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Multi-spacecraft observations of the current system around the dipolarization front and its relation to substorm current wedge

Zhonghua Yao (1), Zuyin Pu (1), and Jiang Liu (2)

(1) School of Earth and Space Sciences, Peking University, China (yzh86716@gmail.com), (2) Department of Earth, Planetary and Space Sciences and Institute of Geophysics and Planetary Physics, University of California, Los Angeles, California, USA

Recently, the current system around the dipolarization fronts (DFs) of earthward-moving flow bursts has attracted much research attention. Both simulations and observations revealed that region-1-sense field-aligned currents (FACs) show up within the DF layer, while region-2-sense FACs show up ahead of the DF. The DFs are found to be closely related to multiple substorm intensifications and are able to make major contributions to substorm onset signatures on ground and in space. This paper briefly reviews studies of multi-spacecraft observations of the current system around DFs and its relation to substorm current wedge (SCW) made in a couple of years. It is shown that (1) behind the DF in the head of the diverted flow near equator, enhanced dawnward/duskward pressure gradient on the morning/evening side near-Earth tail causes downward/ upward FACs, which may contribute to the major part of FACs in the substorm expansion phase and is responsible for the formation of SCWs at dipolarization onset. (2) On the DF layer, the average current near the neutral sheet is perpendicular to the average field direction over the DF thickness; away from the neutral sheet, the average current becomes progressively parallel to the average field direction with region-1-sense FAC directions. The total current carried by a DF can account for a sizable portion of a SCW's current for a typical substorm. (3) In the magnetic dip region immediately ahead of the DF, there exist region-2-sense FACs. These region-2-sense currents are suggested to be associated with the compressional effect ahead of the DF, and the compressional effect can also lead to a local current disruption, in association with a local disappearance of plasma pressure gradient.