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## NEAREST

Integrated observations from NEAR shore sources of Tsunamis:  
towards an early warning system

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## **NEAREST**

**(INTEGRATED OBSERVATIONS FROM NEAR SHORE SOURCES OF  
TSUNAMIS: TOWARDS AN EARLY WARNING SYSTEM)**

<http://nearest.bo.ismar.cnr.it>

**WP 4 - Tsunami signal detection**

**Buoy Operation report  
(October, 17 – 21, 2007; November, 23- 27, 2007)**

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## Content

1. Off-shore buoy operations (16-21 October).....	3
1.1 Purpose.....	3
1.2 Operations performed .....	3
2. On-shore operations (23-27 November) .....	9
2.1 Purpose.....	9
2.2 Operations performed: buoy disassembling and storage .....	9
2.3 Operations performed: acoustic release tracking of the mooring .....	11

## List of figures

Fig. 1 - Buoy test configuration answer (from HMI to buoy) .....	5
Fig. 2 - GEOSTAR DACS status answer .....	6
Fig. 3 - Underwater Acoustic Modem status answer .....	6
Fig. 4 - Configuration file correctly received by GEOSTAR .....	7
Fig. 5 - Time out received indicating no answer from GEOSTAR acoustic modem .....	7
Fig. 6 - The NEAREST buoy in the dock in Faro (November, 23 <sup>rd</sup> ).....	9
Fig. 7 - The stainless steel cable; detail of the bottom of the mooring system of the buoy.....	10
Fig. 8 - Operations for disassembling and long term storage of the buoy .....	10

# 1. Off-shore buoy operations (16-21 October)

## 1.1 Purpose:

The main purpose of the cruise mission around the GEOSTAR deployment site is to restore the electronics of the buoy after a new calibration of the acoustic communication system made by Tecnomare (buoy set-up developer) and Sercel (acoustic system supplier).

A secondary scope of the mission was to control of the GEOSTAR observatory mission status and eventually, depending upon the control outcome, to reconfigure the mission parameters with special regards to those related to the seismic event detection (STA/LTA seismic parameter and deliver of periodic and event messages).

## 1.2 Operations performed

The planned off-shore operations included:

- to find a ship to reach the GEOSTAR and buoy deployment site
- to develop the operation on the buoy for the restoration of the electronics
- to control the GEOSTAR mission status.

The record of the operations on a day basis is reported below.

October, 16 <sup>th</sup> :	at the arrival of the equipment in Lisbon, the electronics of the buoy was successfully checked; the buoy system was set in mission mode. People and equipment moved to Lagos.
October, 17 <sup>th</sup> :	The cruise for off shore operations on the buoy and GEOSTAR started. During the buoy operation continuous communication with Tecnomare engineers in Italy were guaranteed by Iridium satellite communication. In particularly all inquiring operation towards the GEOSTAR observatory via the acoustic surface communication unit were made assisted by phone contact with Tecnomare engineers. In the following table a detailed and referenced time list of the performed operations is reported:
UTC time	
9:00	Leaving from Lagos with the ship, 2 crew members and 3 INGV personnel units (Embriaco, Viezzoli, Lagalante)
12:00	Arrival on the buoy site
12:10	Activation of on-board acoustics to check periodic message issue
12:18	Periodic message from GEOSTAR clearly received from the surface acoustic unit
12:30	Operations to re-install the communication system on the buoy starts
13:40	End of installation of the electronic of the buoy
14:10	starting operation to monitor GEOSTAR status (on the vertical of GEOSTAR, distance aprox. 40 m)
14:15	DACS status command send from surface unit and answer correctly received
14:17	Inquiry to GEOSTAR to send Event Messages of: 5 Oct. 20:00 UTC 12 Oct. 03:00 UTC 06 Oct. 13:00 UTC 09 Sept. 03:00 UTC

	GEOSTAR correctly answered, but none Event Messages did not evidenced any event
14:35	Inquiry to GEOSTAR to send Data Messages of: 9 Sept. 03:00 UTC 16 Oct. 03:00 UTC All those messages were correctly received
14:39	ATS-V-USS parameter status request; Transmission time used was found to be 47 min.
	Inquiry to GEOSTAR to send Event Messages of: 30 Aug. 12:00 UTC GEOSTAR correctly answered, but the event was not found;
	Inquiry to GEOSTAR to send Status messages of: 15 Sept. 12:00 UTC GEOSTAR correctly answered and the message was correctly received; GEOSTAR was found in Pressure EVENT mode at 12:00 of 15 Sept. 07 (MCU in EVENT, PDU in EVENT, SDU in MISSION)
14:50	Setup of the new configuration file for GEOSTAR mission, according to the defined procedure (STA/LTA threshold) and real time instructions from INGV site in Rome (periodic messages delivery): <ul style="list-style-type: none"> <li>STA/LTA threshold set to 12.0</li> <li>Periodic messages are enabled with release time of one every 6 hours (as defined at the start of the mission in August)</li> <li>Event message are enabled.</li> </ul> <p>The configuration file is saved and re-opened from the HMI interface in order to check that it was correctly setup. Parameter of configuration were checked with Tecnomare engineers.</p> <p>According to the defined procedure,</p> <ul style="list-style-type: none"> <li>the command GO IDLE was sent to GEOSTAR and it correctly answer;</li> <li>Inquiry to retrieve DACS status (all board were expected to in idle mode): GEOSTAR correctly answers;</li> <li>Configuration file sent to GEOSTAR: GEOSTAR correctly answers;</li> <li>Sent “reset MCU” command to GEOSTAR: GEOSTAR correctly answers;</li> </ul>
15:00	Following Tecnomare suggestions, we move from 1.1 Km distance from the GEOSTAR site to the vertical closest distance
15:15	Again on the GEOSTAR vertical
15:18	Send GO MISSION command to GEOSTAR
15:22	Time out from ATS V SSS message received, no acoustic answer was hear
15:24	Send GO MISSION command to GEOSTAR again (ship at 120 m from the vertical)
15:26	Time out from ATS V SSS message received, no acoustic answer was hear
15:31	Request ATS V USS parameter (Upload All)
	We move toward the previous position near the buoy
16:05	Near the buoy (870 m from the vertical) : LAT 36° 21' 39.96 “ N, LON 9° 29'24.69” W
16:08	Upload ATS V USS parameter command sent; no answer from the GEOSTAR modem
	Stand by. Tecnomare engineers are performing communication test with the buoy from Italy via satellite link.
	Following Tecnomare suggestions:

	Sent “set power max” command to the ATS V USS unit: no answer from ATS V USS
	Sent “modulation set” command to the ATS V USS unit: no answer ATS V USS
	No more messages from GEOSTAR ATS V USS unit to any command sent since 15:00 UTC were received.
17:00	Departure from GEOSTAR deployment site in the direction of Lagos
21:30	Arrival in Lagos
October 18 <sup>th</sup> :	Because of the unfavourable weather forecast, no more sea operations could be performed. Personnel moved back to Lisbon.

The following figures show the snapshots taken from communication software windows (HMI) ; these snapshots document the operation performed with the surface acoustic unit in communication with GEOSTAR.

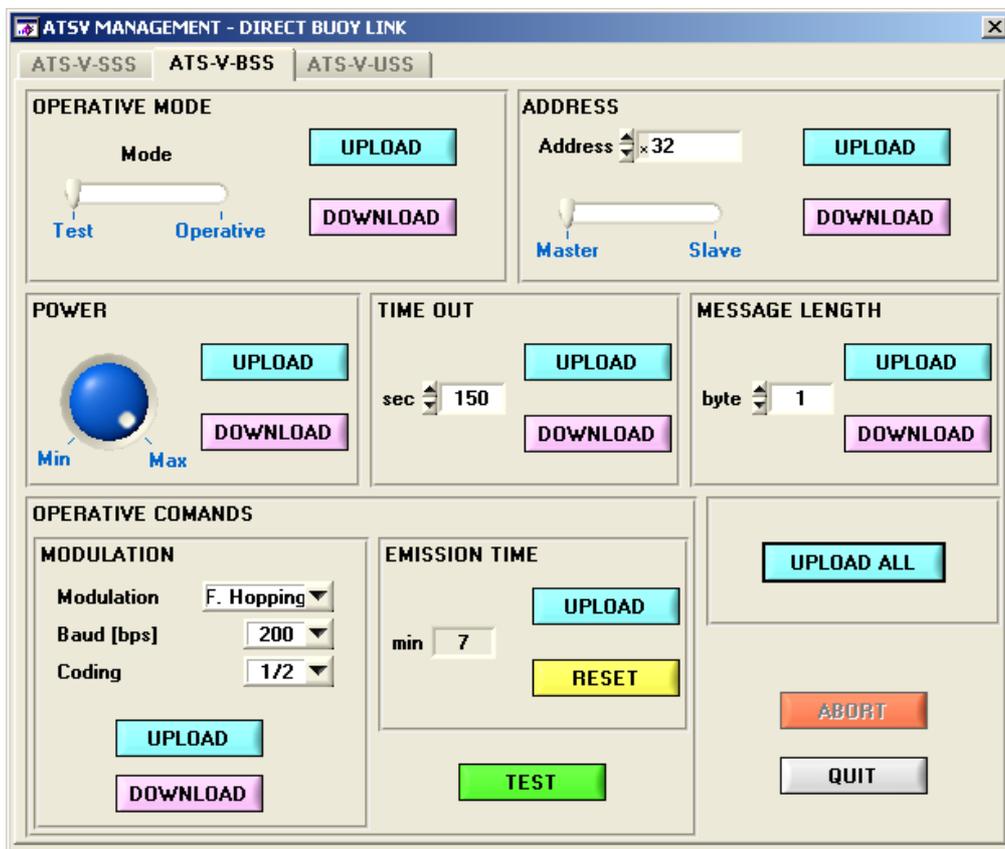


Fig. 1 - Buoy test configuration answer (from HMI to buoy)

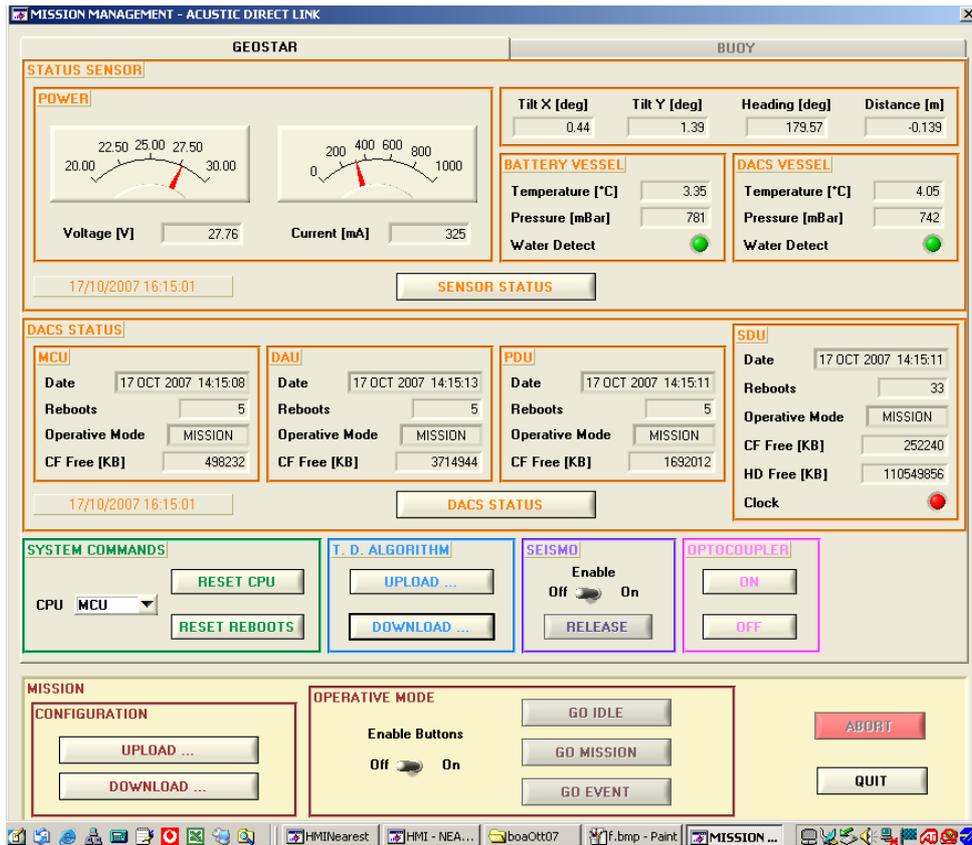


Fig. 2 - GEOSTAR DACS status answer

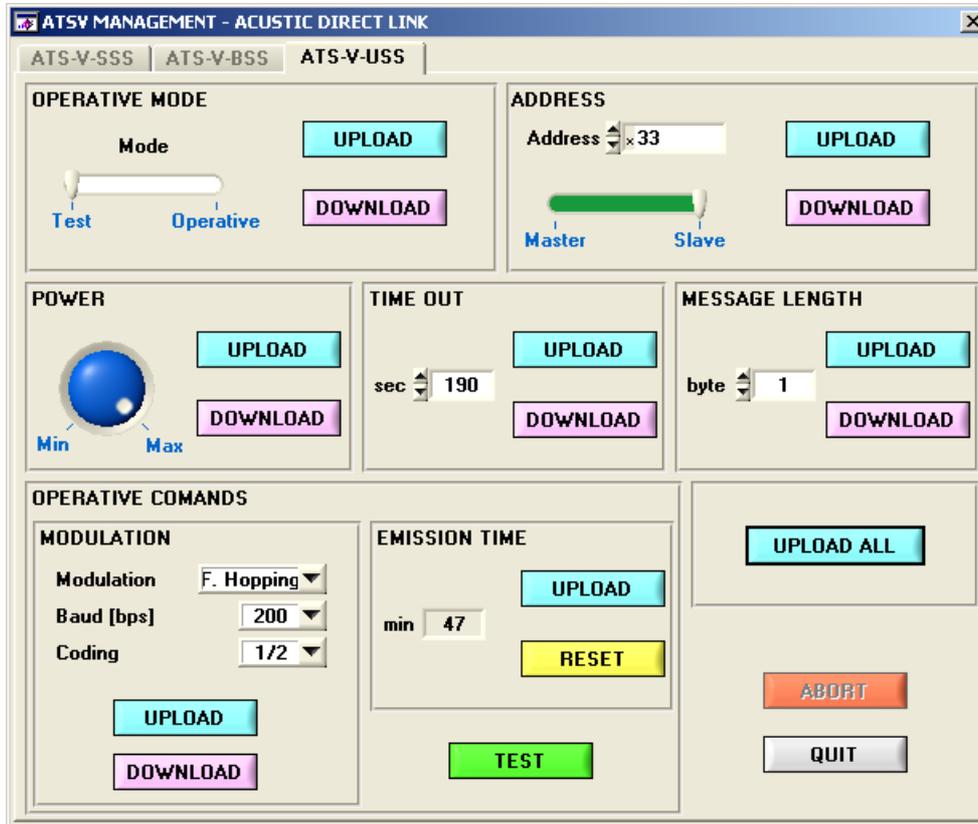


Fig. 3 - Underwater Acoustic Modem status answer

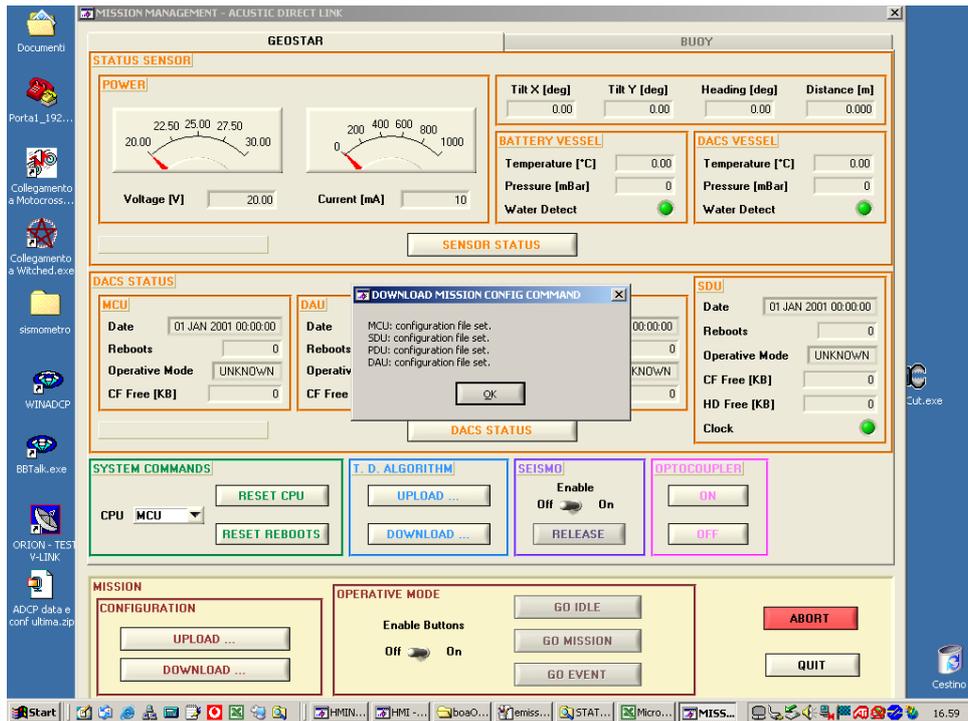


Fig. 4 - Configuration file correctly received by GEOSTAR

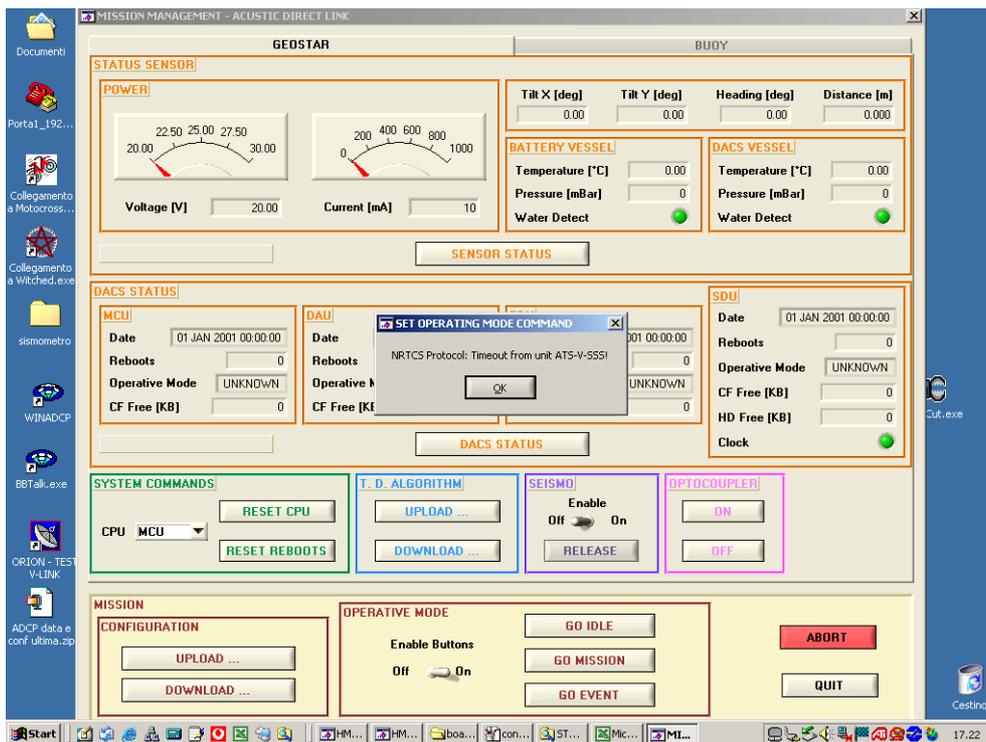


Fig. 5 - Time out received indicating no answer from GEOSTAR acoustic modem

The day after the conclusions of the off-shore operations, an automatic alarm message related to the buoy drift was sent by ARGOS system and received by INGV. Accordingly an extraordinary cruise was urgently arranged to reach the drifting buoy and to recover it.

A record of the operations developed during the extraordinary cruise is reported below.

October 19 <sup>th</sup>	
11.30	INGV personnel, while at Fundação da Faculdade de Ciências da Universidade de Lisboa after a technical operation on the NEAREST boa, received an alarm message from ARGOS regarding the position of the boa outside the tolerance circle.
14.00	The data from ARGOS have been verified by the data from our GPS, installed on the buoy. Both data confirmed that the boa was drifting SW at 1 km/h. The buoy was free floating in direction SW from the mooring position starting from about 3:00 UTC. The Fundação da Faculdade de Ciências da Universidade de Lisboa (Luis Matias) informed the Portugal Navy for the sea security low and also asking a contact of one Rescue Company
17.00	a vessel was found and rented by INGV and 1 INGV logistics expert moved to Lagos harbour to join the vessel.
October 20 <sup>th</sup>	
01.00	The rented vessel, namely Ulisses, left Lagos heading to the buoy position; we had permanent position data by Tecnomare in Italy, able to interrogate the GPS of the buoy.
11.30	Visual contact with the buoy; checking the area for floating rope with negative result.
12.15	buoy hooked, towing to Lagos harbour, slow speed due to sea state .
October 21 <sup>th</sup>	
10.00	alongside a jetty in Lagos, on stand by for the crane to set the buoy on the jetty,
13.00	Buoy on the jetty. The next action planned has been the transport of the boa from Lagos to Faro inside the warehouse that we have used before for the OBS storage.  The visual inspection of the cable suggests that it was cut at the upper side of the ballast weight; the cutting looks very sharp. Possible causes started to be investigated.

## 2. On-shore operations (23-27 November)

### 2.1 Purpose:

The purpose of the on-shore operations in Faro was to recover the electronic devices installed on the buoy and opportunely store the buoy in a warehouse in the Faro dock till new operations for buoy deployment on the GEOSTAR site were planned.

In order to get information on the mooring line location on the seafloor, an off-shore cruise to check the acoustic release status was also planned.

### 2.2 Operations performed: buoy disassembling and storage

On November 23<sup>rd</sup> INGV staff reached the Faro dock where the buoy was temporary stored after the recovery on sea (fig.6) .



Fig. 6 - The NEAREST buoy in the dock in Faro (November, 23<sup>rd</sup>)

The buoy was disassembled with the help of local staff and the use of the dock crane, a fork lift and a caterpillar. The electronic case and satellite antennas were removed, packed and prepared to be shipped to Italy.

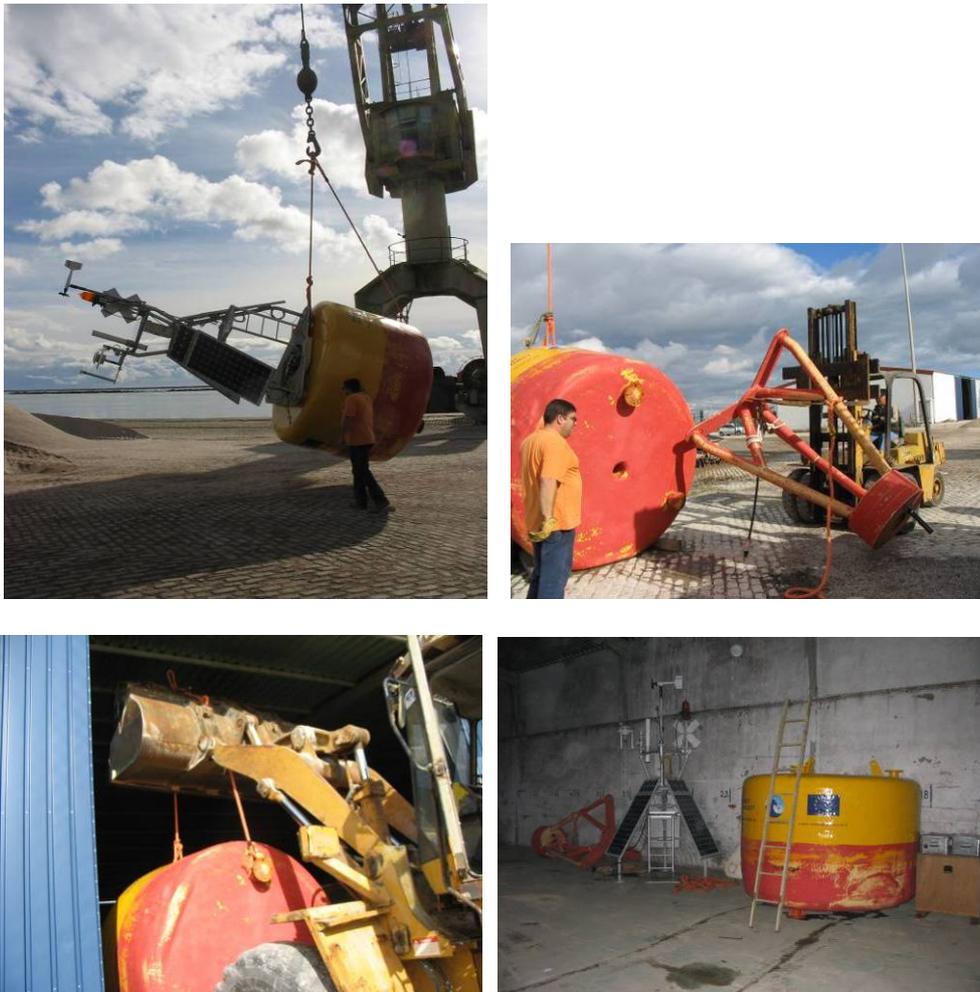
At a visual inspection the stainless steel cable attached to the bottom of the buoy seems to be truncated in the proximity of the bottom ring of the buoy (

Fig. 7).

The stainless steel cable, the electronic box of the buoy and all satellites antennas were shipped to Italy. The buoy was stored in the warehouse.



**Fig. 7 - The stainless steel cable; detail of the bottom of the mooring system of the buoy.**



**Fig. 8 - Operations for disassembling and long term storage of the buoy**

### ***2.3 Operations performed: acoustic release tracking of the mooring***

Taking advantage of the NEAREST OBS cruise planned by AWI in the GEOSTAR deployment area and starting from Portimao on November 27<sup>th</sup>, the interrogation of the acoustic release of the buoy mooring line was performed.

The acoustic release, presently near the death weight of the buoy mooring line, on the sea floor, correctly answered to the acoustic interrogation, thus indicating the possibility to send it successfully the release command. However, given the high probability that the mooring line lies completely on the seafloor, further investigation on suitable techniques and approaches for the recovery of the mooring are needed.