World Academy of Science, Engineering and Technology
International Journal of Environmental and Ecological Engineering
Vol:18, No:04, 2024

Investigating the performance of machine learning models on PM2.5 forecasts: A case study in the city of Thessaloniki

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Abstract : The air quality of modern cities is an important concern, as poor air quality contributes to human health and environmental issues. Reliable air quality forecasting has, thus, gained scientific and governmental attention as an essential tool that enables authorities to take proactive measures for public safety. In this study, the potential of Machine Learning (ML) models to forecast PM2.5 at local scale is investigated in the city of Thessaloniki, the second largest city in Greece, which has been struggling with the persistent issue of air pollution. ML models, with proven ability to address timeseries forecasting, are employed to predict the PM2.5 concentrations and the respective Air Quality Index 5-days ahead by learning from daily historical air quality and meteorological data from 2014 to 2016 and gathered from two stations with different land use characteristics in the urban fabric of Thessaloniki. The performance of the ML models on PM2.5 concentrations is evaluated with common statistical methods, such as R squared (r^2) and Root Mean Squared Error (RMSE), utilizing a portion of the stations' measurements as test set. A multi-categorical evaluation is utilized for the assessment of their performance on respective AQIs. Several conclusions were made from the experiments conducted. Experimenting on MLs' configuration revealed a moderate effect of various parameters and training schemas on the model's predictions. Their performance of all these models were found to produce satisfactory results on PM2.5 concentrations. In addition, their application on untrained stations showed that these models can perform well, indicating a generalized behavior. Moreover, their performance on AQI was even better, showing that the MLs can be used as predictors for AQI, which is the direct information provided to the general public.

Keywords : Air Quality, AQ Forecasting, AQI, Machine Learning, PM2.5
Conference Title : ICUAQMAE 2024 : International Conference on Urban Air Quality Management and Environment
Conference Location : Athens, Greece
Conference Dates : April 04-05, 2024