NEAREST

WP4
Tsunami signal detection
Leader: INGV

Davide Embriaco[1], Laura Beranzoli[1], Francesco Chierici[2], Paolo Favali [1], Giuditta Marinaro[1], Luca Pignagnoli[3], Nevio Zitellini[3]

[1] INGV, [2] IRA-INAF, [3] ISMAR-CNR

NEAREST Meeting
17-18 May, 2007 - Lisbon

Summary

- General on WP4 and WP Tasks
- Part 1: status of the WP activities (Tasks 4.1, 4.2) (INGV)
- Part 2: Tsunamis Detection Algorithm (CNR-ISMAR, IRA-INAF)

WP4 - Tsunami signal detection

Objectives

The WP is aimed at carrying out geophysical and oceanographic measurements on the seafloor and in the water column in the nearby of near-shore tsunamigenic sources for the identification of tsunami signals.

The seafloor and water column measurements will be performed by means of GEOSTAR, a deep seafloor multiparameter observatory developed in previous EC projects. GEOSTAR will transmit essential parameters of the measurements to shore in real-time.

Task 4.1 Definition of sensor requirements and sensor selection; requirements of the detection software (e.g., detection algorithm, triggering threshold, messages).

Task 4.2 Design and development of modifications (e.g., sensor supports of the frame); design and development of the software.

Task 4.3 Integration of new sensors/devices and new software in the seafloor observatory, tests of the functionality in laboratory.

Task 4.4 Preparation planning and implementation of a long-term (about 1 year) mission; cruises for deployment and recovery.

Task 4.5 Data back-up, quality checks, preparation of the data base to be integrated with other data; pre-analysis of 'parent' tsunami signals.

WP4 Deliverables

m 4	D10	definition of sensors', software requirements for the deep-sea platform
m 8	D11	detailed design for the integration of new sensors and device in the deep-sea platform
m 11	D12	integration of new sensors, test of functionality of the deep-sea platform
m 11	D13	deployment procedure for the deep-sea platform
m 12	D14	deployment cruise of the deep-sea platform and cruise report
m 24	D15a	recovery cruise of the deep-sea platform and data quality checks
m 24	D15b	cruise report

Partners involved WP4

ISMAR BO	FFCUL	CSIC	AWI	UBO	INGV	TFH	UGR	IM	CNRST	XISTOS
H	H	M	M		Leader	H	H	M		

ISMAR-BO. FFCUL, CSIC → marine site selection and characterisation for the pilot experimenton the basis of the knowledge of the area

ISMAR-BO → cruises responsible

AWI, UGR, IM → common requirements of sensor sampling rates

TFH → MODUS for the pilot experiment (deployment/recovery)

INGV → Seafloor observatory (GEOSTAR) and communication responsible

1st Year Time scheduling

Planned (DoW)

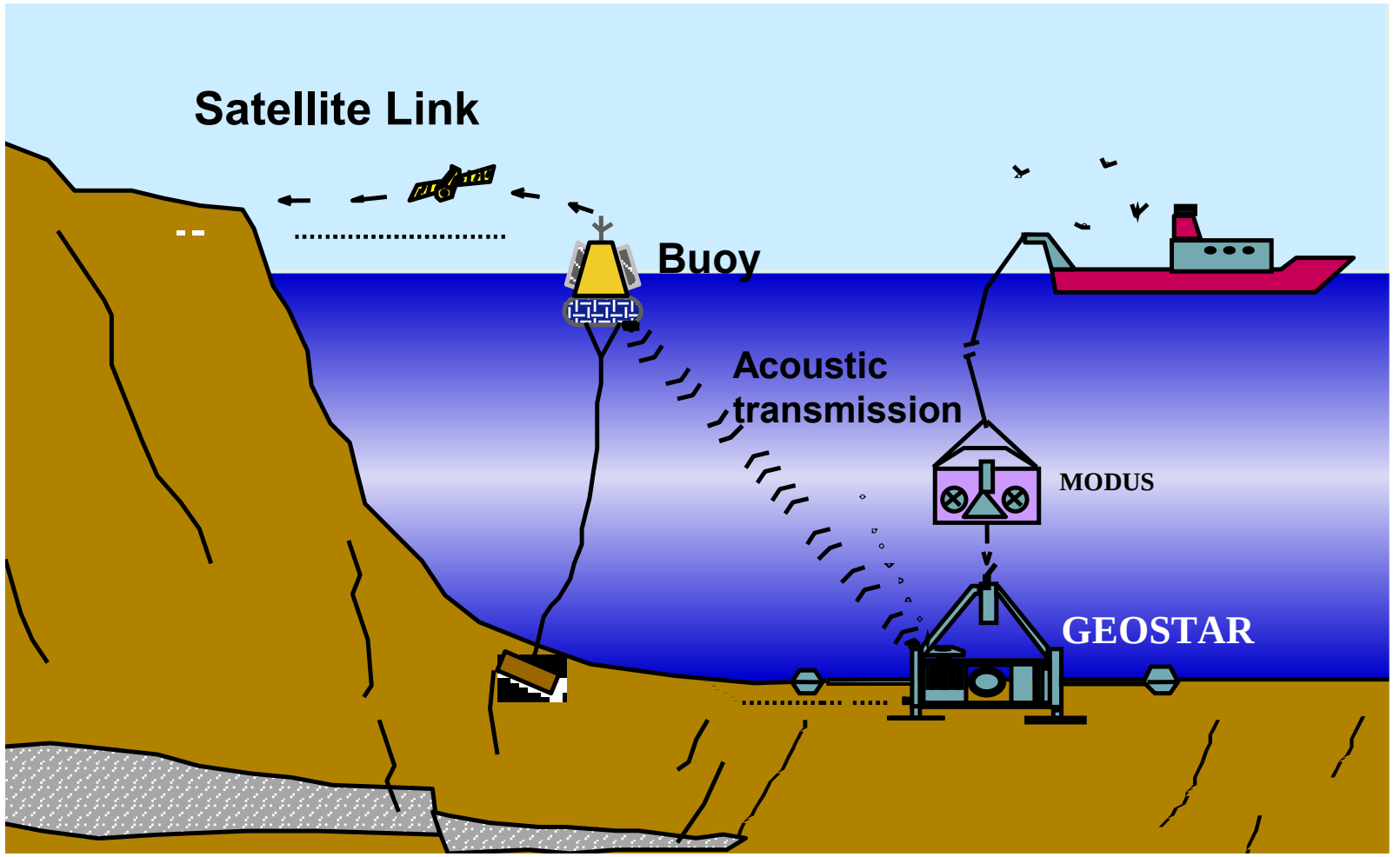
Task											
4.1											
4.2											
4.3											
4.4											
	1	2	3	4	5	6	7	8	9	10	11

Actual

Today

Task											
4.1											
4.2											
4.3											
4.4											
	Oct.	Nov.	Dec.	Jan.	Feb	Mar.	Apr.	May	Jun.	Jul.	Aug.

Experiment overview



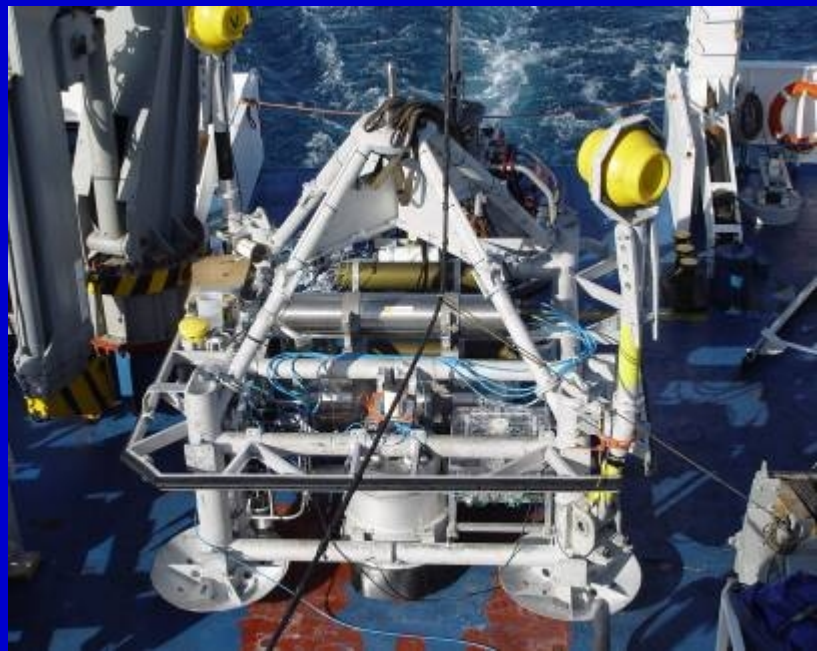
GEOSTAR

Tasks

- Scientific multiparametric data acquisition on relevant seismic source site
- Nearly real time warning event (seismic and sea level) identification and notification

The GEOSTAR seafloor observatory will be equipped with

- sensor packages
- data acquisition, control unit
- data processing
- local memory storage
- acoustic communication system (towards sea surface buoy)



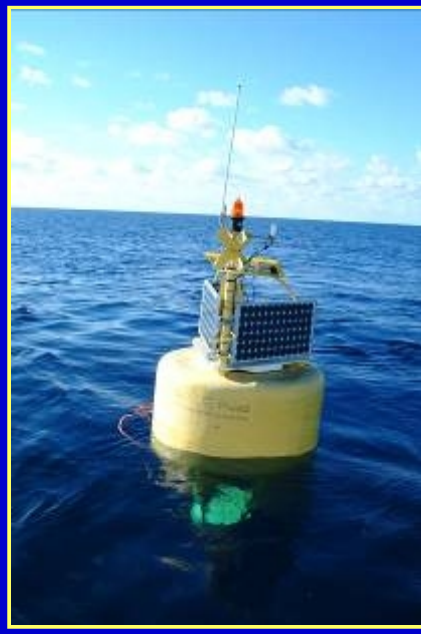
Sensor requirements

Sensor	rate	Acquisition
Triaxial broad band seismometer	100Hz - 3 comp.	Continuous + (decimated) triggered events
Triaxial accelerometer	100Hz - 3 comp.	Continuous + (decimated) triggered events
Hydrophone	100Hz	Continuous
Pressure sensor	15sec	Continuous
accelerometer+Gyros (Structure attitude)	100Hz - 6 comp.	Only on triggered events
Gravity meter	1Hz	Continuous
CTD + Transmissometer	1smp/hour	Continuous
ADCP	1profile/hour (40 layers/3 comp.)	Continuous
Currentmeter	5Hz	Continuous

Buoy

Tasks

- allows communication between GEOSTAR and shore stations (notification of possible tsunamis events)
- detects meteo data



The buoy is equipped with:

- acoustic communication system (towards seafloor station)
- satellite communication system (towards shore stations)
- meteo station

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 anomalies (Tsunamis wave) → details in the PART 2 of presentation (ISMAR)

Sensors

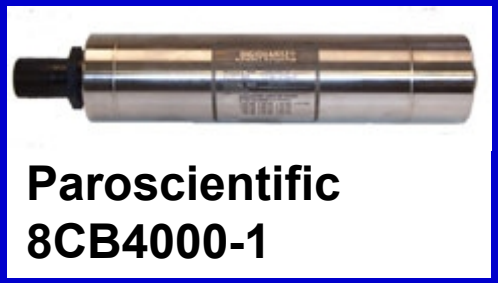
Sensor	rate	MODEL
Triaxial broad band seismometer	100Hz	Guralp CMG-40
Triaxial accelerometer	100Hz	Guralp CMG5-T
Hydrophone	100Hz	OAS E-2PD
Pressure sensor	15sec	Paroscientific 8CB4000-1
Accelerometer+Gyros (IMU)	100Hz	Gladiator Technologies Landmark 10
Gravity meter	1Hz	IFSI (INAF) Prototype #2
CTD + Transmissometer	1smp/hour	SeaBird SBE 16 plus Wet Labs ECO-BBRTD 6000m
ADCP	1profile/hour	RDI Workhorse 300 Khz
Currentmeter	5Hz	Nobska MAVS-3

Sensors


Accelerometer
Guralp GMG 5T


Guralp
CMG-40

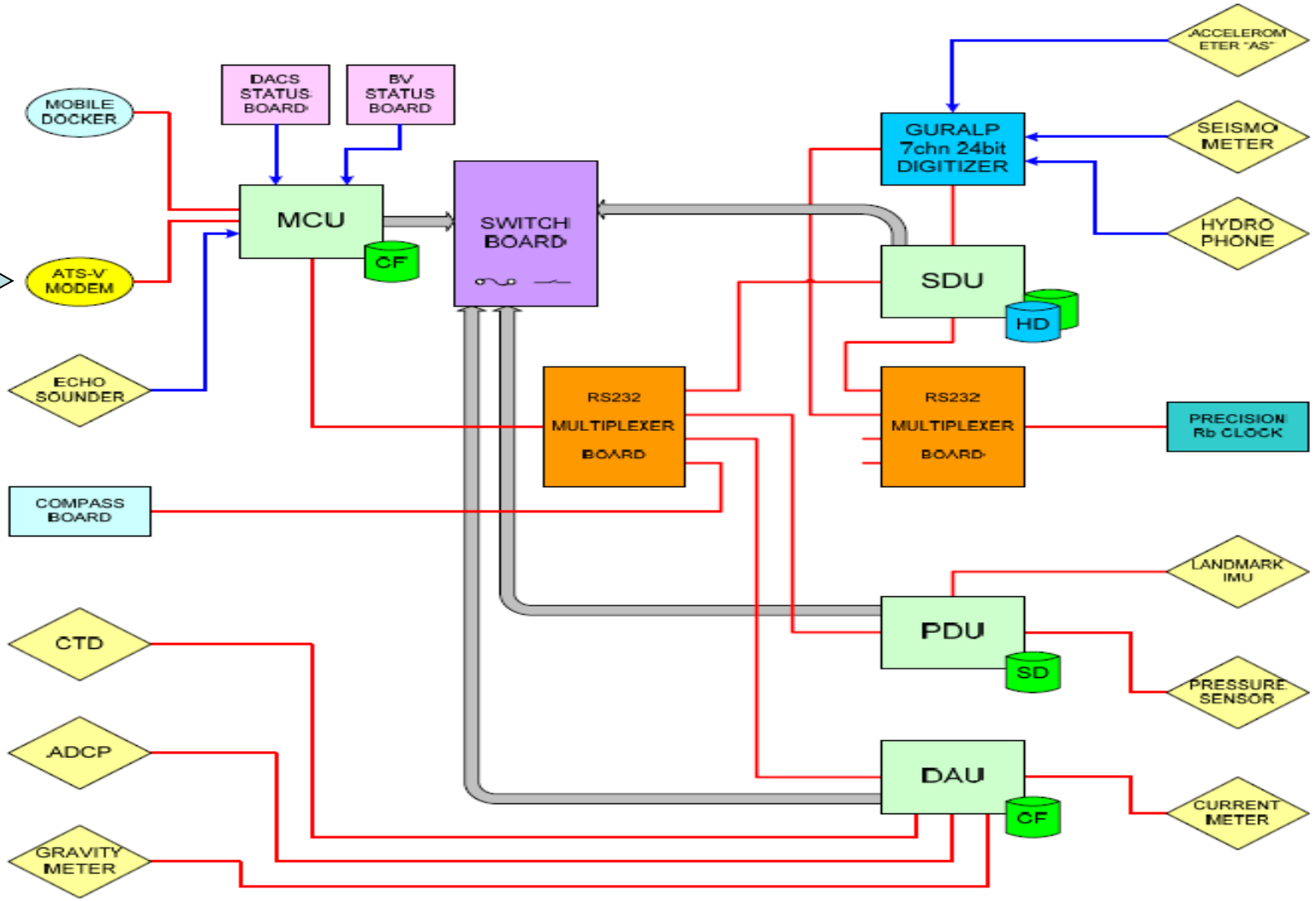

Gladiator
Pitch
Yaw
Roll
Landmark IMU
Accelerometer
+ Gyros (IMU)


Paroscientific
8CB4000-1


Hydrophone

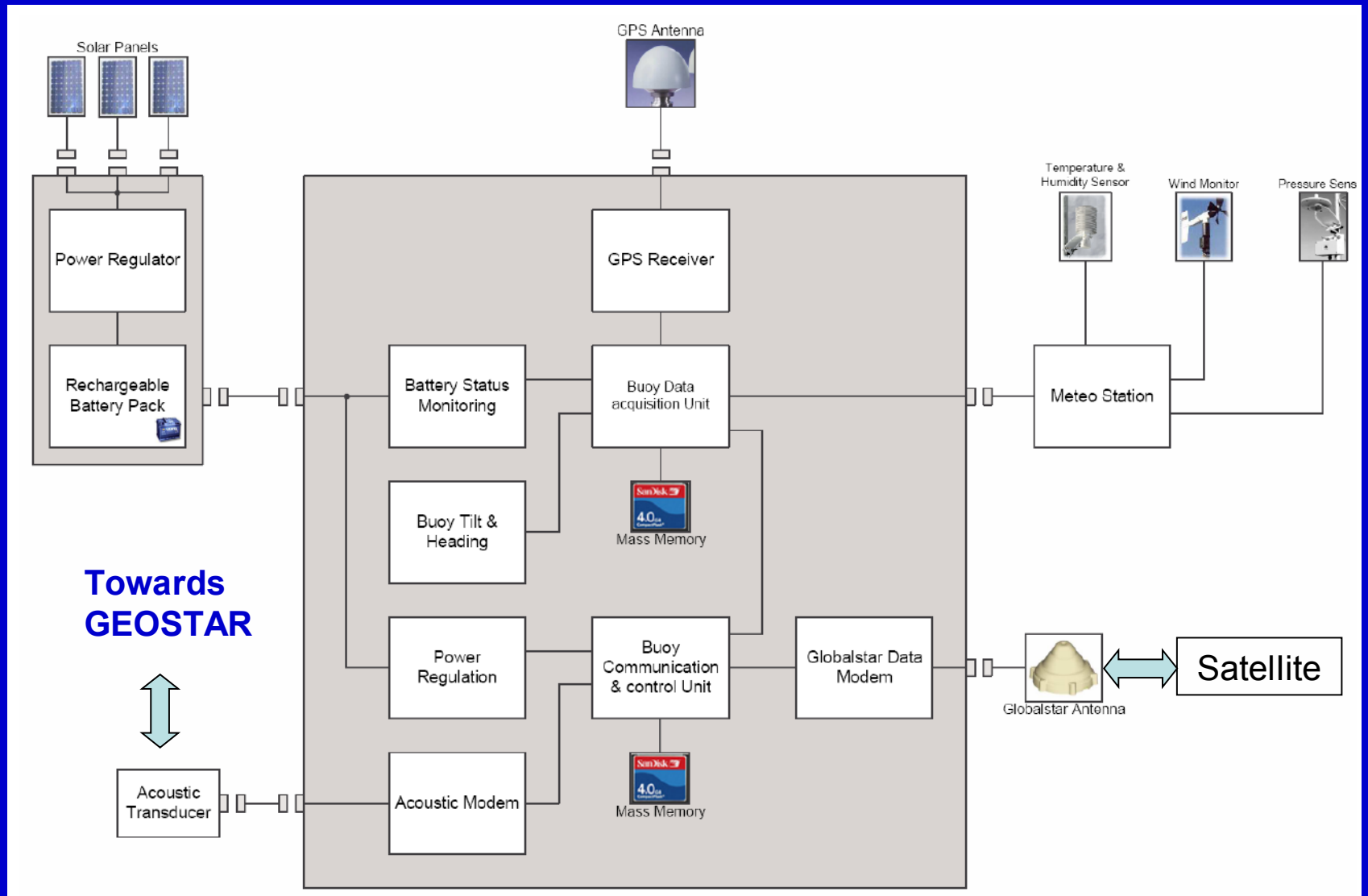
GEOSTAR layout

Towards the surface buoy



Tecnomare

Buoy layout


Solar Panels
GPS Antenna
Power Regulator
Rechargeable Battery Pack
GPS Receiver
Battery Status Monitoring
Buoy Data acquisition Unit
Buoy Tilt & Heading
Mass Memory
Power Regulation
Buoy Communication & control Unit
Globalstar Data Modem
Acoustic Transducer
Acoustic Modem
Mass Memory
Temperature & Humidity Sensor
Wind Monitor
Pressure Sens
Meteo Station
Globalstar Antenna
Satellite
Towards GEOSTAR

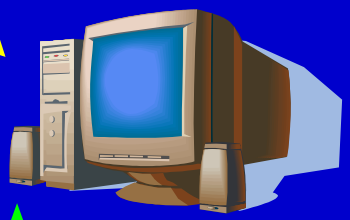
Real time Communication scheme

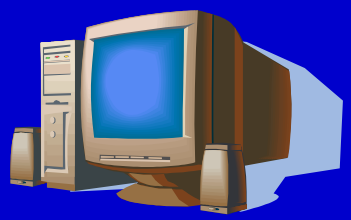
Satellite link

Service station (backUp)

Buoy

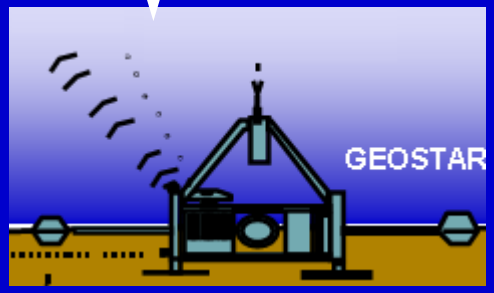
Main station (INGV-Roma)

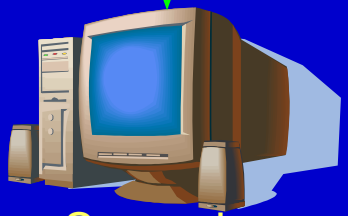




Acoustic link

LAN - Internet link





Secondary station (ISMAR-BO)

Auxiliary stations (mailboxes)

Messages/data availables

Type of messages	Available information	Direct Recipients
Periodic	Sea level/meteo data/mission status	INGV-
Event (seismic - pressure)	Time of event, pressure data (samples @15 sec)	All partners (nearly real time via e-mail)
End of mission	All sensor data	NEAREST partners

Partners must supply a valid e-mailbox

Message to auxiliary stations (Mailboxes)

Content

Message of Event notification:

- **Event classification (seismic or pressure)**
- **Starting time of the event**
- **Pressure value which overcame the threshold (in case of pressure event)**
- **Barometric pressure value (detected by the buoy meteo station)**

During event mode one message every 10 minutes (for 1-2 hours):

- **Pressure data (1 sample every 15 s for the last 10 minutes)**

Work now in progress (m 8) - (task 4.3)

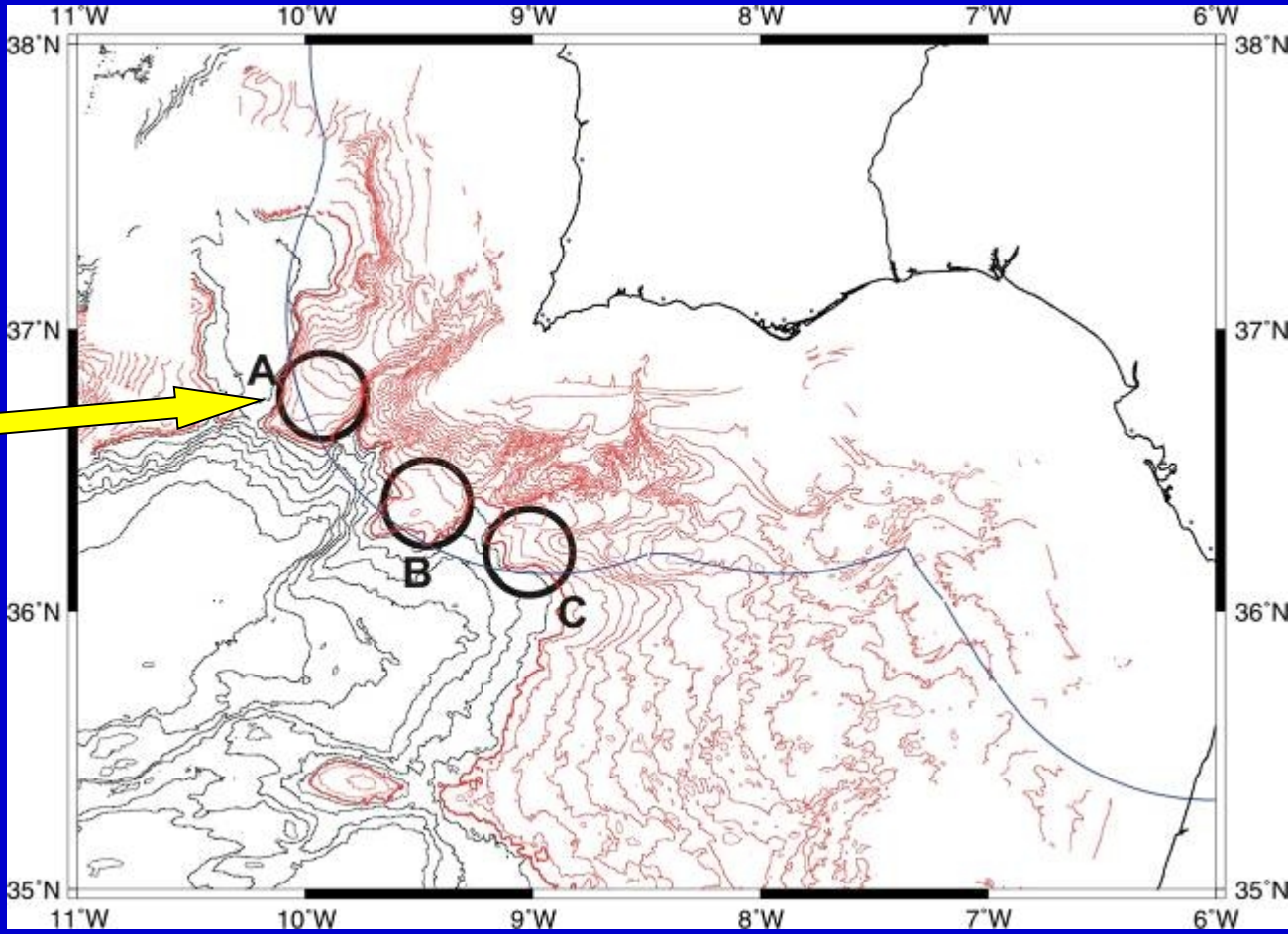
- Implementation of program code for Tsunami Detection Algorithm
- Further Test of TDA on available sea levels data and synthetic tsunamis signals
- Integration of the new GEOSTAR and buoy configuration
- Tests of selected sensors

Mission scheduling

From 10 Aug : r/v Urania (CNR-ISMAR)

NOTE: The mission is anticipated with respect to scheduled time (1 month) !

GEOSTAR deployment in the selected site (A)



Work to be done before the experiment

- Detailed identification of deployement location: input from WP1 (Tsunami source identification) and WP2 (Tsunami source characterisation) before end of July (!)
- Planning of the deep sea long-term (1 year) mission: deployement procedures, cruise mission with R/V Urania and recovery (task 4.4)

PART 2:
Tsunami Detection Algorithm

To be Discussed

- Auxiliary stations mailboxes
- Details on deployement site
- Indication on seismic threshold (STA/LTA) to be used
- Pressure threshold for TDA