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Study of electromagnetic emissions recorded by the DEMETER satellite

Abstract :

This thesis presents results based on wave measurements performed by the DEMETER spacecraft. This French spacecraft was operating between 2004 and 2010 at the altitude of ~ 660 km. We focus on measurements of the electromagnetic waves and plasma density in the vicinity of imminent earthquakes.

In the first part, we present a study of plasma density variations in the vicinity of a very powerful earthquake in Chile (M_w 8.8) which occurred on February 27, 2010. Data recorded before the main shock along orbits close to the future epicenter showed increasing plasma densities. A statistical analysis using 4 years of data to monitor density variations under similar conditions has been performed. This study shows that a large increase of the plasma density is very uncommon at this location.

In the second part, a statistical study (~ 6.5 years) of variations of VLF wave intensity is shown. We have analyzed all available data measured close (in time and space) to large earthquakes ($M \geq 5$). Data related to more than 12000 earthquakes have been compared with an unperturbed background distribution. We confirm the previously reported results of a statistically significant decrease of the wave intensity at frequencies of about 1.7 kHz. This effect might be related to a decrease of the lower ionospheric boundary which affects the VLF waves propagating in the Earth-ionosphere waveguide.

Keywords : DEMETER, earthquakes, electromagnetic waves, space plasma