Japan Geoscience Union Meeting 2014
(28 April - 02 May 2014 at Pacifico YOKOHAMA, Kanagawa, Japan)

PEM05-P02 Room:Poster Time:May 2 16:15-17:30

MQBE and Amplitude Modulation of SAO in the MLT

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Characteristics of various atmospheric waves in the mesosphere and lower thermosphere (MLT) have been investigated by long-term ground-based and satellite-based observation. In the equatorial region, the westward monthly mean wind is enhanced in March in 2 or 3 years in MLT, which is called Mesosphere Quasi-Biennual Enhancement (MQBE) [Rao et al., 2012]. Recently, They showed that MQBE appears once in 2 or 3 years until 2002, based on data analysis of meteor/MF radars in the Asia-Oceania region. However, the occurrence features remained unknown due to no sufficient wind data with high-time resolution from 50 to 80 km.

We analyzed the long-term wind data from 1990 to 2013 obtained from meteor/MF radars in the Asia-Oceania region, such as Kauai, Christmas island, Tirunelveli, Koto Tabang in order to identify the occurrence features and mechanism of MQBE. And also we investigated relationship of the monthly-mean wind between MLT stratosphere using MERRA retrospective-analyses data provided by NASA. We used integrated analysis tool " UDAS " provided by " IUGONET " (Inter-university Upper atmosphere Global Observation NETwork). And We use Stockwell-transform to detect the temporal variation of frequency and amplitude in time series data.

As a result, we found that MQBE occurred in spring of 2005, 2008 and 2011 with amplitude over 32 m/s in an altitude from 80 to 100 km . From an S-transform spectral analysis of zonal wind in MLT, MQBE coincides with the enhancement of the amplitude of 6-months component of zonal wind. Furthermore, comparing the 6-month component in the lower thermosphere at 90 km and stratosphere using retrospective-analyses data of MERRA, 6-months component of lower thermosphere(90 km) and stratopause (1 hPa) are well negative correlated. And also 6-months component of lower thermosphere and lower stratosphere (70 hPa) are well positive correlated. Their correlation coefficients are about 0.6, and lags are under 3 month. the former result is consistent with the fact that the phase of SAO are reversal in the lower thermosphere and in the stratosphere.

Although Rao et al.,[2012] reported that MQBE did not appear after 2002, the present results showed that MQBE takes place after 2002. Next, the SAO amplitude in MLT obtained from the S-transform analysis tends to be enhanced significantly, corresponding to the occurrence of MQBE. This relationship can be a clue of occurrence features of MQBE. Furthermore, the relationship of mean wind between in MLT and stratosphere indicates that MQBE is driven by coupling process of the mesosphere-stratosphere system. We can infer that MQBE is caused by atmospheric gravity waves, which is similar to the generation mechanism of QBO.

In addition, we need to detect and analyze the gravity wave in equatorial region to identify the mechanism of MQBE.

Keywords: meteor radar, MF radar, stratosphere, SAO, MQBE