

Edge of polar cap patches

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A highly sensitive all-sky EMCCD airglow imager (ASI) has been operative in Longyearbyen, Norway (78.1N, 15.5E) since October 2011. One of the primary targets of this optical observation is a polar cap patch which is defined as an island of enhanced plasma density in the F region 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 2D fashion.

During a 4-h interval on the night of December 4, 2013, a series of polar cap patches was observed by the ASI in Longyearbyen. By using the high-quality ASI images, we estimated the gradients in the leading/trailing edges of the patches and found that the gradient in the leading edge is 2-3 times steeper than that in the trailing edge. We also identified finger-like undulating structures growing along the trailing edge of the patches. Generation of these fingers is probably governed by a structuring through the gradient-drift instability which is known to occur only along one side of patches.

From these observations, we suggest that such a structuring process can transport and mix the patch plasma across their trailing edges so that the scale size of the edges get extended. This means that the structuring through the plasma instability can strongly influence the large-scale shape of patches. Such a knowledge is of particular importance for better understanding the space weather effects of patches on the trans-ionospheric satellite communications in the polar cap region.

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