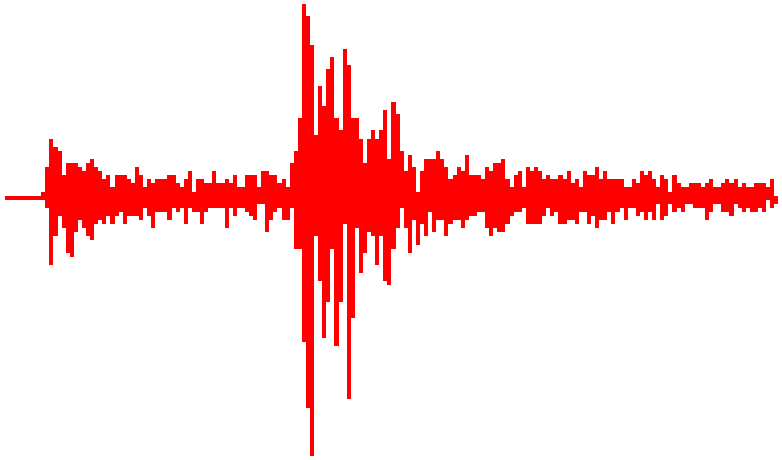
REAL TIME MONITORING OF INDIAN SEISMICITY

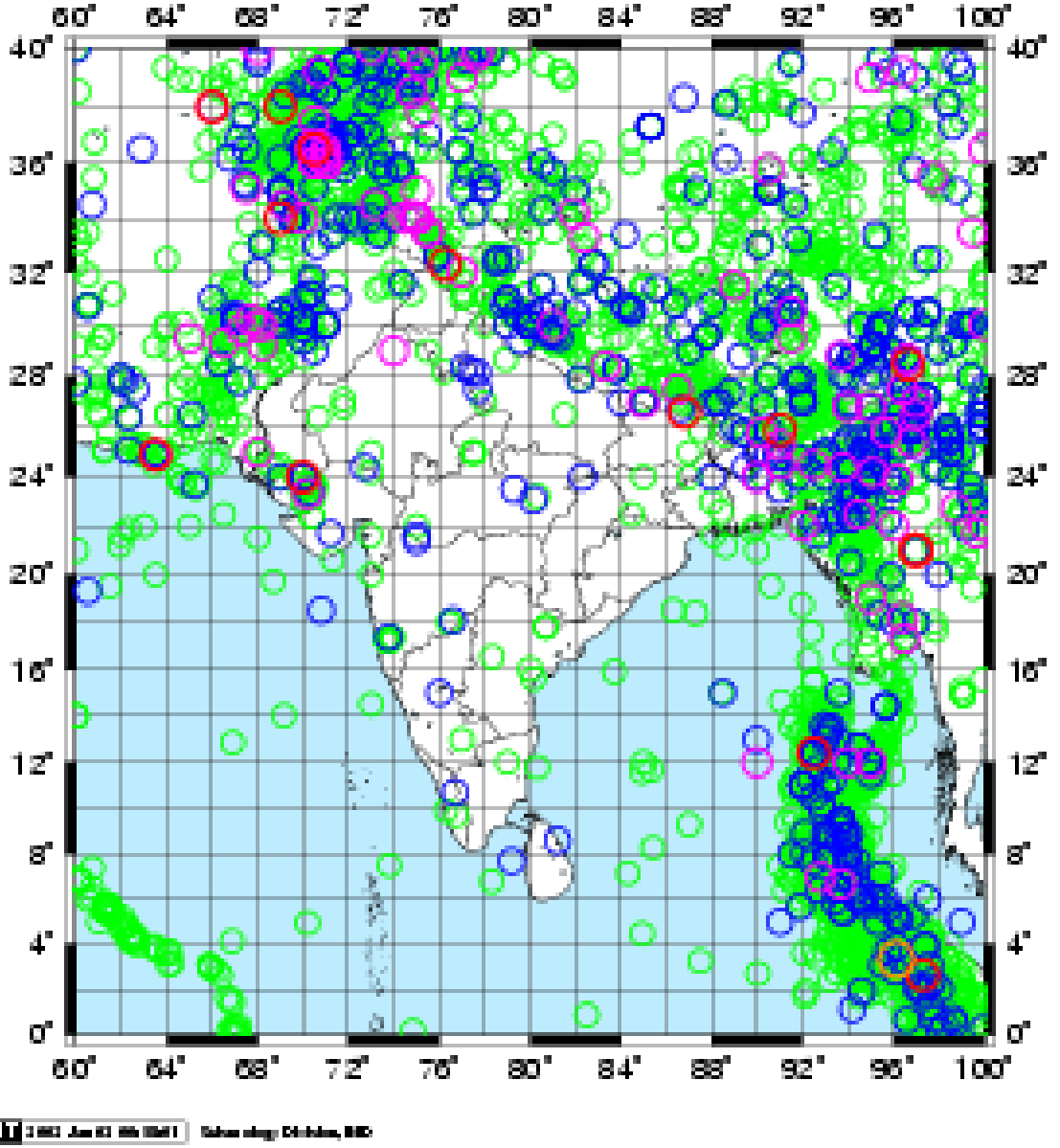


G. Suresh
Seismology Division
India Meteorological Department
New Delhi-110 003

Seismicity map of India and Neighborhood

In India, the main seismic zone runs along:

1. **Himalayan mountain range,**
1. **Northeast India,**
1. **Andaman-Nicobar islands and**
1. **Rann of Kutch region.**

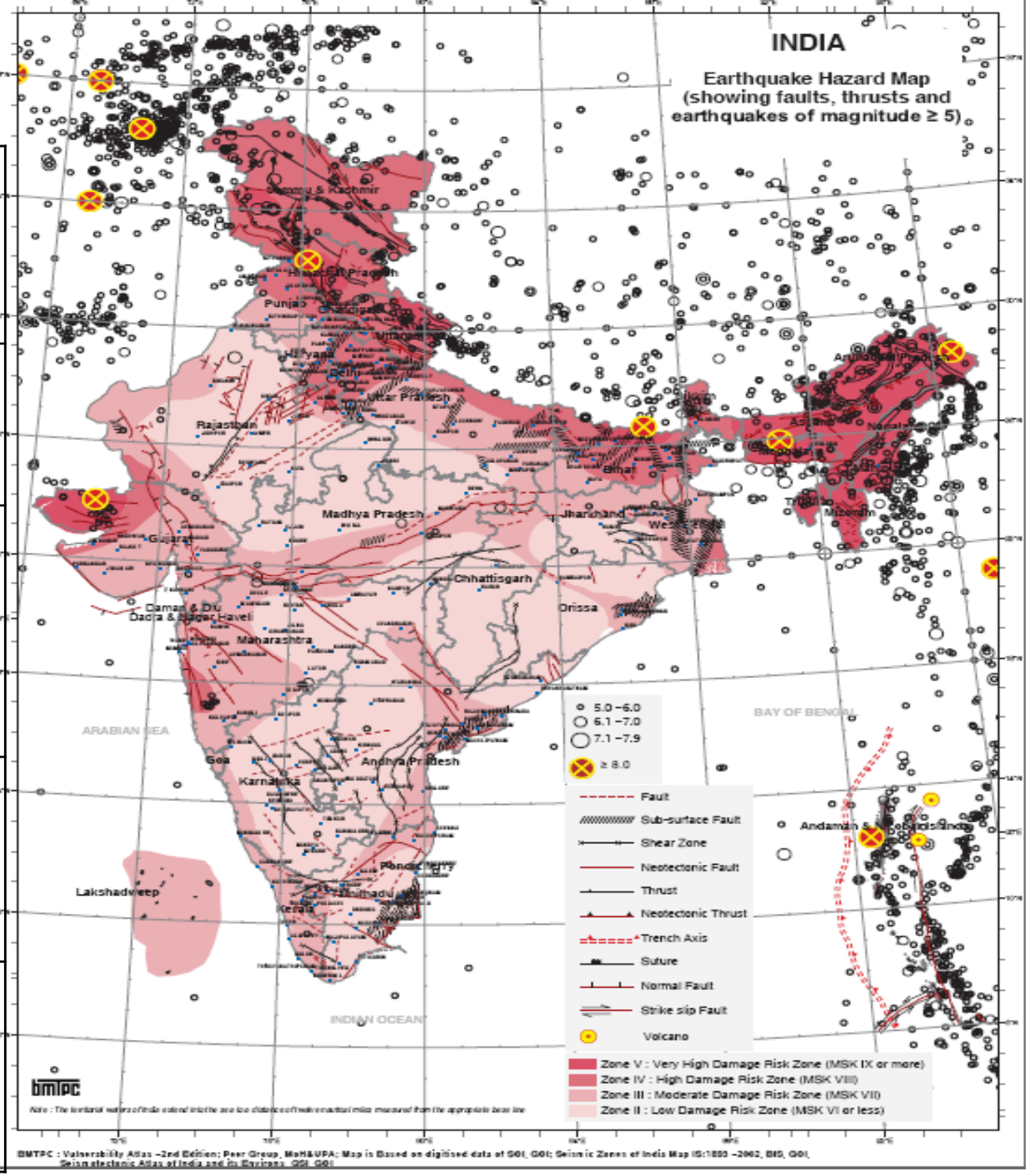


Magnitude

- 5-5.9
- 6-6.9
- 7-7.9
- 8-8.9
- 9.0 and more

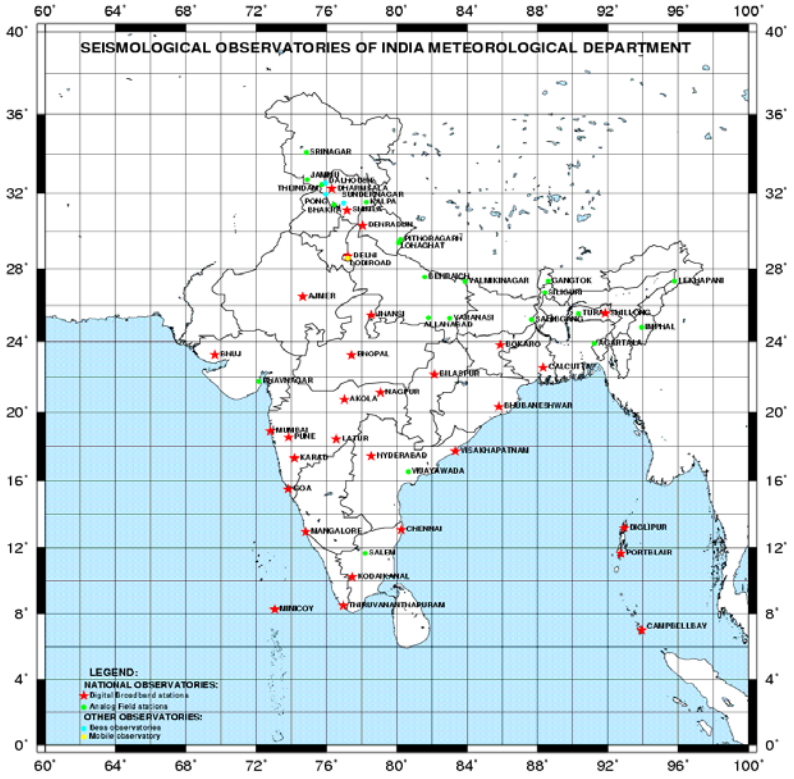
Earthquake Hazard Map of India

Seismic Zone	Intensity on MM 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

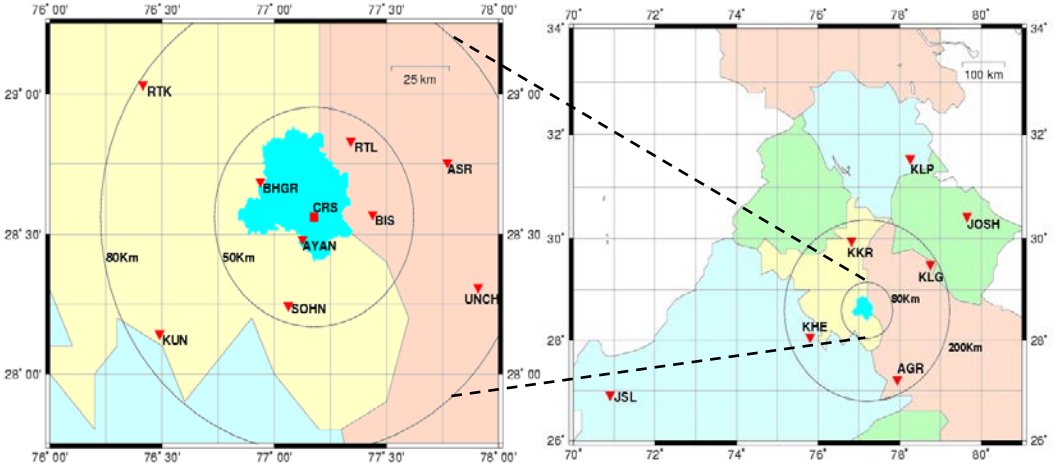


EARTHQUAKE MONITORING NETWORKS OF IMD

National Seismic Network (55)

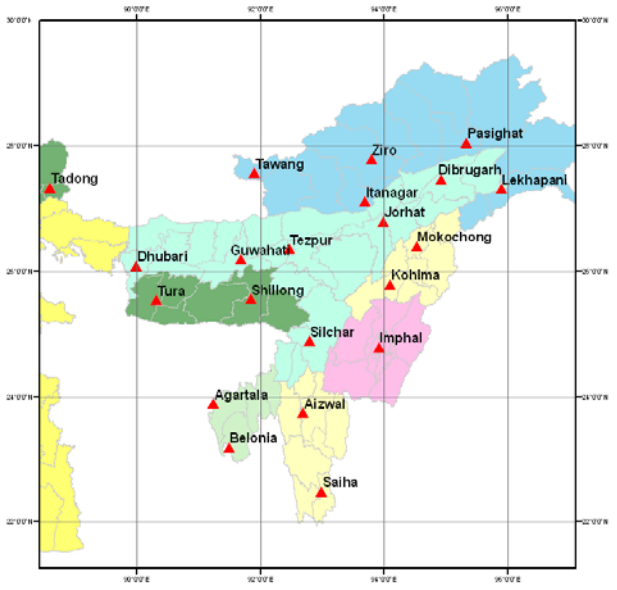


Seismic telemetry network around Delhi (16)



Real time data exchange with IRIS from three Indian stations: PortBlair, Shillong and Minicoy

Seismic telemetry network in Northeast India (20)



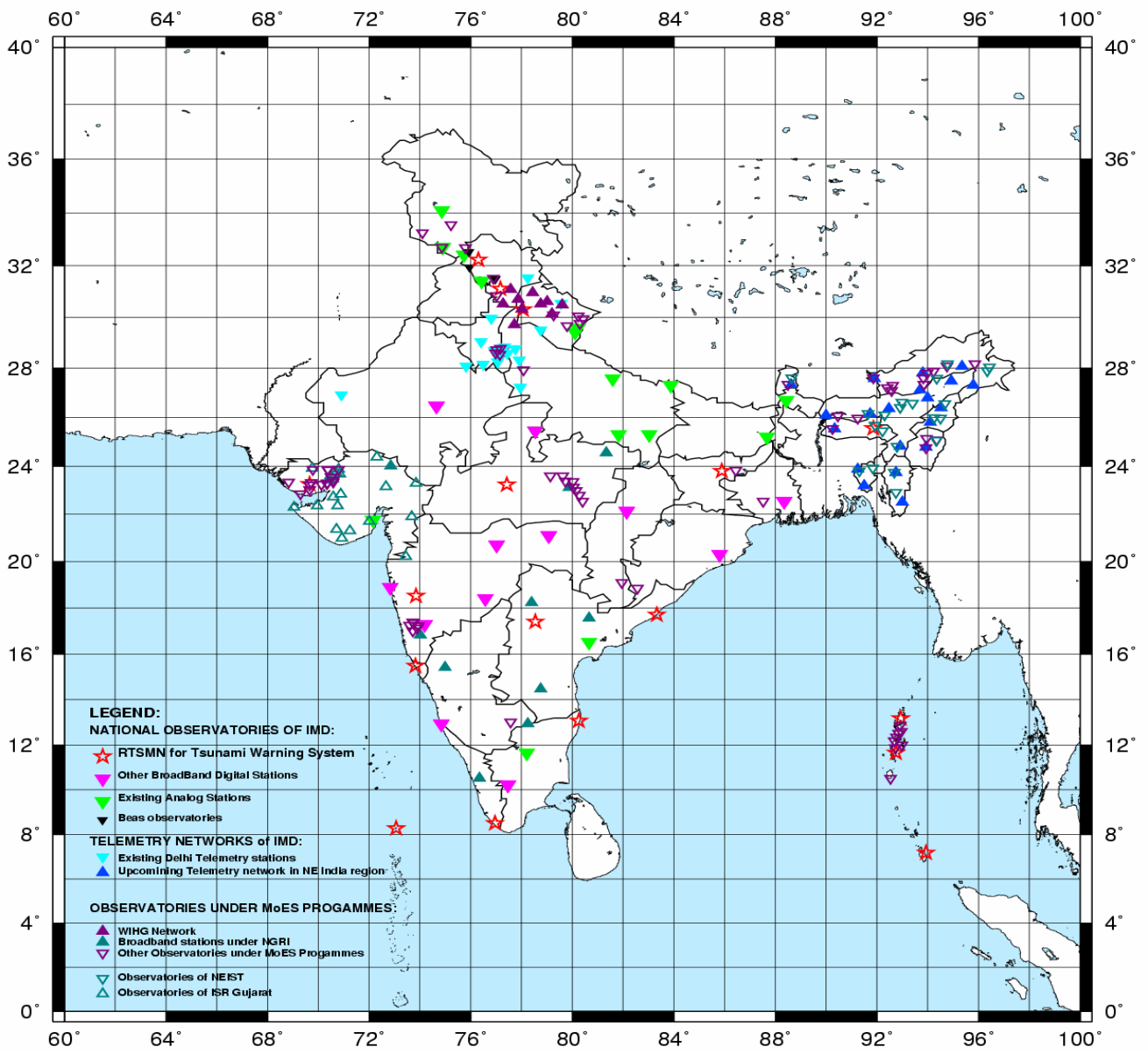
Seismological Observatories in India

M≥3.0 in Peninsular shield and A&N Islands

M≥4.0 in extra-Peninsular region.

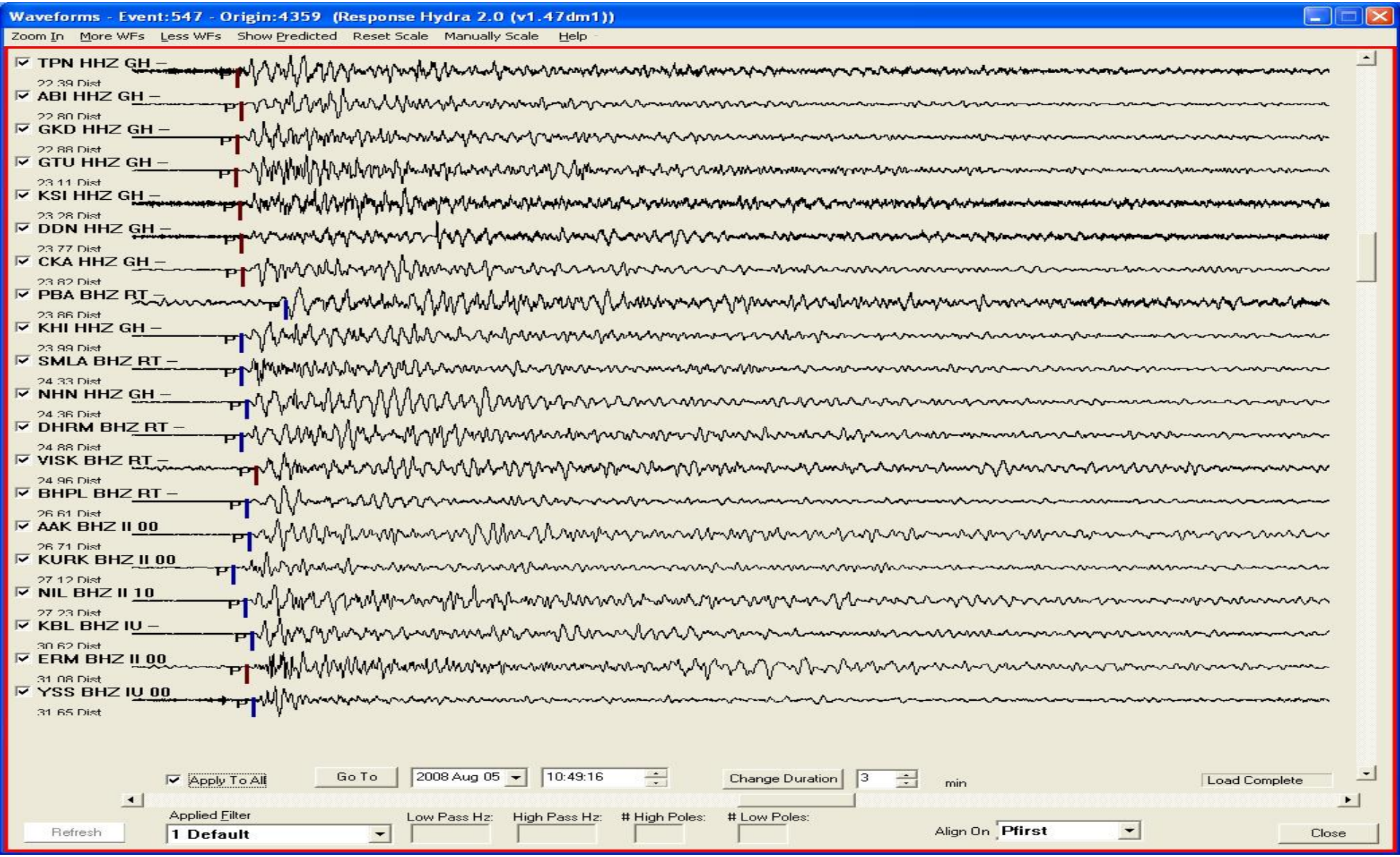
M≥3.0 in the border regions.

The detection capability in some areas such as Koyna, NW Himalaya, Gujarat, Delhi, NE India is M≥2.0



Installations at field station (Bhuj)

Continuous Waveform Display



System Overview Diagram- **Central Receiving Station**

field Stations

VSAT

Processing System

NAQS Server-I

GLASS/ HYDRA (1)

SUN V490 Servers

Windows XP Data Analysis

Waveform Display

Event Display

Event Publishing System (SUN Sparc45)

NGRI and WIHG (NAQS Server) & IRIS GSN Network data (about 106 stations)

Internet

NAQS Server-II

GLASS/ HYDRA (2)

SUN Storedge 3510FC Array 1 TB

Ring Buffers

SUN StorEdge C2 Autoloader -2TB

Simultaneous Fax

Website Updation

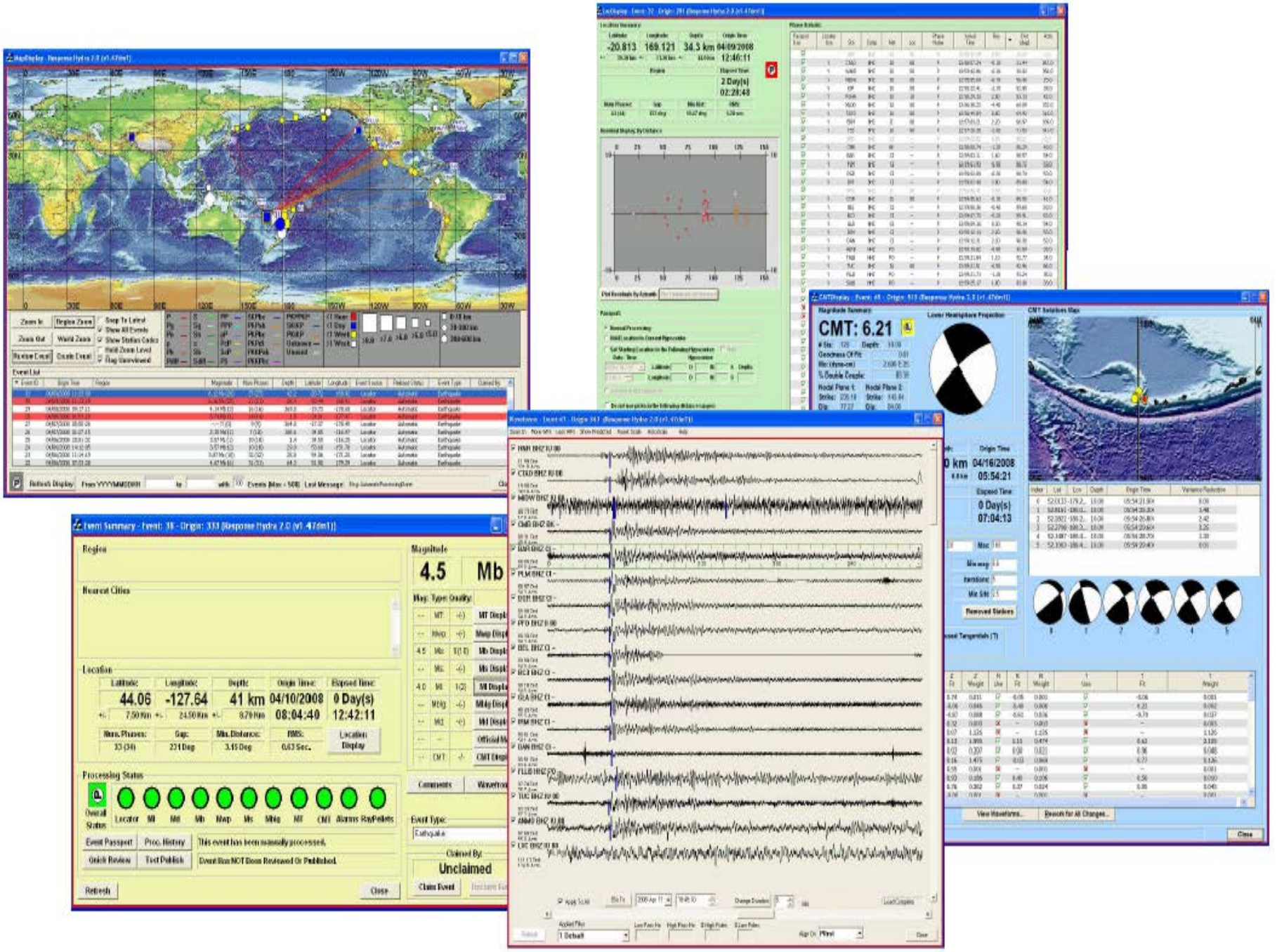
Email

Mobile SMS

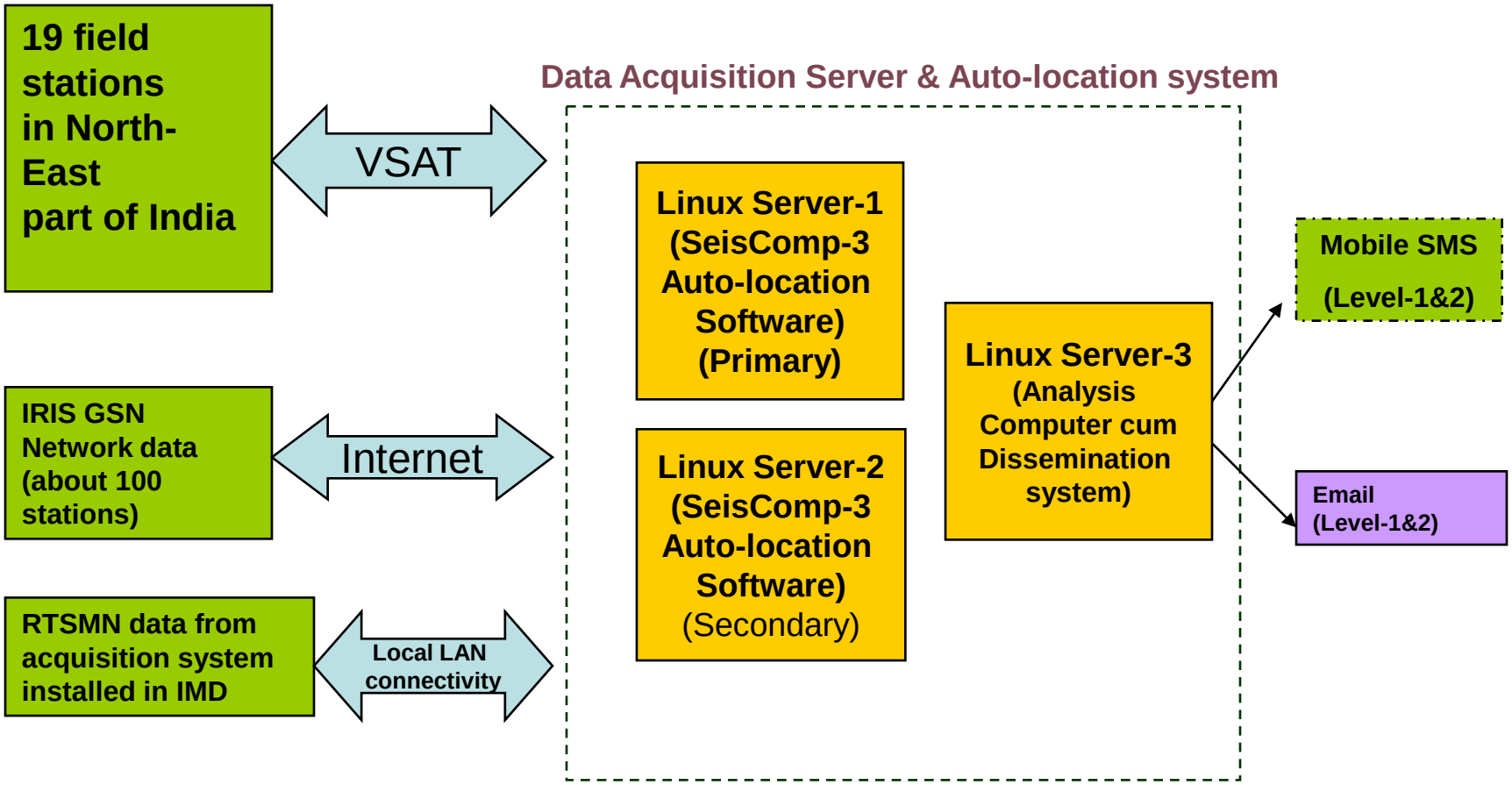
IVRS

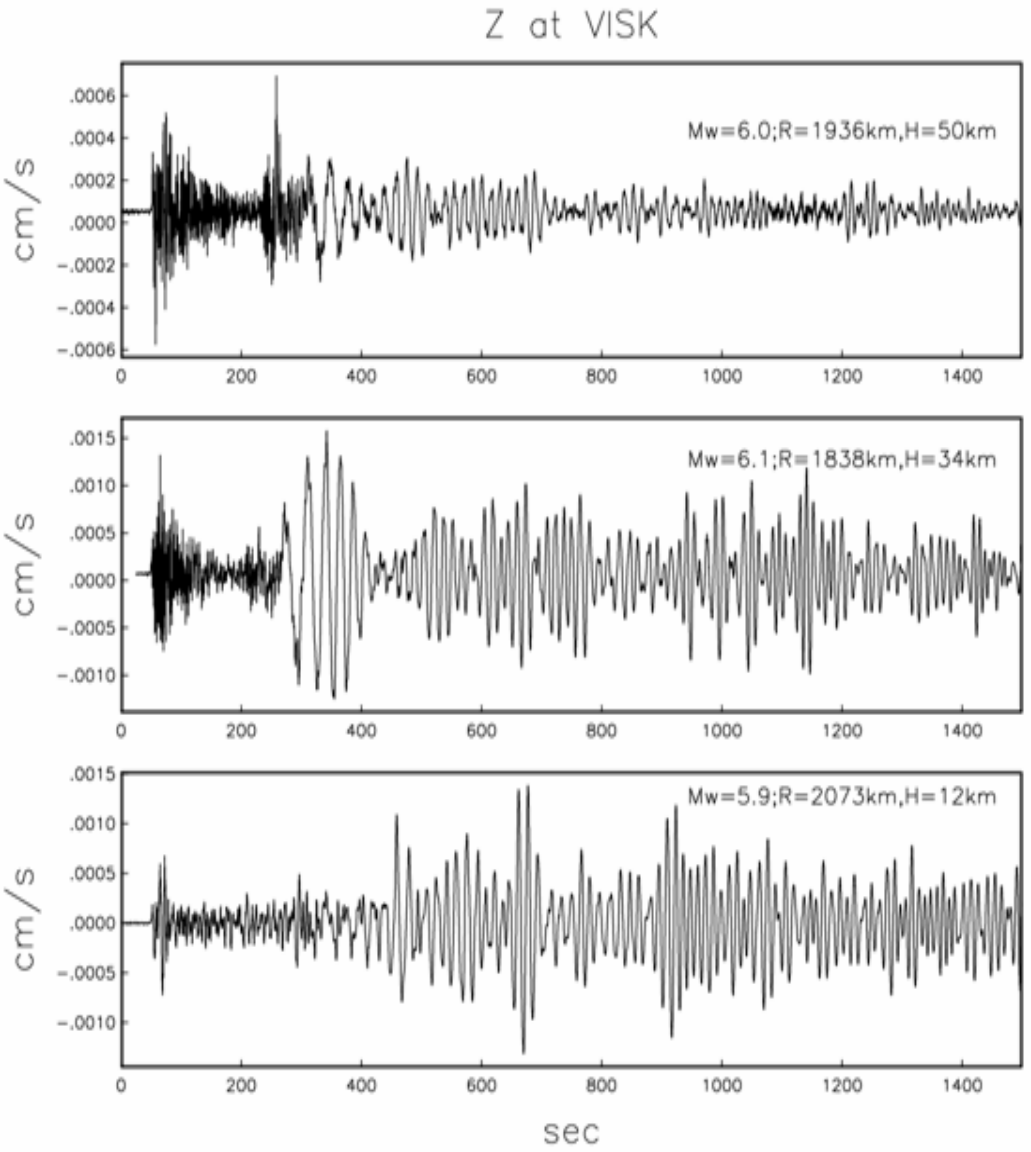
Dissemination System

DISPLAY MAP OF EARTHQUAKE LOCATIONS



Existing System Overview Diagram- **Central Receiving Station of North-East Telemetry Network**

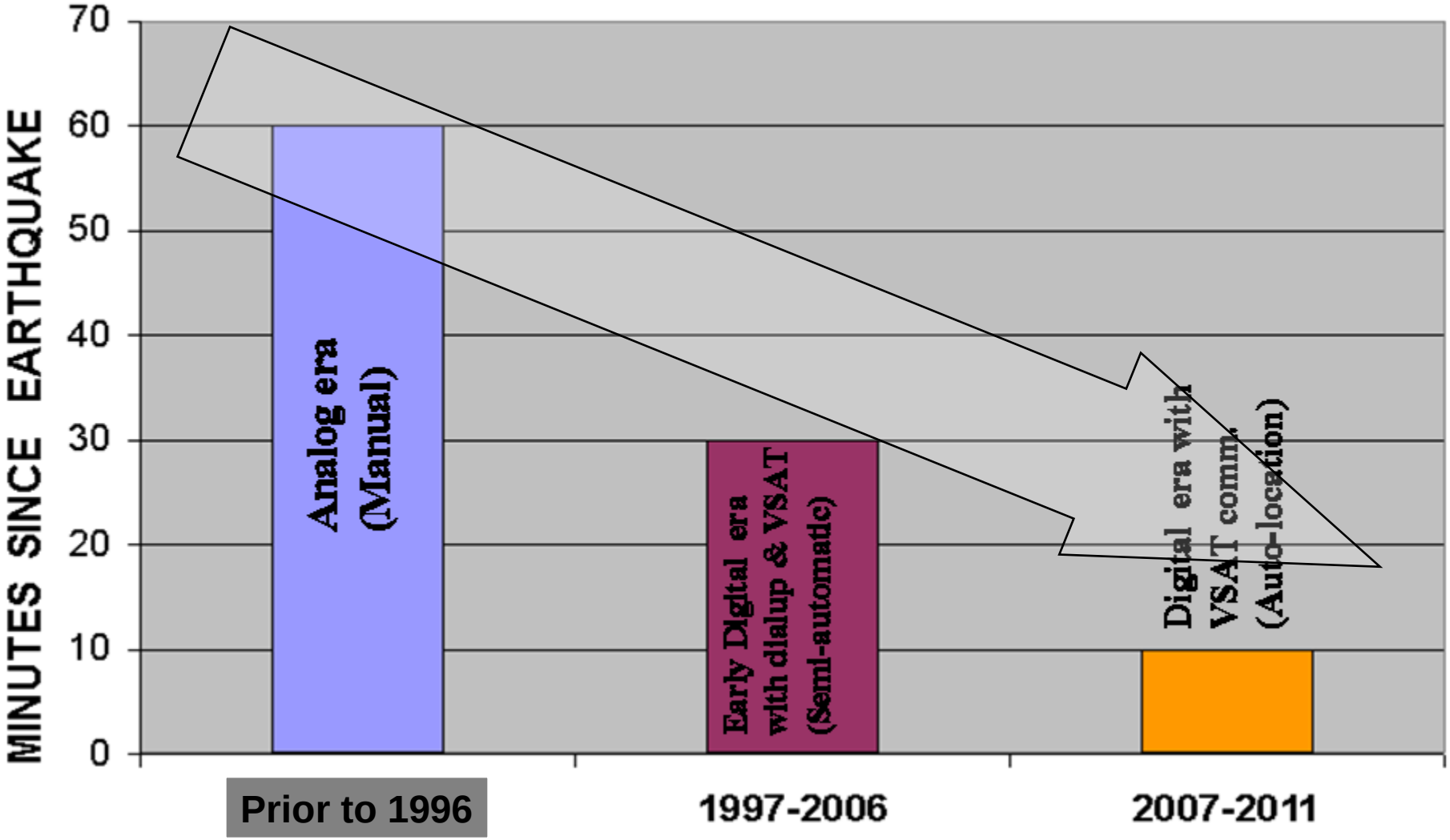


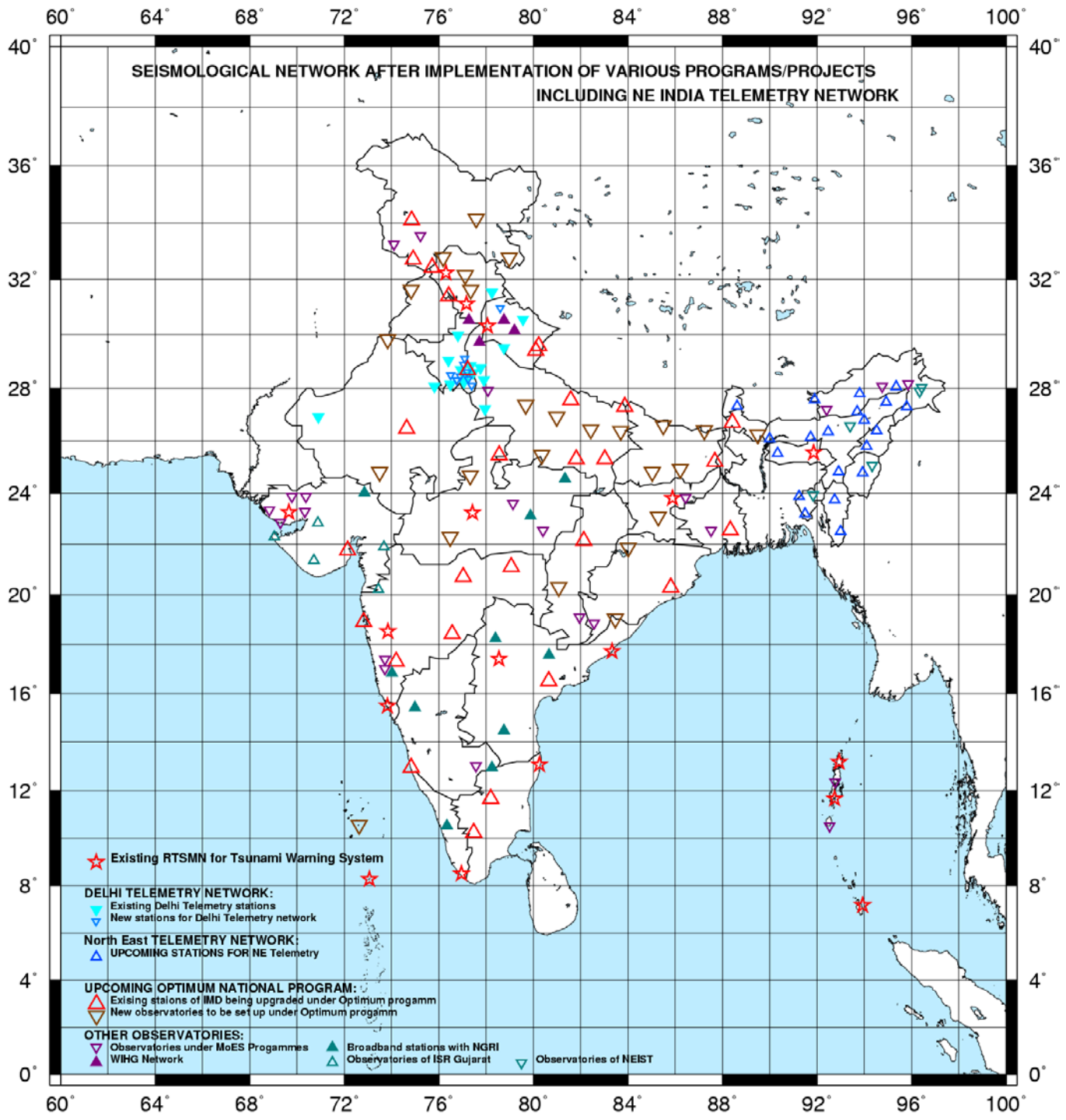


$$E_r = \frac{\int_{f_1}^{f_3} V^2(f)df}{\int_{f_2}^{f_3} V^2(f)df}$$

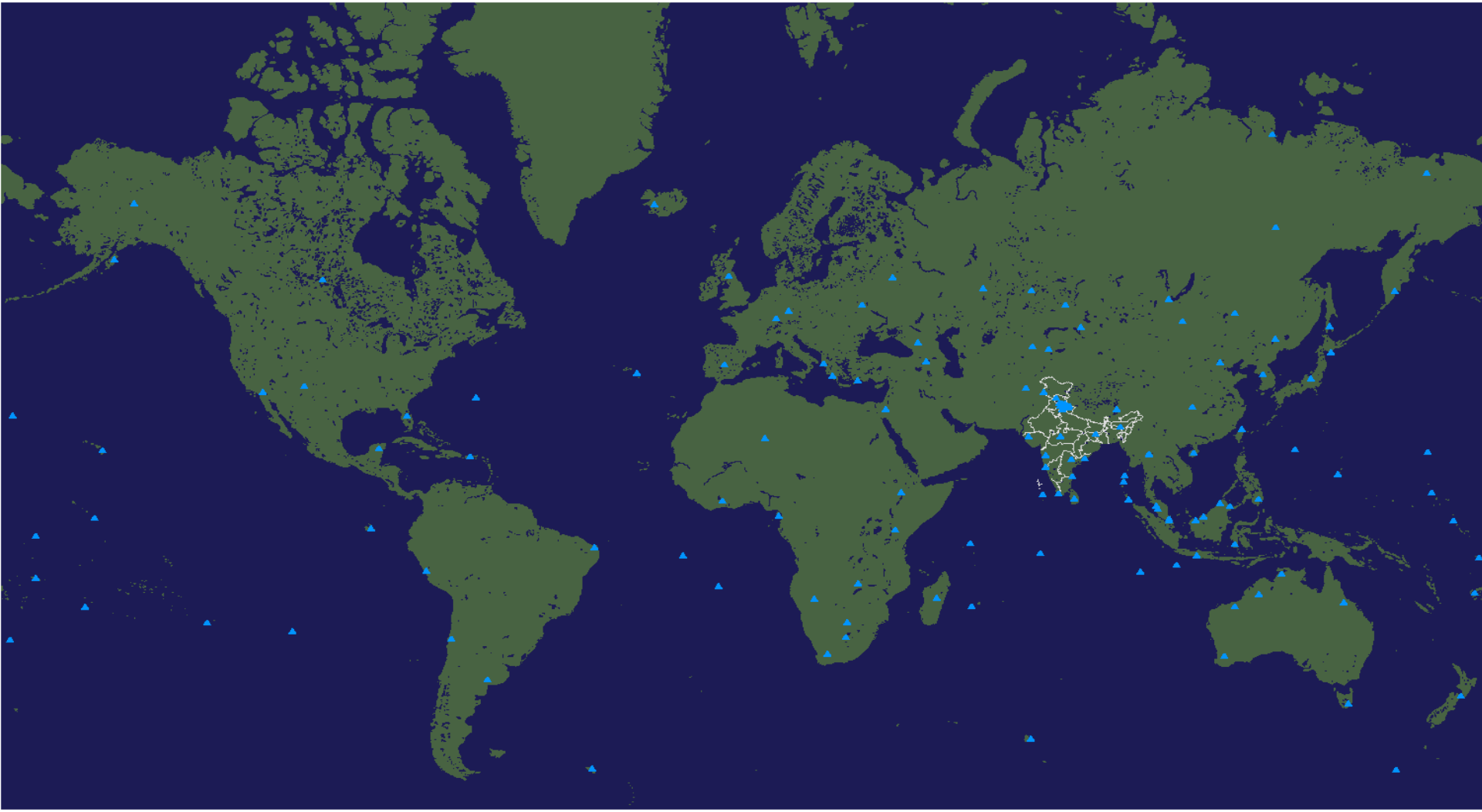
Er–Ratio of Broadband to high frequency energy, where, f_1=0.01 Hz, f_2=0.30 Hz, f_3=2.00 Hz.

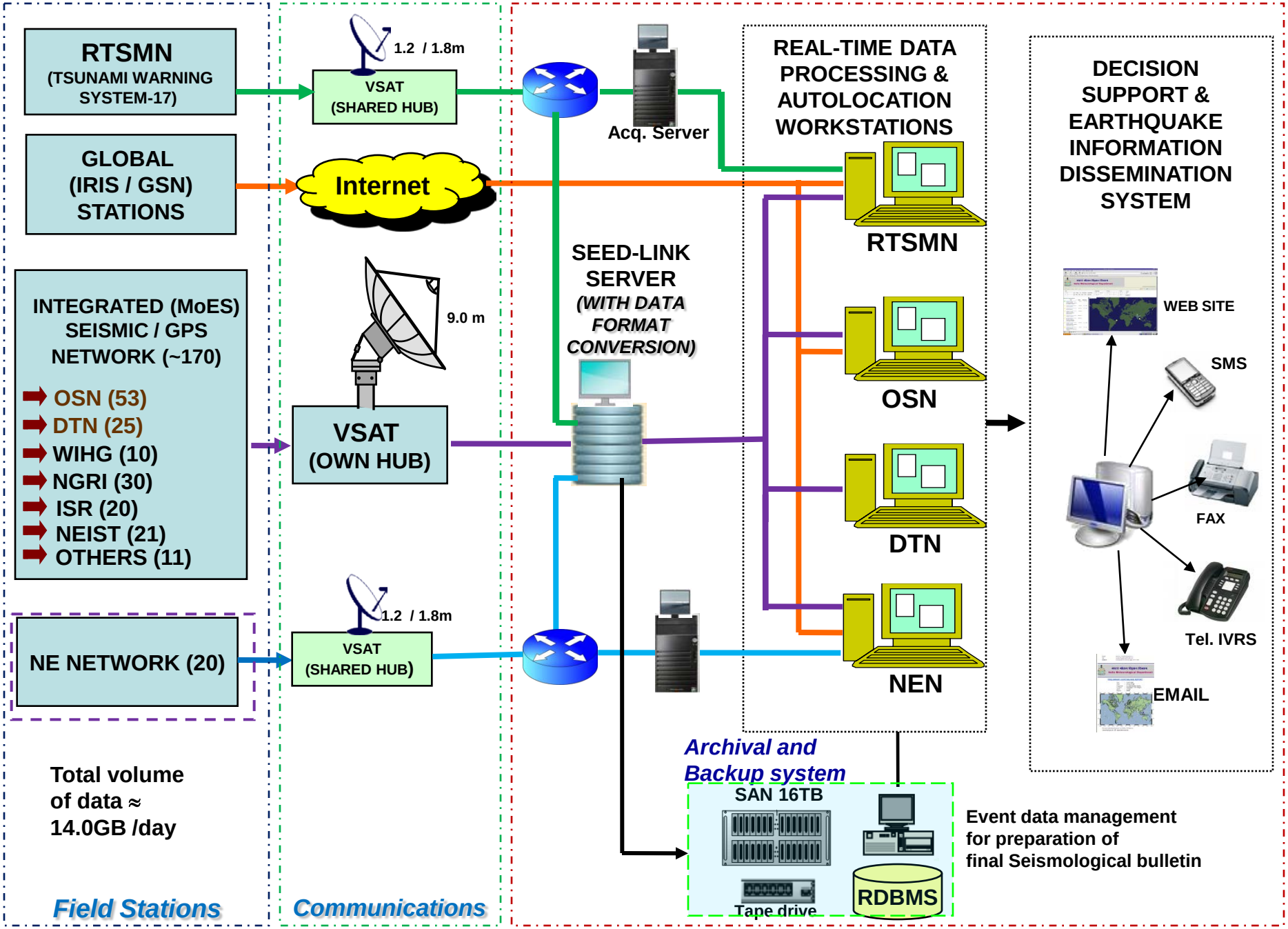
Response time - Status




SEISMOLOGICAL NETWORK AFTER IMPLEMENTATION OF VARIOUS PROGRAMS/PROJECTS
INCLUDING NE INDIA TELEMETRY NETWORK
60° 64° 68° 72° 76° 80° 84° 88° 92° 96° 100°
40° 36° 32° 28° 24° 20° 16° 12° 8° 4° 0°
Existing RTSMN for Tsunami Warning System
DELHI TELEMETRY NETWORK:
Existing Delhi Telemetry stations
New stations for Delhi Telemetry network
North East TELEMETRY NETWORK:
UPCOMING STATIONS FOR NE Telemetry
UPCOMING OPTIMUM NATIONAL PROGRAM:
Exising stations of IMD being upgraded under Optimum progamm
New observatories to be set up under Optimum progamm
OTHER OBSERVATORIES:
Observatories under MoES Progammes
WIHG Network
Broadband stations with NGRI
Observatories of ISR Gujarat
Observatories of NEIST

Stations configured in RTSMN
(NGRI / WIHG stations and ~ 100 IRIS / GSN stations



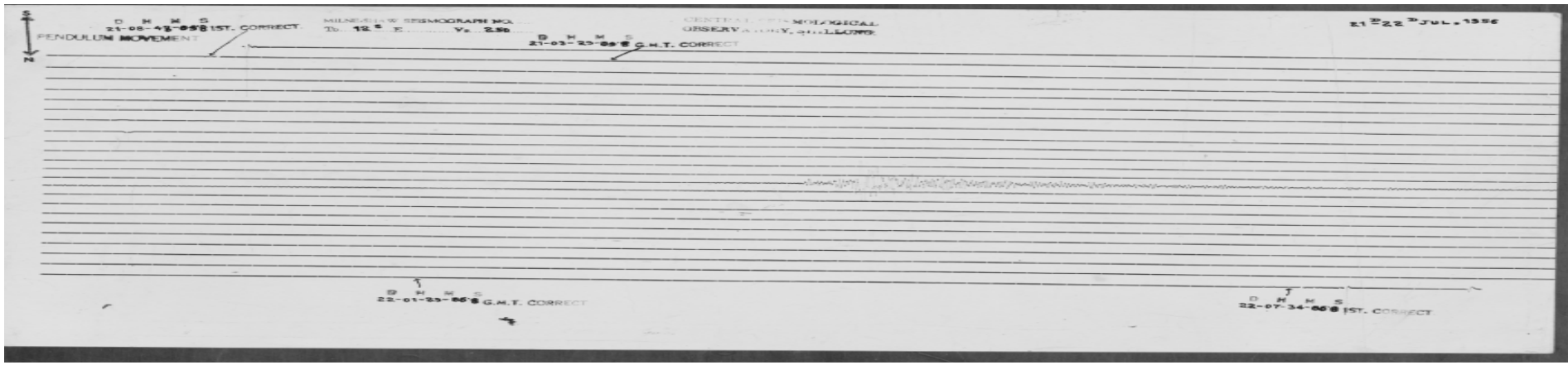


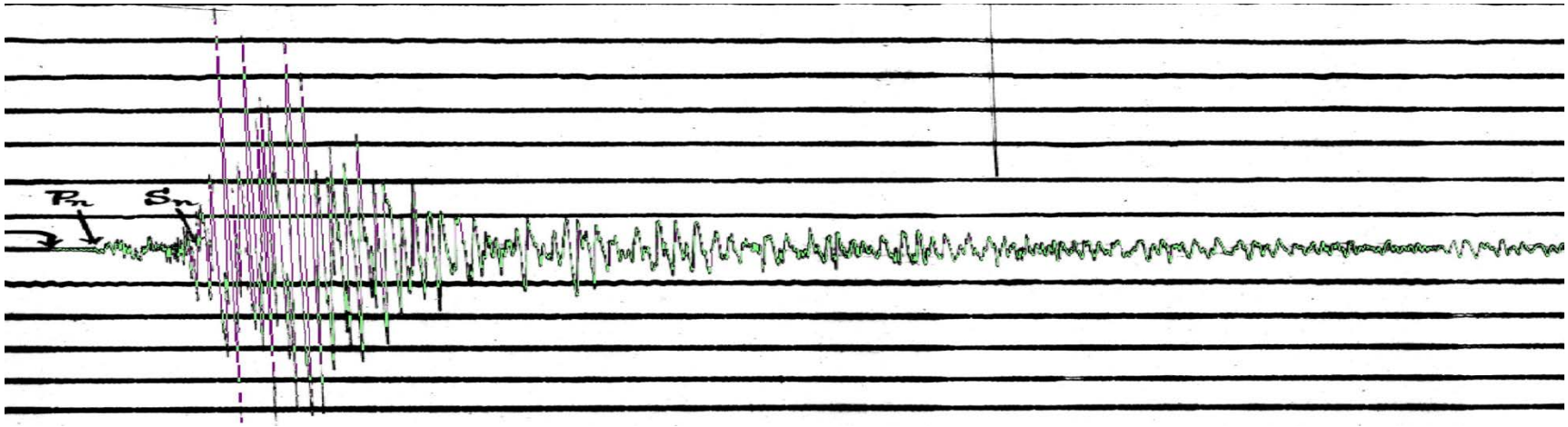
SCHEMATIC OF SEISMOLOGICAL OPERATIONS

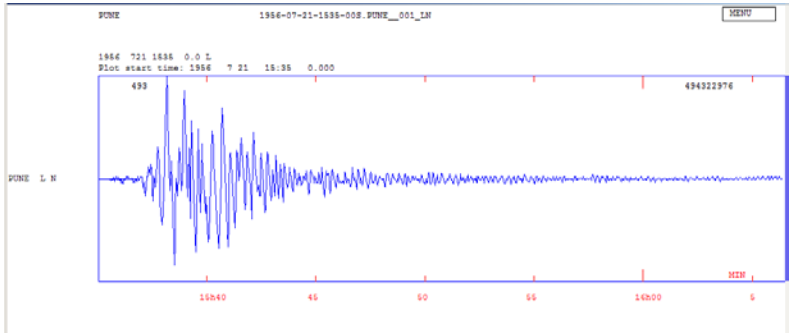
Facilities created for archival and vector digitization of seismic charts

5-scanners (600dpi/800dpi optical resolution), a SAN storage system (84 TB), 2 - Linux servers and 15 desktops

ANJAR EARTHQUAKE OF 21.7.1956, STATION: BHUJ







IMD'S NETWORK DATA GETS INCORPORATED IN THE BULLETINS OF INTERNATIONAL SEISMOLOGICAL CENTRE (ISC)

ISCNEWS

January to June 2010 www.isc.ac.uk

New data and funds, special projects and meetings

International Seismological Centre

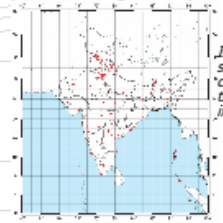
The latest updates, news and activities from the ISC

India MeteorologicalDepartment

The India Meteorological Department (IMD) of the Ministry of Earth Sciences of the Government of India has been a Member of the ISC for many tens of years. Yet the size of Earth Science programmes in India has changed a great deal since the IMD first joined the ISC in 1971. Following the decision of the Ministry of Earth Sciences, the IMD substantially increased its membership contribution and joined the group of ISC's largest supporters that also includes the US, UK, Japan, Russia and China.

The ISC greatly appreciates the help and advice of Prof. Harsh Gupta (Vice-President of IUGG), Dr Brijesh K. Bansal (Ministry of Earth Sciences) and Dr R.S. Dattatrayam (Director of Seismology Division, IMD) who have played vital roles in this important development.

The India Meteorological Department continues with its always timely contribution of seismic bulletin data where seismic arrivals from many stations are included on a regular basis. Seismic networks in India are growing at fast rate and we hope that the IMD will continue providing these data to the ISC. We are also expecting that the IMD would be able to start contributing preliminary bulletin data soon after events occur prior to sending its finally reviewed data.



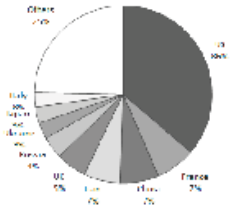
Indian seismic stations that contributed to the ISC Bulletin in 2008-2010

National Science Foundation

WHERE DISCOVERIES BEGIN

The United States National Science Foundation (NSF) is not a regular Member of the ISC though it has contributed a substantial share of funding since the ISC outset in early 1960s. In recent years the ISC has submitted formal proposals to the NSF every four years. One of the previous ISC Directors, Ray Willemann, was particularly skilled at writing convincing and focused proposals and subsequent Directors have followed his lead. The most recent proposal was submitted in July 2009. This proposal, covering the period from mid-2010 to mid-2014, has now been granted in full. The overall amount committed by the NSF represents an increase compared to the last few years. The grant includes supporting regular ISC operations for four years but in addition two add-on projects were highly regarded by the reviewers and have also been funded.

The first of the two add-on projects is to set up an ISC database and website backup at IRIS DMC in Seattle. This development will create a fall-back facility in case of temporary loss of ISC service similar to that narrowly avoided during the Big Thatcham Floods in 2007. It will address concerns about the speed of the Bulletin web queries as well as provide the IRIS DMC with up-to-date access to the ISC Bulletin hypocentres that are currently used (based on the contents of the ISC CDs) to serve waveform requests related to specific seismic events. The NSF grant will pay for the cost of the server at IRIS DMC, the cost of the initial trip to Seattle for the ISC DB Administrator to make an initial setup at IRIS as well as managing the backup remotely thereafter.



Web-based use of the ISC Bulletin by researchers from different countries in the last 10 years

The second add-on project will pay for an additional member of staff for four years, providing a welcome boost to the task of re-building the entire ISC Bulletin for 1960-2009. This project has already started based on additional funding committed for improving the ISC services by Japan, China and India. NSF's support is invaluable in making sure that this development is completed in four years rather than eight as originally planned. The work will include:

- re-computing the ISC hypocentre solutions using the ak135 velocity model and newly developed location algorithm;
- re-computing ISC magnitude estimates using better averaging and outlier removing technique and providing magnitude uncertainties for the first time;
- adding previously unavailable surface wave magnitudes for years 1960-1977, courtesy of GEM project;
- identifying and where possible filling gaps in original bulletin reports from networks;
- adding new datasets from scientific experiments and temporary deploy ments, especially those involving OBS;
- running modern consistency checks on the entire bulletin and correcting identified blunders in the Bulletin.

This project will produce a large scale update to the flagship ISC product that is widely used in many fields of geophysical research.

Thank You