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Projected changes in radiative damping rates and radiative equilibrium temperature over the twenty first century

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To a reasonably good approximation, radiative heating rates in much of the middle atmosphere can be treated as a linear relaxation towards an effective radiative equilibrium temperature. The effects of increasing concentrations of CO₂ and ozone recovery on these linear timescales are estimated in a pair of timeslice runs of the UM UKCA using both a regression methodology and an offline code. Since these timescales determine the thermal response to changes in adiabatic heating, they provide one means of separating the radiatively determined temperature changes from those dynamically forced by changes in the Brewer Dobson Circulation. Throughout much of the middle and upper stratosphere, the strengthening of the radiative spring associated with enhanced CO₂ dominates over the weakening associated with lower temperatures. Estimates of changes in the lower tropical stratosphere are more challenging due to a number of non-local influences, but we show these can be accounted for in the regression methodology. Implications of the structure of these changes will be discussed.