Large-scale signatures of pulsating aurora characterized by ambient parameters in the magnetosphere

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Pulsating aurora (PsA) is one of the predominant classes of diffuse aurora in the morning side. They are characterized by quasi-periodic blinking of luminous patches. There are two types of periodicity in the brightness variation of PsA, that are main pulsation and internal modulation. The main pulsation ranges from a few to a few tens of seconds, and the internal modulation, which is often embedded within the ON time of the main pulsation, shows a few Hz modulation in brightness. A recent study by Kasahara et al. [2018] indicated a one-to-one correlation between the luminosity of PsA, the electron flux in the loss cone and the intensity of chorus waves near the magnetic equator. This result indicates that the observation of PsA in the ionosphere can be used for monitoring the activity of chorus waves and resultant occurrence of wave-particle interaction in the magnetosphere.

In this study, we conducted a frequency analysis for a PsA event which was observed by 100 Hz sampling EMCCD cameras in Northern Scandinavia on March 28, 2017 (23:30 to 24:10 UT). By applying the Fourier analysis to data from all the pixels of the cameras, we succeeded in deriving so-called frequency map, which shows the distribution of dominant modulation frequency of PsA. We also estimated the spatial distribution of chorus waves by mapping the frequency distribution of PsA onto the equatorial plane of the magnetosphere with the Tsyganenko 04 model. As a result, we found that there were three regions showing different modulation characteristics. We named these regions region A, region B, region C which were divided by the difference in periodicity. The equatorward most region (region A) only showed the internal modulation and the poleward most region (region C) showed both the internal modulation and main pulsation. In region B, which is sandwiched by regions A and C, we only observed the main pulsation. An interesting thing is the boundaries between these three regions were quite sharp indicating that similar sharp boundaries in the characteristics of chorus could have existed in the magnetosphere. We also employed outputs from the ring current-atmosphere interactions model with self-consistent magnetic field (RAM-SCB) simulation runs for this interval and found that the electron flux of more than 30 keV increases only in region A. We also found that the linear growth rate becomes higher as L increases in the range of 4.75 to 5.75 where regions A and B exist. In the presentation, we focus on regions A and B and discuss how the ambient parameters, such as linear growth rate, cold plasma density and energetic electron distribution, can contribute to producing the observed differences in the characteristics of chorus and PsA, especially the existence/absence of internal modulation.