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全天カメラと EISCAT レーダーによるポーラーパッチの同時観測
Simultaneous observation of polar cap patches with all-sky imager and EISCAT radars

坂井 純 [1*], 田口 聡 [1], 細川 敬祐 [1], 小川 泰信 [2]
SAKAI, Jun[1*], TAGUCHI, Satoshi[1], HOSOKAWA, Keisuke[1], OGAWA, Yasunobu[2]

[1] 電気通信大学, [2] 国立極地研究所
[1]The University of Electro-communications, [2]National Institute of Polar Research

The airglow intensity of polar cap patches is related to the local electron density profile of the polar cap ionosphere as well as the profiles of neutral gases that contribute to optical emission. Concurrent operation of an all-sky imager and incoherent scatter radars enables simultaneous observations of optical intensity of polar cap airglow and ionosphere parameters. An all-sky airglow imager equipped with a high sensitivity EMCCD detector has been deployed in Longyearbyen, Svalbard (78.1 N, 16.0 E) since October 2011. The imager's fine time and 2D resolution and its proximity to the EISCAT Svalbard radar (ESR) provide opportunities to study the relationship between the optical intensity and electron density of polar cap patches. By virtue of the spatial resolution of approximately 2 km per pixel, it is possible to identify a fine structure of the electron density in the region where the ESR beam crosses at a particular altitude. A 4-second exposure time of the imager combined with its high spatial resolution allows us to detect rapid changes in patch structures which have not been possible to identify with radar-alone observations.

In this study we analyze a storm time polar cap patch event combining the data obtained by the all-sky imager and two radars, the ESR and mainland EISCAT UHF radar. An interval between 17 UT and 24 UT on 22 January 2012 is studied. The variations of optical intensity and electron density show a good agreement, which enables us to cross-calibrate the two parameters. Cross examination of optical intensity and electron density reveals steep gradients and sharp edges of patch structures as narrow as a few kilometers. Temporal variations obtained from the two EISCAT radars suggest that some patches were transported antisunward from the polar cap to lower latitudes, which is in good agreement with the all-sky imager observation. These facts suggest that electron density structures may travel across the polar cap from the cusp region to the night side auroral zone keeping their sharp density gradients.

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