Effects of the Coriolis Force on Intensity of Hurricane PALI in Ensemble Experiments

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Tropical cyclones (TCs) observations are unusual in the equatorial region from 5˚N to 5 ˚S. Therefore, previous studies studied the effects of the Coriolis force on TC in ideal experiments. These studies, however, have not shown the mechanisms for the TC intensification for realistic settings. Thus, the aim of this study is to clarify the mechanisms of the intensification of Hurricane PALI and the effects of the Coriolis force using a regional atmospheric model. PALI occurred at 4.4˚N where is nearly 200 km southeast of Oahu island, USA, on 18Z 7 January 2016 and developed to 43.7 $m \times s^{-1}$ at the mature stage (Category-2) on 18Z 12.

We conducted ensemble downscale experiments to deal with initial uncertainty. The non-hydrostatic mesoscale numerical model, WRF, with horizontal resolution of 10 km is used in the present study. To identify the effects of the Coriolis force, sensitivity experiments with Coriolis parameters are conducted. The sensitivity experiments were conducted by inputting the Coriolis forces relatively north to 10˚ every 1˚ from the calculation domain. The initial states were derived from 11 ensemble members of NOAA’s 2nd-generation global ensemble reforecast dataset. NCEP FNL (Final) Operational Global Analysis data is used as common soil data for all ensemble members and sea surface temperature fixed at the initial time. Among other settings, we used the Kain-Fritsch scheme for cumulus convection parameterization. For the initial time of 00Z 6 January, 36 hours before PALI genesis, all ensemble members forecast a cyclone with TC intensity of 17 $m \times s^{-1}$. The simulated Hurricanes move continuously toward the northwest and locate from the equator to 10˚N during forecast time.

We examined the differences of the intensity of simulated Hurricanes among different Coriolis forces. By changing Coriolis force, the intensity of hurricanes changed, but the tracks were almost the same. The result of sensitivity experiments show that larger Coriolis force does not necessarily make TCs stronger. Furthermore, it is found that the spread of TC intensity varies with the Coriolis force.

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