Artificial ionosphere turbulence features related to short-pulse modifications of ionosphere F_2-region

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We present some experimental results concerning the features of artificial ionosphere turbulence (AIT) excited in the ionosphere F_2-region by HF short-pulse (τ_p = 25 ms – 3 s) powerful O-mode radio waves. Measurements were carried out at the Sura heating facility in 2002 – 2005 employing an additional pumping scheme. In such a scheme one from three modules of the Sura facility is used to radiate a diagnostic wave, which produces a diagnostic stimulated electromagnetic emission (d-SEE). The second powerful wave (pump wave, PW), which is radiated by another two Sura modules, is used as an external source of intensive plasma disturbances. Propagating along geomagnetic field lines and changing conditions of d-SEE generation, these disturbances are responsible for appearance of variations in d-SEE characteristics. Because in the additional pumping scheme two separated in height disturbed volumes are produced in the ionosphere F_2-region, it allows to study an influence of different turbulence component on features of interaction of HF powerful radio wave with ionosphere plasma, as well as to estimate a value of disturbance velocity along geomagnetic field lines. It has been found that in d-SEE temporal evolution four stages can be derived: 1) emission intensity decreasing in 5 – 10 ms after the PW switch on; 2) following growth of emission intensity in 20 – 40 ms after the PW switch on, which can be continued 10 – 100 ms after PW switch off; 3) following fast (for $\leq$ 100 ms) relaxation of PW-induced emission intensity; 4) slower (for $\sim$ 0.3 – 4 s) restoring of d-SEE intensity to a level when the ionosphere is pumped by means of the diagnostic wave only. The first three stages we assign to the manifestation of fast processes in AIT evolution. Notice that plasma disturbances, leading to fast d-SEE intensity variations, have velocities along a magnetic field line $V_l \approx 2{\cdot}10^7 - 2{\cdot}10^8$cm/s ($V_l \geq V_{Te} \approx 2{\cdot}10^7$ cm/s). Taking into account the experimental data obtained, it can be assumed that appearance of these fast d-SEE intensity variations are connected with field-aligned flows of thermal and suprathermal electrons HF-induced in the ionosphere disturbed volume. These electron flows, due to short-circuit currents excited simultaneously in HF-disturbed and background plasma, can also stimulate generation of secondary ionosphere disturbances far from the region of PW-plasma resonance coupling. Generation of large-scale density irregularities outside of the region, in which the main part of HF energy is absorbed, has been recently revealed in satellite tomography experiments (Tereshchenko E.D. et al., Phys. Lett. A, 325 (2004), pp.381-388).