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Heterogeneity in regional responses of Indian summer monsoon to short-lived anthropogenic aerosol emission scenarios

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Rapid growth in industrialization, land use change and other anthropogenic-related activities has led to large amounts of polluting aerosols over India. These anthropogenic aerosols are continuously increasing in terms of their species composition and concentration levels. Increasing anthropogenic aerosol emissions can have substantial impacts on climate as well as human health. India being one of the most heavily polluted and populous regions of the world has been under the scanner to curb down the anthropogenic aerosol emissions by implementing mitigation measures.

In this work, we use the International Centre for Theoretical Physics (ICTP) Regional Climate Model – version 4 (RegCM4) to examine the responses of Indian summer monsoon (ISM) climate to anthropogenic aerosols (black carbon, organic carbon, and sulfates) from the current legislation (CLE) "baseline" scenario for the period (2005-2015) and from short-lived climate pollutant (SLCP) "mitigation" scenario for the near future period (2020-2030) taken from ECLIPSE inventory. Our results show a reduction in carbonaceous aerosols (black carbon and organic carbon) in the mitigation scenario, but an increase in AOD (>0.05) over India due to increased sulfate emissions. The reduction in anthropogenic emissions of SLCPs over the Middle East under the mitigation scenario enhances the radiative effects of dust on the ISM. Specifically, the increase in dust-induced tropospheric warming over the Middle-East deserts and subsequent increase in sulfate aerosol cooling over India increases the strength of the ISM. Further analysis suggests the possible role of aerosols in extending the active phases of the ISM and partially contributing to precipitation extremes following mitigation measures.