

Storm-time global ionospheric potential and induced current distributions

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The estimation of ionospheric potential and horizontal current distributions has been conducted vigorously in a few decades to describe many magnetic disturbance phenomena in storm events or solar active periods [Richmond, 1973; Maekawa and Maeda, 1978; Tsunomura, 1999]. Tsunomura [1999] provided realistic distributions of the equatorial jet current and related magnetic disturbances driven by a sudden commencement (SC) by including a correction to conductivities. They pointed out that reduction to two-dimensional system (zero parallel electric field) causes a singular increase of the equatorial conductivity, and the non-diagonal component should be artificially dumped to obtain the realistic jet currents. The physical meaning of this treatment is that the Hall current points to the vertical direction at equator. However, it is still artificial and the consistency with two-dimensional reduction is not clear. Furthermore, the model is not seamless because they solve only one-side hemisphere with a boundary condition at equator. In this study, we have developed a two-dimensional ionospheric global potential solver, covering both hemispheres, without any dumping treatment for conductivities. We restrict the integration range for height-integrated conductivity within the dynamo layer which definition is provided in this talk. The values of Pedersen and Hall conductivities are calculated as exactly as possible with MSIS-2000, IRI-2007, and IGRF-2005 reference models. In addition, we consider the effect of auroral particle precipitation on conductivities with the Hardy model. We solve the elliptic partial equation with the multigrid and SOR methods, for which the spatial resolution is set to be less than 1 degree. Taking the realistic field-aligned currents from the empirical model by Hori et al. [2009], we successfully reproduce the global distributions of potential, horizontal currents, and magnetic fluctuations in a moderate storm event. In this talk, we discuss characteristics of these distributions along with parametric studies.

Keywords: ionosphere, potential, storm