APPLICATION OF SPATIO-TEMORAL REGRESSION MODEL ACCOUNTING FOR ASIAN DUST (DESERT DUST) TO REGULATORY AIR QUALITY DATA IN JAPAN

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Background and Aims: A 2-stage spatio-temporal regression model has been developed for predicting pollutants, although its application has been limited to western countries. Moreover, most of the models utilized only meteorological factors as the temporal predictors. In Asian countries, Asian dust originating from the desert of Mongolia or China should be considered as an additional temporal predictor since some polluted events due to Asian dust has been reported. Thus, we created the spatio-temporal model accounting for the temporal variation of Asian dust in Hiroshima, Japan.

Methods: We used the monthly-mean nitrogen dioxide (NO_2), sulfur dioxide (SO_2), photochemical oxidant (O_x), and suspended particulate matter (SPM) concentrations between 2005 to 2010. We also obtained the daily Asian dust concentration by Light Detection And Ranging in Matsue. First, we selected spatio-predictors including road type, traffic intensity, land use, and physical component by using land use regression model. Next, we constructed a 2-stage spatio-temporal model including meteorological predictors to predict the monthly-level each pollutant. Then we added the Asian dust concentration as an additional temporal-variable into the models.

Results: The mean concentrations of NO_2, SO_2, O_x, and SPM were 17.2ppb, 3.7ppb, 27.5ppb, and 28.1μg/m^3, respectively. The mean concentration of Asian dust (120m-150m height from the ground) was 30.1μg/m^3. The correlation between each pollutant and Asian dust were 0.18, 0.24, 0.39, and 0.32, respectively. R^2 for NO_2 was 0.85 in the spatio-temporal regression model and 0.84 in Asian-dust model, respectively. R^2 of other pollutants were also greatly improved after introducing temporal-predictors as well as Asian dust, e.g. R^2 for the SO_2, O_x, and SPM was 0.83, 0.91, and 0.86 in Asian-dust model, respectively.

Conclusions: This result suggests that pollutants could be predicted moderately well by the spatio-temporal model even in Asian countries. Further studies which examine the role of the Asian dust would be required.