磁気嵐時の極冠夜側でのポーラーパッチと電子密度の観測

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Storm-time observation of optical polar patches and electron density in evening polar cap

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Ionospheric electron density in the polar cap F2 region occasionally increases during magnetic storms. It is believed that storm enhanced density (SED) plasma plume originated in the mid-latitude region is transported to high-latitude region and forms tongue of ionization (TOI), which eventually creates polar patches in the cusp region. The key features of SED/TOI plasma are high peak density (NmF2), low electron temperature, and lifted peak height (hmF2). These features can be used to identify SED/TOI plasma, and polar patches can be used as tracers of moving SED/TOI plasmas.

In this study we investigated the relation between the optical intensity of 630 nm emission from a polar patch and electron density profile of the patch using a high sensitivity all sky imager installed in Longyearbyen, Svalbard, and EISCAT Svalbard Radar (ESR). The electron density observed by ESR showed typical SED/TOI plasma signatures when the all sky imager was observing a polar patch. The changes in the electron density was generally in good agreement with the changes in optical intensity of the patches. However, it has been revealed that the optical intensity was strongly dependent on the hmF2 of the ionosphere, which supports the idea that the intensity of optical emission depends on the height profile of neutral O_2 as well as that of O^+ ion. Using the electron density data and MSIS model data, we estimated the optical intensity of the 630 nm emission above ESR. The estimated optical intensity and the observed patch intensity showed a good agreement. From this observation, we conclude that storm-time observation of optical patch intensity may lead underestimation of total electron content (TEC) value.