On the shape of polar cap patches

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Polar cap patches are loosely defined as large-scale (large than 100 km) regions in which the F region plasma density is significantly enhanced (more than 100 %) above the background level. Once they are generated on the dayside, they are transported toward the nightside across the central polar cap along the streamline of the higher latitude portion of the twin-cell convection pattern.

In this paper, we statistically investigated the shape of polar cap patches and try to discuss possible factors controlling their shape such as a stirring due to some plasma instabilities. The statistical analysis is based on the optical data obtained by an all-sky airglow imager at Resolute Bay, Canada (geographic latitude 74.7; geomagnetic latitude 82.9) in the last 4 years. We developed an algorithm for tracing the edges of patches from the flat-fielded all-sky images automatically. Then, the algorithm was applied to 314 individual patches that were detected by the method proposed by Hosokawa et al. [2009]. Consequently, the average shape of the patches was visualized in a two dimensional fashion. We also derived the moving direction of the patches by the method of Hosokawa et al. [2006]. Then, we examined a dependence of the scale size of patches on the direction relative to their motion.

As a result, the shape of the patches is found to be asymmetric in their moving direction. Namely, the trailing edge of the patches is found to be more elongated (1.3 times) than the leading edge. This may suggest that stirring processes are working more effectively on the trailing edge. We discuss the cause of the asymmetric shape of the patches in terms of plasma stirring process such as gradient-drift instabilities.