Two-thirds of the world’s population is impacted by monsoonal rainfall, thus knowing how the global monsoon will respond to human-induced climate change is of great importance. Studies into the impact of anthropogenic aerosols on regional summer monsoon rainfall have generally focused on a black carbon-induced enhancement and a sulfate-induced suppression. The latter encompasses significant Asian and non-Asian sources, but their relative roles in forcing historical global and regional monsoon trends are largely unexplored.

We utilise targeted 20th century coupled climate simulations from the CSIRO Mk3A low resolution model, designed to isolate the impact from anthropogenic aerosols. Three sets of eight simulations for the period 1871-1999 are examined, one set with all radiative forcings (ALL), one with ALL forcings but with only time-evolving Asian aerosols (AS), and another with ALL forcings except for global anthropogenic aerosols (AXA). The global aerosol induced signal is taken as the difference between ALL and AXA; for Asian aerosols, it is the difference between AS and AXA.

Results show that Asian aerosols induce a weak suppression of global summer monsoon, confined to the East Asian region. The addition of non-Asian aerosols generates an enhancement and broadening of cooler temperatures over Europe and Asia relative to the ambient oceans, supporting stronger northerly flows that further suppress Asian monsoon rainfall. Furthermore, atmospheric convection is directed away from the Asian monsoon regions, resulting in an equatorward shift in rainfall. Our results highlight the importance of non-Asian aerosols in forcing changes in global monsoon rainfall, particularly across Asia.