Air quality during the 2008 Beijing Olympics: secondary pollutants and regional impact

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This paper presents the first results of the measurements of trace gases and aerosols at three surface sites in and outside Beijing before and during the 2008 Olympics. The official air pollution index near the Olympic Stadium and the data from our nearby site revealed an obvious association between air quality and meteorology and different responses of secondary and primary pollutants to the control measures. Ambient concentrations of vehicle-related nitrogen oxides (NOx) and volatile organic compounds (VOCs) at an urban site dropped by 25% and 20–45% in the first two weeks after full control was put in place, but the levels of ozone, sulfate and nitrate in PM2.5 increased by 16%, 64%, 37%, respectively, compared to the period prior to the full control; wind data and back trajectories indicated the contribution of regional pollution from the North China Plain. Air quality (for both primary and secondary pollutants) improved significantly during the Games, which were also associated with the changes in weather conditions (prolonged rainfall, decreased temperature, and more frequent air masses from clean regions). A comparison of the ozone data at three sites on eight ozone-pollution days, when the air masses were from the southeast-south-southwest sector, showed that regional pollution sources contributed >34–88% to the peak ozone concentrations at the urban site in Beijing. Regional sources also contributed significantly to the CO concentrations in urban Beijing. Ozone production efficiencies at two sites were low (~3 ppbv/ppbv), indicating that ozone formation was being controlled by VOCs. Compared with data collected in 2005 at a downwind site, the concentrations of ozone, sulfur dioxide (SO2), total sulfur (SO2+PM2.5 sulfate), carbon monoxide (CO), reactive aromatics (toluene and xylenes) sharply decreased (by 8–64%) in 2008, but no significant changes were observed for the concentrations of PM2.5, fine sulfate, total odd reactive nitrogen (NOy), and longer lived alkanes and benzene. We suggest that these results indicate the success of the government's efforts in reducing emissions of SO2, CO, and VOCs in Beijing, but increased regional emissions during 2005–2008. More stringent control of regional emissions will be needed for significant reductions of ozone and fine particulate pollution in Beijing.

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