Home
Online Library ACP
- Recent Final Revised Papers
- Volumes and Issues
- Special Issues
- Library Search
- Title and Author Search

Online Library ACPD
Alerts & RSS Feeds
General Information
Submission
Review
Production
Subscription
Comment on a Paper

Volumes and Issues Contents of Issue 21

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Use of a mobile laboratory to evaluate changes in on-road air pollutants during the Beijing 2008 Summer Olympics

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Abstract. China implemented systematic air pollution control measures during the 2008 Beijing Summer Olympics and Paralympics to improve air quality. This study used a versatile mobile laboratory to conduct in situ monitoring of on-road air pollutants along Beijing's Fourth Ring Road on 31 selected days before, during, and after the Olympics air pollution control period. A suite of instruments with response times of less than 30 s was used to measure temporal and spatial variations in traffic-related air pollutants, including NO_x, CO, $PM_{1.0}$ surface area ($S(PM_1)$), black carbon (BC), and benzene, toluene, the sum of ethylbenzene, and *m*-, *p*-, and *o*-xylene (BTEX). During the Olympics (8–23 August, 2008), on-road air pollutant concentrations decreased significantly, by up to 54% for CO, 41% for NO_x, 70% for SO_2, 66% for BTEX, 12% for BC, and 18% for S_{PM_1}, compared with the pre-control period (before 20 July). Concentrations increased again after the control period ended (after 20 September), with average increases of 33% for CO, 42% for NO_x, 60% for SO_2, 40% for BTEX, 26% for BC, and 37% for $S(PM_1)$, relative to the control period. Variations in pollutants concentrations were correlated with changes in traffic speed and the number and types of vehicles on the road. Throughout the measurement periods, the concentrations of NO_x, CO, and BTEX varied markedly with the numbers of light- and medium-duty vehicles (LDVs and MDVs, respectively) on the road. Only after 8 August was a noticeable relationship found between BC and $S(PM_1)$ and the number of heavy-duty vehicles (HDVs). Additionally, BC and $S(PM_1)$ showed a strong correlation with SO_2 before the Olympics, indicating possible industrial sources from local emissions as well as regional transport activities in the Beijing area. Such factors were identified in measurements conducted on 6 August in an area southwest of Beijing. The ratio of benzene to toluene, a good indicator of traffic emissions, shifted suddenly from about 0.26 before the Olympics to approximately 0.48 after the Olympics began. This finding suggests that regulations on traffic volume and restrictions on the use of painting solvents were effective after the Olympics began. This study demonstrated the effectiveness of air pollution control measures and identified local and regional pollution sources within and surrounding the city of Beijing. The findings will be invaluable for emission inventory evaluations and model verifications.

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