AN INNOVATIVE TSUNAMI DETECTOR OPERATING IN TSUNAMI GENERATION ENVIRONMENT

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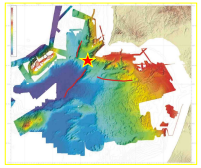
On August 25th 2007 a tsunami detector installed onboard the multi-parameter observatory GEOSTAR was successfully deployed at 3200 b. s. l. in the Gulf of Cadiz, Portugal. This activity is within the NEAREST EC Project (http://nearest.bo.ismar.cnr.it/). Among other deliverables, the NEAREST project will produce and test the basic parts of an operational prototype of a near field tsunami warning system. This system includes an onshore warning centre, based on the geophysical monitoring networks which are already operating, and a tsunami detector installed on board GEOSTAR. On land the warning centre is in charge of collecting, integrating, and evaluating data recorded at sea. At the sea bottom, data are recorded and processed by an advanced type of tsunami detector which includes a pressure sensor, a seismometer and two accelerometers. The detector communicates acoustically with a surface buoy in two-way mode. The buoy is equipped with meteo station, GPS and tiltmeter and is connected to a shore station via satellite dual-link. The prototype is designed to operate in tsunami generation areas for detection-warning purpose as well as for scientific measurements. The tsunami detector sends a near real time automatic alert message when a seismic or pressure threshold are exceeded. Pressure signals are processed by the tsunami detection algorithm and the water pressure perturbation caused by the seafloor motion is taken into account. The algorithm is designed to detect small tsunami waves, less than one centimetre, in a very noisy environment. Our objective is to combine a novel approach to the tsunami warning problem, with a study of the coupling between the water column perturbations and sea floor motion, together with the long term monitoring of geophysical, geochemical and oceanographic parameters.

Gulf of Cadiz NEAREST Pilot Experiment



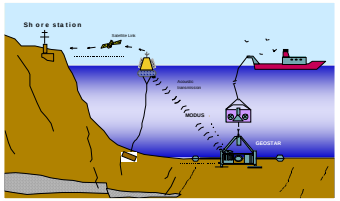
The Gulf of Cadiz is a highly populated area, prones to devastating earthquakes and tsunamis (e.g., 1755 Lisbon earthquake)

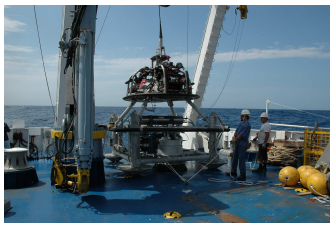
More than ten years of geological and geophysical investigations offshore SW Iberia have been collected (multibeam bathymetry, side-scan sonar, high-resolution and multichannel seismics, and sampling which probed the first kilometres of the upper crust at various resolution) .

Recognition and mapping of active tectonic structures likely to generate large earthquakes and tsunamis have been performed.

The Tsunami Detector

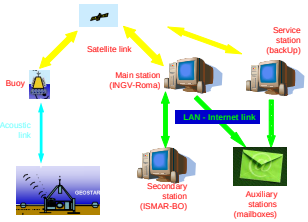
The tsunami detector is capable of real time recognition and transmission of sea water anomalies and seismic signals to shore stations. The new Tsunami detector (green labels in the sensors table), is installed onboard the pre-existent GEOSTAR multiparameter abyssal observatory, that can collect a wide variety of different geophysical and oceanographic data.





Sensor	rate	Acquisition
Triaxial broad band seismometer	100Hz - 3 comp. (0.016-100 Hz f.r)	Continuous + triggered events
Triaxial accelerometer	100Hz - 3 comp.	Continuous + triggered events
Hydrophone	100Hz	Continuous
Pressure sensor	15sec or 1-5 sec	Continuous
Accelerometer +Gyros (Seascrave pendule)	100Hz - 6 comp. (0.3 mg at 2g)	Only on triggered events
Gravity meter	1Hz	Continuous
CTD + Transmissometer	1smp/hour	Continuous
ADCP	1profile/hour (40 layers/3 comp.)	Continuous
Currentmeter	5Hz	Continuous

Near real time Communication scheme



Tsunami Detector Messages

Type of messages	Available information
Periodic (every 6 hours)	Sea level (sample @ 1 hour average) / meteo data / mission status
Event (seismic – pressure, every 10 minutes in case of trigger)	Time of event, pressure data (samples @15 sec average)

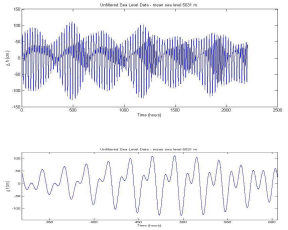
Tsunami Detection Procedure

It is based on trigger on pressure and seismic events

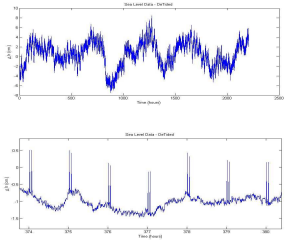
- Seismometer: trigger on local strong eartquakes (STA/LTA)
- Pressure: detection of sea level anomalie (Tsunamis wave) → : trigger on processed sea level data compared to the assigned threshold

The real time Tsunami Detection Algortihm processing sequence is:

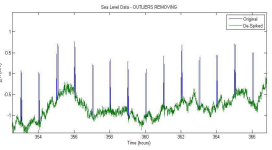
noisy data example: d165_2001-ed.dat (DART courtesy, data and zoom)



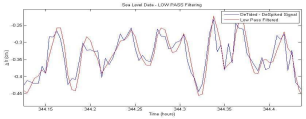
1. Tides Removing (data and zoom)



2. Spikes Removing (zoom)

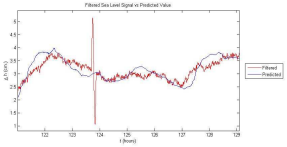


3. Low pass like Filtering (zoom)

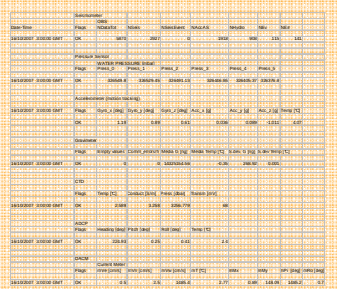


4. Example of difference between Newton Linear Predicted and Filtered Signal:

(zoom, syntethic Tsunami wave inserted: 10 min. period 2 cm. amplitude



Example of GEOSTAR periodic message



On October -19- 2007 at about 2 a.m. GMT we had a main failure on the buoy cable (clean break, may be cut). The buoy will be re-deployed as soon as possible.

REFERENCES

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