極冠域電離圏プラズマの構造化: 高速大気光撮像で見えてきたもの

細川 敬祐 [1]; 田口 聡 [1]; 小川 泰信 [2]
[1] 電通大; [2] 極地研

Plasma structuring in the polar cap ionosphere: an observation with all-sky airglow imager in Longyearbyen, Norway

Keisuke Hosokawa[1]; Satoshi Taguchi[1]; Yasunobu Ogawa[2]
[1] UEC; [2] NIPR

http://gwave.ice.uec.ac.jp/˜hosokawa

A highly sensitive all-sky EMCCD airglow imager has been operative in Longyearbyen, Norway (78.1N, 15.5E) since October 2011. One of the primary targets of this optical observation is polar cap patches which are defined as islands of plasma density enhancement drifting anti-sunward across the central polar cap. Since the electron density within patches is often increased by a factor of 2-10 above that in the surrounding region, all-sky airglow measurements at 630.0 nm wavelength are capable of visualizing their spatial distribution in two-dimensional fashion. The EMCCD imager in Longbyearbyen captures 630.0 nm all-sky images with an exposure time of 4 sec, which is about 10 times shorter than that achieved by conventional cooled CCD imagers. This enables us to image smaller scale structure of polar cap patches without blurring effects and better estimate their periodicities.

We present, as one of the first results from the observations in Longyearbyen, an event of polar cap patches on the night of December 21, 2011. During a 4-h interval from 1900 to 2300 UT on this day, we identified several patches passing through the field-of-view of the imager. A time-series of the optical intensity at zenith showed modulations having two distinguished periods, one at 40 min and the other at 5-12 min. We suggest that such a coexistence of two different periodicities is a manifestation of simultaneous occurrence of patch generation processes in the dayside cusp. Namely, the 40 min periodicity was created by large-scale reconfiguration of the dayside convection pattern due to changes in IMF, while the 5-12 min modulations were closely associated with transient processes directly driven by pulsed reconnections on the dayside magnetopause.

In addition to the above mentioned periodic structures of 5-12 min, we also identified small-scale (˜50 km) undulations along the trailing edge of the patches. Such undulating structures were found to propagate in the direction perpendicular to the motion of the patches. If we assume the gradient drift instability (GDI) as a possible structuring mechanism of patches, structuring occurs only on the trailing edge of patches; thus, GDI may explain the undulations. The current observation implies that the spatial structure of polar cap patches is characterized not only by the generation processes in their source region but also through on-going plasma instabilities during their travel in the central polar cap. To consider such a combined effect of multiple structuring processes would be of particular importance for evaluating the impact of patches on the trans-ionospheric communication environment in the polar cap.