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# Investigation of plasma processes by global MHD simulations

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One of the significant problems in magnetospheric physics concerns the nature and processes which occur at the magnetopause and magnetotail regions. Many observational and model studies have been trying to estimate how much and how energy is transported from the solar wind through the magnetosphere into the ionosphere.

The main processes in the magnetopause boundary are magnetic reconnection and viscous-like interaction (such as Kelvin-Helmholtz instability (KHI)). Magnetic reconnection occurs efficiently when the interplanetary magnetic field (IMF) is southward, and the rate is largest where the magnetosheath magnetic field is antiparallel to the geomagnetic field. [1,2] Viscous-like interaction is driven by the velocity shear with a rapid magnetosheath plasma at the boundary for northward IMF conditions.[3] Despite a lot of effort, the questions are still unsolved.

There have been few studies on the vortices (such as KHI) in magnetosphere boundaries under southward IMF conditions. By global MHD simulation and observational data, KH waves are generated at the magnetopause boundary occur with a period of a few minutes, and propagate to the magnetosphere tail region. [2,4,5]

The global MHD approximation is very well established on a large scale such as the Sun and the Earth's magnetosphere, which is a very good research tool for investigating the topology and dynamics of the near-Earth space environments.

We introduce the simulation results during the weak solar wind condition. The study will provide a comprehensive understanding of the magnetic field topology and magnetosphere and ionosphere response under various solar wind conditions by using a 3-D global MHD simulation. Additionally, the simulation results will answer when, where, and which magnetic reconnection and vortex (such as KH waves) occur in the magnetopause boundary by 3-D magnetic field topology, dynamics, and plasma properties.

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References

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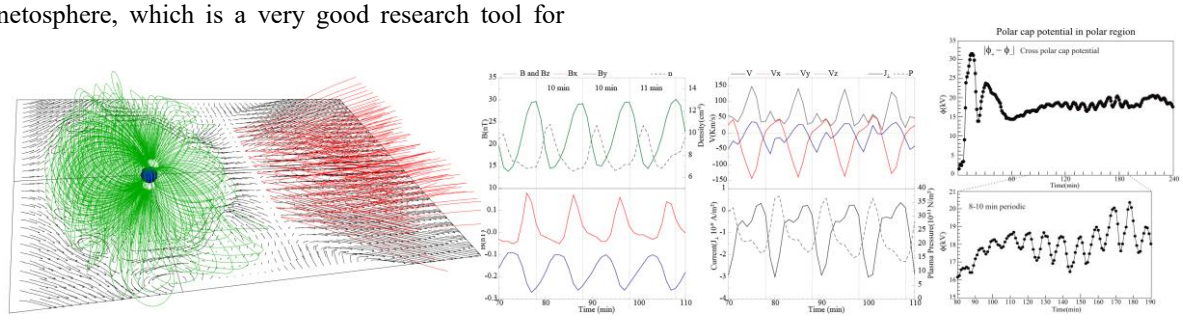


Figure 1. The simulation results of 3D magnetic field structure (left), magnetic field and plasma properties (center), and cross-polar cap potential value (right). [2,5] The magnetic reconnection played a role in generating vortices with a periodicity in the dayside magnetopause boundary under a weak southward IMF in a simulation. Across the vortex, the magnetic field and plasma properties clearly show quasi-periodic fluctuations. Also, the peak value of the cross-polar cap potential fluctuations with the same period during the tail reconnection.