The role of plasmapause in nonducted VLF wave propagation

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The dependence of magnetospheric VLF phenomena on geomagnetic activity and related plasmaspheric structure is a well-established experimental fact. We discuss the role of plasmapause in nonducted VLF wave propagation, on the basis of experimental data from the MAGION 4 and 5 satellites, and using computer simulations. The following model of plasma density is used (ω_p, ω_H are the electron plasma- and gyro-frequencies, respectively, **L** is MacIlwain parameter):

$$\omega_p^2 \sim \omega_H^n \cdot P(L) \qquad (1)$$

The factor **P(L)** that enters the expression (1) for ω_p^2 (thus, for plasma density) and models the plasmapause is chosen in the form:

$$P(L) = (1 - p)\exp\{- \exp[(L - L_p)/\delta L_p]\} + p \qquad (2)$$

The quantity **P(L)** is determined by three parameters, L_p, δL_p and **p**, which have clear physical meaning, namely, **p** is the value of **P(L)** beyond the plasmapause; L_p is the position of the plasmapause, and δL_p is its characteristic width. These three parameters make it possible to model the plasmapause quite well in most “one-drop”cases. Density gradients near the plasmapause location change the VLF wave propagation property typical of a smooth magnetosphere, namely, the wave gradual transition to quasi-resonance regime of propagation. Moreover, some waves return to quasi-longitudinal regime of propagation, which prevents magnetospheric reflections at the lower hybrid resonance level. We discuss some consequences of these changes, in particular, the destruction of high order traces of magnetospherically reflected whistlers beyond the plasmapause, and the existence of “silence zone” in satellite registrations of the ground-based VLF transmitter signals. These effects are found both in observations and computer simulations.