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Team MIROC: Convective control of ENSO simulated in MIROC5

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The high sensitivity of the El Niño-Southern Oscillation (ENSO) to cumulus convection is examined by means of a series of climate simulations using an updated version of the Model for Interdisciplinary Research on Climate (MIROC), called MIROC5. Given that the preindustrial control run using MIROC5 shows a realistic ENSO, the integration is repeated with four different values of the parameter, λ, which affects the efficiency of the entrainment rate in cumuli. The ENSO amplitude is found to be proportional to λ and to vary from 0.6 to 1.6 K. A comparison of four experiments reveals the mechanisms for which the cumulus convections control behavior of ENSO in MIROC as follows. Efficient entrainment due to a large λ increases congestus clouds over the intertropical convergence zone (ITCZ) and reduces the vertical temperature gradient over the eastern Pacific, resulting in a wetter ITCZ and drier cold tongue via accelerated meridional circulation. The dry cold tongue then shifts the atmospheric responses to El Niño/La Niña westward, thereby reducing the effective Bjerknes feedback. The first half of these processes is identifiable in a companion set of atmosphere model experiments, but the difference in mean precipitation contrast is quite small. On one hand, the mean meridional precipitation contrast over the eastern Pacific is a relevant indicator of the ENSO amplitude in MIROC. On the other hand, the nonlinear feedback from ENSO affects the mean state, the latter therefore not regarded as a fundamental cause for different ENSO amplitudes.