

Development of an MHD Simulation Code With Self-Consistent Ionospheric Description on Magnetosphere-Ionosphere Coupling

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Magnetosphere-ionosphere (M-I) coupling is one of the hot and interesting topics in current times. Although a number of global three-dimensional MHD simulations have been carried out, most of the present MHD models focus on the magnetic convection system rather than the ionospheric convection. For example, they represent the ionospheric convection system by solving the Poisson equation at a steady state or make some simple assumptions on keeping physical parameters constant in time. A common method of present simulation models is mapping electric field to a flat ionospheric plate, without considering what is happening within this 'plate'. Though, those simulations have brought us some important ideas of the whole space physical system, but they are unable to describe properly small-scale structures and phenomena like current systems at polar region, which play a decisive role in magnetosphere-ionosphere coupling. The present models are also unable to express the transportation of Alfvén waves between the magnetosphere and the ionosphere. The purpose of this study is to develop a three-dimensional global simulation code of M-I coupling based on the MHD system by including basic ionospheric plasma transport coefficients such as ionization and recombination, ion-neutral friction, Hall term, resistivity, etc. Our code will also be able to specify altitude variations and fluctuations in the electric field in the ionosphere with finite thickness. Such physical phenomena may be of central importance to M-I coupling.