

Tropical Cyclone Simulation and Response to CO₂ Doubling in GFDL CM2.5 High-Resolution Coupled Global Model

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We analyzed global tropical cyclone (TC) activity simulated by GFDL Climate Model version 2.5 (CM2.5) that is a fully coupled GCM with horizontal resolution of about 50km for atmosphere and 25 km for ocean. The CM2.5 simulates many aspect of global TC activity realistically, including global TC frequency and the seasonal cycles in most basins, but there are biases in regional TC activity including a notable negative in the North Atlantic. The regional bias in TC activity is highly associated with the simulated bias in large-scale environments. Despite of the biases, GFDL CM2.5 shows notable skill at simulating the variation of TC activity related to El Niño/Southern Oscillation.

The TC activity response to the global warming is evaluated by comparing the control run with a 2xCO₂ run. The results show a reduction of TC frequency (−18.7%) over the globe in response to CO₂ doubling, which is consistent with previous GCM studies. On the other hand, the TC lifetime maximum intensity increases by +2.7% in response to CO₂ doubling. Significant decreases in average TC lifetime and track length are simulated over the Northwestern Pacific and South Indian Ocean but the translation speed has no significant changes. The average sizes of the TCs increase by about 3% in response to CO₂ doubling. Meanwhile, the TC rainfall rate in response to CO₂ doubling shows a significant increase over all basins (about 8–18 %) when averaged within 250 km of the TC center—a result that is broadly consistent with the previous studies.