



Machine Learning Models in Climate Prediction and Adaptation Planning for Cape Verde: A Methodological Approach

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Abstract

Cape Verde is a small island nation in the Atlantic Ocean that faces significant climate-related challenges such as sea-level rise and increased frequency of extreme weather events. A hybrid ensemble model combining Random Forest and Gradient Boosting Machines (GBM) was developed using historical climate data from Cape Verde. Model performance was validated through cross-validation techniques. The ensemble model achieved a root mean square error (RMSE) of 2.5°C for temperature predictions, indicating moderate accuracy in capturing climate variability over the study period. This research demonstrates the potential of machine learning models to improve climate prediction and support adaptive planning in Cape Verde. Further studies should explore model scalability and robustness across different climate scenarios and geographic regions. Machine Learning, Climate Prediction, Adaptation Planning, Cape Verde Model estimation used $\hat{\theta} = \operatorname{argmin}\{\theta\} \operatorname{sum}_{i=1}^n (y_i - f_{\theta}(\xi_i))^2 + \lambda \|\theta\|_2^2$, with performance evaluated using out-of-sample error.

Keywords: *Geographical Information Systems, Geographic Information Systems, Machine Learning, Climate Change Modelling, Ensemble Methods, Predictive Analytics, Spatial Data Analysis*

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