Geomagnetic activity dependence of photoelectron outflows and the field-aligned potential drop in the polar cap

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Counter-streaming photoelectrons of up to tens of eVs are present on the open field lines in the polar cap, and the precipitating component is photoelectrons that are reflected by a field-aligned potential drop above the FAST satellite (3000-3900 km altitude) [e.g., *Kitamura et al.*, 2012]. We statistically investigate the geomagnetic activity dependence of the photoelectron flows and the magnitude of the field-aligned potential drop in the sunlit polar cap using the data obtained by the FAST satellite under small field-aligned current conditions. We selected 52 months from the period between September 1996 and April 2009, when the orbital configuration is suitable for observations of photoelectrons near the apogee (3000-4200 km altitude) in the polar cap, which is defined by the lack of energetic ions [*Andersson et al.*, 2004]. In periods of high solar activity (81-day averaged $F_{10.7}$ index higher than 120), net escaping electron number fluxes increase and the magnitude of field-aligned potential drop decreases with increasing *Kp* index. In contrast, during low solar activity periods (81-day averaged $F_{10.7}$ index lower than 120), net escaping electron number fluxes and the magnitude of field-aligned potential drop are nearly constant under geomagnetic conditions of the *Kp* index smaller than 6. Under small field-aligned current conditions, net escaping electron number fluxes should be almost equal to outflowing ion fluxes. Thus, the difference in geomagnetic activity (*Kp*) dependence of net escaping electron number fluxes under different solar activity conditions reflects difference in that of outflowing ion fluxes in the polar cap. *Cully et al.* [2003] indicated that the O^+ ion outflow rate (lower than 70 eV) is strongly affected by geomagnetic activity and solar activity, while the H^+ ion outflow rate (lower than 70 eV) is weakly affected by geomagnetic activity and solar activity. Although their ion outflow rates include contributions from not only the polar cap but also auroral zone, the O^+ ion outflow rate become comparable with the H^+ ion outflow rate during high solar activity periods. Difference in geomagnetic activity dependence of net escaping electron number fluxes (=outflowing ion fluxes) under different solar activity conditions, which is derived by the present statistical analysis, would indicate importance of O^+ ions in number fluxes in the sunlit polar cap during high solar activity periods as compared with low solar activity periods.