
2019
1959
CMRE
60th ANNIVERSARY

This publication is produced in commemoration of the significant accomplishments achieved by the Centre for Maritime Research and Experimentation leadership, staff, scientists, researchers, engineers and partners over the past 60 years. Thank you to the Centre's alumni for their incredible hard work and dedication.

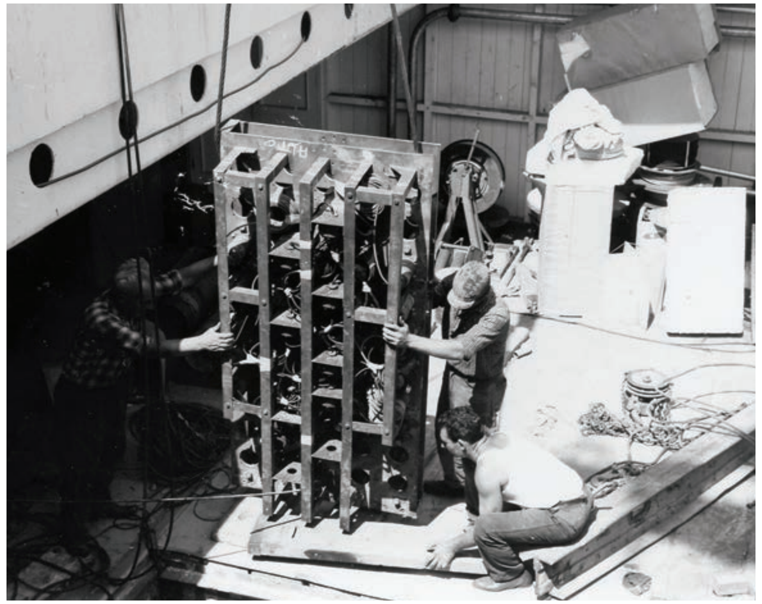
Forward
by the Director


A 5345

The Early Years: 1950s – 1960s

The Centre for Maritime Research and Experimentation, formerly known as SACLANT ASW Research Centre or SACLANTCEN, was established in response to growing geopolitical tensions and technological advancements in naval warfare that occurred during the Cold War. In the late 1950s, NATO realised that greater scientific knowledge of the undersea environment was essential in safeguarding the fleet, providing stronger protection to Alliance Nations, and restricting the movements of the Soviet naval force. With the initial funding contributed by the United States Secretary of Defence, on 2 May 1959 the Centre was officially commissioned. The flags of the nine NATO Nations that provided personnel were raised for the first time with that of the Atlantic Alliance in the Italian naval compound, which still hosts the Centre today. On 20 October 1962 the North Atlantic Council adopted a charter that recognised the Centre as a NATO organisation.

Right: 2 May 1959. The official commissioning ceremony of the SACLANT ASW Research Centre or SACLANTCEN, now known as the Centre for Maritime Research and Experimentation, featuring an address by Supreme Allied Commander Atlantic (SACLANT) Admiral Jerauld Wright of the United State Navy.



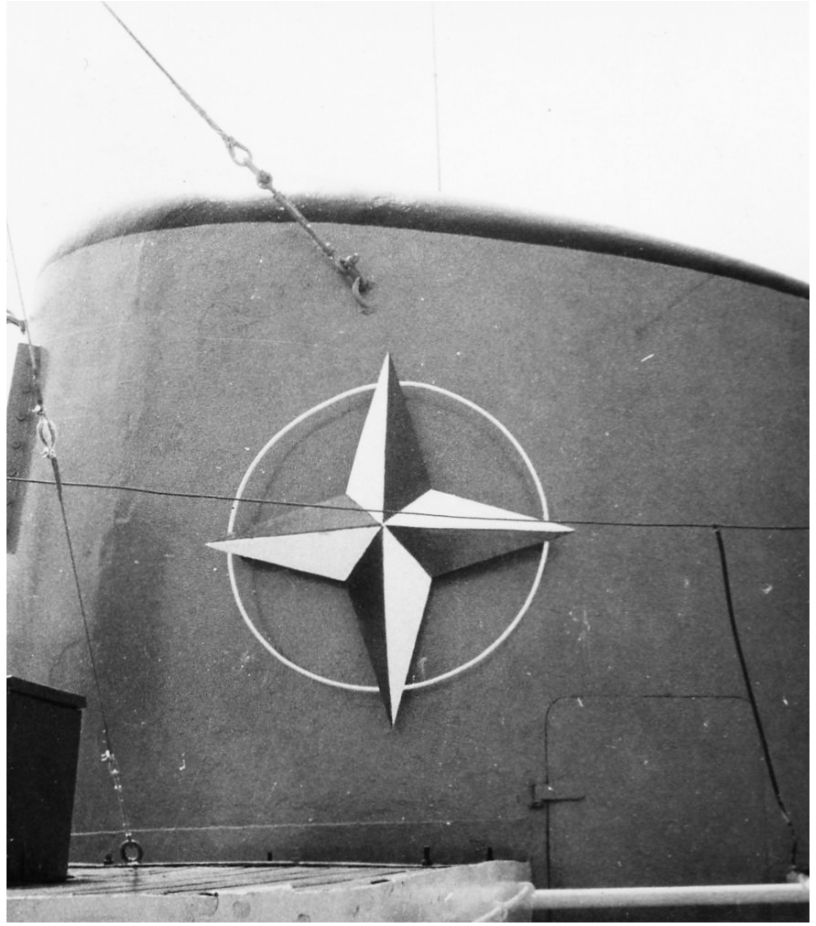
Above: *c.* 1960s. The *Aragonese* in La Spezia.

The Centre was called upon to assist NATO Nations in this domain, especially in deep ocean locations where Soviet nuclear submarines prowled for possible attacks on the continental United States or attempted to disrupt lines of communications between North America and Europe. In the early years, the Centre's mission was to conduct research and provide scientific and technical advice in the field of antisubmarine warfare to NATO. In order to carry out its mission, the Centre chartered an old freighter, the Aragonese, which was quickly transformed into a research vessel, giving the organisation a sea-going capability.

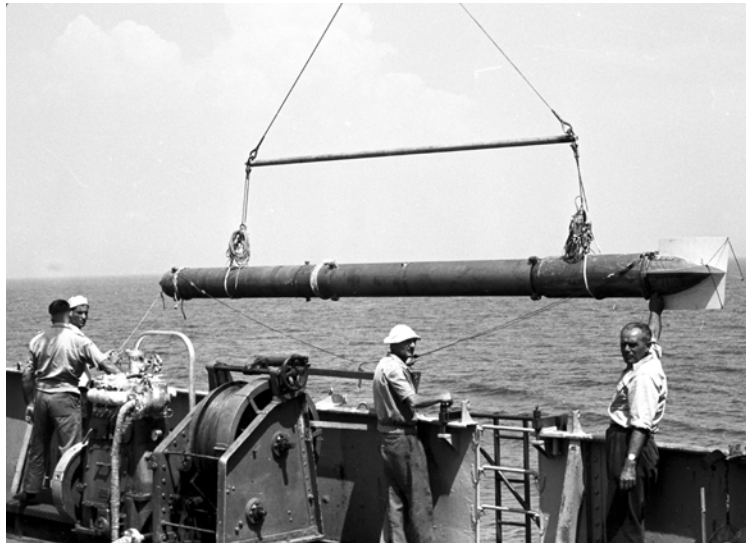
Left: 1961. Crews working to fit the *Aragonese* vessel with research technology.

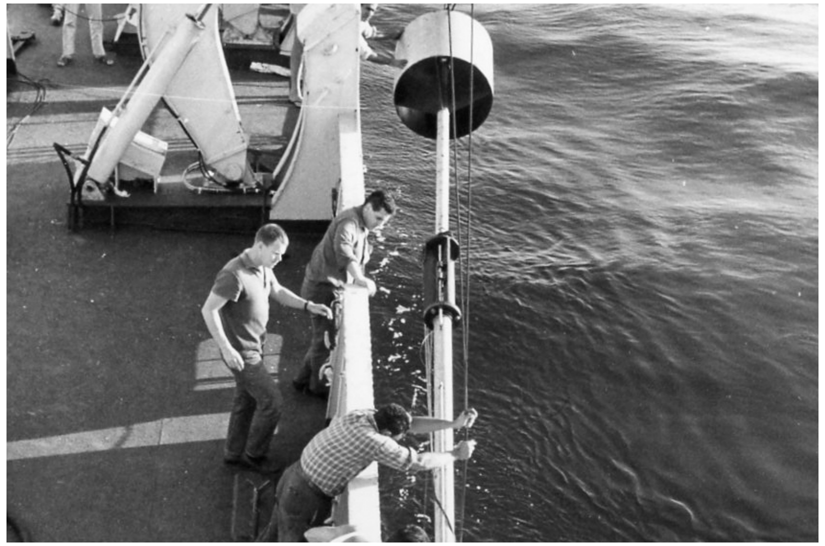
c. 1964. The Maria Paolina G. in La Spezia.

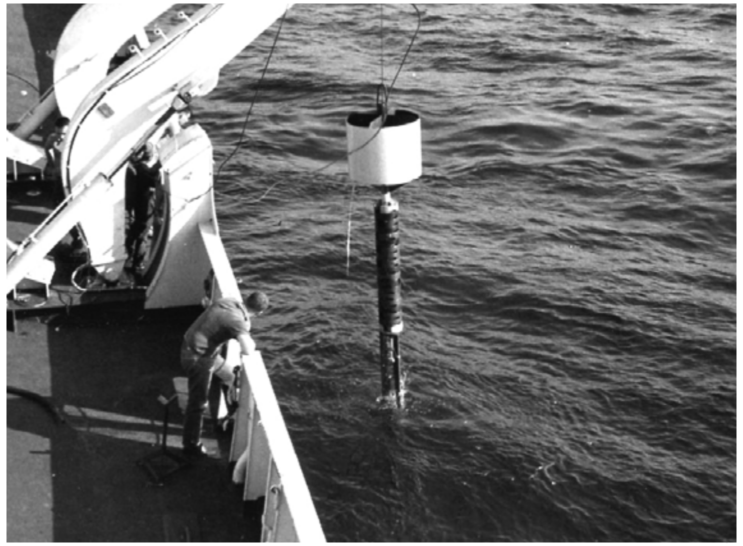
In 1964 the 2,800t Maria PaolinaG.waschartered,replacing the ageing Aragonese. In addition to antisubmarine warfare, scientific research programming was focused on underwater acoustics, oceanography, and systems concepts evaluation.



Top Left: *c.* 1964. The NATO logo atop the *Maria Paolina G.*
Top Right: *c.* 1960s. Centre staff members gather on the *Maria Paolina G.*
Below: *c.* 1967. Engineers conduct experiments at sea.







Above: *c.* 1960s. Scientists work with a wave rider.

Above: *c.* 1960s. Silvio Bongi calibrates a hydrophone.

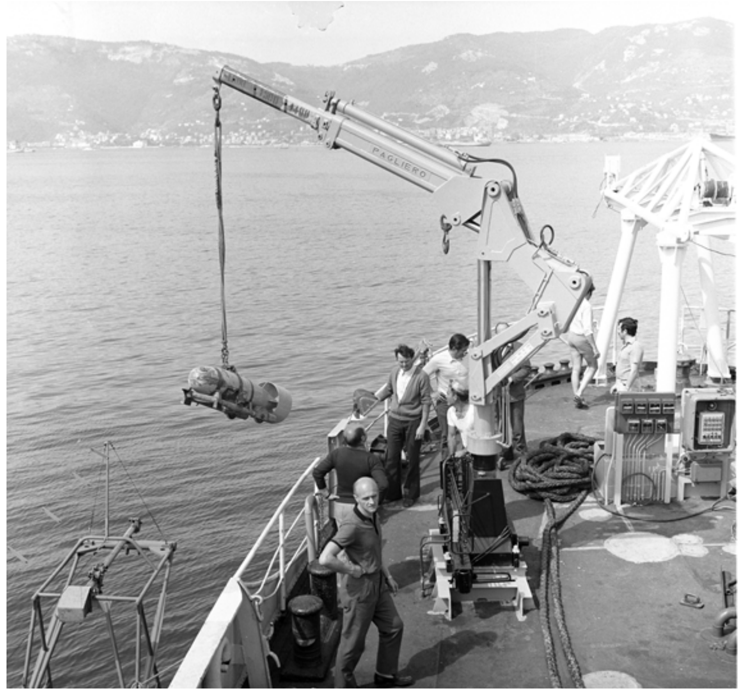
Studies carried out in the mid ´60s produced a number of innovations in ocean engineering, many of which are still in use today. In particular, experiments in the Strait of Gibraltar, a body of water with high currents and internal waves, challenged oceanographers to develop instruments, such as oceanographic buoy technology, that could withstand harsh conditions and produce valid data. During this period, the Centre also constructed a laboratory to test and measure instruments being built, marking the start of calibration activities.

Above: 1968. Gabriella Parmigiani XXXX.

The understanding of the complexity of underwater sound propagation was the basis for detecting and classifying submarines.

c. 1960s. Franco Ravera operating a milling machine.

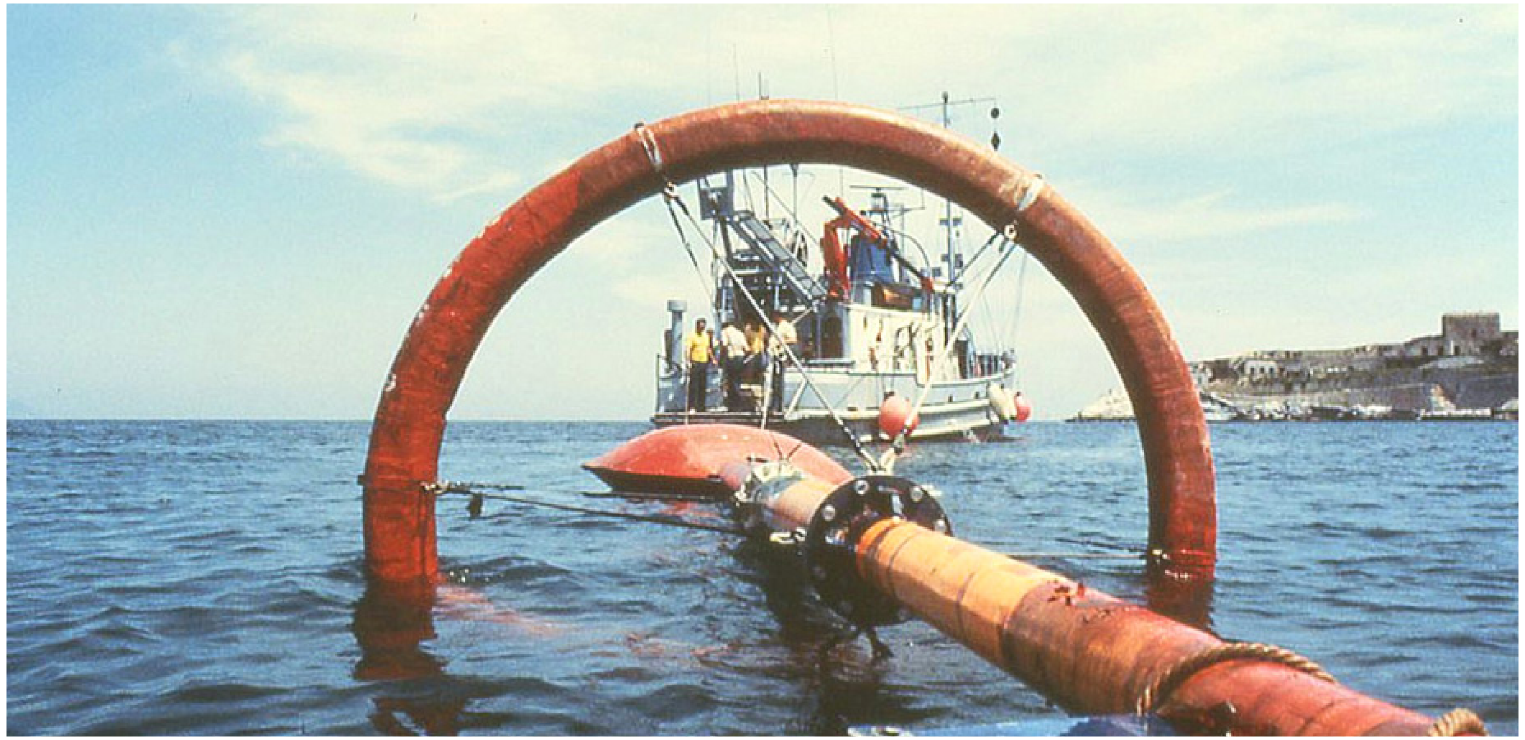
c. 1960s. Roberto Della Maggiora works with an acoustic current meter.



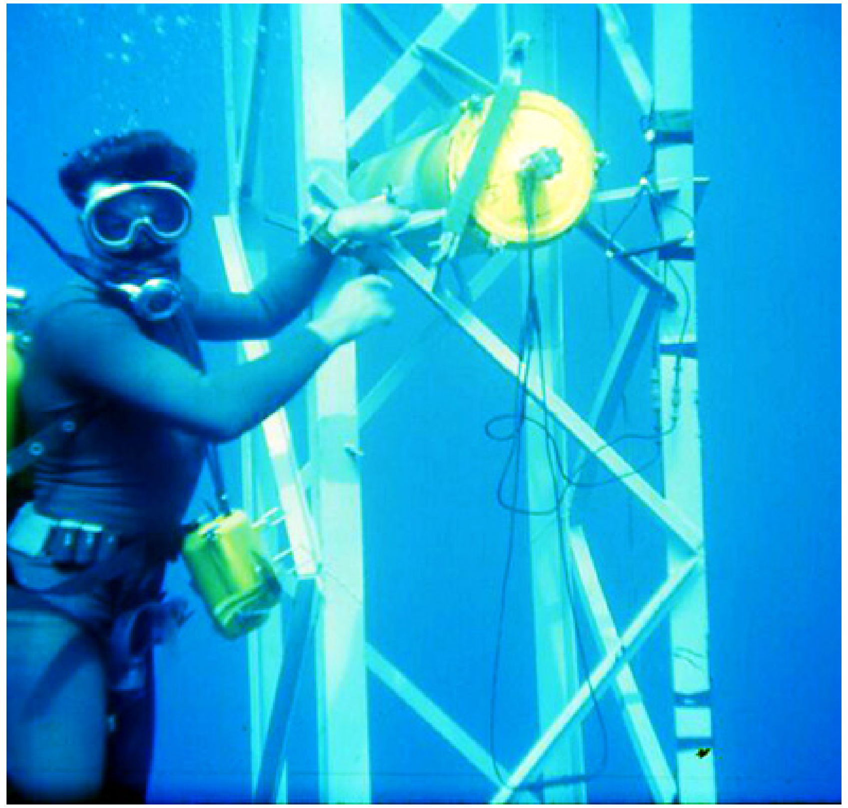
Above: *c.* 1960s. XXXXXXXXXX.

Above: *c.* 1960s. XXXXXXXXXX.

In the late ´60s, the need to increase the efficiency of buoy operations at sea resulted in a new activity, scientific diving. Training some scientists to operate underwater solved the problem of frequently retrieving deployed buoys in order to extract data, not an easy feat in choppy waters. The adoption of mateable connectors for underwater work also made it easier for scientists to connect and disconnect various modules to the instruments. All of these initiatives resulted in more effective operations, enabling scientists to verify how a prototype is functioning in real time. Scientific diving as a professional activity, first practised by the Centre´s scientists in 1969, became recognised by NATO in 1974.



Top: *c.* 1970s. In the 1968 the Centre began to develop the first Italian meteo-oceanographic Spar buoy.
Left: XXXXXXXXX.
Right: Spear buoy sits on the *Manning*.
Photos by: Federico de Strobel.

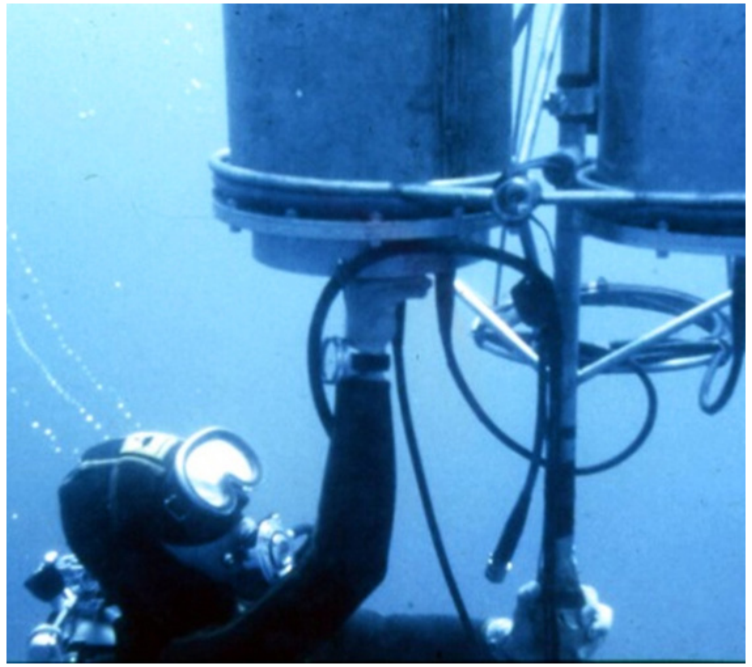


c. 1960s. A number of scientists became certified divers, making it possible for them to work in the underwater environment.
Above: XXXXXXXXXX.
Right Page:
Top Left: XXXXXXXXXX.
Top Right: XXXXXXXXXX.
Bottom: Diver releases fluorescent die streaks during an investigation of oceanic microstructure. **Photos by:** Federico de Strobel.

The Centre
in the 1970s

By the 1970s, the Centre was a leader in the use of underwater buoy connectors, which led to a significant increase in the efficiency of data recording operations. At the same time, technological innovations in electronics resulted in the installation of progressive digital computing equipment and a new facility was created to host a centralized computer system.

The scientific side of the Centre was reorganized into two main divisions: the Environmental and Systems Research Division and the Operational and Analytical Research Division. The Environmental and Systems Research Division consisted of four working groups: deep water research, shallow water research, applied oceanography and signal processing. The Operational and Analytical Research Division was subdivided into three groups: force effectiveness studies, tactical studies and theoretical studies.



Right Top: *c.* 1970s. Advanced computing lab.
Right Below: Divers display early use of underwater pluggable connectors.
Photos by: Federico de Strobel.

To support programming in the new research divisions, the number of scientists at the Centre was increased to a maximum of 50, most researchers working on limited-term contracts. This rotation of personnel enabled a regular inflow of new ideas, and over time, resulted in the establishment of a network of close contacts between the Centre and national research bodies as well as many universities and private companies.

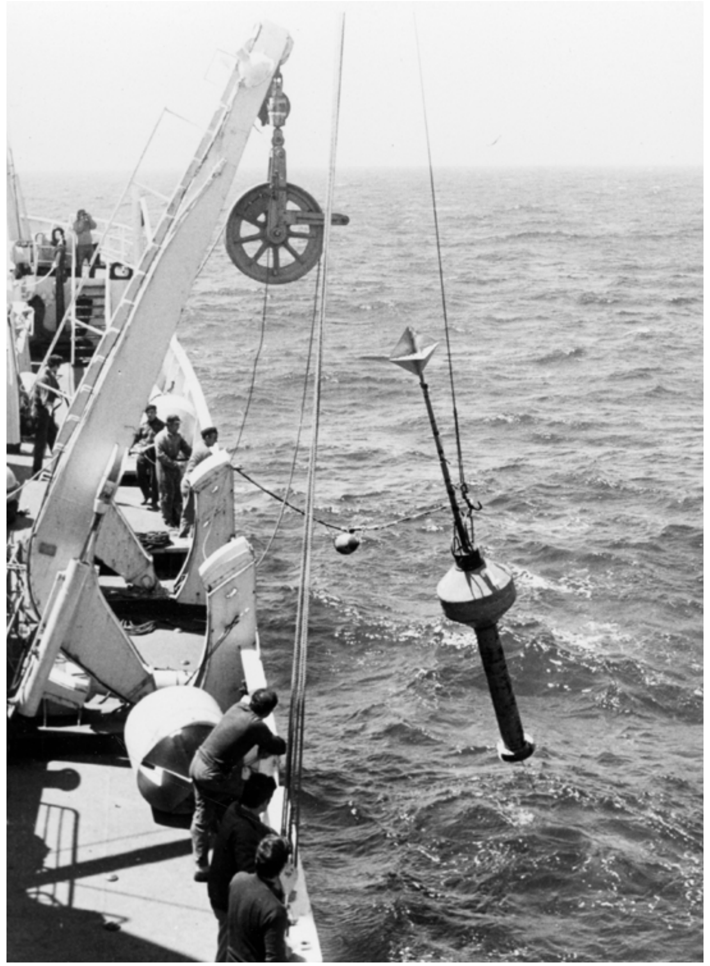
While advanced technologies were assisting scientists and engineers inside the Centre, activity at sea remained quite intensive. After more than a decade mostly dedicated to deep waters, shallow waters emerged as a new priority as submarines were becoming quieter and available to more nations. This led to further research on oceanography and acoustics with the majority of experiments carried out along the Ligurian coasts.

Left: In 1974 the *Manning*, a TBoat built for the United States Army and previously used by Columbia University for oceanographic work, joined the Centre's fleet. **Top:** *c.* 1990s. The *Manning* navagates the Ligurian Sea.
Below: *c.* 2000s. Front row, from right: XX, XX, XX, Umberto Fabiani, Umberto Varlese, XX, XX, Mauro Lazzini. Back row, from left: Giuliano Bertoli, and Salvatore Cuciniello.

c. 1970s. The *Maria Paolina G* was fitted with the most advanced technological research equipment of the time.

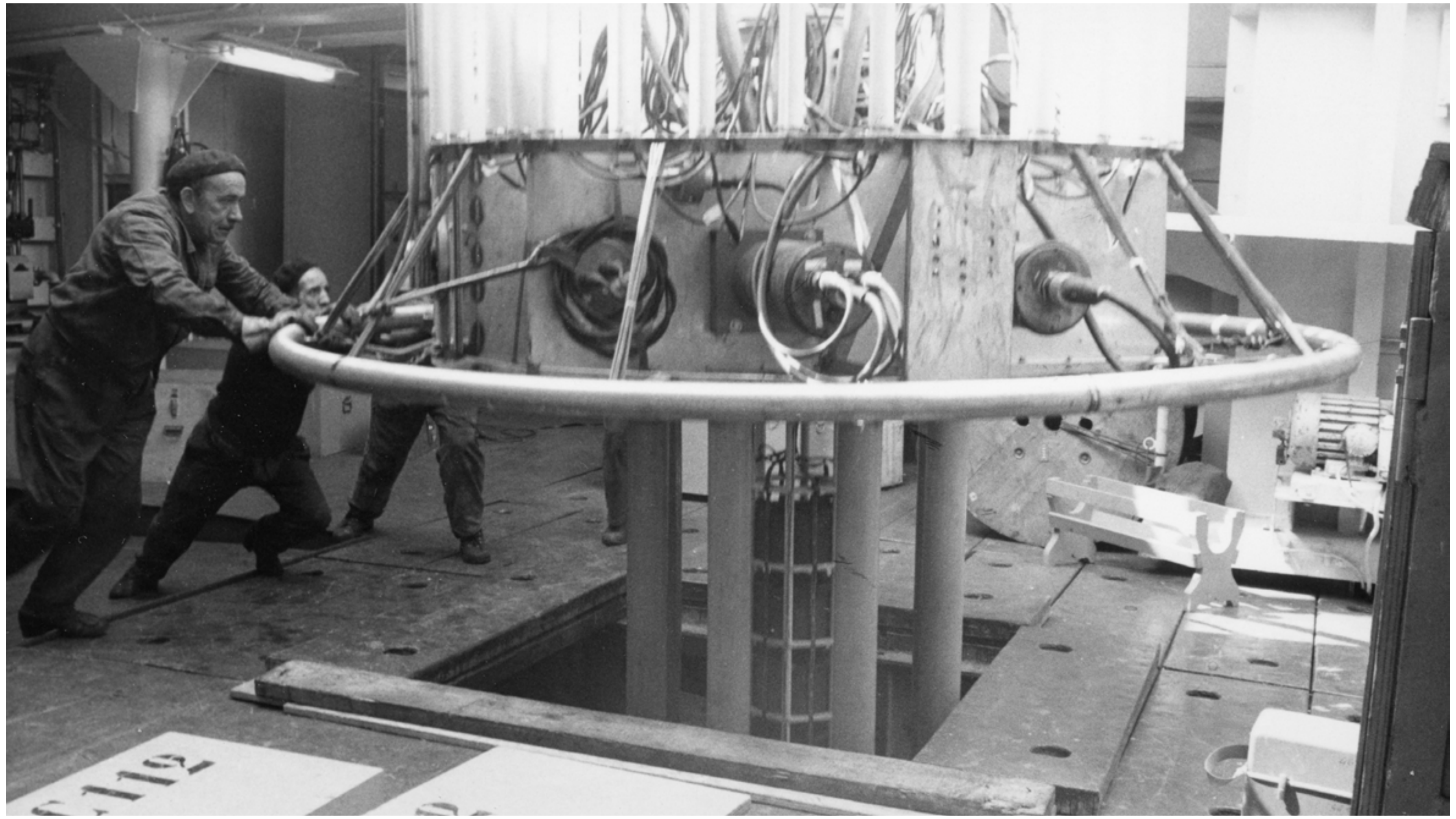
Above: *c.* 1972. XXXXXXXXX.

During this time new shallow water instruments were studied and developed collecting data although the improvement of data collection in deep waters continued. In the late ´70s, towed arrays made their presence in La Spezia. The Centre started testing the first experimental hydrophone linear array built by Hughes Aircraft Corporation.



Right: *c.* 1972. XXXXXXXXX.

c. 1972. XXXXXXX.



Above: *c.* 1972. XXXXXXXXX.

Later, the High Resolution Towed Oscillating System, a fine-scale oceanographic device developed by the Centre's engineering staff, resulted in acoustic coverage of large areas with high resolution. The highly successful design of this unique mechanically oscillating system was used in multiple scientific missions.


1 JULY 1974 15.20GMT
PASSAGE ARCTIC CIRCLE

8 May 1979. The Centre celebrates its 20th anniversary.

Based on studies carried out in 1976, the Bistatic Active Towed Array sonar programme was launched two years later. This system used a second vessel as auxiliary receiver, leading to a considerable increase of the detection range.

The scientific outputs from the Centre were especially valuable to the smaller nations, whose research capacities were behind those of the larger nations. Scientists were supported by administrative and technical teams, in particular, a top-notch engineering department which provided the means to carry out the experimental work needed to develop or verify scientific theories.

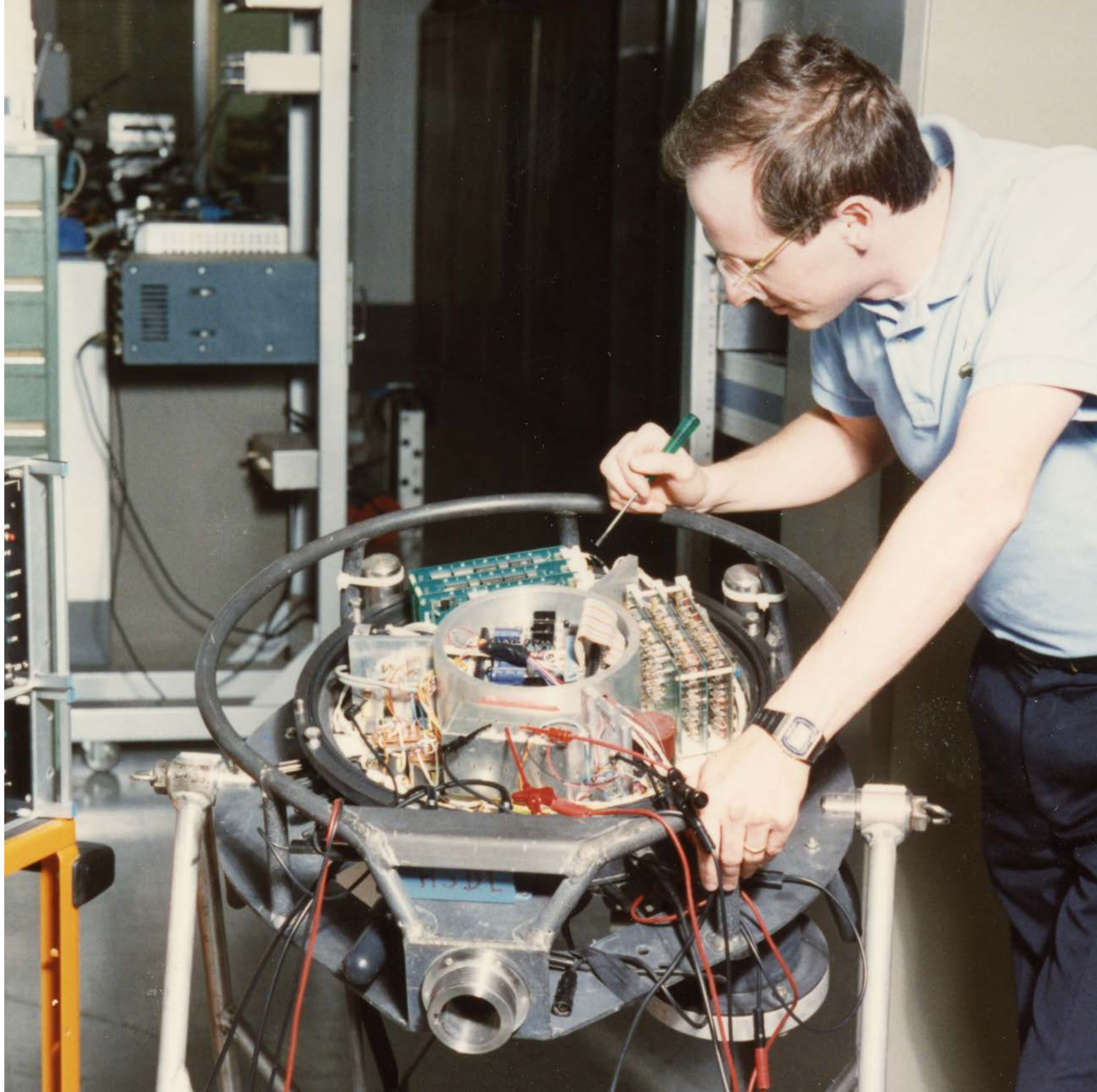
Left: *c.* 1976. Scientist works with the towed oscillating CTD system. **Photo by:** Federico de Strobel.

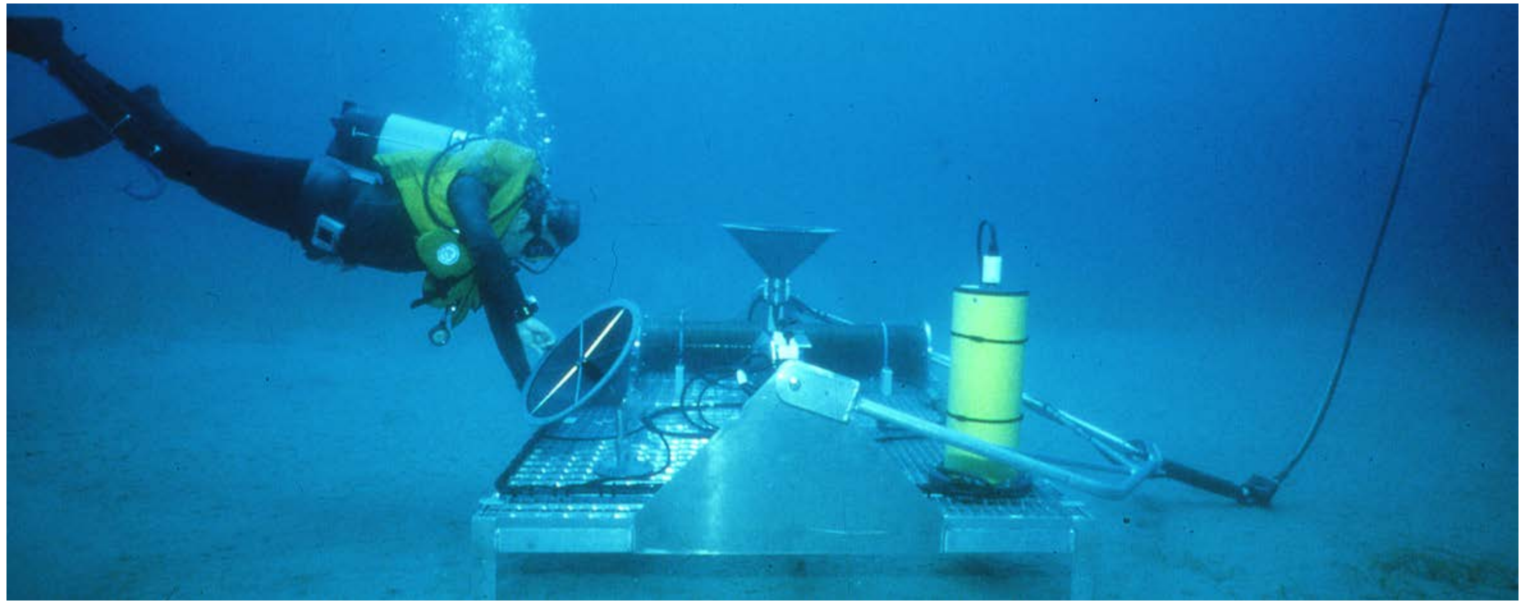
The Centre
in the 1980s

Since its very beginnings the Centre has been a unique facility for research and experimentation. This legacy continued in the early 1980s with the foundation of the Oceanography Calibrating Laboratory, still in operation today, that provides instrument calibration according to the World Ocean Circulation Experiment standard. This laboratory supports the Centre's activity as well as most NATO navies and research laboratories.

Although the Centre's research focus shifted toward shallow waters in the late 70s, submarine detection and classification remained on the agenda. Low frequency activated sonar experimentation started in the 1980s with the Active Adjunct Project that used a passive towed sonar array as well as a towed high power, low to mid-frequency emitter. The aim of the project was to verify the feasibility of the system and to analyse typical performance-linked parameters such as propagation loss, signal coherence, noise, reverberation and target strength.

Right: 1988. Paolo Saia calibrates a magnetometer.





Above: 1980. Diver deploys a bottom-mounted lunar module carrying dedicated sensors.

Above: 1983. Diver deploys a drifter.
Photos by: Federico de Strobel.

Above: 1983. XXXXX works with a drifter in the lab.

Although the Centre's research focus shifted toward shallow waters in the late 70s, submarine detection and classification remained on the agenda. Low frequency activated sonar experimentation started in the 1980s with the Active Adjunct Project that used a passive towed sonar array as well as a towed high power, low to mid-frequency emitter. The aim of the project was to verify the feasibility of the system and to analyse typical performance-linked parameters such as propagation loss, signal coherence, noise, reverberation and target strength.

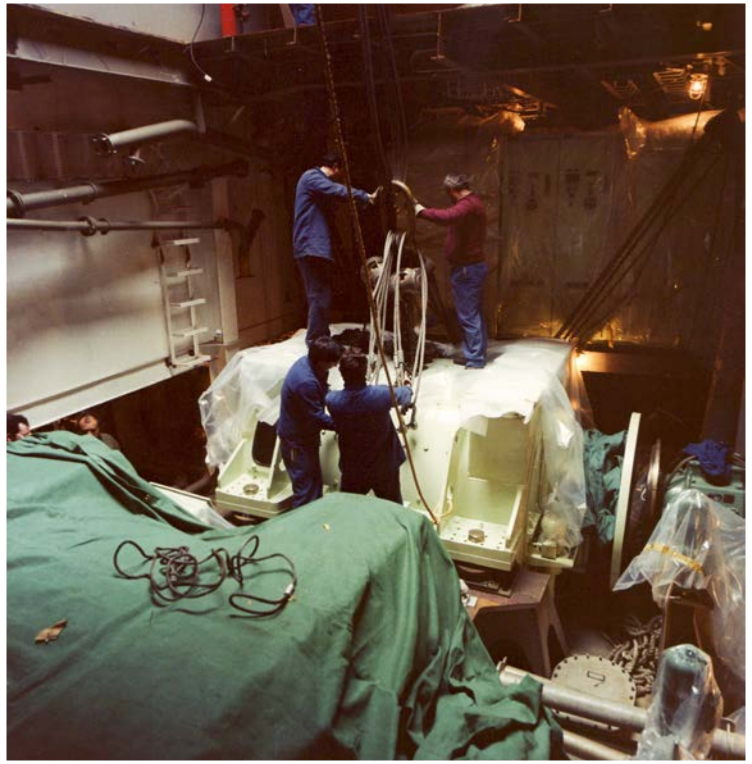
Above: 1989. XXXXXXXXXXX.

c. 1980s. Engineering, technical and administrative staff support research teams in the library.

The Centre's links to military organisations were vital in obtaining support of submarine services for the numerous experiments that were carried out in the Mediterranean in both deep and shallow waters. Mutually beneficial data and information exchanges with multiple nations took place. The Centre played a vital role in closing the gap between paperwork and prototype developments in this field, reducing risks for those nations that developed their own systems.

Left: 1988. Bruno Miaschi works in the cabling area.
Right, Top Right: 1988. Centre main conference area. **Top Left:** 1988. Domenico Galletti works on chemical calibration.
Below: Angiolo Boni XXXXXX.

1984. The *Alliance* under construction at Fincantieri shipyard.



Above: 1984. The *Alliance* under construction at Fincantieri shipyard.

In 1984 the keel of a new research vessel specially designed for the Centre was laid at the nearby Muggiano Fincantieri shipyard. The design priority for this 3,180t ship was the reduction of ship radiated noise, obtained with a double hull and a specially designed propulsion system. The NRV Alliance was launched in 1986, and commissioned in 1988 replacing the Maria Paolina G. Since then it has retained its reputation as one of the quietest ships afloat, spending an average of 170 days a year at sea supporting the Centre's experiments.

1988. The *Alliance* at sea in La Spezia.

Above: 1989. The *Alliance* sailing in Iceland. **Photo by:** Angelo Spairani.

Although both theoretical studies and military oceanography operations partly covered shallow waters, such as the Shallow Meadow campaign in the Baltic in 1983-87, by the late 80s most of the activities were dedicated to deep waters, oriented towards antisubmarine warfare and the protection of sea line communication. In 1986 a five-year survey of the Greenland, Iceland and Norwegian Seas began. New technologies

Above: 1989. The *Alliance* sailing in Greenland. **Photo by:** Angelo Spairani.

were adopted in order to be able to collect data over long periods of time in a harsh environment, with problems ranging from thermal shock on sensors to difficulties in lowering the buoys into the water. A total of 31 buoys with 118 sensors that could record data over the course of a year were positioned, with a loss of buoys below 5 percent. A notable achievement in oceanographic research.

The Iran-Iraq war was a major event during this period, especially the Tanker War. Oil tankers moving through the Persian Gulf were threatened not only by Iranian air and small boat attacks, but also by some 150 sea mines of various types, mostly vintage, laid by Iran. The Centre´s name changed in 1987 to the SACLANT Undersea Research Centre clearly indicated a shift in focus from antisubmarine warfare to underwater research and underlined a widening of the Centre´s interests and competencies. The output of these activities were new concepts for the improvement of sonar and the development of underwater detection systems.

Right: 1988. XXXXXXXXX.

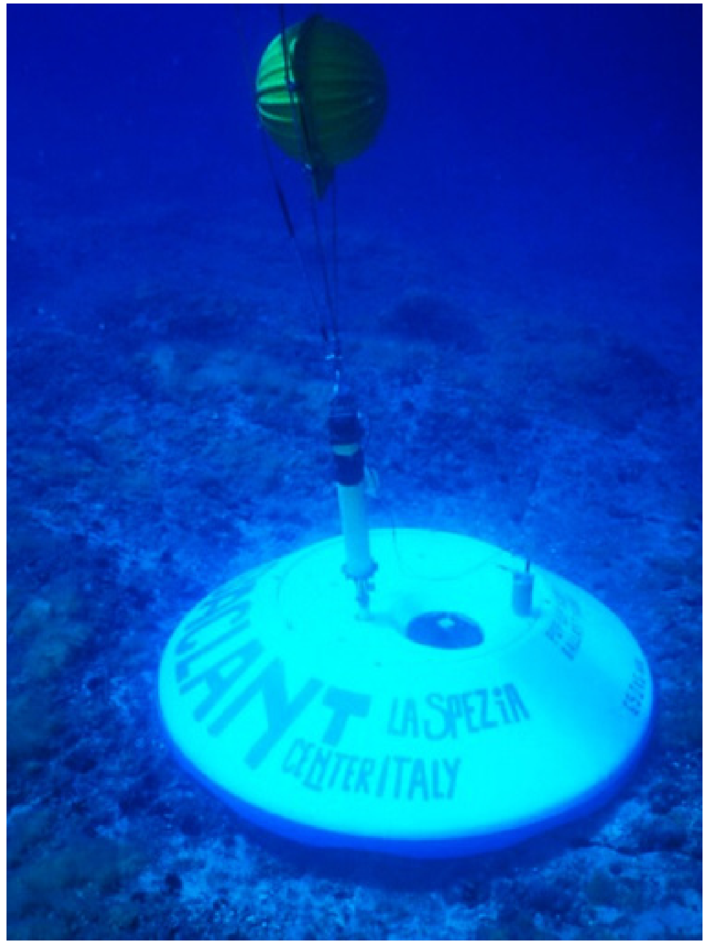
Above: 1989. XXXXXXXXX.

On 9 November 1989 the fall of the Berlin Wall marked the end of the Cold War period. The post-1989 geopolitical environment required a new approach. Crises tended to be regional, taking place in unknown coastal waters, with operations involving joint and combined forces. Mine countermeasures and antisubmarine warfare activities related to those operations required different knowledge of the related environment, silent diesel-electric submarines and mines becoming the dominant threat.

The Centre
in the 1990s

Although shallow waters were not the top priority in the ´80s, testing continued into the early ´90s with a constant upgrading of the system. The Adriatic Sea became the focus of attention in 1992 when NATO took part in a monitoring operation to verify sanctions imposed to Serbia and Montenegro by the United Nations. It was the start of the Balkan Crisis that would see NATO naval forces involved in that area for several years.

A shallow water environment with intense trawler fishing activities, such as the Adriatic, required robust new instrumentation for oceanographic surveys conducted to support naval operations. The Centre designed an Acoustic Doppler Current Profiler with a low profile that was resistant to fishing trawlers. Following tests of the prototype built at the Centre, the device was mass produced by a commercial company under the Centre´s supervision.





Right: c. 1992. Crews onboard the *Manning* deploy the BARNY family of Acoustic Doppler Current Profilers bottom mounted platforms.
Photos by: Federico de Strobel.

The shift in focus from deep to shallow waters came with the advent of small dieselelectric submarines that could operate close to home base. Soon after, the geographical information systems programme started at the Centre, based on previous data which had been digitised and updated constantly with new digital data. However, what changed the most was the processing, which was reduced by one if not two orders of magnitude, from years to months to weeks. The new name of this task became Rapid Environmental Assessment, which was identified by NATOs Supreme Allied Commander Atlantic as a new underwater operational requirement in 1995.

Top Left: *c.* 1990s. XXXXXXX.
Bottom Left: *c.* 1990s. XXXXXXX.
Middle: *c.* 1990s. XXXXXXX.
Right: *c.* 1990s. XXXXXX.

Above: *c.* 1990s. XXXXXXX.

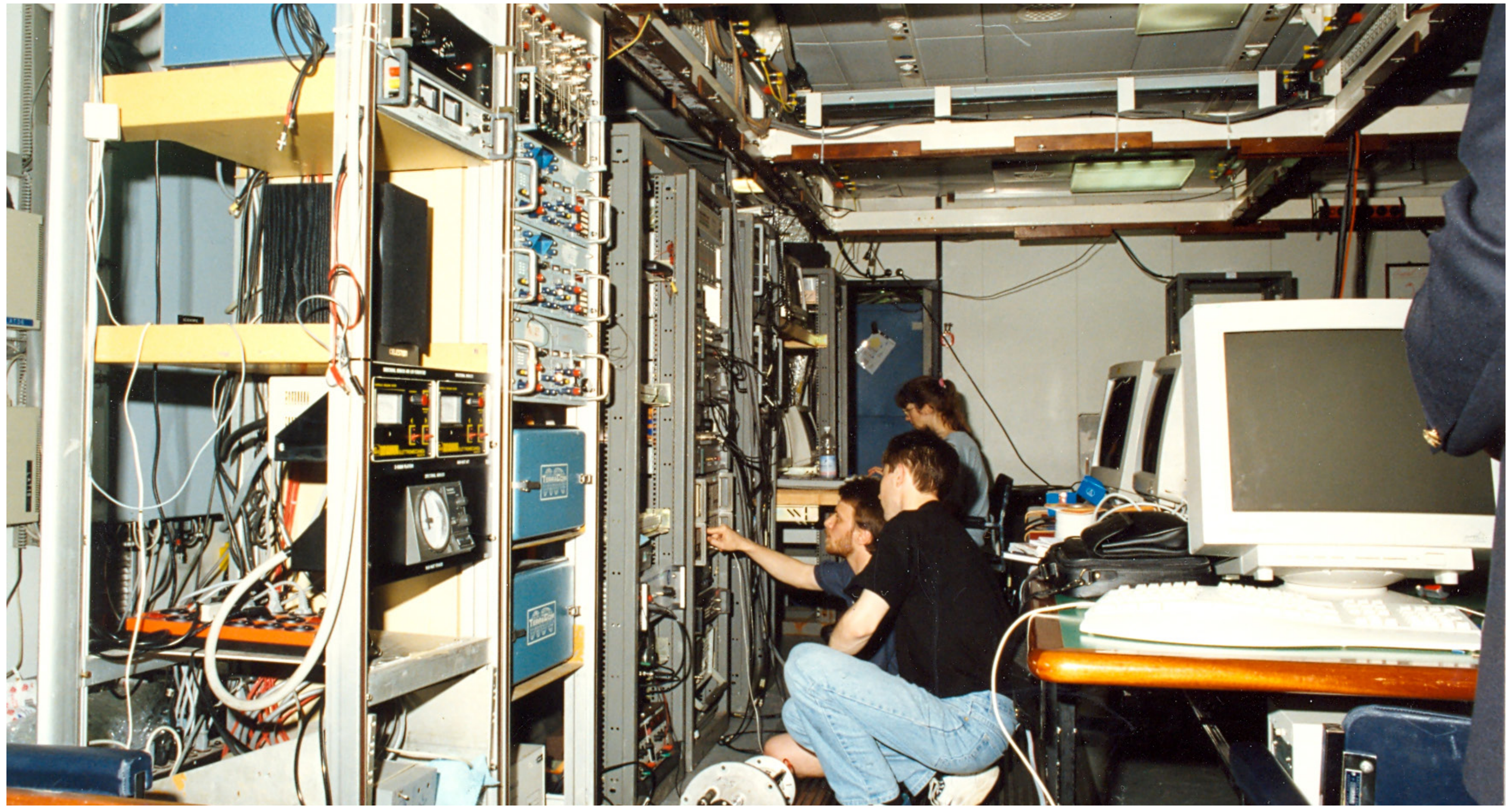
In the early ‘90s the Military Oceanography department in conjunction with the Engineering Technology Department developed a number of instruments to carry out Rapid Environmental Assessment surveys more effectively. The Expendable Bottom Penetrometer, developed in collaboration with Columbia University in the United States, could be launched from a ship, an aircraft or a submarine. The device was used to assess seafloor geotechnical properties and to classify its parameters in relation to mine burial. The first survey was carried out in 1996 in support of a naval exercise, Rapid Response 1996, involving naval and air assets provided by many NATO Nations.

c. 1990s. XXXXXXXXX.

Above: *c.* 1990s. XXXXXXX.

Above: *c.* 1990s. XXXXXXX.

In addition to antisubmarine warfare technology and military oceanography, operational research had been a key activity at the Centre. Mostly dedicated towards operational analysis and operational support, numerous software aids developed in the '90s were provided to NATO Nations through the Centre's Scientific Committee of National Representatives. Leveraging the knowledge acquired from different areas of activities, and showing how a multidisciplinary approach could produce useful tools for warfighters, the Centre was asked by several naval commands



Above: *c.* 1990s. XXXXXXX.

to provide them with antisubmarine warfare planning tools. The Centre was also involved in studies related to changes in naval forces and in exercise evaluation after the end of the Cold War. In order to optimize the protection of shipping vessels in the Mediterranean, the Commander Allied Naval Forces Southern Europe requested support for planning antisubmarine warfare operations. The Centre delivered a prototype software, extended to the whole Mediterranean in 1999, that provided guidance to generate safe convoy routes and search planning and enabled commanders to assess antisubmarine warefare mission effectiveness.

1991. Arial view of the Centre.

In 1999 the Sound Ocean Living Marine Resources programme was established, through which researchers visually and acoustically monitored and acquired information on marine mammals living in that area. During the 1999 experiment 869 individual animals were observed during 146 sighting events. Some whales were tagged with recording devices, and a whale finding sonar was also used.

Left: c. 1990s. XXXXXXX.
Top Right: c. 1990s. XXXXXXX.
Bottom Right: c. 1990s. XXXXXXX.

A New Millennium:
The Early 2000's

As the Centre transitioned into the new millennium, the Ship Management Office developed the mission profile and requirements for a new ship with a size comparable to that of the Manning, but with the silent movement and scientific support capabilities of the NRV Alliance. The Coastal Research Vessel Leonardo was commissioned in La Spezia on the 6 September 2002 as the first Italian public vessel. The new ship, measuring 27.5 m long, with a 260 ton displacement, was equipped with a dynamic positioning system that gave the vessel the ability to sail between 0 and 5 knots in silent mode. With a berthing space for up to 10 people, the CRV Leonardo can host up to 15 persons for a day cruise, and has been designed to integrate a 20 feet laboratory container which augments the 35m2 onboard laboratory. As the use of unmanned or remotely operated vehicles was becoming more and more frequent, the CRV Leonardo turned out to be a perfect support ship for those systems.

Right: c. 2002. The CRV *Leonardo* sails in La Spezia.

2013. The NRV *Alliance* and CRV *LEONARDO* sail together in La Spezia.

Above: 2002. XXXXXXXX documenting deep sea communications tests.

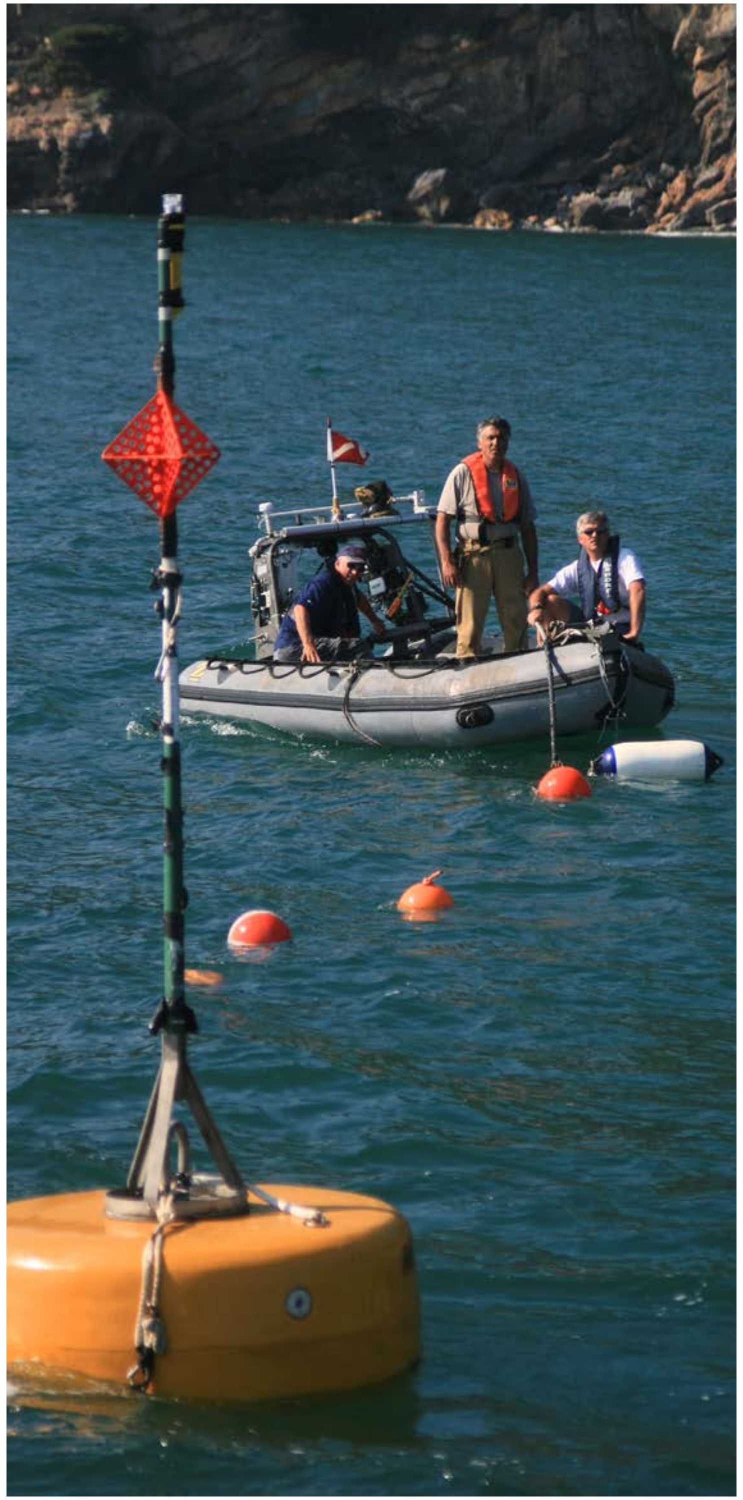
Underwater communications and data fusion became increasingly important topics in the early 2000s. Harbour protection, mine countermeasures operations and antisubmarine missions were completed with the aid of unmanned underwater vehicles and enhanced by the use of underwater communication and networking techniques. The Centre assumed a pivotal role in advancing communications between underwater systems leading towards extending an interconnected communications network deep into the sea.

Above: c. 2000s. Researchers onboard the *Alliance* running deep sea communications experiments.

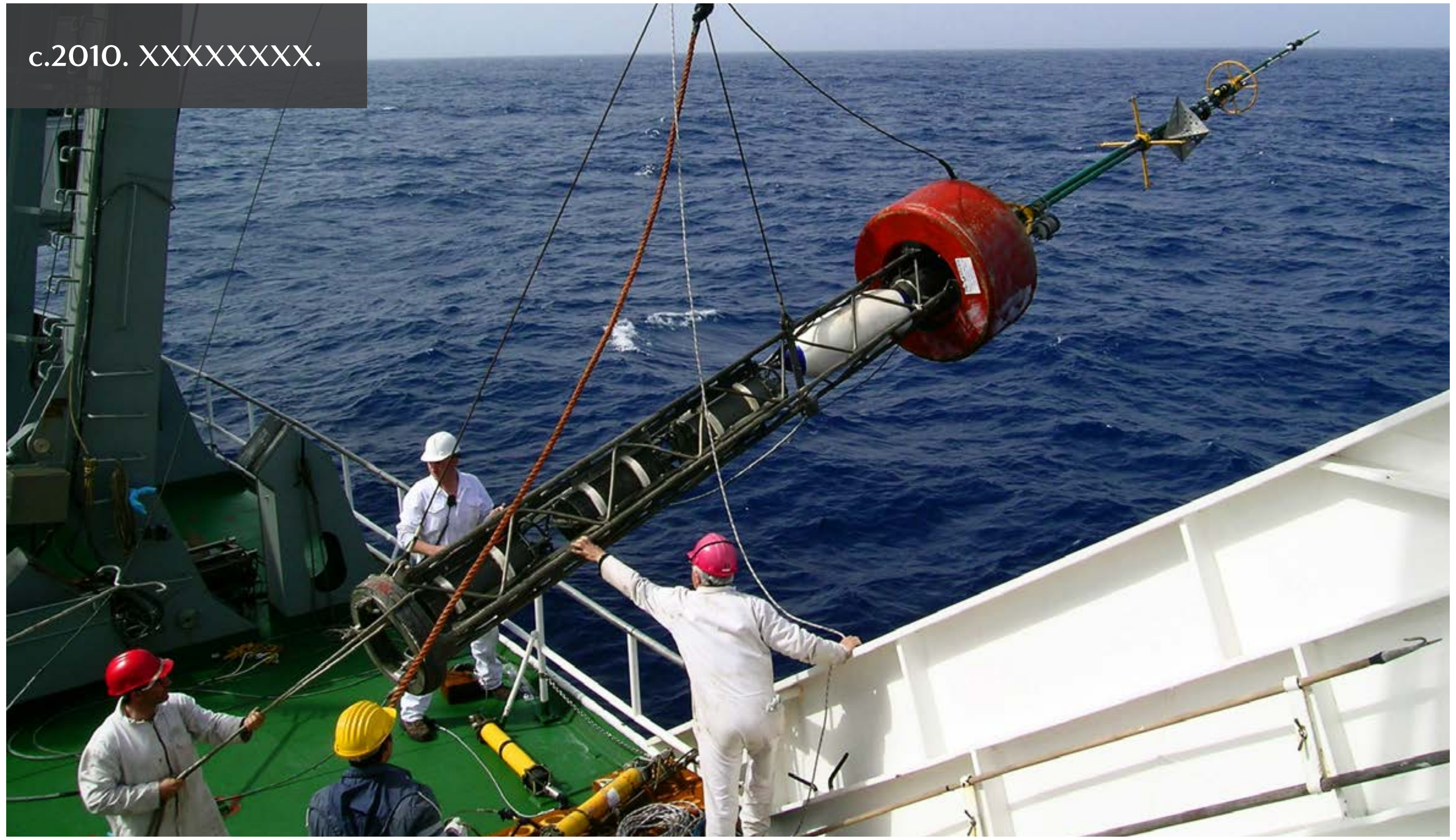
During the 2002 Prague Summit, NATO´s military command structure was reorganized with a focus to become leaner and more efficient. On 19 June 2003 the Centre´s name was changed from SACLANTCEN to the NATO Undersea Research Centre, referred to as NURC, and the Center´s field of activities were considerably extended. The focus of the Centre was shifted from regional crises to expeditionary and asymmetric warfare, with operations on sea, air and land, with an increasing attention to undesired collateral damages. To conduct research that would support NATO forces facing new maritime threats, the Centre started to move into areas that are not limited to the undersea world, covering maritime, coastal and surface problems, for example, supporting amphibious landings.

New NATO missions required a more comprehensive view of the environment, and a shift was made from military oceanography to meteorology and oceanography, as the interaction between the ocean and the atmosphere becomes more significant closer to the coast, and weather forecasting becomes more uncertain.

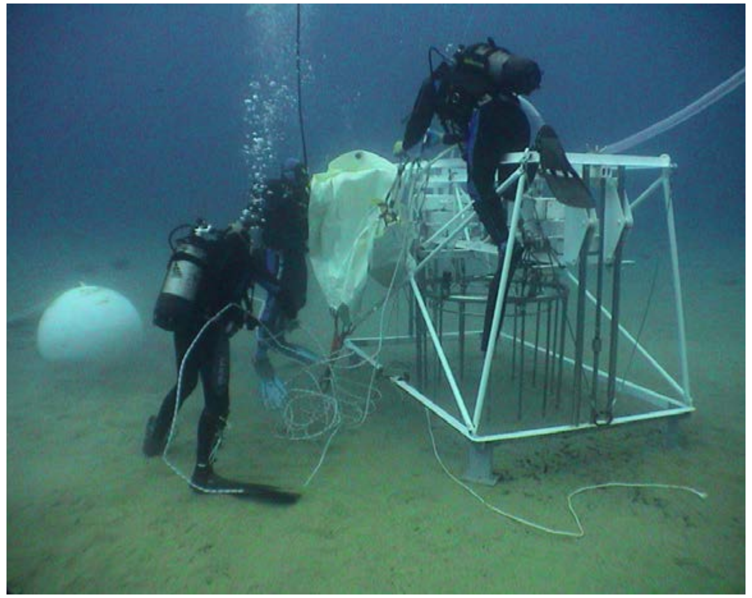
In 2007 Maritime Situational Awareness was added on to the Center´s portfolio of research programmes. Such work was a natural extension from projects in surf zone monitoring, leveraging the Centre´s expertise in underwater acoustics, exploiting the same tools with a different set of parameters. The objective was to develop tools based on software and algorithms to detect abnormal movements in ships, fusing data coming from different sensors. A Maritime Data Simulator was developed to help the optimisation of surveillance assets needed to cover a specific area.

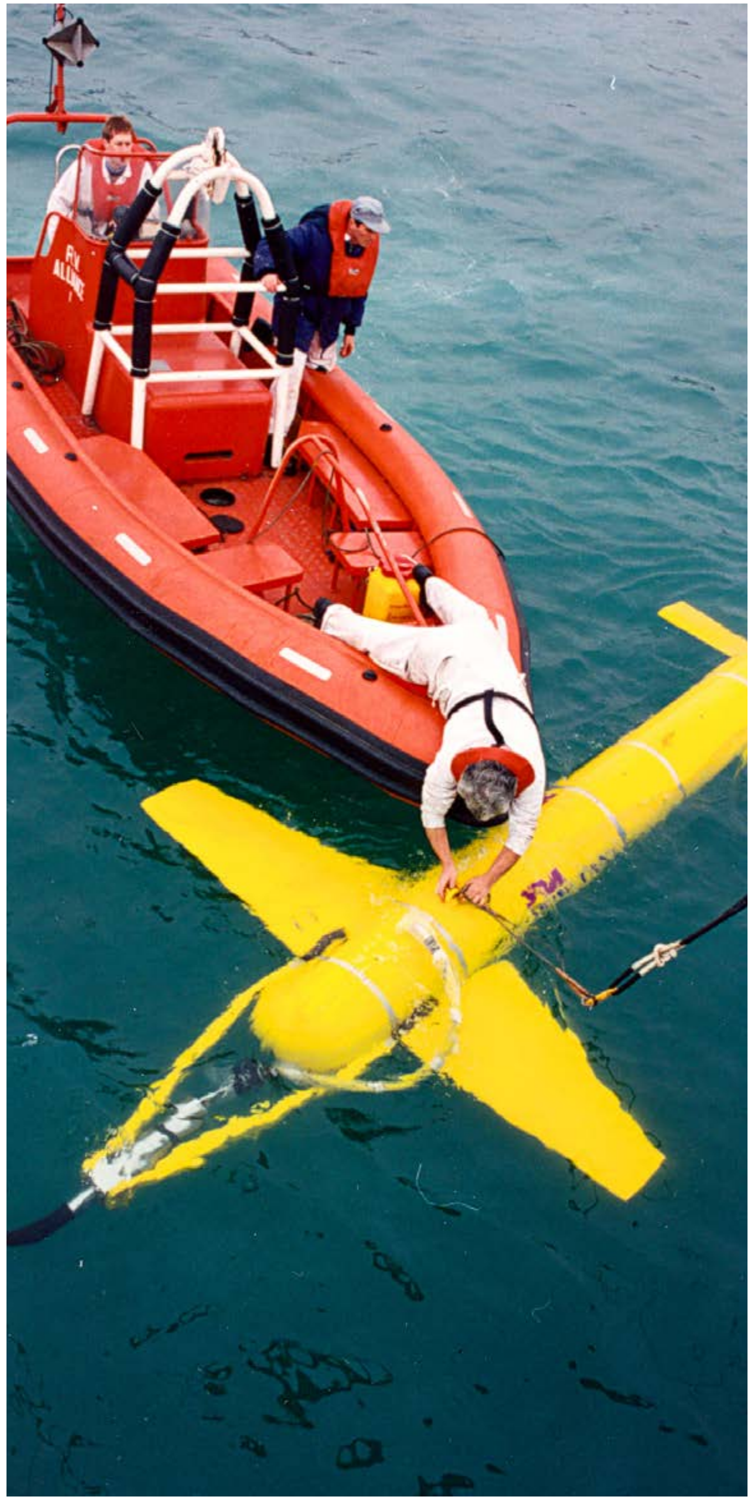


Right: 2008. XXXX
Photos by: Andrea Cavanna.



c.2010. XXXXXXXX.





Advances in technology led to the commissioning of new classes of silent and highly maneuverable submarines. Researchers from the Centre continued to focus on submarine detection by improving target detection, tracking and classification, and reducing false alarm rates caused by clutter. The Centre was a pioneer in the field of multistatic sonar. In particular the Cooperative Antisubmarine Warfare programme, started in 2009, took an integrated approach to investigate novel and innovative mechanisms to counter the quiet, small, diesel-electric submarines.

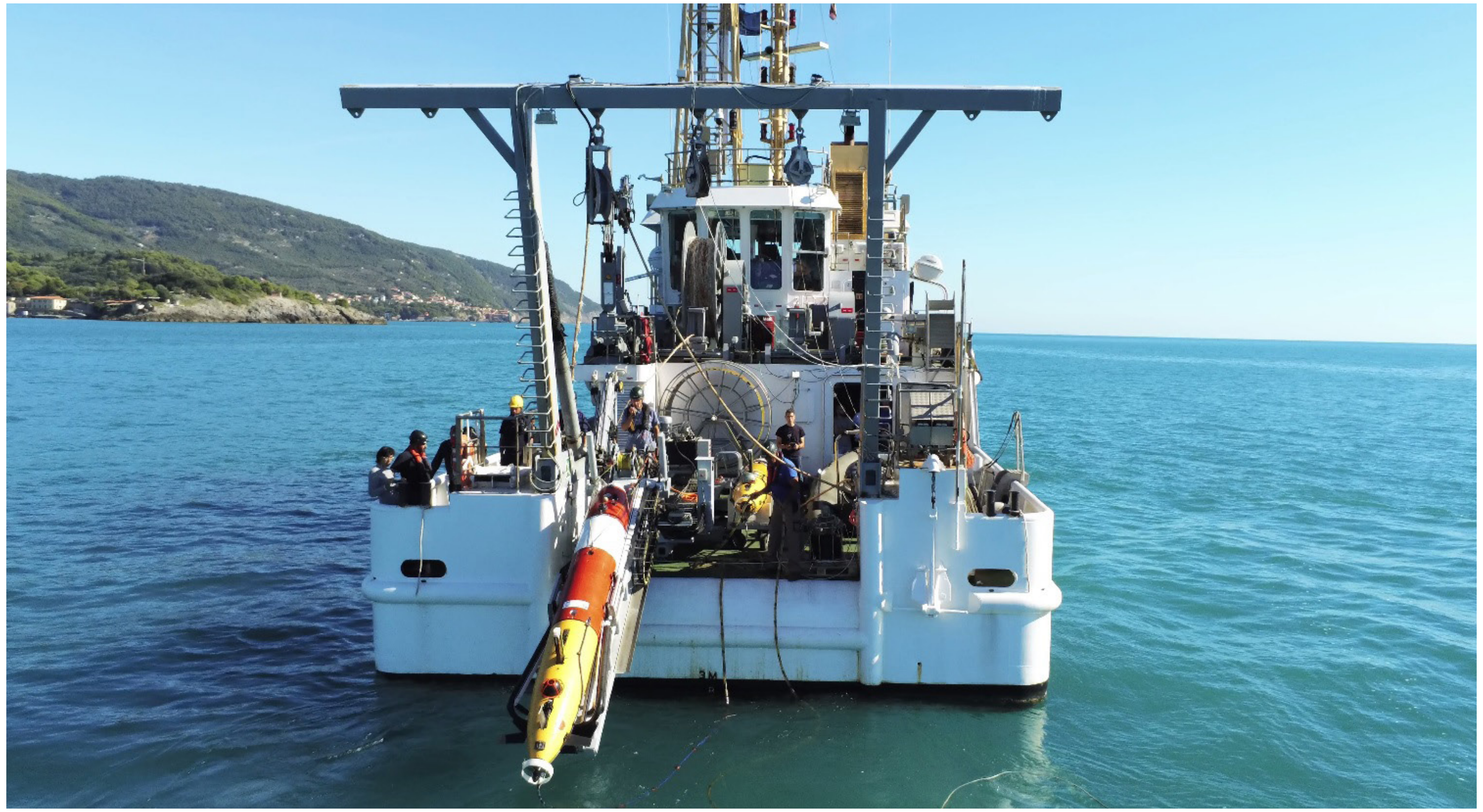
Right: *c.* 2000s. XXXX.

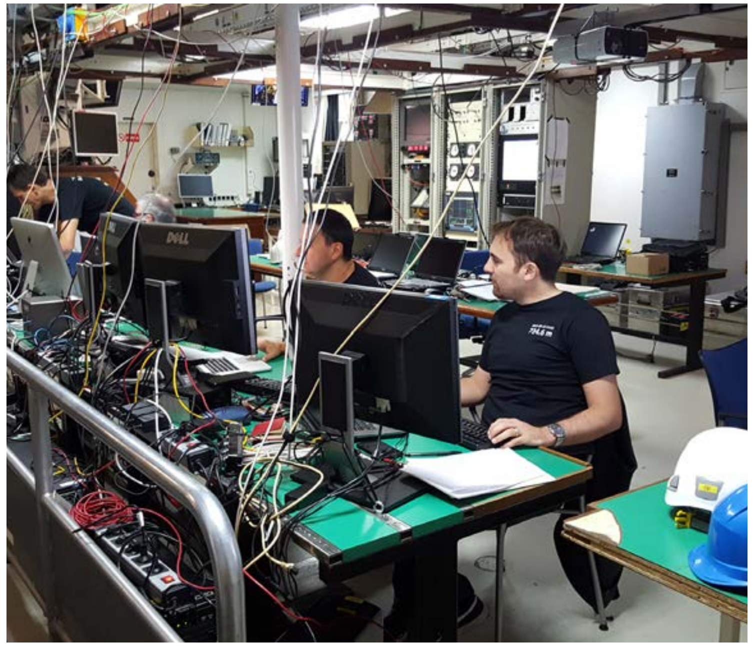
Toward the Future:
2010 and Beyond

At the November 2010 Lisbon Summit NATO leaders endorsed a new strategic concept to engage in a process of continual reform including streamlining working methods and maximising efficiency. In 2012 the NATO Science & Technology Organization was established as a NATO subsidiary body to the North Atlantic Council with the mission to help to strategically position the Alliance's science and technology investments in areas that advantage defence and security.

Within the framework of the STO in-house delivery business model, the Centre's name was changed to the Centre for Maritime Research and Experimentation (CMRE), with the specific mission of organizing and conducting maritime scientific research, technology development, and experimentation to deliver innovative and field-tested science and technology solutions to address the maritime defence and security needs of the Alliance. The Centre has great strides in expanding its reach.

Right: 2019. XXXXXXXXX.





In recent times, in addition to providing science and technology research, CMRE has demonstrated the value to be gained from much closer ties with the operational community. The Centre has unique capabilities to support the operational community in a number of areas including through the introduction of prototypes (hardware and software), analyst support, and through operational experimentation during maritime exercises. In 2017, CMRE worked with the Allied Maritime Command to introduce Maritime Unmanned Systems into antisubmarine warfare exercises.

Left: 2018. XXXXXXX.

2018. XXXXXXX.

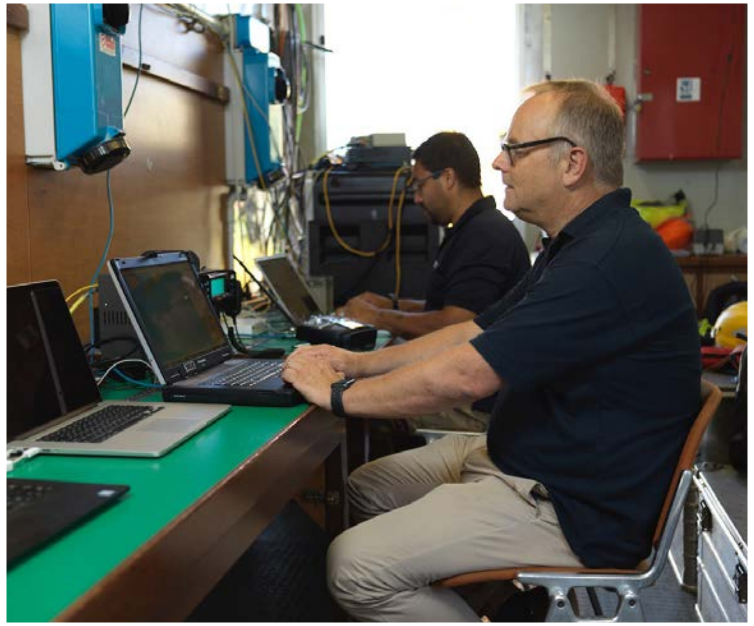
Above: 2019. CMRE Modelling and Simulation team.

CMRE remains a recognised centre of world-class expertise, at the leading edge of Maritime Unmanned Systems development, intelligent autonomy, data mining. deep-learning, and distributed networked sensing research. The Centre continues to conduct cutting-edge

Above: 2019. CMRE Modelling and Simulation team.

maritime research and experimentation in extremely challenging ocean conditions. It provides an outstanding at-sea research environment where internationally recognized scientists and engineers from NATO Nations uniquely share their knowledge and experience while delivering results more economically than would be possible by Nations independently.

2019. CMRE staff at work.

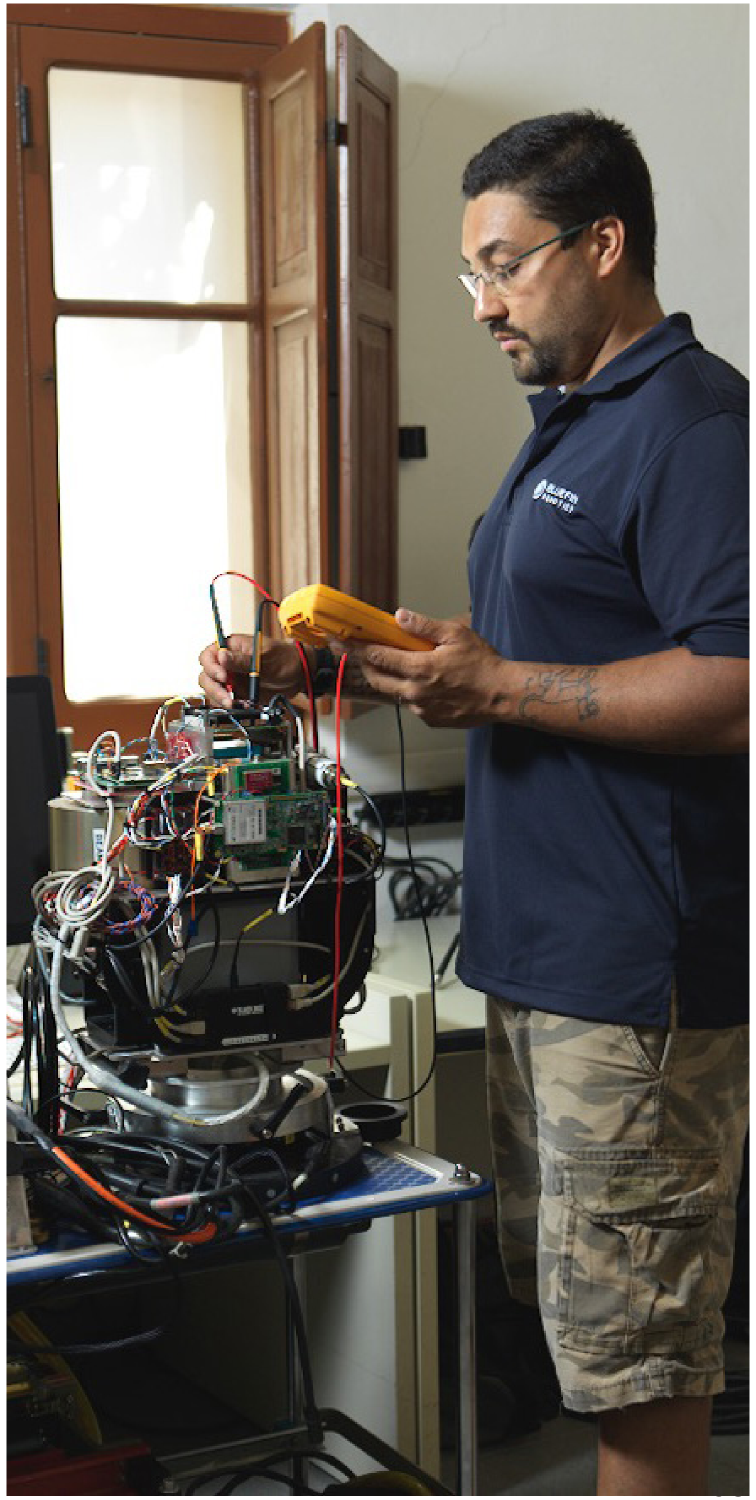


Above: 2019. CMRE Director Dr Catherine Warner works with local highschool students onboard the *Leonardo*.

Outreach to local and international students involved in science, technology and engineering is part of CMRE programming. In 2010 the Centre began organising the Student Autonomous Challenge-Europe (SAUC-E) at the CMRE sea water basin. This robotics tournament has become the leading student Autonomous Underwater Vehicle competition in Europe, bringing the engineers of tomorrow to CMRE.

Right: 2015. European Robotics League Tournament hosted by CMRE.
Photos by: Cesarini.

The Centre is at the core of international efforts to develop autonomous maritime vehicles, essential to the effectiveness of future maritime hybrid forces. Unmanned and autonomous systems will create fundamental shifts in the conduct of naval operations. The work at CMRE in this area focuses on developing and testing innovative, interoperable technologies at sea, thereby helping to de-risk the introduction of unmanned systems to the maritime operational community. The creative application of commercial off-the-shelf products and the development of associated mission logic is a highly effective way to inject new technology into NATO maritime missions.



Right: 2019. Engineers at work at CMRE.

2018. The *Alliance* in the High North.

2019. The crew of the *Alliance*.

2017. XXXXXXX.

CMRE has more than 60 years of experience as a collaboration hub within NATO intended to accelerate the development and introduction of new technologies while ensuring interoperability. As Nations commence the journey to unmanned autonomous maritime solutions, CMRE will be a key facilitator of a smooth transition to a new portfolio of interoperable capabilities. The Centre has a key role to play as the maritime collaboration hub for NATO, both in the laboratory and at sea. Collaboration is key, both to interoperability and the development of disruptive technologies and new approaches. The Centre has fulfilled this role effectively in the past and continues to do so now and into the future when the benefits to military capability and economies of scale are clear for all to see.

Left: 2018. XXXXXXX.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