Transient and localized field-aligned current in the cusp region associated with the Sudden Commencement

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The Preliminary Impulse (PI) and the Main Impulse (MI) are the characteristic geomagnetic variations in the high-latitude region associated with the Sudden Commencement (SC) [Araki, 1994]. These geomagnetic variations appear mainly in the region below the auroral latitudes. This is because the field-aligned currents (FACs) causing these variations appear there [Fujita et al., 2003a,b]. Thus, many studies have been treating the behavior of SC in the region below the auroral latitudes. However, there are few studies about the SC-associated plasma and geomagnetic variations in the cusp region and the polar cap region.

We will report the transient and localized FAC in the cusp region associated with the SC. This FAC is found in the numerical results by REPPU (the global MHD simulation). This current appears in the northward IMF condition with a non-zero IMFBy component. The transient FAC in the cusp region is upward for the positive SC in the pre-noon sector when IMFBy is eastward. The upward FAC in the afternoon sector appears in the negative SI case under the same IMF condition. This transient FAC does not seem to appear in the southward IMF condition. We note that the FAC is too small to make a significant ground magnetic signature.

We will explain the mechanism of the transient FAC associated with the SC. Before the SC, there exists the magnetospheric convection corresponding to the round cell convection in the ionosphere for the north IMF condition. The simulation reveals that the sudden compression of the magnetosphere deforms the pattern of this magnetospheric convection to create a small-scale clockwise vortex transiently in the pre-noon sector. Deformation of the magnetospheric convection and formation of the vortex causes the transient FAC from the NBz current system. In the negative SI case, the clockwise vortex appears in the afternoon sector. When the IMF is southward, such transient vortex does not seem to appear in the two-cell pattern of the magnetospheric convection.

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