

The Madden-Julian Oscillation in CCSM4: An analysis of its relation with other climate phenomena

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We assess the ability of the Community Climate System Model-4 (CCSM-4) to represent the Madden Julian Oscillation, the dominant mode of intraseasonal variability in the tropical atmosphere. We use the US CLIVAR MJO Working Group prescribed diagnostic tests to evaluate the model's mean state, variance and wavenumber-frequency characteristics in a 20-year simulation of the intraseasonal variability in zonal winds at 850 hPa (U850) and 200 hPa (U200) and Outgoing Longwave Radiation (OLR). Unlike its predecessor, CCSM4 reproduces many realistic aspects of MJO behavior. CCSM4 produces coherent, broadbanded and energetic patterns in eastward propagating intraseasonal zonal winds and OLR in the tropical Indian and Pacific Oceans that are generally consistent with MJO characteristics. Strong peaks occur in power spectra and coherence spectra with periods between 20-100 days and zonal wavenumbers between 1 and 3. Model MJO's, however, tend to be more broadbanded in frequency than in observations, with higher frequencies being associated with zonal wavenumbers in the MJO band. But broadscale patterns, as revealed in combined EOFs of U850, U200 and OLR, are remarkably consistent with observations and indicate that convergence-convection coupling occurs in the simulated MJOs. Relations between MJO in the model and its concurrence with other climate states are also explored. Higher amplitude MJO activity occurs during weak warm ENSO events and during periods of weak meridional shear and negative zonal shear during the Indian Monsoons.