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Did tropical precipitation improve in CMIP6 simulations?

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Climate models are known to have biases in tropical precipitation. We assessed to what extent simulations of tropical precipitation have improved in the new Coupled Model Intercomparison Project (CMIP) phase six, using state-of-the-art observational products and model results from the earlier CMIP phases three and five. We characterize tropical precipitation with different well-established metrics. Our assessment includes (1) general aspects of the mean climatology like precipitation associated with the Intertropical Convergence Zone and shallow cloud regimes in the tropics, (2) solar radiative effects including the summer monsoons and the time of occurrence of tropical precipitation in the course of the day, (3) modes of internal variability such as the Madden-Julian Oscillation and the El Niño Southern Oscillation, and (4) changes in the course of the 20th century. The results point to improvements of CMIP6 models for some metrics, e.g., the occurrence of drizzle events and consecutive dry days. However, no improvements of CMIP6 models are identified for other aspects of tropical precipitation. These include the area and intensity of the global summer monsoon as well as the diurnal cycle of the tropical precipitation amount, frequency and intensity.

All our metrics taken together, CMIP6 models show no systematic improvement of tropical precipitation across different temporal and spatial scales. The model biases in the spatial distribution of tropical precipitation are typically larger than the changes associated with anthropogenic warming. Given the pace of climate change as compared to the pace of climate model improvements, we suggest to use novel modeling approaches to understand the responseof tropical precipitation to changes in atmospheric composition.

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