Solar wind influence on Jupiter’s inner magnetosphere derived from the global MHD simulation

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Dawn-dusk asymmetric features in Jupiter’s inner magnetosphere, i.e., Io plasma torus (IPT), have been reported. Presence of dawn-to-dusk electric field is one of the leading explanations of the asymmetry. The extreme ultraviolet spectroscopy of IPT by Hisaki revealed that such a dawn-dusk asymmetry clearly responses to a rapid increase of solar wind dynamic pressure. However, the physical process of such a response and generating an intense electric field in Jupiter’s inner magnetosphere still remains unclear. Here we investigate the physical mechanism between the solar wind and Jupiter’s inner magnetosphere by using 3-dimensional global magnetohydrodynamic (MHD) simulation. We have calculated several cases with different solar wind conditions and compared the results with Hisaki observations. We found clear dependence of the field-aligned currents (FACs) from the mid-magnetosphere (~20-30 Rj) to the ionosphere on the solar wind dynamic pressure. Such FACs generates an additional electric potential pattern in the ionosphere and forms an electric field even in the inner magnetosphere. Thus our result agrees with the Hisaki observations and the scenario that dawn-to-dusk electric field is generated by the magnetosphere-ionosphere (M-I) coupling via FACs. This suggests that the solar wind influence can penetrate into Jupiter’s inner magnetosphere from the mid-magnetosphere via FACs.