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# An estimation of the vertical plasma density distribution in the region of SED/TOI plume by the Akebono and DMSP

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It was reported that the local plasma density enhancement (>1000 $cm^{-3}$) is occasionally identified above 4000 km altitude in the polar cap ionosphere on the basis of long-term (over 10 years) plasma density observations by the Akebono satellite, while the electron density is usually on the order of 100 $cm^{-3}$. In addition, such a high density region is characterized by a distinctively low electron temperature. The parallel drift velocity of ions is significantly smaller in the high density region compared to the average in the general situation, in that the polar wind ion outflow is driven by the ambipolar electric field along the magnetic field lines.
As for low-altitude polar ionosphere, the local increase of electron density in the polar cap F-region ionosphere has been investigated with data from the DMSP satellites, GPS networks and ground-based radars, and these include SED (storm enhanced density) and TOI (a polar tongue of ionization). The term "TOI" is used to indicate the local plasma density enhancements with low temperature plasma in the F-region polar ionosphere. Combined observations from ground-based radars and GPS networks have shown that there is a plume of the SED streaming from the pre-midnight sub-auroral ionosphere towards the noontime cusp during the early stage of magnetic storms. Also, the SED/TOI plume is thought to be one of the important sources originated from the polar cap ionosphere to the magnetospheric plasma.
From a comparison of the Akebono, GPS-TEC, DMSP, and SuperDARN radar data about the SED /TOI plume, we suggest that the high-density low-temperature plasma existing in the high-altitude polar cap was identified as the high-altitude counterparts of the SED/TOI plume. The insignificant velocity of ions observed by the Akebono in the high density plasma region implies that the ambipolar electric field due to the plasma pressure gradient along the magnetic field lines is smaller than the average on the general polar wind situation. On the other hand, the low-altitude DMSP observations indicate that the ion upflow velocity becomes larger in the TOI plume than that in the surrounding region.
The vertical plasma density distribution inside the SED/TOI plume above the F-region altitude has not been clarified. It is important to know the vertical density profile of the SED/TOI plume in order to further understand the generation mechanism and temporal variation of the SED/TOI plume. Therefore, we try to estimate the field aligned distribution of the plasma density in the SED/TOI plume by using the ion drift velocity and electron density obtained from the Akebono and DMSP satellites' observations.

Keywords: polar cap, plasma density, SED, TOI, outflow