IMF By dependence of polar cap patch occurrence: statistics using airglow data from Eureka, Canada in comparison with SuperDARN convection patterns

K. Hosokawa[1], M. Nagata[1], K. Shiokawa[2] and Y. Otsuka[2]

[1] University of Electro-Communications, Tokyo, Japan

[2] Solar-Terrestrial Environment Laboratory, Nagoya University, Nagoya, Japan

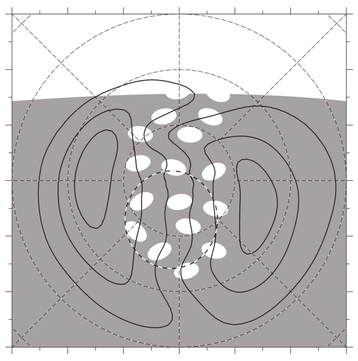
Background - Polar patches and all-sky imager at EUR

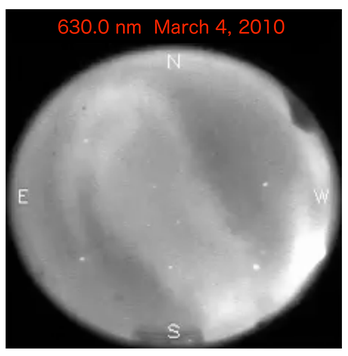
What are polar cap patches

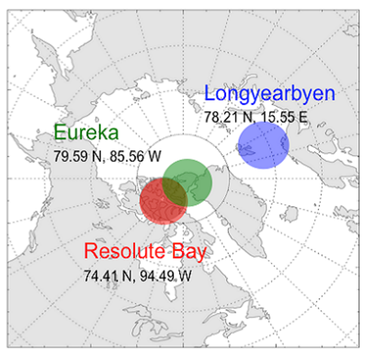
1. Horizontal scale: 200-1000 km
2. 2-10 times denser plasma density
3. Often accompanied by FAIs

A highly sensitive all-sky airglow imager has been operative since October 2015 at Eureka, Canada

557.7nm, 630.0nm, OH-band every 2 min

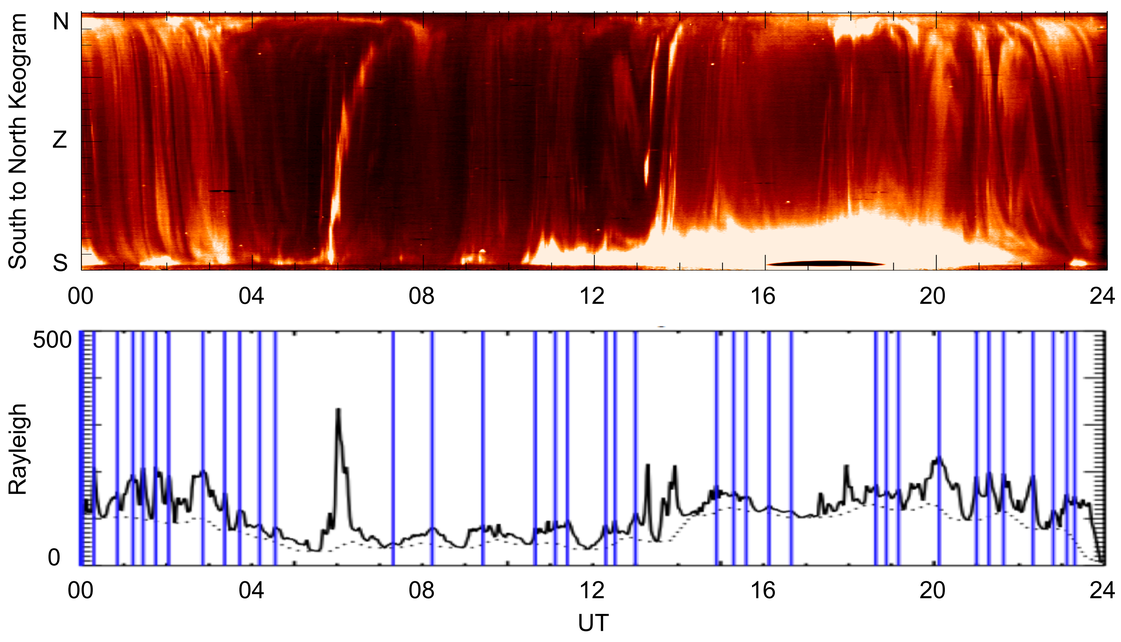






Automated detection of polar cap patches from ASI data

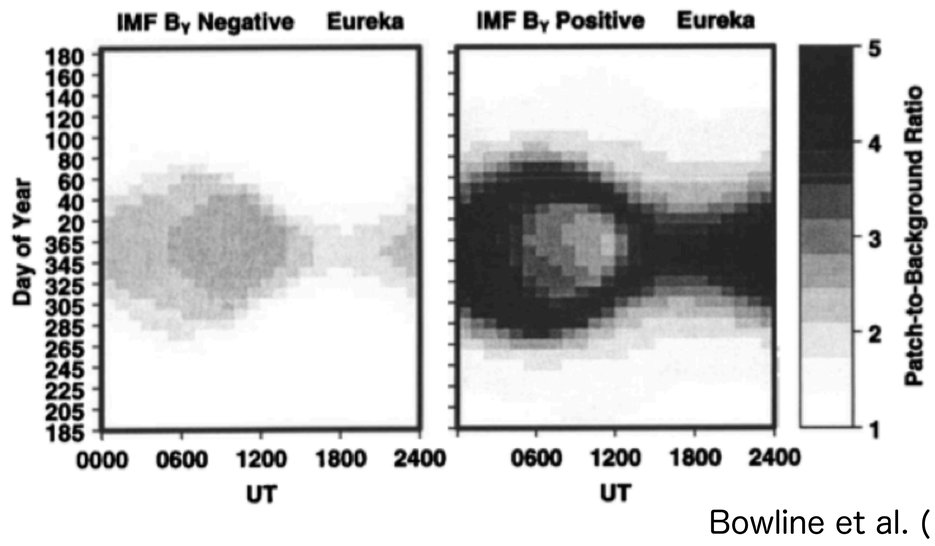
In this study, we investigate the occurrence distribution of polar cap patches by using data from Eureka and clarify the factors controlling the generation of patches. We have used 630.0 nm all-sky images from two winter seasons from 2015 to 2017. The amount of data used is 87 days in 2015-2016 and 89 days in 2016-2017, respectively. We automatically identified the appearance of patches from the time-series of the optical intensity at zenith and made a list of patches.



We have removed possible contaminations from other sources, for example polar cap aurora, through manual inspection.

Dependence of patch occurrence rate on IMF By and UT

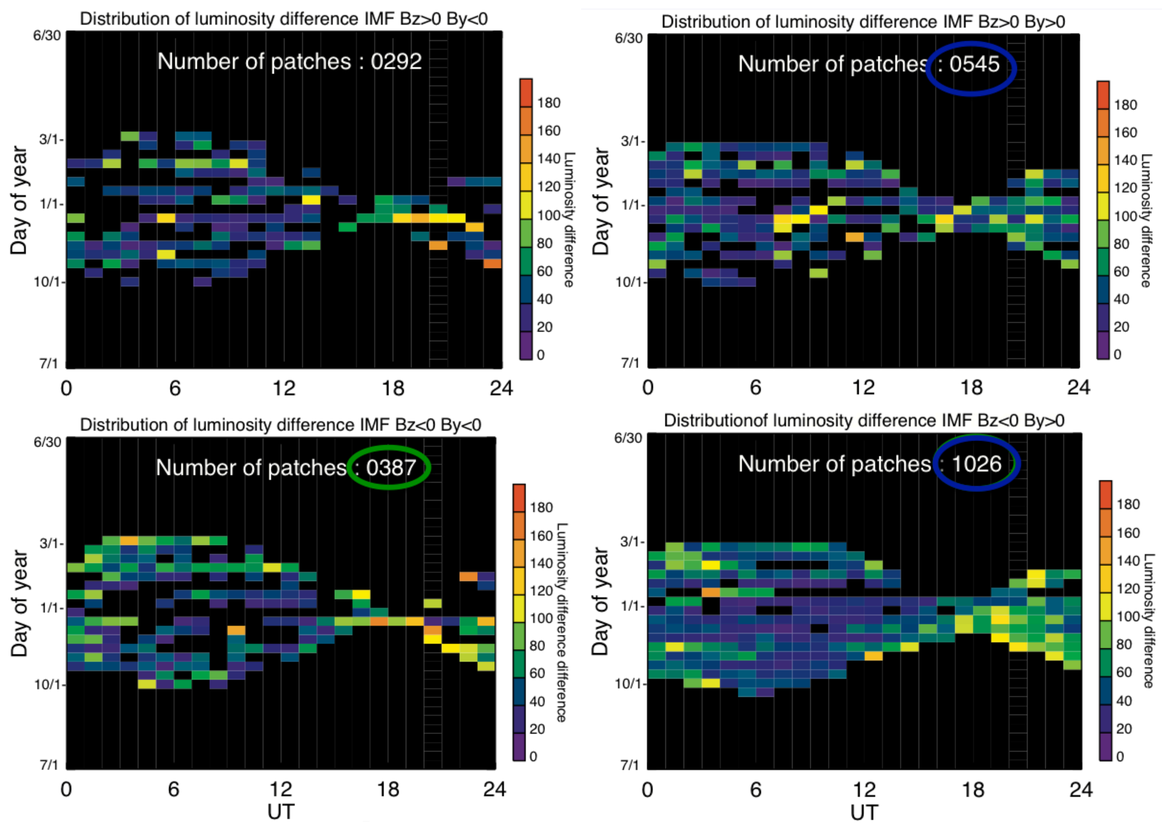
Previous simulation studies (Bowline et al., 1996) suggested that the occurrence of polar cap patches tends to be higher during positive IMF By intervals in the central polar cap region (for example at Eureka). There is also a noticeable dependence of the occurrence on the UT.



Bowline et al. (1996)

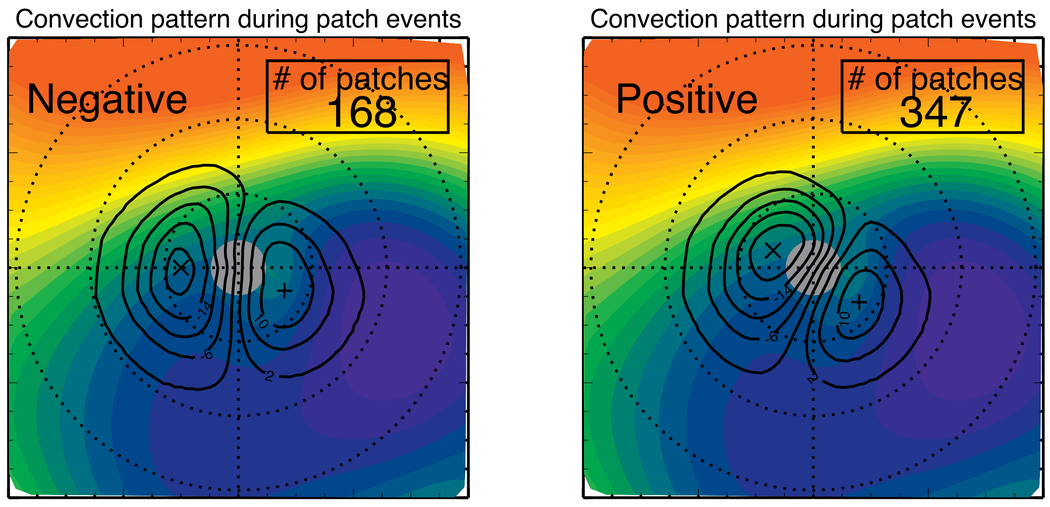
Statistical results

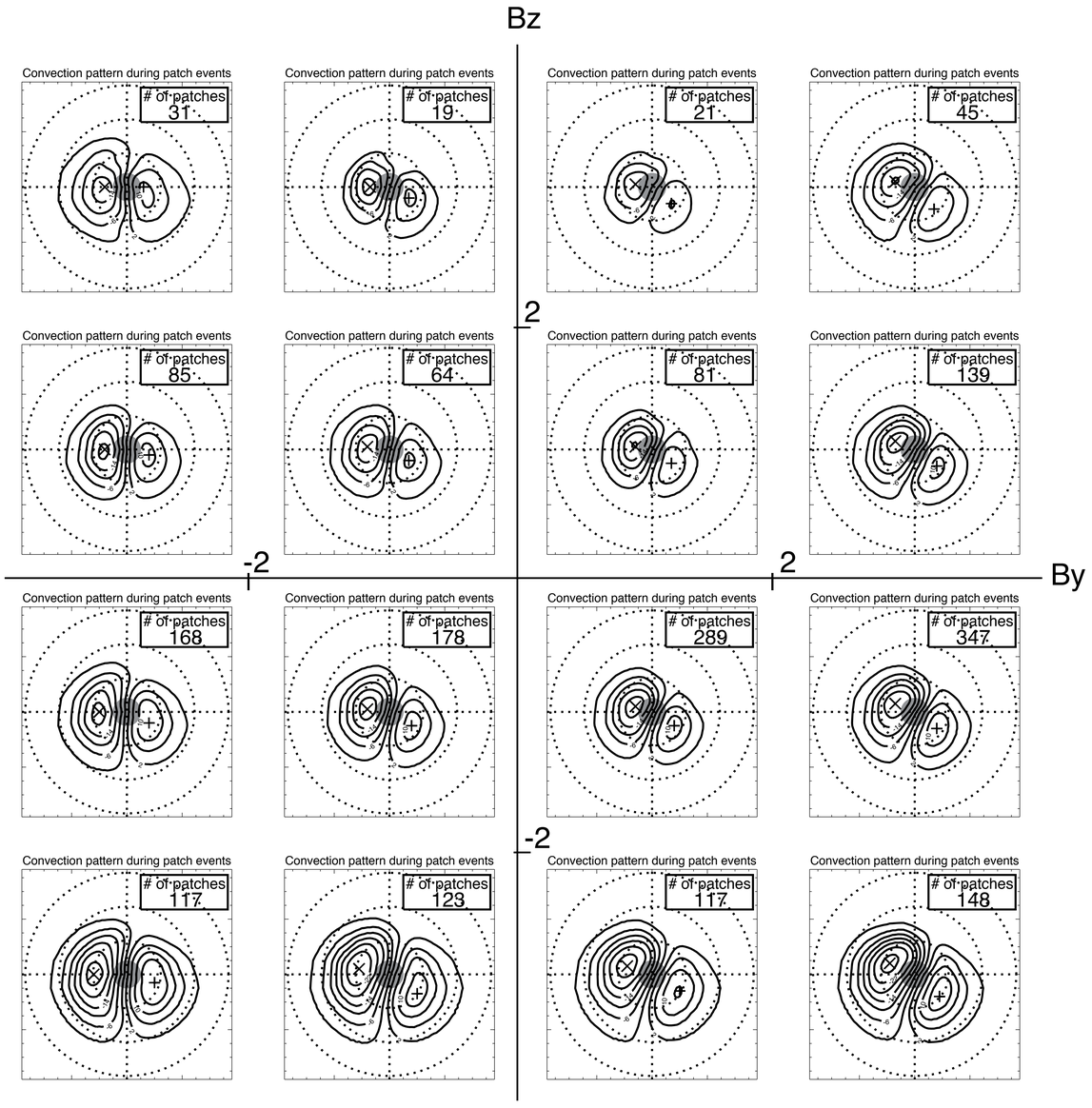
By using this list of patches, we investigated the dependence of patch occurrence on the IMF By statistically. As a result, it was found that when the IMF By is positive, the number of polar cap patches was twice of that in the negative IMF By cases.



Average patterns of high-latitude convection during patch intervals derived from SuperDARN map potential data

By deriving average convection patterns from the archived SuperDARN map potential data, we confirmed that the configuration of plasma convection is more appropriate for patches to be transported toward the magnetic pole during the positive IMF By conditions, which is the primary reason for the asymmetric occurrence of patches in respect to the sign of IMF By.





Summary and conclusion

★ The occurrence rate (and luminosity) of polar cap patches detected by an all-sky airglow imager deployed near the magnetic pole at Eureka, Canada was examined statistically

★ The statistics shows that the occurrence of patches is approximately twice higher during positive IMF By conditions confirming strong asymmetry against IMF By

★ The observed asymmetry in the occurrence of patches regarding IMF By orientation can be explained by the shape of high-latitude convection pattern

★ Especially, the spatial overlap between the high-density sunlit plasma on the duskside and the shape of the convection was found to be critical for the patch generation and subsequent transport to the central polar cap