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The Madden-Julian Oscillation in a Warming World

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Climate models remain challenged by accurate simulation of the Madden– Julian oscillation (MJO). This has limited the study of the impact of global warming on this phenomenon. He we apply the newly developed ECHAM5-SIT coupled model that is able simulate the MJO with realistic strength, structure, period, and propagation speed. The model consists of a high-resolution one-column ocean model (SIT) coupled to the ECHAM5 atmospheric model. Numerical experiments were conducted to explore the changes in the MJO by the end of 21st Century under the RCP8.5 scenario. In the warming climate, the MJO remains wavenumber-one structure with larger amplitude and stronger circumglobal propagation, and faster eastward propagation. The convection develops higher in the upper troposphere and the overturning circulation expands zonally but contracts meridionally. The shallow and deep convective heating are both enhanced and a stronger low-level convergence enhances westward tilting with height. Enhancement of MJO amplitude and extent can be explained by enhanced intraseasonal low-level convergence and increased mean moisture under global warming. The moister mean state contributes to the enhancement of deep convection, which excites stronger Kelvin waves. This reinforces low-level convergence through the enhanced Frictional Convergence Mechanism and leads to the more efficient and timely preconditioning of the deep convection, and therefore to a faster development and enhancement of the deep convection in MJO.