Dependence of low-latitude thermospheric wind on geomagnetic disturbance

Tomoaki Hori[1]; Yuichi Otsuka[2]; Kazuo Shiokawa[2]; Atsuki Shinbori[3]
[1] STE lab., Nagoya Univ.; [2] STEL, Nagoya Univ.; [3] RISH, Kyoto Univ.

A statistical study has been made on variations in horizontal neutral wind velocity in the thermosphere at altitudes of ˜400 km observed as Doppler shifts in 630 nm wavelength night airglow taken by the Fabry-Perot Interferometer (FPI) at Shigaraki (34.8N, 136.1E). The goal of the present study is to examine characteristics of the low-latitude thermospheric wind during geomagnetically active periods and address its role in evolving disturbance dynamo. For this purpose, unlike most of the past studies examining correlations with the Kp index, the present study focuses on correlations with the AE index which directly reflect the Joule heating in the polar region. On the basis of the long-term (2000-2009) FPI data with the filter for 630 nm, we firstly construct the quiet-time model of large-scale thermospheric wind above Shigaraki by sorting the data with very low AE activities by local time, season, and solar activity and then averaging them for each condition. Subtracting the quiet-time averages from the observed wind velocities, we conduct superposed epoch analyses on evolution of the residual wind velocity associated with auroral electrojet activities by referring to the AE index. As a result, the thermospheric wind velocity starts shifting westward and slightly southward 1-2 hours after AE rises from the quiet to high (˜several hundreds of nT or greater) level. In particular, the westward shift of low latitude thermospheric wind becomes larger with increasing intensity and duration of AE activity. These changes of wind velocity with AE activities are basically consistent with the scenario of disturbance dynamo that the Joule heating caused by enhanced auroral electrojets in the polar region generates an additional, large-scale equatorward wind and the equatorward wind changes its direction to the west as it comes over to the low-mid. latitude region where the interaction of the westward neutral wind with ionospheric plasma drives a dynamo for an eastward current in the night-time equatorial ionosphere. Our detailed statistics also reveal that the westward shift is more evident in the post-midnight sector than pre-midnight and this local time asymmetry becomes clearer during summer. These spatial structures may be formed by mechanical interactions between the disturbance wind component and the global background wind primarily driven by the thermaltide caused by the Sun.