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Physics parameter ensemble of MIROC5 AOGCM

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To investigate physics parameter uncertainty of feedback (FBK), radiative forcing (RF) and climate sensitivity (CS), we are performing a new physics parameter ensemble (PPE) of MIROC5 coupled atmosphere-ocean general circulation model (AOGCM). Previous studies of PPE have mainly used atmospheric model coupled with slab ocean model (ASGCM). However, it has been suggested that CS is sometimes different between ASGCM and AOGCM. Therefore we use the AOGCM in this study. When parameter values in physics schemes are changed, net radiation balance at top of atmosphere (TOA) will alter, resulting in climate drifts. Flux corrections were applied in previous PPE studies to avoid climate drifts. However, flux corrections modify climate states, and may affect distributions of CS. In this study, we developed a new method to suppress climate drifts in the PPE experiments of AOGCM without flux corrections. We simultaneously change values of 10 parameters in physics schemes of cumulus, cloud, turbulence, aerosol and surface albedo. By combining a Latin hypercube sampling method and an emulator of net radiation balance at TOA, we can choose combinations of parameter values with little changes in the net radiation balance. The CS of the standard MIROC5 model (T42 version) is 2.85 K. To estimate, feedback parameter, stratosphere-troposphere adjusted radiative forcing, and effective climate sensitivity, we perform Gregory-style experiments, i.e. 20-yr runs of preindustrial control and 4xCO2 concentrations. The range of CS (estimated from our 25 ensemble members so far) is not wide (2.4K-3.2K). SW cloud is the most important component for the inter-member variances of both RF and FBK. Since the SW cloud FBKs are negative in all the members, no models having high climate sensitivity appear. We found a significant anti-correlation between RF and FBK, which also contributes to the small range of CS.