



Critical analysis of plasma wave disturbances over the Sichuan region in a period encompassing the May 12, 2008 EQ

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We report initial results from a detailed statistical study of the plasma waves observed by the DEMETER satellite over the Sichuan region during a period of 20 days encompassing the large earthquake of magnitude $M=7.9$ that occurred on May 12, 2008. The main objective of this paper is to present a statistical method to process and analyze plasma wave data and help in detecting possible earthquake precursors among larger irregular disturbances arising from the natural variability of the ionized environment of the Earth. This method, presently used for dayside observations, involves 2 stages. First, VLF wave spectra are processed to recognize the various types of plasma waves usually observed at mid and low latitudes and derive a reduced number of parameters that fully characterize these emissions and may be conveniently used for a detailed statistical study. In a second stage, we perform a statistical analysis of the results by taking into account two “reference zones” displaced respectively 30° eastward and westward from the “epicentre zone”. Plasma and wave disturbances possibly induced by earthquakes in preparation are likely to maximize close to the “epicentre” zone, while natural disturbances associated, in particular, with the varying magnetic activity are rather uniform over a wider longitude sector, thus enabling to use the observations over the reference zones as a base line. The initial results of this study show a large ($>4\sigma$) deviation of the intensity of electrostatic turbulence in the EQ epicentre region about 6 days prior to the earthquake in the same time interval when large ionospheric density disturbances were previously reported. The DEMETER observations might have been considered as a real effect associated with the EQ preparation. However an in-depth analysis of DEMETER data show (i) that a similar increase is observed with a larger amplitude in the conjugate zone and (ii) a similar effect is also observed in the reference zone to the west of the EQ zone. Using recently produced sector magnetic indices that describe the variation of magnetic activity in longitude separately for the northern and southern hemispheres, we have been able to show that the DEMETER observations can be well understood by a rather untypical magnetospheric disturbance in a longitude interval that encompasses the EQ and west reference zones and gives rise to a significantly higher magnetic activity in the southern hemisphere. These results point out the necessity of an extremely careful and critical analysis of statistical data in searching for pre-seismic effects in the ionosphere.