Influence on photoelectron by polarization electric field in polar cap

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In general situation, the electron density in the ionosphere decreases with altitude. Few reliable measurements have been made to estimate thermal electron temperature with conventional instruments such as Langmuir probe in the high-altitude polar cap ionosphere. For example, only the limited amount of the electron temperature data are available above altitude of 3000 km, where the density is generally less than $1.0*10^3$ /cm^3. However, on the basis of statistical study of Thermal Electron energy Distribution (TED) data onboard 'AKEBONO' (EXOS-D) satellite for about 10 years, it was found that the electron number density occasionally increases up to 1.0-3.0$*10^3$ /cm^3 in the high-altitude polar cap ionosphere, where it is usually much smaller than $1.0*10^3$ /cm^3.

In the last report, by Thermal Electron energy Distribution (TED), Suprathermal ion Mass Spectra (SMS), Low Energy Particle (LEP) data onboard 'AKEBONO' (EXOS-D) satellite, and ion drift meter, ion density observation data onboard DMSP satellite, and Total Electron Count (TEC) observation data onboard GPS satellite, such high density plasma in the polar cap may be generated by Storm Enhanced density (SED) plasma transport process and anti-sunward convection plasma transport process. Also, a characteristic feature of the high density plasma observed in the high-altitude polar cap was summarized as follows. 1) The H+ ion velocity in the upward field-aligned direction is lower than the averaged velocity at the same altitude. 2) The downward electron flux in the energy range below 50 eV is observed to be lower than that in the adjacent region.

In this study, we analyzed about the origin of the downward electron flux of energy below 50eV, paying attention to items 1) and 2) described above. In general, North-South hemispheres are not connected with the geomagnetic field line because those are open in the polar cap region. The observations show that the fluxes of upward and downward photoelectrons in the energy range below 30 eV are almost same, while the downward flux is much smaller than the upward one in the energies above 30 eV. Therefore, the downward electron flux may be generated by some mechanism which can accelerate electrons downwardly at higher altitudes.

It is supposed that the downward acceleration of electrons may be due to the polarization electric field which is known to accelerate polar wind ions upward. In this presentation, we discuss the relationship between the ionospheric photoelectron and the polarization electric field in polar cap region.