Three Dimensional Hall-MHD Simulation of Magnetosphere-Ionosphere Coupling by Yin-Yang Grid

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In the global MHD model, the ionosphere has been treated as a sheet model with electrical conductivity. However, the sheet model is not sufficient to essentially understand the magnetosphere-ionosphere coupling system. We need the 3D model to self-consistently solve structure and dynamics of ionosphere. When we calculate magnetosphere-ionosphere coupling system in spherical geometry, it needs too long computation time.

In this study, we adopt Yin-Yang grid composed of two identical spherical grids. The Yin-Yang grid was developed by Kageyama and Sato [2004]. By using this new grid, some problems that occur in high latitude region of latitude-longitude grid are resolved. In addition Yin-Yang grid has some strong advantage that the calculation is speedy, we can heighten accuracy easily, and it is also suitable for massively parallel computers.

We have solved 3D Hall-MHD equations extended by adding Hall term and ion-neutral collision term for altitudes of 80-480 km where a small grid size of 1 km is used in the altitude direction. A static equilibrium solution of ionosphere is given at the initial state. The simulation result shows that the convection was given at an altitude of 480 km as the upper boundary conditions to propagate toward the earth, and the current closure is formed in the ionosphere. We will present these simulation results on the magnetosphere-ionosphere coupling.