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Forcing and Feedback in MPI-ESM

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Radiative climate change feedback mechanisms, such as those associated with temperature, water vapor, cloud and surface albedo change, determine climate sensitivity to an external radiative forcing. Here we apply the linearized radiative kernel technique to determine the strength of CO_2-forcing and feedbacks in the Max Planck Institute Earth System Model (MPI-ESM). The radiative kernels are validated against accurate feedback calculations for a short period at near-equilibrium in a mixed-layer ocean simulation with doubled CO_2. Subsequently, we take advantage of the computationally efficient radiative kernels by performing a combined Kernel-Gregory feedback-analysis in a simulation with the fully coupled model and abruptly quadrupled CO_2. The approach permits an elegant separation of rapid temperature adjustment and cloud-induced CO_2-indirect forcing from the temperature-dependent feedbacks without the need to define the tropopause level.