154. Development of Machine Learning model for estimation of spatial distribution of particulate matter pollutant in air

Alex Mwololo Kimuya[1]*, Daniel Memeu Maitethia[1] and Dickson Mwenda Kinyua[1]

[1]Department of Physical Sciences, Meru University of Science and Technology.

Corresponding author's e-mail: alexkimuya23@gmail.com

Subtheme: Pure and Applied Sciences for Climate Action

Abstract

Creating accurate air pollution maps is crucial for environmental health monitoring. However, traditional sensor systems provide limited information, offering only single-point, instantaneous readings. This research investigates a novel approach to address this limitation. We propose a machine learning-based system to predict the spatial distribution of particulate matter (PM) across a region using data from a sparse network of sensors. The system collects data on various factors, including PM concentrations (PM1.0, PM2.5, PM10), weather parameters (wind speed, temperature, humidity), and spatial information (longitude, latitude). We explore the effectiveness of Long Short-Term Memory, Artificial Neural Networks (ANNs), Support Vector Regression, and Random Forest models. Our findings reveal that ANNs outperform other models in terms of accuracy and consistency across all feature combinations surpassing 75% threshold, particularly within a 160-meter radius of a central sensor. Furthermore, the inclusion of weather parameters and feature engineering significantly improve model performance, leading to enhanced generalization and lower error rates for all PM types. This study paves the way for a new paradigm in particulate matter sensor design, one that overcomes the limitations of single-point measurements. Additionally, it underscores the importance of incorporating weather data into machine learning models for accurate spatial distribution prediction of air pollutants.

Keywords: *Air pollution, Particulate matter (PM), Air quality sensors, Environmental parameters, Spatial distribution*