Assessing the Impact of Atmospheric CO_2 Concentrations on Rainfall Patterns

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I certify that I have read this thesis and that in my opinion it is fully adequate, in scope and in quality, as a thesis for the degree of Master of Science.

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DECLARATION

This is to certify that the work is entirely my own and not of any other person, unless explicitly acknowledged (including citation of published and unpublished sources). The work has not previously been submitted in any form to the Sri Lanka Institute of Information Technology or to any other institution for assessment for any other purpose.

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ABSTRACT

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MSc. In Information Technology

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This research aims to assess the impact of atmospheric CO_2 concentrations on rainfall patterns, focusing on the relationship between key environmental parameters such as temperature, humidity, wind speed, wind direction, atmospheric pressure, and rainfall. Data were collected over 17 months, including CO_2 data sourced from the National Building Research Organization (NBRO) in Colombo and additional CO_2 measurements captured via MG811 CO2 sensor. Environmental data such as temperature, humidity, wind speed, wind direction, and pressure were obtained from the Sri Lanka Meteorological Department, ensuring a comprehensive dataset for analysis. Machine learning algorithms, including Random Forest, XGBoost, and LSTM, were employed to develop predictive models for rainfall based on the collected data. The performance of these models was evaluated using various metrics like Root Mean Squared Error (RMSE), Mean Absolute Error (MAE), and R-squared values. Results indicate that incorporating CO_2 data improves model performance, particularly with the Random Forest model, which demonstrated the lowest error rates and highest predictive reliability when CO_2 was included as a feature. The findings underscore the importance of considering atmospheric CO_2 in climate modeling, revealing that CO_2 levels may have a more complex and region-specific influence on rainfall than previously recognized. This enhanced forecasting approach has significant implications for various sectors in Sri Lanka, including agriculture, aviation, and fisheries, where accurate rainfall predictions are critical for planning and resource management. The study's outcomes are especially relevant for policymakers and environmental stakeholders, as they highlight the potential for data-driven strategies to mitigate climate impacts and promote sustainable development practices. Additionally, the research contributes to the academic discourse on climate dynamics, offering valuable insights for future studies and serving as a foundation for educational initiatives in environmental science and meteorology.

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TABLE OF CONTENTS

List of Figures

List of Tables