Lower thermospheric wind variations in auroral patches during the substorm recovery phase

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Measurements of the lower thermospheric wind with a Fabry-Perot interferometer (FPI) at Tromsø, Norway, found the largest wind variations in a night during the appearance of auroral patches at the substorm recovery phase. Taking into account magnetospheric substorm evolution of plasma energy accumulation and release, the largest wind amplitude at the recovery phase is a fascinating result. The results are the first detailed investigation of the magnetosphere-ionosphere-thermosphere coupled system at the substorm recovery phase using comprehensive data sets of solar wind, geomagnetic field, auroral pattern, and FPI-derived wind. This study used three events in November 2010 and January 2012, particularly focusing on the wind signatures associated with the auroral morphology, and found three specific features: (1) wind fluctuations that were isolated at the edge and/or in the darker area of an auroral patch with the largest vertical amplitude up to about 20 m/s and with the longest oscillation period about 10 min, (2) when the convection electric field was smaller than 15 mV/m, and (3) wind fluctuations that were accompanied by pulsating aurora. This approach suggests that the energy dissipation to produce the wind fluctuations is localized in the auroral pattern. Effects of the altitudinal variation in the volume emission rate were investigated to evaluate the instrumental artifact due to vertical wind shear. The small electric field values suggest weak contributions of the Joule heating and Lorentz force processes in wind fluctuations. Other unknown mechanisms may play a principal role at the recovery phase.