Long-term effect of barotropic instability across the moat in double-eyewall tropical cyclone-like vortices

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ABSTRACT

Secondary eyewall formation and the ensuing eyewall replacement cycles may take place in mature tropical cyclones (TCs) during part of their lifetime. A better understanding of the underlying dynamics is beneficial to improving the prediction of TC intensity and structure. Our previous simulation of Hurricane Wilma (2005) and modelling studies suggested that the barotropic instability (BI) across the moat (a.k.a. type-2 BI) can make a substantial contribution to the inner eyewall decay through the associated eddy radial transport of absolute angular momentum (AAM). Simultaneously, the type-2 BI can also increase the AAM of the outer eyewall. While the previous studies focused on the early stage of the type-2 BI, this work explores the long-term effect of the type-2 BI and the underlying processes in forced and unforced shallow water experiments. Under the long-term effect, it will be shown that the inner eyewalls repeatedly weaken and strengthen (while the order is reversed for the outer eyewalls). Sensitivity tests are conducted to examine the sensitivity of the long-term effect of the type-2 BI to different vortex parameters and the strength of the parameterised diabatic heating. Implication of the long-term effect for the intensity changes of the inner and outer eyewalls of real TCs are also discussed.

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