ABSTRACTS (MASTER THESIS)

Atmospheric dynamics in the mesosphere and lower thermosphere on the basis of long-term-radar observations

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In order to clarify the generation mechanism of the periodic oscillations of wind velocity and their irregular variations in an altitude range of 70-110 km in the equatorial Mesosphere and Lower Thermosphere (MLT) region, we analyzed the long-term observation data obtained from the meteor/MF radars in the Asia-Oceania region. Especially, in this study, we focused on a specific phenomenon called Mesospheric Quasi-Biannual Enhancement (MQBE). The MQBE phenomenon shows an enhancement of the westward wind in March equinox with an interval of 2-3 years. If we assume that the MQBE phenomenon is an enhancement of the westward phase of the Mesospheric Semiannual Oscillation (MSAO), the MQBE phenomenon should occur also in September equinox, but this phenomenon is not actually observed in September equinox. Therefore, another process which produces one-year periodicity of wind perturbations can be thought in addition to the generation mechanism of the MSAO phenomenon; however, the mechanism remains unknown. In this study, we examined two processes: (1) coupling of the meridional wind with an annual variation, and (2) seasonal variation of the atmospheric wave activity that produces the MQBE phenomenon.

Correlation analysis between the zonal and meridional winds

In the equatorial MLT region, the meridional wind flows from the summer to winter hemisphere with an annual period (Annual Oscillation: AO), so we can consider that the wind perturbations with an annual period should appear in the zonal component due to some coupling processes between the zonal and meridional winds. However, since the Coriolis force disappears on the equator, it is theoretically expected that the zonal wind does not interfere with the meridional wind at all. Here, we examined whether the correlation between the zonal and meridional winds can be recognized by analyzing the long-term wind data obtained from the MF radar at Tirunelveli. As a result, the long-term variation of the amplitude of SAO and AO as seen in the zonal and meridional winds, respectively, resembled each other. However, we could not statistically find a crucial evidence on this relationship.

Generation process of MQBE through atmospheric gravity waves

Rao et al. [2012] reported that an enhancement of atmospheric gravity wave activity in the equatorial MLT region tends to coincide with an occurrence of MQBE. This result suggests that atmospheric gravity waves produce the MQBE phenomenon. However, in order to clarify the relationship between the gravity wave activity and MQBE occurrence, the correlation analysis between the mean zonal wind and its variance is insufficient, and we need to obtain the momentum flux associated with atmospheric gravity waves. In this study, we adopted the Hocking method [Hocking, 2005] to determine the momentum flux from the radial wind velocity observed with the meteor wind radars at Koto Tabang and Biak. Since these two meteor wind radars having the same observation system are installed at two sites in Indonesia with a longitudinal distance of 4000 km, we can evaluate the momentum fluxes derived from the Hocking method by comparing the analysis results between at Koto Tabang and Biak. As a result, the variations of the momentum flux at Koto Tabang and Biak resemble each other during two periods (2011/12-2012/04 and 2013/06-2013/10) when both the data rates are relative large. Therefore, it can be concluded that we derived the momentum flux with high accuracy by adopting the Hocking method. Moreover, using the long-term observation data obtained from the meteor wind radar at Koto Tabang, we investigated the climatology of the zonal momentum flux within an altitude range from 86 to 94 km. As a result, the zonal momentum flux showed a semi-annual oscillation indicating that the maxima appear on February and August.