An assessment of temporal and spatial scales of field-aligned currents by SuperDARN

Hiroki Deguchi[1], Takesi Iijima[2], Natsuo Sato[3]

[1] Earth and Planetary Sci, Kyushu Univ, [2] Earth & Planetary Sci.,Kyushu Univ, [3] NIPR

By using the plasma flow data acquired with HF radar experiments by the international SuperDARN project, we have determined various characteristics of the plasma flow vorticity in the plane perpendicular to the background geomagnetic field at an altitude of 400 km. Characteristics include, (1) simple linear shear (corresponding to largescale field-aligned currents (FACs)), (2) non-linear shear with its intensity varying along the flow velocity (corresponding to mesoscale FAC), and (3) time-dependent shear (corresponding to time-varying FAC). Based on the analysis of more than ten events that were associated with various degrees of ground-based polar geomagnetic activity and IMF activity, we will argue generation of FACs.

Field-aligned currents (FACs) play a crucial role for the magnetosphere-ionosphere (M-I) coupling process by virtue of their transmission of the momentum and the energy along magnetic field lines. The master physics demands the matching of the following quantity between the magnetospheric source region and the ionosphere: the electric current, the transverse momentum flux (transverse stress) and the energy flux. If the domain under investigation were subject to uniform ionospheric conductivities, FACs are well represented simply by field-aligned components of plasma flows vorticity. The actual state of the M-I coupling has to be addressed to inhomogeneous ionospheric conductivities and FACs are not guaranteed to be associated with the simple vortex motion (the linear shear in flow velocity). By using the plasma flow data acquired with HF radar experiments by the international SuperDARN project, we have determined various characteristics of the plasma flow vorticity in the plane perpendicular to the background geomagnetic field at an altitude of 400 km. Characteristics include, (1) simple linear shear (corresponding to large scale FACs), (2) non-linear shear with its intensity varying along the flow velocity (corresponding to mesoscale FAC), and (3) time-dependent shear (corresponding to time-varying FAC) . Based on the analysis of more than ten events that were associated with various degrees of ground-based polar geomagnetic activity and IMF activity, we will argue generation of FACs.