Observed dependence of surface ozone on increasing temperature in Shanghai, China

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Eight-year measurements at urban (Xujiahui, XJH) and remote (Dongtan, DT) stations during 2010-2017 are employed to examine the surface ozone (O_3)-temperature relationship in Shanghai, China. O_3 pollution was getting worse in Shanghai, with daily maximum O_3 concentrations increasing at a rate of 2.45 ppb yr^{-1} in urban site. The climate penalty ($m_{O3\text{-}T}$), defined as the slope of O_3 change with increasing temperature, exhibited largest values in summer. Summertime O_3 increased faster as temperature increased, with mean rates of 6.7 and 13.7 ppb $^{\circ}C^{-1}$, respectively in XJH and DT above 30°C. Sensitivity experiments indicate that the temperature dependence of biogenic volatile organic compounds (VOCs) emissions should be the main chemical driver of the high-temperature O_3 response in summer, since simulated values of $m_{O3\text{-}T}$ are most sensitive to the temperature-related changes in biogenic isoprene emissions. NO_x emission reductions strengthened the high-temperature O_3 response in Shanghai, with summer mean $m_{O3\text{-}T}$ values increasing from 1.52 ppb$^{\circ}C^{-1}$ during 2010-2012 to 2.97 ppb $^{\circ}C^{-1}$ during 2013-2017. As NO_x emissions continue to decrease, the dependence of $m_{O3\text{-}T}$ on the biogenic VOC emissions could be weakened. Model results suggest that reductions in anthropogenic VOC emission reductions would effectively reduce the sensitively of O_3 to increasing temperatures in urban Shanghai. Effective emission reduction strategies should be formulated to balance VOC/NO_x ratios, so as to wrestle with the challenges for future O_3 pollution.

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