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Seasonality of Particulate Matter Enhancement by Aerosol Climate Effect in East Asia

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A fully online coupled Weather Research and Forecasting model with Chemistry (WRF-Chem) is used to identify impacts of aerosol climate feedback in East Asia in different seasons in 2014. Simulation results could successfully capture both spatial and temporal distribution of temperature, relative humidity, wind speed and particulate matter concentration. Direct and semi-direct climate effect of aerosols could reduce monthly mean values of surface heat flux, temperature, wind speed, and planetary boundary layer height by up to 27 W/m^3, 1.0K, 0.1m/s, and 160m respectively, yet increase relative humidity by up to 4%. Meanwhile, indirect effect of aerosols plays a more important role in suppressing precipitation. Direct and semi-direct effects is more crucial in modulating $PM_{2.5}$ with a maximum enhancement of over 50 μg/m^3 ,comparing with a minor effect from indirect feedback which is within 3 μg/m^3. Enhancement by species is different in four seasons. In moist seasons (spring, summer, and autumn), nitrate composed a higher proportion in enhanced concentrations (36.7%, 32.6%, and 37.8%) comparing to the concentration in non-feedback simulation (23.6%, 21.1%, and 24.6%). Correspondingly, percentage of sulfate drops from 14.2%, 18.9%, and 13.2% to 3.5%, 7.1%, and 4.2% respectively. This could possibly results from rising of relative humidity which may influence various chemical processes in moist seasons.