Geophysical Research Abstracts, Vol. 8, 03576, 2006
SRef-ID: 1607-7962/gra/EGU06-A-03576

The observed polarisation of sferics in the frequency range of 0.1-8.0 kHz and corresponding features seen in the ELF-VLF emissions of magnetospheric origin

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The response of the Earth-ionosphere wave-guide can be tested by using sferics. The sferic waveforms radiated from lightning and received at long distances from the source stroke contain a great deal of information about the state of the ionosphere along the propagation path.

In September-October 2005 a VLF receiver having orthogonal loop antennae was used at L=5.5 in Northern Finland. The receiver was adjusted to pass even the strongest sferics without saturation. High dynamic range was arranged by 24-bit AD conversions and direct digital recording. The polarisation behaviour of ELF-VLF waves becomes accurately measured over a wide frequency band and different propagation modes appear very clearly. Especially the mode-1 cutoff near 1.7 kHz is interesting. At frequencies above 5 kHz the polarisation of sferics is highly linear, but between 1.7 kHz and $\sim$5 kHz left-hand polarised component appears. Just above the mode-1 cutoff the sferics are almost purely circularly left-hand polarised and the difference between left and right-hand polarised components can exceed 20 dB.

The sferics offer an easy way to check the effects of Earth-ionosphere wave-guide on the propagating ELF-VLF waves. The propagation path is often very long exceeding several thousands of kilometres.

It is not common to consider Earth-ionosphere wave-guide propagation effects for waves entering to this wave-guide from the ionosphere i.e. whistlers, chorus, auroral hiss, magnetospheric line radiation (MLR), certain phenomena relating to power line harmonics, and triggered emissions of various kind. Those waves propagate in the

magnetosphere in right-hand polarised whistler mode. In general they are received as right-hand polarised waves having varying level of ellipticity. However, certain phenomena like MLR and power line triggered emissions measured on the ground show left-hand polarisation. In this study examples are shown, which indicate, that in detailed studies the effects of Earth-ionosphere wave-guide must be taken into account when considering the detailed amplitude and polarisation behaviour of waves entering to the ground after magnetospheric and ionospheric propagation. The effects are quite similar to those seen in sferics.