Coupling of the current generator and the voltage generator in the dayside interplanetary magnetic field B_y-dependent field-aligned current system

Masakazu Watanabe[1,2], Takashi Tanaka[1] and Shigeru Fujita[3,4]
[1]*International Center for Space Weather Science and Education, Kyushu University*
[2]*Department of Earth and Planetary Sciences, Faculty of Science, Kyushu University*
[3]*National Institute of Polar Research, Research Organization of Information and Systems*
[4]*Meteorological College*

The field-aligned current (FAC) system that appears in the noon sector is known to be controlled by the dawn-dusk component (B_y) of the interplanetary magnetic field (IMF). The currents are associated with the cusp/mantle particle precipitation and therefore often called cusp/mantle currents. Observations by low-altitude satellites indicate that when IMF B_y is positive, in the Northern Hemisphere, there appears a pair of FAC sheets flowing into the ionosphere on the equatorward side (midday region 1) and flowing away from the ionosphere on the poleward side (region 0). The flow directions are opposite in the Southern Hemisphere. When IMF B_y is negative, the above-mentioned flow directions reverse in both hemispheres. Concurrent precipitating particles imply that the midday region 1 on the equatorward side is collocated with field lines threading the magnetospheric cusp, whereas the region 0 on the poleward side is collocated with field lines threading the plasma mantle. The important elements of a large-scale magnetosphere-ionosphere current system include the magnetospheric dynamo (voltage generator) that maintains the voltage of the current system constantly and the current generator that produces the FACs constantly. For the so-called region 1 and region 2 current systems, recent development of numerical simulation has revealed the physical processes of the above two elements. That is, the dynamo and the current generator are formed nearly at the same place, with the slow mode disturbance responsible for the dynamo and the Alfven mode disturbance responsible for the FACs being coupled. However, this coupling mechanism seems not applicable to the dayside cusp/mantle FAC system described above, because the current closure in the magnetosphere is expected to be latitudinal or meridional, rather than the dawn-dusk closure as in the region 1 and region 2 cases. Thus, this study focusses on the current generator of the dayside cusp/mantle current system and its coupling to the voltage generator. Using the Reproduce Plasma Universe (REPPU) code developed by Tanaka (2015), we successfully reproduced the region 1/region 0 system in the noon sector. Based upon the results of this simulation, we discuss the relation between the current generator and the voltage generator of the dayside cusp/mantle current system.

Reference

Tanaka, T., Substorm auroral dynamics reproduced by advanced global magnetosphere-ionosphere (M-I) coupling simulation, in *Auroral Dynamics and Space Weather* edited by Y. Zhang and L. J. Paxton, Geophysical Monograph Series Vol. 215, pp. 177–190, Washington DC, American Geophysical Union, 2015.