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Uncertainty in aerosol radiative forcing impacts the simulated global monsoon in the 20th century

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Anthropogenic aerosols are dominant drivers of historical monsoon rainfall change. However, large uncertainties in the radiative forcing associated with anthropogenic aerosol emissions, and the dynamical response to this forcing, lead to uncertainty in the simulated monsoon response. We use historical simulations in which aerosol emissions are scaled by factors from 0.2 to 1.5 to explore the monsoon sensitivity to aerosol forcing uncertainty (−0.3 W m−2 to −1.6 W m−2). Hemispheric asymmetry in emissions generates a strong relationship between scaling factor and both hemispheric temperature contrast and meridional location of tropical rainfall. Increasing the scaling from 0.2 to 1.5 reduces the global monsoon area by 3% and the global monsoon intensity by 2% over 1950–2014, and changes the dominant influence on the 1950–1980 monsoon rainfall trend from greenhouse gas to aerosol. Regionally, aerosol scaling has a pronounced effect on Northern Hemisphere monsoon rainfall.