

Modeling analysis of the spatiotemporal distribution characteristics of the atmospheric ultrafine particle in North China Plain and Yangtze River Delta of China in 2016

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Epidemiological studies identify the strongest health associations with particles that have diameters $<2.5 \mu\text{m}$ ($\text{PM}_{2.5}$) but toxicology studies suggest that particle with diameters $<0.1 \mu\text{m}$ ($\text{PM}_{0.1}$) maybe even more dangerous. And $\text{PM}_{0.1}$ can be used as cloud condensation nuclei (CCN) to influence cloud processes. At present, there is no conventional observation of $\text{PM}_{0.1}$ in China, so its spatiotemporal distribution characteristics are not clear.

Model simulation is another effective method for the study of air pollution. Chemical transport model (CTM) is often used to reproduce the past pollution event, test the new air pollution mechanism, predict future air quality and provide high time-and-space resolution data for the epidemiological study. Until now there have been many CTMs analyzing the air pollution events in China, and the Community Multiscale Air Quality model (CMAQ) is one of the most commonly used CTM in China. In the numerical simulation of particulate matter by the CMAQ model, except for one level of nanometer of nucleation, simulation of particulate matter less than $2.5 \mu\text{m}$ is often used without smaller particle size bins. Therefore, the domestic model simulation study of $\text{PM}_{0.1}$ is rare.

The University of California, Davis/California Institute of Technology (UCD/CIT) regional reactive chemical transport model is a third-generation air quality model developed by the UC Davis team based on the 1980s California Institute of Technology (CIT). The composition, mass and number concentrations of the particle with the diameter between 0.01 and $10 \mu\text{m}$ are showed in 15 size bins. The first 5 size bins of the UCD/CIT model are for $\text{PM}_{0.1}$, so it can simulate $\text{PM}_{0.1}$. At present, the UCD/CIT model has been applied in the simulation of $\text{PM}_{0.1}$ in America. In this paper, for the first time, we use the UCD/CIT model to simulate the pollution of gas and particulate matter in China, compare the model performance of UCD/CIT with CMAQ and analyze the spatiotemporal distribution characteristics of $\text{PM}_{0.1}$ in China.

Keywords: ultrafine particle, spatiotemporal distribution, China, modeling