MODELING OF A SUBSTORM EVENT USING THE RICE CONVECTION MODEL WITH AN EQUILIBRIUM MAGNETIC FIELD

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We present a simulation of an isolated substorm that occurred on Oct. 29, 2004, using the Rice Convection Model coupled with a magneto-friction equilibrium solver. This model includes the self-consistent feedback of both the ionospheric electric potential coupled with magnetospheric convection and the magnetic field equilibrated with particle pressures. The simulation achieves good agreement of multipoint data-model comparison at both Geotail (~-9R_E) and geosynchronous orbit. The model results confirm the global view of a typical substorm growth phase, including enhancement of the cross tail current density, earthward motion of the plasma sheet, sharpening of the transition region, dropouts of the energetic particle fluxes. At the end of the growth phase, the model produces a very stretched magnetic field and B_z minimum (~1.3nT) at ~-13 R_E, which results in the plasma sheet from -7 to -17 R_E mapping to an extremely thin layer (~0.5 degree in latitude) on the ionosphere. The expansion phase is modeled using a boundary condition that imposes depleted magnetic flux tubes with low values of the entropy parameter $PV^{5/3}$. We find that sufficient reduction of $PV^{5/3}$ for several minutes near onset plays a central role in the strong plasma injection, which is accompanied by the significant enhancement of partial ring current with closure to the region-2 field-aligned currents; short-lived, strong dawn-to-dusk electric field; prompt over-shielding pattern of electric potentials; dramatic magnetic field dipolarization outside partial ring current region; and formation of the substorm current wedge with total current magnitude of 10^6A.

Substorm current wedge, Entropy, Ring current

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