SUBSTORM CONVECTION AND CURRENT SYSTEM DEDUCED FROM THE GLOBAL SIMULATION

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The convection and current system generating the substorm are investigated by analyzing the numerical solution obtained from the recent refined magnetohydrodynamic simulation. The present solution reproduces the observed signatures of substorm onset quite well, including a formation of the near earth neutral line (NENL), earthward flow in the plasma sheet, the dipolarization, the geosynchronous D deflection, a development of the nightside field aligned currents (FACs), and electrojets in the ionosphere. After the NENL formation, a rapid change appears in background convection to bring about transient magnetospheric compression that extends as far as the geosynchronous orbit. The compression results in the formation of high pressure in the ring current region. A primary driver of the substorm current is the partial ring current and incidental region 2 FAC which are generated by the high pressure and convection crossing it. Inertial current due to the braking of fast flow from the NENL does not generate the FAC. Inside the ionosphere, the region 2 FAC is not closed by midnight eastward ionospheric current, since it is equivalent to the dusk to dawn electric field which interrupts the convection. Alternatively, the region 2 FAC is closed by connecting with the nightside region 1 FAC from the cusp, forming a grand loop. The present model explains the longstanding question concerning the position of first brightening arc, because the region 2 FAC is expected to connect with the region 1 FAC through the nearest preexisting arc that is the most equatorward arc.

substorm, partial ring current, arc

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