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ULF wave-power databases inferred from space-borne and ground-based magnetic field observations

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ULF waves are important in radiation belt dynamics, playing a critical role both in local acceleration and in the radial diffusion of energetic electrons. The focus of the present work is a statistical study of ULF waves as observed by the CHAMP satellite and the IMAGE ground magnetometer array, both of them being European initiatives in the realm of geomagnetism and geospace physics. The CHAMP (Challenging Minisatellite Payload) was a German LEO satellite, which flew for more than 10 years (from July 2000 to September 2010) on a polar orbit of initial altitude of 454 km, providing among others high quality measurements of the Earth's magnetic field. The IMAGE (International Monitor for Auroral Geomagnetic Effects) array consists of 31 magnetometer stations in central and northern Europe.

In the framework of the MAARBLE project, we have developed a set of tools based on the wavelet transform, which enable us to detect ultra low frequency (ULF) wave activity through both in situ and ground magnetometer observations. The application of these tools, on data from the CHAMP satellite mission and selected stations of the IMAGE ground magnetometer array, enabled us to create a database of wave power spectral density (PSD), for the entire first decade of the new millennium, spanning years from 2001 to 2010. Our focus here is on the lowest bands of the ULF waves, with frequencies lower than 100 mHz and down to a few mHz.

For the case of the CHAMP satellite, the creation of such a database with the inclusion of additional data, enable us to derive valuable statistics for many important physical properties relating to the spatio-temporal location of these waves, the wave power and frequency, as well as other parameters and can be used as a starting point in the launch of further investigations on the correlation of low frequency ULF waves with solar wind conditions, magnetospheric indices, electron density data, ring current decay and radiation belt enhancements.

From the wave PSD database of the IMAGE network arises the additional opportunity to calculate radial diffusion coefficients, which in turn can be used to improve radiation belt modeling.

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