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Evaluating uncertainty in aerosol forcing of tropical precipitation shifts

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Increasing anthropogenic aerosol emissions have been attributed as the main driver of an observed southward shift in tropical precipitation between the 1950s and 1980s. In the near-term future, anthropogenic aerosol emissions will decline which could drive a northward shift in tropical precipitation over the coming decades. We use a perturbed parameter ensemble (PPE) of transient coupled-ocean atmosphere simulations that span a range of aerosol radiative forcing to investigate the role of aerosol radiative forcing uncertainty on tropical precipitation shifts in the 20th and 21st centuries. We find no relationship between the strength of the hemispheric contrast in pre-industrial to 1975 anthropogenic aerosol radiative forcing and tropical precipitation shifts during the 20th century. This result is in contrary to that from CMIP5, and we suspect internal variability plays a large role in why we do not see the expected relationship in our PPE. Tropical precipitation shifts are associated with major volcanic eruptions over the 20th century. However, we do find a relationship between the hemispheric contrast in pre-industrial to 2005 anthropogenic aerosol radiative forcing and the magnitude of future tropical precipitation shifts over 2006 to 2060 under scenario RCP8.5. Overall, our results suggest that reduction in aerosol radiative forcing uncertainty would improve projections of future precipitation shifts, but any predictive gains would be offset if future major volcanic eruptions temporarily shift tropical precipitation.