VLF Noise Bursts Related To Major Seismic Activities Observed At Agra

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Introduction

The electromagnetic emissions during earthquakes and their precursory characteristics have been studied extensivily during the last one and half decades. The facilities for such studies have been created at Agra, India, recently, and VLF noise bursts related to some major seismic activities that occurred in Afghanistan, Iran, Turkey etc have been observed. Attempts have also been made to identify the seismogenic signals from other noises. In this paper, these results are reported and discussed.

Experimental set up

The experimental arrangement consists of a set of terrestrial crossed loop antenna of the size 144 m^2, a vertical antenna of the height 21 m, a borehole antenna of the length 120 m installed in a noise free rural area about 11 Km west of Agra city. The induced voltages in the vertical antennas are amplified, detected and filtered at the frequency of 3.5 kHz (BW ~ 250 Hz) using a band pass filter.. The output is recorded on a chart recorder regularly. Arrangements have also been made to record the data digitally using PCL 206 A/D converter and LABTECH software.

Results

The monitoring of the electromagnetic signals at the frequency of 3.5 kHz has been in progress since January, 1998, using the borehole antenna. Since then VLF noise bursts of varying durations have been recorded on a number of occasions that corresponded to the periods of major seismic activities that occurred in Afghanistan, Iran, Turkey in the north - west and some other places in the north - east directions from Agra. Such noise bursts have not been recorded in the absence of seismic activities. The onset of the noise bursts occurred 1 - 2 days prior to the occurrence of the main shocks. The results are interpreted in terms of wave propagation through waveguides created along fault lines (Kingsley, 1989).

In order to identify the seismogenic signals from other noises caused by spherics, both the terrestrial vertical and borehole antennas are operated, one after the other, during the onset of the noise bursts. It is found that the amplitude enhancement in the case of the nose bursts produced by the borehole antenna are larger during seismic activities. The tendency is reversed during nonseismic activities. This provides a useful method of confirmig the seismic sources of the noise bursts.

References

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Statistical Study of Ionospheric Precursors of Strong Earthquakes at Taiwan Area

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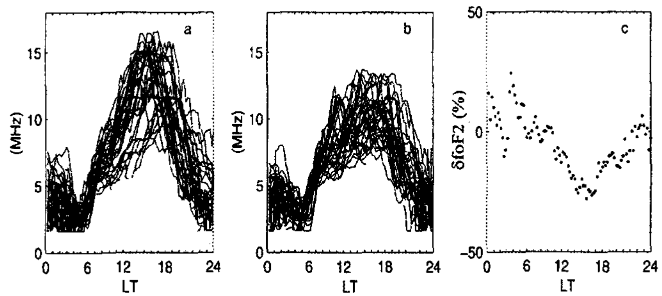
Introduction

The main problem of studies of the seismo-ionospheric coupling effects from the practical point of view is a poor statistics and controversial information regarding the shape of seismo-ionospheric variations (variations of critical frequency before the strong earthquakes). The main approach for many years was collecting the case studies, which never satisfy people who should be convinced. The real statistical study is possible only on the basis of homogeneous database, as it was done for example by Molchanov et al. [1]. Unfortunately, the data of ground based vertical sounding are very different for different stations (data quality, distance to the earthquake epicenter, etc.) In addition, it was revealed the regional dependence of the seismo-ionospheric variations shape. From this point of view the Taiwan Area is ideal place for statistical studies: frequent and strong earthquakes (M>5, close distance to epicenter area ~ 200 km or less, high quality of ionospheric data). 4 years (1994-1997) of Chung-Li ionosonde station were processed for the following purposes:

- To reveal the typical shape of seismo-ionospheric variations
- To estimate the probability of detecting the seismo-ionospheric variations for strong earthquakes
- To estimate the prediction probability for strong earthquakes

Techniques and results

A statistical technique is introduced to estimate the variance of the sample median. The estimated variance will be applied to find the precursor of earthquake. To avoid other geophysical effects (magnetic storms, tides, thunderstorm effects, etc.), the variance of the sample median over a 15-days period is estimated. Figure 1a displays the median values which represent foF2 observed during the undisturbed days while Figure 1b illustrates foF2 recorded 1-5 days before occurring of earthquake. To identify the earthquake signature, a percentage of the deviation of foF2 is derived, which is obtained by subtracting median from the observation and then divided by the median. The obtained curve is similar to that published by Pulinets et al. [2], where such attempt was made by collecting variations from 54 all over the world earthquakes.



a) undisturbed days b) seismically disturbed days c) typical earthquake signature

Figure 1c shows a typical earthquake signature. The probability of observing the signature 1-5 days priori earthquake is found to be about 82%.

References

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