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The Improvement of Spatial-Temporal PM2.5 Resolution in Taiwan by Using Data Assimilation Method

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Forecasting air pollution concentration, e.g., the concentration of PM2.5, is of great significance to protect human health and the environment. Accurate prediction of PM2.5 concentrations is limited in number and the data quality of air quality monitoring stations. The spatial and temporal variations of PM2.5 concentrations are measured by 76 National Air Quality Monitoring Stations (built by the TW-EPA) in Taiwan. The National Air Quality Monitoring Stations are costly and scarce because of the highly precise instrument and their size. Therefore, many places still out of the range of National Air Quality Monitoring Stations. Recently, there are an enormous number of portable air quality sensors called "AirBox" developed jointly by the Taiwan government and a private company. By virtue of its price and portative, the AirBox can provide higher resolution of space-time PM2.5 measurement. However, the spatiotemporal distribution and data quality are different between AirBox and National Air Quality Monitoring Stations. To integrate the heterogeneous PM2.5 data, the data assimilation method should be performed before further analysis.
In this study, we propose a data assimilation method based on Ensemble Kalman Filter (EnKF), which is a variant of classic Kalman Filter, can be used to combine additional heterogeneous data from different source while modeling to improve the estimation of spatial-temporal PM2.5 concentration. The assimilation procedure uses the advantages of the two kinds of heterogeneous data and merges them to produce the final estimation. The results have shown that by combining AirBox PM2.5 data as additional information in our model based EnKF can bring the better estimation of spatial-temporal PM2.5 concentration and improve the it's space-time resolution. Under the approach proposed in this study, higher spatial-temporal resoultion could provide a very useful information for a better spatial-temporal data analysis and further environmental management, such as air pollution source localization and micro-scale air pollution analysis.

Keywords: PM2.5, Data Assimilation, Ensemble Kalman Filter, Air Quality