IMF北転に伴う磁気圏電離圏複合系の状態遷移と過遮蔽電場の生成の数値シミュレーション

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State transition of magnetosphere-ionosphere compound system due to IMF northward turn and formation of overshielding potential

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Using a self-consistent global magnetohydrodynamic (MHD) simulation, we investigate the transient behavior of the magnetosphere-ionosphere compound system during deformation of the magnetosphere after a northward turn of the interplanetary magnetic field (IMF). We find that a peculiar Region 2 field-aligned current (R2 FAC) caused by a transient dynamo is enhanced in the ionosphere and, consequently, the convection field in the ionosphere is overshielded after the northward turn of the IMF. On the other hand, in the magnetosphere, the transient dynamo appears on the lower-latitude side of the dayside cleft. This dynamo is driven by the sunward convection flow that descends the enhanced pressure in the cleft region. This sunward flow and the enhanced pressure are caused by the release of magnetic tension accumulated in the southward IMF interval. Simultaneously, a counter-clockwise vortex on a sphere of r=8Re (a clockwise vortex in the equatorial plane) in the afternoon sector appears in the magnetosphere. Consequently, the overshielding potential due to the R2 FAC in the ionosphere is a counterpart of the flow vortex in the magnetosphere. Finally, we note that the effect of the grad-B/curvature drift, which is due to the ring-current particles, may be insignificant because the dynamo responsible for the overshielding appears in the higher-latitude region.