Polarization electric field inside auroral patches: Simultaneous experiment of EISCAT radars and KAIRA

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We primarily concern with the motion of the auroral patches and the polarization electric field generated inside the auroral patches. We investigated those relationship using data obtained simultaneously with the EISCAT radars, KAIRA, and all-sky imagers on 9 November, 2015. This simultaneous observation provided the electric field, the electron density/temperature, and ion velocity/temperature with a temporal resolution of 1 min. Auroral patches were captured by the all-sky camera at Tromso from 02:40 to 03:10 UT. Based on the all-sky camera data, the drift speed of auroral patches was estimated from 313 to 383 m/s and its direction was almost east corresponding with the southward electric field from 14.1 to 17.2 mV/m. The convective electric field was derived about 14.9 mV/m in the southward direction by the EISCAT radars and KAIRA experiment. The electric field estimated from the drift speed of auroral patches approximately corresponded with the convective electric field. This indicates that the motion of the auroral patches was governed the convective electric field.

We found that the electron density increased in the lower E region (below 110 km) inside of these auroral patches. The Hall and the Pedersen conductance were calculated from the electron density data observed by the EISCAT VHF radar. Although the Hall conductance enhanced from 80 to 120 km, there were no remarkable enhancements in the height profile of the Pedersen conductance. Since the polarization electric field relative to the Hall conductance enhancement was likely to be generated inside the auroral patches in this case, we calculated the polarization electric field based on the current continuity. As a result of the calculation, the polarization electric field was estimated to be from 28.7 to 37.4 mV/m. However the observed ion velocity was much less than expected by the acceleration of the polarization electric field. If the polarization electric field was weakened to 40%, the observed and expected ion velocity showed the good agreement. Thus, the magnitude of polarization electric field was slightly small compared with the convective electric field and its direction was approximately perpendicular to the convective electric field. Furthermore, according to height profile of the ion velocity, the polarization electric field propagated up to 200 km at least. In this presentation, we will summarize these results and explain the generation mechanism of the polarization electric field inside the auroral patches.

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