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Effect of the Initial Vortex Structure on Intensification of a Numerically Simulated Tropical Cyclone

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The dependence of intensification rate (IR) of a tropical cyclone on its initial structure, including the radius of maximum wind (RMW) and the radial decay rate of tangential wind outside the RMW, is examined based on ensemble of simulations using a nonhydrostatic axisymmetric cloud-resolving model. It is shown that the initial spinup period is shorter and the subsequent IR is larger for the storm with the initially smaller RMW or with the initially more rapid radial decay of tangential wind outside the RMW. The results show that the longevity of the initial spinup period is determined by how quickly the inner-core region becomes saturated and thus deep convection near the RMW is initiated and organized. Because of the larger volume and smaller surface moisture flux inside the RMW, and weaker Ekman pumping, the inner core of the initially larger vortex takes longer time to become saturated and thus experiences a longer initial spinup period. The vortex initially with the larger RMW (the more rapid radial decay of tangential wind outside the RMW) has lower inertial stability inside the RMW (higher inertial stability outside the RMW) develops more active convection in the outer-core region and weaker boundary-layer inflow in the inner-core region and thus experiences lower IR during the primary intensification stage.