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The experimental studying of nonlinear waves strictures in the ionospheric plasma caused by the solar terminator and a powerful radio emission of "Sura" facility

Theoretically and numerically the generation and evolution of solitary IGW and TID at the front of the solar terminator for conditions close to real ones in the F-layer of the ionosphere was studied. In particular it is shown that under certain conditions in the morning and in the evening, sectors of the solar terminator front can generate the soliton-like "precursors" with periods of order 40-60 min. The results of the measurements of total electron content (TEC) at two spatial-separated experimental sites during the solar terminator passage in the evening hours are presented in this report. Parameters of TEC variations were obtained by dual frequency global navigation satellite systems (GNSS) diagnostics. Obtained good qualitative agreements between the theoretical and numerical modeling results are presented. At present, the fact of generation of the TID under the influence of the ionosphere by powerful radio emission of "Sura" facility is experimentally proved. In this case, the TID may travel over long distance (up to 1000 km) along and across the magnetic field lines of the Earth, but as it is well known, the development of artificial ionospheric irregularities including the large-scale irregularities in the field of powerful radio waves occurs along the geomagnetic field lines, i.e. along the geomagnetic longitude. However, the results of the experiments, obtained on network of GNSS-receivers situated at spatially separated sites along the geomagnetic latitude: Vasilsursk (56^{0}08'N, 46^{0}05' E), Zelenodolsk (55^{0}52'N, 48^{0}33'E) and Kazan (55^{0}48'N, 49^{0}08'E), presented in this report allow to speak about development of large-scale ionospheric irregularities stimulated by powerful radio waves of “Sura” facility that can propagate along the geomagnetic latitude, i.e. across the magnetic field lines of the Earth. One possible mechanism to explain this phenomenon may be the one that is described below. In it shown that within the “Sura” facility main lobe a region of reduced electron density is formed, while outside this region the electron density is increased. Thereby, a sharp gradient of the electron density is formed on the border of the main lobe of “Sura” facility that may cause the generation of a solitary wave, as is discussed in. In this case, a solitary wave of the charged component of ionosphere may cause the generation of IGW that in turn can cause the formation of a TID. As it is well known, non-linear solitary waves can propagate over significant distances under certain conditions, and the Earth’s magnetic field does not affect the propagation of IGW.

Biography

Igor Nasyrov received the MS degrees in Radiophysics and Electronics from the Kazan State University, Kazan, Russia, in 1990 and PhD degree in Physics from Kazan State University, Kazan, Russia, in 2000. From 1990 to 1994, he was a Research Fellow at the Department of Radio Waves Propagation and Diffraction, Institute of Terrestrial Magnetism, Ionosphere and Radio Waves Propagation (IZMIRAN), Troitsk, Moscow region, Russia. From 1994 to 2001, he was a Scientific Worker at the Radiophysics Research Laboratory, the Kazan State University, Kazan, Russia. From 2001 to 2004, he was a Research Fellow with Radio Systems Research Laboratory, Department of Engineering, University of Leicester, United Kingdom. Since 2004, he has been Docent (Associate Professor, USA equivalent) with Chair of Radioelectronic, the Kazan State University (now the Kazan Federal University). He has published more than 20 papers in reputed journals. He is a member of the Scientific Council of Russian Academy of Sciences on the complex problem "Radio Waves Propagation". His research interests include nonlinear interaction of electromagnetic radiation with substance, interaction of waves and flows, active experiments in space plasma, heating experiments on ionosphere.

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