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Dynamics of Saturn's magnetotail under different solar wind conditions: 3D global MHD simulations

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As revealed by the remote observations from the Hubble Space Telescope and in-situ observations from Cassini, Saturn's magnetosphere responds strongly to the solar wind driving. We have used a 3D global MHD simulation to investigate in detail the global configuration and dynamics of Saturn's magnetosphere in response to changes in the solar wind. Compared with our previously used global models using a Cartesian grid, our new model adopted a high resolution, non-uniform spherical grid, which enables to better resolve fine structures of the large-scale magnetospheric currents responsible for the coupling between the magnetosphere and the ionosphere. In order to distinguish effects due to different types of variations in the solar wind, we use an idealized solar wind input with characters typical of those of Corotating Interaction Regions seen at Saturn's orbit. In particular, we divide our simulation into four stages during each of which (spans about one week) the strength of the IMF remains fixed but its orientation is set southward, dawnward, northward and duskward, respectively. A forward shock is then introduced in the solar wind during each of the four intervals. In this paper, we will compare the global configuration of Saturn's magnetosphere before and after the shock compression under different IMF conditions. Our simulation results show that when a forward shock impinged on the magnetosphere, as the global magnetosphere significantly shrinks, periodic reconnection events in the magnetotail with periodicity very close to the planet rotation period are observed. We will discuss possible mechanisms that may have caused the periodic reconnection events in the tail.