Numerical methods useful for modeling the solar wind-magnetosphere-ionosphere interaction: Div B=0 constraint/gyrokinetic approach

Naoki Terada[1]; Takashi Tanaka[2]; Hiroyuki Shinagawa[3]
[1] NICT/JST; [2] Kyushu University; [3] NICT

We have developed numerical methods that are useful for modeling the solar wind-magnetosphere-ionosphere interaction. In performing global modeling of the solar wind interaction, accumulation of numerical errors often causes serious problems. For example, the violation of div B=0 condition is a well-known problem, and several methods to constrain div B=0 have been proposed. The proposed methods, however, are found to be inadequate for the use in global modeling, because some yield errors that are small but can keep accumulating around stagnation points, and the others cause unphysical penetration of the correction field in a weak magnetic field region such as reconnection region and unmagnetized ionosphere. In this presentation we present a new method to constrain div B=0 condition, monopole diffusion-convection method, that is efficient and avoids the above-mentioned problems. We also present a numerical method that reduces numerical errors as well as computational costs in following ionospheric ions in the presence of a strong intrinsic magnetic field. We show some results of the solar wind-magnetosphere-ionosphere interaction model using these numerical methods.