Simulation of LF propagation modulation caused by earthquake by means of wave-hop method

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Fine observation of LF standard frequency and time signals (SFTS) at Rikubetsu, Hokkaido (RKB) detected oscillating structures on the received signal intensity and phase after 2011 Tohoku Earthquake. Electric field at the receiving point is described as vectorial summation of the electric fields due to the ground wave and sky waves. Numerical LF prediction by means of wave-hop method adopted in the Recommendation ITU-R P. 684-6 entitled “Prediction of field strength at frequencies below about 150 kHz” estimates the every component waves in the steady conditions. Only a few dominant mode contributes the total signal strength at the receiver. The electric field deviation of each component wave is obtained by fluctuating the reflection height of the ionospheric reflection point. A little uplift of the reflection height provides increased field strength of the component wave due to decreased ionospheric absorption. However, total electric field at the receiving point depends on phase relations between component waves. Receiving signal fluctuation is simulated as follows: 1. Calculate steady state condition parameters and synthesis all the component waves, then get the field strength at steady state. 2. Modulate each reflection height following to the earthquake perturbation spreading concentrically from epicenter. 3. Recalculate the propagation parameters of the component waves such as the SFTS propagation path length, ionosphere/ground incident angles, and absorption factors under the modified conditions. 4. Finally obtain the fluctuated field strength. Calculated field strength is consistent with the observation under the appropriate condition.

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