Study of the solar wind influence on the Jovian inner magnetosphere using an ionospheric potential solver

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The solar wind hardly influences the convection in the Jovian inner magnetosphere, because the corotation of magnetospheric plasma dominates the convection there. However, the extreme ultraviolet spectroscope (EXCEED) aboard the Hisaki satellite observed change in a dawn-to-dusk asymmetry in the brightness distribution of the Io plasma torus. This asymmetry can be explained by assuming the existence of a dawn-to-dusk electric field of ~3-7 [mV/m] around Io's orbit. The influence of the solar wind is suggested as its cause: First, the solar wind compresses the Jovian magnetosphere. Then, the magnetosphere-ionosphere current system is modified, and the field-aligned current into the high-latitude ionosphere increases. As a result, the ionospheric electric field increases and penetrates to low-latitude regions. It is mapped to the equatorial plane of the magnetosphere along the magnetic field line, and the dawn-to-dusk electric field is created at Io's orbit in the inner magnetosphere.
An ionospheric potential solver is one of the best tools to test this scenario quantitatively. The ionospheric potential solver is a simulation code by which we can investigate how the global ionospheric potential gets distributed responding to the input of the field-aligned current. We constructed an ionospheric potential solver and investigated whether the dawn-to-dusk electric field generated by the solar wind interaction could penetrate into the Jovian inner magnetosphere. We validated this potential solver by applying it to the Earth's ionosphere and comparing with an established code [Nakamizo et al., 2012]. Our code succeeded to reproduce a similar potential distribution, however there remain minor differences caused by minor differences in the assumption of the ionospheric conductivities, i.e., their spatial distributions including relative positions to the field-aligned current. Then, we applied this code to the Jovian magnetosphere-ionosphere current system. As a peak intensity of the field-aligned current, we used a value based on the observation of FUV aurora by HST [Gustin et al., 2004] and adopted the Earth's empirical model for its distribution [Hori et al., 2009]. We assumed the Jovian ionospheric conductivities as 10 percent of the Earth's values [Tao et al., 2009]. The electric field mapped to Io's orbit appears to be on the same order as or smaller than the value suggested by the Hisaki satellite observation. In this paper, we will present a result using more realistic spatial distributions of the ionospheric conductivities and the field-aligned current obtained from the Galileo spacecraft observation and a Jovian upper atmospheric model.

Keywords: Jupiter, Io plasma torus, dawn-to-dusk electric field

