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Travelling Ionospheric Disturbances Generated by High Power HF SURA Facility: the Results from Kharkiv Incoherent Scatter Radar

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The results of ionospheric disturbances observation which accompanied periodic near-Earth plasma heating by high-power HF SURA facility radiation were presented. The experiments to modify the ionosphere were conducted on September 20 – 23, 2010 between 12:50 and 17:40 UT. The temporal and height variations of electron density obtained by Kharkiv incoherent scatter radar were analyzed. The main feature of the present study was that the diagnostic instrument was located 1000 km away from the SURA facility.

The ionospheric modifications were detected to significantly change the spectral content of wave disturbances in the electron density. The wave disturbance with a period of near 30 min that corresponds to facility cyclic operation (the heating of 20 min and the pause of 10 min) and with relative amplitude of 0.08 – 0.10 was at the heights of 200 – 300 km. Its time delay was of 60 – 90 min between the first heating start and wave observation. It is important that such disturbance was observed in all time intervals when the ionosphere was heated by high power HF radio waves.

The apparent velocity of this wave disturbance was about 190 – 280 m/s, assuming that it was generated by the first heating switch-on. Since the ionosphere is inertial (and hence integrating) medium, it can be assumed that ionospheric disturbance generation occurred after second or third heating switch-on. The apparent wave velocity was then in the range of 280 – 560 m/s. Internal gravity waves and traveling ionospheric disturbances are known to have such horizontal velocities.

Thus, the effect observed over Kharkiv may be explained by the generation and/or amplification of traveling ionospheric disturbances. This inferred wave pattern was in good agreement with theoretical estimates. The interaction of subsystems in the Earth – the atmosphere – the ionosphere – the magnetosphere system may possibly contribute to this observable effect.

The observed wave disturbances may also be generated by solar terminator moving. Long-term, regular measurements are needed to more accurately separate the effects of ionosphere heating from those of terminator moving.