Rotation of Inner Eyewall within Double-Eyewall Typhoons

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Observations indicate that offset inner-eyewall of the double eyewall typhoons would rotate counterclockwise inside the outer eyewalls. The rotation results in a trochoidal track when the typhoon moves. Trochoids have two types: prolate with loops and curtate without loops. The research is to understand the curtate trochoidal track of Typhoon Dujuan (2003) and the relevant parameters. Inner-eyewall rotation is studied with the shallow-water model. Three types of model parameters are designed: the vorticity structure of the double eyewalls, the geometric size, and the offset distance. The parameters are from Typhoon Dujuan (2003). The simulation is similar to the observation in rotation's spatial and temporal scales. Sensitivity experiments indicate that the rotation is insensitive to the offset distance, possibly due to the smallness of 5~10 km distance as is in typical typhoons. The rotation period decreased (increase) with the decrease (increase) of vortex size, and the increase (decrease) of the vorticity in the eyewalls. The small and strong double-eyewall typhoon is with a fast rotation. The elongation of the inner-eyewall rotation circle by the vortex translation results in the trochoidal track. When the translation distance (the translation speed multiplies the rotation period) is larger (smaller) than the circumference of the inner-eyewall rotating circle, the track is curtate (prolate) trochoid. The Dujuan's curtate trochoidal track is due to the relatively slow rotation (~230 min) and the relatively fast translation speed (30 km/h). My study indicates that curtate trochoidal track is likely to occur with a fast, large, and weak double-eyewall typhoon.

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