Geophysical Research Abstracts
Vol. 13, EGU2011-6304, 2011
EGU General Assembly 2011

Line Radiation: types and sources

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ELF/VLF electromagnetic (EM) waves observed by the low-altitude DEMETER spacecraft have sometimes - when represented as a frequency-time spectrogram - a form of several nearly parallel and almost equidistant clearly defined lines. Apart of Power Line Harmonic Radiation (PLHR) events, i.e. events generated due to the electromagnetic radiation from electric power systems on the ground, there are two additional naturally generated types of these emissions: i) Magnetospheric Line Radiation (MLR), i.e. emissions observed at frequencies between about 1 and 8 kHz at larger geomagnetic latitudes ii) EM harmonic ELF radiation, i.e. emissions observed at frequencies below about 1 kHz close to the geomagnetic equator. We examine both types of emissions in detail and discuss their properties and possible generation mechanisms.

All the six electromagnetic field components measured by DEMETER at frequencies below 1.25 kHz allow us to perform a detailed wave analysis of EM harmonic ELF radiation events. It is shown that their properties correspond to the equatorial noise emissions routinely observed in the equatorial region at larger radial distances. Equatorial noise observations performed by both WBD and STAFF-SA instruments on board the Cluster spacecraft are used for comparison. Finally, supposing that the waves are generated at multiples of local proton cyclotron frequency, the radial distance of a source region is estimated for both EM harmonic ELF radiation observed by DEMETER and equatorial noise emissions observed by Cluster.