

Il Test Bed marittimo del CNR

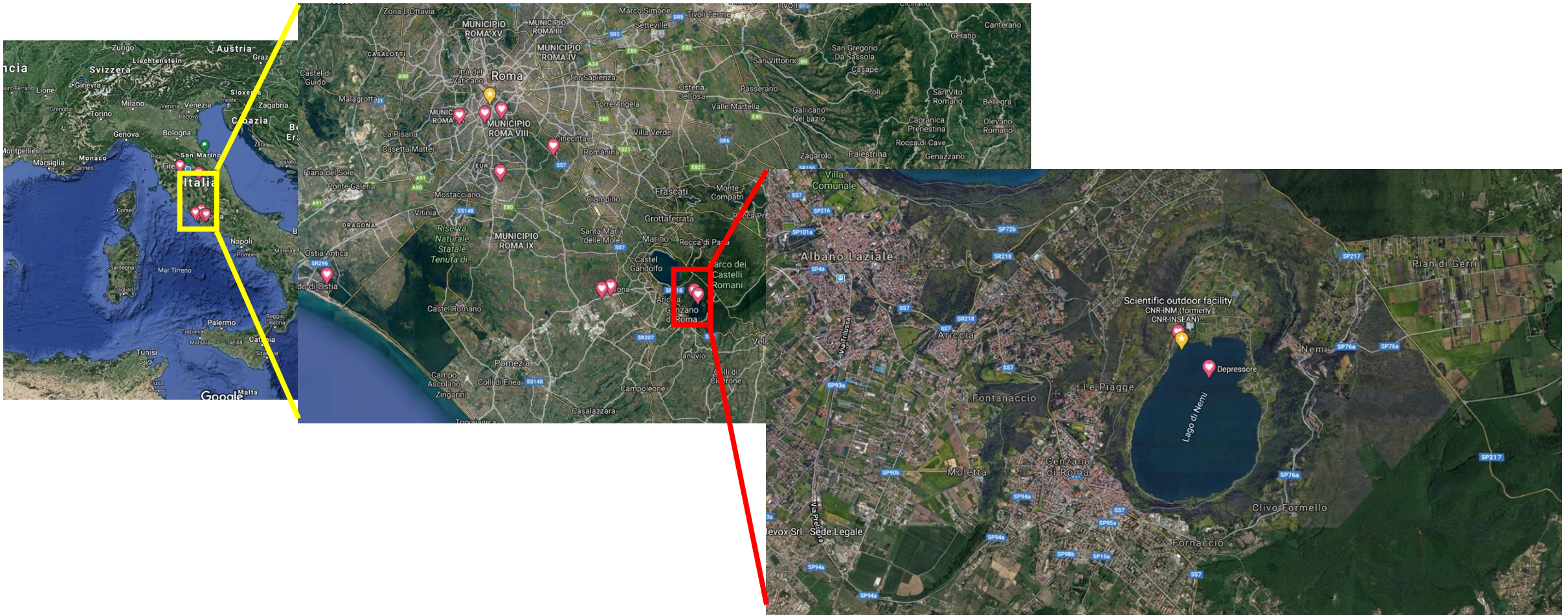
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Sinossi

- **The Outdoor Facility**
- **Experimental activities at the Nemi Lake (Manoeuvrability)**
- **Experimental activities at the Nemi Lake (UW acoustic)**
- **Future activities as MASS test area**

The CNR-INM's outdoor facility on the volcanic lake of NEMI

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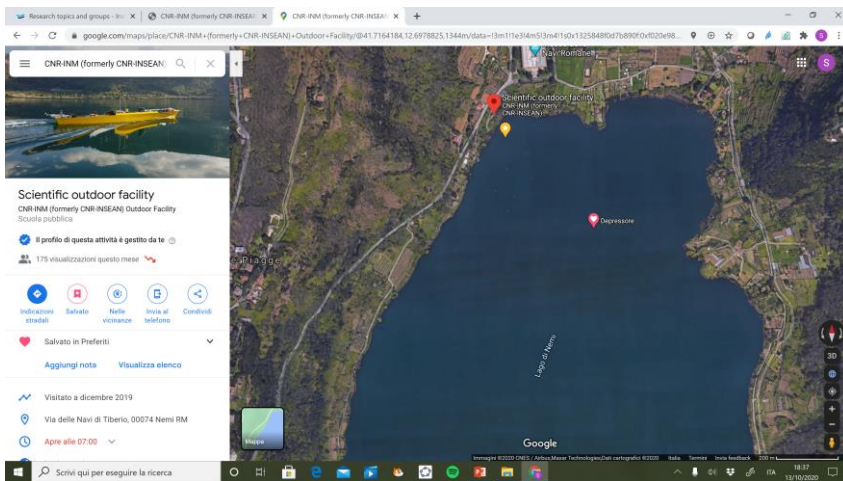




- **Since 1937** is the Outdoor Maneuvring Basin at INSEAN
- Database of more than 5000 test carried out on more than **50** ship models **manned**
- **From 1960** is part of the **ITTC's** (International Towing Tank Conference) catalog of facilities



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Type of tests:

Experimental meth.:

Sep-up of the meth.:

Activities carried out:

R&D:

Database:

What we verify [∇ , V , Δ , $(r-a)$, $d\delta/dt$]

What we measure (standard)

Manoeuvrability/Controllability (IMO/ANEP)

Free running self-propelled **unmanned** surface ship's models

1998

new ships/existing ships of the Italian Navy and other Navies (NATO and extra NATO)

PNRM (Prossima, Prossima II), EDA (FLOWIS)

More than 10000 test carried out with unmanned ship's models

Rudder's effectiveness/efficiency (size, shape, position, etc.)

DGPS (x_g , y_g , speed), gyro (ψ , $d\psi/dt$), IMU (6 DOF), n_r , T_r , Q_r , n_l , T_l , Q_l , Q_δ

Constrains on the size of the model and on the tests conditions

Max dimension of the ship's model

10m

Δ_{max}

1500 Kg

Speed max.

10 m/s

Speed min.

0.05 m/s

Any restriction on the duration in time of the single test (irrespective of the speed of the test)

Any waiting time between consecutive tests (irrespective of the speed of the test)

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The CNR-INM Outdoor Facility at the Lake of Nemi



UW Noise measurements

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Data collected at the outdoor basin

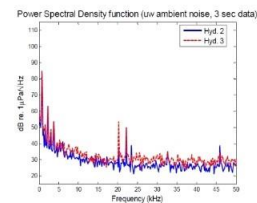


Figure 1: PSD function of 3 seconds of "test" data file recording lake ambient noise around 10:46 AM.

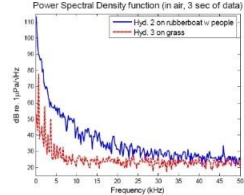
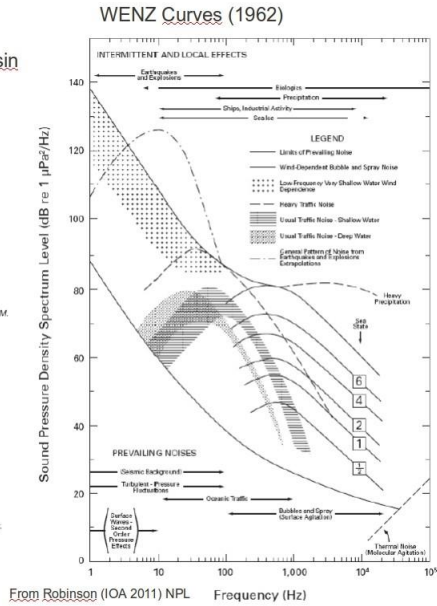
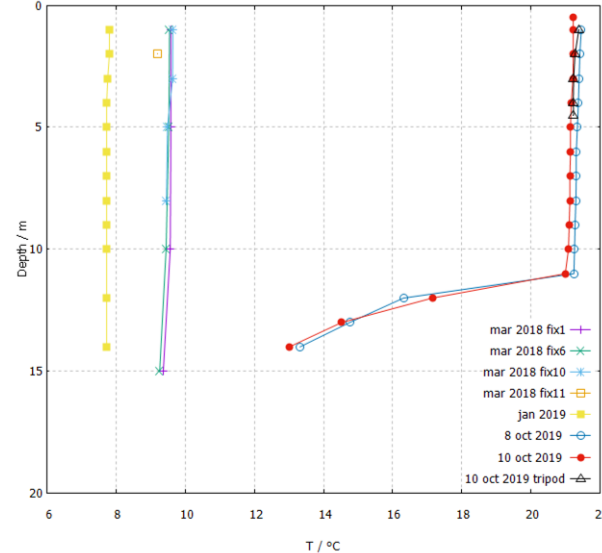
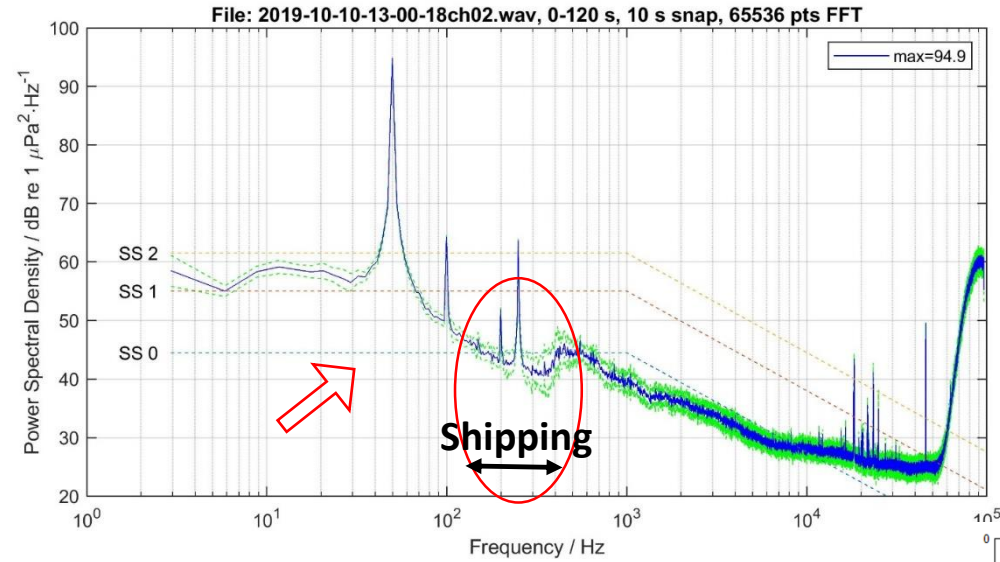


Figure 2: PSD function of 3 seconds of "12:33:09_001" data file recording ambient noise in air.



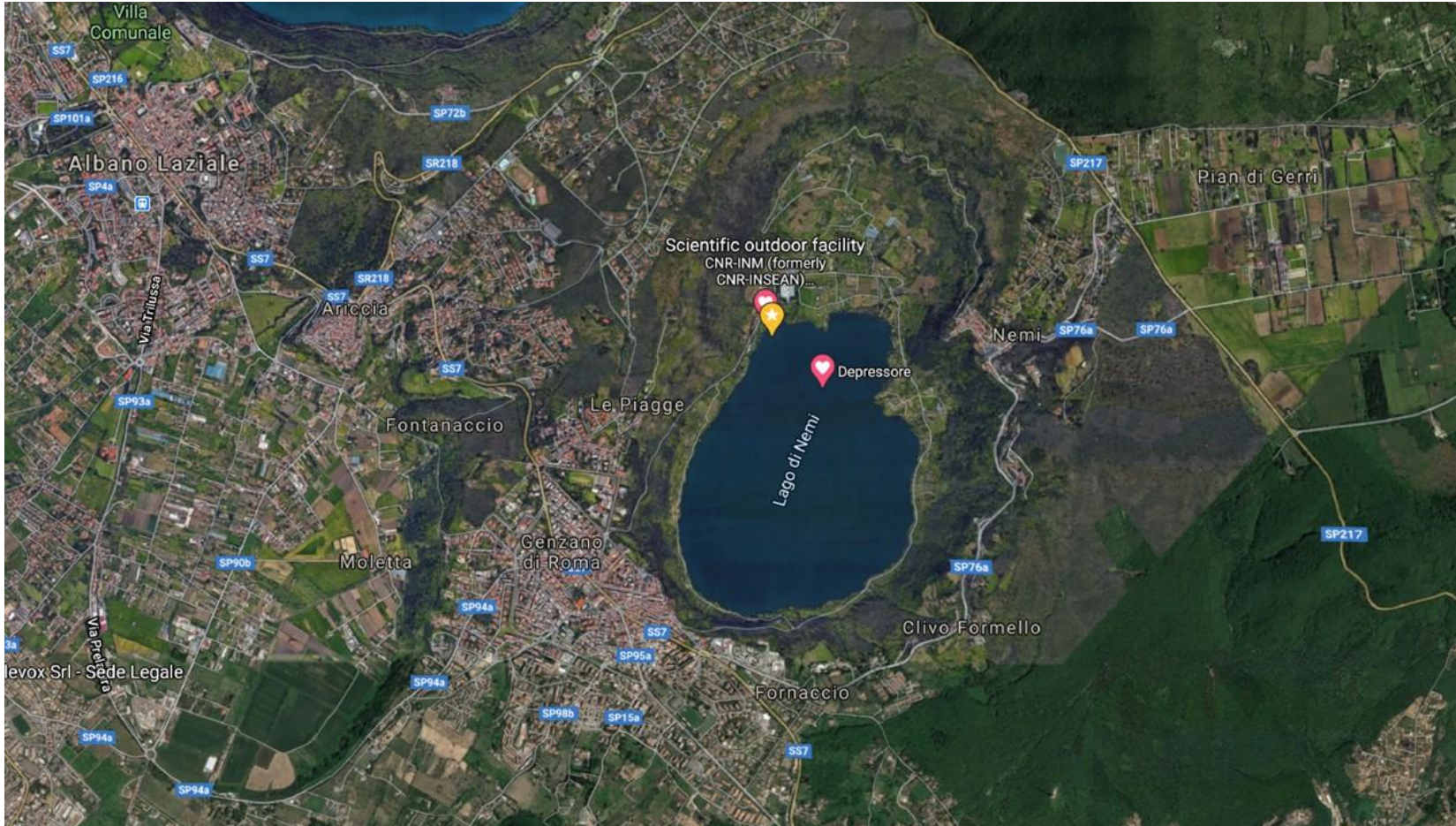
From Robinson (IOA 2011) NPL



$1\text{m} < \text{depth} < 11\text{m} \rightarrow \Delta T \cong 13^\circ\text{C}$

The future of global navigation is focused on raising MASS (Maritime Autonomous Surface Ships) level

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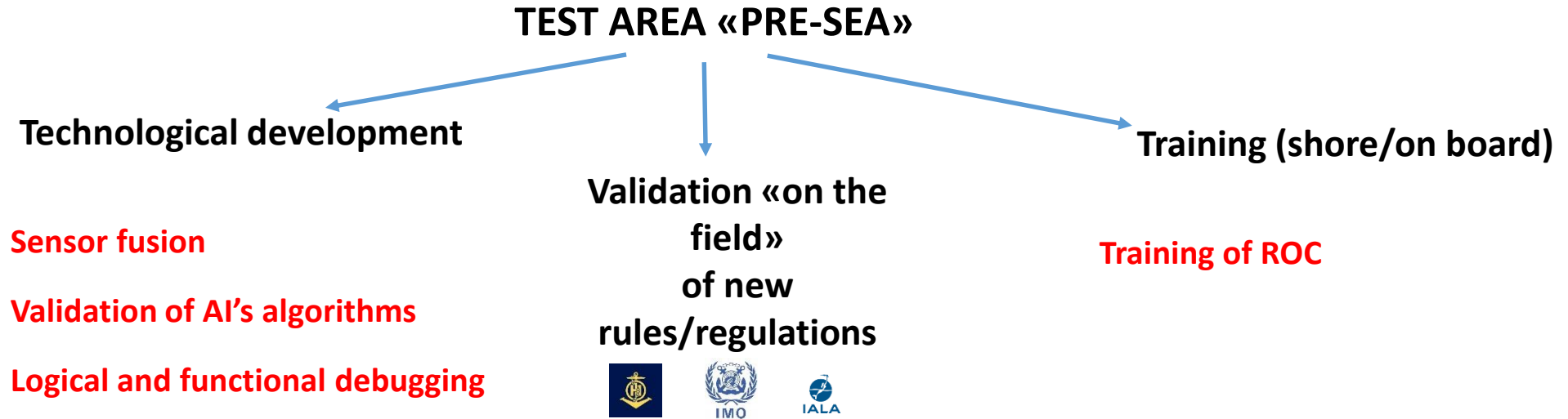


Our proposal is to realize an operative MASS=4 test area

**In fresh waters
(volcanic lake)**



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ADVANTAGES (lake vs sea)

Absence of manned traffic	Logistic area already existing (to be adapted) + No permission required	Test of a large number of scaled autonomous vessels already at MASS=4 level (technological cooperative ecosystems both surface & underwater)	High economicity and safety compared with an equivalent test area at sea	Scalability
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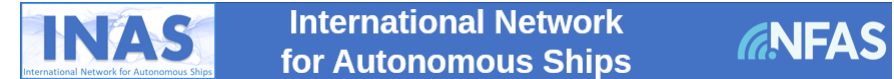
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Member of the SSC (Smart Ship Coalition) Network <https://smartshipscoalition.org/>



Member of the INAS (International Network for Autonomous Ships)

<http://autonomous-ship.org/index.html>



Member of the MASS People (International Working Group for Remote and Autonomous Training Standards)

<https://www.fugro.com/media-centre/news/fulldetails/2021/02/18/fugro-launches-masspeople-international-working-group-for-remote-and-autonomous-training-standards>



Member of IMO_MASS CG_Italy (led by Italian Coast Guard)



Scientific projects on MASS>2 topics:

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In partnership with:

- **SUNMARE**



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Il progetto **SUNMARE** (**S**urface **U**n**M**anned multipurpose research **M**ARine **V**eh**E**icle)

IL GRUPPO di RICERCA:

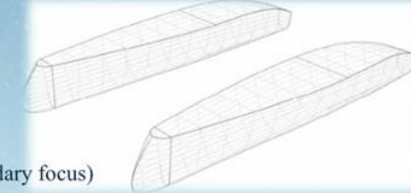
- **CNR - Istituto di Ingegneria del Mare (INM, ex INSEAN):**
Dott. Massimo De Lauro, Dott. Salvatore Mauro, Dott. Ing. Malito Alec
- **La Sapienza - Dipartimento di Ingegneria Meccanica e Aerospaziale (DIMA):**
Prof. Antonio Carcaterra (Coordinatore), Prof. Antonio Culla, Dott. Gianluca Pepe, Dott. Federica Mezzani, Dott. Ing. Maicol Laurenza

I PRODOTTI:

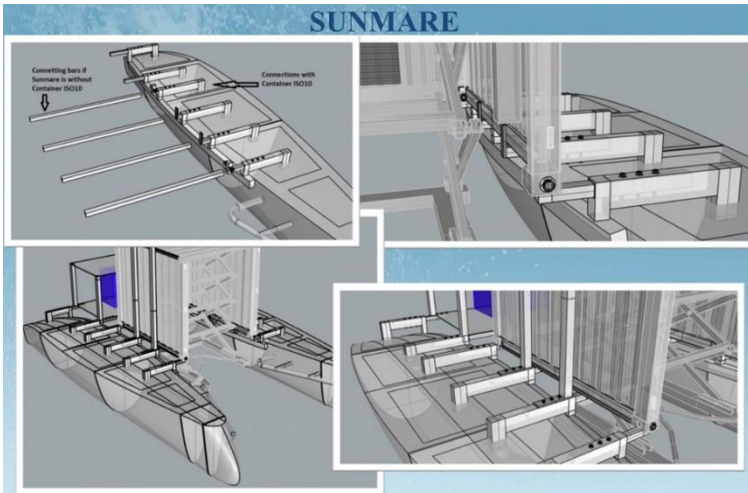
- Progetto funzionale (**CON**cept of **OP**eration**S** (**CONOPS**)) di una imbarcazione autonoma di 10 metri per le attività in mare di ricerca e applicazioni tecnologiche.
- Studio di fattibilità tecnico economico di un modello gestionale pubblico/privato

Technical Specifications

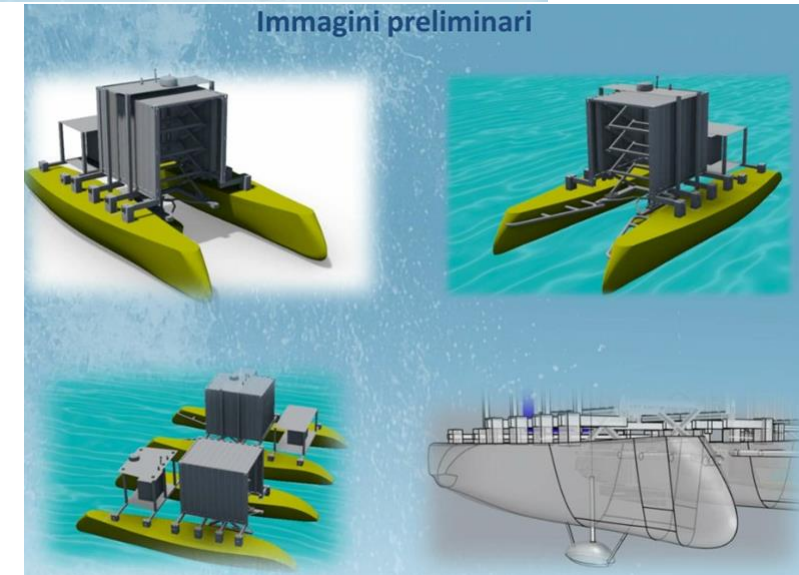
- **Tipologia:** Catamarano o Similare
- **Materiale di costruzione:** alluminio o VTR
- **Lunghezza:** 10m Lol
- **Larghezza :** 5,8m in grado di trasportare un container ISO10
- **Attività:** scientifica e tecnologica in un range di profondità operativa da 3 a 200 metri
- **Punti di forza:** Smontabile e trasportabile senza necessità di trasporto eccezionale, stabilità di rotta e alta manovrabilità, basse emissioni di rumore e di inquinanti
- **Tipo di Navigazione:** Non meno di navigazione costiera nazionale certificata da ente di classifica MASS 3 (IMO) , Italian flag.
- **Motori:** 2 Motori ibridi con propulsori pod.
- **Energie alternative :** Pannelli fotovoltaici
- **Carico pagante:** container ISO10, 2t.
- **Range in fuel mode:** 75h.
- **Range in fully electrical mode:**
7h in research mode (primary focus) or 3h in transfer mode (secondary focus)



Laurenza, M., Pepe, G., Mezzani, F., Malito, A., De Lauro, M., Mauro, S., Culla, A., Carcaterra, A., » *Surface Unmanned Multipurpose Research Marine Vehicle: SUNMARE Project*», Proceedings of NAV 2022, pp. 522-529, doi:10.3233/PMST220062



Immagini preliminari



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Expected contribution of an Italian MASS Test Range



- Increase the contribution of the Italian scientific and industrial community to the proposition in international context of requirements, procedures and certifications for MASS
- Support the expansion of national industrial expertise related to the shipbuilding, aerospace, naval, electronic and telecommunications sectors in the development of new products and skills for MASS
- Create new professional figures and lines of research in the MASS sector
- Test and validate new vessels, devices, subsystems, apparatuses and procedures for MASS
- Contribute to the certification of boats, devices, subsystems, apparatuses and procedures for MASS, according to present and future international regulations
- Train ground personnel for MASS operations
- Activate international cooperation and contribute to the dissemination of best practices and national technologies in the MASS sector

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Project Phases

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Co-funded by NAVISP – Element 3

12-15 months

12-18 months

...continued

...continued

**Design and preliminary
MASS demo**

**Complete Test Range
Set-up**

**MASS
Demonstrations**

**Open Sea
Validation**

Operational phase

↑ Analysis and definition
of the requirements

↑ Detailed design of the
Test Range

↑ Algorithms Analysis

↑ Preliminary set up and
MASS Demo

↑ Preparation and
setup of buildings

↑ Development

↑ Complete Test Range
Installation &
validation

↑ MASS Demo

↑ Initial exploitation

↑ Standards &
Procedures

↑ International
cooperation

↑ Validation in
open sea
scenario in
specific
controlled areas

↑ Certification of
technologies,
devices and
systems

↑ Validation of
innovative
technologies and
equipment



NAVISP EL 3 - 30

ESA Contract No. 4000143254/23/NL/GP/dg



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