Magnetosphere-ionosphere connection of storm-time Region-2 FAC and ring current: Arase and AMPERE observations

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Storm-time region-2 field-aligned currents (R2 FACs) are believed to be connected between the ring current region and the ionosphere, but this connection has not yet been clarified by simultaneous in situ observations. We quantitatively confirmed the connection of upward R2 FACs during July 16, 2017 and June 18, 2017 storm events using coordinated magnetic observations by the Arase satellite and the Active Magnetosphere and Planetary Electrodynamics Response Experiment (AMPERE) including the Iridium constellation. The upward FACs were determined by drastic changes in the azimuthal magnetic field at Arase in the off-equatorial (magnetic latitude of 23-30^o) postmidnight inner magnetosphere. The magnetic latitude of the FAC projected onto the ionosphere was consistent with the ionospheric FAC observed by the AMPERE/Iridium. Using the conservation of the ratio between the current density and the total magnetic field along the field line, we showed that the current between Arase and Iridium was almost conserved, meaning that a large portion of the R2 FAC was driven in the low-latitude inner magnetosphere. We also calculated the plasma pressures of H^+ and O^+ ions and pressure-driven currents that are considered to be a source of storm-time R2 FACs and examined their relationship for the first event. The O^+ pressure contributed significantly to the inner part of the total azimuthal current. The total pressure and pressure-driven current peaks were located inside and outside the FAC, respectively. A simple model calculation indicated that this spatial relationship can be explained by the day-night asymmetry of magnetic field.