The concentric eyewalls formation with asymmetric convection

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Abstract

The asymmetric convection (AC) before the formation of the concentric eyewalls (CE) is studied. We show three observational evidences to indicate the presence of significant AC right before the CE formation and thus suggest the importance of axisymmetrization process in the CE formation. First, significant AC occurred downshear to the left 24 hr before the CE formation from the 1997-2012 passive microwave satellite image in the western North Pacific (WNP) and Atlantic basins. The occurrence of AC before the CE formation may be related to the monsoon in the WNP basin. As a detail example of the AC downshear to the left and the formation of the CE, the reflectivity and velocity at 0.5 elevation angle of Typhoon Lekima (2001) from the Ken-Ting Doppler is studied. Due to the special location of Typhoon Lekima with respect to the radar, we were able to derive the tangential wind from the radar. The analysis indicates that there is AC and asymmetric tangential wind expansion before Lekima's CE formation. Third, Japanese GMS IR and SSM/I microwave image demonstrate the binary vortex interaction of Typhoon Alex around Zeb (1998). Typhoon Alex was quickly elongated and wrapped cyclonically around Zeb to become a spiral band of Zeb. The spiral band is organized by Typhoon Zeb to become a secondary eyewall. This gives an observational evidence of binary vortex interaction may led to the CE formation. To study the characteristics of asymmetric tangential wind expansion in the binary vortex interaction, we develop a slab-boundary layer model coupled with a non-divergent barotropic model. The model supports the idea that the asymmetric tangential wind expansion occurred in the boundary layer due to the binary vortex interaction before the CE formation.

Key words: concentric eyewall, asymmetric convection, tangential wind expansion