



University
of Victoria

Graduate Studies

Notice of the Final Oral Examination
for the Degree of Master of Science

of

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“Effect of Equatorially Trapped Waves on the Tropical Cyclone Drift”

Department of Mathematics and Statistics

Wednesday, August 7, 2019
10:00 A.M.
David Strong Building
Room C128

Supervisory Committee:

Dr. Boualem Khouider, Department of Mathematics and Statistics, University of Victoria (Supervisor)
Dr. Slim Ibrahim, Department of Mathematics and Statistics, UVic (Member)

External Examiner:

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Chair of Oral Examination:

Dr. Vivienne Temple, School of Exercise, Science, Physical & Health Education, UVic

Dr. David Capson, Dean, Faculty of Graduate Studies

Abstract

The movement of tropical cyclones (TC) is studied numerically based on a two-dimensional barotropic model, using a previously developed non-oscillatory balanced scheme. The model of TC used here takes an exponential form, and its size and strength are selected to be of a middle scale. Without a background flow, TCs move in the northwest direction due to the beta effect. In addition, the amplitudes of high wavenumber modes of the asymmetric flow, that are believed to be responsible for the TC drift, are computed using Fourier analysis. The amplitude of wavenumber one and two modes are dominant, so they are indicators of beta conversion of energy. Also, the effect of the monsoon trough on the TC movement is investigated. The results show a sudden change of the TC propagation path, consistent with earlier work. These two studies correspond to previous works. Here, the effect of equatorially trapped waves such as Kelvin, Rossby, and Mixed Rossby Gravity, on the TC path is newly studied by varying the wavenumber and wavespeed of the underlying waves. The effect of the waves is considered because they are believed to contribute to cyclogenesis. For studying the effect, the barotropic flow induced by these waves via momentum transport and its variation were simulated for 50 days, and some patterns are found in the change of maximum wind speed. At a given time during the simulation, a TC is injected and the effect of the background wave is obtained and analyzed. Using the wavefield of 11 cases from 10 days to 30 days, the trajectories are calculated, and their patterns appear to be stochastic. So, the patterns are identified by calculating the mean path and its spread. The trajectories of TCs are different for different developed time of the waves. Kelvin waves make small variations on the length and direction of trajectory of TC. On the contrary, Rossby waves cause a dramatic change in the TC path and yield longer trajectories. Meanwhile, TCs in MRG waves keep fairly the same direction and usually have longer traveling distance. These changes vary by wave conditions. Therefore, the three kinds of waves have different effects on the trajectories of the TC. For some peculiar cases, the movements are explained based on wavefields.