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Geophysical Activities at Maitri, Antarctica

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National Geophysical Research Institute, a premier laboratory under the CSIR, is carrying out two scientific projects in Antarctica:

A. Seismological Observatory at Maitri

B. Permanent GPS tracking station at Maitri

A. SEISMOLOGICAL OBSERVATORY AT MAITRI, ANTARCTICA

1. Introduction

Antarctica is one of the stable continents in the world. Seismic activity is very low and the modern crustal deformation is highly precise. Only ten earthquakes with magnitudes 4.1 ~ 4.9 were located by the world wide seismic network in stable Antarctica during last three decades. In order to monitor the seismic activity in Antarctica and Indian ocean, a reconnaissance survey for site selection and the feasibility of operation of seismological observatory in Antarctica was initiated during the 16th expedition, in January-February 1997. A permanent Digital Seismological Station has been installed during the 17th expedition. The station was fully commissioned on 26th January 1998.

2. Objective

The establishment of the seismic station with high-resolution digital seismograph station as well as analog seismic recorder is intended to monitor the seismic activity within Antarctica. The station also aims at monitoring of teleseismic activity as well as the activity in mid oceanic ridge in the Indian Ocean. Data exchange with other stations besides participating in the global earthquake epicentral determination is envisaged.

3. Methodology and Results

A special thermally insulated vault was designed and fabricated by R & D Engineers, Pune of DRDO. An underground pit has been dug and the vault was buried in that pit. An electronically controlled temperature device has been installed in the seismic vault, which maintains the inside temperature at 170+/-2 det. Celsius. Recording of the data is done in the "Tirumala" hut. Digital data acquisition system (REFTEK) is connected to three S-13 short period seismometers (of Teledyne Geotech). A GPS clock has been attached for accurate time keeping. Three component digital data is collected @50 samples /sec. A vertical component analog record (S-13 of teledyne Geotech) is also being operated simultaneously. Recording is done with ink on RV320R Portacorder. Drastic changes in temperatures inside the hut were observed during previous winters. To prevent damage to equipment wooden partition was erected during this winter, inside the hut due to which temperature within the hut was maintained above 15° C throughout the winter, using only two heaters.

New software SEISAN has been installed in the computer for analysis of the Digital Data. Preliminary analysis of both the digital and analog records is done regularly. Management of data is done using FOXPRO programs, written by the project member. The phase data for the period February 2000 to May 2000 was sent to NGRI, Hyderabad and USGS. Later due to the problems with email facility, data exchange could not take place. Epicentral data for the months of January and February 2000 were received from NGRI through FAX. Final analysis of the data for the month of January 2000 is in progress. The station recorded more than 400 earthquakes during the wintering period. Most of the earthquakes are teleseismic. Few regional earthquakes with its epicenter in Indian Ocean were recorded.

4. Highlights

The observatory is running satisfactorily without any interruption till date. Seismic data acquisition, storage and analysis is going on uninterruptedly with desired precision. More than 400 earthquakes from different azimuths, distances and of varied magnitudes are recorded. Daily 16 MB of digital data is generated and the data is stored on tapes on a weekly basis. At the end of every month, data is stored on compact disks also after conversion to archive format. In all about 6 GB of digital data is generated and stored for further analysis.

Two tremors were recorded on March 25, 2000 from a distance of about 500 km. One tremor (3.5 MD) was recorded on December 22, 2000 from a distance of about 600 km.

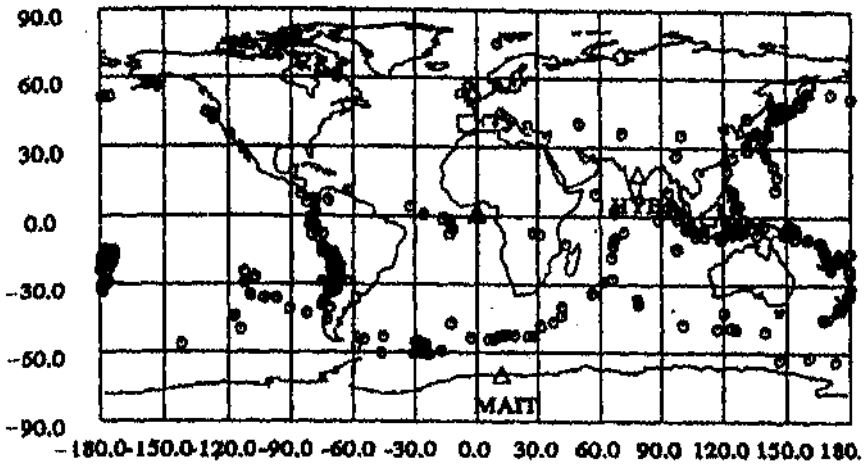

Fig. 1: Events recorded at Maitri, year 2000; total events 461, selected events 461,

B. PERMANENT GPS TRACKING STATION AT MAITRI

1. Introduction

NGRI, Hyderabad has launched a study with a focus on plate movement and crustal deformation, precisely between India and Antarctica by establishing permanent GPS station at Antarctica, adopting space geodetic technique.

2. Objective

The objective of GPS tracking station is to measure very long base lines between India and Antarctica by continuous GPS monitoring. The estimation of coordinates, the change in position coordinates, baselines, rate of base line vectors and velocity fields will enable us to assess the crustal deformation and the following :

1. Relative displacement between India and Antarctica.
2. Crustal Uplift after deglaciation.
3. Elevation changes.

Having established the permanent GPS station, NGRI could participate in the Global Antarctic Program (GAP) campaign by contributing Maitri GPS data as a fundamental marker to Scientific Committee of Antarctic Research (SCAR) GPS 1998 campaign.

3. Methodology and Results

During the 19th expedition, continuous GPS monitoring was carried out with the help of Ashtech Z XII GPS Geodetic receiver. New TURBOROGUE GPS system was installed on May 11,2000. Initially this system performed satisfactorily, but stalled giving problems from August 06, 2000. Hence data collection was shifted to ASHTECH GPS system again.

The ASHTECH receiver is setup everyday and allowed acquiring data throughout 24 hours. Everyday about 6 MB of data is generated, with a sampling rate of 1 sample per 15 sec. The data is stored on tapes on a weekly basis. Altogether more than 2.0 GB volume of data was generated and stored.

4. Highlights

About 2 GB of precious geodetic data is recorded and stored for analysis. GPS data collected at Maitri (during the previous expeditions) is now available on web site for interested users.

C. CONSTRAINTS

The absence of Internet facility made data exchange impossible. Seismic Earthquake parameters could not be received from either USHS or NGRI. This has hampered the analysis work.

D. RECOMMENDATIONS

1. "Tirumala" hut may be provided with a 3-phase power line, so that load distribution can be properly done.
2. Isolated earth connections for all the recording equipment is necessary. Power cables to seismic vault are to be replaced and properly secured.
3. Temperature within "Tirumala" hut should be maintained within a small range so that there is no variation in calibration pulse amplitudes.

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