

Monitoring of seasonal variability of the ionosphere over Japan region on the base of GPS and COSMIC RO measurements

ZAKHARENKOVA, Irina^{1*}, CHERNIAK, Iurii¹, SHAGIMURATOV, Irk¹, Andrzej Krankowski²

¹West Department of IZMIRAN, ²University of Warmia and Mazury in Olsztyn, Poland

Knowledge of the state of the upper atmosphere, especially its ionospheric part and its diurnal and seasonal variations, is a very important. Different radio methods and techniques are applied in order to study the ionosphere variability and structure. Nowadays the majority of the ionospheric research activities are base on the measurements of GPS radio signals. Data provided by ground-based GPS receivers allows to estimate values of vertical total electron content (TEC) up to the 20,200 km. GPS measurements onboard Low Earth Orbiting satellites provide possibility to study ionospheric electron density distribution on a global scale. This paper presents results of the joint analysis of GPS/GLONASS observations and FORMOSAT-3/COSMIC radio occultation (RO) measurements at the extended solar minimum of cycle 23/24 over Japan region. COSMIC RO data for different seasons corresponded to equinoxes and solstices of 2007-2009 (March, June, September and December) were analyzed. All selected RO electron density profiles were integrated up to the height of 700 km (altitude of COSMIC satellites), the monthly median estimates of ionospheric electron content (IEC) were retrieved with use of spherical harmonics expansion. Also there was selected several GPS stations located in north-south direction at Japan region. Monthly medians of TEC values were calculated from diurnal variations of GPS TEC estimates during considered month. Joint analysis of GPS TEC and COSMIC data allows us to extract and estimate electron content corresponded to the ionosphere (IEC) and to analyse redistribution of electron content between bottom and topside parts of IEC as well as PEC (plasmaspheric electron content) for different seasons of 2007-2009. Percentage contribution of PEC to GPS TEC indicates the clear dependence from the time and varies from a minimum of about 25-30% during day-time to the value of 50-60% at night-time of winter season. Contribution of bottomside IEC has minimal values during winter season in compare with summer season (for both day and night time). The obtained results were compared with TEC, PEC and IEC estimates retrieved by Standard Plasmasphere-Ionosphere Model (SPIM, <http://ftp.izmiran.ru/pub/izmiran/SPIM/>) that has the plasmasphere extension up to 20,000 km (GPS orbit altitude). A fair agreement was found between SPIM-derived TEC and GPS TEC for Japan region for solar minimum period.

We acknowledge the University Corporation for Atmospheric Research (UCAR) for providing the COSMIC Data and IGS community for GPS permanent data. This work was supported by Russian Federation President grant MK-2058.2011.5.

Keywords: Ionosphere, GPS, FORMOSAT-3/COSMIC, Radio occultation