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The Asian-Australian Monsoon: Tropical intraseasonal variability simulated in the NASA GISS General Circulation Model

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The tropical intraseasonal variability simulated by different versions of the atmospheric model of the National Aeronautics and Space Administration Goddard Institute for Space Studies general circulation model (GCM) - Model_E is examined in this study. The new version of Model_E, which will be used for the Intergovernmental Panel for Climate Change (IPCC) 5th Assessment Report (AR5) shows clear improvements compared to the AR4 version in simulating the magnitude of intraseasonal variability, and the amplitude and phase speed of convectively coupled Kelvin waves. Despite these improvements, the AR5 version still lacks the Madden-Julian oscillation (MJO) mode, which dominates intraseasonal variability over the tropics and interacts with many other climate components in nature. As consistent with previous studies, simulation fidelity of the MJO strongly depends on cumulus parameterization. When the convective scheme is tuned to have greater entrainment, the AR5 version of Model_E simulates precipitation variability with spatial and temporal scales of the MJO. The MJO life-cycle composites of outgoing longwave radiation, 925-hPa moisture convergence, specific humidity, diabatic heating, and moistening are compared to observations to show that the simulated MJO has realistic features. It is also found that, besides the MJO, the statistics of tropical cyclones (e.g. number) in the model are also affected by the changes in convection scheme. With the larger entrainment rate, the model simulates a smaller number of tropical cyclones. It is shown in composites of variables based on precipitation and precipitable water that the interaction between moisture and convection is strengthened in the version with enhanced entrainment rate. The implication of the current study is that modeling adequate moisture sensitivity of convection is important in the simulation of the tropical intraseasonal variability, such as the MJO and tropical cyclones.