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Conjugate ground and Van Allen Probes observations of narrow-band VLF hiss emissions

Elena E. Titova[(1)], Andrei G. Demekhov*[(1)(2)], Jyrki Manninen[(3)], Dmitry L. Pasmanik[(2)], Ondrej Santolík[(4)(5)], Alexey V. Larchenko[(1)], and Tauno Turunen[(3)]
(1) Polar Geophysical Institute, Apatity, Russia
(2) Institute of Applied Physics RAS, Nizhny Novgorod, Russia
(3) Sodankylä Geophysical Observatory, Finland
(4) Institute of Atmospheric Physics, The Czech Academy of Sciences, Prague, Czech Republic
(5) Faculty of Mathematics and Physics, Charles University in Prague, Czech Republic

Extended Abstract

We present the results of simultaneous observations of narrowband ($\Delta f = 1$–3 kHz) hiss-like VLF emissions at the ground-based station Kannuslehto (KAN) in northern Finland and by the Van Allen Probes spacecraft (VAP) in the equatorial region of the magnetosphere. Several cases of such emissions were found for which the projection of satellite trajectory was at a distance of no more than 2–3 thousand km from KAN. The VAP spacecraft detected relatively narrow band (with a bandwidth of about 20%) VLF signals whose frequency varied in proportion to the equatorial electron gyrofrequency for the spacecraft L-shell. During certain short time intervals ($\Delta t < 5$ min), the spectral and temporal characteristics of the VLF emissions detected on the ground and on board the spacecraft showed one-to-one correspondence with each other in localized areas ($\Delta L < 0.5$). In these cases, the VLF emissions at lower frequencies show good correlation during the spacecraft location at higher L shells. The results of multicomponent measurements on board VAP showed that the wave normal directions of VLF emissions which were correlated with ground-based data, were usually close (within 20°) to the magnetic field, and their Poynting vector was directed away from the geomagnetic equator.

A good correlation between the signals detected at Kannuslehto and by the VAP spacecraft was often observed near the plasmapause and in the presence of large-scale irregularities of cold plasma density with transverse dimensions of about 700–900 km. These inhomogeneities can guide whistler mode waves to the ground. The results of ray tracing of VLF waves using the measured distributions of the plasma density show the possibility of wave trapping in the density ducts at frequencies below one half of the equatorial gyrofrequency of electrons. The wave normal angles for these waves remain small inside the duct which enables them to reach the ground. Therefore, we conclude that the exit of narrow-band VLF emissions to the ground was possible due to their guiding in the observed enhanced density ducts.

References

[1] E. E. Titova, A. G. Demekhov, J. Manninen, D. L. Pasmanik, and A. V. Larchenko, "Localization of the sources of narrow-band noise VLF emissions in the range 4–10 kHz from simultaneous ground-based and Van Allen Probes satellite observations," *Geomagnetism and Aeronomy*, **57**, No.6, pp. 706–718.