The inner edge location of SAPS electric field and the ring current in the equatorial magnetosphere as observed by Arase and SuperDARN

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Electric field (E-field) enhancement of subauroral polarization streams (SAPS) and associated particle boundaries in the inner magnetosphere is extensively investigated by analyzing particle and field data obtained by the Arase satellite and ionospheric convection data obtained by Super Dual Auroral Radar Network (SuperDARN). A previous study using Arase and SuperDARN revealed that there are two types of the SAPS events in terms of the spatial correspondence with the ring current: (type A) the inner edge location of SAPS matches with that of the ring current in some cases, while, (type B) in some other cases, their inner edge locations do not match well, and the ring current appears to extend further inward from SAPS. To address why these two types of spatial relationship occurs and what condition controls them, we statistically examined their correlation with substorm activity. Our statistical study indicates that almost all the type-B SAPS events are accompanied by some preceding substorm activity including intermittent occurrence of multiple substorms. This result suggests that a ring current portion located inward of SAPS has been injected by preceding substorms. Such a fossil population drifts around the Earth for some time and its azimuthal pressure gradient would be smeared out, unable to drive downward field-aligned current and thus SAPS. In contrast to type-B, we do not find a clear-cut tendency about the type-A events: they occur either during isolated substorms after prolonged (~several hours) quiet periods, or during a substorm preceded by separate ones. We speculate that these conditions somehow create a relatively simple structure of injected ions at its inner edge, leading to a smaller separation of SAPS inner edge.

