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Structuring of polar cap patches: all-sky airglow observations in Longyearbyen, Svalbard

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A highly sensitive all-sky EMCCD airglow imager has been operative in Longyearbyen, Svalbard (78.1N, 15.5E) since October 2011. Primary target of this optical observation is ”polar cap patches” which are defined as regions of plasma density enhancement drifting anti-sunward across the polar cap. Since the electron density within patches is often enhanced by a factor of 2?10 above a background level, airglow measurements at 630.0 nm wavelength are able to visualize their spatial structure in two-dimensional fashion. The imager in Longyearbyen obtains the 630.0 nm all-sky images with an exposure time of 4 sec, about an order of magnitude shorter than the conventional cooled CCD airglow imager. This could allow us to capture the small-scale plasma structuring process occurring in the vicinity of patches.

We present, as one of the first results from the imager, an event of polar cap patches drifting anti-sunward during the southward IMF conditions. On the night of December 21, 2011, between 1900 and 2300 UT, several polar cap patches were observed by the imager near midnight. The patches were much more elongated in the direction perpendicular to their motion. They passed through the zenith every about 7 min, which is comparable to the periodicity of the flux transfer event in the dayside equatorial magnetopause. This may imply that the patches during the current interval were generated in close association with transient reconnection on the dayside. In some images, small-scale undulations (˜50 km scale) were identified along the trailing edge of the patches. This may be an indication that the structuring of patches is dominated by the gradient-drift instability because the trailing edge of patches is expected to be unstable for the gradient-drift waves in their linear stage.

Keywords: Polar cap patches, Plasma instability, Plasma convection, Airglow observations, Polar ionosphere