

赤道ジェット電流強度と熱圏・中間圏大気擾乱長期変動の関係 Long-term variation relationship between the strength of EEJ and atmospheric disturbance in the MTI region

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The equatorial electrojet (EEJ) is a huge eastward current which flows at the dayside equatorial region of the Earth's ionosphere, in a narrow channel ($\pm 3^{\circ}$ degrees in latitudinal range). The EEJ current is observed as an enhanced magnetic variation of horizontal component of geomagnetic field at the dayside magnetic dip equator. In the past studies, many researchers showed that the main mechanism of EEJ is an effect of polarization electric field in the E region of the ionosphere at the dip equator caused by the horizontal magnetic field at the magnetic equator [e.g., Forbes, 1981]. In a recent study, the observation of atmospheric radars located at the equatorial region showed the existence of neutral wind in the E region of the ionosphere and vertical polarization electric field derived from ionospheric dynamo generated by the gravity wave originating from the lower atmosphere [Aveiro et al., 2009]. In addition, Fang et al. (2008) shows the relationship between wind dynamo effect and EEJ by using their simulation model. However, lack of the long-term comparison analysis of geomagnetic field and wind data obtained from ground magnetometer and atmospheric radars, the detailed relationship between the EEJ and neutral wind fluctuation at the mesosphere and lower thermosphere (MLT) regions has not yet been revealed.

To clarify the relationship between the variations of the EEJ strength and neutral wind at the MLT regions, we perform the long-term comparison analysis of geomagnetic field and neutral wind data obtained from ground magnetometer and medium frequency (MF) radar located at the equatorial region. We use the neutral wind data estimated from the MF radar at Pamuenpauk, which has been operated by Research Institute for Sustainable Humanosphere, Kyoto University. We also used many magnetometer data observed at CEB (geomagnetic latitude=2.53, geomagnetic longitude=195.06), DAV (-1.02, 196.54), YAP (1.49, 209.06), ANC (0.77, 354.33), and EUS (-3.64, 34.21). CEB, DAV, and YAP are located in the Asia and Pacific region, close to the MF radar. ANC and EUS are located at the South America region, far from the radar site. All the magnetometers belong to MAGDAS managed by Space Environment Research Center, Kyushu University. We can observe global and local effect by using these magnetometers and radar data. The analysis period is from 1996 to 2011, over one solar cycle.

As a result, the relationship between the variations of zonal wind and the residual-EEJ showed a clear inverse correlation. Here, the residual-EEJ is defined as the deviation from the second order fitting curve between the F10.7 solar flux and the EEJ amplitude. This trend is observed in not only the Asia Pacific region (close to the radar) but also the South Africa region (far from the radar site). In addition, we performed the frequency analysis to quantitatively define the relationship of zonal wind and residual-EEJ. These results suggest that the vertical current (J_z), which is generated by the dynamo action due to the zonal wind perpendicularly across to the background magnetic field, changes the Cowling conductivity derived under the condition of $J_z=0$. On the other hand, there was no correlation between the variations of the meridional wind and the residual-EEJ amplitude. This implies that the meridional wind parallel to the background magnetic field does not contribute to the dynamo action. These results allow us to solve the Cowling conductivity including the neutral wind effect, and offer new insight into the study of ionosphere-aerosphere coupling at the equatorial region.

Keywords: equatorial electrojet, MF radar, magnetometer, IUGONET, neutral wind