



National Research Council – CNR (ITALY)

Oceanographic infrastructure an overview

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***Central Management for Planning and Infrastructure
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18th ERVO Annual meeting

May 10-12, 2016

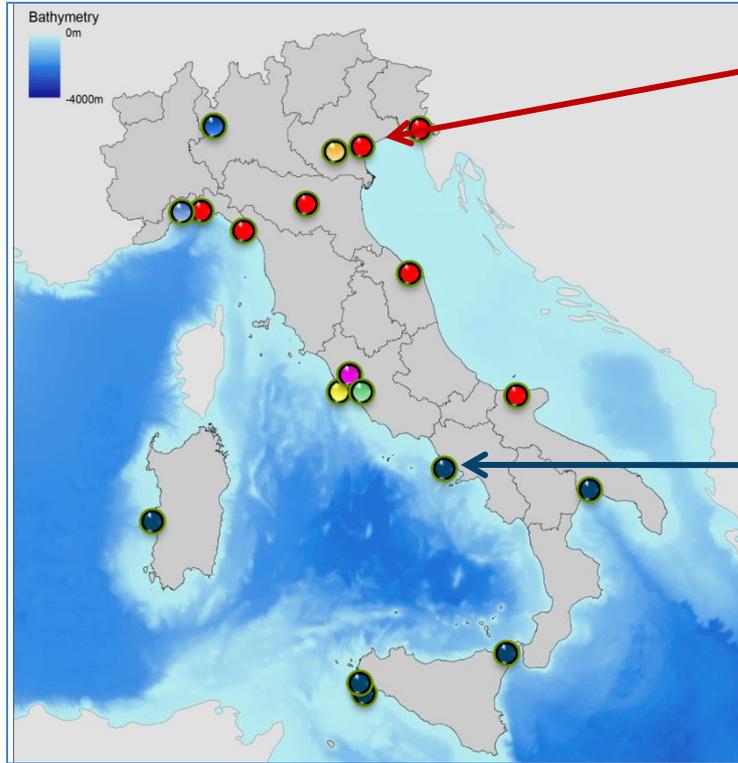
Hellenic Centre for Marine Research, Rhodes Island (Greece)

CNR SCIENTIFIC NETWORK

SCIENTIFIC DEPARTMENTS	INSTITUTES
Physical Sciences and Technologies of Matter	15
Agri-food and Biosciences	11
Biomedical Sciences	19
Earth System Sciences and Technologies for the Environment	12
Engineering, ICT and Technologies for Energy and Transport	20
Humanities, Social Sciences and Cultural Heritage	19
Chemical Sciences and Technologies of Material	13
TOTAL	109
8.195 units of CNR personnel of which 6.822 researchers	



MARINE SCIENCE AT CNR



VENEZIA

- TRIESTE
- GENOVA
- LA SPEZIA
- BOLOGNA
- ANCONA
- LESINA



NAPOLI

- ORISTANO
- TARANTO
- MESSINA
- MAZZARA
- CAPO GRANITOLA



The other Institutes have teams working in: in *marine engineering and naval architecture (INSEAN)*, *remote sensing (ISAC)*, *marine and maritime technologies (ISSIA & IREA)* and *geologic hazard (IGAG & IGG)*

CNR has about 400 researchers who work in the wider area of marine research

CNR “OFFICE FOR PLANNING”

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Central Management for Planning and Infrastructure

Director Dr. Massimiliano Di Bitetto

- It manages the main CNR oceanic research infrastructure
- It is in charge of the scheduling of the oceanographic surveys proposed by CNR researchers
- It coordinates the oceanographic observation system of Platforms, Buoys and long-term mooring stations
- It coordinates national and international cooperation with other organizations



ASSESSMENT PROCESS FOR CRUISES

Jun/July – Aug.

**SHIP TIME
PROPOSALS
APPLICATION**

- Invitation to all Institutes Directors
- On-line procedure for applications

TO BE IMPLEMENTED:

- *Cruise report on-line data base*
- *Shared meta-data for all cruises*

Sept. – Oct./Nov.

**ASSESSMENT OF
PROPOSALS**

- Marine Commission
- Dispatch of proposals to anonymous referees for scientific assessment
- Commission gives final response considering scientific and functional evaluation

Nov. – Dec.

CRUISE PLANNING

- Cruise plan optimization
- Diffusion and adjustments

Feb. – Dec.

**REALIZATION OF
PLANNED CRUISES**

MAIN CNR RESEARCH VESSELS

RV "G. DALLAPORTA"



Main Technical Features

- Category: **Regional**
- Tonnage: 285 Tons
- Length overall: 35.3 m
- Breadth: 7.7 m
- Depth: 4.1 m
- Draft: 3.0 m
- Speed: 11,5 kn
- Drive system: 1100 CV
- Crew: 8 people
- Scientists: 12 people
- Built year: 2001

Years	N. surveys	Days at sea	Average days per survey
2013	26	294	10.5
2014	28	302	10.8
2015	25	310	12.4
2016	28	304	10.9

RV "MINERVA UNO"



Main Technical Features

- Category: **Regional**
- Tonnage: 624 GRT
- Length overall: 47.66 m
- Breadth: 9 m
- Full load Draft: 4.6 m
- Max speed: 12.5 kn
- Average speed: 10.8 kn
- Endurance: 30 days
- Crew: 9 people
- Scientists: 13 people
- Built year: 2003
(upgrading 2010 and 2014)

Years	N. surveys	Days at sea	Average days per survey
2013	3	49	16.3
2014	1	15	15
2015	21	294	14
2016	20	300	15

RV “MINERVA UNO” REFITTING

In 2014 RV “Minerva UNO” underwent an **extensive refitting with interventions on the naval platform and its scientific equipment**, in order to improve and enhance the operational capabilities of the ship on a functional and safety point of view.

NAVAL PLATFORM UPGRADING

- Electricity grid improvements
- More powerful generators to meet new electricity requirements
- Air conditioning system enhancement
- Fuel purification system improvement
- Garbage management system renovation
- Garbage management system renovation
- New bow design to improve seakeeping
- New double seated cabin
- New refrigerators for samples storing
- DP1
- Bow thruster and stern thruster
- Fixed stabilizer fin
- New engine control system

SCIENTIFIC EQUIPMENT RENEWAL

- Ship positioning system
- High resolution bathymorphologic system
- Geomorphic and bottom sampling system
- Magnetometric survey system
- Seismostratigraphic survey system
- Bottom visual inspection system

RV “MINERVA UNO” REFITTING



RV “Minerva UNO” lifted by the crane



The new more powerful
bow thruster



Stern thruster and fixed stabilization fin



RV “Minerva UNO” with the RV
“Urania” new 6 meters section



New bow design of RV “Minerva UNO”

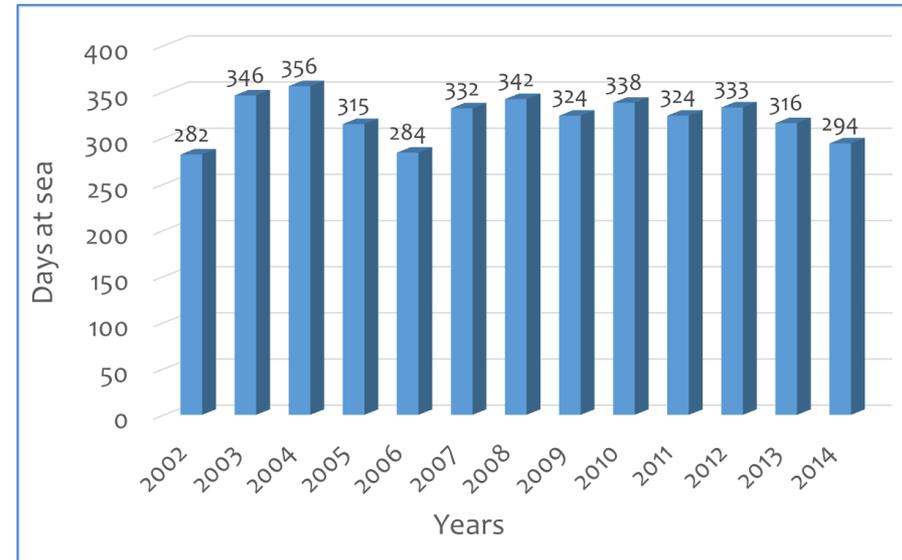
RV "URANIA"



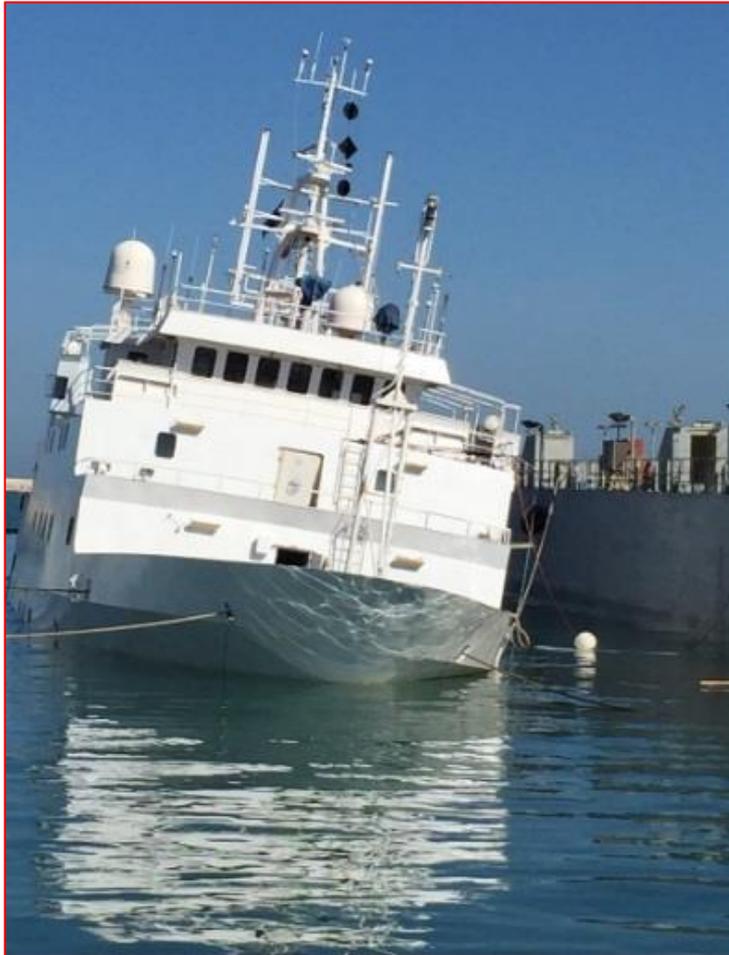
Main Technical Features

- Category: Oceanic/Regional
- Tonnage: 1115 GRT
- Length overall: 61.3 m
- Breadth: 11.1 m
- Depth: 5.3 m
- Draft: 4,6 m
- Height: 5.3 m
- Max speed: 14.5 kn
- Average speed: 11.0 kn
- Endurance: 45 days
- Crew: 16 people
- Scientists: 20 people
- Built year: 1992

Years	N. surveys	Days at sea	Average days per survey
2013	23	316	13.7
2014	24	294	12.3
2015	-	-	-



RV “URANIA” ACCIDENT



On August 25th 2015 while RV “Urania” was in a floating dry dock in Livorno (Italy), a severe accident happened. For reasons still under investigation by the Italian Judicial Authorities and that are to be clarified by an official inquiry, the vessel suddenly heeled portside. In the accident one member of the crew died and others were injured with different seriousness.

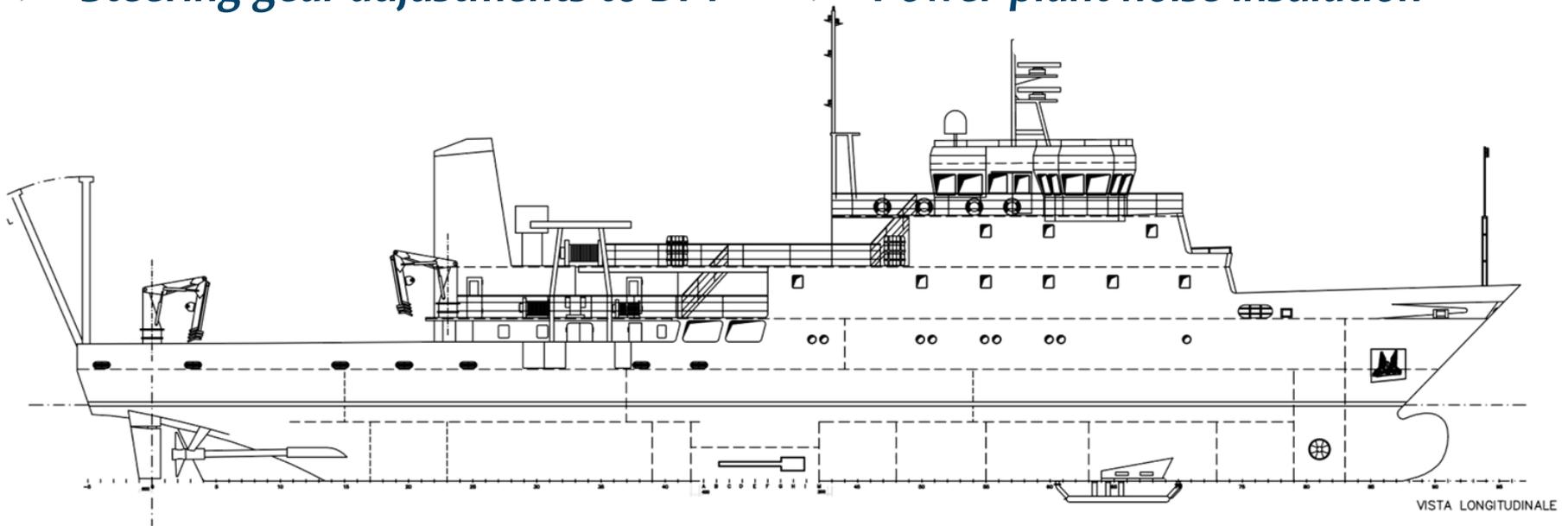
When the accident happened RV “Urania” was undergoing improving and strengthening work. The commissioning was expected by November 2015 and works were at full speed. Notably, the most distinguishing part of interventions, the 6 meters hull lengthening, was already completed.

At the moment it’s hard to assess the damages the hull and the equipment had, because the vessel cannot be accessed due to the current inquiry.

EXPECTED RV “URANIA”

This is how RV “Urania” should have looked after the end of interventions. At the time of the accident, many tasks were already fulfilled, among them:

- *Lengthening of the hull*
- *Four new cabins for scientists*
- *Scientific winches inspection*
- *New DP1 system*
- *Steering gear adjustments to DP1*
- *New more powerful bow thruster*
- *New stern thruster*
- *Three newer and more powerful generators*
- *Power-plant noise insulation*



RV “URANIA”.....last considerations

For about 25 years RV “Urania” has been a strategically important oceanographic facility not only for CNR but also for all the Italian marine research community.

The scientific results obtained thanks to the use of this vessel are evident from the large number of scientific publications, the European projects undertaken and the numerous national and international collaborations, all of which have contributed to reinforce the image of CNR at the European and international levels.

Main research results obtained in the past using RV “Urania”

- Complete bathymetry of Italian seas, important also for natural risk assessment (i.e. detection of active and possibly seismogenetic faults)
- Mapping of underwater habitats to assess the impact of human activities
- Discovery of still alive white coral communities, important for capturing CO₂
- Study of oceanographic events like the exceptional formation of cold waters in the winter of 2012 and their subsequent transport to Ionian abyss in the following months

Relevant planned cruises onboard RV “Urania” in 2016

- Red Sea, as an analogue of the Atlantic Ocean 100 million years ago
- Western Mediterranean, to work on stratification of deep waters and likely increase of salinity
- Study of underwater mudflows and slides, relevant for earthquakes (paleo-seismology)

LOCAL/COASTAL CNR RESEARCH UNITS

Name	Length	Operator	Operating area	Main activity
RV "Boreana"	10.00 m	ISMAR-CNR	Mediterranean Sea	Multiple activities
RV "Cerruti"	14.50 m	IAMC-CNR	Mediterranean Sea	Multiple activities
RV "Furetto"	10.00 m	IAMC-CNR	Mediterranean Sea	Multiple activities
RV "Litus"	10.20 m	ISMAR-CNR	Mediterranean Sea	Multiple activities
RV "Luigi Sanzo"	15.00 m	IAMC-CNR	Mediterranean Sea	Multiple activities
RV "Tecno pesca II"	16.30 m	ISMAR-CNR	Mediterranean Sea	Multiple activities

RV "Luigi Sanzo"



RV "Litus"



RV "Tecno pesca II"





- Multibeam System Kongsberg EM 2040D-C
- Positioning system Kongsberg Seapath 300 with DGPS correction
- Motion sensor Kongsberg Seatex MRU 5
- Valeport Mini SVS and AML Ocenographic SV Profiler





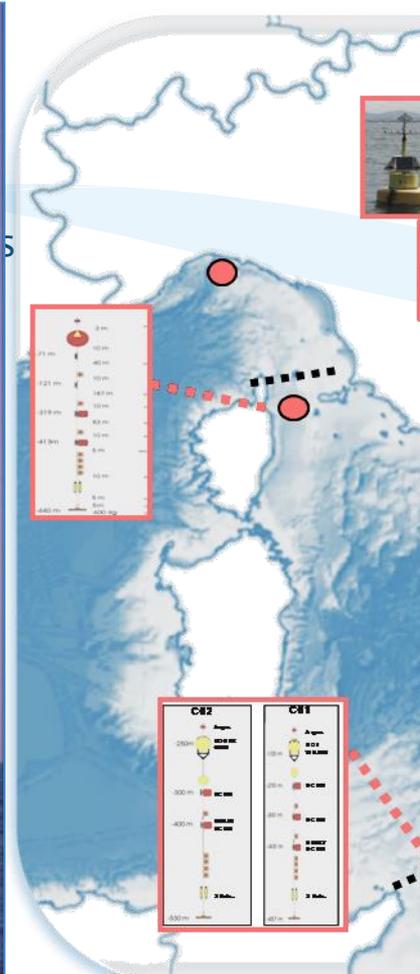
Litus at work on the Gran Canal

This new system was adopted recently for bathymetric surveys, habitat mapping, geo-archeology studies and hydrodynamic modeling of the Venice Lagoon

CNR MARINE OBSERVING SYSTEM



ODAS ITALIA 1
Buoy



ACQUA ALTA
Tower

“ODAS ITALIA 1” SPAR BUOY



- an offshore laboratory for air-sea interaction studies (12 tons/ 51 m long)
- moored in the Ligurian Sea, at 80 km far from the coast and on a 1300 meters deep seabed
- equipped with a set of meteorological and marine sensors
- data are sent in near real time to the land by a phone link

“ACQUA ALTA” OCEANOGRAPHIC TOWER



- located in the Northern Adriatic Sea 16 km off the coast of Venice
- equipped with a meteo-oceanographic station
- data are recorded on board and also telemetered to land
- measurements of atmosphere (wind, temperature, humidity, solar radiation and rain) and sea (waves, tide and temperature)



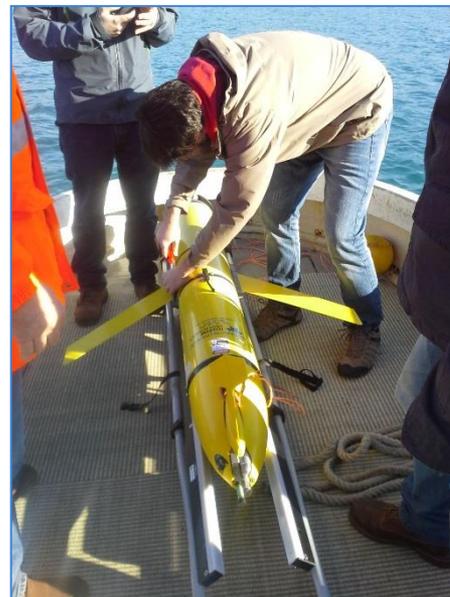
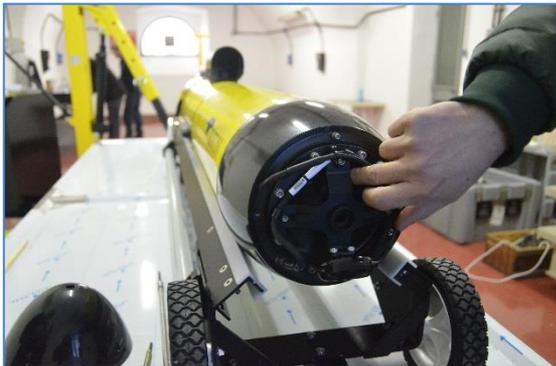
SLOCUM DEEP GLIDER G2 “TERESA” + ROCKLAND SCIENTIFIC MICRORIDER



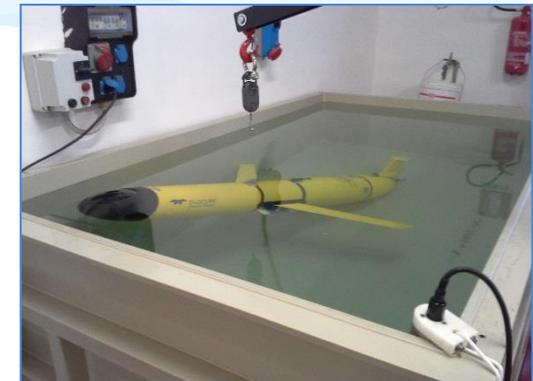
Autonomous underwater vehicle, operating along vertical sections to monitor the water column up to 1000 m depth. It provides vertical profiles of hydrological properties and turbulence through continuous cycles of immersion-emersion. The system was acquired by CNR in 2014 as part of the project EUROFLEETS.

Measurements:

- Temperature
- Salinity
- Oxygen
- Integrated speed
- Turbulence (microprofiler interface)



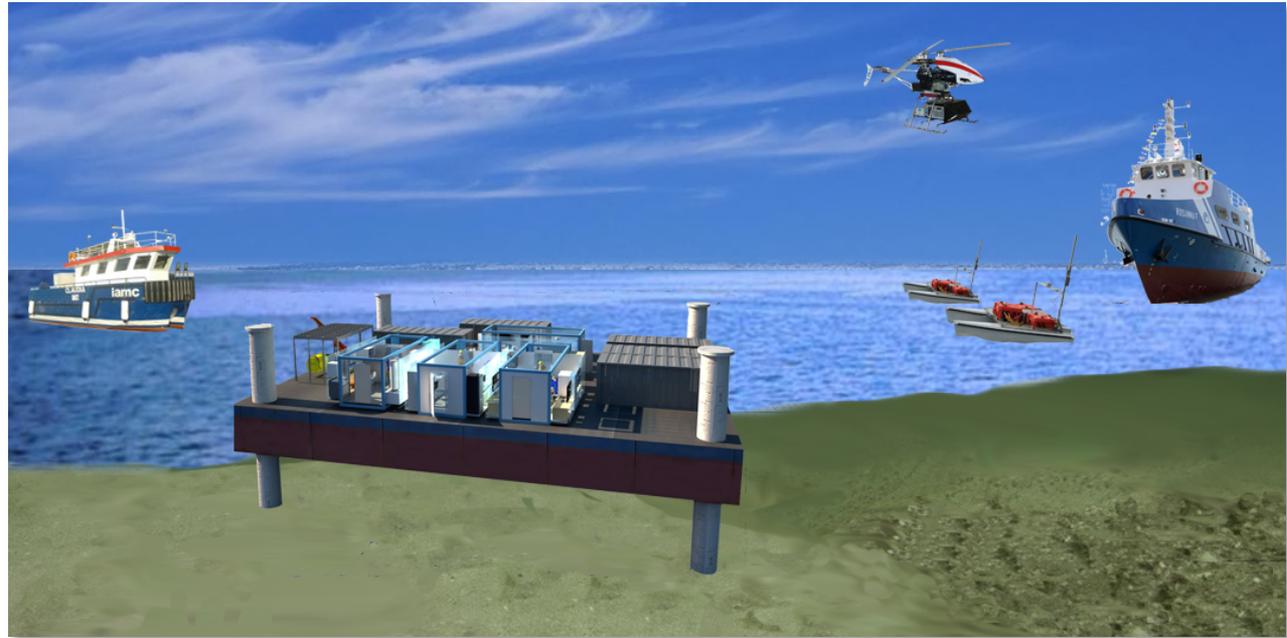
Deployment during a test phase in the Gulf of Poets – La Spezia



Ballasting procedures in the CNR La Spezia Laboratory, Italy



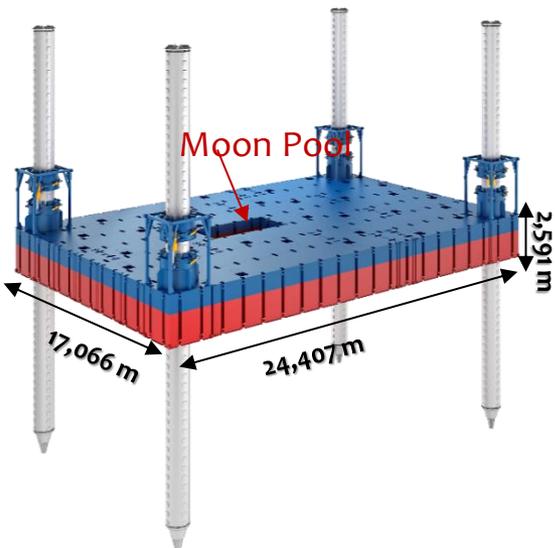
ADVANCED TECHNOLOGICAL SYSTEMS AND INTEGRATED RESEARCH LABORATORIES FOR COASTAL AND MARINE ENVIRONMENTAL SURVEY



- Technological Jack-up Barge & tug-boat
- Fast Cargo Vessel
- Geophysical Shelter Lab
- Geochemical Shelter Lab
- Geotechnical Shelter Lab
- Two Unmanned Surface Marine Vehicles
- Unmanned Aerial Vehicle

TECHNOLOGICAL JACK-UP PLATFORM

12-20 scientific & technical operators
Endurance: 7 days

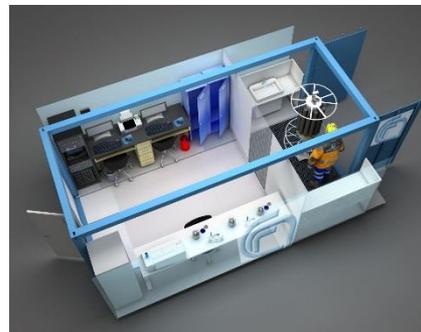


Min draft: 1,064 m abt.
Max draft: 1,245 m abt.
Length overall: 36 m
Max operating depth : 25 m
Lifting capacity: 4 x 250 mT
Autonomous drive
Power : 1000 kW abt

Design parameters
Wind: 10 m/s
Current Wave : 1 m/s
Wave Heigth: 1,5m



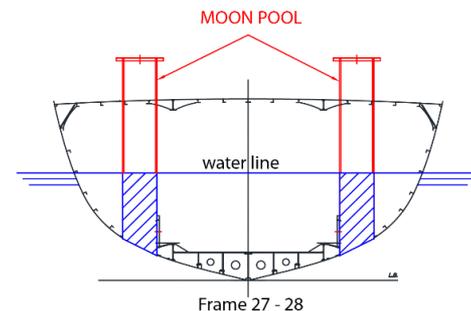
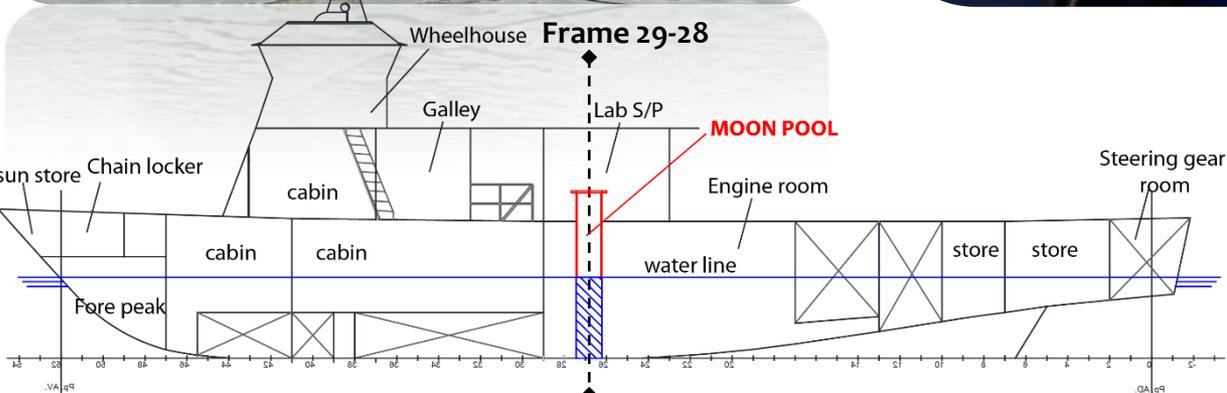
Shelter Lab



Control Room



FAST CARGO VESSEL



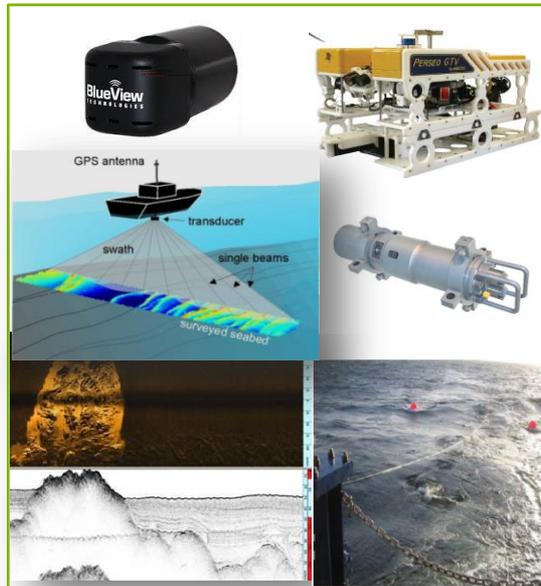
Length: 28.45m
Breadth: 7.00m
Height: 3.20m
Draught: 1.90m
Payload: 40t

Main engine power: 2x735 kW
Auxiliary engine power: 1x200kW + 1x50kW
Speed: 16 kn
technical operators: 5 people
scientific operators: 8 people
A-frame: 5t SWL



3 INTEGRATED RESEARCH LABORATORIES FOR MULTIDISCIPLINARY DATA ACQUISITION AT HIGH OPERATIONAL PERFORMANCES

Geophysical Lab



- ROV PERSEO^{GTV}
- 3D microbathymetry
- Laser scanning survey
- Thermic-camera survey
- Seismic reflection survey
- 3D velocity current profiling
- Magnetometric survey
- Seismic Streamer
- GI.GUN Seismic source

Geochemical Lab



- Sampling water
- Sea-bird profiling CTDs
- Photometric analysis
- Trace metal analysis
- Black-carbon analysis concentration
- Aethalometer

Geotechnical Lab



- Sampling core (6m)
- **Sea-bed CPT profile up to 50-1500m depth**
- Mechanical characterization of soils under static and dynamic stress conditions



Length: 2.00m

Width: 1.50m

Draught Height (with roll bar): 0.40m @120 Kg

Height: 1.20m

Hull: 35Kg

Thrusters: 10 Kg

Box control: 10 Kg

Battery box: 30 Kg

Max payload (including box payload): 35 Kg

Power engines: 300 W (x2)

Engines push forward: 13 Kgf (x2)

Thrust engines in reverse: 12.8 Kgf (x2)

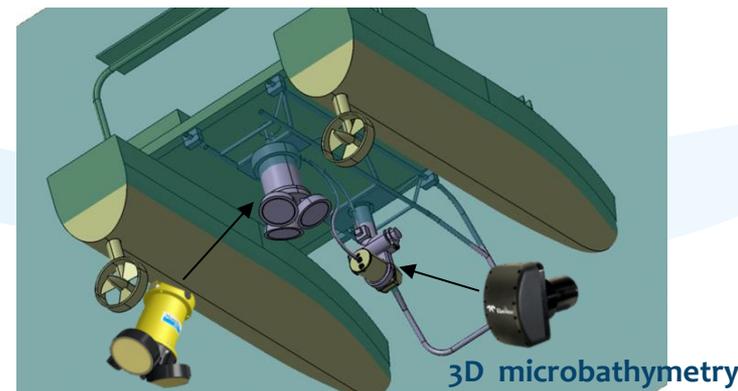
Supply voltage (min-max): 35-55 V

Supply voltage (nominale): 46.8 V

Capacity: 69.6 Ah

Charging time: 12 hours

Layout configuration



3D Velocity current profiler

MB1350-N/W Multibeam Profiler Sonar

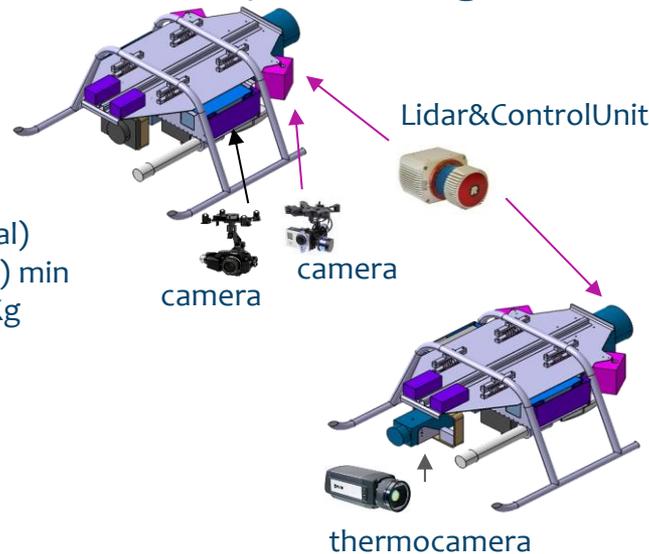
- Field of View: $42^\circ \times 1 / 76^\circ \times 1^\circ$
- Max Range: 90 ft
- Beam Width: $1^\circ \times 1^\circ$
- Number of Beams: 256
- Beam Spacing: 0.18°
- Time Resolution: 0.015 m (0.59 in.)
- Max Update Rate: 40 Hz
- Frequency: 1.35 MHz

UNMANNED AERIAL VEHICLE



Layout configuration

Length: 2.170m
Width: 0.70m
Height: 0.980m
MR Diameter: 2 x 2.80m
Dry Weight: 37 Kg
Fuel capacity standard: 6L
Max Fuel capacity: 20L (optional)
Endurance 6 L (20 L) Fuel: 50 (200) min
Payload 6 (20) L Fuel: 26 (18) Kg
Max Airspeed: 80 Km/h
Engine: 19.5 Hp
Fuel Type: gasoline
Generator: 200W
OAT: "-10° C / +35° C"
Max Crosswind: 24 Km/h



Laser Scanner: RIEGL VUX-1

- 10 mm survey-grade accuracy
- scan speed up to 200 scans / second
- measurement rate up to 500,000 meas./sec
- (@ 550 kHz PRR & 380° FOV)
- operating flight altitude up to more than 1.000 ft
- field of view up to 380° for practically unrestricted data acquisition
- regular point pattern, perfectly parallel scan lines
- scan data storage on internal 240 GByte SSD Memory



ALANIS dual-mode vessel



CART/Shark USSV



Charlie USV



AscTec FireFly UAV



VideoRay Pro 4 mini-ROV



R2 ROV



E-URoPe AUV/ROV



Unmanned Vehicles for Autonomous Sensing and Sampling Project (2015-2016)



The “**Autonomous robotic systems and control**” group of CNR-ISSIA UoS Genova has been developing a small fleet of UMVs (**Romeo ROV, Charlie USV, SHARK ROV**) that have been extensively used for collecting scientific data during scientific campaigns performed everywhere in the world and that have also already been successfully exploited in Polar Regions.

“*Shark is the little autonomous semi-submersible robot that measures the environmental parameters and perform the water sampling at the air-sea-ice interface. It is fitted with a compass and GPS, automatic control systems, and a radio to transmit images and telemetric values as well as receiving instructions. The drone is technology-intensive. It navigates with support from a flying drone with eight propellers, who can photograph and videotape the surface of the glaciers*”

Two towing tanks:

- **Tank 1** - among the largest worldwide (470 x 13.5 x 6.5 m, carriage max. speed 15 m/s)
- **Tank 2** - equipped with wave-maker for rough sea experiments (220 x 9 x 3.5 m, carriage max. speed 10 m/s)

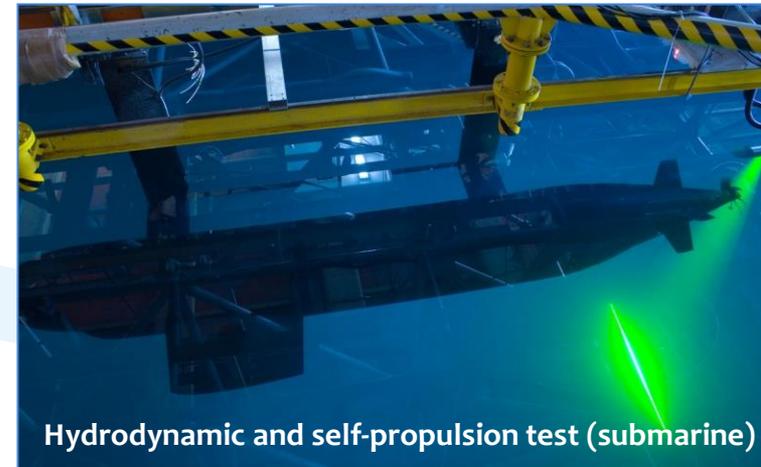
Towing tank 1

Towing tank 2



Towing tanks activities (e.g.)

- resistance and self-propulsion tests
- seakeeping and propulsion evaluation in head and following waves
- 3D wake surveys
- open water propeller characterization

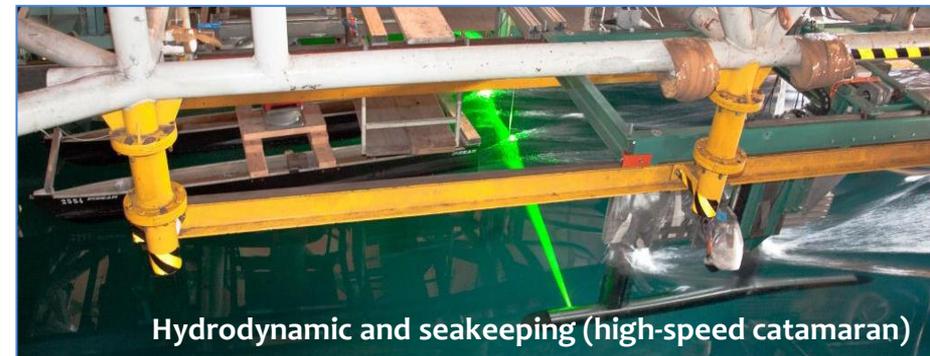


On (e.g.)

- conventional/unconventional marine vehicles
- high-speed vehicles
- submerged bodies



Including tests on innovative technologies for the shipbuilding Industry



Circulating water channel (test section 10 x 3.6 x 2.2 m, maximum water speed 5 m/s and the pressure in the test section can be reduced up to a minimum of 30 mbar)

CEIMM cavitation tunnel (test section 2.6 x 0.6 x 0.6 m, speed range is 3-12 m/s, static pressure 300-1500 mbar)

Circulating channels activities (e.g.)

- performance tests on propellers and propellers/rudders interaction
- cavitation tests and cavitation inception measurements
- propeller noise and radiated noise
- hull pressure fluctuation measurements

Sloshing Lab

- sloshing flows in a LNG ship tank

