

Numerical study of the PM2.5 emission control during APEC 2014 in Beijing by WRF-SMOKE-CMAQ model system

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In the year 2014, the APEC meeting was held in Beijing, where the fine particulate matter (PM2.5) concentration is high and worried. In such a heavily air-polluted environment, people want access to reasonable air quality predictions, that the government can take necessary short-term emissions reduction measures to improve air quality. A new model system, with the enhanced 9km domain and latest emission inventory in WRF-SMOKE-CMAQ model, was established before APEC. As a result, the model system plays good performance in October 2014: 1) the model catches four air pollution episodes in October, and has a high correlation coefficient of 0.89, 2) the daily forecast of PM2.5 concentration reaches $277 \mu\text{g m}^{-3}$ and close to the observed value ($320 \mu\text{g m}^{-3}$), but still a little underestimated, 3) the mean bias(MB) of the forecast to observed is $1.03 \mu\text{g m}^{-3}$ and the normalized mean bias(NMB) is 24.9%, 4) the normalized mean square error (NMSE) between the forecast and observed is 0.137. This result indicates the emissions inventory used in the model system is reasonable as baseline scenario, which scenario without any emission-sources reduction. From 3th to 12th November, the emission-sources reduction measures, e.g. the factory cut production and closures, are carried step by step in Beijing and its surrounding areas. Those measures information is collected, corrected and used in the SMOKE model to prepared as a reduced emissions inventory as APEC scenario. The same WRF-CMAQ model system, but be driven by the emission inventory of APEC scenario, is used to simulate the air quality under such emission-sources reduction measures, and evaluate the effect of emission-sources reduction during APEC 2014 in Beijing. According to the results, the daily PM2.5 concentration would reduce from $107 \mu\text{g m}^{-3}$ in the baseline to $72 \mu\text{g m}^{-3}$ in the APEC scenario, while the observed is $69 \mu\text{g m}^{-3}$ on 8th November. From 6th to 10th November, the observation is lower than the forecast results in the baseline scenario, that indicates the emission-sources reduction measures effects in the air quality in Beijing, if we trust the model. We also found that the observation on 7th ~ 8th November even lower than the forecast results in the APEC scenario, which indicates the emission reduction efforts more than expected. And the emission reductions will be given based on the model estimates.