

OBSERVATIONS IN THE TROPICAL TROPOPAUSE REGION WITH THE EQUATORIAL ATMOSPHERE RADAR

Masayuki Yamamoto[1], Masayuki Oyamatsu[1], Takeshi Horinouchi[1], Masatomo Fujiwara[2], Hiroyuki Hashiguchi[1], Mamoru Yamamoto[1], Shoichiro Fukao[1], Manabu D. Yamanaka[3]

[1] RASC, Kyoto Univ., [2] RASC, Kyoto Univ, [3] SciTech, Kobe Univ

Now there are many controversies about the airmass motions in the tropical tropopause layer (TTL). The Equatorial Atmosphere Radar (EAR), located at the equator in West Sumatra, Indonesia (0.2 degrees south, 100.32 degrees east, 865 m above mean sea level), is a 47-MHz clear-air Doppler radar. The EAR has been observing three-dimensional wind velocities and the intensity of turbulent eddies with half the radar wavelength (about 3m) in the troposphere and the lower stratosphere (2-20km) since July 2001 [Fukao et al., 2003]. So far, the EAR has been observed the enhancement of turbulence due to an equatorial Kelvin wave [Fujiwara et al., 2003] and the frequent occurrence of the Kelvin-Helmholtz instability (KHI) around the tropical tropopause [Yamamoto et al., 2003]. In this paper, we show that the EAR has the ability of determining the tropopause height and the observational result especially in the region 0-1km above the tropopause.

A clear-air VHF Doppler radar receives the strong echo around the tropopause due to the rapid increase of static stability in the region. The scattered signals in the region comes from the horizontally stratified echo layer (Frenel reflection). By using these properties, we determined the tropopause height (Radar Tropical Tropopause: RTT) from the height profiles of echo power and echo power aspect ratio. The height of RTT was compared with the height of lapse-rate tropopause determined by the radiosonde soundings at Kototabang, and its correspondence was excellent.

The height of RTT was almost corresponding to the maximum of the westward wind (20-35m/s), and the strong vertical shear of zonal wind (10-50m/s/km) was observed in the region 0-1km above RTT. The spectral width, which indicates root-mean-square turbulent motion of the 3-m eddies, increased in the region (0.5-0.9 m/s in northward beam and 0.7-1.2 m/s in eastward beam). The spectral width observed in the zonal direction was greater than that in the meridional direction, because the vertical shear of horizontal wind generates turbulence and the vertical shear of zonal wind was stronger than that of meridional wind.

Yamamoto et al. [2003] showed that vertical wind measured with the vertical beam was continuously upward in the region 0-1 km above the tropopause in November 2001, and it contained a spurious-updraft component caused by the tilted echo layer generated by the KHI billows and the strong westward wind. Upward wind measured with the vertical wind in the region 0-1 km above the tropopause was observed throughout July-December 2001, which suggests the frequent occurrence of KHI not only in November 2001 but also in the long term. To avoid the effects of spurious vertical wind component caused by tilted echo layer generated by KHI billows and the strong westward wind, vertical wind was calculated with two symmetric meridional beams (NS vertical wind), which is little effected by the tilted echo layer and the horizontal wind to the vertical wind measurement. The NS vertical wind also showed updrafts with the magnitude of 1-5 cm/s.