

Estimation of the Plasmaspheric Electron Content on the Base of FORMOSAT-3/COSMIC POD-Antennas Measurements

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Abstract

Our research is based on the foremost LEO mission - FORMOSAT-3/COSMIC, a joint scientific mission of Taiwan (NSPO) and the U.S. (NOAA), that was launched on April 2006. The mission placed six micro-satellites into six different orbits at 700~800 km above the Earth's surface. Each satellite is equipped by BlackJack GPS receiver with 4 antennas: two GPS antennas are employed for radio occultation (RO) with a 50 Hz sampling rate and two quasi-zenith GPS antennas with 1 Hz tracking are employed for precise orbit determination (POD). The POD antennas observations can be used to determine the electron content between the COSMIC satellite and GPS satellite, viz, plasmaspheric electron content in the altitudinal range of 750-20,200 km. Two POD antennas of each satellite are able to track up to 13 GPS satellites simultaneously with 1 sec resolution. The slant total/plasmaspheric electron content (TEC/PEC) is the integrated electron density along the line from GPS satellite to the COSMIC onboard GPS receiver and can be obtained from the pseudo-ranges or the carrier phase advances of two different frequencies. By considering the lower accuracy of absolute PEC with pseudorange observations and the higher accuracy of relative TEC with phase observations, a phase-leveling code algorithm is used to obtain the absolute slant TEC. Unknown GPS and COSMIC satellites differential code biases are obtained during solution of overdetermined system of polynomial expansion equations with use of least-squares fitting technique and singular value decomposition. To analyze the plasmaspheric electron density morphology, the global maps of PEC were constructed in magnetic latitude and local time coordinates for different seasons of the 23/24 solar cycles extended minimum. Main peculiarities of the COSMIC-derived plasmasphere electron content variability for solar minimum are discussed; obtained results were compared with modeled PEC values, simulated with use of the International Reference Ionosphere Extended to Plasmasphere (IRI-Plas).