

# **Seismological activities**

## **1. Earthquake monitoring**

India Meteorological Department (IMD) is the nodal agency of Government of India responsible for monitoring seismic activity in and around the country. IMD has rendered more than a century of seismological service to the nation with the first seismological observatory of the country having been set up by the department at Kolkata in 1898. The operational task of the department is to quickly estimate the earthquake source parameters immediately on occurrence of an earthquake and disseminate the information to all the user agencies including the concerned State and Central Government agencies responsible for carrying out relief and rehabilitation measures. The information relating to under-sea earthquakes capable of generating tsunamis on the Indian coastal regions is also disseminated to all concerned user agencies including the Indian National Centre for Ocean Information Services (INCOIS), Hyderabad for issue of tsunami related messages and warnings. The earthquake information is transmitted to various user agencies including public information channels, press, media etc. using different modes of communication, such as SMS, fax, email and also posted on IMD's Website ([www.imd.gov.in](http://www.imd.gov.in)).

## **2. National Seismological Network (NSN)**

India Meteorological Department is maintaining a country wide National Seismological Network (NSN), consisting of a total of 82 seismological stations, spread over the entire length and breadth of the country. This includes: a) 16-station V-SAT based digital seismic telemetry system around National Capital Territory (NCT) of Delhi, b) 20- station VSAT based real time seismic monitoring network in North East region of the country and (c) 17-station Real Time Seismic Monitoring Network (RTSMN) to monitor and report large magnitude under-sea earthquakes capable of generating tsunamis on the Indian coastal regions. The remaining stations are of standalone/ analog type. A Control Room is in operation, on a 24X7 basis, at IMD Headquarters (Seismology) in New Delhi, with state-of-the art facilities for data collection, processing and dissemination of information to the concerned user agencies

## **3. Real time seismic monitoring for early warning of tsunamis**

In the aftermath of the Great Sumatra earthquake of 26th December, 2004, Ministry of Earth Sciences has set up an Indian Tsunami Early Warning Center at the Indian National Centre for Ocean Information Services (INCOIS), Hyderabad. The Center is mandated to provide advance warnings on Tsunamis likely to affect the coastal areas of the country. As part of this, a 17-station Real Time Seismic Monitoring Network (RTSMN) has been set up by India Meteorological Department. The network is capable of monitoring and reporting, in least possible time, the occurrence of earthquakes capable of generating Tsunamis likely to affect the Indian coastal regions. The data from the 17 Broadband seismic field stations is transmitted simultaneously in real time through V-SAT communication facilities to the Central Receiving Stations (CRSs) located at IMD, New Delhi and INCOIS, Hyderabad for processing and interpretation. The CRSs are equipped with state-of-art computing hardware, communication, data processing, visualization and dissemination facilities. For providing better azimuthal coverage towards detecting earthquakes of tsunami-

genic potential, the RTSMN system has been configured to include about 100 global stations of IRIS (a consortium of Incorporated Research Institutions in Seismology), whose data is available freely through internet. The earthquake information is disseminated through various communication channels to all the concerned user agencies in a fully automated mode. Based on the earthquake information provided by the RTSMN and other ocean related observations / analysis, INCOIS evaluates the tsunamigenic potential of the undersea earthquakes and issues necessary warnings / alerts, as per the situation.

#### **4. National Seismological Data Base Centre (NSDC)**

The available seismological data from all the network stations including those operated by other agencies is compiled, processed, analyzed and archived systematically at the National Seismological Database Centre (NSDC) on a regular basis. Monthly National Seismological Bulletins containing the phase data and the processed information on source parameters of all earthquakes located by the seismological network of IMD are prepared regularly. India, represented by IMD, is a permanent Member of the International Seismological Centre (ISC), UK. Seismological Bulletins of IMD are shared regularly with International Seismological Centre (ISC), UK for incorporation in the ISC's Monthly Seismological Bulletins, which contain information on earthquakes occurring all across the globe. As part of systematic archival of historical analog charts, state-of-the-art facilities have also been established for raster scanning and vector digitization of seismic analog charts. These facilities have enabled raster scanning of a lakh old analog charts and vector digitization of significant earthquake waveforms. Seismology Division supplies earthquake data and seismicity reports of specific regions to various user agencies such as, insurance companies, industrial units, power houses, river valley projects etc. on payment basis. Seismological data and earthquake related information is also supplied to agencies dealing with relief and rehabilitation measures, earthquake disaster mitigation and management related matters, seismic zoning, etc. Earthquake data is shared with various scientific, academic and R&D institutions for research purposes. Towards early warning of tsunamis, real-time continuous seismic waveform data of three IMD stations, viz., Portblair, Minicoy and Shillong, is shared with global community, through IRIS (Incorporated Research Institutions of Seismology), Washington D.C., USA.

#### **5. Training & Human Resource Development in Seismology**

Seismology Division organizes training courses/ awareness programs in Seismology and allied subjects at various levels to station operators and scientists of departmental and various non-departmental agencies. Officers of Seismology Division also deliver lectures on various Seismology related topics, on request, for the benefit of various state / central government organizations dealing with earthquake related matters. Familiarization training on various operational activities related to earthquake monitoring is also imparted to trainees from various organizations including those deputed by WMO.

## **6. Seismic Zoning of India**

Bureau of Indian Standards [IS-1893 . part . 1: 2002], based on various scientific inputs from a number of agencies including earthquake data supplied by IMD, has grouped the country into four seismic zones viz., Zone-II, -III, -IV and -V. Of these, zone V is rated as the most seismically prone region, while zone II is the least. The Modified Mercalli (MM) intensity, which measures the impact of the earthquakes on the surface of the earth, broadly associated with various zones, is as follows:

Seismic Zone	Intensity on MMI scale	% of total area
II (Low intensity zone)	VI (or less)	43%
III (Moderate intensity zone)	VII	27%
IV (Severe intensity zone)	VIII	18%
V (Very severe intensity zone)	IX (and above)	12%

## **7. Research and Development**

Seismology Division is actively involved in Research and Development related activities in the field of Seismology and allied subjects. The upgraded seismological network has generated very useful and unique digital broadband and strong motion data sets for several significant earthquakes including the recent great Sumatra earthquake of 26th December, 2004, Pakistan earthquake of 8th October 2005 and Sikkim Earthquake of 18th September, 2011. Analyses of these data sets have greatly helped in improving our understanding about the earthquake processes in the inter- and intra-plate seismic regimes and the crust and upper mantle structure of the Peninsular shield region. Bilateral collaboration in various fields of Seismology has also been established with Mexico and Russia, where necessary.

## **8. Seismic Hazard and Seismic Microzonation**

Seismic hazard assessment and seismic microzonation studies have emerged as major tools towards our efforts for preparedness and mitigation of losses due to earthquakes. Seismic microzonation is a process of classifying a region into zones of relatively similar exposure to various earthquake-related effects and has emerged as a major tool towards providing user-friendly, GIS-based and site-specific hazard and risk related information products to enable appropriate planning of pre- and post- disaster management strategies. The Earthquake Risk Evaluation Centre (EREC) set up in IMD has the mandate to generate and disseminate user-friendly GIS-based and site-specific hazard and risk - related information products to enable appropriate planning of pre- and postdisaster management strategies. The Centre has completed microzonation of Delhi region on 1:50,000 scale and played a key role in various studies relating to the seismic microzonation of other cities, such as, Jabalpur and Guwahati. EREC is currently engaged in refining the seismic microzonation of NCT, Delhi on 1:10,000 scale.