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Multi-instrument observations of multiple auroral arcs in the duskside polar cap region

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Polar cap auroral arcs (PCAs) are one of the outstanding phenomena in the polar cap region during periods of northward interplanetary magnetic field (IMF). Smaller scale PCAs tend to occur either in the duskside or dawnside of the polar cap and are known to drift in the dawn-dusk direction depending on the sign of the IMF By. Studies of PCAs are of particular importance because they represent dynamical characteristics of their source plasma in the magnetosphere, for example in the interaction region between the solar wind and magnetosphere or in the boundary between the plasma sheet and tail lobe. To date, however, very little has been known about the spatial structure and/or temporal evolution of the magnetospheric counterpart of PCAs. In order to gain more comprehensive understanding of the origin of PCAs, we have investigated an event of PCAs on November 10, 2005, during which multiple PCAs were detected by a ground-based all-sky camera at Resolute Bay, Canada. During this interval, several PCAs were detached from the duskside oval and moved poleward. The large-scale structure of these arcs was visualized by space-based imagers of TIMED/GUVI and DMSP/SSUSI. The images from these instruments indicate that the arcs were pointing towards the dayside cusp. In addition to these optical observations, we employ the Cluster satellites to reveal the particle signature corresponding to the small-scale PCAs. The ionospheric footprints of the 4 Cluster satellites encountered the PCAs sequentially and observed well correlated enhancements of electron fluxes at weak energies (< 1 keV). The Cluster satellites also detected signatures of upflowing ion beams exactly at the times of the satellite crossing of the PCAs. This implies that the ions were accelerated upward by a quasi-stationary electric field existing above the PCAs. Ionospheric convection measurement from one of the SuperDARN radars shows an existence of velocity shear across one of the PCAs. This signature is consistent with converging electric field structure in the vicinity of the arc. In the presentation, we will show the results of detailed comparison between the ground-based radio and optical signatures of the PCAs and those obtained by the Cluster spacecraft at magnetospheric altitudes.