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The effects of polarizations of the ELF-VLF waves in waveguide Earth – ionosphere

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Ground based recordings of ELF-VLF waves with right-hand and left-hand circular polarization have been performed in frequency range of 0-39 kHz in Northern Finland in November 2006. Monitoring showed different behavior of VLF waves with right-hand (R) and left-hand (L) circular polarization: (1) waves are linearly polarised in frequencies above 4 kHz but below that the left-hand circular component becomes dominating, (2) the waves show often perfect left-hand circular polarization at and just above Earth-ionosphere waveguide cutoff frequency which is critical frequency of first transverse resonance Earth-ionosphere waveguide (varies between 1.6 and 2.3 kHz).

Wave with R and L polarizations correspond to ordinary and extraordinary modes in ionosphere in presence magnetic field of Earth. The estimates show that R-waves have long skin length and large attenuation. In contrast L-wave in the ionosphere has less skin length and less attenuation. For study the feature propagation of VLF waves near mode cutoff frequencies we calculated attenuation of VLF waves with right (R) and left (L) polarization based on full wave equation for the different models of ionosphere. Appearance of maximum in spectrums of VLF waves near critical frequencies 1.6 - 2.3 kHz due to small absorption of L waves and excitation of resonance waves of waveguide Earth – ionosphere.