Measurements of O₃, NOₓ and VOCs during summer in Beijing, China

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Abstract

Measurements were taken for Ozone (O₃) and its precursors simultaneously from June to August 2008 in Beijing. We analyzed the spatial and temporal variability of O₃ and its precursors and the roles of the precursors in O₃ formation. The results suggest that O₃ mixing ratios are higher in rural areas than in urban areas. Highest mixing ratios of VOCs were alkanes, followed by aromatics; alkenes and biogenics were present at lower mixing ratios. Because of their relatively high reactivities, aromatics and alkenes play dominant role in O₃ formation. NO and NO₂ mixing ratios are lower during weekends because of reduced automobile traffic, resulting in the formation of higher amounts of O₃ during weekends; average O₃ mixing ratio on weekends was higher than on weekdays. Changes in NOₓ emissions on the weekends may be the chemical cause of this ozone “weekend effect”. Based on the control measurements in 2008, O₃ mixing ratios at noon are higher in BVCM (Before the Vehicle Control Measures) than in DVCM (During the Vehicle Control Measures); NO and NO₂ mixing ratios are lower in DVCM than BVCM. Mixing ratios of alkanes, aromatics, alkenes, and biogenics were lower by 34.5%, 31.1%, 21.4%, and 7.4%, in DVCM than in BVCM, respectively. The Ozone Isopleth Plotting Package (OZIPR) model is applied to assess the sensitivity of O₃ formation to the presence of nitrogen oxides (NOₓ) and volatile organic compounds (VOCs). Results from OZIPR simulations of a reduction in VOCs or NOₓ mixing ratios, indicate that an increase in VOCs would result in an increase in O₃, whereas a reduction in VOCs would reduce O₃ mixing ratios. The influence of NOₓ is exactly the opposite: increasing the mixing ratio of NOₓ would result in a decrease in O₃ mixing ratios. It can be concluded that there is a VOCs/NOₓ ratio, approximately 8 and lower NOₓ mixing ratios in this urban area would lead to an increase in O₃ mixing ratios.

Key words: Beijing, nitrogen oxides, ozone, volatile organic compounds

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