The Hong Kong University of Science and Technology

Department of Mathematics

MPhil THESIS EXAMINATION

Spatial and Temporal Bias Correction in Air Quality Models Using Station Spatial Representativeness

By

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ABSTRACT

Air pollution is one of the biggest threats to public health, and so air quality health studies are in urgent need. To capture the spatial variations of air pollutions in health studies, one approach is to use the concentration fields generated by air quality models. However, models have their systematic bias. Without correcting, the modeled air quality concentrations may lead to incorrect relationships with human health. It is thus crucial for air quality models to undergo bias correction. Common bias correction methods include constant correction and deep learning methods. However, using a single value throughout the domain may fail to capture the spatial variations, while deep learning methods often require auxiliary data. At the same time, station representativeness had been shown to be capable of capturing the spatial pattern of air quality models. This study proposes a spatial bias correction algorithm incorporating station spatial representativeness that uses only model outputs and observations. This correction scheme was implemented in the Atmospheric Dispersion Modelling System (ADMS) and Community Multiscale Air Quality Modelling System (CMAQ) air pollution models. Performance of the current hour spatial bias correction on pollutants NO2, O3, PM2.5 and PM10, was evaluated over January, April, July and October in 2024. Averaging over 18 stations in ADMS, the bias correction scheme achieved leave-one-out indices of agreement (IOA) of 0.827, 0.945, 0.945, 0.944 for NO2, O3, PM2.5 and PM10, respectively, at the current hour, with slightly lower average IOAs in CMAQ. The spatial bias correction algorithm was then coupled with a temporal forecasting algorithm to perform bias correction in model forecasts over October, 2024. The temporal correction maintained an average IOA of around 0.7 up to forecast hour 3.

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Time : 9:00 am

Venue : Room 4503 (Lifts 25-26)

Thesis Examination Committee

Chairman	**:**	**Prof. Shing Yu LEUNG, MATH /HKUST**
Thesis Supervisor	**:**	**Prof. Jimmy Chi Hung FUNG, MATH/HKUST**
Member	**:**	**Prof. Kai Hon Alexis LAU, ENVR/HKUST**

(Open to all faculty and students)

The student's thesis is now being displayed on the reception counter in the General Administration Office (Room 3461).