1. INTRODUCTION

Aircraft observations (Black and Willoughby 1992) show that the contraction of the outer tangential wind maximum from a distance of 90 km from the storm center to 60 km in approximately twelve hours in the formation of concentric eyewall structure. Moreover, the core vortex intensity remained approximately constant during the contraction period. An important issue in the formation of concentric eyewalls in a tropical cyclone is the development of a symmetric structure from asymmetric convection.

Dritschel and Waugh (1992) described the general interaction of two barotropic vortices with the parameters of dimensionless gap (separation distance of two vortices divided by a vortex radius) and vortex radius ratio for two equal vorticity strength vortices. The complete straining out regime of the interaction shows a small, weaker vortex being sheared out into thin filaments of vorticity surrounding the large, stronger vortex with no incorporation into the large vortex. The regime resembles the concentric vorticity structure except the filaments are too thin to be called a concentric eyewall. An extension of the complete straining out regime to include a finite-width outer band is needed to explain the interaction of a small and strong vortex (representing the tropical cyclone core) with a large and weaker vortex (representing the vorticity induced by the moist convection outside the central vortex of a tropical cyclone). In radar observations of Typhoon Lekima of 2001 (Kuo et al. 2004), we noticed a huge area of convection outside the core vortex that wraps around the inner edge to form the concentric eyewalls in a time scale of 12 hours.

The interaction of a small and strong vortex with a large and weak vortex was not studied by Dritschel and Waugh (1992) as their vortices are of the same strength and their larger vortex was always the “victor” and the smaller vortex was the one often being partially or totally destroyed. We propose, with the nondivergent barotropic model, that concentric vorticity structures result from the interaction between a small and strong inner vortex and neighboring weak vortices.

REFERENCES


**Fig 1.** The binary vortex experiments for vortex strength ratio 6, radius ratio 1/3, and dimensionless gap 1 (top); and vortex strength ratio 10, radius ratio 1/4, and dimensionless gap 0 (bottom).

**Fig 2.** Summary of numerical experiments with the parameters of the vorticity strength ratio ($\gamma$), the dimensionless gap $\Delta/R_1$, and the vortex radius ratio $r$. 