

EGU22-11037

<https://doi.org/10.5194/egusphere-egu22-11037>

EGU General Assembly 2022

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MJO diversity in CMIP6 models

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The Madden-Julian oscillation (MJO) events can be categorized into four types based on their propagation characteristics: standing, jumping, slow-propagating, and fast-propagating types. While the characteristics of each MJO type have been documented in the literature, it remains unknown whether such diversity is realistically represented in the state-of-art climate models. This study evaluates the MJO diversity in 28 Coupled Model Intercomparison Project Phase 6 (CMIP6) models. We find that many CMIP6 models reasonably reproduce the MJO diversity although the relative frequency of propagating types tends to be underestimated. When individual models are grouped into the GOOD and POOR models by considering the performance in capturing propagation pattern of the four MJO types, the GOOD models show a much stronger relationship between MJO type and underlying sea surface temperature (SST) anomalies, especially for standing and fast-propagating types. We find a systematic difference in the model biases in the climatological mean SST and column water vapor between the GOOD and POOR models, with the POOR models exhibiting much stronger cold and dry biases over the equatorial western Pacific. Our results suggest that the MJO diversity can be improved by reducing model mean bias.