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Statistical study of pulsating auroral types and high-latitude chorus waves based on Arase – ground conjugate observations

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Pulsating aurora (PsA), which is characterized by quasi-periodic luminosity modulation of ~2 – 30 sec, is a common aurora associated with ~10 keV electron precipitation. During PsA, much higher energy (i.e., sub-relativistic/relativistic) electrons sometimes precipitate into the ionosphere. The highly energetic electrons penetrate into lower altitudes and induce ozone depletion in the mesosphere and upper stratosphere. In our previous study, we have observationally proposed a physical process in which wave propagation latitudes, the energy of scattered electrons, and patchy structure of PsA are controlled by “density ducts”. However, no previous study has statistically investigated the relationship between chorus wave propagation, the energy of electron precipitation, and auroral types, which is necessary to understand importance of the density ducts.

In order to examine the relationship, we make a statistical analysis of simultaneous PsA and chorus wave observation data from 2017 to 2024. These simultaneous conjugate observations were archived with the Arase satellite and multi-point ground instruments in Scandinavia. We identified a total conjunction duration of 25.5 hours under the following conditions: 1) Arase was located at the absolute value of magnetic latitudes higher than 10°, 2) auroral structures related to magnetospheric plasma waves can be identified. The identified auroral structures were categorized into diffuse auroras, amorphous pulsating auroras (APA), patchy pulsating auroras (PPA), patchy auroras (PA). First, we compared auroral types with the presence or absence of chorus waves. When chorus waves were observed (Case 1), 84% of auroras included PPA/PA. In contrast, when chorus waves were not observed (Case 2), 86% of auroras were diffuse auroras or APA. In Case 1, the occurrence frequency increased toward the morning sector. In addition, we derived the background electron density from the UHR frequency measured with Arase for each event, and we found some events demonstrating a clear correlation between chorus wave intensity and background electron density variations. In this presentation, we show the observational results and discuss the background processes of energetic electron precipitation during PsA, focusing on density ducts.