A Numerical Study of Outer Rainband Formation in a Sheared Tropical Cyclone

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The dynamical process of outer rainband formation in a sheared tropical cyclone (TC) is examined in this study using the fully-compressible, nonhydrostatic TC model. After the easterly vertical wind shear of 10 m s^{-1} was imposed upon an intensifying strong TC, an outer rainband characterized by a wavenumber-1 structure formed as a typical principal rainband downshear. Further analysis indicates that the outer rainband formation was closely connected to the activity of the inner rainband previously formed downshear. Moving radially outward, the inner rainband tended to be filamented due to the strong radial gradient of angular velocity. As the inner rainband approached the outer boundary of the inner core, convection in its middle and upwind segments reinvigorated and nascent convective cells formed upwind of the rainband, caused mainly by the decreased filamentation and stabilization. Subsequently, the rainband reorganized into a typical outer rainband. Three different scenarios are found to be responsible for the outer rainband formation from downshear inner rainbands. The first is the outer rainband forming from an inner rainband downshear as a sheared vortex Rossby wave. The second is the outer rainband forming directly from a single deformation-induced inner rainband. The third is the outer rainband developing from an inner rainband downshear organized from a blend and merger of inner rainbands that were initiated from locally deformed convection upshear right.

Keywords: Tropical cyclone, Outer rainband, Vertical wind shear

