磁気圏電離圏対流生成機構

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A driving mechanism of the magnetosphere-ionosphere convection

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We present a new idea about a driving mechanism of the magnetosphere-ionosphere convection. Traditionally, the magnetospheric convection was regarded to be driven by the tension force derived from the dayside reconnection [Dungey, 1962; Hughes, 1995]. The reconnection was regarded to play an essential role in transportation of energy from the solar wind to the magnetosphere [Dungey, 1962]. This idea has been widely accepted by many scientists. It has been passed a half-century since Dungey [1961] proposed the convection model based on a simplified configuration. It is the time when we should re-consider the old idea in the three-dimensional configuration with the realistic global MHD simulation.

First, we need to understand a three-dimensional topology of magnetic field merging in the dayside magnetosheath under the obliquely southward IMF condition. The global simulation presents the null-separator structure [Watanabe et al, 2005]. We found that no significant energy conversion is invoked in the region surrounding the null points. This fact is inconsistent with arguments by the old model [Dungey, 1962]. Then, we need to identify energy conversion mechnism by which energy, momentum, and mass of the solar wind are transported into the magnetosphere. As a result, the simulation indicates that the field-aligned plasma acceleration in the cusp entry region transports mass, momentum, and energy from the magnetosheath to the magnetosphere. This aceleration is caused by field-aligned pressure gradient due to combination of enhanced pressure in the magnetosheath and open magnetic fields passing the enhanced pressure region. Namely, the thermal energy in the magnetosheath is converted to the field-aligned flow energy. The field-aligned flow thus accelerated is converted to the field-perpendicular flow by cuved magnetic field in the cusp. Afterwards, the perpedicular flow becomes again to be field-aligned in the mantle region. The slow mode expansion invokes a dynamo of the R1 FAC. Once generation mechanism of the R1FAC dynamo is elucidated, the concept of the magnetosphere-ionosphere couopound system [Tanaka, 2003] explains the magnetosphere-ionosphere coupled convection. Fig. 1 shows a schematic explanation of the magnetosphere-ionosphere convection system.

References

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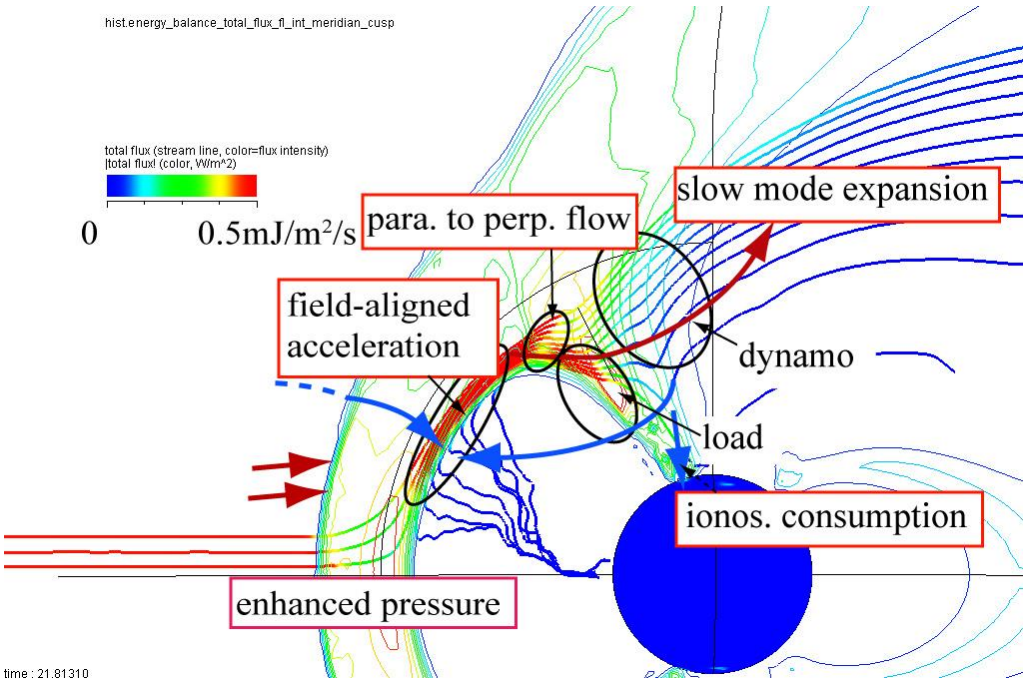

Fig. 1 A schematic illustration of generation mechanism of the magnetosphere-ionosphere convection. The colored curves denote stream lines of flow motional energy.