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Aerosol's effect on precipitation anomalies over East Asia

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Anthropogenic aerosols (sulphate and black carbon) effects on precipitation over East Asia are examined using an atmosphere model, which is a component of the High Resolution Global Environmental Model (HiGEM) developed by NERC and the Hadley Centre, UK. In summer, the duration of the East Asian Summer Monsoon (EASM) is significantly extended when decreasing sulphate aerosol concentration. It is due to sulphate aerosol's first indirect effect: less sulphate aerosols act as cloud condensation nuclei (CCN), decreasing the cloud droplet number but increasing the cloud droplet size. Consequently, as the cloud albedo decreases, more solar radiation reaches the surface and increase land surface temperature, which maintains the favourite land-sea temperature contrast and extends the summer monsoon circulation over East Asia. While black carbon exerts a similar effect, the magnitude is much smaller, and this is because the relative position between black carbon and clouds – black carbon lies at the bottom of the atmosphere, while cloud as dominated by cumulus above it, also this is because black carbon is treated as hydrophobic in the model. In winter, a decrease in black carbon concentration leads to a decrease in precipitation. As solar-absorbing particles, black carbon heats the atmosphere, especially the bottom of the atmosphere where concentration of black carbon is maximum. A decrease in black carbon actually cools the atmosphere comparing to control run, and this suppresses atmospheric instability by either weaken the lapse rate or trigger an additional subsidence to compensate the cooling caused by black carbon decreasing.