Estimation of the altitude of pulsating aurora emission by using five-wavelength photometer

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Pulsating aurora (PsA) is a kind of diffuse aurora which almost always appears in the morning side during the recovery phase of auroral substorm. PsA is known to show two characteristic temporal variations. One is so-called main pulsation whose period ranges from a few to a few tens of seconds. The other is a few Hz modulation (internal modulation), which is often seen during the ON time of main pulsation. In recent years, the altitude of ionization associated with PsA has been investigated in detail by incoherent scatter radars. Such studies indicated that the altitude of PsA ionization is slightly lower in the morning side that that in the post-midnight. However, the altitude of PsA emission has not been examined in the past. Scourfield et al. [1971] proposed a method for monitoring significant changes in the emission altitude of PsA by using the lifetime of excited state atoms O(1S) seen in the optical observations. This method is also is useful for estimating the energy of precipitating electrons causing PsA. In this study, we performed a statistical analysis of the altitude of PsA emission by applying this method to multi-wavelength optical observations of PsA.

We employed the five-channel photometer in Tromso, Norway (69.6N, 19.2E, 66.7MLAT), whose FOV is directed along the magnetic field line. The five-channel photometer measured the auroral emissions at five wavelengths (427.8 nm, 557.7 nm, 670.0 nm, 777.4 nm, and 844.6 nm) with a temporal resolution of 400 Hz. In the analysis, we extracted the time series of main pulsation at 427.8 nm and 557.7 nm and calculate the lifetime of O(1S) state by performing a cross correlation analysis between them. Then, we succeeded in deriving the distribution of lifetime showing a strong peak at 0.70 sec. This result is in good agreement with a previous study by Brekke and Henriksen [1972]. We also classified the events by magnetic local time and derived the distribution of lifetime for each MLT sector. There is a tendency that the lifetime becomes shorter as going to morning side. By using the model atmospheric density profile of O2, we derived the altitude of the 557.7 nm emission of PsA. The altitude of PsA becomes lower as going to morning side, which indicates that the energy of PsA electrons tends to be higher in the later MLT sector.

We will compare the temporal variations of the effective altitude of PsA estimated from the photometer and the altitude profile of ionization observed by the European Incoherent Scatter (EISCAT) radars at the same time. In the presentation, based on the current statistical analysis, we will discuss what controls the energy precipitating electrons of PsA.