

## ENSEMBLE FORECASTING OF TROPICAL CYCLONE MOTION

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Ensemble forecasting has been used in many operational NWP centres to simulate the effects of initial observational errors on the subsequent forecasts. Most of the simulations are applied to global models and only until recently have some studies been devoted to the forecasting of smaller-scale features. In this paper, we present results of a study to examine the feasibility of applying such a technique to the problem of tropical cyclone (TC) motion prediction.

A barotropic model is employed because of its simplicity. The first part of the study perturbs only the environmental flow surrounding the TC obtained using a smoothing technique to remove the TC circulation. Three perturbation methods are used: the Monte-Carlo (MCF), the lagged-average (LAF) and the breeding of growing modes (BGM). The results from 66 TC cases in 1990 over the western North Pacific suggest that the MCF method does not improve the overall performance of the model but the other two techniques can produce better forecasts in many cases. Synoptic-scale features associated with these cases are identified.

The second part of the study involves the perturbation of the vortex circulation. In addition to the three techniques mentioned above, experiments are performed by perturbing the parameters used to spin up a symmetric vortex that is subsequently inserted into the model initial conditions. The initial position of the TC is also perturbed. The MCF technique again proves to be of little use, along with perturbation of the initial position. The LAF and BGM are useful in some instances but create distorted vortices in other situations, which then result in erroneous forecasts. Perturbations made to the pre-spun-up vortex give the best results, probably because the spun-up vortex can simulate the asymmetric structure of a TC to a large extent. However, even the improvements in these situations are less significant than those obtained from perturbing the environmental flow, which demonstrate the importance of the latter in governing TC movement.

**Key Words:** tropical cyclone, ensemble forecasting