Mid-latitude Sporadic E-Layers studies by API technique using added heating of the ionosphere

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We present some results on Sporadic E-layers events using the method of the resonance scattering of radio waves on artificial periodic irregularities of the ionospheres' plasma (API technique). The API technique includes the API formation by means of the reflection the powerful radio wave radiated in zenith and probing of the ionosphere using short pulses signals [1]. The diagnostics of the ionosphere by API technique bases upon the Bragg scattering of probe radio waves from artificial periodic structure and the measurements of an amplitude and phase of the scattered signal.

An application of API technique to experimental studies of E_s-layers including the added heating of the lower ionosphere is presented . Experiments were carried out at the mid-latitude SURA heating facility (56.1 N, 46.1 E). APIs were formed using quasi-continuous heating scheme that was allowed us to study both process of the irregularities evolution and relaxation and the evolution of the sporadic E-layer.
We used a compound heating scheme for pumping of powerful radio waves during 1 minute as added heating interval and 2 minute pause after that. The effective radiated power was PG=70-100 MW at the frequency of 4.7 MHz [2]. During additional heating period, the sporadic E-layer often intensified, which led to an increase in the amplitude of the API scattered signals in the D and E regions. During the heating period API were formed and they scattered probe radio waves. In the pause, APIs disappeared and only probe diagnostic waves were emitted.

Figure 1 shows the development of the sporadic E-layer during the one-minute added heating interval and the amplification of the API scattered signal in the lower ionosphere.

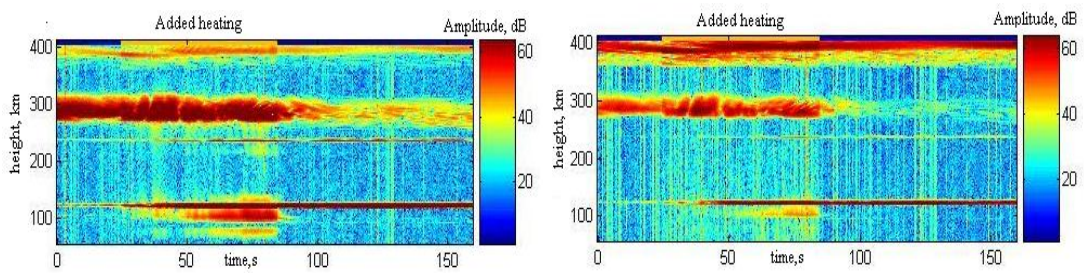

Figure 1. Formation and relaxation of API scattered signals in the D- and E-regions and sporadic E-layer during the added heating of the ionosphere.

The disturbance of the sporadic E-layer by the powerful radio waves resulted to increasing of amplitudes of all ionospheres' scattered signals by 5-20 dB. It was a new effect for the first time registered in the API measurements.
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References

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[2] N. V. Bakhmet'eva, V. V. Belikovich, "Modification on the Earth's ionosphere by the high-power HF radio emission: Artificial periodic inhomogeneities and the sporadic E-layer", Radiophysics and Quantum Electronics, 50, 8, 2007, pp. 633-642, doi: 10.1007/s11141-007-0055-3.