



Envirtech Deep Sea Tsunamis Alarm System

Development of an operational tsunameter was an extraordinary engineering accomplishment. The task was to design, develop, test, and deploy real-time reporting, deep-ocean instrumentation capable of surviving a hostile ocean environment while performing with the quality and reliability demanded of an operational tsunami warning system.

How to measure Tsunamis

Many technologies has been tested in the past 15 years to measure Tsunamis in deep sea. At present the best way known to detect a tsunami is to measure very accurately water pressure on the sea bottom.

Pressure Gauge -

The pressure acquisition station is a critical component of the tsunameter system and includes an ultrastable, high precision, high accuracy, pressure depth Sensor, a computer, a data logger and an acoustic modem to communicate with surface buoy. The remarkable performance of depth sensor is achieved through the use of Paroscientific 8000, a Precision quartz crystal resonator whose frequency of oscillation varies with pressure-induced stress. A quartz crystal temperature signal is provided to thermally compensate the calculated pressure and achieve high accuracy over a broad range of temperatures. The depth sensors include waterproof housings with integral shock protection buoy.

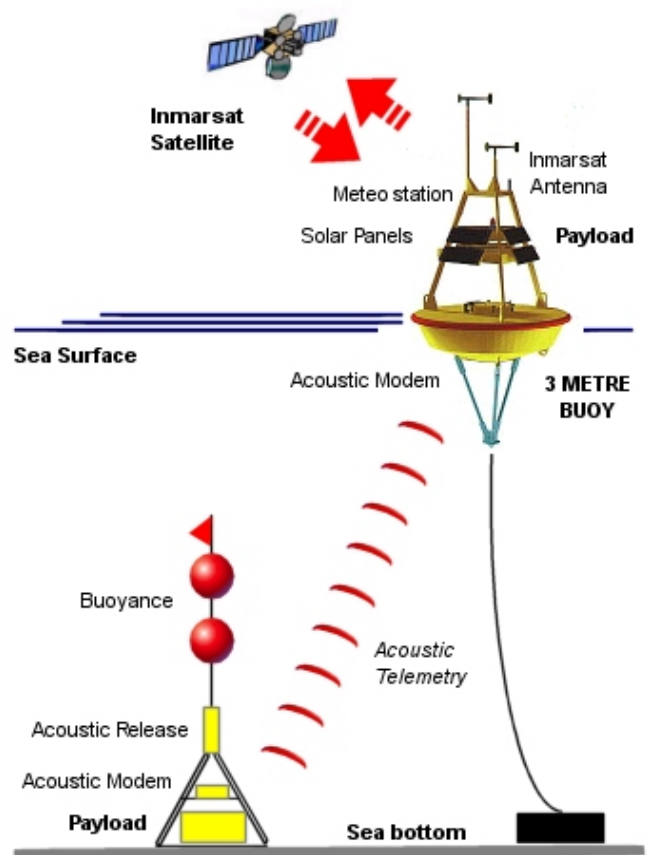
Tsunami Detection Algorithm

Each deep sea station is designed to detect and report tsunamis on its own, without instructions from land. The tsunami detection algorithm in the gage's software works by first estimating the amplitudes of the pressure fluctuations within the tsunami frequency band and then testing these amplitudes against a threshold value.

How the system works

System consists of an anchored seafloor bottom pressure transducer and a companion moored surface buoy for real-time communications. A powerful acoustic spread spectrum modem

transmits data from the submerged platform to the surface buoy. The data are then relayed via Inmarsat-C satellite link to Land stations, which forward the signals for immediate dissemination to Warning Centers.



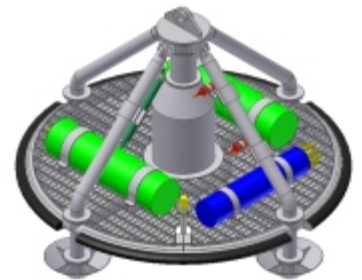
Inmarsat EGC Warning Bulletins

Control Center dispatches three kinds of Tsunami Bulletins, via Inmarsat-C, ECG Fleetnet - SafetyNET and/or via Navtex. *Alert Bulletin* as soon as detected superficial water seismic waves. *Alarm Bulletin* as soon as detected Tsunami Waves, *END Bulletin* when no more Tsunami waves has been detected within 4 hours -.

Technical Specifications

DS - Deep Sea Station

Shape	Dish F 2200 mm High 1400 mm		
Weight out of water	In air 420 Kg, in water 278 Kg, Typical Ballast 300 Kg		
Instruments cage	TITANIUM		
Max deployment depth	Max 6,000 meters - Typical 3000 meters		
Maintenance Interval	1 years to 3 years depending on battery package		
Pressure gauge	Paroscientific 8000		
	Accuracy	0.01 % FS	
	Resolution	0.0001 % FS	
Processor	Architecture	32 bit	Low consump.
	Ram	384 Kbyte	Expandible up to 1024 Mb
	Flash Eprom	1.024 Kbyte	
Acoustic Telemetry	Modulation Acoustic Spread Spectrum		
	Acoustic Link	8,500 bps	
	Bit Error rate	$< 10^{-9}$	
	Operating Frequency	12.75 to 21.25 KHz	
Datalogger	NVRAM	1 Gbyte	
Acoustic Release	Operating Frequency	12.50 to 14.50 KHz	
Optional Pay-Load	Seismic instrumentation, ADCP, Chemical Gauges.		



RB - Relay Buoy

Dimensions	Diameter 3 meters x 3.4 meter high		
Weight	1,500 Kg		
Power Supply	Solar Cells		
Satellite Telemetry	Inmarsat mini-C with embedded GPS		
Acoustic Telemetry	Modulation Acoustic Spread Spectrum		
	Acoustic Link	8,500 Bps	
	Bit Error rate	$< 10^{-9}$	
	Operating Frequency	12.75 to 21.25 KHz	
Pay-Load	Wind speed/direction - Barometric pressure - Air Temperature - Water temperature. Optionals: solid state package for directional waves measuring, ADCP, Chemical Gauges.		



CC - Control Center

Fault Tolerant Cluster	Doubled Bi-Processor Pentium Server, 1 GB Ram - 100 GB Raid 5 - Ultrawide SCSI Redundant - Double UPS - 19" RACK mounted - Windows 2003 SQLServer 2000 - Application software for LES connection and alarm management
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XDSL or Inmarsat B-GAN	Fucino Inmarsat LES Connection for users in Indian Ocean Region or AOR-E
Inmarsat EGC FleetNET	Tsunami Bulletins dispatched via EGC Fleetnet SafetyNET - NAVTEX



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