Thermospheric wind variations at substorm onset: Multi-event study using a Fabry-Perot interferometer at Tromsoe, Norway

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Introduction

In this study, we focused on the thermospheric wind variations at the onset of isolated substorms. Substorms input energy into the ionosphere from the magnetosphere, during which the high-latitude ionosphere and thermosphere are severely influenced. One purpose of this study is to find the characteristics of thermospheric wind variations at the substorm onset. At the same time, we expect to investigate the possibility that wind variations as a potential driver of substorm-onset-related ionospheric current system according to the magnetosphere-ionosphere coupling substorm model [Kan, 1993].

A Fabry-Perot interferometer (FPI) at Tromsoe of Norway provided us with wind observations from Doppler shift of both red-line (630.0 nm for the F region) and green-line (557.7 nm for the E region) emissions of aurora and airglow. We used seven-year data from 2009 to 2015 with a time resolution of ~13 min. We obtained 4 red-line events and 5 green-line events located at different local times. In order to discuss the possible causes of these wind variations, we checked the IMAGE magnetometer data, all-sky auroral images, directional winds as well as the real-time SuperDARN and EISCAT data.

Conclusions

We checked SuperDARN data, but there were no reliable echoes. We have EISCAT data for one event, we averaged the ion drift velocities over 180-280 km.

Fig. 1. AE indices for all the event times.

Fig. 2. X-component of magnetometer data at TRO and Bjin stations.

Fig. 3. 4-h wind variations of green-line events over-plotted on the auroral keograms. We calculated the weighted means in two time intervals (during and after the substorm onset). The differences of them were used to indicate the degree of variation (wind velocity variation vector).

Fig. 4. Altitudinal averaged EISCAT ion drift velocity.

Fig. 5. Wind velocity variation vector on the polar plot.

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