Model Simulation of the Equatorial Electrojet and Vertical Drift

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Between 100 and 120 km above the Earth's magnetic equator, the equatorial electrojet (EEJ) flows as an enhanced eastward current in the daytime E region ionosphere which can induce a magnetic perturbation on the ground. Calculating the difference between the horizontal components of magnetic perturbation at magnetometers near the equator and about 6-9 degrees away from the equator, △H, provides us information about the strength of the EEJ. The NCAR Thermosphere-Ionosphere-Electrodynamics General Circulation Model (TIE-GCM) is capable of simulating the EEJ current and its magnetic perturbation on the ground. The simulated diurnal, seasonal (March equinox, June solstice, December solstice), and solar activity (F10.7 = 80, 140 and 200) variations of △H in the Peruvian (75°W) sector, and the relation of △H to the ionospheric vertical drift velocity under fixed solar zenith angle, are presented in this paper. Results show the diurnal, seasonal and solar activity variations are captured well by the model. Agreements between simulated and observed magnitudes of △H and its linear relationship to vertical drift are improved by modifying the standard daytime E region photochemistry in the TIE-GCM in order to better simulate observed E region electron densities. In addition, we examine two important factors to understand mechanisms which may cause the scatter of data in the linear relationship. First, we make changes in the amplitudes and phases of migrating tides from the Global Scale Wave Model, which is utilized to specify the lower boundary in the TIE-GCM. Secondly, we modify the cross polar cap potential and total hemispheric power to represent the Kp effects during a geomagnetic storm. Investigating these parameters not only helps us understand the day to day variability of the EEJ, but also provides a basis for improved prediction of vertical drifts from ground magnetometer measurements.