Why we carry out a global MHD simulation of the solar wind interaction with the Earth's magnetosphere?

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Global MHD simulation have been quite successful in reproducing overall magnetospheric dynamics and ionosphereic phenomena. However, there are few simulations with spatial resolution high enough to quantitatively study the effects of solar wind and IMF conditions. For understanding where the magnetic reconnection occur, how the reconnected field lines move to tail, and how much energy transported from the solar wind, we perform a 3-D global MHD simulation. Several of our simulation studies have been reported for event study and steady state cases.

I will introduce the results of previous and recent research. Recently, we carried out a 3-D MHD simulation on the responses of the Earth's magnetosphere and ionosphere to the impact of large magnetic flux ropes(MFR). The magnetic field strength of MFR changes from 5 through 30 to 5 nT during 25 hours (e.g. size ~ 5644RE). We considered four types of MFR structures according to the alignment direction of the flux rope axis in the plane perpendicular to the Sun-Earth line. The simulation shows that the magnetic field of MFR where IMF has a southward B_z with dawnward or duskward B_y component lead to plasmoid formation in the tail. The peak values of cross-polar cap potential ranges from 25 kV to ~70-114 kV for all types of MFR. When the magnetic field of MFR has a southwhard B_z and duskward B_y (i.e. IMF angle has between 252°and 300°) for two types, strong earthward flow appears >400 Km/s. At the same time, total magnetic field and plasma temperature increase and also the number density decreases. These features resemble bursty bulk flows which are often observed in the tail region.