The estimation of the altitude of auroral emission from grand-based multiple optical observation and EISCAT UHF radar

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We report the estimation of the altitude of auroral emission from grand-based multiple optical observation and EISCAT radar. Although pulsating aurora would be generated by relatively high energy (greater than 10 keV) electrons, precise characteristics of precipitating electrons producing pulsating aurora have not been understood well. Ground-based optical triangulation is useful to estimate the auroral peak height, which is responsible to the energy of precipitating electrons. In this study, we analyzed the data of N2+ 428nm auroral emission that obtained with ground-based all-sky EMCCD cameras at three stations in Northern Scandinavia (Kilpisjarvi, Abisko and Tromso), for the pulsating auroral event during 26th February, 2014 to estimate the pulsating auroral height with the triangulation method.
We chose an auroral patch which was identified near the center of images taken by all the EMCCD cameras. We used data in the latitudinal range of 69.1-69.4° and longitudinal range of 19.2-20.5°, where an auroral patch was clearly identified. The patch area also overlapped the FOV of EISCAT Tromso UHF radar.
Next, we normalized the auroral intensity for each image data obtained at the two stations (Tromso and Kilpisjarvi) and mapped the image data at a certain altitude. We estimated the variance between two image data at the same latitude and longitude. Changing the mapping altitude at intervals of 2km, we calculated the variances. Finally we determined the auroral emission height when the variance showed minimum. From the data obtained during 02:00 -03:00 UT on Feb. 26, we found the auroral emission height in the range of 102 -110km. When the auroral patch located near the center of the horizontal range, emission height was stable at 104km. On the other hand, when the patch strayed from the center of the range, emission height rose approximately 110km. This estimation of emission height reflected existence or nonexistence of the auroral patch. This result indicates that the auroral patch were produced by precipitating electrons with stable energy.
In addition, we derived the energy distribution of precipitating electrons from the EISCAT UHF radar observation using the CARD method [Fujii et al., 1994]. he results are summarized as follows: (1) With or without the auroral patch, the energy around 10keV maintained. (2) When the patch in the FOV of EISCAT radar, the width of energy peak increased 30keV. (3) We often found significant flux in energy band up to 100keV, and the high-energy flux depended of existence or nonexistence of the auroral patch. In this presentation, we discuss the relationship between the energy distribution of precipitating electrons from EISCAT radar and auroral emission height from optical observations.

Keywords: Pulsating aurora, EISCAT radar, Auroral emission height, Energy distribution of precipitating electrons

