Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

PEM10-27 Room:A01 Time:May 28 17:15-17:30

Comprehensive observations on the pulsating aurora from satellite and ground-observations

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The pulsating aurora are caused by intermittent precipitations of tens keV electrons. The modulation for the pitch angle scattering take place at the magnetosphere via whistler mode wave-particle interactions. Usually, it is not possible to detect the electron flux modulation at the magnetosphere because of the small loss cone angle. On the other hand, an integration of several ground instruments provides the data for precipitating electrons. Here, we report an ideal observation for the pulsating aurora in November 2012. During the period,the pulsating aurora are observed at Tromso, Norway. The VHF radar obtained the height-resolved electron density profile during the period, which can be used to estimate the electron energy spectrum. As a result of the EISCAT observations, we identify at least 200 keV electrons precipitate simultaneously associated with the pulsating aurora. The riometer and subionospheric radio wave networks support this observation, and the radio wave network identified that the energetic electron precipitation occurred from 01 MLT to 07 MLT. During this period, the footprint of the Van Allen Probe-A satellite was very close to Tromso and the satellite observed rising tone emissions of the lower-band chorus (LBC) waves near the equatorial plane. Using the satellite observed LBC and trapped electrons as an initial condition, we conducted a computer simulation of the wave-particle interactions. The simulation showed simultaneous precipitation of electrons at both tens of keV and a few hundred keV. And the simulated energy spectrum is consistent with that derived from the EISCAT observation. From a comparison between the simulation and the observations, we specified the strong diffusion at ˜100 keV, and the propagating whistler mode waves cause further precipitation at ˜200 keV. This result revealed that electrons with a wide energy range simultaneously precipitate into the ionosphere in association with the pulsating aurora.

Keywords: pulsating aurora, EISCAT, high energy electron precipiation