Characteristics of the ionospheric variations in the dayside polar region

Hitoshi Fujiwara[1]; Satonori Nozawa[2]; Yasunobu Ogawa[3]; Yasunobu Miyoshi[4]; Hidekatsu Jin[5]; Hiroyuki Shinagawa[5]; Chihiro Tao[5]
[1] Faculty of Science and Technology, Seikei University; [2] ISEE, Nagoya Univ.; [3] NIPR; [4] Dept. Earth & Planetary Sci, Kyushu Univ.; [5] NICT

Some observations have revealed existence of the significant ionospheric variations in the polar cap region. Since the steep density gradients in the polar cap ionosphere may cause severe problems in radio wave communications, e.g. GPS navigation for trans polar flights, it should be one of important space weather issues to understand variations of the polar cap ionosphere.

The origins of the disturbances are thought to be transport of plasma produced by the solar EUV and/or auroral processes from the lower latitude (namely, polar cap tongue of ionization, polar cap patches, and blobs) and/or insitu particle precipitation and heating in the polar cap region. We have observed spatio-temporal variations of the dayside polar cap ionosphere with the European Incoherent Scatter (EISCAT) radar system to investigate characteristics of the ionospheric variations in the dayside polar region and their origins. The EISCAT observations enable us to understand variations of the electron density, electron and ion temperatures, and ion drift motion, simultaneously. In addition, simultaneous observations with the EISCAT UHF radar (at Tromsoe) and EISCAT Svalbard radar (ESR) (at Longyearbyen) are extremely helpful to compare the ionospheric variations in the polar cap with those in the auroral regions.

In the present study, we will report on our recent observations with the EISCAT UHF radar (at Tromsoe) and ESR at Longyearbyen in March 2019. The geomagnetic activities during the periods were almost quiet (Kp =1-2). Significant ionospheric disturbances were observed in the dayside polar region at around or higher than 80 deg latitude with the ESR 32 m antenna (elevation angle of 30 deg) on March 18 and 19, 2019, while the quiet ionosphere was observed in the same periods with ESR 42 m antenna (field-aligned direction) and the EISCAT UHF radar (at Tromsoe). Enhancements of the ion drift velocity and ion temperature were simultaneously observed with the ESR 32 m antenna during the disturbed periods. These features seem to be similar to those seen in the ionospheric data during geomagnetically quiet periods in our previous observations (e.g., March 2014, 2015, and 2018). On the other hand, we observed ionospheric variations during geomagnetically disturbed periods in March 2017. Significant disturbances were observed with the ESR 32 m and 42 m antennas and the EISCAT UHF radar. The ESR 32 m antenna observed interesting features of the ionospheric variation during the periods. When enhancements of the ion temperature were observed (more than 2000 K), the ion drift velocity was not so large with changing the direction of the motion. When enhancements of the ion velocity were observed (more than 1000 m/s), the ion temperature was small (about 1000 K).

We will clarify the variations of the dayside polar cap ionosphere during the geomagnetically quiet periods and those during geomagnetically disturbed period.