
CDR (OF-4) Gustavo Gómez-Pimpollo Crespo(ESP N)
Deputy Director

Supporting ASW & Amphibious Operations using MUS

23 MAY 2024



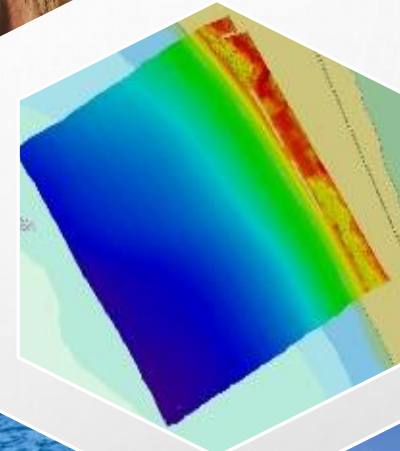
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AGENDA



1. ACT
2. What is a NATO accredited COE?
3. NATO MGEOMETOC COE
4. REA SUPPORT (ASW, MCM & AmphibOps)
in MUS exercises



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COEs under the umbrella of ACT



ACT oversees 29 COEs + one in progress to be established soon (CC&S COE in Montreal-Canada)

- Establishment:29
- Accreditation:28
- Periodic assessment:

For all COEs accredited every 3 years

COEs are classified in Clusters

COEs do not receive funding from NATO

COEs cover the gaps within NATO in a functional area

- One foot within NATO
- One foot outside NATO

- No part of the NATO Command Structure or of other NATO entities

- More flexibility in the relationship with other international and civilian entities



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ABOUT US



What is a NATO Centre of Excellence (COE)?

It is a multi-nationally established and sponsored entity, accredited by NATO, offering recognized expertise and experience to support the transformation of the Alliance.

COE's activity focus the four transformation pillars of the Alliance:



**CONCEPT DEVELOPMENT
& EXPERIMENTATION**



**DOCTRINE DEVELOPMENT
& STANDARDS**



EDUCATION & TRAINING



**ANALYSIS
& LESSONS LEARNED**

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ABOUT US



What is the background of the NATO MGEOMETOC COE?

- Excellence of the work carried out by the **Portuguese Navy GEOMETOC Centre**
- Expertise of the **Portuguese Hydrographic Institute**, a Navy body and National State Laboratory, internationally recognised
- **Fulfil the existing gaps** on Maritime GEOMETOC in NATO



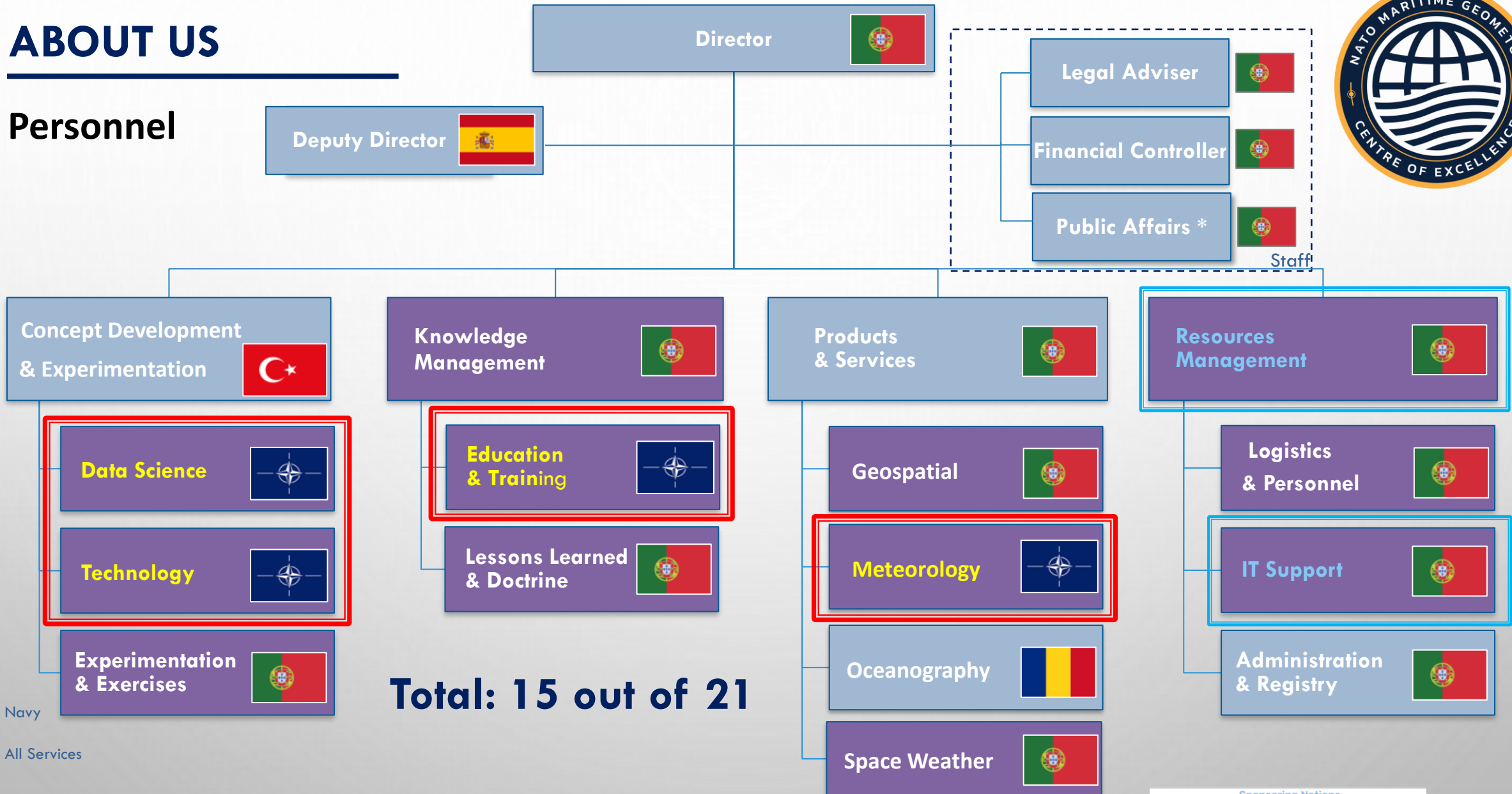
- **Portugal** is the MGEOMETOC COE Framework Nation
- **Romania, Spain** and **Türkiye** are the MGEOMETOC COE Sponsoring Nations



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ABOUT US

Personnel



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NATO MARITIME GEOMETOC

Mission

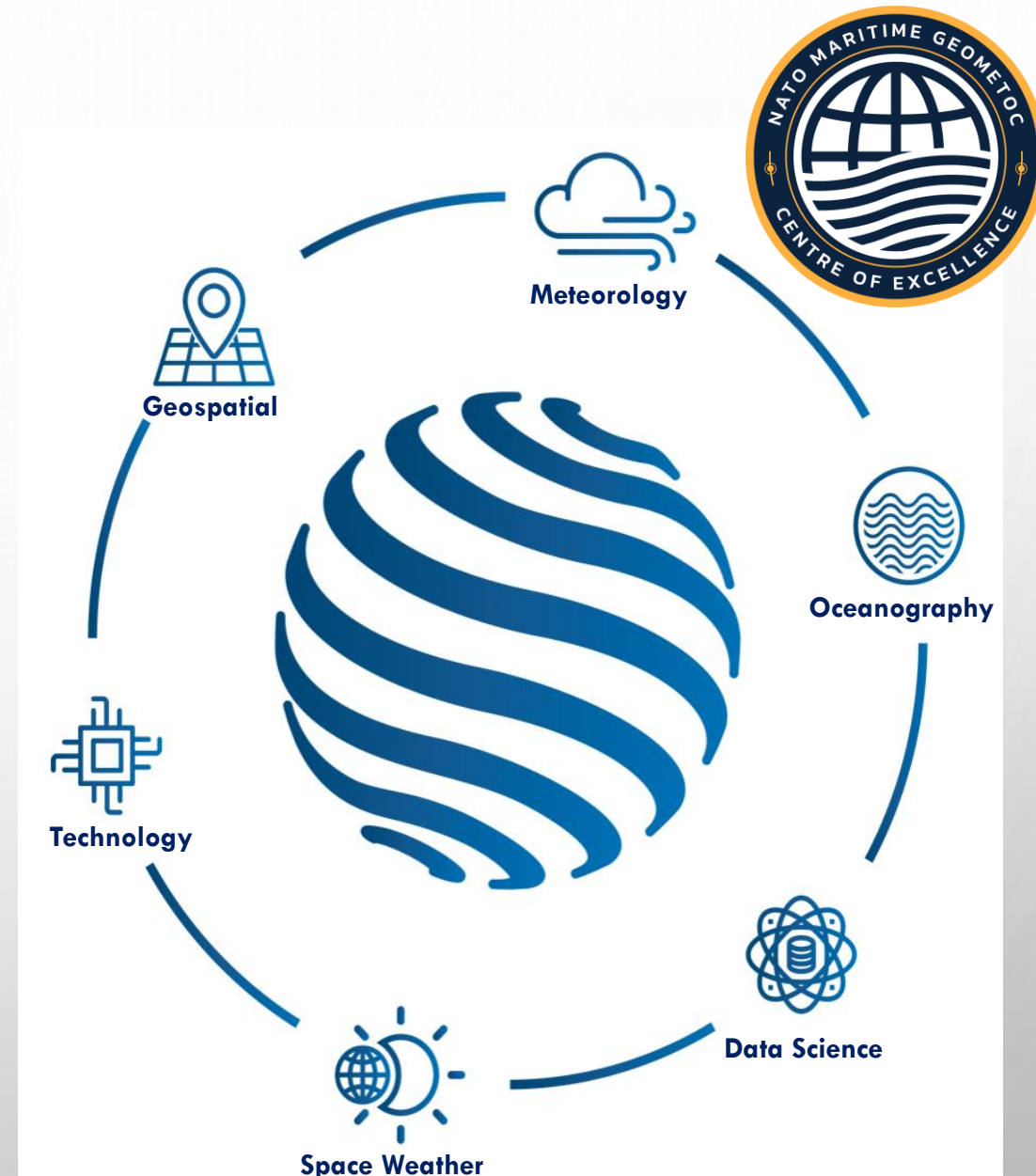
To enhance the transformation efforts in the field of Maritime GEOMETOC to the benefit of the Alliance.

Vision

To be an internationally recognized hub of expertise, working to expand the capabilities in the field of Maritime GEOMETOC.

Aim

To explore maritime battlefield environment in order to optimize the employment of sensors, weapons, targeting, logistics, equipment and personnel.



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NATO MARITIME GEOMETOC



HOW does the MGEOMETOC COE enhance the Alliance's transformation effort in the development of GEOMETOC Support capabilities?

- Enabling close cooperation within NATO and between NATO and partners (including industry, academia and international organisations), in the development of collaborative partnerships networks.
- Conducting results-oriented research, studies, experiments, analysis, education and training, while applying lessons learned and best practices, within the Alliance.



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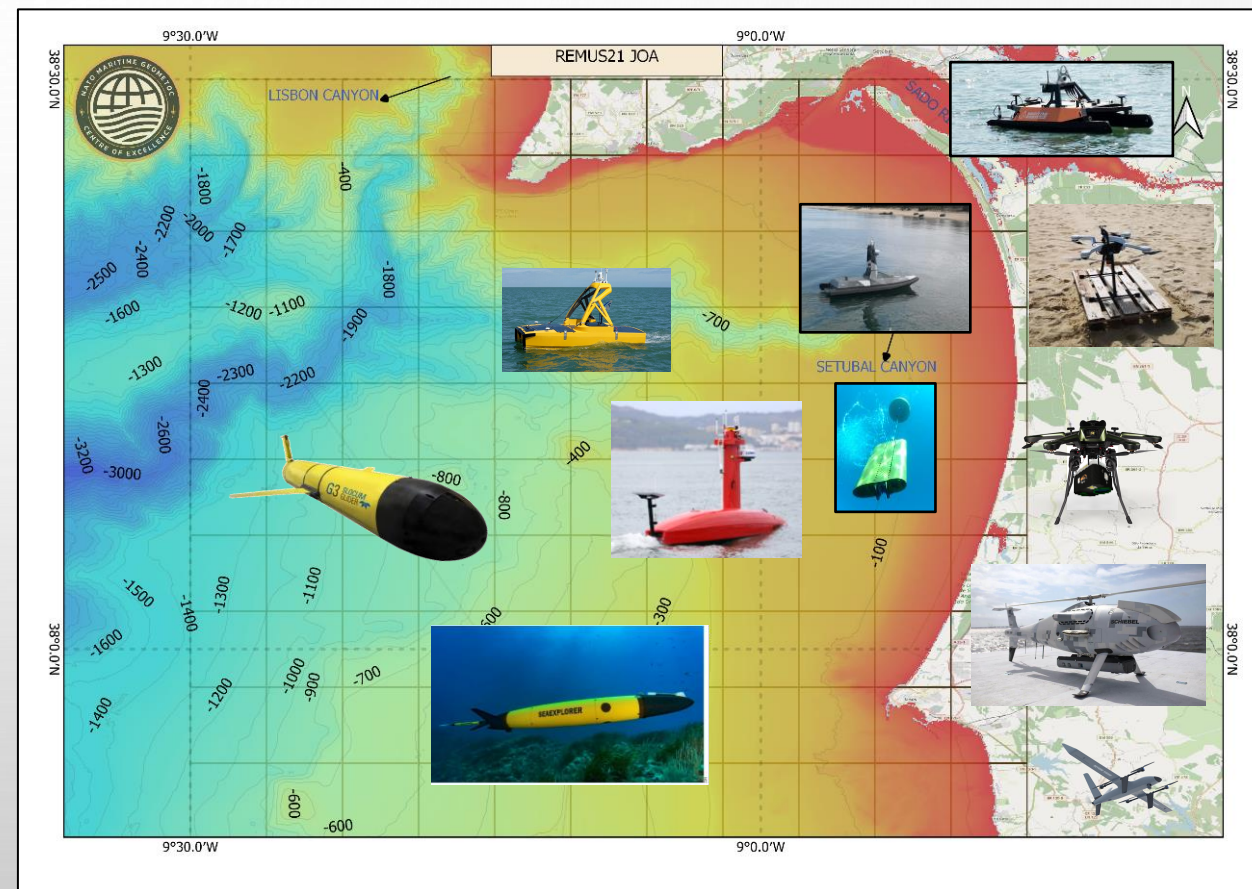
REPMUS23

REA MUS ASSESSEMENT



REPMUS23 Exercise:

- REP(MUS) is an experimentation exercise conducted annually, designed to allow large-scale experimentation where **Operational Communities** work together with **Academia** and **Industry** to develop and test operational **concepts** and **requirements**, technological advances and new progresses in sensors, actuators, C3, tactics and procedures on MUS
- NATO MGEOMETOC COE was the **REA Group** coordinator in support of **AMPHIBOPS/MCM** and **ASW**



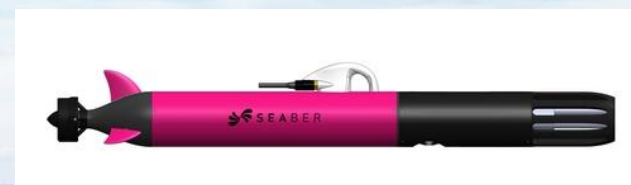
REPMUS 23 – FORCE LAYDOWN (UNDERWATER)



**SLOCUM UNDERWATER
GLIDER (TELEDYNE)**



**YUKO
MICRO AUV (SEABER)**



**APEX UNDERWATER
PROFILER (TELEDYNE)**



**SEAEXPLORER UNDERWATER
GLIDER (ALSEAMAR)**



Sponsoring Nations



REPMUS 23 – FORCE LAYDOWN (SURFACE VEHICLES)



DRIX USV (Arditi/Exail)



OTTER USV (Royal Navy)



C-ENDURO USV (University of Plymouth, UK)



SEAD-23 USV (Seadrone)



REPMUS 23 – COLLECTION FORCE LAYDOWN (AERIAL)



**ACECORE Technologies UASs
ZOE, NOA and ASOPUS
(NLD NAVY)**



**DJI Matrice 300
(IHPT – PRT NAVY)**



**SCHIEBEL CamCopter S-100 with PILLS
(ARETE / SCHIEBEL / ONR – USA NAVY)**



**BEYOND VISION UASs
Heifu, VT-One
(BEYOND VISION / CEOM /
PRT NAVY)**





RAPID ENVIRONMENTAL ASSESSMENT(REA) REPMUS23 CHALLENGES (REPMUS22 SHORTFALLS)

CHALLENGE 01:

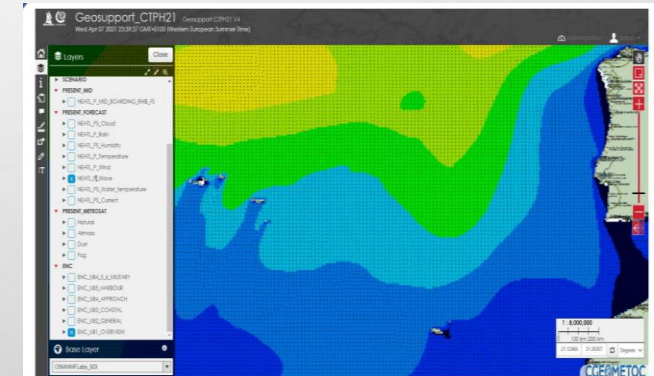
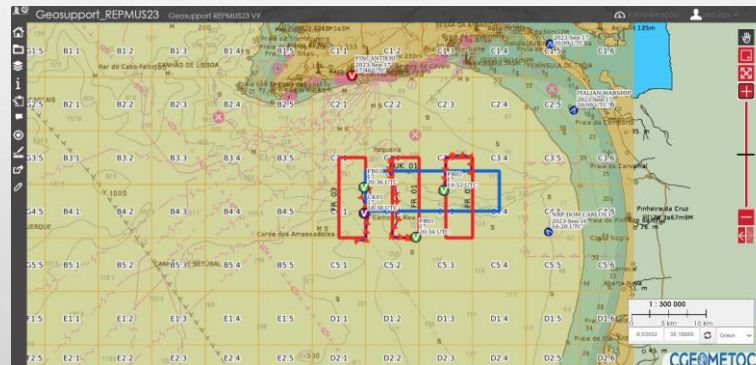
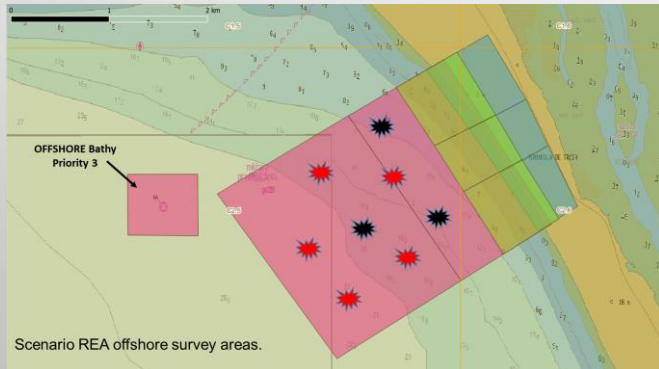
- Explore new technologies to survey very-shallow water littoral areas (Topo-bathymetric Lidar / multispectral sensing)

CHALLENGE 02:

- Explore processing techniques to exploit underwater Glider's data collection into 3D ocean structure models

CHALLENGE 03:

- Explore GEOMETOC information dissemination solutions into operational clients



1. support AMPHIBIOUS/MCM OPs

2. support UW OPs

3. Apart from direction, data collection and processing, the dissemination of information too

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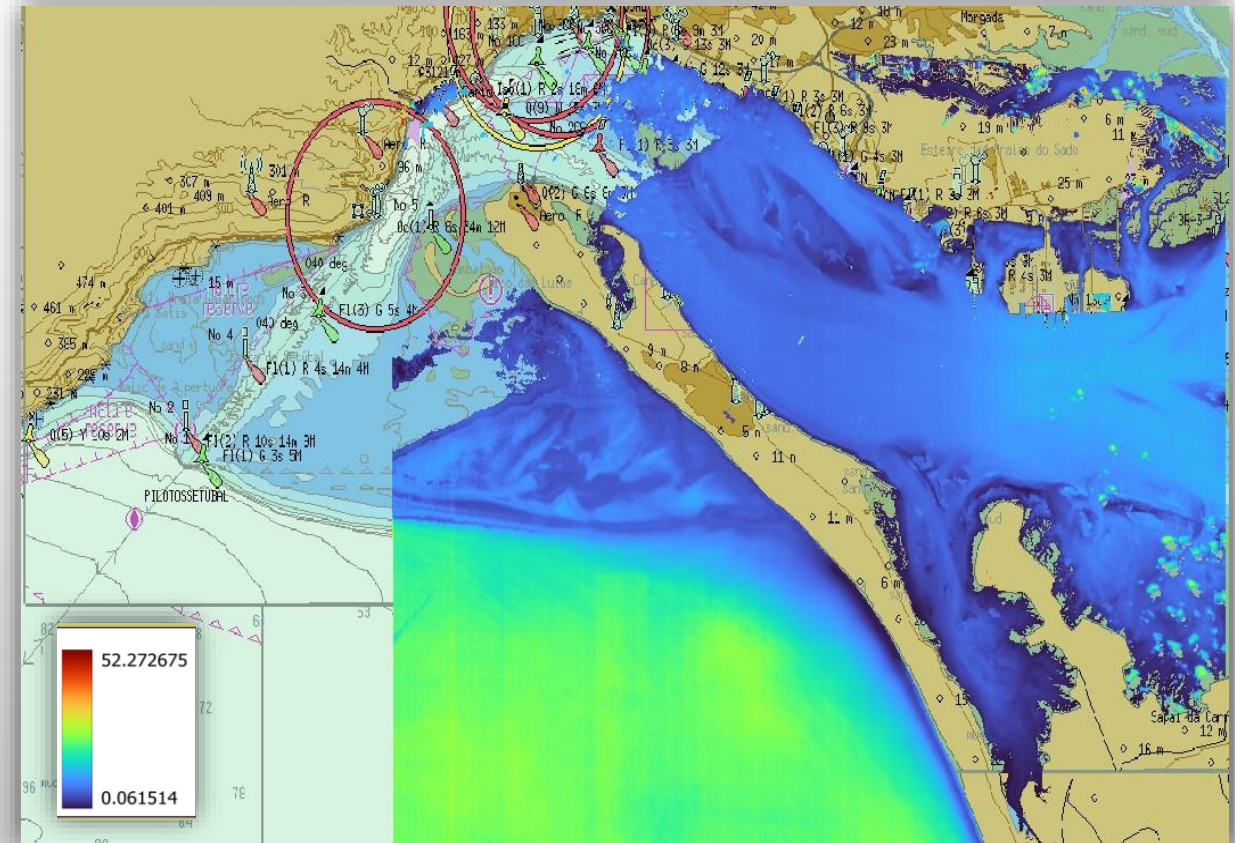
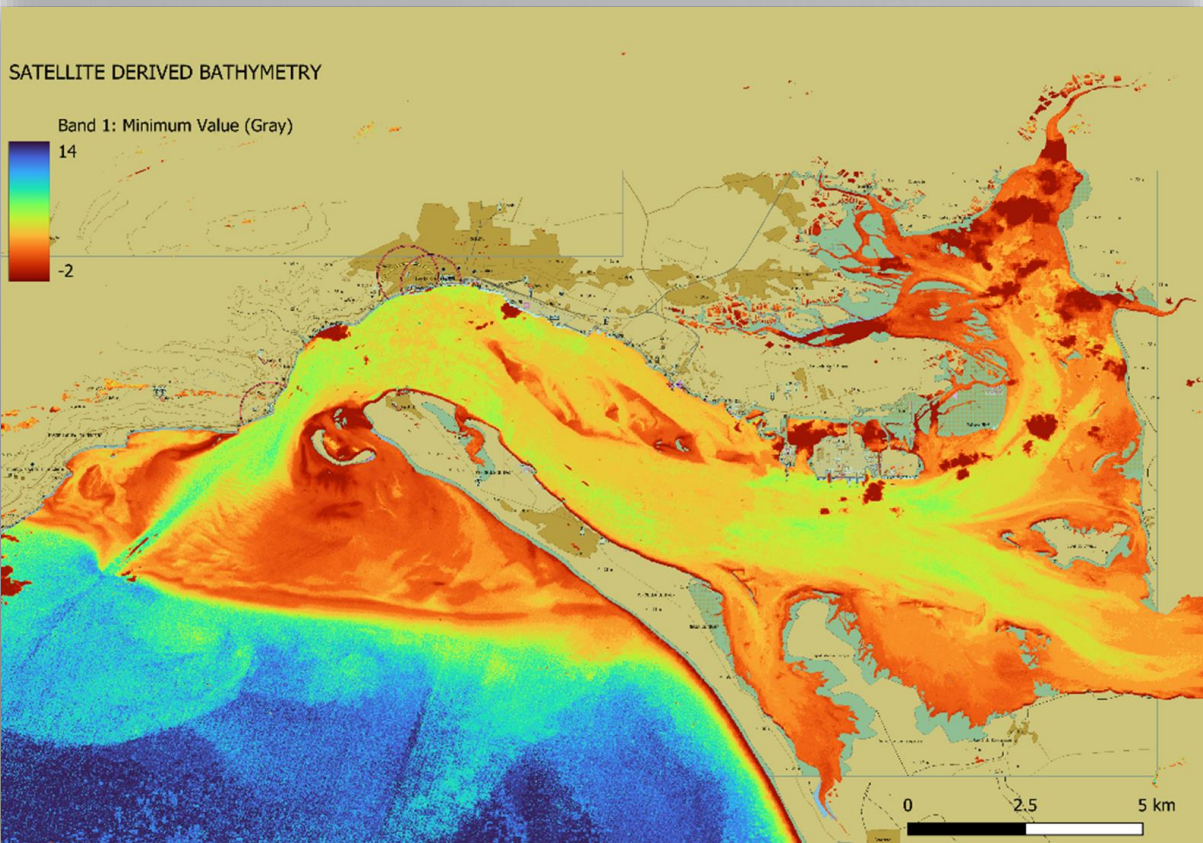


CHALLENGE 1

SATELLITE DERIVED BATHYMETRY IN SUPPORT OF AMPHIBOPS & MCM



Sentinel-2 
Earth observation mission



NATO UNCLASSIFIED



CHALLENGE 1

TOPOGRAPHIC SURVEYS – DIGITAL TERRAIN MODELS IN SUPPORT OF AMPHIBOPS



UX-31 Heifu
PT07

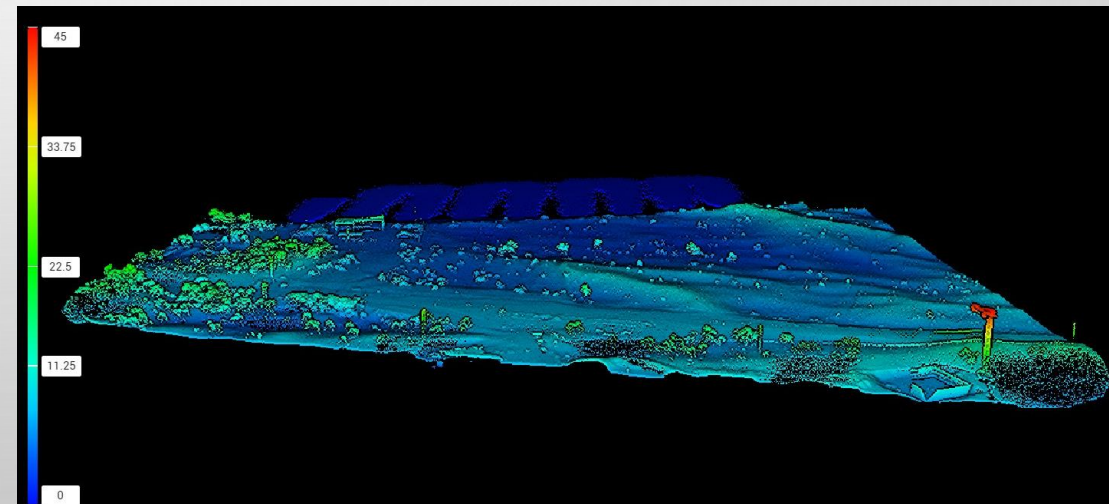


IHPT DJI Matrice 300
PT08 (Lidar)



MARITIEM DRONE TEAM NIEUWE HAVEN

ACECORE NOA/ZOE
NL02

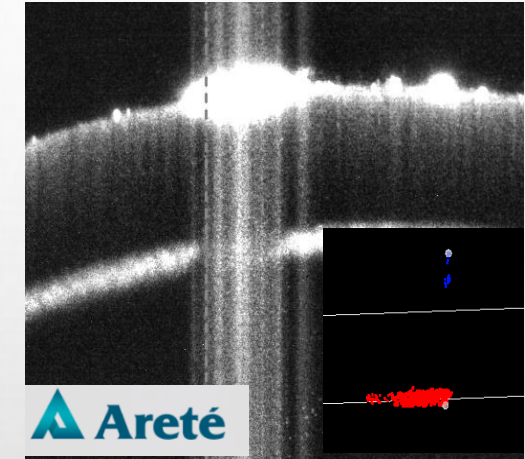
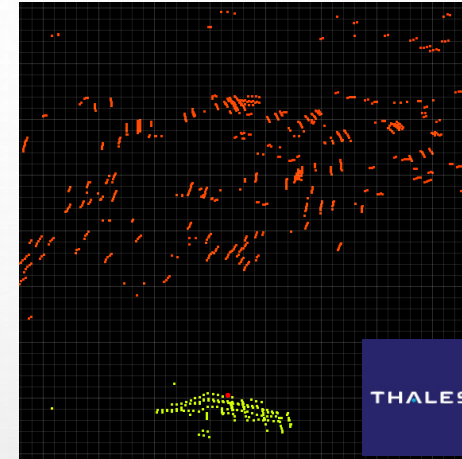
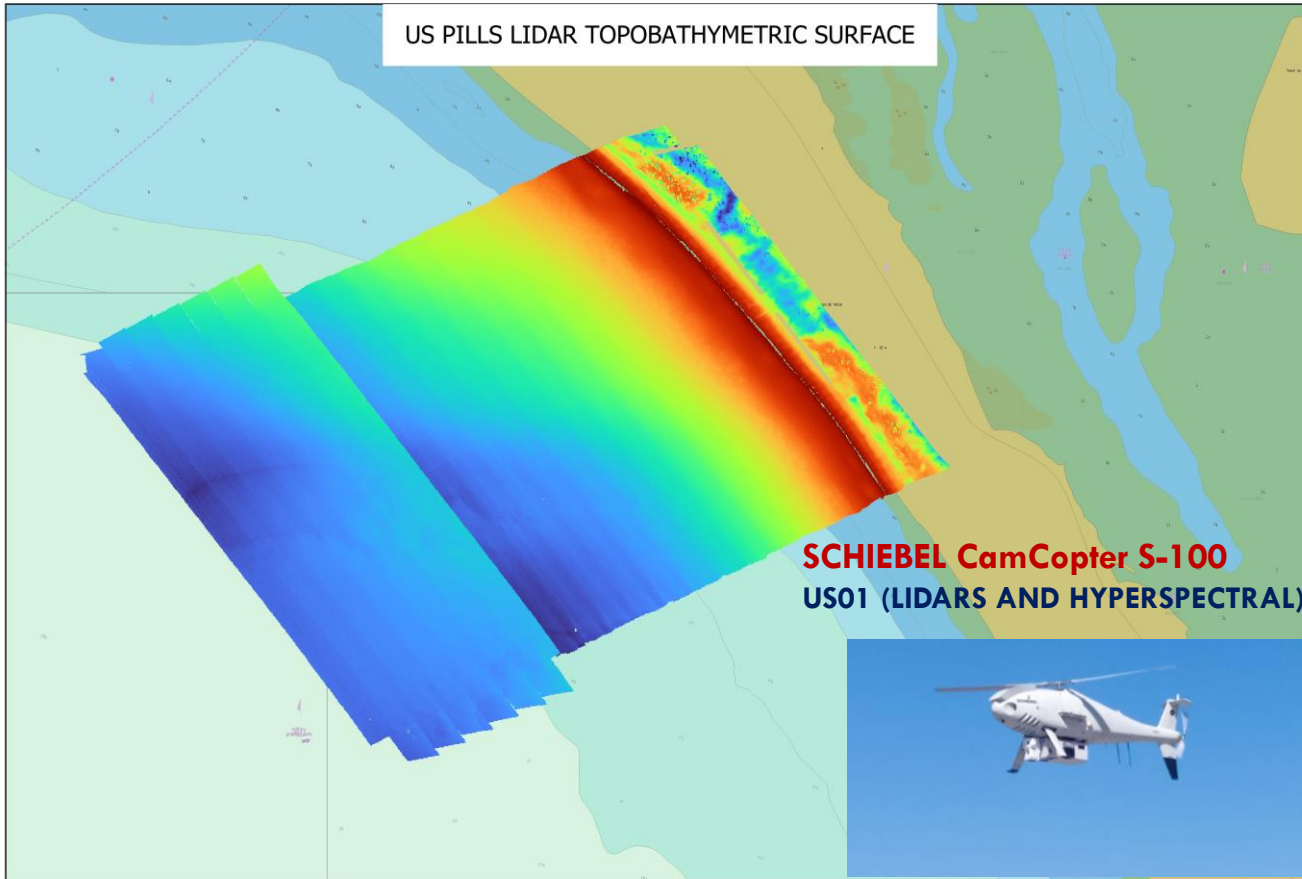




CHALLENGE 1

TOPOGBATHYMETRIC SURVEYS – LIDAR/HYPERSPECTRAL

IN SUPPORT OF AMPHIBOPS & MCM



LIDAR UNDERWATER/SURFACE CONTACTS





Amphibious landing site near Praia Verde
 Position SPATIAL:
 Correct PORTUGAL
 subworksheet 7 coordinates.

HEIGHTS IN METERS
 Sounding Conversion Table

BOUNDINGS IN METERS
 Sounding Conversion Table

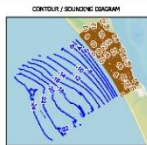
GLOSSARY
 MAF: Higher Approximate Tide
 LAT: Lower Approximate Tide
 MHTM: Mean High Water Springs
 MHW: Mean High Water Neap
 MLLWS: Mean Low Water Springs
 MSL: Mean Sea Level
 DGM: Digital Elevation Model
 UTM: Universal Transverse Mercator

LIMITED DISTRIBUTION

AMPHIBIOUS OPERATIONS GRAPHIC
 MALDA COSTA BEACH, PRAIA VERDE, PORTUGAL
 MALDA DA COSTA BEACH AMPHIBIOUS LANDING



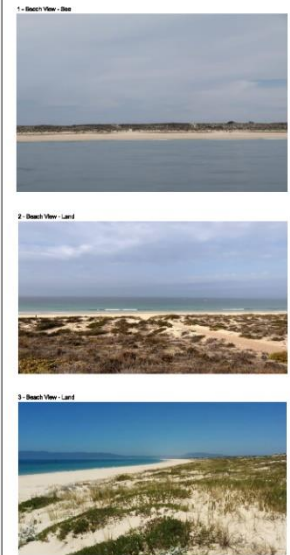
Depth Contours in Blue
 Referenced to Chart Datum
 Contour Contours in Brown
 Referenced to Chart Datum
 Soundings in Blue
 Referenced to Chart Datum



TOTAL INFORMATION

Location	Lat N	Lon W	HEAT	SRPD	SRPD	SRPD	SRPD	SRPD	SRPD	SRPD	SRPD	SRPD	SRPD	SRPD	SRPD	SRPD	SRPD	SRPD
Sancti Petrus	38°29'7N	008°58'0W	3.8	3.3	2.8	2.3	1.8	0.8	0.1									
Osido	38°28'6N	008°58'0W	3.8	3.3	2.8	2.3	1.8	0.8	0.1									
Costa Comersal	38°21'2N	008°58'0W	3.8	3.3	2.8	2.3	1.8	0.8	0.1									
Linha Comersal	38°20'2N	008°45'0W	4.2	3.8	2.7	2.3	1.2	0.4	0.1									
Damascosquedo	38°27'0N	008°51'0W	4.0	3.5	2.6	2.3	1.2	0.3	0.1									
Baixa 4	38°27'0N	008°57'0W	3.8	3.3	2.8	2.3	1.3	0.7	0.2									
Sesimbra	38°26'2N	008°06'0W	3.8	3.3	2.5	2.0	1.4	0.8	0.2									
Ilha de S. Pedro II	37°58'0N	008°33'0W	3.8	3.3	2.8	2.3	1.4	0.8	0.2									

Remarks: Bathymetric Data



Malda da Costa beach is a coarse sandy near shore beach, subjected from a beachrock off (20-30m Htssd) to a deep near-shore zone (15-10m depth) exposed to the Atlantic wind and waves.

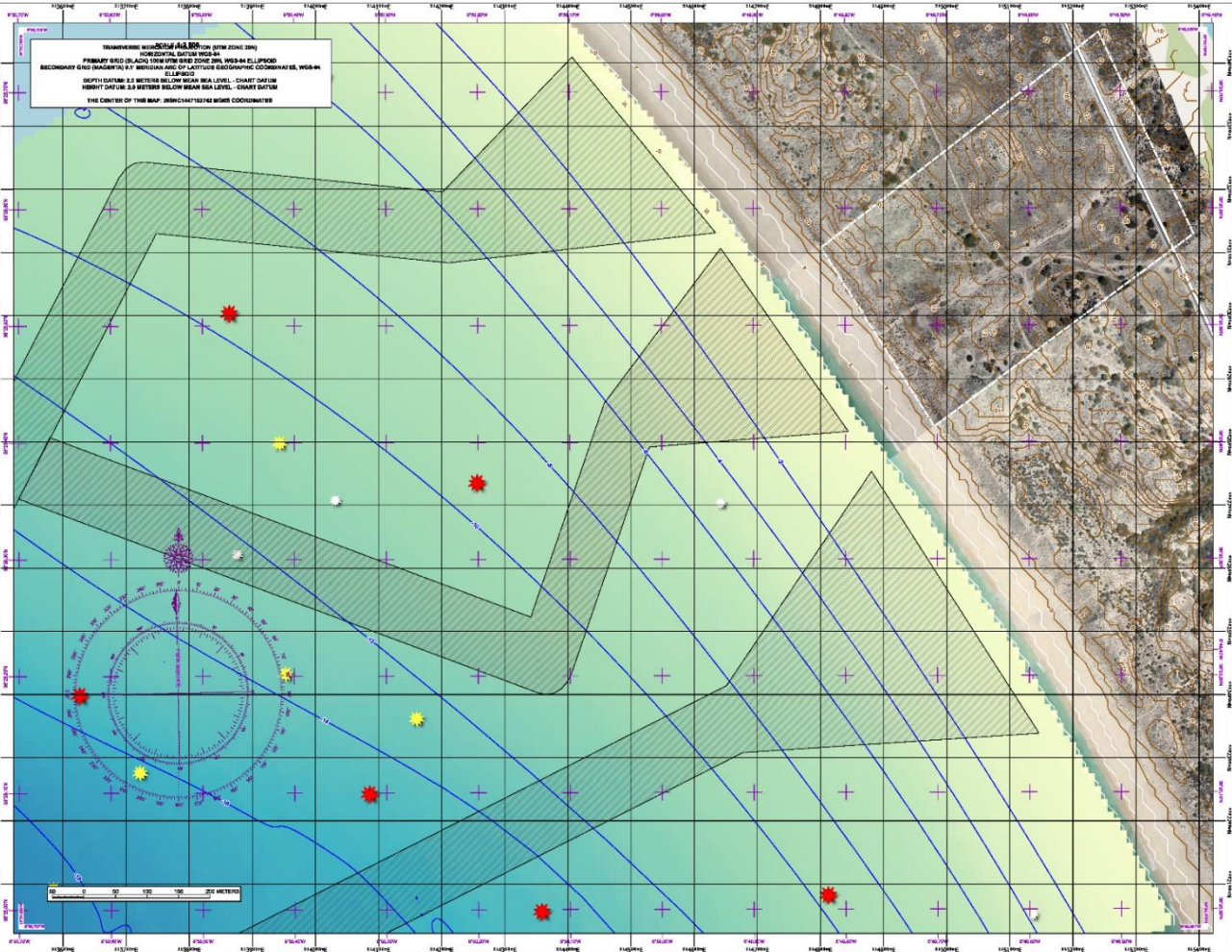
Beach undertow profile gradient is strong (2-10%), with a pronounced beach step and a gentle beach slope. Typical beach profiles do not show underwater bar features (conditioned by the general morphologic history - Figure). During winter, the beach changes to 'beach beach' profile configurations. Daily steps can be observed over the beachrock during summer to winter transition periods.

Tides are semi-diurnal, 2-3m range from high tide to spring tide. Ocean wave regime can be defined as energetic, varying from gentle (high) to very rough (low) with significant SW (1h 4-6h, max >12h, 15-16h) to summer align to moderate wind.

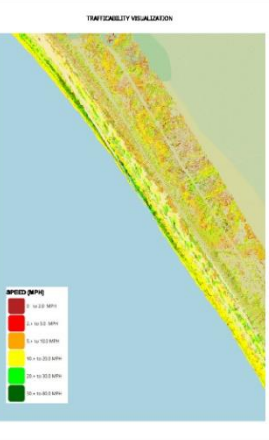
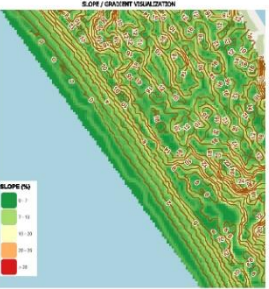
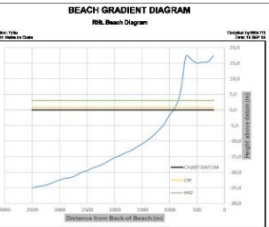
The nearby presence of Cape Espichel, creates an important refraction effect in the surrounding location (always expecting smaller wave breaking heights to North of the area).

Strong longshore currents (0.2-0.5 knots), and large rip-currents (10-100m) are observed along the year, especially upon large NW events.

The only existing beach wall is a paved road, connecting Malda da Costa beach backshore to N223 - high road.



TRANSVERSE SECTION A-A (100m FROM SHORE ZONE END)
 HORIZONTAL SECTION W-W (400m FROM SHORE ZONE END)
 PRIMARY GRID (SLIGHTLY OVER THE SHORE ZONE END, WITH AN ELLIPSOID
 RECTANGULAR GRID (DIRECTION BY REDDISH LINE) OF 100M X 100M SQUARES, WITH AN
 ELLIPSOID
 RECTANGULAR GRID (DIRECTION BY REDDISH LINE) OF 100M X 100M SQUARES, WITH AN
 ELLIPSOID
 HEIGHT DATUM OF 2.8 METERS BELOW MEAN SEA LEVEL - CHART DATUM
 THE CENTRE OF THIS MAP, INDICATES THE MORE COORDINATES



AMPHIBIOUS OPERATIONS GRAPHIC (AOG)



Graphic Identifier - 0001
 Unique Identifier - REA-0001-NC

COMPLETION SOURCES

USV Hydrographic Survey (SEP2023)
 Hydrographic Institute
 Portuguese Navy
 Army
 ANS

Legacy Hydrographic Survey (SEP2023)
 Hydrographic Institute

SCHIEBEL
 VARDI
 Marinha
 CEGM
 ANS

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LIMITED DISTRIBUTION

2023 DATE OF EXPIRATION: 29/09/2023
 FOLLOWING VERSION IDENTIFIER: NC

CAUTION: THIS MAP AND ANY INFORMATION DERIVED THEREFROM ARE UNCLASSIFIED INFORMATION AND ARE NOT TO BE RELEASED TO THE PUBLIC.

SCALE CORRECT
 WHEN PRINTED AT A0 (841 x 1189 mm)

HEIGHTS IN METERS
 SOUNDINGS IN METERS

ANALYSIS AND DATA GENERATED FOR THIS PRODUCT TO BE USED FOR DEMONSTRATION PURPOSES ONLY, DURING REPUMS23 AND DYMS23 EXERCISE

MALDA COSTA BEACH AMPHIBIOUS LANDING
 EDITION 1
 PRODUCED: 01 SEP 2023

Graphic Identifier - 0001
 Unique Identifier - REA-0001-NC

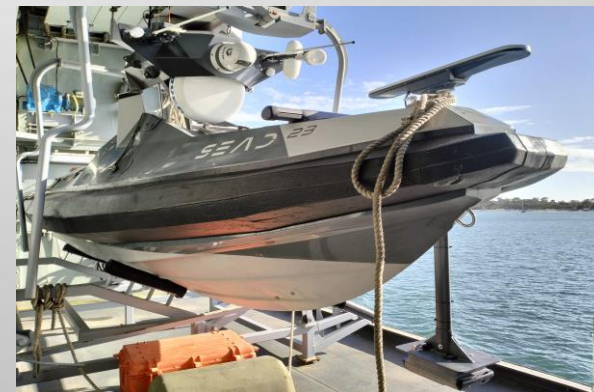


CHALLENGE 1

BATHYMETRIC SURVEYS – SEABED MAPPING

IN SUPPORT OF AMPHIBOPS & MCM

DRIX USV (PT03)



SEAD23 USV
SP01

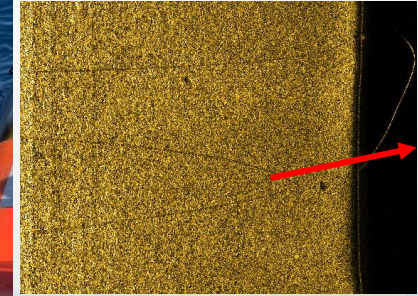
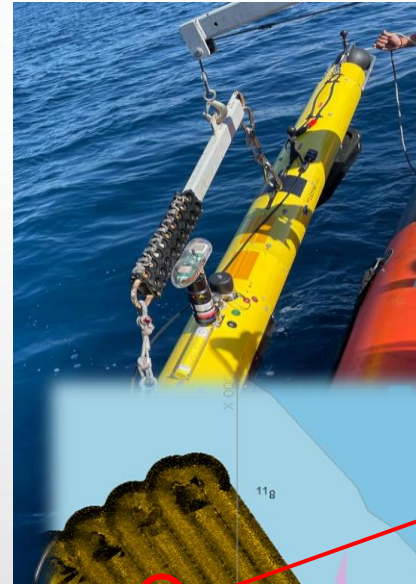
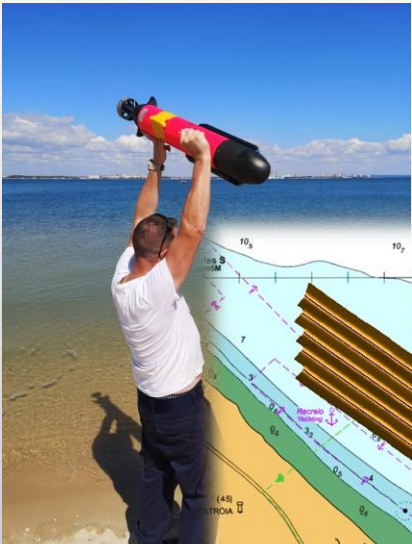


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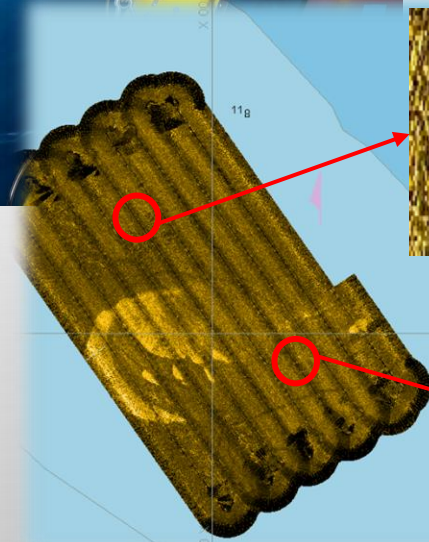
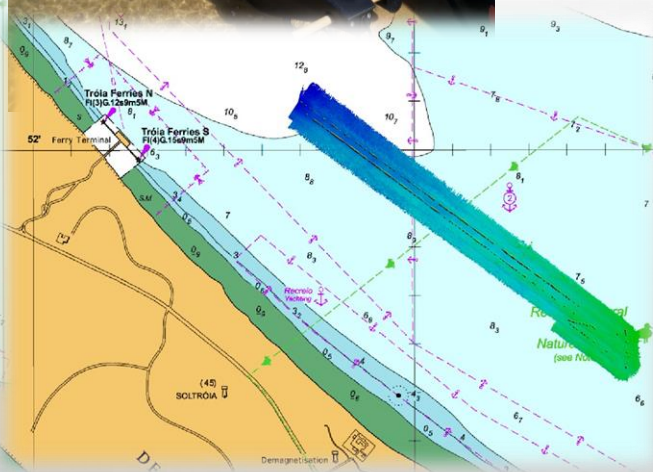
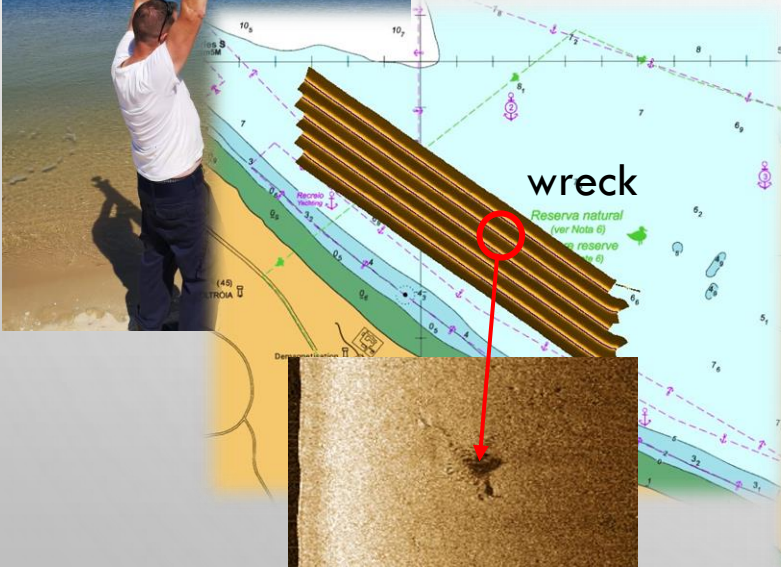
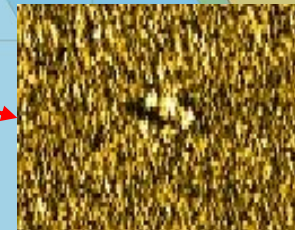
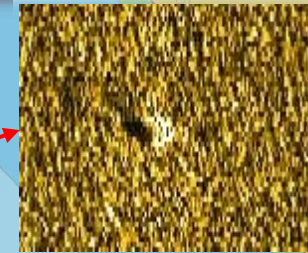


CHALLENGE 1

BATHYMETRIC & SIDESCAN SURVEYS – CRITICAL UNDERWATER INFRASTRUCTURES



3 cm. cable



MicroAUV Seaber (YUKO) (HECLA)
(UK03, UK04, UK05) Sidescan
survey



OTTER USV (HECLA-RN)
(UK06) Bathymetric survey

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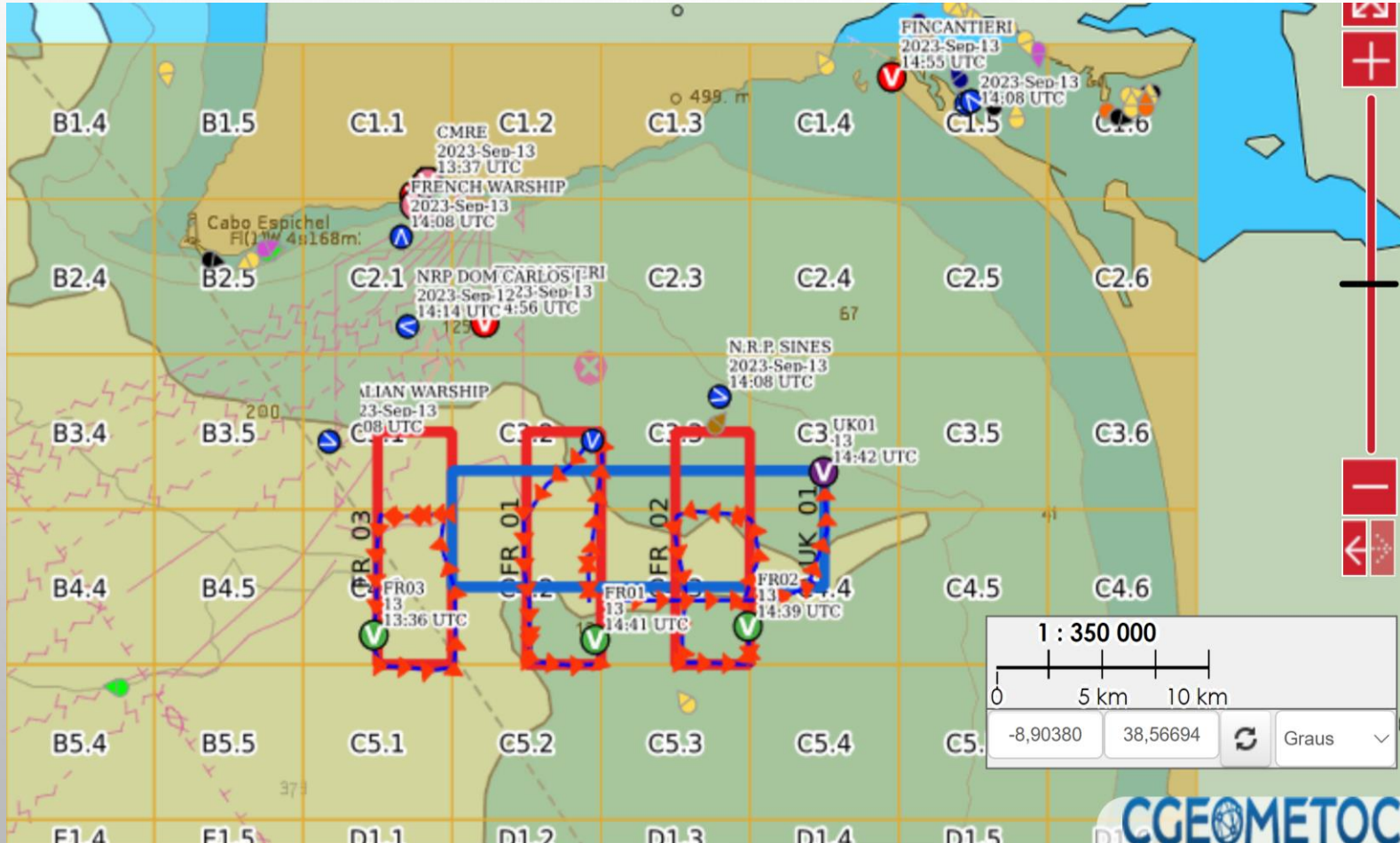
GAVIA AUV (DNK NAVY)
(DA01) Sidescan survey



CHALLENGE 2

OCEANOGRAPHIC SURVEYS – PHYSICAL PROPERTIES OF THE WATER COLUMN

IN SUPPORT OF UW



SEA EXPLORER
(FR01, FR02, FR03 Glider)



G3 SLOCUM
(UK01 Glider+Hydrophone)



C ENDURO ASV
(HECLA-RN)
(UK07 CTD/ADCP)



4 WEEKS GLIDER SURVEY

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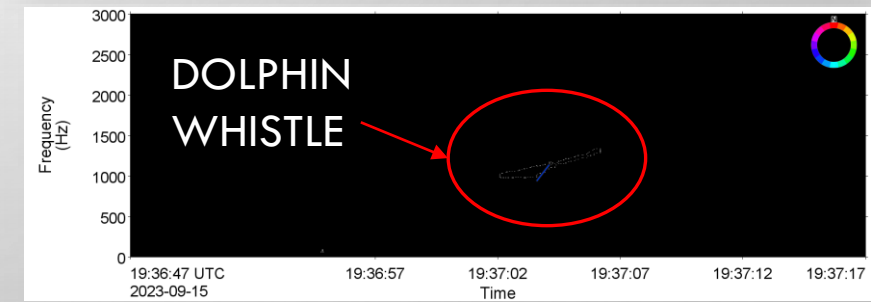
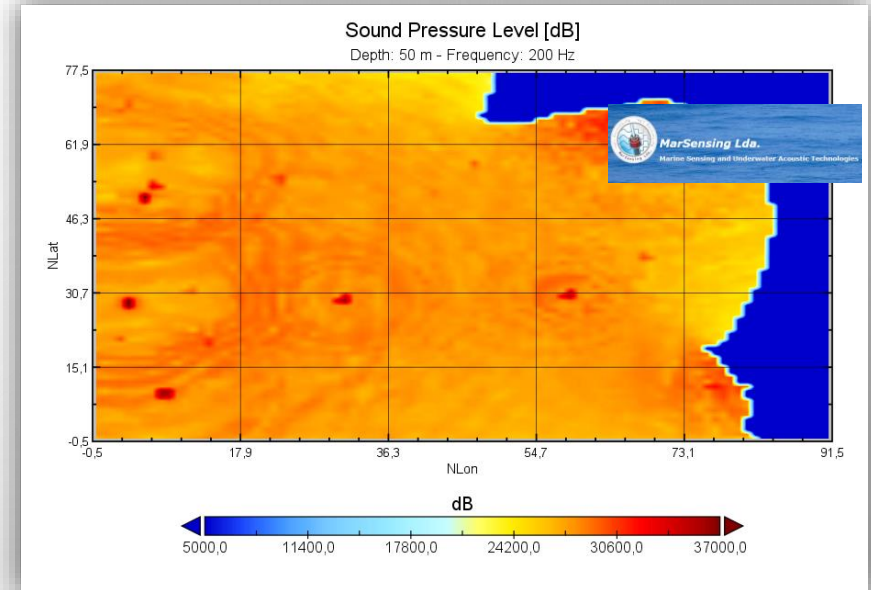
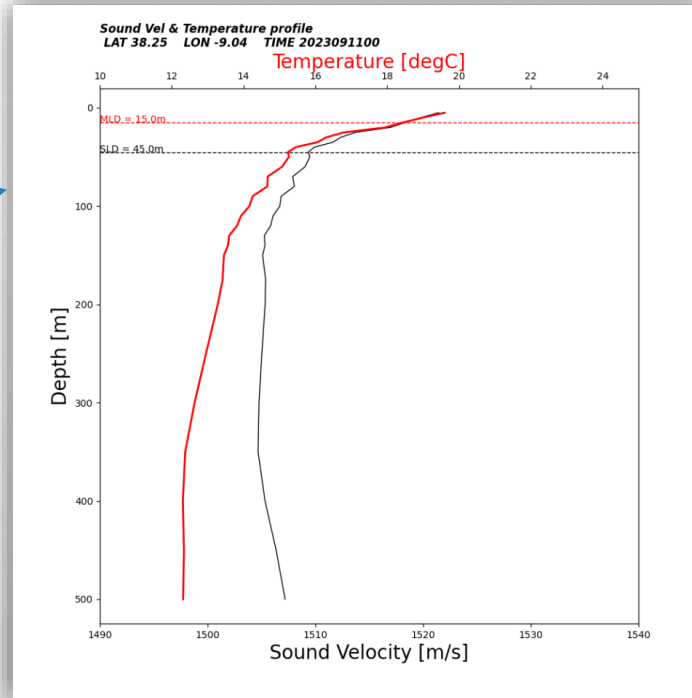




CHALLENGE 2

OCEANOGRAPHIC SURVEYS – PHYSICAL PROPERTIES OF THE WATER COLUMN

IN SUPPORT OF UW



**4D Oceanographic Volume
(created every 24h)**

SOUND VELOCITY INFO

**AMBIENT NOISE, MAMMAL
DETECTIONS**

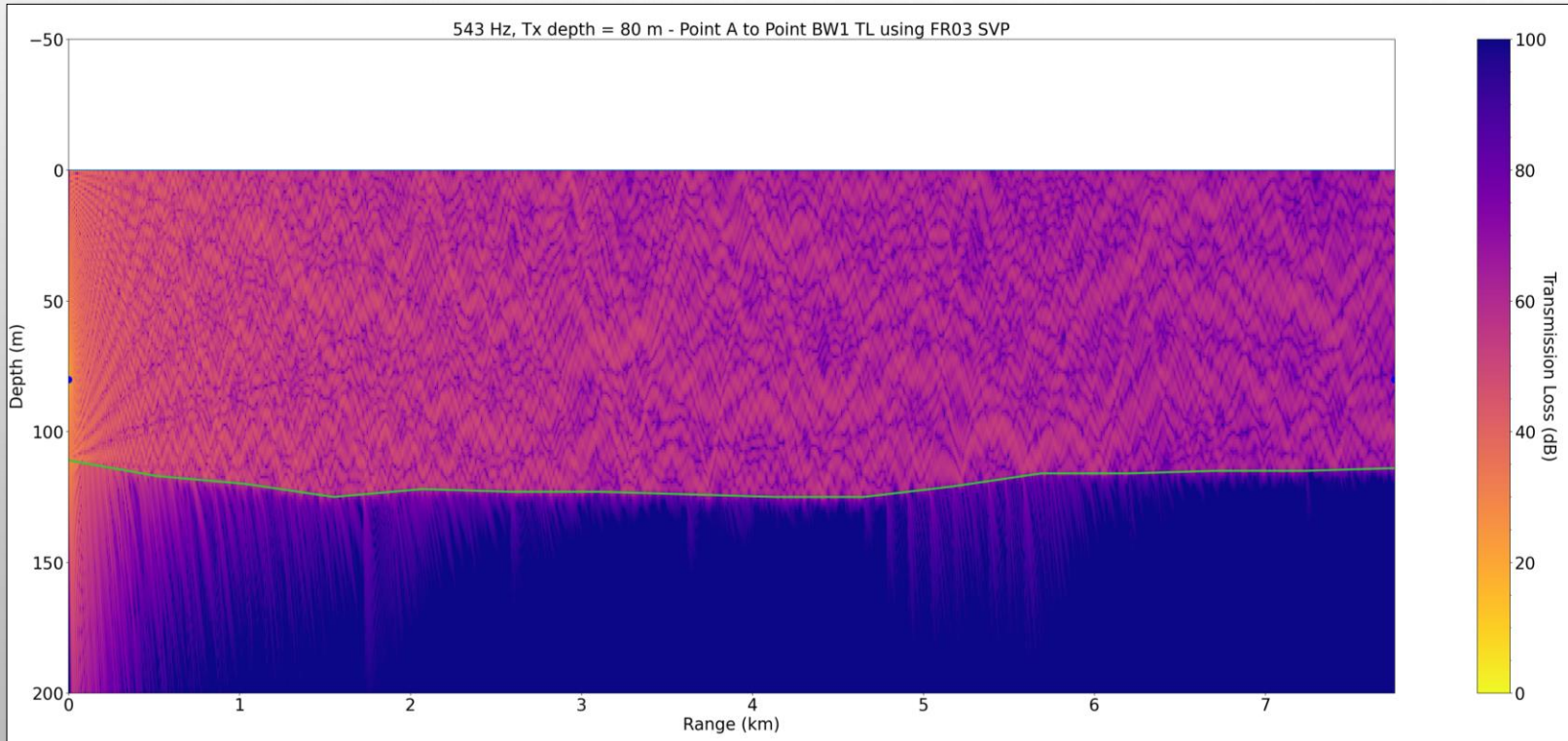


CHALLENGE 2

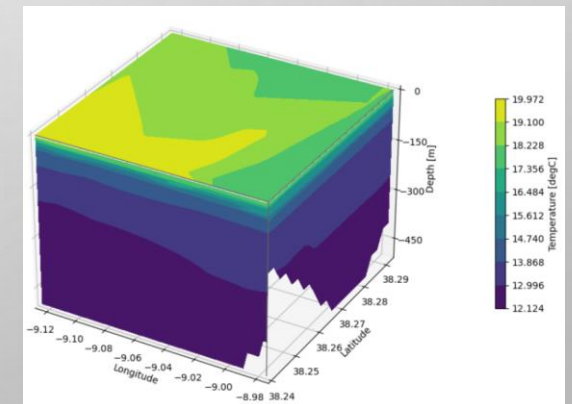
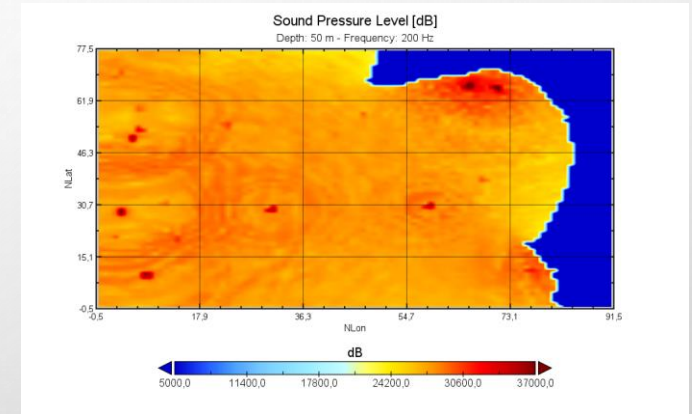
OCEANOGRAPHIC SURVEYS – PHYSICAL PROPERTIES OF THE WATER COLUMN

IN SUPPORT OF UW

SOUND TRANSMISSION LOSS INFORMATION



GEOMETOC DATA ANALYZED TO SUPPORT SONAR PROPAGATION COMPUTATIONS



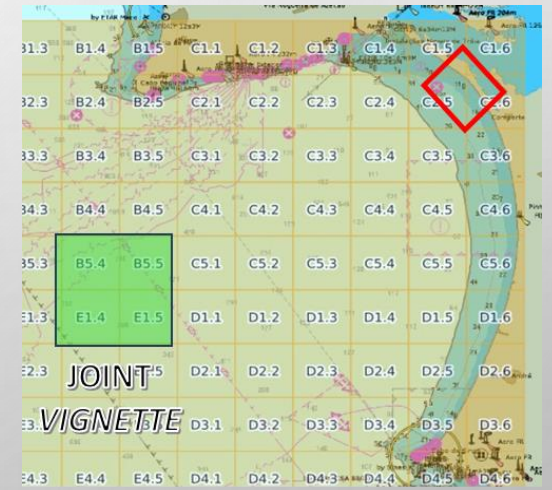
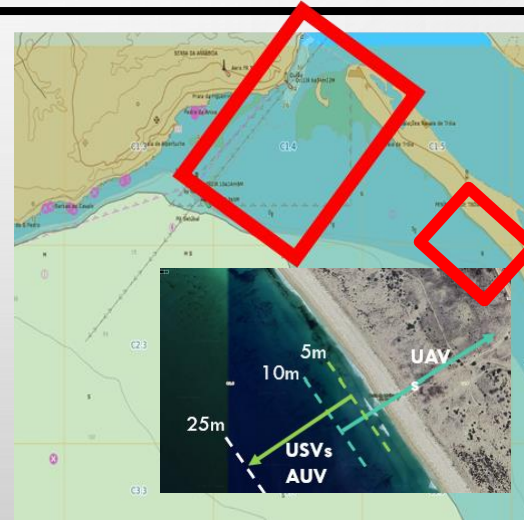


RAPID ENVIRONMENTAL ASSESSMENT REPMUS24

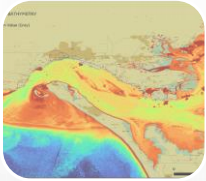


Week 0 Reception and Staging [02-06 SEP]	Phase1 Integration and Experimentation [09-13SEP]	Phase2 Directed Experimentation [16-20SEP]	Phase3 Tactical Experimentation Context/Phibex [23-27 SEP]
	<i>Test / Calibrate / Integrate the REA MUS</i>	REA Challenge 1 Shallow water / Littoral REA	REA Challenge 2 Seabed Warfare Concept REA Challenge 4 REA from the sea
Challenge 3 - Optimize REA information exchange from MUS to datahubs and datahubs to operational clients			

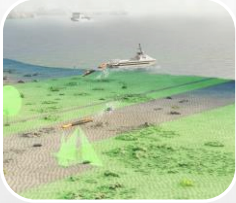
REA PLAN



CHALLENGES FOR REPMUS 24



- Improve Shallow water / Littoral REA (high resolution bathymetry/topography, breaking wave height, littoral currents, sea floor bottom type, land coverage, water column structure, etc.).



- Bring REA contribution to Seabed Warfare Concept (maximize interoperability and optimize efforts in MUS employment in deep water environment).



- Increase GEOMETOC information dissemination capability (near real time data and products sharing solution).



- Conduct REA operations from the sea.



- Link CWIX with REPMUS from the GEOMETOC data exchange viewpoint

DACIA/TOMIS OPEX EXERCISE 24



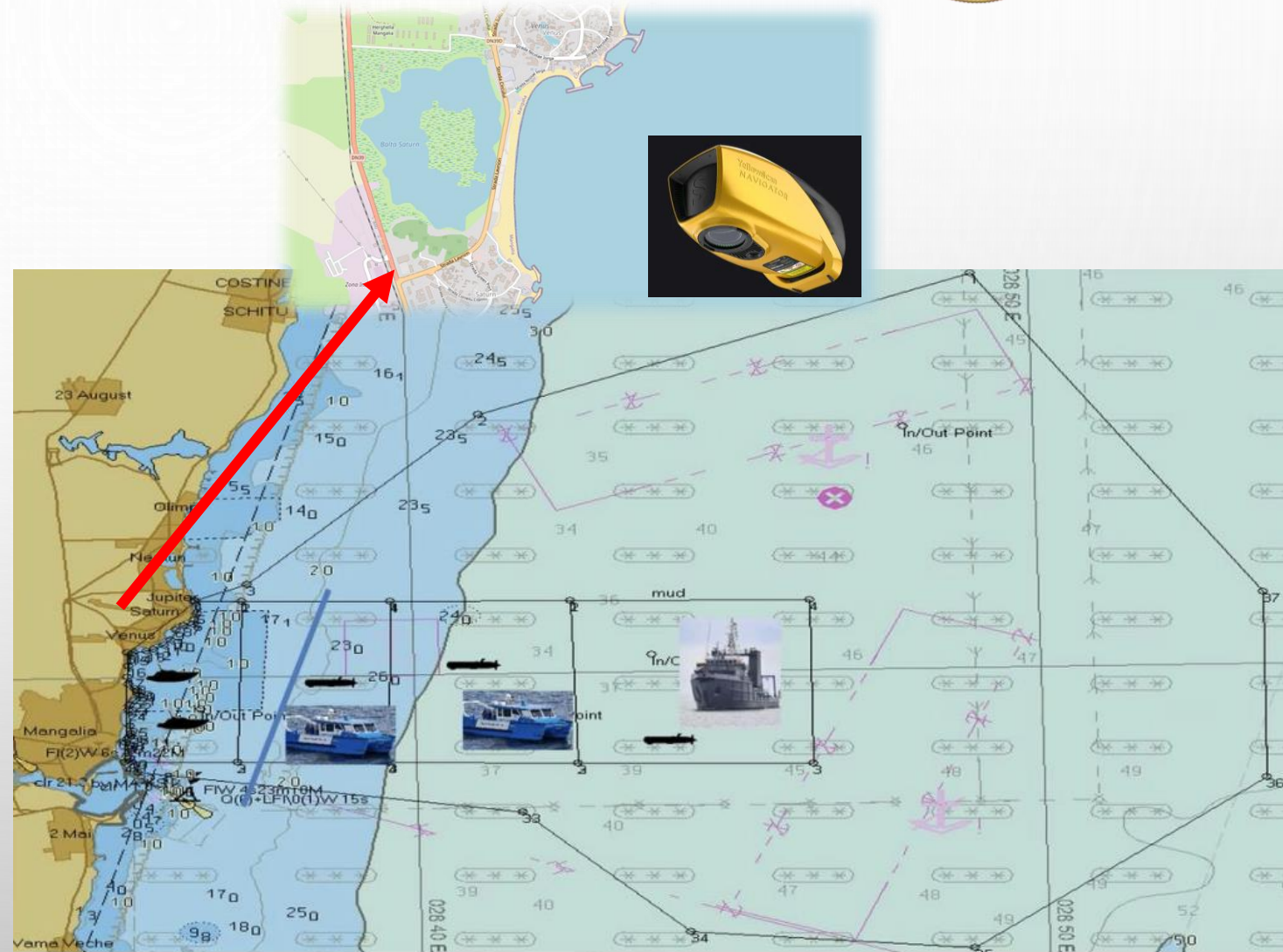
Training objectives

Contribution to characterize a very shallow water scenario:

- Support MCM activities
- Topo/Hydrographic surveys (including land swamp areas)
- Support AMPHIBIOUS activities

Our role:

- REA Group Coordination
- REA Plan and C2 of the REA Exercises/serials
- Assessment of REA technology.





**NATO MARITIME
GEOMETOC
COE**

Thank you

**TRANSFORMING MARITIME
ENVIRONMENTAL KNOWLEDGE**



in mgeometcocoe **X** mgeometocoe

<https://www.mgeometcocoe.org/>