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Ensemble data assimilation for ozone forecast: Uncertainty identification and constraint

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This study develops an ensemble data assimilation system to improve the ozone forecast based on a Nested Air Quality Prediction Modeling System. The ensemble system is composed of Monte Carlo uncertainty analysis module and Ensemble Kalman Filter data assimilation module. Monte Carlo uncertainty analysis is employed to identify the main sources of uncertainty in ozone simulation. Ensemble Kalman Filter is then used to constrain initial conditions as well as other important uncertainty sources with observed surface ozone concentration. The performance of this system is assessed for urban ozone forecast at Beijing during the 2008 Olympic Summer Games, where a number of measures for reducing pollutants emissions are conducted at Beijing and surrounding area. The results shows that the most influential uncertainty sources to the ozone simulation in Beijing is the local precursor emissions, NO2 photolysis coefficient, wind direction, precursor emissions from outside of Beijing and vertical diffusion coefficient during the 2008 Olympic Summer Games. Forecast skills of different constraining designs for uncertainty sources are compared. Significant improvements can be achieved for urban ozone forecast by jointly adjusting ozone initial conditions and local $NO_x and VOC initial values and emissions$.

$Keywords: Data assimilation, Ensemble Kalman Filter, Monte Carlo uncertainty analysis$