A Modified Magnetosphere-Ionosphere Coupling Model by Including the Hall Effects due to Thinning of the Near-Earth Plasma Sheet

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Thinning of the near-Earth plasma sheet is commonly observed during the growth phase of a substorm. If the thickness of the near-Earth plasma sheet is between the ion’ s gyro radius and the electron’ s gyro radius, the unmagnetized ions and the magnetized electrons will move in different directions and result in a Hall effect in the near-Earth plasma sheet. This situation is similar to the collisional ions and the collisionless electrons in the E-region ionosphere. Kan et al. (1988) have proposed a Magnetosphere-Ionosphere coupling model to simulate the field-aligned current distributions in the ionosphere before the onset of a substorm. We modify the 1988 M-I coupling model by adding the Hall effect in the near-Earth plasma sheet during the growth phase of a substorm. We find that the Hall effect in the tail can enhance the field-aligned current and change the spatial distribution of the field-aligned current. As a result, both the intensity of the field-aligned currents and the spatial distribution of the upward field-aligned currents obtained in our simulations are in good agreement with the observed field-aligned currents at the onset of a substorm.

Keywords: Substrom, Field-aligned current, Magnetosphere-Ionosphere coupling

