Predicting Particulate Matter (PM_{10}) Levels in Morocco: A 5-Day Forecast Using the Analog Ensemble Method

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Abstract

Accurate prediction of Particulate Matter (PM_{10}) levels, an indicator of natural pollutants such us those resulting from dust storms, is crucial for public health and environmental planning. This study aims to provide accurate forecasts of PM_{10} over Morocco for five days. The Analog Ensemble (AnEn) technique was employed to postprocess PM_{10} forecasts produced by the Copernicus Atmosphere Monitoring Service (CAMS) global atmospheric composition forecasts, using CAMS reanalysis data as a reference. Seven variables from the forecasts are used as predictors alongside PM_{10}. Additionally, bias correction technique (AnEnBc) was applied to enhance AnEn's performance for rare events. The results shows substantial prediction improvements: the Root Mean Square Error (RMSE) decreased from 63.83 $\mu g/m^3$ in the original forecasts to 44.73 $\mu g/m^3$ with AnEn and AnEnBc, while the Mean Absolute Error (MAE) reduced from 36.70 $\mu g/m^3$ to 24.30 $\mu g/m^3$. Additionally, the coefficient of determination (R2) increased more than two folds from 29.11% to 65.18%, and the Pearson correlation coefficient increased from 0.61 to 0.82. The integrating reanalysis data and the utilization of the AnEn substantially improved the accuracy of PM_{10} 5-day forecasting in Morocco. This is the first use of this approach for Morocco and the Middle East and North Africa and has the potential for translation into early and more accurate warning of PM_{10} pollution events. The application of such approaches into environmental policies and public health decision making can minimize air pollution health impacts.

Early Career Scientist

YES, I am an early career scientist.