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The response of surface ozone to current mitigation strategies for reducing air pollution in Chinese megacity clusters

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China, with rapid urbanization and industrialization, has experienced severe air quality deterioration in recent decades. To release heavy air pollution in China, Chinese government implement the Clean Air Action Plan initiated in 2013. Fine particles ($PM_{2.5}$) concentrations have shown significant declines over the nationwide, which attribute to mitigating anthropogenic emission of primary $PM_{2.5}$, and precursor gases of nitrogen oxides (NOx), sulfur dioxide (SO_2), and carbon monoxide (CO). However, surface ozone concentrations have unexpectedly increased during the implementation of 2013 to 2019. China has an average trend of 1.9 ppbv a^{-1} in same period, measured by ambient monitoring station of China's Ministry of Environment and Ecology (China MEE). Notably, surface ozone has faster increased trend in megacity clusters, with 3.3 ppbv a^{-1} inBeijing-Tianjin-Hebei, 1.6 ppbv a^{-1} in Yangtze River Delta, 1.1 ppbv a^{-1} in Pearl River Delta. At shorter temporal scale, the lockdown during outbreak of COVID-19, in which human activities dramatically decreased with reduction of industry and transport emission, witnessed exceeding 30% increase of maximum daily 8h average (MDA8) O_3, in major cities (e.g., Shanghai, Hangzhou, Hefei etc.). The investigated results suggested simultaneous controlling concentration of PM2.5 and ozone should coordinate inner physical and chemical processes. In this study, the weather Research and Forecasting with Chemistry was applied to reproduce the following two pathways: (1) The response of surface ozone to modification of photolysis by changed radiation budgets induced by scattering and absorbing aerosols; (2) The further impacts of altered atmospheric oxidizing capacity on surface ozone and aerosols concentrations. This study can provide reasonable advice to air pollution control strategies in Chinese megacity clusters.