

Centre for Seismology, IMD under Ministry of Earth Sciences is nodal agency of Government of India dealing with various activities in the field of seismology and allied disciplines. The major activities currently being pursued by the Centre for Seismology include, a) Earthquake monitoring on 24X7 basis, including real time seismic monitoring for early warning of tsunamis, b) Operation and maintenance of national seismological network and local networks c) Seismological data centre and information services, d) Seismic hazard and risk related studies e) Field studies for aftershock / swarm monitoring, site response studies f) Earthquake processes and modelling, etc. These activities are being managed by various units/groups of the Centre for Seismology as detailed below:

1. Earthquake Monitoring & Services (EMS)

Centre for Seismology (CS) is the nodal agency of Government of India responsible for monitoring seismic activity in and around the country. CS/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 Centre 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.

The available seismological data from all the network stations including those operated by other agencies is compiled, processed, analyzed and archived systematically at the Database Centre of CS 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 CS are prepared regularly. India, represented by CS/IMD, is a permanent Member of the International Seismological Centre (ISC), UK. Seismological Bulletins of CS/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.

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.

Centre for Seismology 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.

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.

2. Geophysical Observational System (GOS)

Centre for Seismology 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 premises of IMD Headquarters in New Delhi, with state-of-the art facilities for data collection, processing and dissemination of information to the concerned user agencies

In the aftermath of the Great Sumatra earthquake of 26th December, 2004, Ministry of Earth Sciences has set up an Indian Tsunami Early Warning Centre at the Indian National Centre for Ocean Information Services (INCOIS), Hyderabad. The Centre 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 Centre for Seismology/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 CS/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.

In addition to calibration, standardization, checking the health of equipment, maintenance of all the hardware and software, GOS group are also involved in upgradation of existing field observatories, setting up of new seismological observation as per requirement, integration of all data at central site for online processing and archival.

3. Earthquake Hazard & Risk Assessment (EHRA)

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 EHRA unit of Centre for Seismology 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 post disaster 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. EHRA unit is currently engaged in refining the seismic microzonation of NCT, Delhi on 1:10,000 scale. Action has also been initiated for taking up microzonation of other important cities.

Field studies for aftershock / swarm monitoring, site response studies are also being taken as per requirement.

4. 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%

5. Program Planning & Coordination (PPC)

In order to generate trained manpower in the field of seismology and allied subjects, Centre for Seismology 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. Earthquake Processes & Modeling (EPM)

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.

Centre for Seismology is actively involved in Research and Development related activities in the field of Seismology and allied subjects.

Bilateral collaboration in various fields of Seismology has also been established with various countries doing research work in the field of seismology and allied subjects.

