Simulation study of the driving mechanism of the magnetosphere-ionosphere coupling convection

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The Region 1 field-aligned current (R1FAC) controls the magnetosphere-ionosphere coupling convection. The global MHD simulation reveals that the dynamo of the R1FRC appears in the cusp-mantle region [Tanaka, 1995]. So, in order to elucidate the driving mechanism of the convection, we investigate the link between the solar wind energy and the dynamo of the R1FAC by analyzing the numerical results of the global MHD simulation in the southward IMF condition. This study presents an alternative model of the magnetosphere convection proposed by Dungey (1961). First, the flow motional energy in the solar wind is converted to the thermal energy in the bow shock. This thermal energy is transported to the magnetopause reconnection region. Second, plasma acceleration due to the reconnection in the dayside magnetic field configuration of the null-separator structure does not directly drive the dynamo of the R1FAC. The plasmas in the magnetosheath also contribute to the plasma acceleration. Third, the accelerated plasmas are decelerated when they are transported to the high-latitude magnetosheath next to the cusp. This deceleration invokes the local dynamo. This local dynamo does not drive the R1FAC. This result indicates that the mechanical energy from the solar wind does not directly contribute to driving the R1FAC dynamo. Plasma acceleration in the reconnection region and formation of the local dynamo can be called as the local Dungey process. Fourth, the magnetic energy produced in the local dynamo is transported to and deposited as the thermal energy in the cusp entry region. This mechanism is called as the cusp bridge. Fifth, the thermal energy in the boundary region is accelerated along the field line into the cusp due to the field-aligned pressure gradient. Sixth, the field-aligned accelerated flow is converted to the perpendicular flow in the cusp due to the centrifugal force caused by the field-aligned flow along the bending field line in the cusp. The perpendicular flow goes to the cusp-mantle region. Last, the slow mode expansion mechanism invokes the dynamo of the R1FAC in the cusp-mantle region.

In the talk, we will present how the solar wind condition control the energy transport and conversion from the solar wind to the dynamo region of the R1FAC.

Keywords: magnetospheric convection, MHD simulation , energy conversion

