

# Earthquake precursory studies in India

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## Earthquake precursory studies in India have been based on

1. Seismicity patterns
2. Seismic Gaps
3. Changes in 'b' value
4. Stress changes

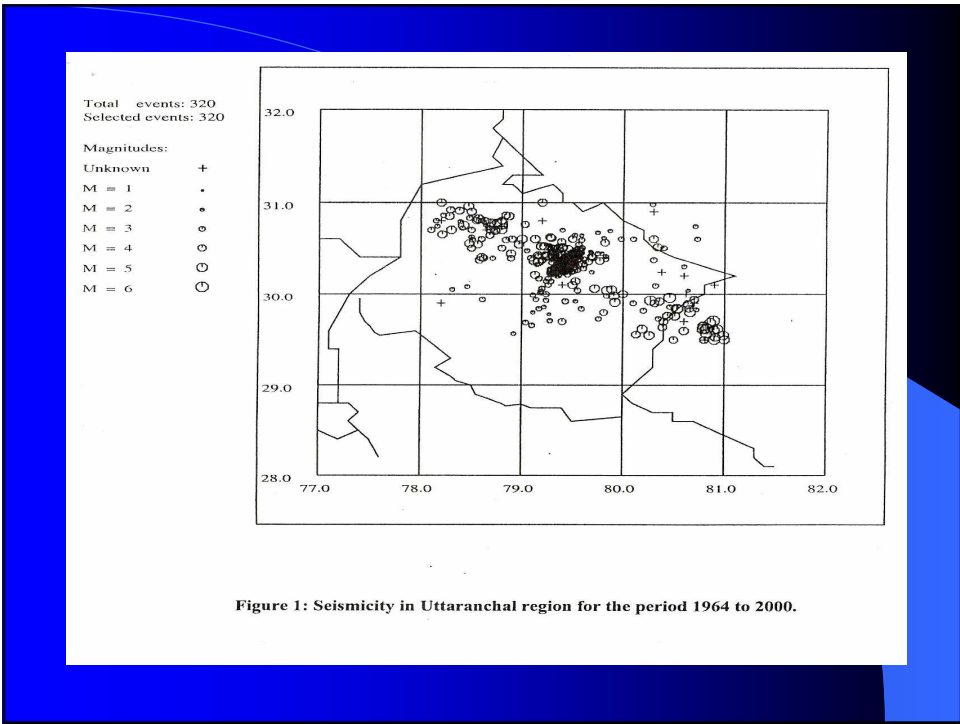
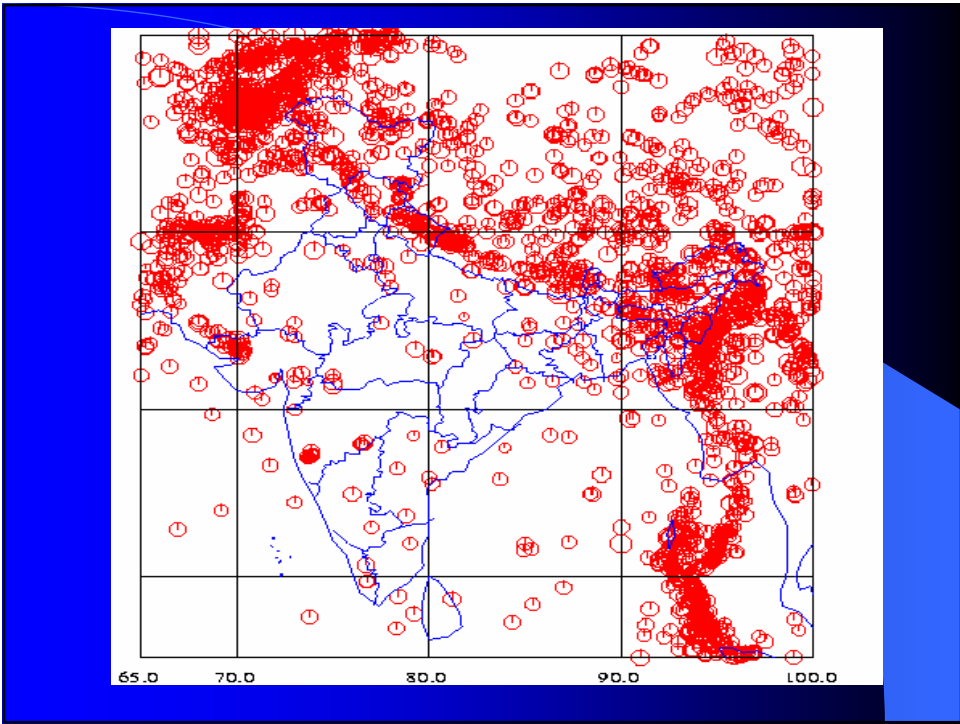


Figure 1: Seismicity in Uttarakhand region for the period 1964 to 2000.

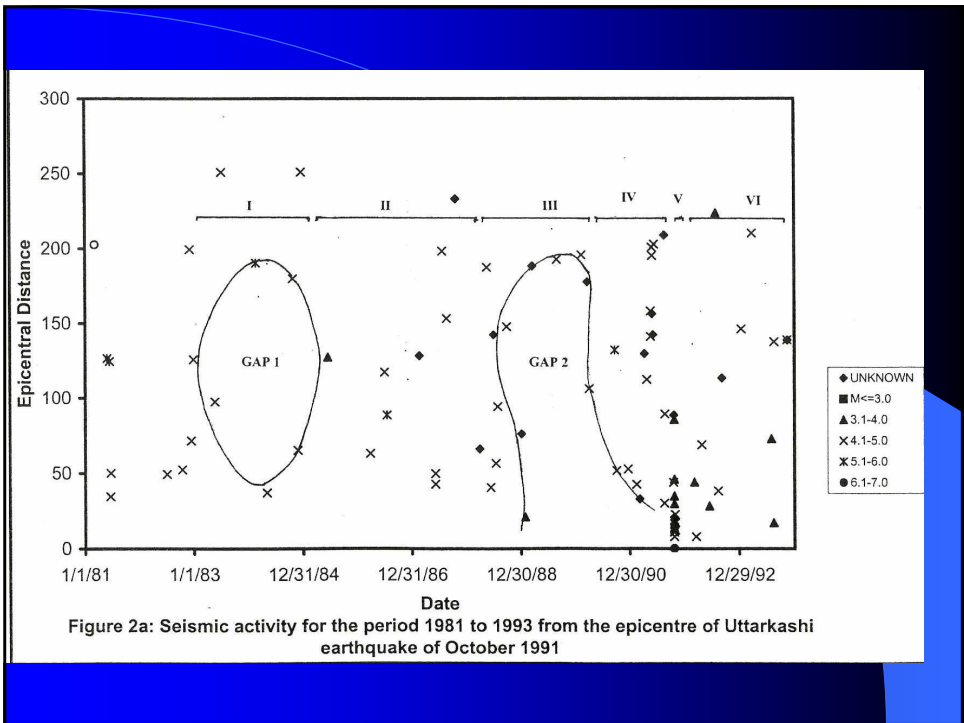


Figure 2a: Seismic activity for the period 1981 to 1993 from the epicentre of Uttarkashi earthquake of October 1991

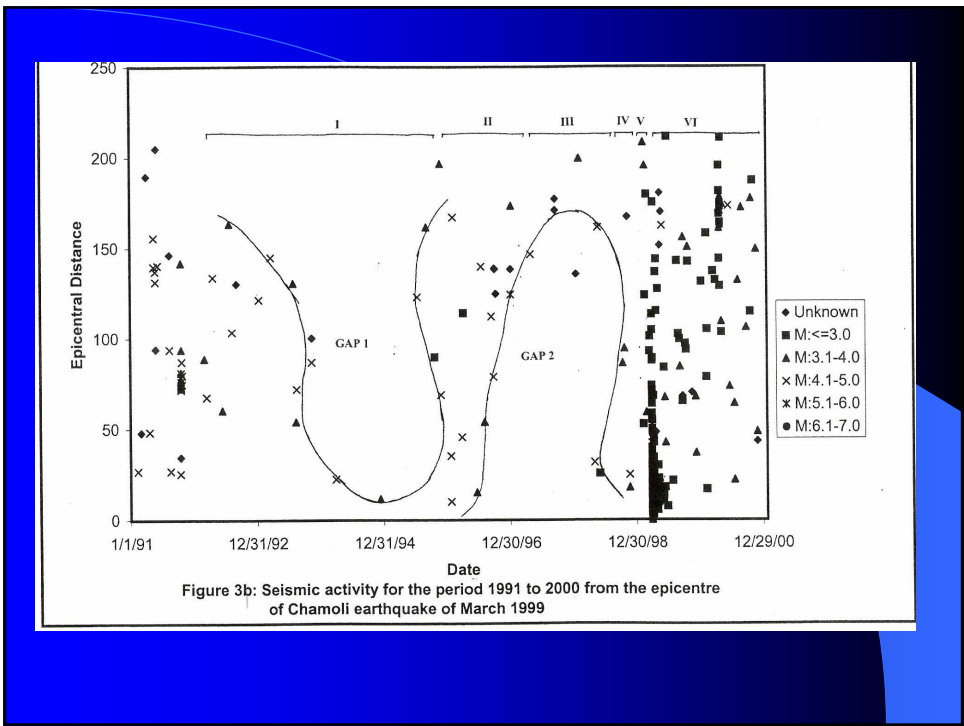
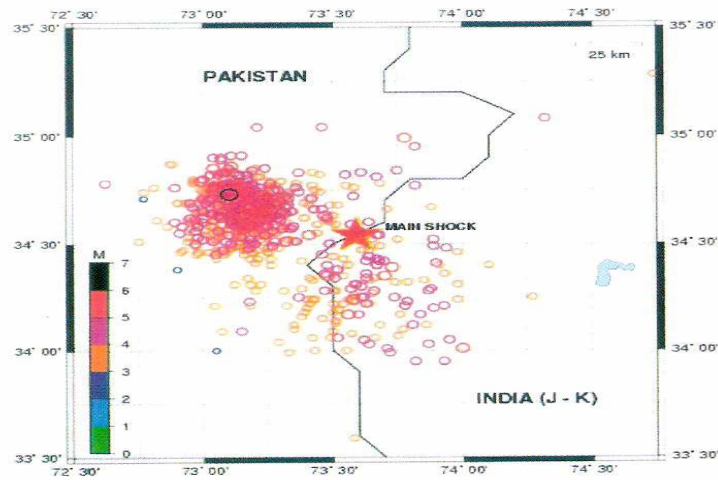
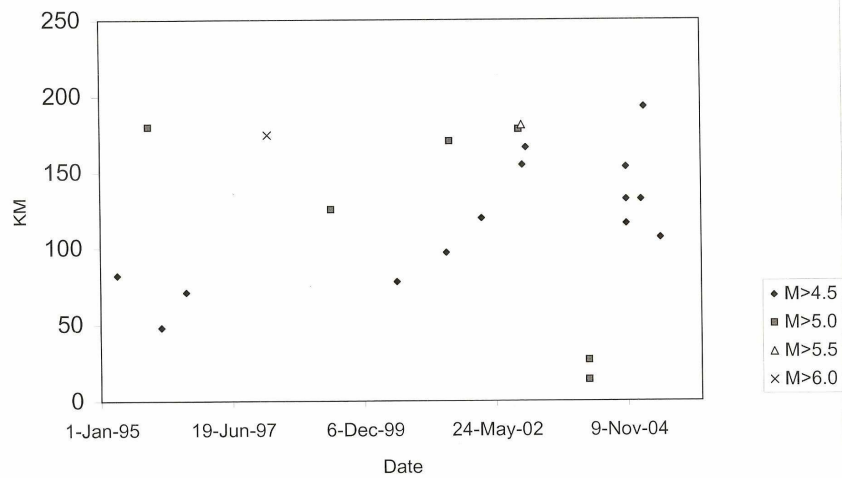


Figure 3b: Seismic activity for the period 1991 to 2000 from the epicentre of Chamoli earthquake of March 1999

### As on 25th Dec' 2005



### 1995 - 2005' Sep



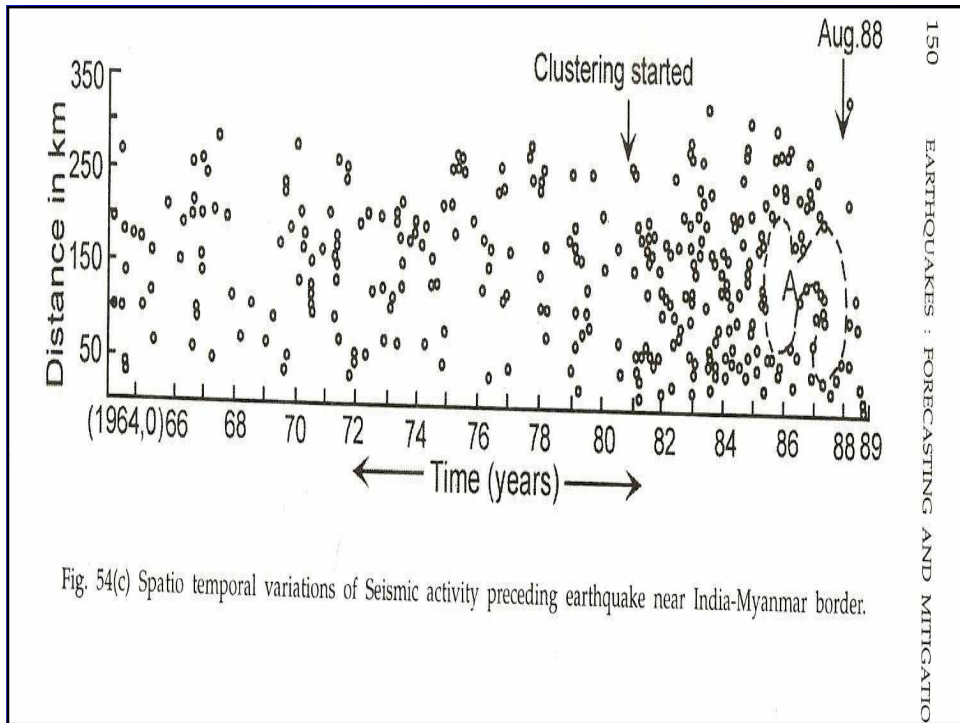
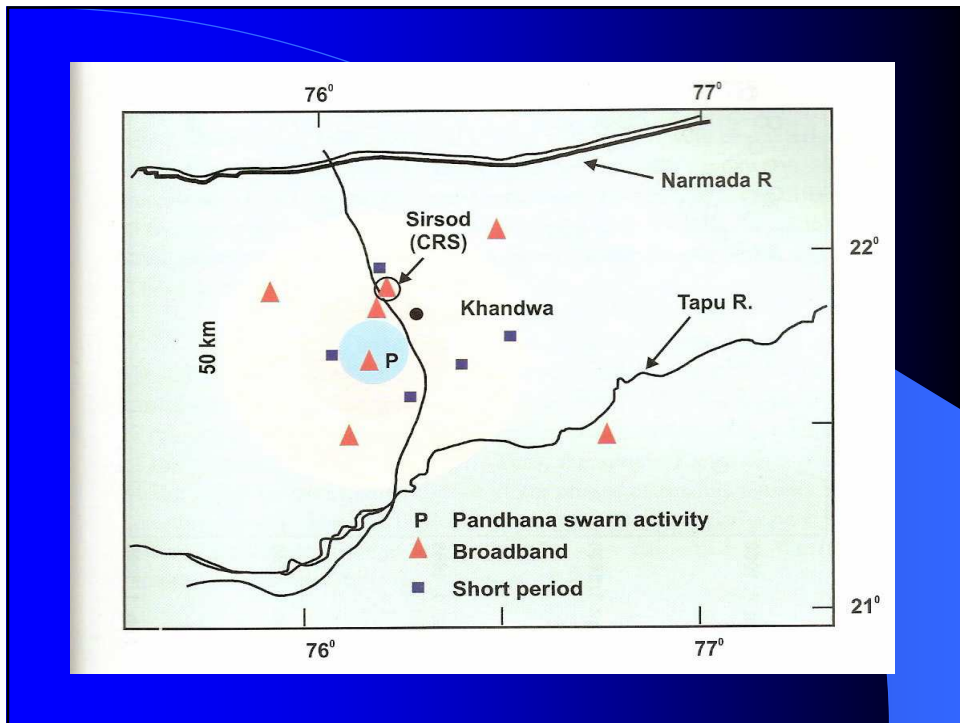
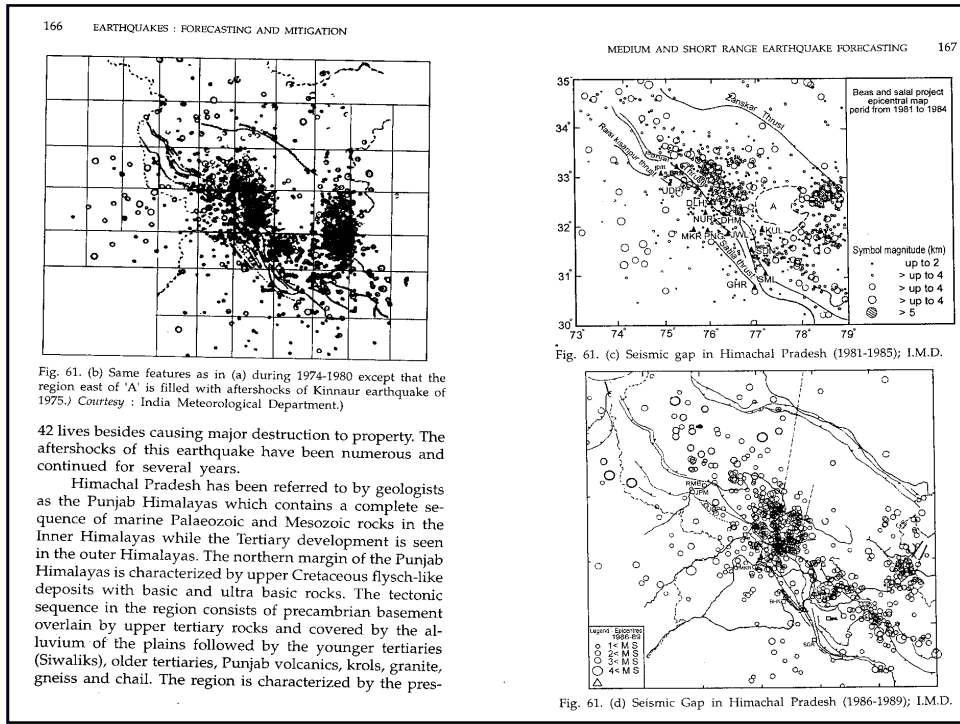
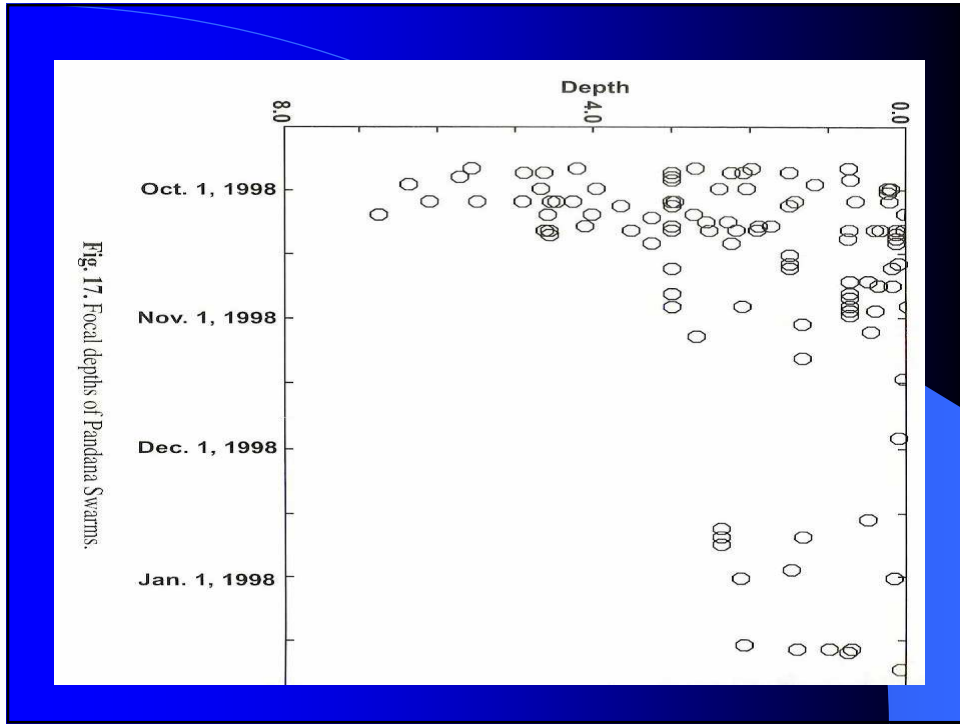
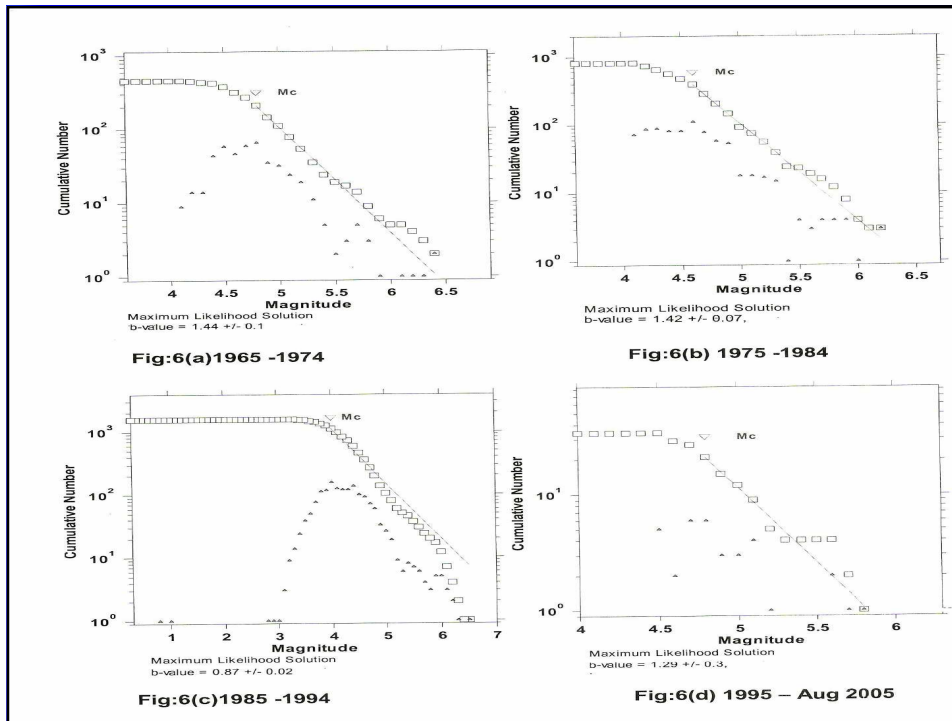


Fig. 54(c) Spatio temporal variations of Seismic activity preceding earthquake near India-Myanmar border.

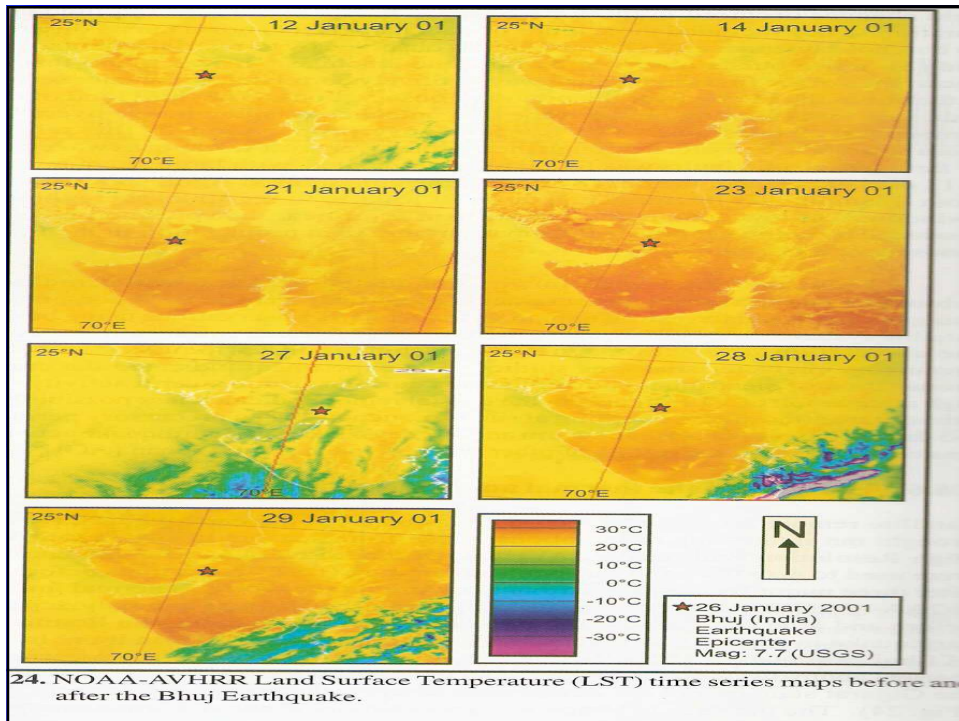






## Other Geophysical studies are based on :-

1. Geomagnetic changes
2. Electrical Resistivity Changes
3. ULF-VLF anomalies
4. Radon and Helium anomalies
5. Changes in Ground water levels.
6. Crustal deformation using synthetic aperture radar, strain meters, tilt meters
7. Thermal anomalies through space technology.



**It is well known that a single parameter is not considered reliable and so multi parametric observations have been planned through the Department of Science and Technology.**

**Instrumental set up at multi parametric observatory.**

- 1. Very Broad Band Digital seismographs**
- 2. Proton precession and flux gate magnetometers**
- 3. ULF and VLF monitoring**
- 4. Radon anomalies**
- 5. Bore hole strain meters.**
- 6. Super conducting gravimeters.**

**Six such observatories are being installed.**

**Attempts so far in India have been based on medium to long turn prediction methods. For short term reliable prediction methods we need a technique to combine the role of different physically linked parameters.**

**Amongst the different parameters. Seismological observatories though sometimes effected by ground noise provide a more authentic record of seismic signals. All other observations are effected by several atmospheric and lithospheric perturbations.**

## **Limitations of Other Geophysical Parameters**

**Most of the precursory geophysical observations in India have not been standardised with respect to –**

- (i) Epicentral distance of earthquake**
- (ii) Focal depth**
- (iii) Magnitude**

### **There is another aspect**

**Studies in India and else where suggest that earthquakes are chaotic in nature implying the constraints in developing models for earthquake prediction. An interesting observations by our group has shown a marked different in strange attractor dimension between interpolate and intra plate earthquakes. Dimri and his group at NGRI supported with slightly different methodology. The technique for earthquake prediction can therefore be based on a probabilistic approach.**

## **There are two approaches**

1. Synthesized Probability approach
2. Principal Components analysis

## **Conclusions**

**Any attempt to use seismological and geophysical parameters need to be interpreted by incorporating all the possible variables effecting a region through the Principal Component Analysis.**