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Influence of azimuthal variations in the jovian magnetospheric field on global thermospheric energy inputs

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Abstract

Jupiter's upper atmosphere is coupled to the magnetosphere via an electrical circuit in which current travels along the planetary magnetic field between these two regions, radially outwards in the magnetospheric equatorial plane, and equatorward through the ionosphere. Energy and momentum are communicated to the thermosphere by a combination of joule heating and ion drag. Together, these processes modify the local thermosphere, and produce a system of meridional and azimuthal winds, as well as localized heating. The driver for this current circuit is the radial transport of plasma outward through the planetary magnetosphere. Io ejects ~1000 kg/s neutral material, which then becomes partly ionized through electron impact and charge exchange, leaving ~500 kg/s plasma to be transported through the magnetosphere. As the remaining plasma moves outwards, it slows in its rotation to conserve angular momentum, bending back the planetary magnetic field lines that thread it. Field-aligned currents simultaneously develop to support this magnetic geometry, transporting angular momentum from the planet to the magnetospheric plasma. In the equatorial plane, a **j x B** force accelerates the plasma towards corotation with the planet. Axially symmetric models for the magnetic field and plasmasheet have been extensively applied to describe this process. Outside of ~20 R_J (jovian radii), however, the north-south component of the equatorial magnetic field varies significantly with azimuth (local time). Therefore, the magnitude of the current is also expected to change, in accordance with the corresponding variation in the radial profile of magnetospheric plasma angular velocity. Using the UCL JASMIN model, which describes the coupled thermosphere-ionosphere-magnetosphere system in 2.5 dimensions, we explore how these azimuthal variations in the equatorial magnetic field structure modify the ionospheric currents, and discuss the ensuing effects on the thermospheric heating and flows.