Magnetosphere-ionosphere coupling processes through aurora electrons using the THEMIS satellite data

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Field-aligned currents play a key role on the magnetosphere-ionosphere coupling process. The electrons in the magnetosphere precipitate along the upward field-aligned currents, and cause aurorae in the ionosphere. The electron precipitation without the potential difference causes diffuse aurora, and electrons accelerated by a field-aligned potential difference cause the intense and bright type of aurora, namely discrete aurora. We are trying to find out when and where the aurora can be caused with or without electron acceleration. In this study, we investigate electron density, temperature, thermal current, and conductivity in the plasma sheet using the data from the electrostatic analyzer (ESA) onboard the THEMIS-D satellite. According to Knight (Planet. Space Sci., 1973) and Lyons (JGR, 1980), the thermal current, jth(n,T), represents the field-aligned current that can be carried by magnetospheric electrons, (density n and temperature T), without field-aligned potential difference. The conductivity, K(n,T), represents the efficiency of the field-aligned current (j) that the field-aligned potential difference (V) can produce (j=KV). Therefore, estimating jth and K in the plasma sheet is important to know the ability of plasma sheet electrons to carry the field-aligned current which is driven by various magnetospheric processes such as flow shear and pressure gradient. Similar study was done by Shiokawa et al. (2000) based on the auroral electron data obtained by the DMSP satellites above the auroral oval and the AMPTE/IRM satellite in the near Earth plasma sheet at 10-18 Re on February-June 1985 and March-June 1986 during the solar minimum. The purpose of our study is to examine inside 12 Re where Shiokawa et al. (2000) did not investigate well. THEMIS-D launched in 2007 is in an elliptical orbit with an apogee of 12 Re. We found that in the dawn side inner magnetosphere (source of the region 2 current), electrons can make sufficient thermal current without acceleration, particularly during active time (AE, 100nT -). On the other hand, dusk side outer magnetosphere electron density and temperature are small, thus the thermal current is much smaller than the typical auroral current. From this result, we suppose that electron acceleration is necessary on the dusk side region 1 field-aligned current.