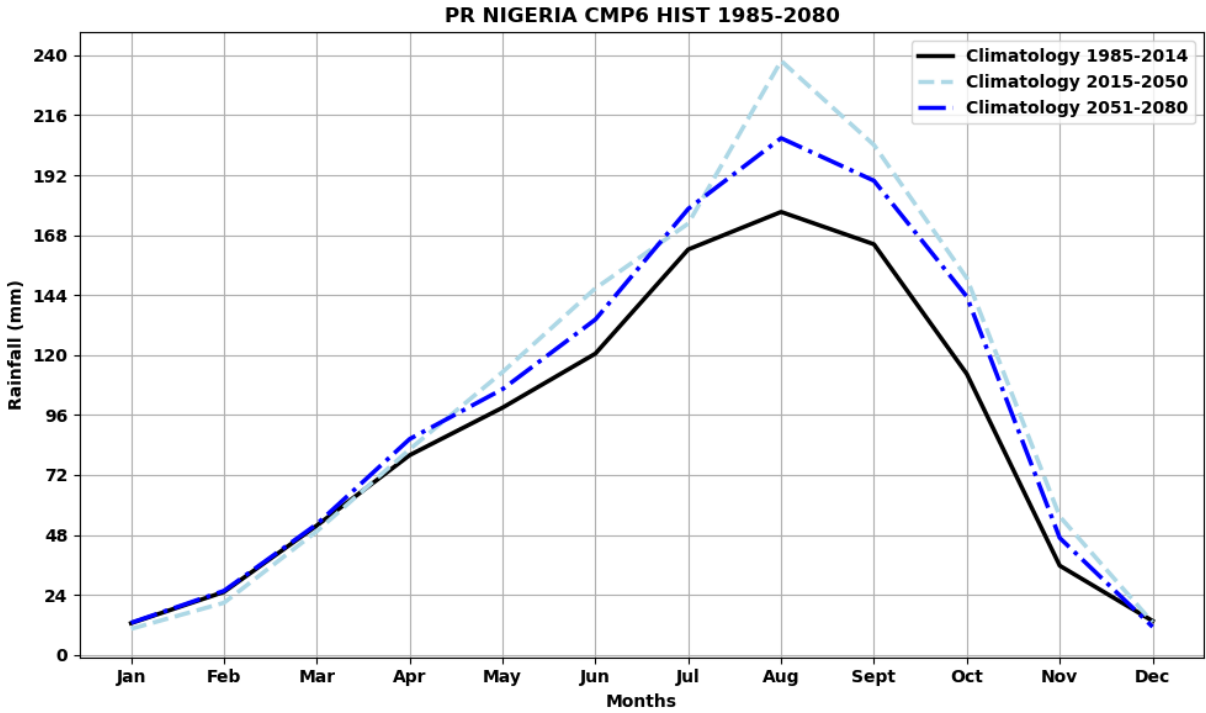
For **Nigeria**:

•**Historical and Future Rainfall Data**: Maps illustrate rainfall data from 1985-2014 alongside projections for 2015-2050 and 2051-2080.

•**Geographic Rainfall Variability**: There is notable regional variation in rainfall, with southern zones consistently receiving higher amounts. Future projections point to increasing rainfall trends, particularly in the northern and southern regions of the country.

# Current and Projected Rainfall Changes in Senegal and Nigeria




For **Senegal**:

•**Decreasing Trends**: Future projections indicate a decrease in overall peak rainfall amounts, suggesting reduced intensity during peak periods.

•**Consistency**: Despite the reduction in peak rainfall, the general trend and pattern of rainfall remain stable over time, with no significant changes in the seasonal distribution.

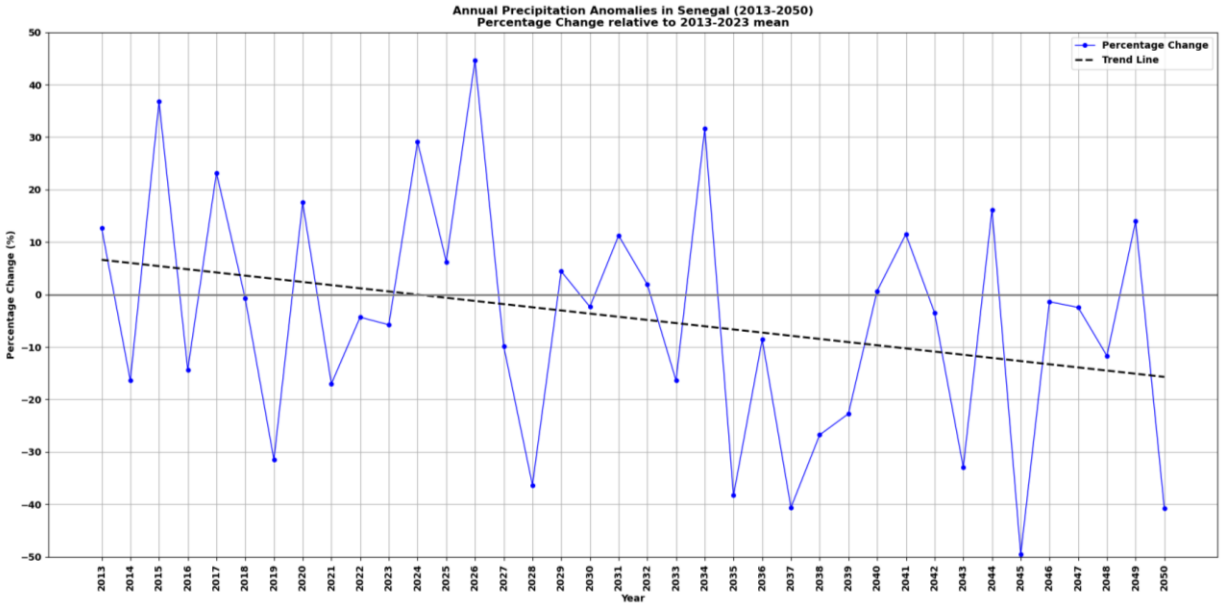
For **Nigeria**:

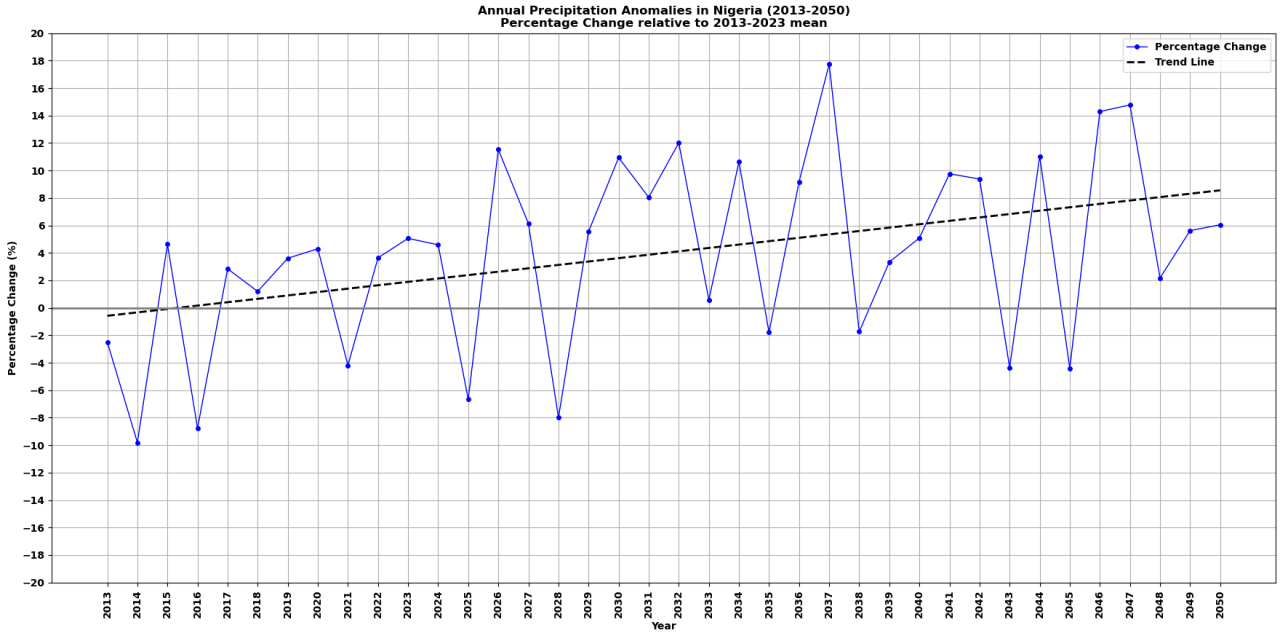
•**Increasing Rainfall**: Projections for 2015-2050 and 2051-2080 show an increase in rainfall compared to historical data from 1985-2014.

•**Peak Shifts**: There are slight shifts in peak rainfall months, with wetter conditions extending into later months.

•**Seasonal Patterns**: The overall seasonal rainfall patterns remain consistent, with typical peaks around August and lower levels during December and January.

# Projected Annual rainfall Anomalies in Senegal and Nigeria (2013-2050)



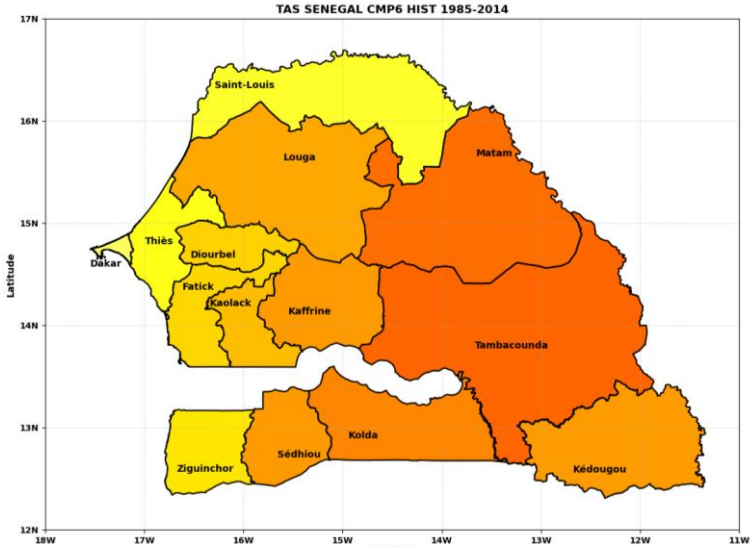

For **Senegal**:

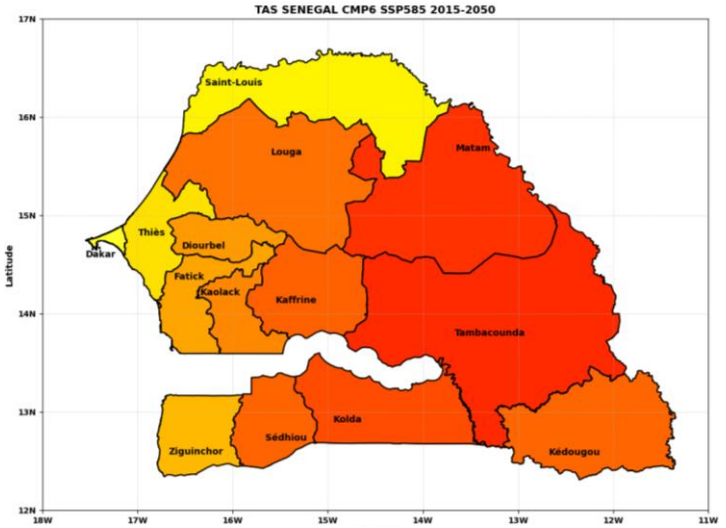
- **Decreasing Trend**: An overall decreasing trend in annual rainfall anomalies is observed.
- **Yearly Variability**: There are significant fluctuations from year to year, indicating high variability in rainfall.
- **Future Projections**: The general downward trend in rainfall is expected to continue, with ongoing variability.

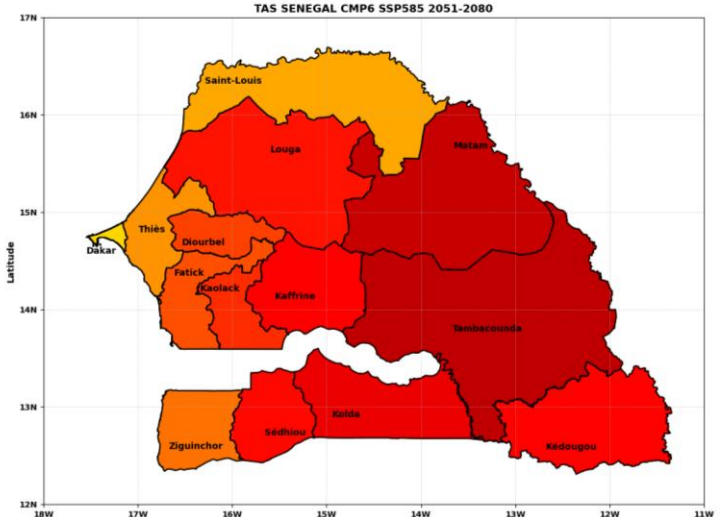
For **Nigeria**:

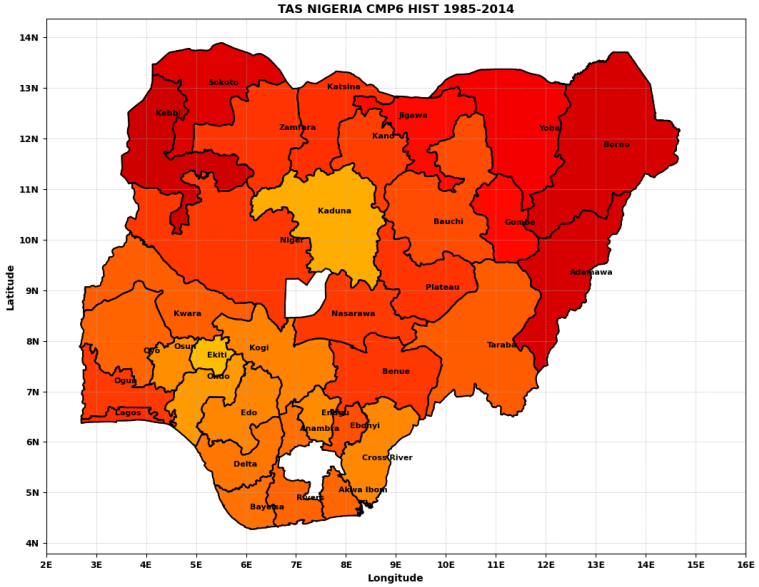
- **Increasing Trend**: rainfall anomalies show a general upward trend compared to the 2013-2023 mean.
- **Variability**: High variability is observed, with significant annual fluctuations in rainfall.
- **Trend Line**: The trend line indicates a gradual increase in percentage change over the years, suggesting a rise in rainfall.

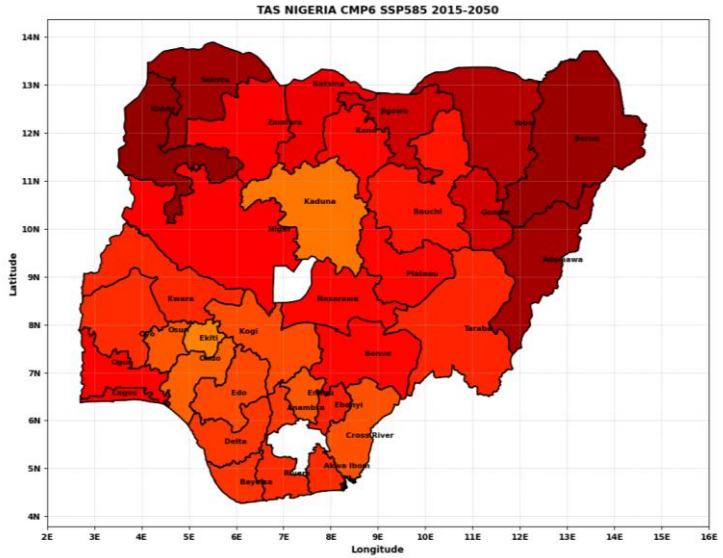
# Current and Projected Changes in Temperature Patterns in Senegal and Nigeria

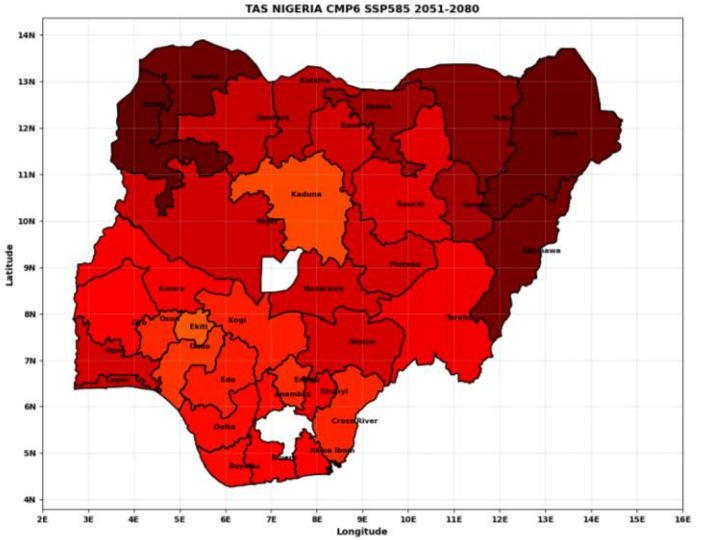


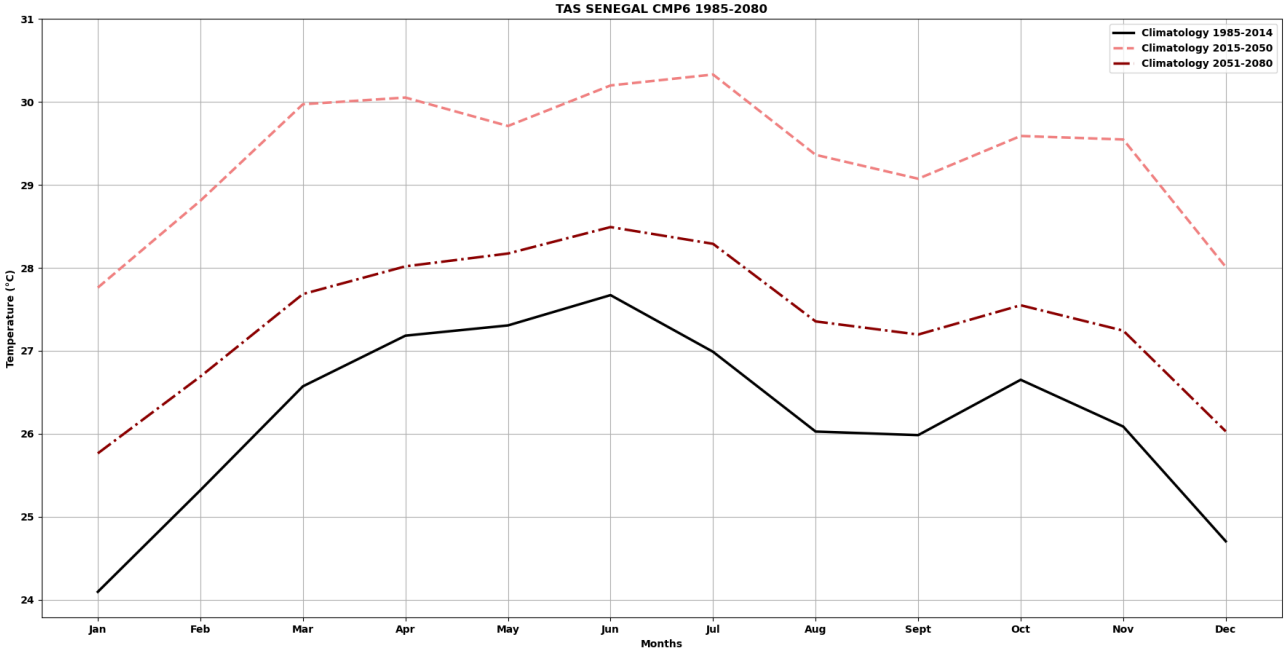

For **Senegal**:

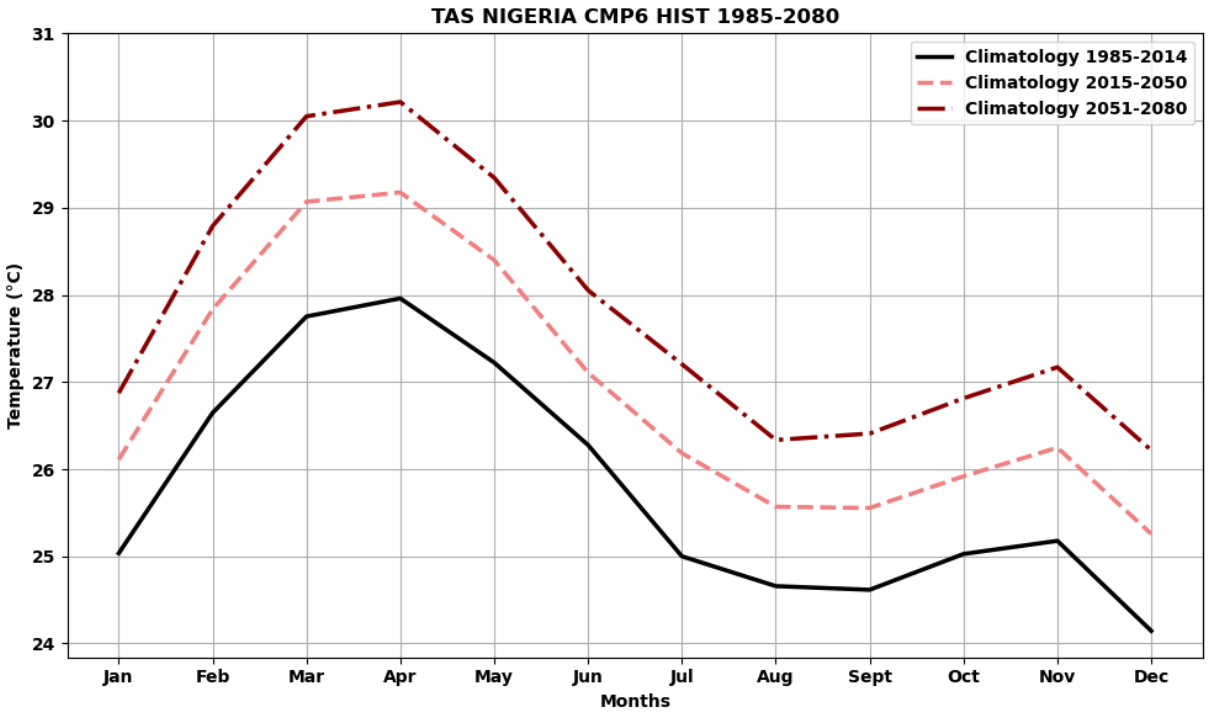
- **Past and Current (1985-2014)**: Eastern Senegal has been warmer, while the northwest has remained cooler.
- **Mid-Century (2015-2050)**: Temperatures are projected to rise across all regions, with notable warming in central and western areas.
- **Late-Century (2051-2080)**: Significant increases are expected, especially in the southern regions, with high temperatures becoming more common.

For **Nigeria**:

- **Historical vs. Projected**: Comparing 1985-2014 data with future projections (2015-2050, 2051-2080), significant warming is expected, particularly in the northern regions.
- **Climate Action**: Urgent strategic planning is needed to mitigate the adverse effects of rising temperatures.

# Current and Projected Temperature Changes in Senegal and Nigeria



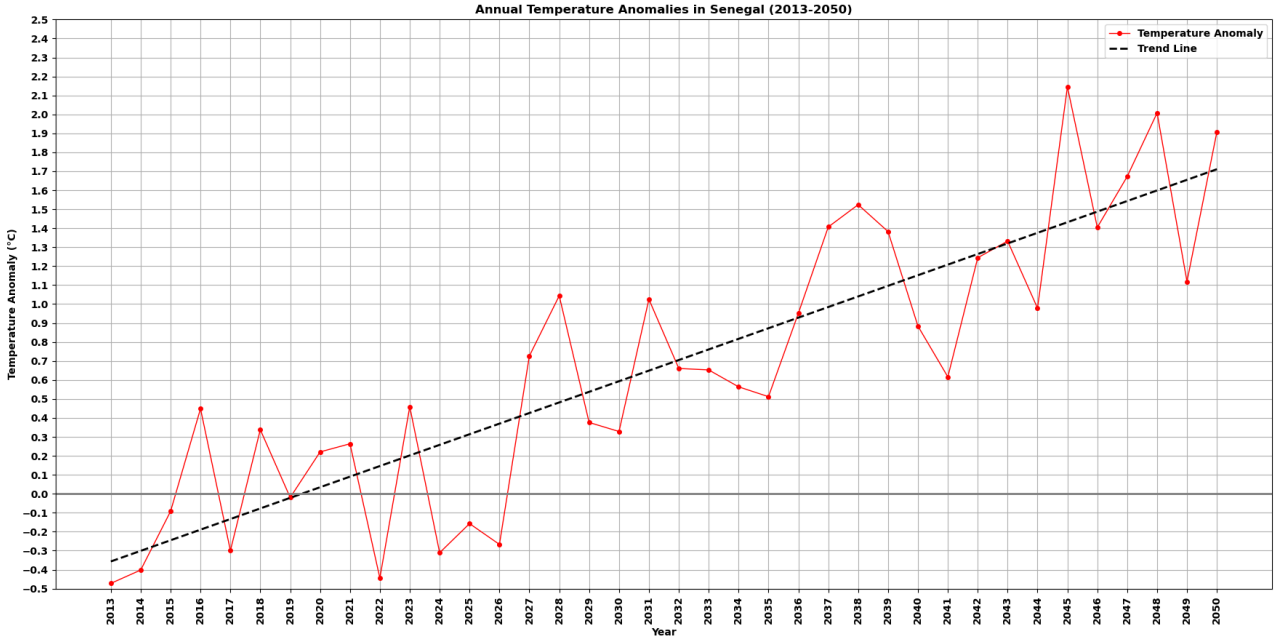

**For Senegal:**

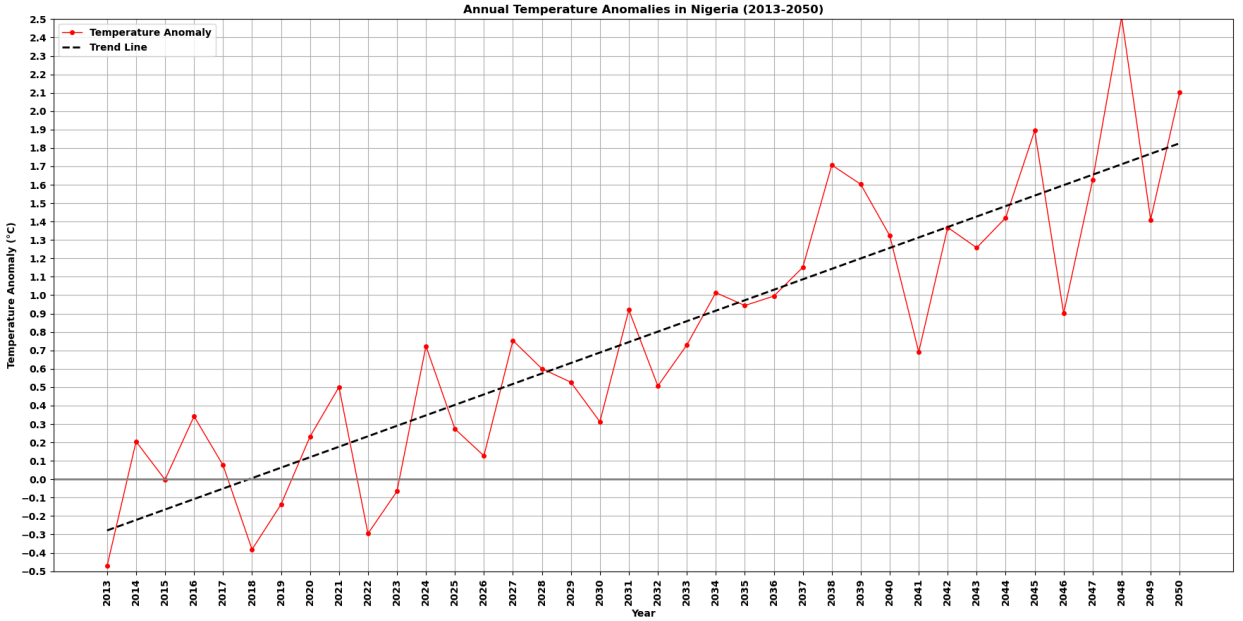
- **Overall Trends:** Significant rise in average temperatures from 1985 to 2080.
- **Mid-21st Century (2015-2050):** Temperatures higher than in the late 20th century (1985-2014).
- **Late 21st Century (2051-2080):** The highest projected temperatures, indicating a continuous upward trend.

**For Nigeria:**

- **Observational Periods:** Data includes 1985-2014 (black), 2015-2050 (dashed red), and 2051-2080 (solid red).
- **Increasing Temperatures:** A noticeable rise in average temperatures across the decades.
- **Seasonal Peaks:** Highest temperatures occur in March-May, with future increases in severity expected.

# Predicted Temperature Trends (1985-2080) for Senegal and Nigeria



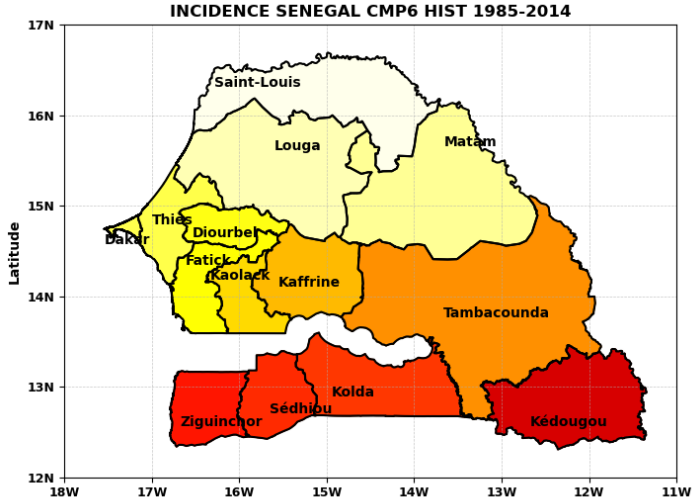

**For Senegal and Nigeria:**

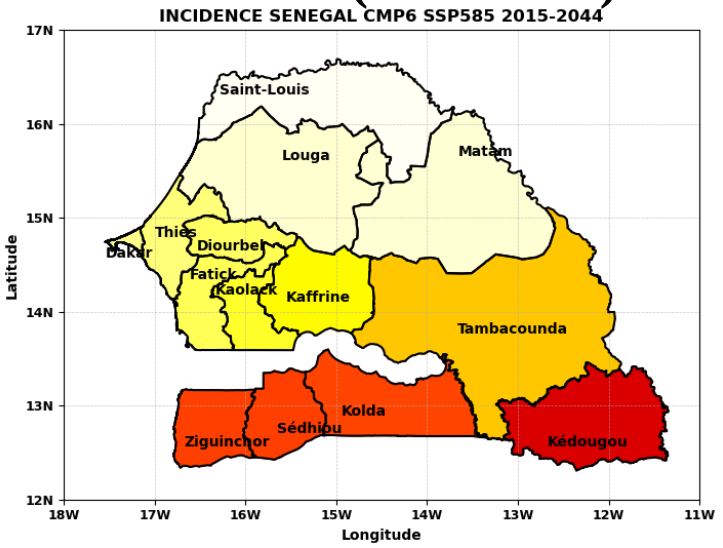
Rising Trend: Both Senegal and Nigeria show a clear upward trend in temperature anomalies from 2013 to 2050.

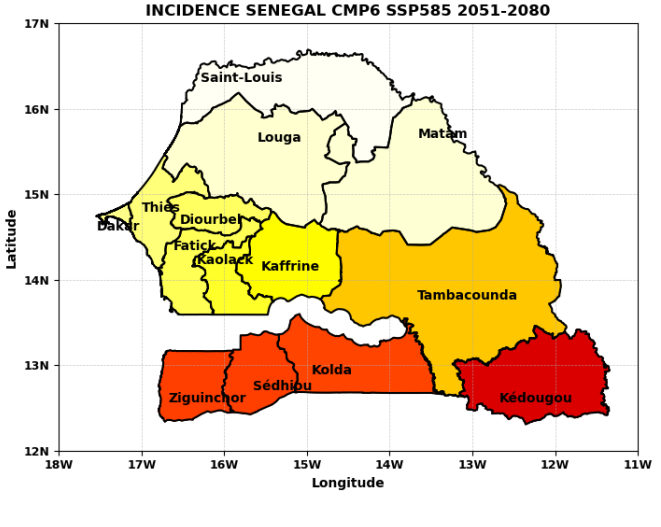
Increased Variability: Year-to-year fluctuations in temperature anomalies are significant in both countries, indicating potential for extreme temperature events.

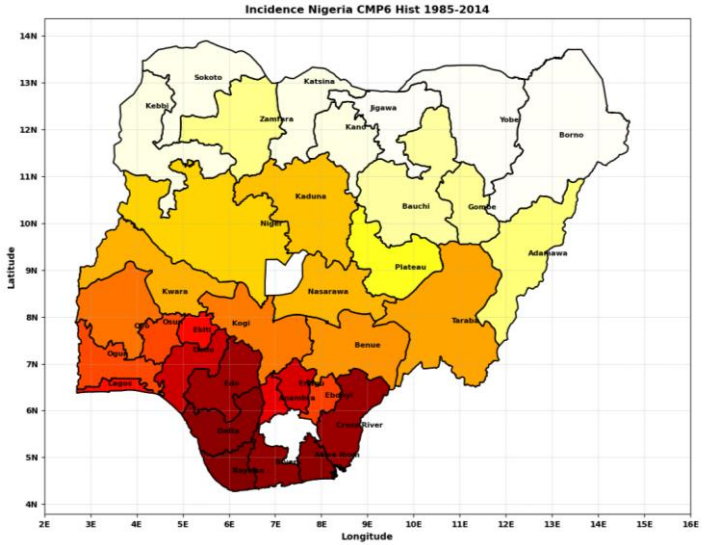
Overall Increase: By 2050, temperature anomalies are projected to rise by up to 1.5°C in Senegal and over 2.0°C in Nigeria, starting from a baseline of approximately -0.2°C in 2013 for Nigeria.

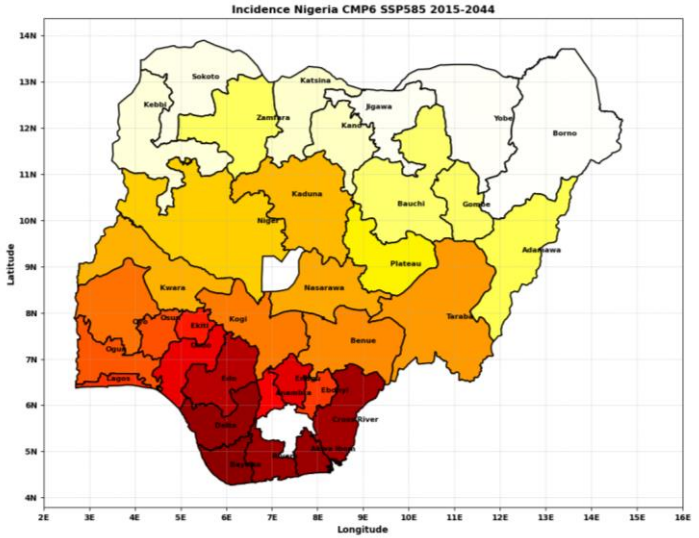
# Projected Trends in Malaria Incidence (1985-2080) for Senegal and Nigeria

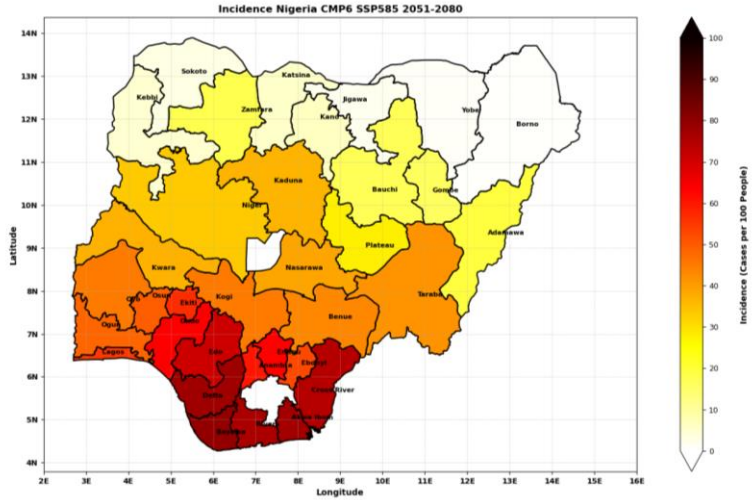



**For Senegal:**

•**Historical (1985-2014):** Highest incidence in southeastern regions, particularly Kédougou; lower incidence in the north.

•**Mid-Term (2015-2044):** Increase in incidence in southeastern regions; stable or slight increases elsewhere.

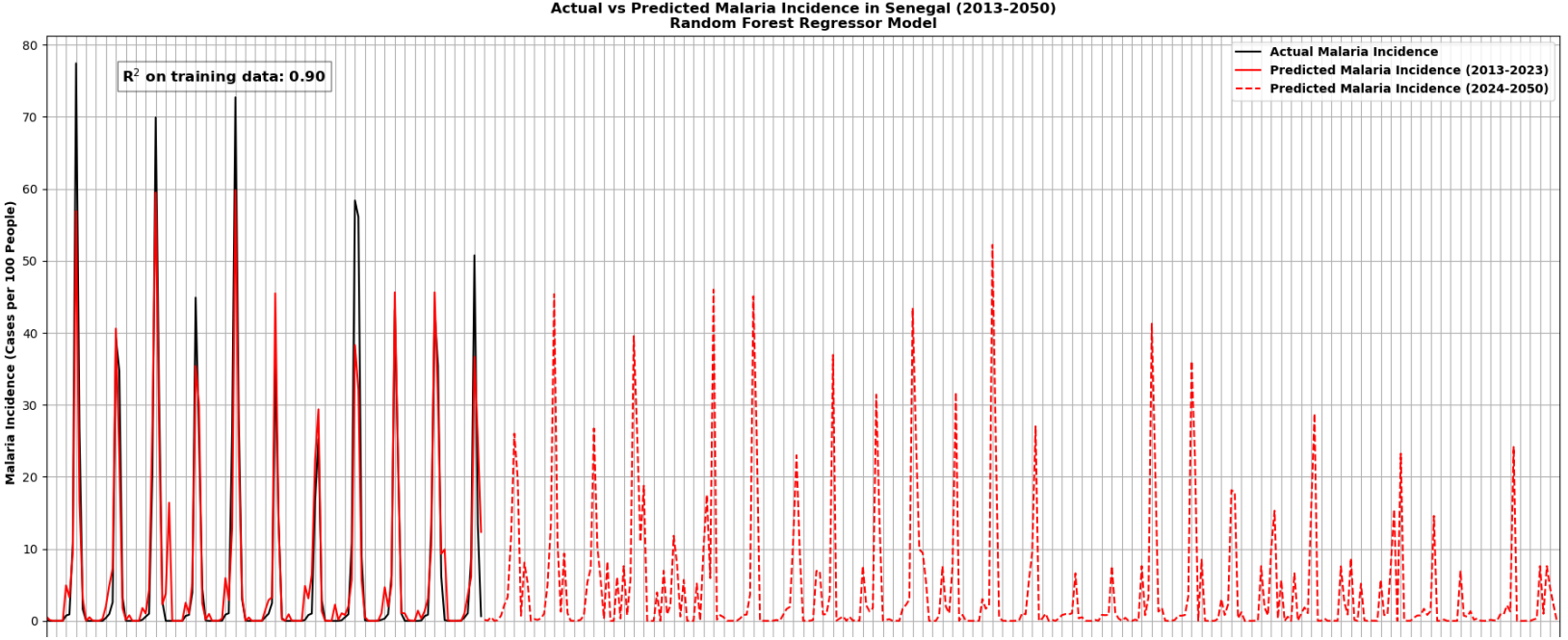
•**Long-Term (2051-2080):** Continued high incidence in the southeast, with a gradual increase in other regions.

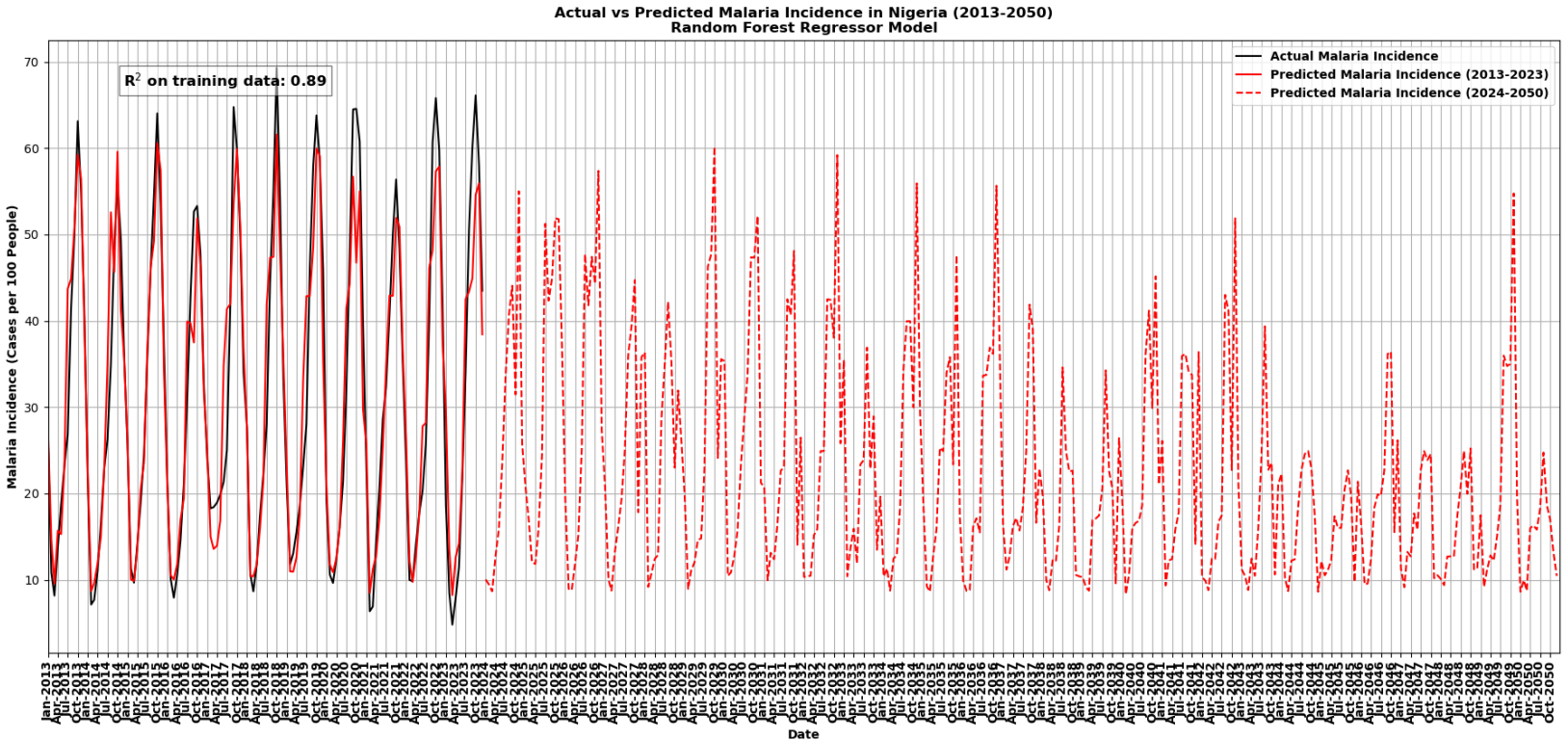
**For Nigeria:**

•**Historical (1985-2014):** High incidence in southern regions, decreasing towards the north.

•**Mid-Term (2015-2044):** Continued high incidence in the south, with spread towards central regions.

•**Long-Term (2051-2080):** Significant spread of high and moderate incidence, affecting nearly the entire country except some northern areas.




# Predicted Malaria Incidence (2013-2050) for Senegal and Nigeria

**Model Accuracy:** Both Senegal and Nigeria show strong prediction accuracy using Random Forest models (Senegal: $R^2 = 0.90$, Nigeria: $R^2 = 0.89$).

**Senegal:** Future projections (2024-2050) indicate periodic peaks in malaria incidence, with a strong alignment between actual data (2013-2023) and model predictions.

**Nigeria:** Projections (2024-2050) suggest continuous fluctuations in malaria incidence, with seasonal peaks and overall trends observed.

# Conclusion on Climate Trends and Disease Impact

**Summary of Findings:**

- Historical climate data analysis (1985-2014) reveals significant variability in rainfall and temperature across Senegal and Nigeria.
- Future projections (2015-2080) indicate a general trend towards increased temperatures and varying rainfall patterns, including an increase in average rainfall in Nigeria but a decrease in Senegal.
- Malaria incidence shows a rising trend in Nigeria, and particularly in southeastern regions of Senegal, influenced by climate variables.
- Accurate Prediction of Malaria Incidence in Senegal (2013-2050): Predictive models have effectively forecasted historical malaria incidence with high accuracy (up to $R^2 = 0.90$), demonstrating strong alignment with actual incidences from 2013 to 2023 and projecting periodic peaks in malaria incidence through 2050.

❑ **Key Insights:**

- Climate change is expected to exacerbate disease dynamics, with implications for public health strategies.
- Southern regions in both countries are projected to experience more pronounced climate impacts, including increased rainfall and higher temperatures.
- Effective mitigation strategies must integrate climate data to anticipate and respond to disease outbreaks.

❑ **Implications:**

- Urgent need for adaptive healthcare policies to address escalating disease burdens in vulnerable regions.
- Collaboration across sectors is crucial for implementing climate-resilient health interventions.
- Continued monitoring of climate and disease trends is essential for proactive health management.

# Perspectives

- **Extension to other vector-borne diseases**
  - Explore applying our predictive approach to other diseases such as dengue, adapting the necessary predictive variables.
- **Geographical expansion**
  - Extend our model to other geographical areas to assess the impact of climate change on public health at regional or global scales.
- **Integration of additional data**
  - Incorporate additional climate and environmental data to refine predictions and enhance resilience to vector-borne diseases.
- **Interdisciplinary collaborations**
  - Foster collaborations with experts in public health, climatology, and ecology for a holistic approach to modeling and forecasting.
- **Education and awareness**

Enhance community awareness and education on the impacts of climate change on the spread of vector-borne diseases and adaptation strategies.

# THANK YOU FOR YOUR ATTENTION