Geophysical Research Abstracts
Vol. 18, EGU2016-5246, 2016
EGU General Assembly 2016

Estimating ground-level $PM_{2.5}$ concentrations over three megalopolises in China using satellite-derived aerosol optical depth measurements

Yixuan Zheng (1), Qiang Zhang (1), Yang Liu (2), Guannan Geng (1,3), and Kebin He (3)

(1) Ministry of Education Key Laboratory for Earth System Modeling, Center for Earth System Science, Tsinghua University, Beijing 100084, People's Republic of China, (2) Department of Environmental Health, Rollins School of Public Health, Emory University, Atlanta, GA 30322, USA, (3) State Key Joint Laboratory of Environment Simulation and Pollution Control, School of Environment, Tsinghua University, Beijing 100084, People's Republic of China

Numerous previous studies have revealed that statistical models which combine satellite-derived aerosol optical depth (AOD) and $PM_{2.5}$ measurements acquired at scattered monitoring sites provide an effective method for deriving continuous spatial distributions of ground-level $PM_{2.5}$ concentrations. Using the national monitoring networks that have recently been established by central and local governments in China, we developed linear mixed-effects (LMEs) models that integrate Moderate Resolution Imaging Spectroradiometer (MODIS) AOD measurements, meteorological parameters, and satellite-derived tropospheric NO_2 column density measurements as predictors to estimate $PM_{2.5}$ concentrations over three major industrialized regions in China, namely, the Beijing-Tianjin-Hebei region (BTH), the Yangtze River Delta region (YRD), and the Pearl River Delta region (PRD). The models developed for these three regions exploited different predictors to account for their varying topographies and meteorological conditions. Considering the importance of unbiased $PM_{2.5}$ predictions for epidemiological studies, the correction factors calculated from the surface $PM_{2.5}$ measurements were applied to correct biases in the predicted annual average $PM_{2.5}$ concentrations introduced by non-stochastic missing AOD measurements. Leave-one-out cross-validation (LOOCV) was used to quantify the accuracy of our models. Cross-validation of the daily predictions yielded R^2 values of 0.77, 0.8 and 0.8 and normalized mean error (NME) values of 22.4%, 17.8% and 15.2% for BTH, YRD and PRD, respectively. For the annual average $PM_{2.5}$ concentrations, the LOOCV R^2 values were 0.85, 0.76 and 0.71 for the three regions, respectively, whereas the LOOCV NME values were 8.0%, 6.9% and 8.4%, respectively. We found that the incorporation of satellite-based NO_2 column density into the LMEs model contribute to considerable improvements in annual prediction accuracy for both BTH and YRD. The satisfactory performance of our models indicates that constructing LMEs models using various combinations of predictors for different regions would be helpful for predicting $PM_{2.5}$ concentrations with high accuracy.