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ScienceDirect
Advances in Space Research 57 (2016) 1015–1020
ADVANCES IN SPACE RESEARCH (a COSPAR publication)
www.elsevier.com/locate/asr

The measurement of the ionospheric total content variations caused by a powerful radio emission of "Sura" facility on a network of GNSS-receivers

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Received 12 October 2015; received in revised form 1 December 2015; accepted 10 December 2015
Available online 18 December 2015

Abstract

Observations of the perturbations of total electron content (TEC) caused by a powerful radio emission of "Sura" facility (Radio Physical Research Institute, N. Novgorod) were carried out during several experimental campaigns from March of 2010 to March 2013. In this paper the data of experimental measurements of TEC-variations conducted on March, 15, 2010 and on March, 12, 2013, are presented. Parameters of TEC-variations were obtained by dual-frequency global navigation satellite systems (GNSS) diagnostics. Registration of signal parameters from GNSS-transmitters was performed at spatially separated sites along the geomagnetic latitude: Vasilsursk (56°08′N, 46°05′ E), Zelenodolsk (55°52′N, 48°33′E) and Kazan (55°48′N, 49°08′E). In the experiments radio path from GNSS satellite to Vasilsursk passed over the disturbed region of ionosphere, but radio paths to Zelenodolsk and to Kazan did not. However, TEC-variations correlated with pumping of ionosphere by "Sura" facility were detected for all up to three ground measurements sites. Magnitudes of TEC-variations reached up to ~ 0.6–0.7 TECU. The speculation that a sharp gradient of the electron density formed at the border of the main lobe of "Sura" facility may cause the generation of IGW is presented.

Keywords: Total electron content; Large-scale irregularities of the ionospheric plasma; Global navigation satellite systems; Sura ionospheric heating facility; Internal gravity waves; Travelling ionospheric disturbances

1. Introduction

A basic problem of upper atmosphere physics (altitudes from 80 to 1000 km) is the identification of physical mechanisms of plasma instabilities evolvement responsible for the development of electronic density fluctuations. A powerful O-mode electromagnetic pump wave transmitted vertically into the bottomside ionospheric *F* region plasma excites a wide range of plasma processes leading to the appearance of the artificial ionospheric turbulence, i.e., generation of the different *HF* and *LF* plasma modes, plasma density inhomogeneities on the scales from tens of centimeters to kilometers, enhancement of the electron temperature, electron acceleration and ionization, etc. (Gurevich, 2007). Large-scale irregularities with the scales of 5–50 km can be effectively studied using dual-frequency signals of the Navstar (GPS) or GLONASS microwave satellite systems. Propagated through the heated region, such signals acquire an additional phase increment stipulated by the dispersion of the radio waves in the ionospheric plasma and linearly related to the total electron content (TEC) on the propagation trajectory (Ginzburg, 1970; Afraimovich and Perevalova, 2006).

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http://dx.doi.org/10.1016/j.asr.2015.12.008
0273-1177/