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Role of Atmospheric Stochastic Variability in ENSO Simulated by Coupled Global Climate Models

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A procedure is developed to quantify the role of atmospheric stochastic variability in ENSO simulated by coupled GCMs (CGCMs). Stochastic components derived from both a global reanalysis product and CGCM simulations were subscribed as external forcing to a version of the Cane-Zebiak (CZ) model whose nonlinear chaotic behavior is suppressed and whose time step is reduced to one day for receiving atmospheric stochastic influences. Comparisons between ENSO observed and simulated by the CZ model forced by the stochastic perturbations from the reanalysis indicate that ENSO statistics can be best reproduced when the coupling strength of CZ model is tuned to be slightly stable. Further comparisons between ENSO variability simulated by the CZ model forced by the stochastic perturbations from the reanalysis and CGCM and between ENSO simulated by the CGCM and CZ model with stochastic perturbations from the CGCM revealed that the stochastic forcing is responsible for some ENSO statistics in the CGCM (e.g., PDF and spectrum of Nino3 SST, seasonal dependence of SST decorrelation) but not for others (e.g., seasonal lock of ENSO peaks). The stochastically forced CZ model is unable to reproduce major cold ENSO events. The Madden-Julian Oscillation is shown to be the main component in the total stochastic forcing of ENSO. Preliminary results are also presented to compare the derivations of atmospheric stochastic perturbations by linear statistics and an ensemble approach.