



Ground observation of electromagnetic emissions related to clusters of earthquakes

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ULF-VLF data obtained from three ground based experiments working at Agra station (geograph. Lat. 27.20N, Long. 780E) in India namely measurement of ultra low frequency (ULF) magnetic field emissions using a 3-component search coil magnetometer, vertical component of very low frequency (VLF) electric field emissions with a borehole antenna, and phase and amplitude of fixed frequency VLF transmitter signals using AbsPAL receiver are analysed in search of possible precursors of two major seismic activities that occurred in Sumatra (Indonesia) during post-tsunami period between January and April, 2005. These two major seismic events occurred as clusters of earthquakes during 27-29 January and 28-30 March, 2005. The results show that barring borehole all the experiments showed precursors due to these clusters of earthquakes. Such precursors were not seen in the case of isolated large magnitude earthquakes. Further, the precursory duration was influenced by the magnetic storm which occurred about a week before the clusters. The mechanism of ULF propagation to long distances between Sumatra and Agra, and perturbations in the ionosphere before the clusters are discussed.