

STATISTICAL STUDY OF ELF/VLF EMISSIONS AS OBSERVED BY THE DEMETER SPACECRAFT; MAN-MADE EFFECTS AND SEISMIC ACTIVITY

Nemec Frantisek, O. Santolik, M. Parrot and J.J. Berthelier, Charles University, V Holesovickach 2, Prague, Czech Republic

Abstract:

We present a preliminary statistical study of low-frequency electromagnetic waves observed by the DEMETER spacecraft launched in June, 2004. The satellite has a low orbit (at an altitude of 710 km) with an inclination of 98 degrees and is devoted to the studies of ionospheric perturbations connected with seismic or man-made activity. We focus on low-frequency phenomena, limiting our research to ELF/VLF frequency bands of the on-board instruments (up to 20 kHz). We use only data obtained during the Survey mode, collected all over the Earth (during the Burst mode, the data are collected only above seismic regions) and consist of spectra of one electric and one magnetic field component with a frequency resolution of 19.5 Hz and a time resolution of 1 or 4 seconds. We use the entire set of available data, excluding the known artifact of the measurements, for example the frequencies where weak onboard interferences occur. We construct maps of average power spectral densities of ELF/VLF emissions as a function of the position of the spacecraft. In each latitude-longitude bin we accumulate all the data which satisfy predefined selection conditions. These conditions are used to define the parameters of the model and consist of the level of geomagnetic activity (in three intervals of the Kp index), local time, and period of year. For a given set of parameters we additionally calculate the standard deviation of the power spectral density, and we characterize its statistical distribution by a histogram of obtained values. These maps can be used in advance to represent which power spectral densities are expected at a given place under given conditions. Such studies are useful for estimates of statistical properties of exceptional phenomena, such as man-made effects or effects connected with the seismic activity. In these maps, we examine the correlation between zones with exceptionally intense emissions and locations of industrialized regions. Periods of low geomagnetic activity are especially interesting for this study. Above the industrialized regions we also study how the intensity of emissions depends on the day of week. This study enables us to distinguish between natural and artificial emissions because we expect to obtain a correlation with the day of week for artificial industrial sources. Concerning the electromagnetic effects possibly connected with the seismic activity, we approach this problem in a most simple way, as a statistical study of the observed power spectral densities. This requires the knowledge of the common levels of the intensity of emissions, and their statistical distributions. We compare the intensity of emissions above

active seismic zones with the distributions of intensities which could be expected at the same place under the given conditions during the entire time period without the seismic events. This allows us to estimate the probability that the observed intensities are random fluctuations and distinguish if there are any systematic trends connected to the seismic activity.