Simulation study of the driving mechanism of the magnetosphere-ionosphere coupling convection in the northward IMF condition
-Energy transport from the solar wind to the dynamo region of the NBZ current-

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The advanced global MHD simulation, the REPPU code, was utilized to elucidate the driving mechanism of the magnetosphere-ionosphere coupling convection in the southward IMF condition [Fujita et al., 2017]. In order to investigate the driving mechanism, we elucidate a link between the solar-wind energy and the dynamo of the Region 1 field-aligned current (R1FAC) from the global MHD simulation in the southward IMF condition. At first, the null-separator structure divides the plasma regimes in the dayside magnetosheath-magnetopause region into the IMF regime, the open-field regime, and the closed-field regime. The magnetic tension force derived from parallel reconnection accelerates plasmas in the open-field regime. Next, energy transport and conversion in the way from the transport are elucidated. Plasmas in the magnetosheath are accelerated in the open-field regime by both the tension force and the pressure gradient force, and transported to the upper boundary region of the cusp. Then, a dynamo is driven in the upper boundary of the cusp by the deceleration of plasmas and by conversion from the thermal energy to the magnetic energy. This process including plasma acceleration and dynamo generation is referred to the local Dungey process. The magnetic energy by the local Dungey process is transmitted to the cusp entry region (the magnetopause adjacent to the cusp), and deposited as the thermal energy there. The thermal energy in the cusp entry region accelerated along field lines is converted to the field-perpendicular flow in the cusp and arrives at the dynamo region. The combined model of the present energy transport mechanism and the magnetosphere-ionosphere compound system studied by Tanaka [2003] is an alternative of the convection model presented by Dungey [1961].

The present study deals with the case of the northward IMF condition with finite east-west IMF component. We first notice that the dominant current system which determines the ionosphere-magnetosphere convection is the NBZ current in the northward IMF condition. Thus, we study energy transport from the solar wind to the dynamo region of the NBZ current and the energy conversion in the way of the transport. It is obtained that the local Dungey process and the cusp bridge process are valid in the northward IMF condition. However, the transport process is complex compared with the case of the southward IMF condition because there are double cusp bridge processes and two cross-cusp transport processes of the mechanical energy.

References

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