Development of a new M-I coupling algorithm in global MHD magnetosphere simulation: Alfvénic-Coupling

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Presently, most global MHD magnetosphere models equip ionospheric solvers at their inner boundaries and then simulate the magnetospheric and ionosphere (M-I) processes. Here the ionospheric solver is the so-called "thin shell model" which solves the Ohm's law under the thin shell approximated ionosphere with FACs in the polar region and the height-integrated ionospheric conductivity. With this solver, the global MHD models solve the inner boundary condition of electromagnetic field in the following manner. (1) The FAC distribution obtained from the rotation of the magnetic field at the inner boundary (usually placed at the altitude of 2–3 Re) is mapped to the ionospheric altitude. (2) The mapped FAC is inputted to the solvers equipped at the ionospheric altitude, then the ionospheric potential is calculated. (3) The potential is mapped back to the inner boundary and the bulk velocity is updated there.

On the other hand, Yoshikawa et al. [2010] proposed a new M-I coupling algorithm which guarantees the continuities of physical quantities between the magnetosphere and ionosphere and therefore the momentum and energy conservations by considering the incident and reflection process of shear Alfvén waves. We call the new algorithm 'Alfvénic-coupling.' We discuss in detail the characteristics of the traditional algorithm and the concept of Alfvénic-coupling algorithm. We report on the progress of the implementation of Alfvénic-coupling in a global MHD code and will show the preliminary results.

References

Yoshikawa, A., H. Nakata, A. Nakamizo, T. Uozumi, M. Itonaga, S. Fujita, K. Yumoto, and T. Tanaka, Alfvénic-coupling algorithm for global and dynamical magnetosphere-ionosphere coupled system, *J. Geophys. Res.*, 115, A04211, 2010, doi:10.1029/2009JA014924.