Long-term relationship between thevariations of equatorial electrojet and neutral wind in the mesosphere and thermosphere

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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 (+-3˜5 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 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]. 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 netral wind data obtained from ground magnetometer and medium frequency (MF) radar located at the equatorial region. We used the magnetometer data observed at YAP (dip latitude=1.70), which belongs to MAGDAS managed by Space Environment Research Center, Kyushu University. We also use the neutral wind data estimated from the MF radar at Pamuenpauk, which has been operated by Research Institute for Sustainable Humanosphere, Kyoto University. The analysis period is from 2007 to 2010.

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 result suggests that the vertical current (Jz), 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 Jz=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.