

Air quality modeling of mega cities in Yangtze River Delta region

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Recently with the development of industry and population growth in Yangtze River Delta (YRD) region, air pollutants emitted by human activities have risen dramatically. Air pollutants emitted by mega cities in Yangtze River Delta mainly include: SO₂, NO_x, CO, VOCs and aerosol. Both VOCs and NO_x play critical roles during O₃ formation in the troposphere. A better understanding of the relationship between O₃ precursors (VOCs, NO_x) and O₃ formations in Yangtze River Delta region is one of the critical pre-required information to develop effective O₃ control strategies. A third generation air quality model Models-3/CMAQ developed by U.S. Environmental Protection Agency are used to study the combined pollution in YRD region.

In this paper we verified the simulation results and found that the simulation results of O₃, SO₂ and NO₂ are in agreement with experiment results. The mean correlation coefficient and mean normalized bias and mean agreement index are 0.96, 7.26% and 0.92 separately. Mean agreement index of SO₂ is 0.62. Mean correlation coefficient and mean agreement index are 0.66 and 0.67 separately. Simulation results of PM₁₀ are somewhat lower than experiment results. However, the trend of simulation results is consistent with the observation data. The lifetime of SO₂ and NO_x are too short to long-range transport. High concentration of NO in urban area leads to ozone loss. The highest mean ozone concentration appeared in spring and lowest in winter, this phenomenon is correlated with O₃ production rate and surrounding transportation. High O₃ concentrations were associated with the occurrence of high-pressure systems. Wind field convergence is beneficial to air pollutant accumulation.

In this study we closed the emission of NO_x and VOCs in January and July 2008, to test the contribution of O₃ and its precursors (VOCs, NO_x) from surrounding places. The mean contribution rate of NO_x, VOCs and O₃ in January are 9.5%, 38.9% and 125.1%, separately. NO_x and VOCs mainly comes from north-west direction of YRD region. O₃ mainly came from south-east direction of YRD region. During winter YRD is an ozone net loss region. The mean contribution rate of NO_x, VOCs and O₃ in July are 7.7%, 51.4% and 94.4%. During summer monsoon brought NO_x from northern part of Zhejiang Province. VOCs mainly came from mountain area in south-west direction of YRD. Ozone from land around YRD is more than from ocean.

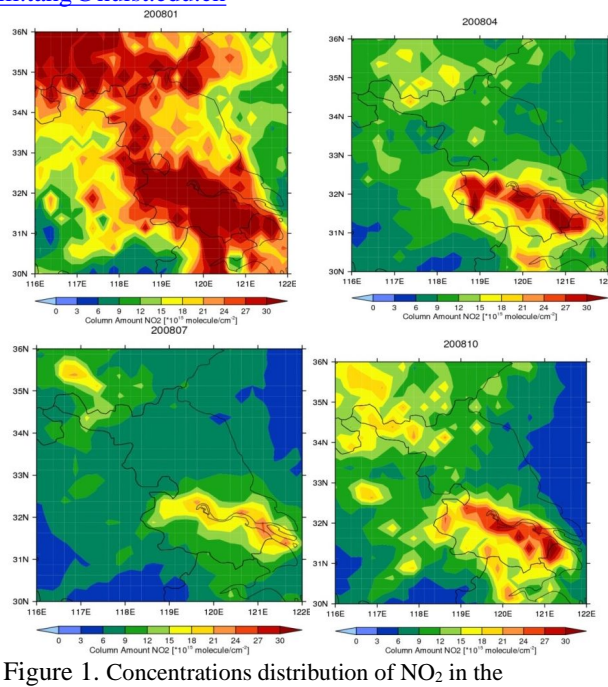


Figure 1. Concentrations distribution of NO₂ in the atmosphere of Yangtze River Delta region during different seasons

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