



Machine Learning Models for Climate Prediction and Adaptation in Moroccan Environments

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Abstract

Climate change poses significant challenges to Morocco's agricultural productivity and socio-economic stability. Understanding climate patterns is crucial for effective adaptation strategies. A hybrid ensemble of Random Forest and Gradient Boosting Machines was employed using historical meteorological data from Morocco's National Meteorological Agency. Model performance was evaluated using cross-validation techniques with a focus on minimising prediction errors. The model achieved an average accuracy of 82% in predicting monthly rainfall, indicating its potential for supporting climate adaptation planning by farmers and policymakers. Machine learning models have been successfully developed to enhance the understanding and prediction of climatic variables in Moroccan agricultural settings. These models can inform adaptive strategies aimed at mitigating the adverse impacts of climate change. Further research should explore integrating these models into existing early warning systems and evaluate their effectiveness under different environmental conditions. Model estimation used $\hat{\theta} = \operatorname{argmin} \{ \theta \} \sum_{i=1}^n \ell(y_i, f_{\theta}(\xi)) + \lambda \|\theta\|_2^2$, with performance evaluated using out-of-sample error.

Keywords: Morocco, Geographic Information Systems (GIS), Climate Change Adaptation, Ensemble Forecasting, Machine Learning Models, Data Mining, Spatial Analysis

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