

ESTABLISHMENT OF PERMANENT GPS TRACKING STATION AT MAITRI, INDIAN ANTARCTIC STATION.

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Introduction

Keeping in view of the innumerable scientific objectives such as studies on crustal uplift after deglaciation, local earthquakes, accurate determination of hypocentres of earthquakes which occur throughout the world, crustal movements and to interpret the structure and composition of the earth's interior, NGRI has launched a study adopting space geodetic technique using GPS during the XVI Indian expedition to Antarctica.

Among the space geodetic techniques, GPS is state-of-the-art, inexpensive, easy to use technique for crustal deformation studies. Since GPS is the THRESHOLD TECHNOLOGY. It is being used for Geodynamic applications worldwide. In USA, JAPAN, AUSTRALIA, NEWZEALAND, and GERMANY cluster of GPS continuous monitoring networks are established to conduct regional and local campaign for crustal deformation studies. As part of the global campaign, NGRI has launched this programme for the first time at Antarctica.

Initial short term GPS measurements were carried out at Maitri, Indian station at Antarctica with an objective of filling up the GPS data gap in Antarctica region between LAT 0° to 30° East and LON 60° and 80° South in the context of global GPS network as well as to study the ongoing Indian plate motion south of Indian Peninsula. ASHTECH Z XII GEODETIC 12 channel GPS receiver was commissioned and data was acquired for about 45 days from Jan 97 to Feb 97 during XVI expedition.

IGS permanent GPS station at NGRI

Already NGRI has established an IGS permanent tracking/reference station in JUNE 1995 to participate in the IGS global network for the following scientific objectives to study the ongoing Indian plate motion by:.

- 1) determination of intercontinental and intraplate baseline vectors and monitor the deformation process along the vectors.
- 2) fixing a reference point in an inertial frame of reference and providing scope for establishing fiducial sites to constrain GPS measurements.

Continuous operation of the station, data acquisition, data transfer to our German collaborators are on from SEPTEMBER 1995. GPS data analysis and processing was carried out for the first data set by the GLOBAL NETWORK SOLUTION. Very long baselines of 6900 km from NGRI, HYDERABAD to OTHER ITRF94 STATIONS have been estimated within an rms error of 2cms. Hyderabad site coordinates were fixed up.

As an extension of this already established activity, to emphatically focus the studies on interplate movement and crustal deformation precisely between INDIA AND ANTARCTICA by establishing a permanent GPS station at ANTARCTICA, this GPS Antarctica programme was initiated during XVI Expedition.

An experiment to measure the VERY LONG BASELINES between INDIA AND ANTARCTICA by continuous GPS monitoring has been designed to carry out the crustal deformation studies. Estimation of coordinates, the change in position coordinates, baselines, rate of base line vectors and velocity fields thus computed will enable us to assess the crustal deformation and the following. (Ref. 1)

- 1) Relative displacement between INDIA and ANTARCTICA.
- 2) CRUSTAL UPLIFT after deglaciation.
- 3) Elevation changes.

Establishment of permanent GPS tracking station at Maitri.

During XVII expedition, a permanent GPS tracking station at Maitri was established by commissioning Ashtech Z XII 12 channel Geodetic dual frequency GPS Receiver. Geodetic monument /permanent pillar was constructed and GPS choke ring antenna was installed. Continuous monitoring have commenced from Jan.'98.

A suitable site was selected adjacent to Tirumala hut to construct the Geodetic monument/permanent pillar.(fig. 1)

GPS system consists of following :**1) Antenna / Front end :**

The antenna is a drooped crossed-dipole type mounted to a choke ring antenna base plane. The DORNE MARGOLIN T choke ring, L band Omni directional antenna receives the L1 and L2 signals from all visible GPS satellites. These signals pass through an L band pre selection filter of 500MHz bandwidth centered at 1400 MHz before amplification by a low-noise (1250 K) amplifier. The L band RF signal is then communicated along coaxial cable of up to 75 feet length to the receiver which is housed in Tirumala hut (fig.2)

2) Receiver :

The GPS receiver is connected to a onsite Digital Lap top computer via a serial communication port. The receiver continuously tracks those satellites which fulfill preset criteria such as elevation cutoff (set at 10°). There is no obstruction of the horizon. Measurements are at every 15 sec interval which is the standard followed for Geodetic Antarctica Programme. The raw track data is stored in an internal memory of the receiver. The daily track data is downloaded to the onsite PC regularly by a HOSE.EXE downloading program. Downloaded data is in binary format. About 2MB of data accrues every day.

Data is collected in 3 kinds of files namely BEN, EPH and SITE. BEN contains the information about the observables, EPH contains satellite ephemeris information whereas SITE contains the approximate coordinates of the site. Daily data is archived and

stored in DAT tape as well as in the hard disk.

Data Processing

Data of about 45 days from Jan 98 to Feb 98 during 17th Expedition was processed using Bernese software version 4.0 using the best possible strategies. The following strategy was followed.

- 1) Absolute antenna phase
- 2) Ionosphere free combination
- 3) 4 troposphere parameters/day
- 4) 1day/week solution
- 5) precise orbits from CODE
- 6) Elevation mask 10°
- 7) No ambiguity solution
- 8) Fiducial stations: Hartbeesthock, Sandiego, Yaragadee, Tidinbilla, Kerguelen (fig 3).
- 9) Coordinates estimated with network solution.

Site coordinates of MAITRI were estimated in ITRF96 reference frame and the baseline vectors between MAITRI and IGS GLOBAL TRACKING STATIONS around ANTARCTICA by GLOBAL NETWORK SOLUTION, (fig.4)

Lat.	=	S	70°	45'	56.902288"
Lon.	=	E	11°	44'	08.620111"
Ht ell	=		132.2187		M

Baseline lengths from Maitri :

to KERG	3742927.351 m
to HART	4959281.878 m
to SANT	6037483.432 m
to YAR1	7046530.622 m
to TIDB	7283941.403 m

This has resulted in the refinement of repeatability and resolvability of the measurements. These results were obtained by analyzing in tandem with the already established baselines. Having established the Permanent GPS station, NGRI could participate in

the Global Antarctic Programme (GAP) Campaign by contributing Maitri GPS data as a fundamental marker to International Scientific Collaboration of Antarctica Research (SCAR) GPS1998 campaign (fig.3). This will entail access to global Antarctica data for crustal deformation studies once the online data communication between Maitri and NGRI is established.

Conclusion

Continuous GPS measurements at ANTARCTICA and INDIA will help assess

- 1) The large inferred rate of uplift which is not a continuous movement but an intermittent one.
- 2) Vertical crustal movement.
- 3) crustal velocity model.

These studies along with estimation of intercontinental baselines may help us to join the study of global absolute uplift which is equal to expansion of earth's radius.

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Figl. GPS Choke Ring Antenna mounted on a Permanent Concrete Pillar.



Fig 2. Ashtech Z-XII GPS Receiver and on site computer installed inside the Tirumala Hut.

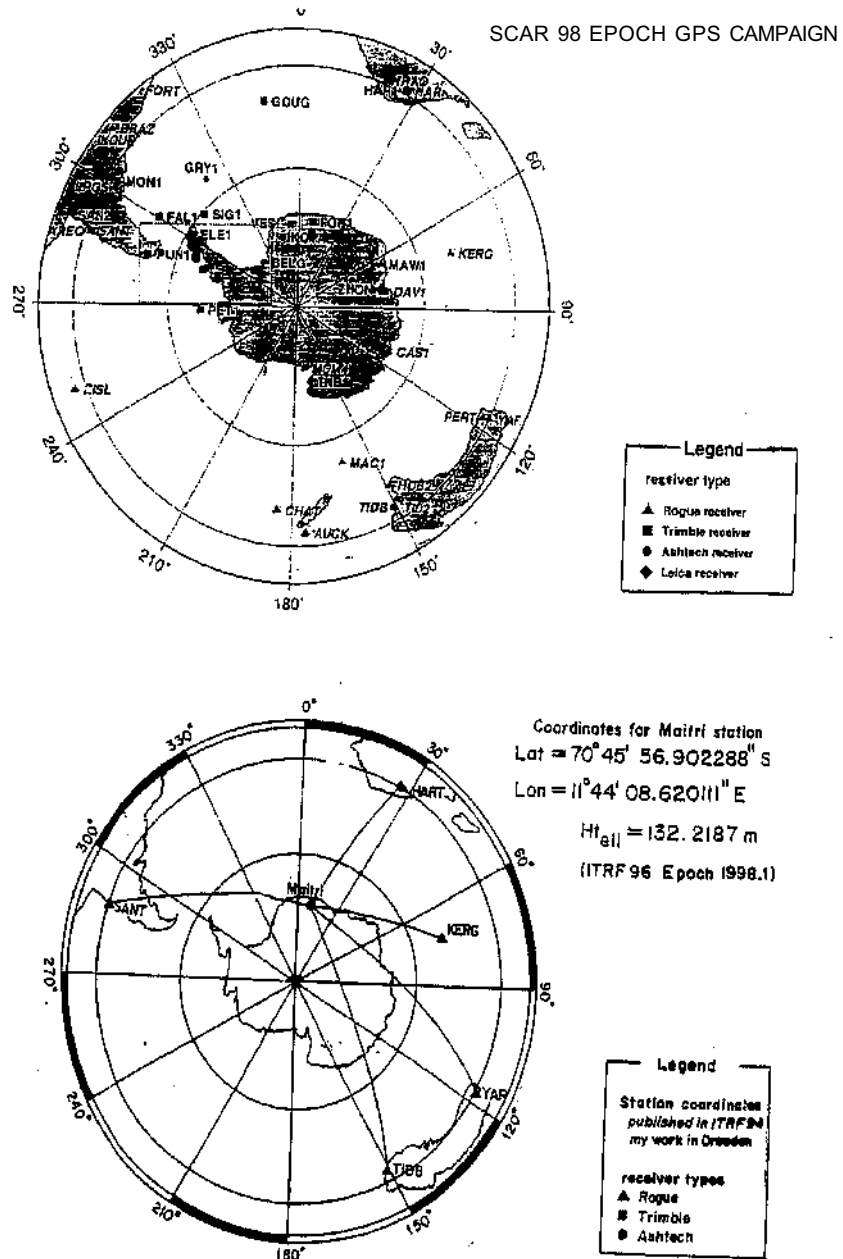


Fig. 4