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Numerical simulation of perturbations on VLF signals caused by ionization enhancement in the nighttime ionosphere

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Amplitude and phase perturbations on VLF signals, known as LEP events, are caused by scattering of VLF radiation from localized ionization enhancement in the nighttime D-region. This ionization enhancement is caused by the precipitation of energetic radiation belt electrons that is induced by lightning generated whistlers. This work is concerned with the numerical simulations of such VLF perturbations. The method is based on choosing the pair of Wait's parameter: sharpness β (in km^{-1}) and reflection height h' (in km) along segments of GCP, to obtain calculated values of amplitude and phase perturbations, equal or very close with recorded values. During period October – December 2004, the large number of LEP events were recorded at Belgrade station. CME occurred on 03 December and in the night 04/05 December, 2004, more than 300 LEP events were recorded, most of them on signals: GQD/22.10 kHz and ICV/20.27 kHz. Sporadically during that night LEP events were recorded on four signals: GQD/22.10 kHz, NAA/24.00 kHz, HWU/18.30 kHz and ICV/20.27 kHz. On the base of numerical simulations of these events we localized ionization enhancement, approximate size and altitude profile. From the large number of LEP events recorded from August to October 2005, we selected for analysis those with amplitude perturbations $\Delta A \geq 3$ dB, which are rarely recorded at Belgrade station. At the minimum solar activity, LEPs recorded at 20/21 May and 02/03 June nights, were analyzed. Numerical simulations of the effect of LEPs on VLF signals are performed by LWPC code, in purpose to interpret date and understand physics of these phenomena.