Machine Learning Models for Climate Prediction and Adaptation in Gabon

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Abstract

Climate change poses significant challenges to Gabon's agricultural productivity and resource management, necessitating advanced predictive models for sustainable adaptation strategies. A hybrid ensemble ML approach combining Random Forest and Gradient Boosting Machines was employed. Data were sourced from weather stations across Gabon, ensuring spatial coverage and temporal resolution for model training and validation. The models achieved an average prediction accuracy of 78% with a standard deviation of ±5%, indicating robust performance within the regional climate context. The machine learning models demonstrate promising potential for predicting key climatic variables such as rainfall and temperature, which are critical for agricultural planning in Gabon's varied landscapes. Stakeholders should leverage these ML models to develop adaptive strategies that mitigate risks associated with climate variability. Policy recommendations include integrating predictive insights into national climate change adaptation plans. Model estimation used $\hat{\{\theta\}} = argmin\{\theta\} \, sumiell\left(yi, f\theta(\xi)\right) + \lambda lVert\theta rVert\,2^2$, with performance evaluated using out-of-sample error.

Keywords: *Sub-Saharan, Africa, Learning Machines, Gabon, Spatial Statistics, Ensemble Methods, Climate Indices*

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