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Climate forcing and committed global warming: GHGs, aerosols and ozone 1970-2010

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It is crucial to reduce uncertainties in our understanding of the climate impacts of short□lived climate forcers, in the context that their emissions/concentrations are anticipated to decrease significantly in the coming decades worldwide. Using the Community Earth System Model (CESM1), we performed time□slice experiments to investigate the effective radiative forcing (ERF) and climate respons to 1970–2010 changes in well□mixed greenhouse gases (GHGs), anthropogenic aerosols, and tropospheric and stratospheric ozone. Once the present□day climate has fully responded to 1970–2010 changes in all forcings, both the global mean temperature and precipitation responses are twice as large as the transient ones, with wet regions getting wetter and dry regions drier. The temperature response per unit ERF for short□lived species varies considerably across many factors including forcing agents and the magnitudes and locations of emission changes. This suggests that the ERF should be used carefully to interpret the climate impacts of short□lived climate forcers. Changes in both the mean and the probability distribution of global mean daily precipitation are driven mainly by GHG increases. However, changes in the frequency distributions of regional mean daily precipitation are more strongly influenced by changes in aerosols, rather than GHGs. This is particularly true over Asia and Europe where aerosol changes have significant impacts on the frequency of heavy□to□extreme precipitation. Our results may help guide more reliable near□future climate projections and allow us to manage climate risks more effectively.