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Aerosols delay the emergence of greenhouse gas forcing on 21st century South Asian monsoon precipitation by several decades

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Anthropogenic aerosols (AERs) affect several aspects of the climate system across the world through radiative forcing and microphysical effects. These influences are particularly strong across South Asia, where AER concentrations are highest and further projected to increase in coming decades. Using large ensemble experiments from Earth system model, we examine how AERs shape the evolution of seasonal precipitation over South Asia inlate 20th century and 21st century climate in the presence of rising greenhouse gases (GHGs) concentrations. We find that AERs strongly reduce monsoon precipitation, moderately reduce post-monsoon precipitation, and negligibly influence pre-monsoon precipitation. Consequently, AERs delay the emergence of GHG-forced increases in precipitation by ~5 decades in the monsoon season and ~1 decade in the post-monsoon season. However, GHGs are projected to outpace the influence of AERs by mid 21st century, causing a steep intensification of monsoon and post-monsoon precipitation. We further show that local AERs have the strongest influence on precipitation in the monsoon and post monsoon seasons in the near-future (2020-2049). However, the contribution from remote AERs changes is also important in shaping the monsoon precipitation changes over northwestern South Asia. Further, the influence of local AERs monsoon precipitation remains stationary throughout the 21st century, indicating the insensitivity of relationship between local AOD and precipitation to the projected warming. A better understanding of aerosol-climate interactions and associated precipitation responses in is pertinent for policymakers to address the critical aspect of regional consequences over South Asia induced by externally forced climate change.