

Research on nonlinear cross-modulation of power line emission and other very low frequency radiations in the ionosphere

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By analyzing the observation data on electric field intensity from DEMETER satellite, we found that there exists a special type of line radiation events in the ionosphere above China. Their time-frequency power spectrums have several parallel lines with the center frequency 19.8 kHz, interval 50 Hz/100 Hz, and bandwidth 10 Hz. This phenomenon mostly occurs above central and eastern regions of China, which are the magnetic conjugate point of NWC transmitter in Australia (21.81°S, 114.16°E) [1]. The 19.8 kHz-spectral line is considered from the transmitter, which generates signal with center frequency 19.8 kHz and frequency band 200 Hz.

We applied bicoherence spectral analysis [2] to the spectrum of these events and found that they are likely to be generated by the wave radiated from NWC transmitter nonlinearly cross-modulated by 50 Hz-power line emission (PLE) from Chinese power grid. We further used the theory of interaction of plane radio waves for the theoretical analysis on such nonlinear cross-modulation. This phenomenon indicates that radiation from ground power grid can not only directly propagate into the ionosphere, but also interact with other waves in the ionosphere and further change their original state.

Reference: [1] J. Macnae. (2015) *Geophysics*, 80, E343-E353. [2] D. B. Graham, et al. (2014) *Geophys. Res. Lett.*, 41, 1367-1374.

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