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Time of Emergence of discernible climate mitigation.

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Climate change mitigation is based on the simple logic that reducing emissions of greenhouse gases will reduce the rate of increase of their atmospheric concentration, potentially even decreasing concentration if emission reductions are strong enough. This will lead to a reduction of the anthropogenic radiative forcing and hence the global warming. This is true in the long run, but might not be discernible in the short term. Indeed, the climate system and the global carbon cycle are both characterised by long inertia and significant natural mode of variability. The implication is that a reduction of greenhouse gas will not directly translate into a reduced warming. In particular, interannual to decadal variability in the Earth system will lead to an apparent negligible effect of emission mitigations. Here we make use of the CMIP5 climate simulations of the 21st century to investigate when mitigation becomes indeed clearly discernible, using the RCP2.6 scenario as a reference for a strong mitigation strategy. The analysis is performed for several key variables (atmospheric CO_2, global and regional surface temperature) by comparing their evolution and changes to those occurring under non-mitigation pathways (RCP4.5 to RCP8.5). We take advantage of those model experiments that supply multiple runs per scenario (i.e. single model initial condition ensembles) and through a quantification of the signal to noise ratio, separating forced from internal variability, and the significance of the differences between scenarios we characterize the time until the effect of emission mitigation becomes non-negligible.