Polarization electric field inside of auroral patches observed with EISCAT and KAIRA radars

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A pulsating aurora (PsA) is a quasi-periodic modulation of the auroral luminosity with a period from a few seconds to a few tens of seconds. It is well known that the intensity of the PsA is typically excited by the precipitation of electrons in the energy range from a few keV up to a few tens of keV. The high energy electrons release their energy into the ionosphere by modulating the ionospheric parameters such as electron density. In a previous study, ion velocity variations harmonized with PsA were observed by SuperDARN radar. The main cause behind this phenomenon has been considered to be the polarization of the electric field, which is generated by the enhancement of the ionosphereic conductance inside PsA patches. A previous EISCAT radar observation has revealed the response of electron density and Hall conductance to the appearance of the pulsating auroras. However, it is still not clear what is the exact relationship between the variations of the direction of the electric field, the ionosphereic conductance, and the optical pulsation.

On November 9, 2015, the EISCAT Tromsoe UHF and VHF radar operated with the KAIRA instrument installed at Kilpisjarvi, Finland. This simultaneous observation provided the electric field, the electron density/temperature, and ion velocity/temperature with a temporal resolution of 5-sec from the E region to F region. Auroral patches were captured by the all-sky camera at Tromsoe from 02:40 to 03:10 UT. We found that the electron density increased in the lower E region (below 110 km) inside of these auroral patches. Thus, the edges of the PsA patches seemed to be polarized by the Hall conductance enhancement. The ion velocity of the northward direction was increased during the PsA patches passed above Tromsoe. This indicates that the eastward electric also increased at that time. This electric field modulation was consistent with the polarization of the electric field created by the enhancement of the Hall conductance. In this presentation, we will summarize these results and explain the generation mechanism of the polarization electric field caused by the Hall conductance enhancement in the E region.