Unintentional Regional Ozone Increase in the Western Pacific Due to Particulate Matter Controls in China

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China has been suffering severe particulate matter (PM) and ozone (O3) pollution due to large amount of fossil fuel consumption associated with rapid economic growth, industrialization, and urbanization during the past four decades. Air pollution control measures have recently been taken into action to reduce the levels of air pollutants, primarily focusing on PM2.5 by reducing SO2 and industrial smoke and dust emissions. Recent monitoring data shows that declining trends in PM2.5 in China, reflecting the effectiveness of PM2.5 control measures. However, ozone, the major pollutant of photo chemical smog which also causes serious damages to public health and agricultural products, is becoming more serious meanwhile. Although particles are not the precursors of O3, particles scatter and absorb the sunlight, reduce the UV radiation and consequently suppress O3 formation. Declining trends in radiation has been found in observations for the last half century, and studies indicate that serious PM pollution is responsible for some of the radiation reduction. Theoretically, the current PM controls lower the PM concentrations, and thus would increase the radiation and enhance O3 formation.

To investigate the impact of PM and SO2 emission controls in China on the ground level O3 formation, we used Community Multi-scale Air Quality Model (CMAQv5.0.1) to simulated O3 concentrations under different PM and SO2 emission control scenarios. We simulated 2013 summer (June, July, and August) with a 36-km horizontal resolution East Asia region. We used the online photolysis rate module to calculate the effects of scattering and absorbing aerosols in modulating photolysis rates. The results show that seasonal average 8h peak O3 is predicted to increase with the reduction in the SO2 and PM emissions in the NCP area and its downwind ocean areas. The maximum 1h peak O3 concentrations in the three months are over 10 ppbv in the center and east China. The largest increase of 45 ppbv in 1h O3 concentration is over the east China sea, downwind of Shanghai and Jiangsu province. Moreover, the PM and SO2 controls also may greatly increase the 1h O3 concentrations (~15-25 ppbv) in Korea and Japan, even though the seasonal average increase of 8h maximum O3 is not significant (~0.5-1.5ppbv).

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