Impact of emission reduction on aerosol-radiation interaction during heavy pollution periods over Beijing-Tianjin-Hebei region in China

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In December 2015, the Beijing-Tianjin-Hebei (BTH) region in China experienced several episodes of heavy air pollution. The government issued emergency control measures immediately to reduce the pollution, which provided a good opportunity to explore impact of emission reduction on aerosol-radiation interaction. In this study, four tests were conducted, including the BASE1 simulation with emission reduction and aerosol-radiation interaction on, BASE2 simulation with emission reduction and aerosol-radiation interaction off, SEN1 simulation without emission reduction and aerosol-radiation interaction on and SEN2 simulation without emission reduction and aerosol-radiation interaction off. Results show that the aerosol-radiation interaction reduced downward shortwave radiation, temperature at 2 m and boundary layer height in region, but increased the relative humidity at 2 m, which were favorable for pollution accumulation. The interaction effect due to emission reductions increased downward shortwave radiation by 0–5 W/m\textsuperscript{2} on average, leading to a weak decrease of surface temperature by 0–0.05 °C, a weak decrease of the daytime boundary layer height by 0–8 m, and a weak increase of daytime mean relative humidity at 2m by 0.5%. If there were with aerosol-radiation interaction, it would enhance the effectiveness of emission control measures on air pollution control. The enhancement of PM\textsubscript{2.5}, PM\textsubscript{10}, and NO\textsubscript{2} emission reduction effects reaches by 7.62%, 6.90%, 11.62% over region, respectively.