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Global MHD simulation of substorm with effective resistivity models

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Magnetic reconnection is considered to play an important role in space phenomena such as substorm in the Earth's magnetosphere. In the MHD framework, the dissipation model is introduced for modeling of the kinetic effects. Tanaka and Fujita found that the normalized reconnection viscosity, one of the dissipation model employed there, gave a large effect for the dipolarization, central phenomenon in the substorm development process, though that viscosity was assumed to be a constant parameter.

It is well known that magnetic reconnection is controlled by microscopic kinetic mechanism. Horiuchi and his collaborators showed that reconnection electric field generated by microscopic physics evolves inside ion meandering scale so as to balance the flux inflow rate at the inflow boundary, which is controlled by macroscopic physics. That is, effective resistivity generated through this process can be expressed by balance equation between micro and macro physics. We also propose other resistivity model generated in wave-particle interaction, which was evaluated by Moritaka and Horiuchi.

In this paper, we perform substorm simulation by using the global MHD code developed by Tanaka with these effective resistivity models instead of the empirical resistivity model. We obtain the AE indices from simulation data, in which substorm onset can be seen clearly, and investigate the relationship between the substorm development and the effective resistivity model.

Keywords: substorm, global structure, magnetic reconnection, anomalous resistivity