Wave activity in the tropical troposphere and lower stratosphere observed with the Equatorial Atmosphere Radar

Fumitaka Tsujino[1], Masayuki Yamamoto[2], Masatomo Fujiwara[1], Hiroyuki Hashiguchi[2], Mamoru Yamamoto[2], Shoichiro Fukao[2]

[1] Rasc, Kyoto Univ, [2] RASC, Kyoto Univ.

The tropics is the region where convective activities are very active, because of a strong solar heating and water vapor supply from the ocean. These convective activities generate equatorial waves, which have a significant influence on the global-scale atmospheric circulation. Especially, equatorial Indonesia is one of the regions where convective activities are very prominent in the tropics.

The Equatorial Atmosphere Radar (EAR), which is newly installed at Kototabang, West Sumatra, Indonesia (0.2 degrees south, 100.32 degrees east, 865m above mean sea level), can observe three-dimensional wind velocities in the whole troposphere and the lower stratosphere (2--20km) with good time and height resolution of about 85 sec and 150m, respectively. The EAR has been continuously operated since July 2001.

The purpose of this research is to clarify the seasonal variations of the equatorial waves in the troposphere and lower stratosphere over equatorial Indonesia.

The principal data used for this study are three-dimensional wind velocities obtained with the EAR for the period from July to December 2001. We classified four height regions for the wind spectral analysis : lower troposphere (2--5km), middle troposphere (5--10km), upper troposphere (10--15km) and lower stratosphere (15--20km).

At the lower troposphere, spectral peaks at 1 day were seen at all wind components. Spectral densities of meridional and zonal wind components at 1 day increased during the observational period. Spectral peaks of meridional and zonal wind components at 4--5 days matched the typical period of mixed Rossby-gravity waves. These spectral densities at 4--5 days decreased during observational period. The magnitude of spectral densities of zonal wind component was large at the period of 15 days or more. This enhancement of spectral densities was considered to be associated with Intraseasonal Oscillation (ISO).

At the lower stratosphere, spectral peaks at 1 day were also seen at all wind components. Spectral peaks at 4--5 days were also seen at meridional and zonal wind components. The time variations of spectral peaks at 4--5 days were almost the same as at the lower troposphere. The magnitude of spectral densities of zonal wind component was large at the period of 6 days or more, while enhancement in meridional wind component was not seen. Thus it is considered that this spectral enhancement was associated with the equatorial Kelvin waves.

In order to see the relation of equatorial waves and cumulus convection, we investigated infrared equivalent blackbody temperature (TBB) and wind data by National Centers for Environmental Prediction reanalyses (NCEP wind). There was a good correlation between TBB and NCEP vorticity at 500hPa. The daily variations of TBB were large when spectral peaks at 1 day at the lower troposphere were large. It is also noticed that NCEP westward wind at 300hPa and 70hPa over the Western Pacific agreed well with the spectral peaks at the period of 6 days or more period. When NCEP westward wind at 300hPa and 70hPa over the Western Pacific became weak, spectral densities at the period of 6 days or more decreased.