Local and Remote Impacts of Asian Aerosols during The Monsoon Season

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Abstract

Densely populated Asian region emits large amounts of aerosols and trace gases. To understand the impacts of Asian aerosols we use observational data sets and ECHAM-HAMMOZ model simulations. The model simulations for a 50% enhancement in emissions of anthropogenic black carbon aerosol show an enhancement in Indian summer monsoon rainfall (ISMR) by 25%, while for a similar enhancement of sulfate aerosol emissions, ISMR decreases by ~23%. Sulfate aerosols from the volcanic eruptions also affect the ISMR. Our analysis of 145-year (1871–2016) records of volcanic eruptions and ISMR show that tropical volcanic eruptions reduce ISRM for two years. Our simulations also show that anthropogenic emission reduction during the COVID-19 period has increased Indian summer monsoon precipitation by 17%. Additional effects of Air pollution reduction during the COVID-19 lockdown caused a reduction in black carbon in snow over the Himalayan glaciers by 14% and thus reduced snowmelt by 10-40%. The boundary layer pollutants over the Asian region are transported to the Asian Summer Monsoon Anticyclone (ASMA) by large-scale monsoon convection. The pollutants are trapped in the ASMA. The satellite observations and ECHAM-HAMMOZ model simulations also show high amounts of gases and aerosols within the ASMA. The highly dynamic ASAM shades eddies to the east and west of ASAM over the Western Pacific (25%) and West Africa (68%). The eddies carry Asian pollutants away from the ASAM thereby affecting the chemical composition and radiative forcing at these locations. The aerosols from the ASMA enter the lower branch of Brewer-Dopson circulation which are then transported to the Arctic. The model ECHAM-HAMMOZ simulations show that East and South Asian anthropogenic emissions contribute significantly to the aerosol transported to the Arctic. The aerosol transported from East Asia caused a higher negative net aerosol radiative forcing (and surface cooling) at the surface at the Arctic -0.09±0.02Wm^{-2}(0.56K) than South Asia -0.0 ±0.02 Wm^{-2} (-0.043 K).

Early Career Scientist

NO, I am not an early career scientist.

IGAC Regional Working Groups

MANGO: Monsoon Asia and Oceania Networking Group