Relationship between the By component of Interplanetary Magnetic Field and occurrence of polar cap patches

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Polar cap patches are regions of high density plasma in the polar cap F region ionosphere. The electron density within patches is known to be 2 to 10 times higher than that in the surrounding region. It has been suggested that patches are produced by long distance transportation of high-density plasma from the dayside sunlit area towards the dark central polar cap region by the anti-sunward convection during negative Bz conditions. Polar cap patches have been observed in many places in the polar cap. In the past, however, most of the observation stations were located at magnetic latitudes around 80 degrees (e.g., Resolute Bay in Canada and Longyearbyen in Norway). Thus, continuous observations at a fixed point in the magnetic coordinate system have not yet been done due to the rotation of the Earth. This has made it difficult to follow the statistical characteristics of patches, especially seasonal and UT dependence of their occurrence. In this study, we statistically investigate the occurrence distribution of polar cap patches by using data from a station near the magnetic pole and clarify the factors controlling the generation of patches.

We have used 630.0 nm all-sky images from Eureka, Canada (80.0 N, 85.9 W, 87.7 MLAT) for almost three winter seasons from 2015 to 2017. The amount of data used is 85 days in 2015, 108 days in 2016 and 47 days in 2017, respectively. We automatically identified the appearance of patches from a time-series of the optical intensity at zenith and made a list of patches. Then, we manually checked all the patches in the list and discarded other phenomena such as polar cap aurorae which have been miss-identified by the automated detection. By using this list of patches, we analyzed how the occurrence of patches depends on UT, season, and IMF. As a result of the statistics, generation of patches is dominated not only by the Bz component of IMF but also season, UT and IMF By. In particular, we found that polar cap patches were observed more often when the IMF By was positive, which has not suggested in the previous studies. In actual, the occurrence of patches was 3 times higher during positive IMF By periods. That means more patches should be observed during intervals of away sector of the IMF (IMF By is positive and Bx is negative in the away sector). To interpret this result, first we suspected a bias in the occurrence of toward and away sectors. However, there was not such a difference during the period of statistical analysis. We also tried to explain the result by the so-called Russell-McPherron effect by comparing the distribution of the polar cap patches in autumn and spring. But, the bias due to the Russell-McPherron effect was not clear. Therefore, at this stage, we speculate that the shape of polar cap convection pattern is favorable for capturing and transporting dense plasma in the duskside sunlit region during the positive IMF By intervals. To evaluate this scenario, we visualize the average pattern of plasma convection in the polar cap area during intervals of positive IMF By patches by analysing data from the SuperDARN radars in a statistical way. In the presentation we will present the results of this analysis and discuss the origin of the observed preference of patch occurrence for positive IMF By intervals.