Anomalous VLF subsurface electric field changes associated with India – Nepal border Earthquake (M = 5.7) of 4, April-2011 and their lithosphere-atmosphere coupling observed at Mathura (India)

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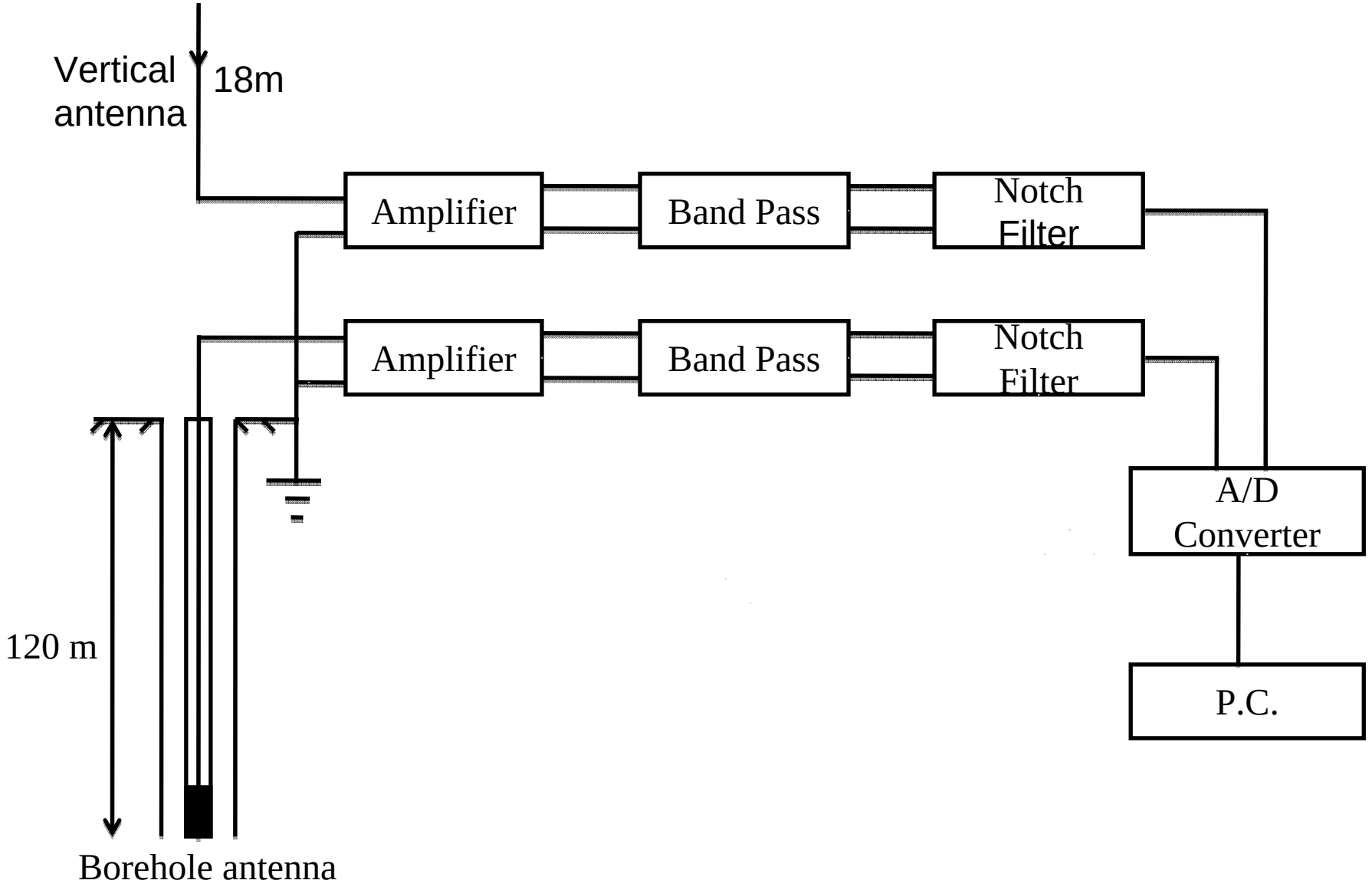
INTRODUCTION

Several workers have observed electromagnetic emissions before, during and /or after the seismic activities in a wide band ranging from ULF to HF on the basis of ground and satellite based observations (Gokhberg et al., 1982; Warwick et al., 1983; Parrot and Mogilvesky, 1989; Fujinawa and Takahashi 1990, 1994; Takeuchi et al., 1996, Fujinawa et al., 2001, Liperovsky et al, 2001, Pulinets and Legen'ka, 2003. Laboratory rock fracturing experiments have confirmed the association of electromagnetic emissions with seismic events (Cress et al., 1987; Yamada et al., 1989; Yoshida et al., 1998; Takeuchi and Nagahama, 2001; Freund et al., 2004). Parrot (1995) and Hayakawa (1996) have reviewed thoroughly the work done in this field. Recent work done in this field have been compiled by Hayakawa (1999), Hayakawa and Molchanov (2002) and Pulinets (2004).

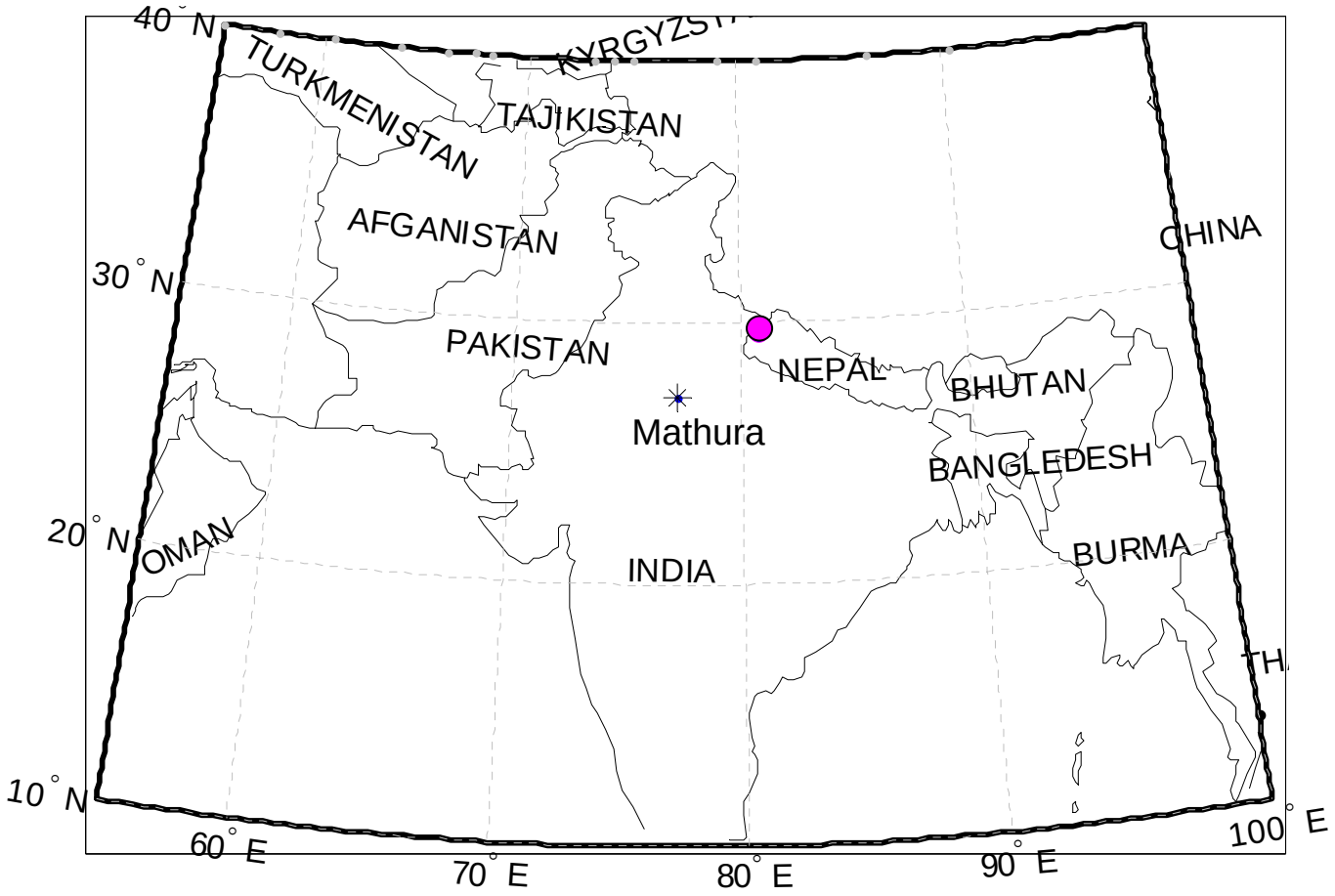
Motivated from the precursory nature of the seismogenic emissions and work of the above workers, we at Mathura have also started to monitor the vertical component VLF electric field emissions employing borehole and vertical antenna since 24 March,2011 and the initial results of the analysis of the data are presented in this paper.

Experimental Set Up for monitoring vertical component of subsurface VLF electric field emissions

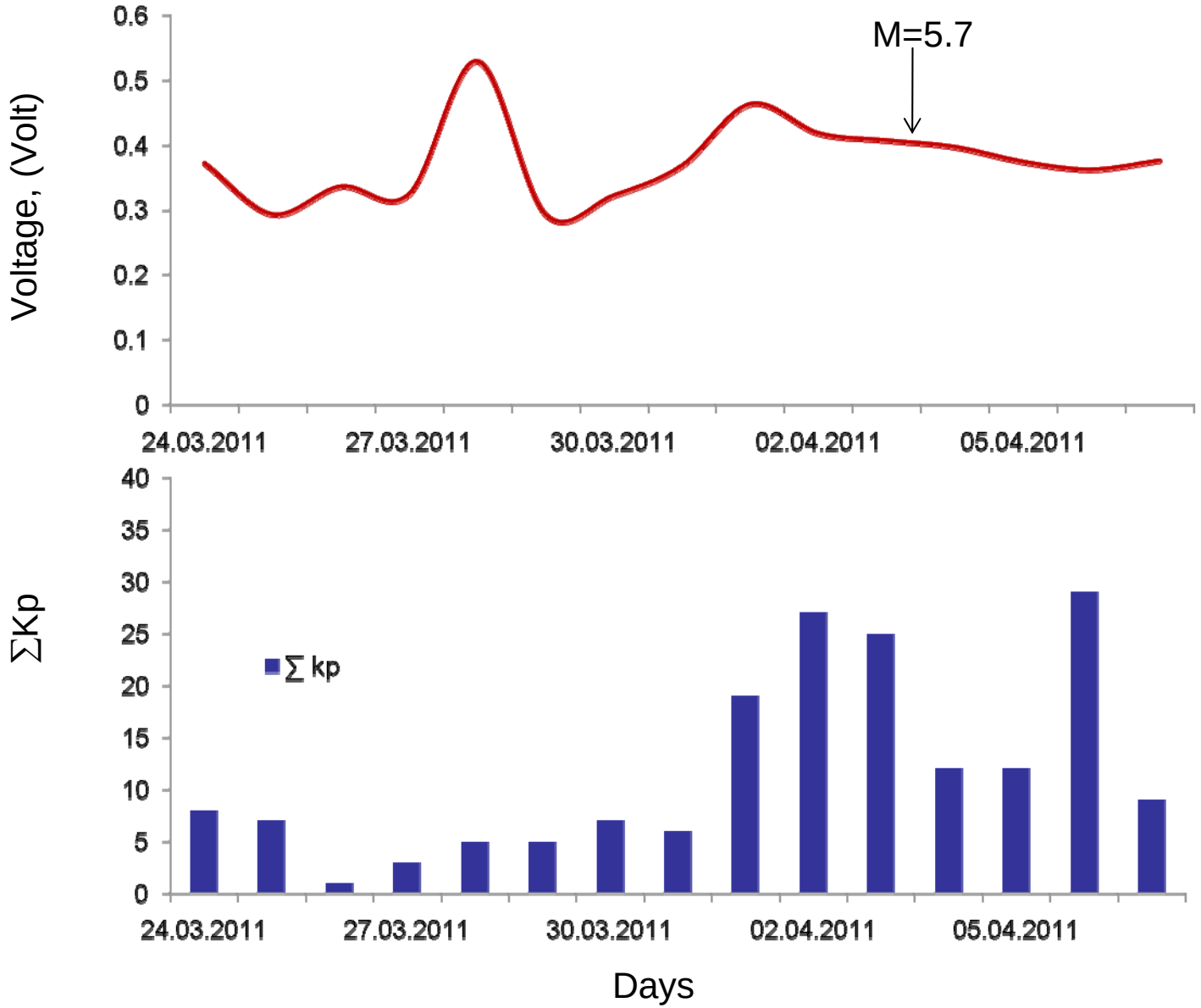


Arial view of vertical antenna

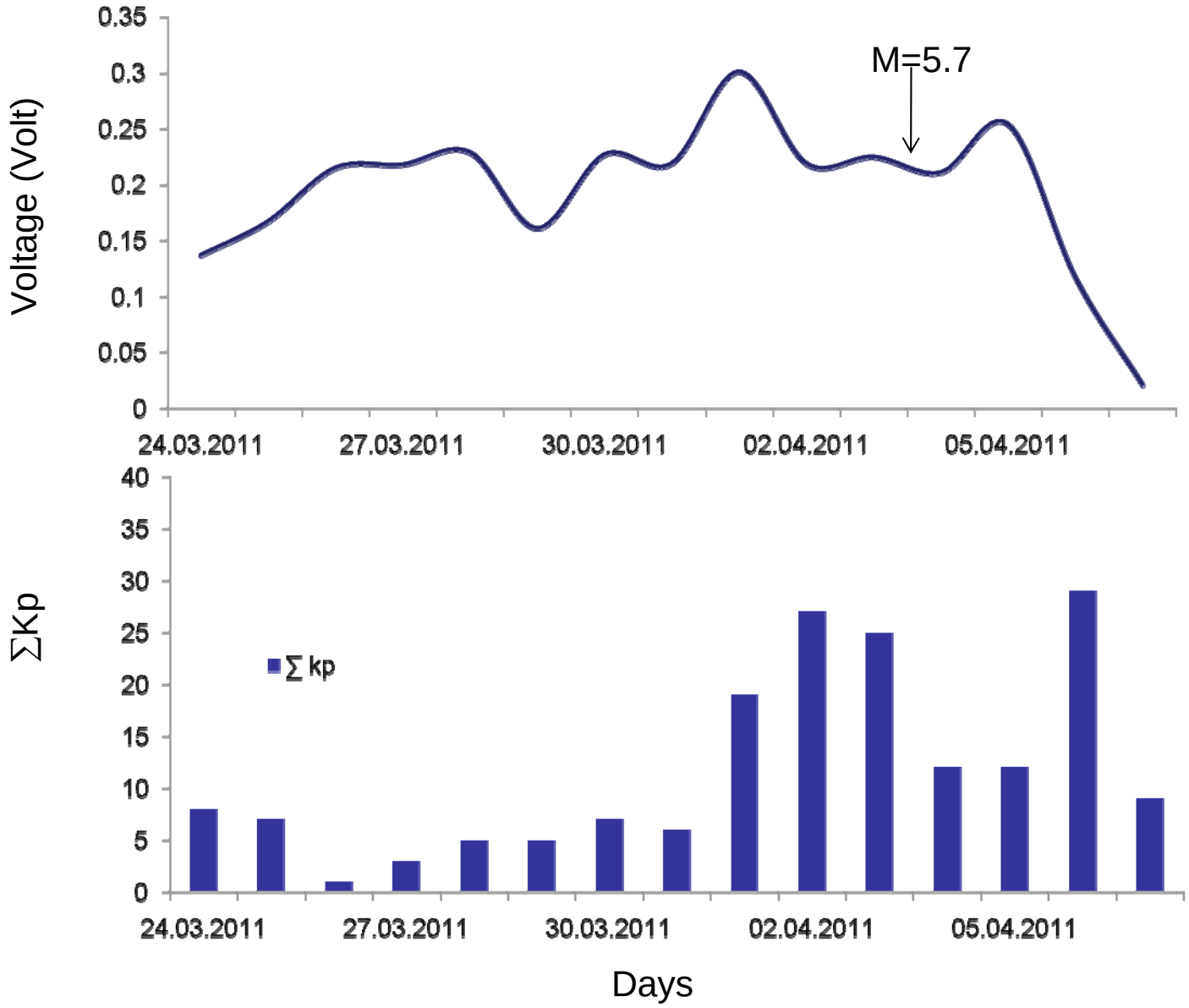
Location of the epicenter of the India-Nepal border earthquake (M=5.7) occurred on 04 April, 2011



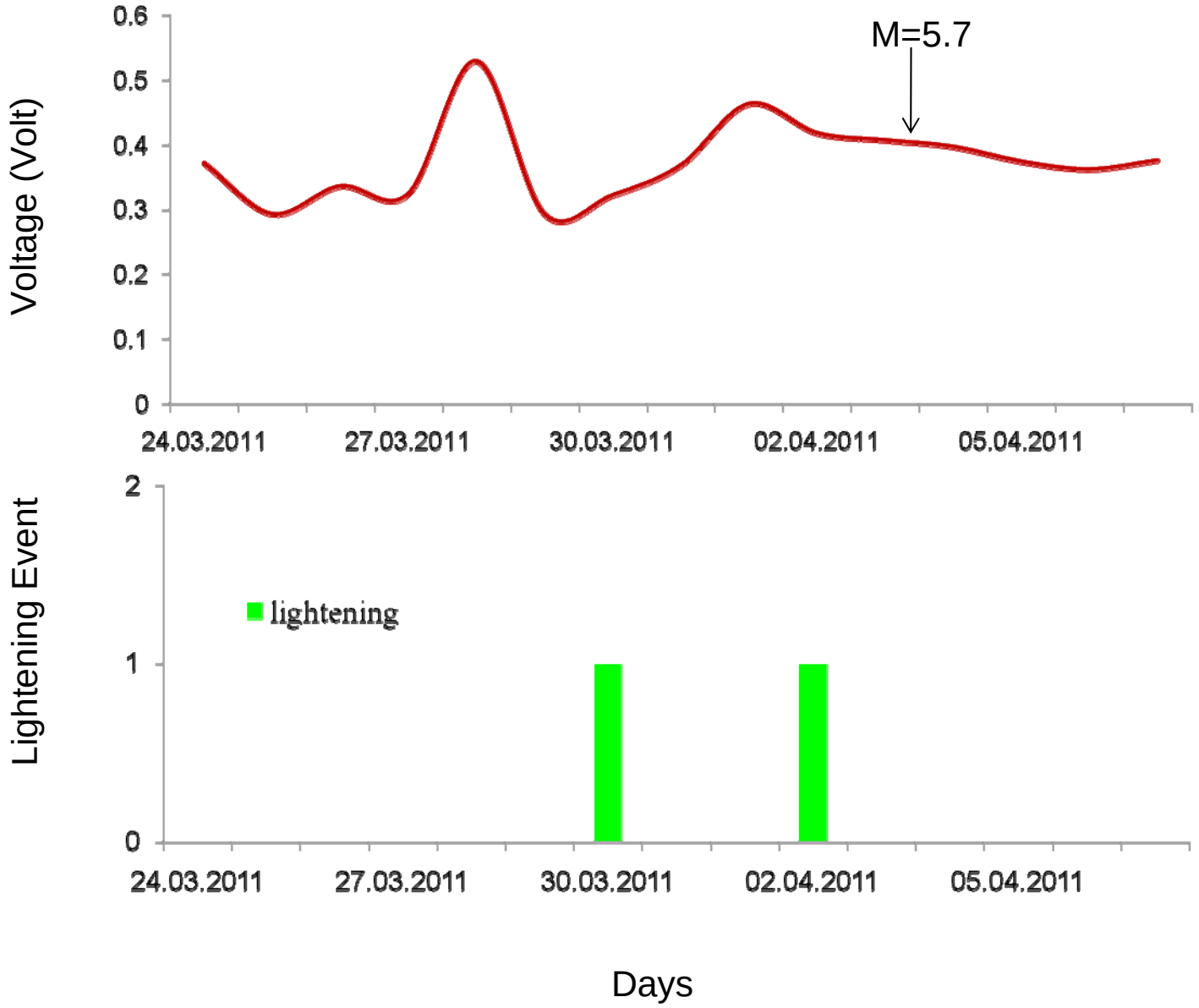
Daily variation of the borehole data and ∑Kp data during the India-Nepal border earthquake occurred on 04 April, 2011



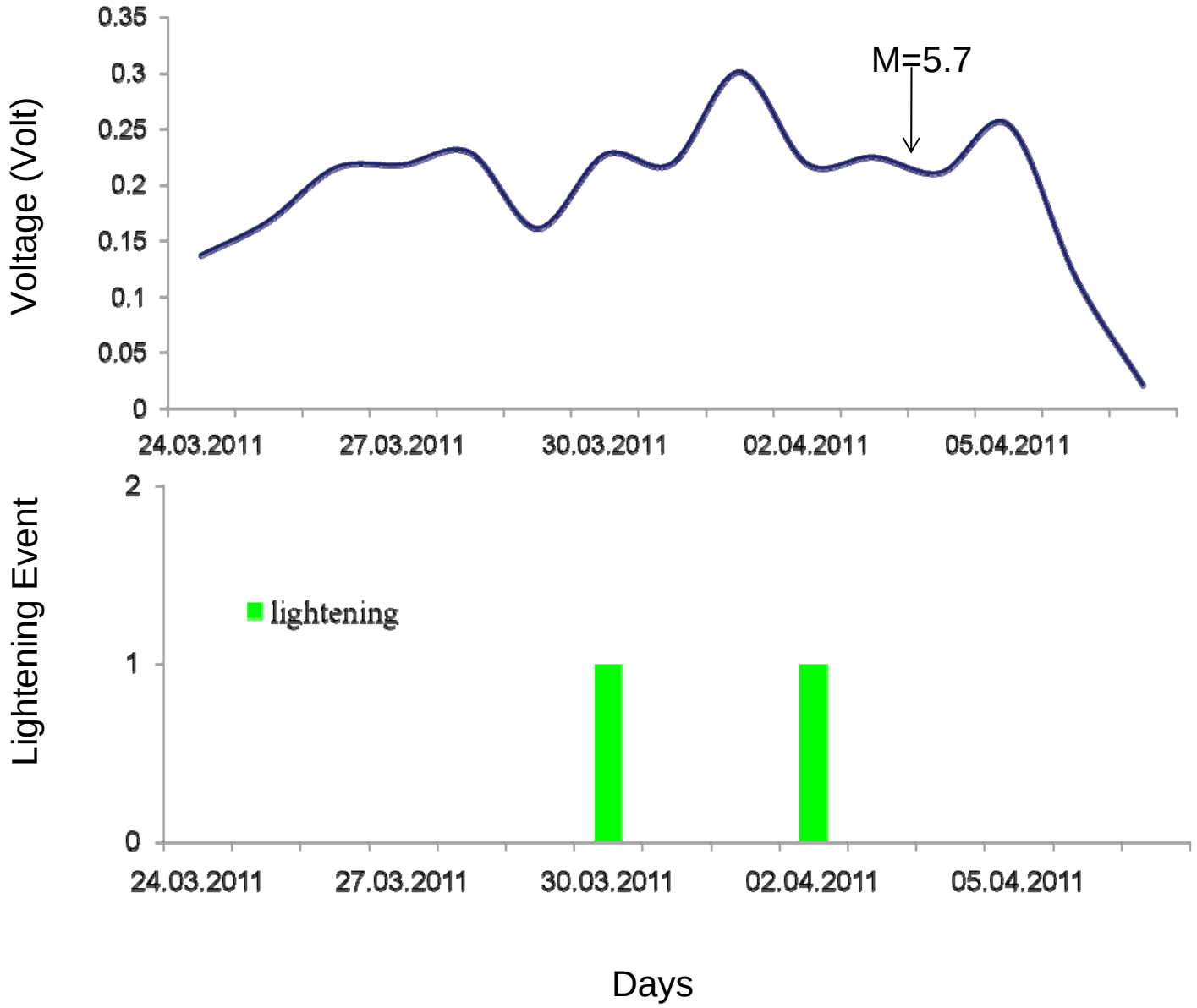
Daily variation of the vertical antenna data and ∑Kp data during the Indo-Nepal border earthquake occurred on 04 April, 2011



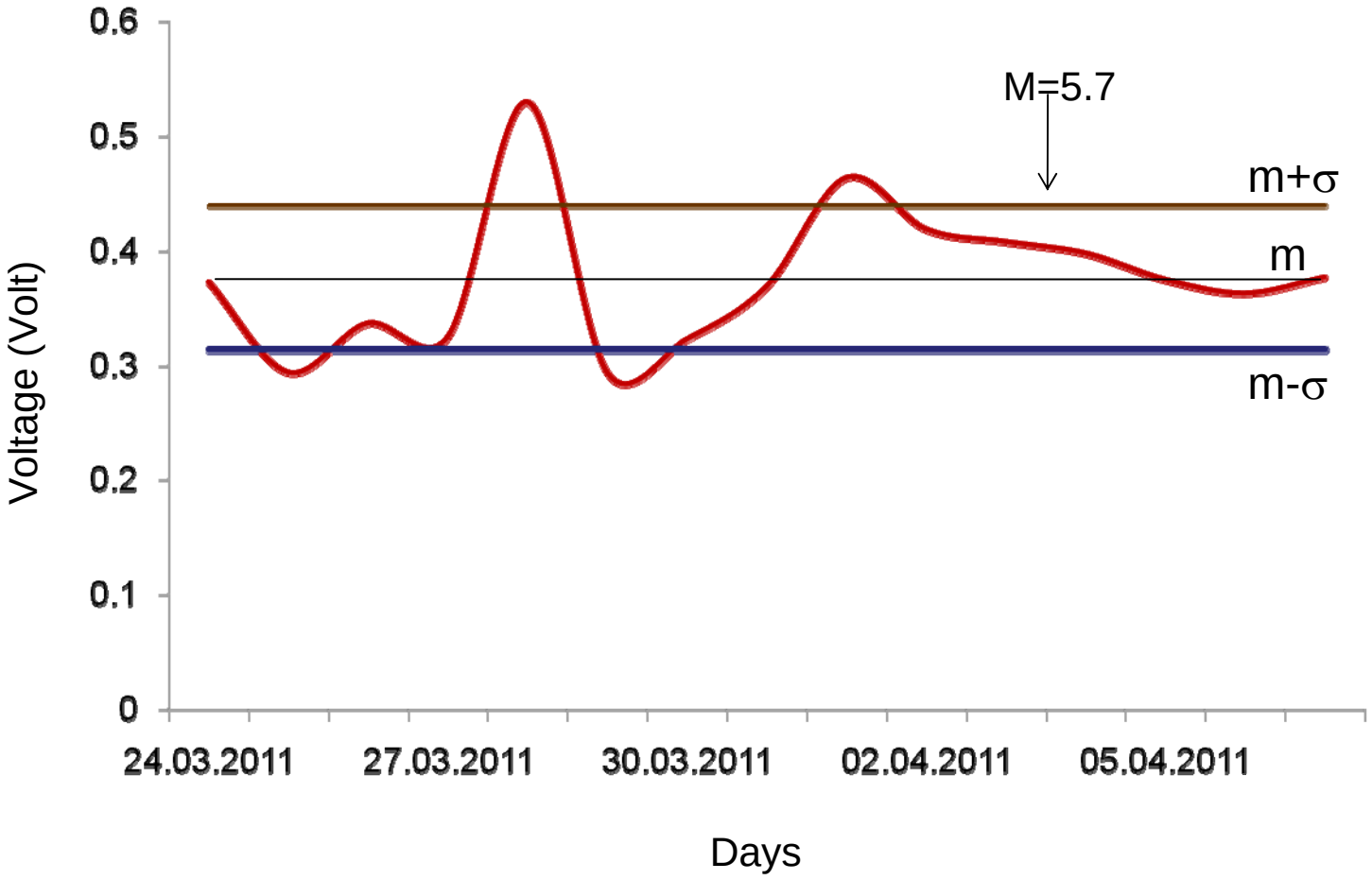
Daily variation of the borehole data and lightening activity around the observing station between 24 March and 07 April, 2011



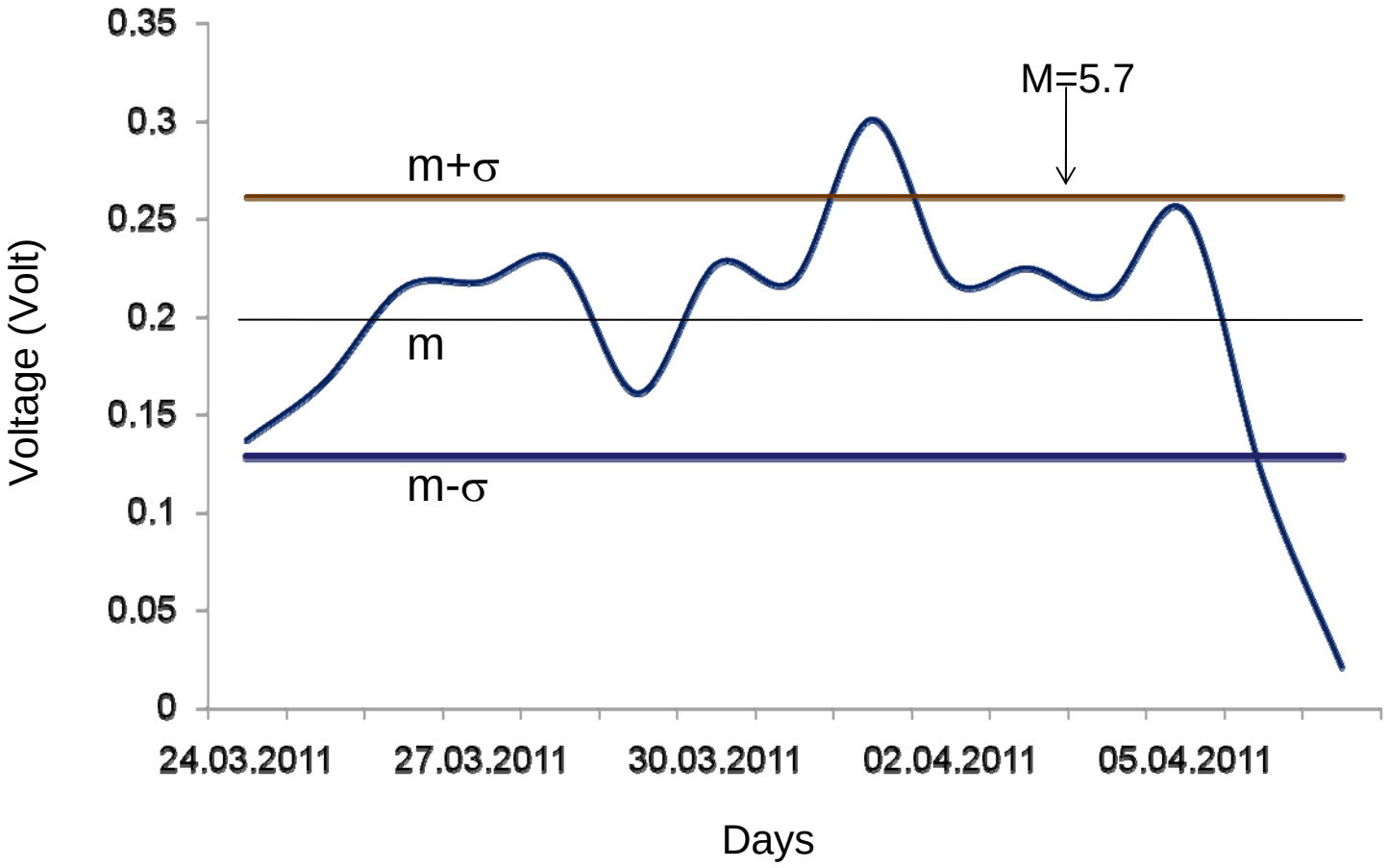
Daily variation of the vertical antenna data and lightening activity around the observing station between 24 March and 07 April, 2011

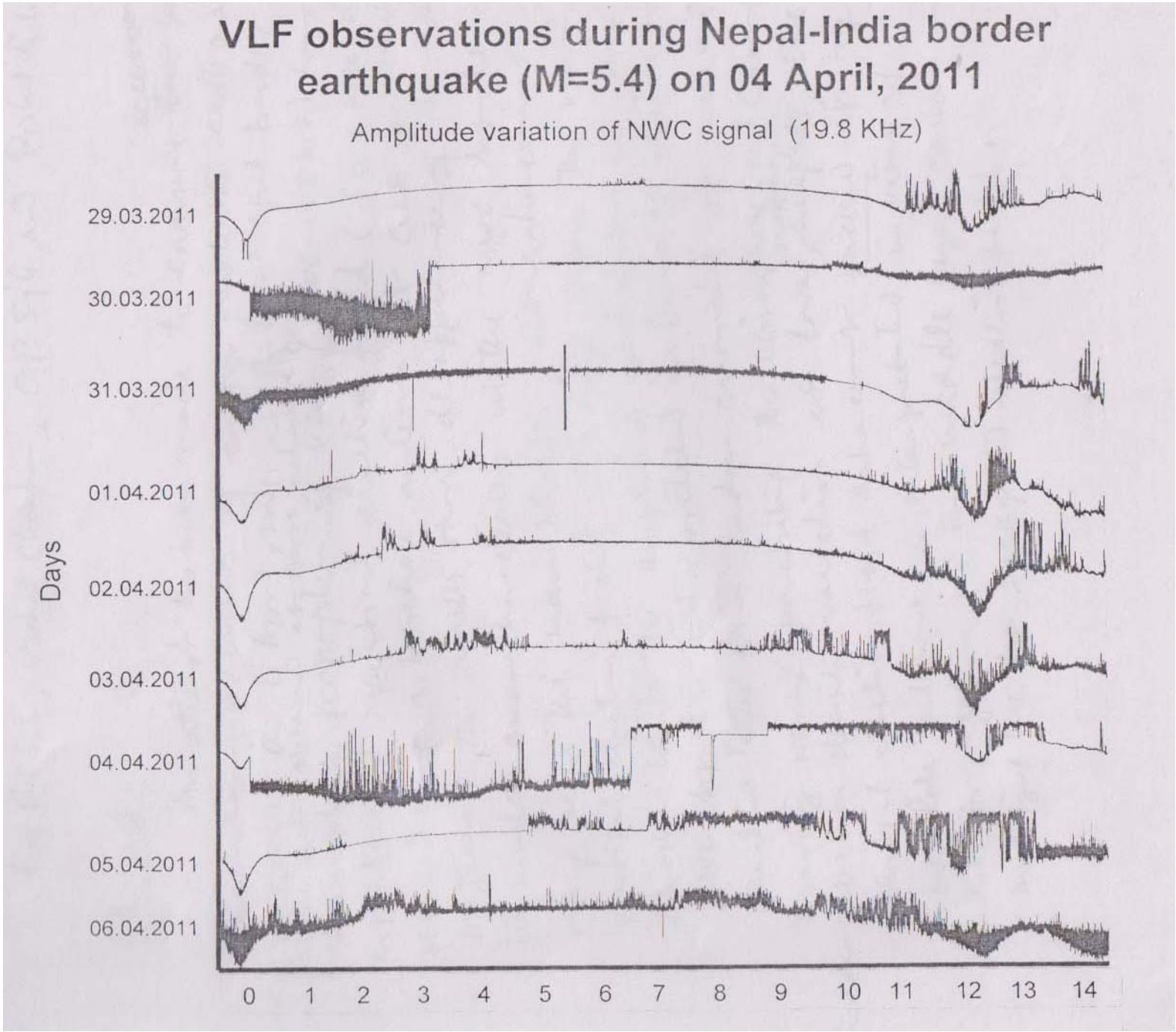


Statistical analysis of the borehole data during the Indo-Nepal border earthquake occurred on 04 April, 2011

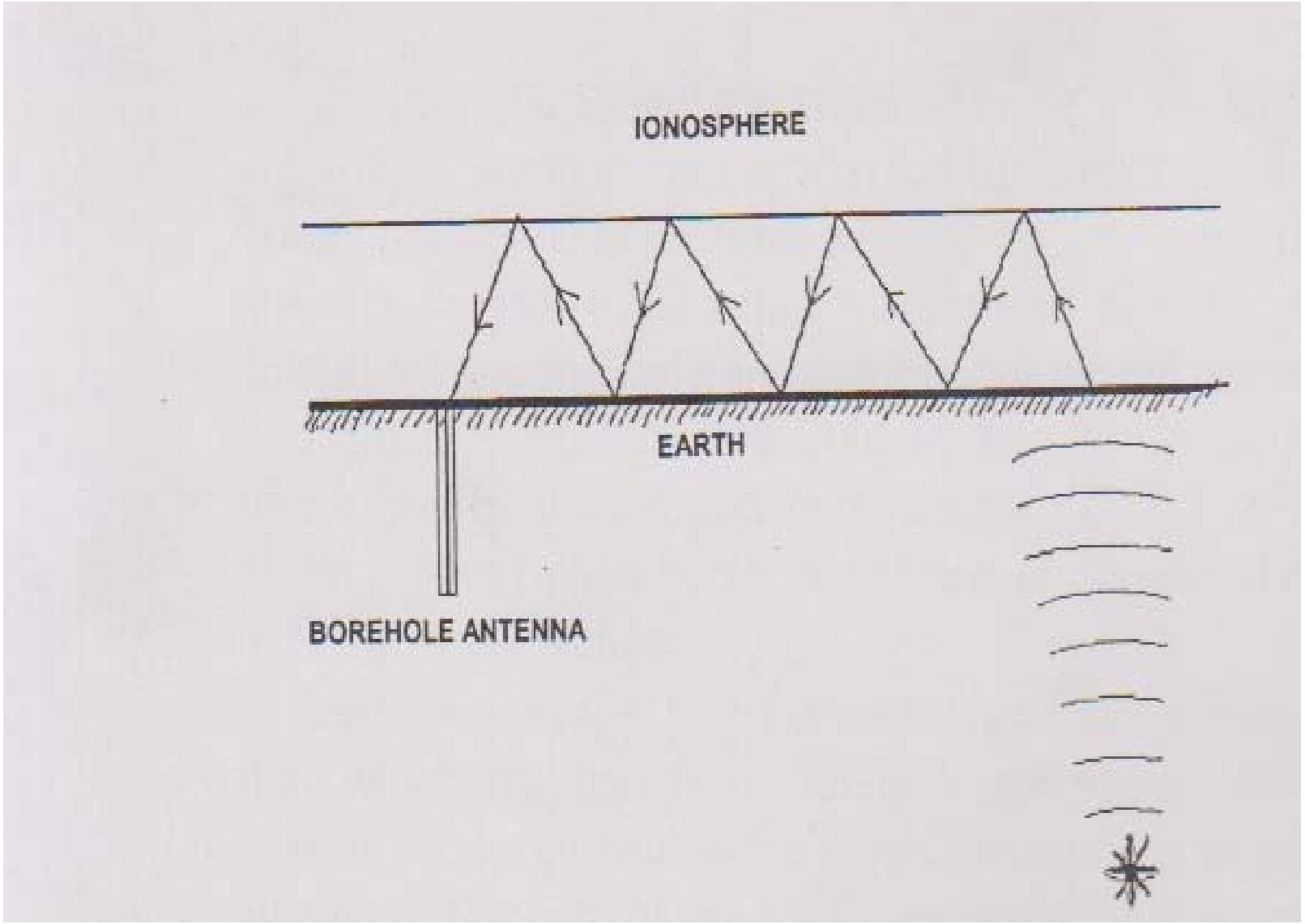


Statistical analysis of the vertical antenna data during the Indo-Nepal border earthquake occurred on 04 April, 2011




VLF observations during Nepal-India border earthquake (M=5.4) on 04 April, 2011
Amplitude variation of NWC signal (19.8 KHz)
Days
29.03.2011
30.03.2011
31.03.2011
01.04.2011
02.04.2011
03.04.2011
04.04.2011
05.04.2011
06.04.2011
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14

Possible mechanism of the propagation of the seismo-electromagnetic signals



Conclusion

1. Precursory effect is observed 3-7 days before the occurrence of main shock in the borehole data.

2. Precursory effect in the data of vertical antenna is observed just 3 days before the occurrence of main shock.

3. Anomalous enhancements observed both in borehole and vertical antennas are related with not magnetic storm and lightening activity. Hence, these enhancements may be due to earthquake of 4 April that occurred on Bihar-Nepal Boarder.

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