Modelling the radial penetration of a cross-polar cap electric field in the Jovian magnetosphere, in relation to observed local-time asymmetries

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Résumé

Many current models of plasma transport in the Jovian magnetodisk/plasmasheet consider it to be azimuthally symmetric over radial distances extending from the outer edge of the Io torus to about 50 Jovian radii. But there are also many pieces of evidence pointing to a local time asymmetry in this system at such radial distances, and in the upper atmosphere to which it is coupled. Many of these observed asymmetries have been interpreted as the result of a large-scale dawn-to-dusk electric field generated across the magnetospheric cavity that would be superimposed to the dominant corotation electric field. But no consistent model of this electric field, of its generation and of its mapping to different magnetospheric radial distances and ionospheric altitudes exists yet. We attempt to fill this gap by developing a simple semi-analytical model of electric fields, plasma convection, and current flows

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in the Jovian ionosphere and magnetosphere derived from the Earth case, which describes their variations with ionospheric colatitude and magnetospheric radial distance. Comparison to existing estimates of asymmetries and currents support the idea that the dawn-dusk electrostatic potential existing across the polar cap inside the main auroral emissions does penetrate to lower latitudes and down to the Io torus location, and is only partly attenuated by the shielding effect of trapped particles in the magnetodisk.