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WIDE ENERGY ELECTRON PRECIPITATIONS AND THEIR IMPACT ON THE ATMOSPHERE DURING THE PULSATING AURORA

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Pulsating aurora is caused by intermittent precipitation of electrons with energies of tens of keV; the energy spectrum of the precipitating electrons is formed as a result of chorus wave particle interactions. From theory, it is expected that not only tens keV electrons but also sub-relativistic/relativistic electrons will precipitate simultaneously into the polar ionosphere because the resonance energy increases when the chorus waves propagate to higher latitudes. We analyzed a pulsating aurora event in November 2012 using several ground-based observational data from EISCAT radar, riometer, sub-ionospheric radio wave receivers, and also the Van Allen Probes satellite. The electron density profile obtained from the EISCAT Tromsø VHF radar identifies enhancements at >68 km altitudes. The electron energy spectrum derived from a Markov Chain Monte Carlo (MCMC) method indicates wide energy electron precipitation spanning from 10 - 200 keV, suggesting precipitation of this population from the outer belt. The riometer and network of sub-ionospheric radio wave observations also show energetic electron precipitation coinciding with the electron density enhancements starting at 68 km altitude. During this period, the footprint of the Van Allen Probe-A satellite was very close to Tromsø, and the satellite observed rising tone emissions of lower-band chorus (LBC) waves near the equatorial plane. Using the satellite-observed LBC and trapped electrons as an initial experimentally determined 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 (Miyoshi et al., 2015). This result is consistent with the energy spectrum estimated with the MCMC method. This result revealed that electrons with a wide energy range spanning those of the plasma sheet to the outer belt simultaneously precipitate into the polar ionosphere in association with the pulsating aurora. Using the Sodankylä Ion and Neutral Chemistry (SIC) model which includes a detailed description of middle atmospheric/lower ionospheric chemistry, we also discuss the possible impacts of wide-energy electron precipitation on atmospheric composition, e.g., ozone.

REFERENCE

Miyoshi, Y., et al., Energetic electron precipitation associated with pulsating aurora: EISCAT and Van Allen Probes observations, J. Geophys. Res., 120, doi:10.1002/2014JA020690, 2015