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Parameter dependence of the dynamics of radiative-convetive equilibrium in MPI-ESM

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The climate and its sensitivity is explored in a global model run in radiative-convective equilibrium: results are presented from simulations with the ECHAM6.3 atmospheric model of the Max Planck Institute for Meteorology, coupled to a slab ocean. Simulations both with and without a parameterised representation of deep convection are conducted for CO_2 concentrations ranging from one eighth of present day values to thirty-two times the present day, and for variations in the solar constant of more than a factor of two. Very long simulations, in some cases more than a thousand years, are performed to adequately sample the attractor of the different climate states of the model. The linearized sensitivity itself of the system exhibits strong dependence on all of the factors varied. This results from the appearance of different dynamical regimes giving rise to nontrivial changes in the cloudiness. As a case study, for increasing CO_2 concentration within the default setup we characterize in detail how intermittent stratiform cloud fields form and become more and more important. Their cooling effect reduces global warming and enhances variability.