Thermospheric winds in the vicinity of auroral arcs

Lei CAI[1,2], Shin-ichiro OYAMA[1], Anita AIKIO[2], Heikki VANHAMÄKI[2], and Kirsti KAURISTIE[3]

(1) Institute for Space-Earth Environmental Research, Nagoya University, Japan

(2) Ionospheric Physics Unit, University of Oulu, Finland

(3) Finnish Meteorological Institute, Finland

Momentum and energy input from the magnetosphere to the ionosphere is one of the primary sources that force the high-latitude thermospheric dynamics. This forcing can disturb the thermospheric wind in various temporal and spatial scales. Compared with the change of global circulation, mesoscale (less than a few hundreds of kilometers) and small scale (a few tens of kilometers) disturbances are less studied due to the lack of observations. One of the most concerned disturbances is the thermospheric response in the vicinity of the auroral arc. Although the arc is the simplest form of aurora, its electrodynamics and the effect on thermosphere can be an essential process to understand coupling of the magnetosphere-ionosphere-thermosphere system.

The Fabry-Perot Interferometer (FPI) at Tromsø in Norway with the switchable filters for the 557.7 nm and 630.0 nm emission lines has been used to observe the thermospheric wind in both E and F regions since 2009. The high-resolution mode of the FPI can measure the wind velocity with a time resolution of 6 min. Auroral arc events were selected with simultaneous measurements by the EISCAT radars, MIRACLE network, and satellites, which give the electric field, conductivities, and currents. The horizontal wind has a significant westward acceleration accompanied with the equatorward motion of the auroral arc in the evening sector. We estimate each term in the momentum equation to investigate the relative importance between ion-drag force and Joule heating in determining the horizontal acceleration. The vertical wind has a clear fluctuation, and the fluctuation becomes stronger with the brightness of the auroral arc. The physical mechanism for fluctuations in the vertical wind will be discussed. The winds in the upper and lower thermosphere in response to the auroral activity will be compared.