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FPI-derived lower thermospheric wind at high latitude during DELTA-2 campaign for periods of geomagnetic disturbance

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Simultaneous observations were conducted with a Fabry-Perot interferometer (FPI) at a wavelength of 557.7 nm, an all-sky camera at a wavelength of 557.7 nm, the European Incoherent Scatter (EISCAT) UHF radar, and a rocket-borne chemical release method using trimethyl aluminum during the Dynamics and Energetics of the Lower Thermosphere in Aurora 2 (DELTA-2) campaign in January 2009 near Tromsoe, Norway. A notable advantage of this campaign was the intensive measurement of the thermosphere and ionosphere with various independent instruments, which provided thermospheric wind velocity, ionospheric density and temperature, electric field, and auroral intensity. Since these physical parameters were simultaneously obtained from a localized volume of the thermosphere and ionosphere, ambiguities caused by data interpolation under assumption of spatiotemporal homogeneity were minimized. This paper concentrated on the lower-thermospheric wind dynamics at the poleward side of a bright aurora associated with breakup at 00:23 UT on 26 January 2009. The FPI showed that the lower-thermospheric wind (in altitude range of 120-150 km) was accelerated upward and poleward by 17 m/s and 29 m/s, respectively, for 2.75 minutes. The Joule and particle heating rate and the Lorentz force were calculated from the EISCAT radar data then estimated the wind acceleration due to thermal expansion and momentum transfer by collisions. The comparison of the wind acceleration between the observed and the predicted suggested that the observed acceleration was larger than the predicted one by more than 1 order, although the data set minimized ambiguities induced by assumption of the spatiotemporal homogeneity. This paper proposed another energy dissipation process in association with fluctuating electric field at frequency of about 10 Hz. While there were no diagnostic tools during the DELTA-2 campaign for measuring the fluctuating electric field, predicted temperature enhancements were in sufficient level to explain the observed wind acceleration.

Keywords: aurora, airglow, optical instrument, ionosphere, thermosphere, high latitude