Spectra of The Stratospheric GWs Induced by A Tropical Cyclone

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Source spectra of Gravity Waves (GWs) are prerequisite for gravity-wave-drag parameterization schemes (GWD). In this presentation, an unique spectra of the GWs induced by a tropical cyclone (TC) will be introduced.

The spectra was derived from a numerical simulation with a North-Western Pacific typhoon. The simulation revealed that pronounced stratospheric GWs with distinct appearance, for example, spiral wave fronts seen at 20 km altitude, were generated during a typhoon passage (TC-GWs). With conducting spectral analysis with model output, spectra of the TC-GWs were found to be also distinctive. The salient feature was that predominant GW components exhibited persistent oscillation with time periods around 14-hr. In general, the shape of momentum flux spectra with respect to horizontal wave-number and frequency was different to those having been already presented in the previous studies where corresponding mechanisms responsible for the respective GW generation have also been proposed, such as 'thermal forcing mechanism', 'mechanical oscillator effect' and 'moving mountain effect'. The singular momentum flux spectra of the TC-GWs suggests that TC-GWs were triggered by an independent mechanism.

Extensive investigation on the primary circulation of the TC, i.e., the vorticity in mid-troposphere, was conducted with using the empirical orthogonal function (EOF) method. Significant oscillation was seen in the leading EOF vectors representing the evolution of the main body of the cyclone. Concurrently, the TC related circulation in the mid- to upper troposphere was analyzed, which showed obvious indication of oscillation in the divergence field and vertical velocity field. Both oscillations share a common frequency coincided to that of the TC-GWs. Moreover, 500-km horizontal extent of the TC's primary circulation seen in the leading EOF vectors corresponds to the horizontal scale of the predominant TC-GW components (~1000 km). These reults suggested that the mechanism responsible for the generation of the TC-GWs resided in the TC's intrinsic behavior.

Oscillation in the TC's primary circulation as well as in the mid- to upper tropospheric circulation can be intepreted by the vortex Rossby wave theory, which futher explained the oscillating spectra of the TC-GWs. Details will be introduced in the presentation.