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National Report of India
on
TIDE GAUGE NETWORK
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Survey of India has a long history of about 130 years since 1877 of maintaining tidal data, generated from dedicated tide gauge network along the Indian coast and islands. In each tidal observatory, a mechanical float type tide gauge has been installed. Tide Gauge Bench Mark (TGBM) / Chart Datum of observation is connected to a precision levelling bench mark network. Data collected at these locations is being used for subsequent processing, analysis and predictions for various purposes. Major thrust of the activities of Survey of India is as under:

1. Publication of INDIAN TIDE TABLE comprising tidal predictions of 76 Indian and selected foreign ports, mainly for navigational activities and harbour developments brought out in advance.
2. Annual publication of Hugli River Tide Table containing predictions of 6 ports on the Hugli River, viz., Sagar, Gangra, Haldia, Diamond Harbour, Mayapur and Garden Reach (Kolkata).
3. Survey of India provides tidal predictions for any place along the Indian coast (other than 30 ports included in the Indian Tide Table) to the various government or private agencies on demand.
4. One of the major activities of Survey of India is the determination of Mean Sea Level (MSL), which also forms the basis for defining the Vertical datum of the country.
5. Monthly and Annual Mean Sea Level data are sent to Global Data Bank of Permanent Service for Mean Sea Level, UK for long term sea level change information from tide gauges. Information is available on website: www.pol.ac.uk/psmsl/

6. A long historical tidal data set is lying in Survey of India in the form of record volume on paper media. An initiative has already been taken to transform this data into computer accessible format.
7. Work has already been undertaken to study the precise inter-island drifts due to global green house effect on sea level rise and determination of SLBM (Sea Level Bench Marks) position on same Global Geocentric Reference System in order to decouple vertical crustal movements from true sea level variations.

During the last decade it was felt to develop an integrated Ocean Observing System for the Indian Ocean, which can only be established by improving the data collection procedure, storage and dissemination processes. In order to do this, efforts were made by Survey of India since long and as part of quest, digital tide gauges were installed during ninety's, but it delivered limited results.

Modernization and Expansion of Indian Tide Gauge Network

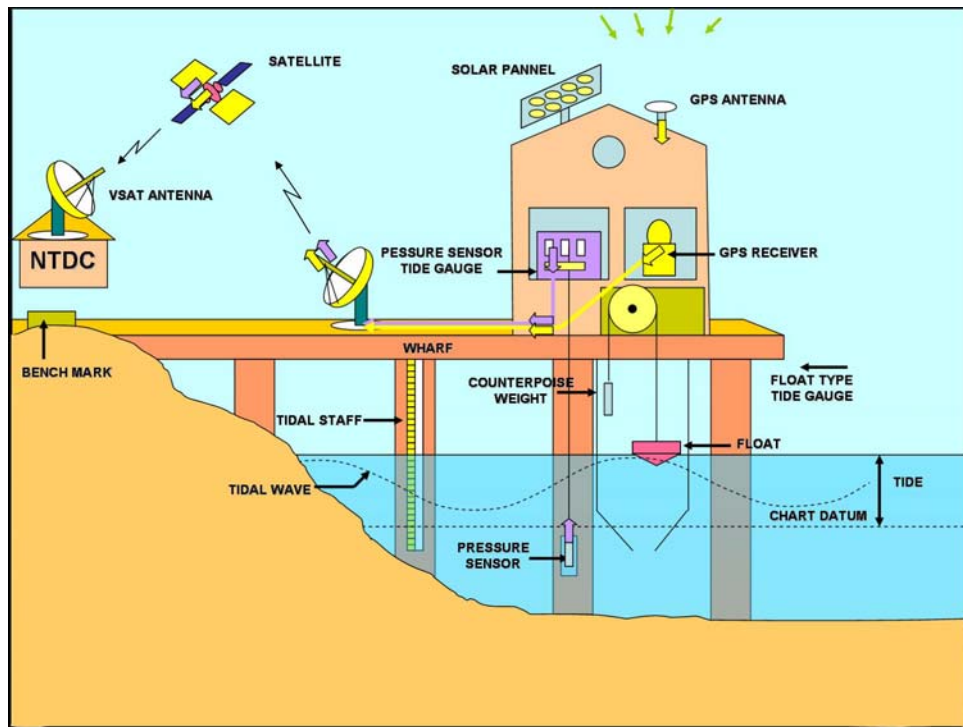
Aftermath great earthquake of Sumatra and subsequent tsunami on 26th Dec., 2004 major loss in the form of precious human lives and property, process of modernization of Indian Tide Gauge network got hastened. A project for the “Modernization and Expansion of Indian Tide Gauge Network” was initiated and now it has taken a shape of reality.

Under Modernization and Expansion of Indian Tide Gauge Network Project, it has been decided to establish 36 state-of-the-art digital tide gauges co-located with dual frequency GPS receivers at strategic locations all along the Indian coastline and its islands.

GPS receivers are being deployed to segregate the sea level rise from that of possible subsidence or upheaval of the land mass.

Both tidal and GPS data are being transmitted in real time from the remote locations and received through dedicated VSAT network, at the central hub installed at National Tidal Data Centre / National GPS Data Centre located at Geodetic & Research Branch, Survey of India, Dehra Dun.

A typical network is shown in the figure given below:



GPS data is being encrypted at remote locations (Tidal Observatories) and decrypted at central hub.

Tidal and GPS data are being analysed in the real time to identify any possible signatures related to the tsunami and storm surge. In the event of tidal heights crossing a preset threshold, the information will be passed on to the Tsunami Warning Centre being established at the Indian National Centre for Ocean Information Services (INCOIS), Hyderabad for dissemination or issuance of alert.

Indian Tide Gauge Network



List of Tide Gauge Stations in the Indian Tide Gauge Network

EXISTING TIDE GAUGE STATIONS WITH FLOAT TYPE MECHANICAL TIDE GAUGES		EXISTING TIDE GAUGE STATIONS WITH MECHANICAL TIDE GAUGES, DIGITAL TIDE GAUGES, DUAL FREQUENCY GPS RECEIVERS AND REAL TIME DATA TRANSMISSION FACILITIES		PROPOSED TIDE GAUGE STATIONS WITH MECHANICAL TIDE GAUGES, DIGITAL TIDE GAUGES, DUAL FREQUENCY GPS RECEIVERS AND REAL TIME DATA TRANSMISSION FACILITIES	
Sl. No.	NAME OF SITE	Sl. No.	NAME OF SITE	Sl. No.	NAME OF SITE
1.	OKHA	1.	KANDLA	1.	PORBANDAR
2.	VADINAR	2.	MUMBAI	2.	MAGDALLA
3.	GARDEN REACH	3.	MARMAGAO	3.	JAIGARH
4.	DIAMOND HARBOUR	4.	COCHIN	4.	KARWAR
		5.	TUTICORIN	5.	NEW MANGALORE
		6.	CHENNAI	6.	BEYPORE
		7.	ENNORE	7.	ANDROTH
		8.	MACHILIPATNAM	8.	RAMESHWARAM/ KANNIYAKUMARI
		9.	VISAKHAPATNAM	9.	NAGAPATTINAM
		10.	PARADIP	10.	PONDICHERRY/ CUDDALORE
		11.	HALDIA	11.	KRISHNAPATNAM
		12.	KAVARATTI	12.	KAKINADA
		13.	MINICOY	13.	GOPALPUR
		14.	PORT BLAIR	14.	SAGAR
		15.	NANCOWRY	15.	AERIAL BAY
				16.	CAMPBELL BAY
				17.	VERAVAL

Types of Tide Gauges in use

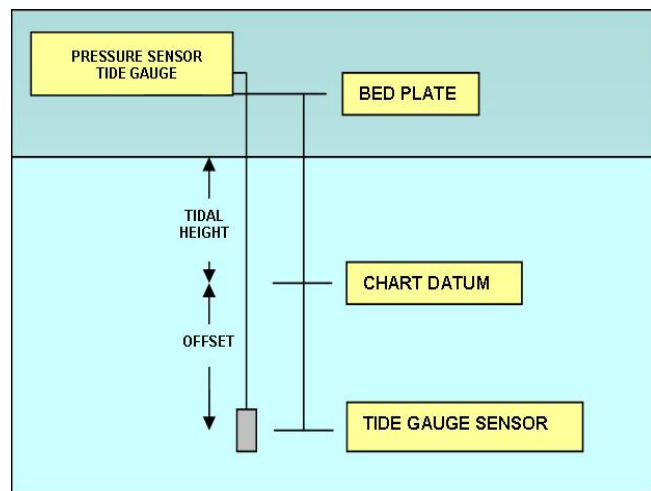
i) Float Type Analogue Tide Gauge

Long period observations covering several years are carried out using self registering float type tide gauges, installed at selected ports along the Indian coast and islands. Normally, tide gauge consist of two units. One comprising of drum and driving clock and the other a float and counter weight mechanism. The chart on the drum contains two perpendicular ordinates for height and time. The charts are changed daily and sent to Survey of India, Dehradun by post. Here data has been extracted after applying number of quality checks. Mechanical clock of this tide-gauge has been replaced with the stepper motor digital clock.



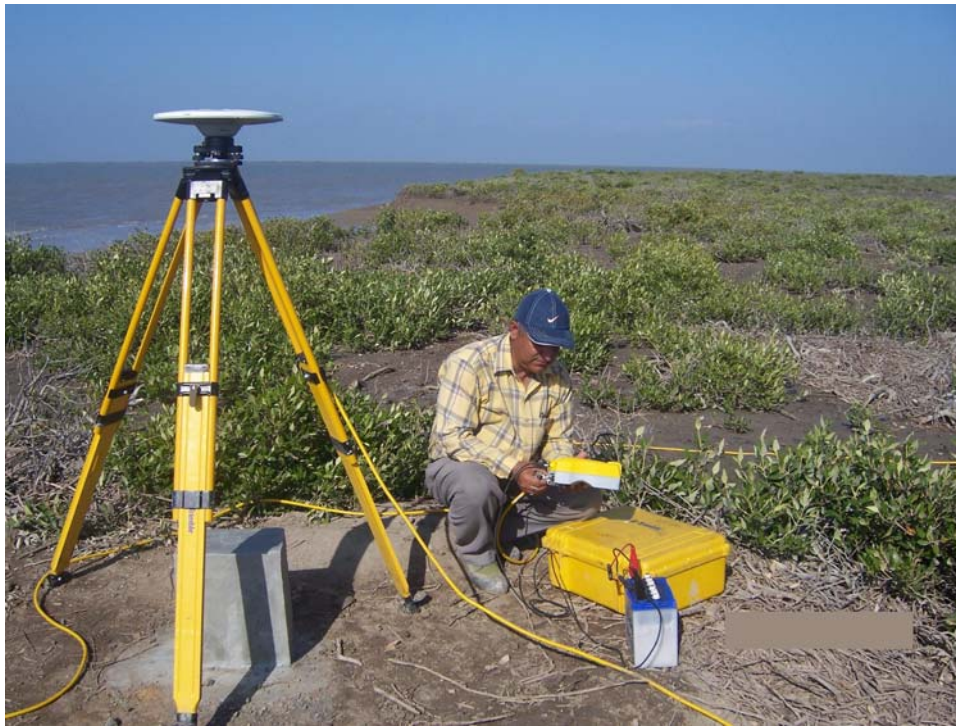
ii) Pressure Sensor Tide Gauge

Under the Modernization & Expansion of Indian Tide Gauge Network Program, Pressure Sensor Tide gauges are being deployed at various ports along the Indian coasts and islands. These can be used to measure tidal heights upto one minute interval in digital form. This digital data is now being sent to National Tidal Data Centre, Dehradun through VSAT on real time for further analysis.



Type of GPS receivers in use

To monitor the crustal movement and to segregate the sea level rise from that of possible subsidence of upheaval of land mass, Trimble 5700 dual frequency GPS receivers have been installed at all the tidal stations.



Research Project initiated:

1. Digitisation of Historical tidal records and maintenance of tidal data in digital format for scientific research use.
2. Determination of Tsunami precursors based on tidal records available during 1881, 1945 and 2004.
3. Determination and analysis of sea level rise over the past 100 years.
4. Efforts to develop website of Geodetic & Research Branch for easy access to tidal data and information available with Survey of India.

Publications:

- Nagarajan B., Shetye S. R. “The Great Tsunami of 26th December, 2004: A description based on tide – gauge data from the Indian Sub continent and surrounding areas”, *Earth Planets Space* 58, 211-215, 2006.
- Shetye S. R., Nagarajan B., “Source Region of the 26th December, 2004 Tsunami and Indian Tide Gauge Records”, *S.P. Nautiyal memorial Lecture in Wadia Institute of Himalayan Geology*, 2006.