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Effective Radiative Forcing and Adjustments in CMIP6

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The effective radiative forcing, which includes the instantaneous forcing plus adjustments from the atmsophere and surface, as emerged as the key metric of evaluating human and natural influence on the climate. We evaluate effective radiative forcing and atmospheric adjustments in 13 contemporary climate models that are participating in CMIP6 and have contributed to the Radiative Forcing Model Intercomparison Project (RFMIP). Present-day (2014) global mean anthropogenic forcing relative to pre-industrial (1850) from climate models stands at 1.97 (± 0.26) W m^{-2}, comprised of 1.80 (± 0.11) W m^{-2} from CO_2, 1.07 (± 0.21) W m^{-2} from other well-mixed greenhouse gases, -1.04 (± 0.23) W m^{-2} from aerosols and -0.08 (± 0.14) W m^{-2} from land use change. Quoted ranges are one standard deviation across model best estimates, and 90% confidence in the reported forcings, due to internal variability, is typically within 0.1 W m^{-2}. The majority of the remaining 0.17 W m^{-2} is likely to be from ozone. As determined in previous studies, cancellation of tropospheric and surface adjustments means that the "traditional" stratospherically adjusted radiative forcing is approximately equal to ERF for greenhouse gas forcing, but not for aerosols, and consequentially, not for the anthropogenic total forcing. The spread of present-day aerosol forcing has narrowed compared to CMIP5 models to the range of -0.63 to -1.37 W m^{-2}, with a less negative mean. The spread in CO_2 forcing has also narrowed in CMIP6 compared to CMIP5, which may be a consequence of improving radiative transfer parameterisations. We also find that present-day aerosol forcing is uncorrelated with equilibrium climate sensitivity. Therefore, there is no evidence to suggest that the higher climate sensitivity in many CMIP6 models is a consequence of stronger negative present-day aerosol forcing.

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