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A study on gravity waves generated by Typhoon Ewiniar using mesoscale model and observations

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Recently numerical modeling studies found that convection in the cloud bands accompanied by typhoon is a significant source of convective gravity waves that propagate into the middle atmosphere. Although numerical modeling is a useful tool to examine typhoon-generated gravity waves, simulation results need to be validated by comparison with observations. In this study we simulate Typhoon Ewiniar, which passed through the Korean peninsula in 2006, using a mesoscale model (WRF) to examine the characteristics of gravity waves generated by the typhoon. Then, the simulation result is validated by comparison with Atmospheric Infrared Sounder (AIRS) observation and high-resolution European Center for Medium-range Weather Forecasts (ECMWF) analysis data. From the numerical simulation, large amplitude stratospheric gravity waves having horizontal wavelengths of 200-700 km appear in the eastern side of the typhoon during northward moving of the typhoon, and they propagate eastward. After landing of the typhoon, waves propagate northeastward as the typhoon moves northeastward. Those wave patterns with similar phase and propagation direction are also found in the temperature perturbations observed by AIRS and ECMWF analysis. Westward propagating waves generated by the westward components of convective forcing are filtered out by the background wind as they enter the stratosphere where the strong shear of the easterly wind exists. For the amplitude of waves, there are differences among three datasets: Maximum amplitude from the simulation is slightly smaller compared with that in the AIRS observation, while it is about twice as large as that in the ECMWF analysis data. This difference is likely due to different typhoon intensity and distribution of convective forcing in each dataset.