STO-CMRE

Dynamic Messenger 2022: CMRE trials and the impact on UW protection

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UNDERWATER DEFENCE & SECURITY- Fully integrated UW response

25 May 2023

CMRE NATO Science and Technology Organization, Centre for Maritime Research and Experimentation

CMRE Mission

CMRE contributes to preserving NATO's technological edge as a thriving research and experimentation organization within NATO's innovation ecosystem, exploiting emerging and disruptive technologies in developing innovative solutions to the challenges facing NATO's military instrument of power, predominantly in the maritime domain.

CMRE Programme Of Work

- **Aligned with**
  - ACT “NATO Warfighting Capstone Concept” TT-2826, 02 Dec 2020
  - ACT “Warfare Development Agenda” TT-4319, 16 Feb 2022
  - “SACT’s Direction, Guidance and Priorities for 2022”, 27 Jan 2022
  - “The EDT Implementation Strategy” DPRC-N(2021)0006;
  - Longer Term Aspects MCR20-NC0023
  - STO, CNAD, ESC activities on innovation.
- **Maritime S&T POW**
  - Autonomy for ASW
  - E-DKOE
  - Autonomous Naval MCM
  - Maritime Unmanned Systems Enablers

CMRE EDT and ST Capabilities

DYMS22 Exercise

- NATO's first ever unmanned systems exercise
- Jointly conducted by MARCOM and ACT
- Hosted 19-30 Sept 2022 by Portuguese Navy in Troia/Sesmibra
- Directly following REPMUS22
- Vignettes in UW (ASW), NMW, MIO/MSO, FP/HP, REA, Amphib

DYMS22 Exercise: ACT funded CMRE Tech Demo

NMW

- Collaborative multi-phase NMW operations in Sesimbra
  - Deploy MUSCLE UUV with SAS for Mine Search
  - Machine to Machine tasking of small UUV BIONDo for Mine ID using CATL

C4 Interoperability

- Provide C3MRE interoperability platform in MOC
  Collect, manage and distribute CATL messages
  - 30 federates from 11 Institutions
- Exchange C4 information with I2I network

UW (ASW)

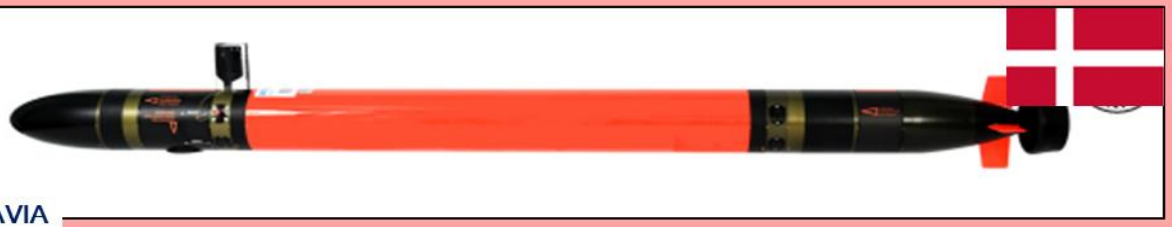
- Deploy heterogeneous network at sea
  - UUVs with towed arrays
  - Bottom nodes with acoustic vector sensors
- Collaborative prosecute passive target and create fused picture
  - CATL messaging to MOC

REA

- Deploy glider and WaveRider in DYMS OPAREA
- Utilize SSP to estimate ASW performance

UW (ASW) Force Offerings

RHIB



GAVIA

NRVA

CUSV

MARLIN

UW (ASW) CMRE Force Offerings

2x OEX UUV

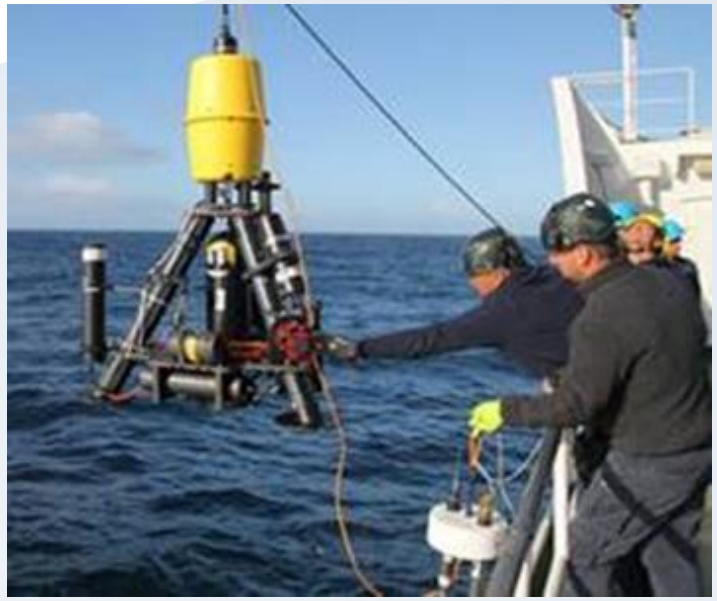
- Towed Array

2x Bottom Nodes

- Acoustic Vector Sensors

NRV Alliance

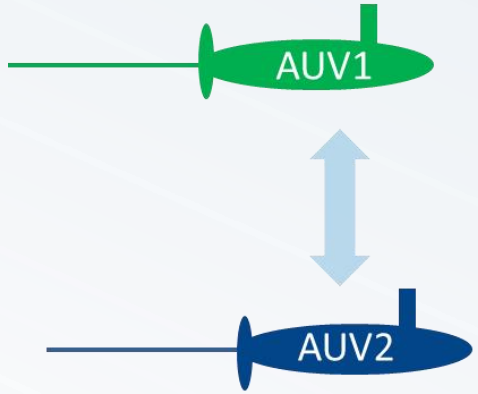
- Towing source
- GCS
- CATL connectivity via C3MRE

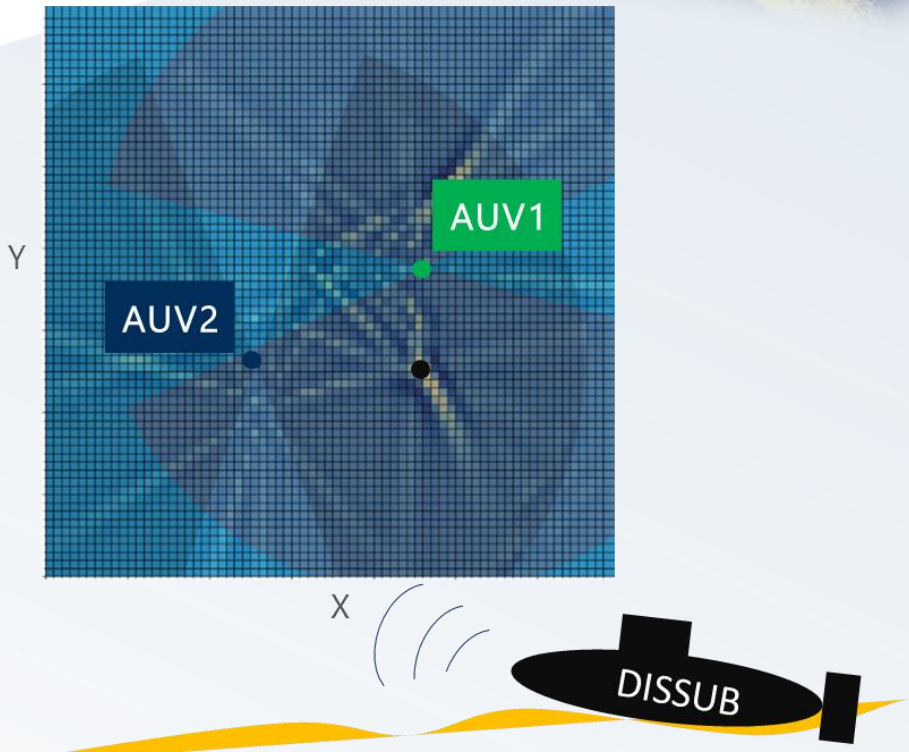


Robotics and Autonomy during DYMS22

Support to human-unmanned ASW teaming

- Real-time collaboration improves Autonomous Underwater Vehicles (AUV) situational awareness and probability of detection
- Validated in a real DISSUB scenario during REP(MUS)21 Tech Demo

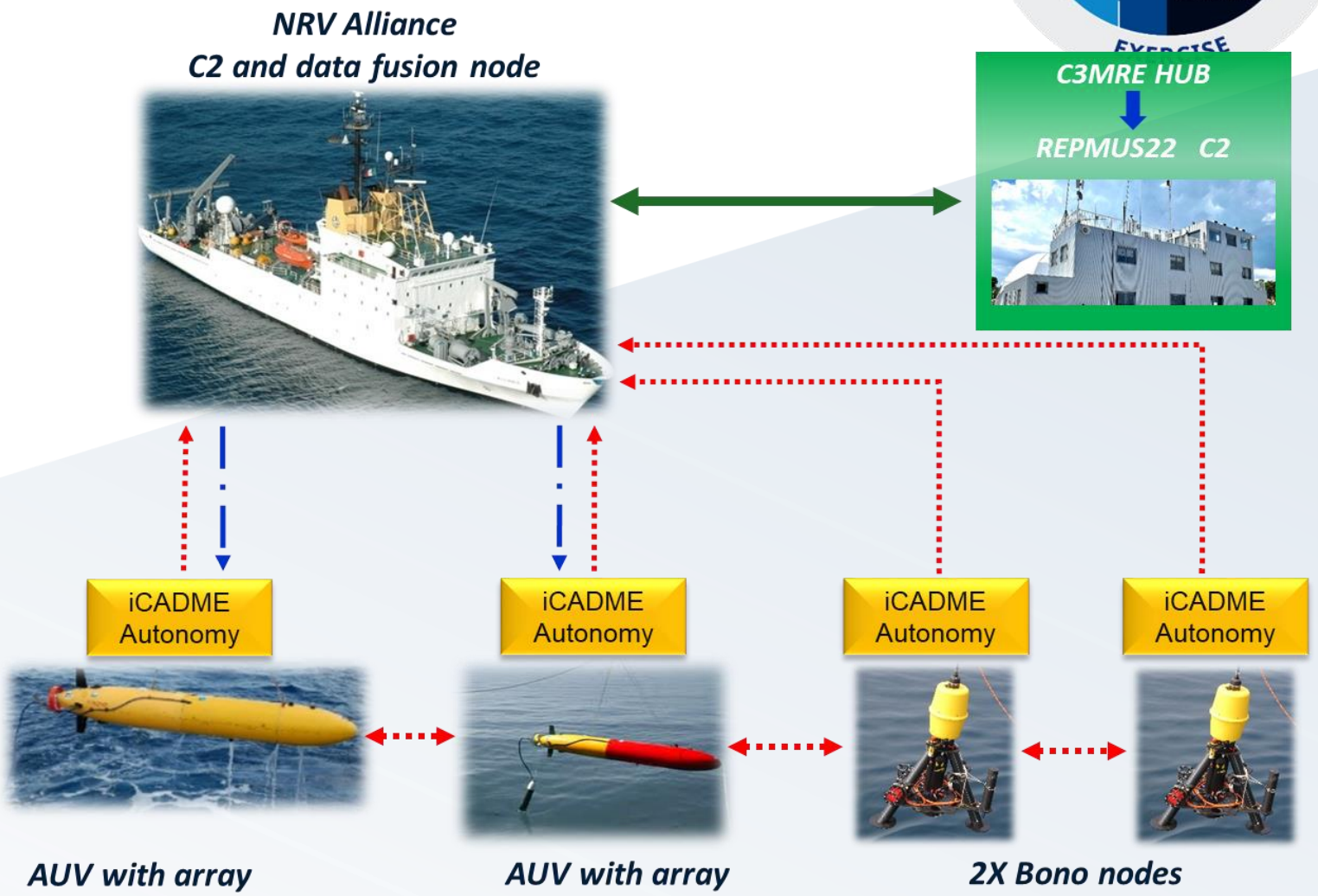




Cooperative ASW during DYMS22

iCADME architecture @ DYMS22

- A perception layer based on a novel occupancy grid mapping framework
- Real-time data fusion using multiple heterogeneous nodes
- Controlled multi-task, cooperative robot missions
- Network fully integrated with the MOC w/CATL messages through C3MRE
- ASW federate received high-level re-tasking from the MOC via C3MRE



Results of survey task during DYMS22

Good localization and tracking results

- Exploitation of the network spatial diversity

Target of opportunity
Estimated Target
AUV 1
AUV 2
BONO2
BONO1

REA Force Offerings

CMRE REA Force Offerings

1x Buoyancy Glider

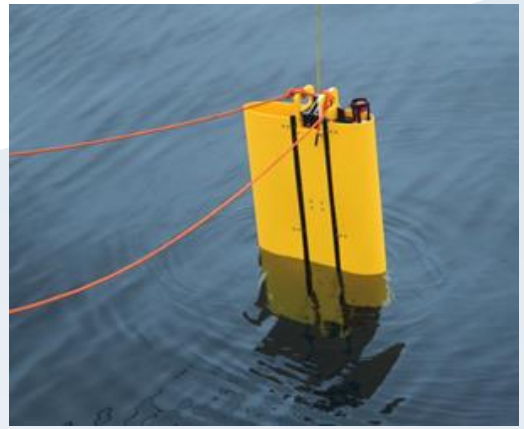
- Oceanographic and wave packages
- Hydrophone

1x WireWalker

- High resolution SSP measurements

Waverider Buoy

- Surface wave spectrum



Subbottom Profiler

NRVA Organic CTD

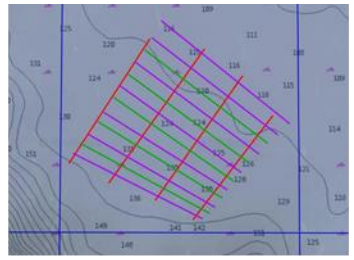
REA Results during DYMS22

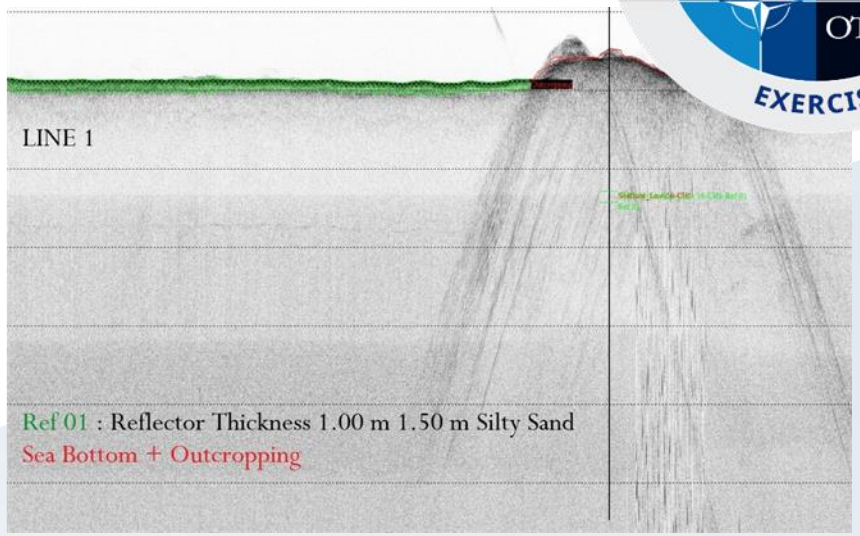
Sea bottom structure

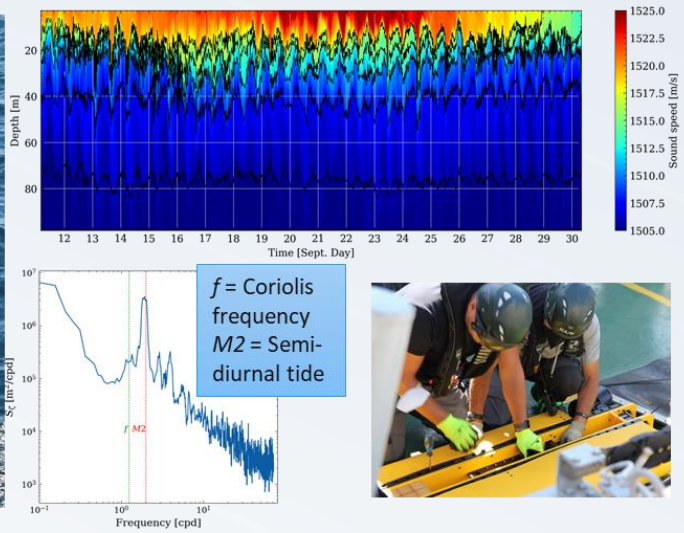
- sub-bottom survey
- sediment coring
- sediment grabs

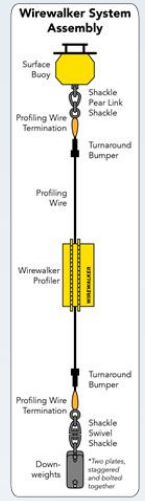
Wirewalker

- 20 days of continuous data collection
- 2700 complete up-casts executed with average inter-cast period of 10 min.
- Shared 220 netcdf files with NATO GEOMETOC CEO





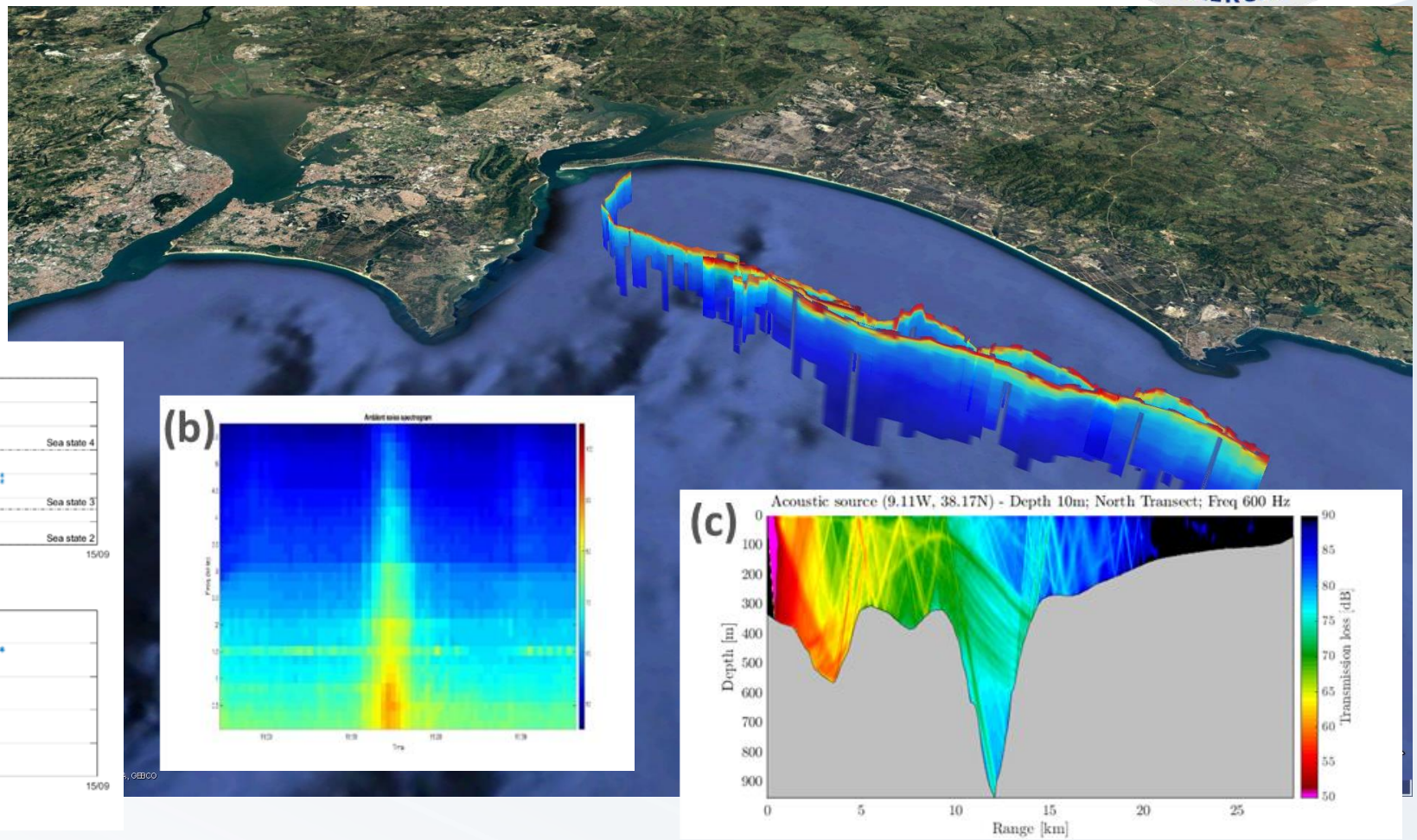




REA Results during DYMS22

NOA buoyancy glider

- Wave height (a)
- Averaged Ambient Noise (b)
- Sonar performance products (c)



NMW Force Offerings


MANTA


MANTA


MOORED


ROCKAN


CASE


BOMB


HURW


REMUS100


KING


REMUS 100


MOSE


LAUV


KURS


LAUV


GEOS


A18


INSPECTOR


REMUS


SEASCAN


A9


MUSCLE


BIONDo


REMUS 100


REMUS 100


REMUS 600


REMUS 300

CMRE NMW Force Offerings

1x MUSCLE

- HFSAS
- WIFI, RF and acoustic communication
- On board processing with ATR and P&E products
- Real time contact sharing

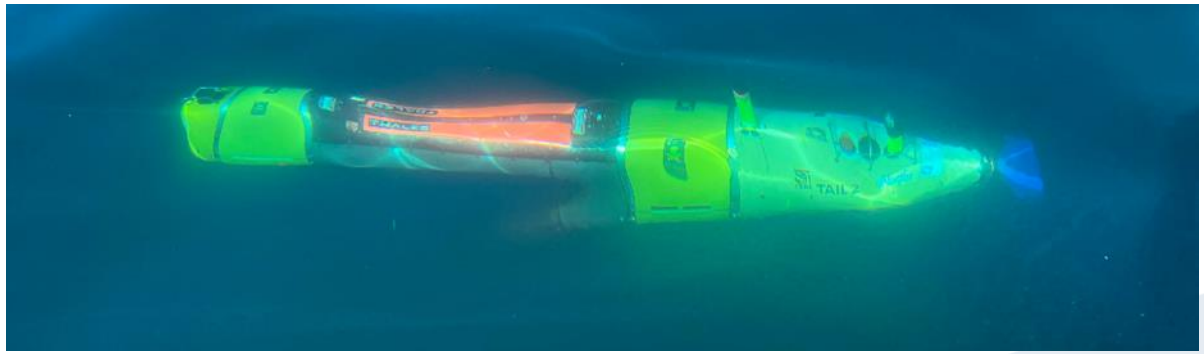
1x BIONDo

- ARIS3000 acoustic camera
- WIFI and acoustic communication
- CATL compatible

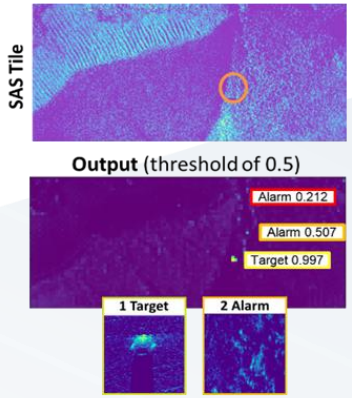
NMW Results during DYMS22

ML & AI achievements

- Real Time On board implementation of the Single Stage Detector/Classifier and the Prediction of auxiliary features

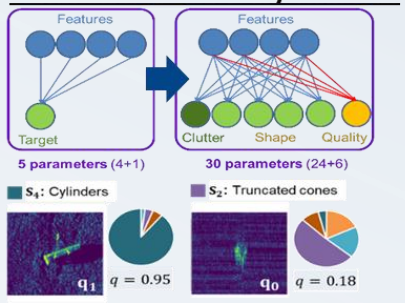


Single stage detector classifier



Increasing probability of detection by 10%

Prediction of auxiliary features



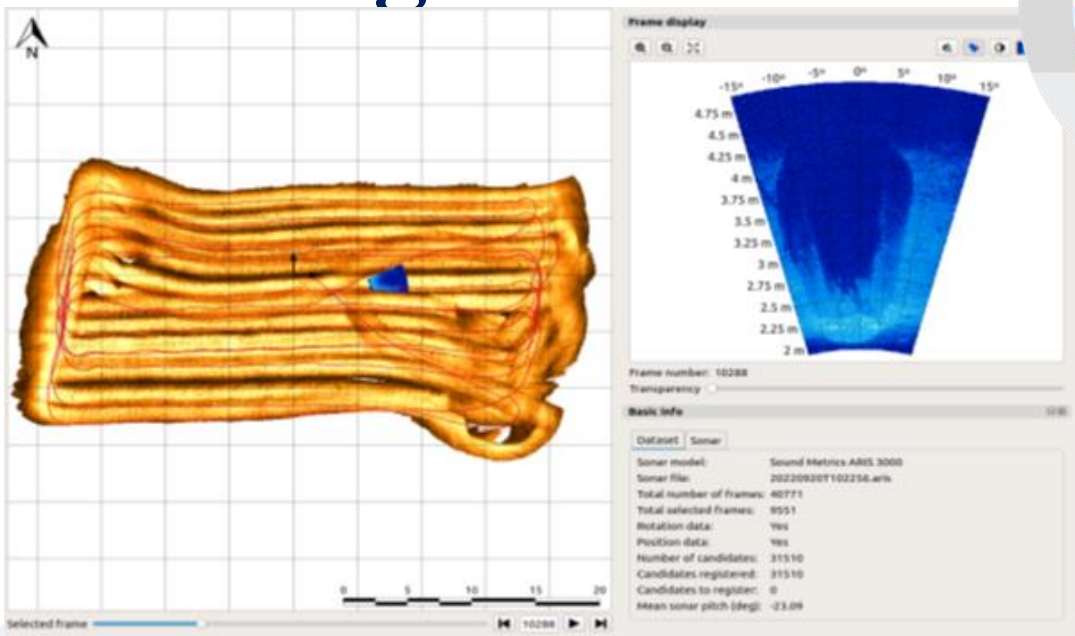
Around 20% less false alarms

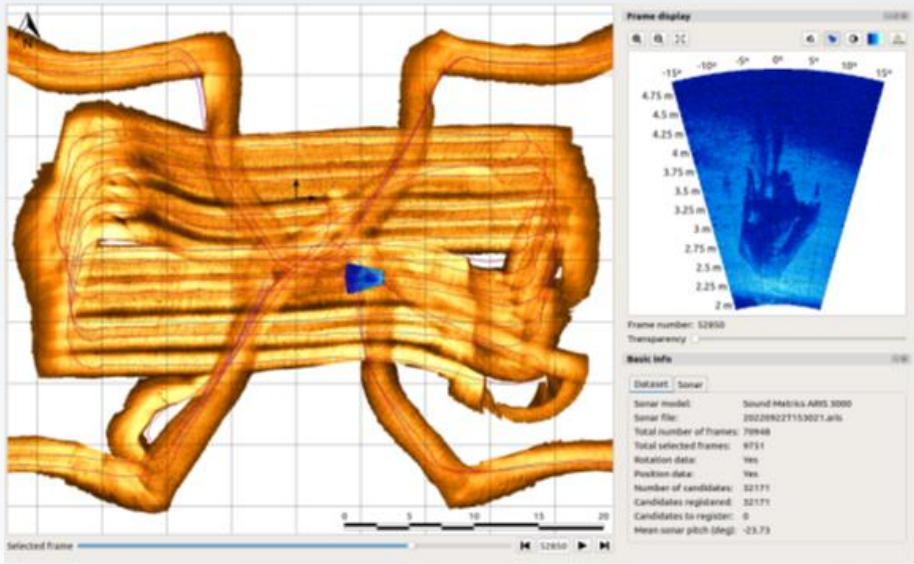
CONTACT sent to topside

NMW Results during DYMS22

Interoperability with partners

- DEU (WTD71 & Atlas)
  - 2x SeaCAT AUV
  - CATL integration with C2 onboard RV Planet
  - Survey followed by contact reporting
- ITA N (CSSN & Graaltech)
  - 2x AUV + 1x USV
  - CATL integration from USV and from onboard Geosea
  - Survey capability and contact reporting
  - No targets from CSSN via C3MRE

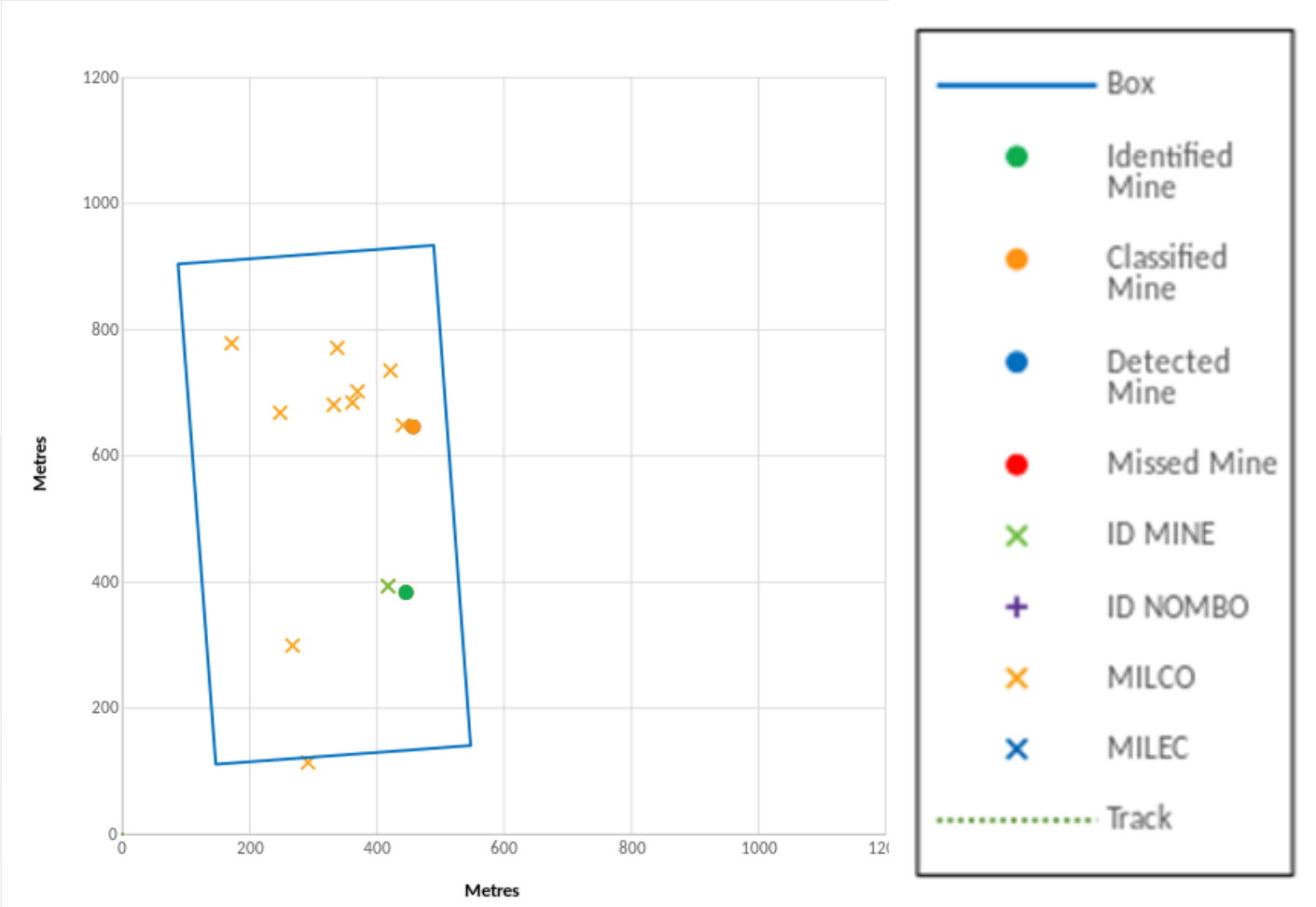




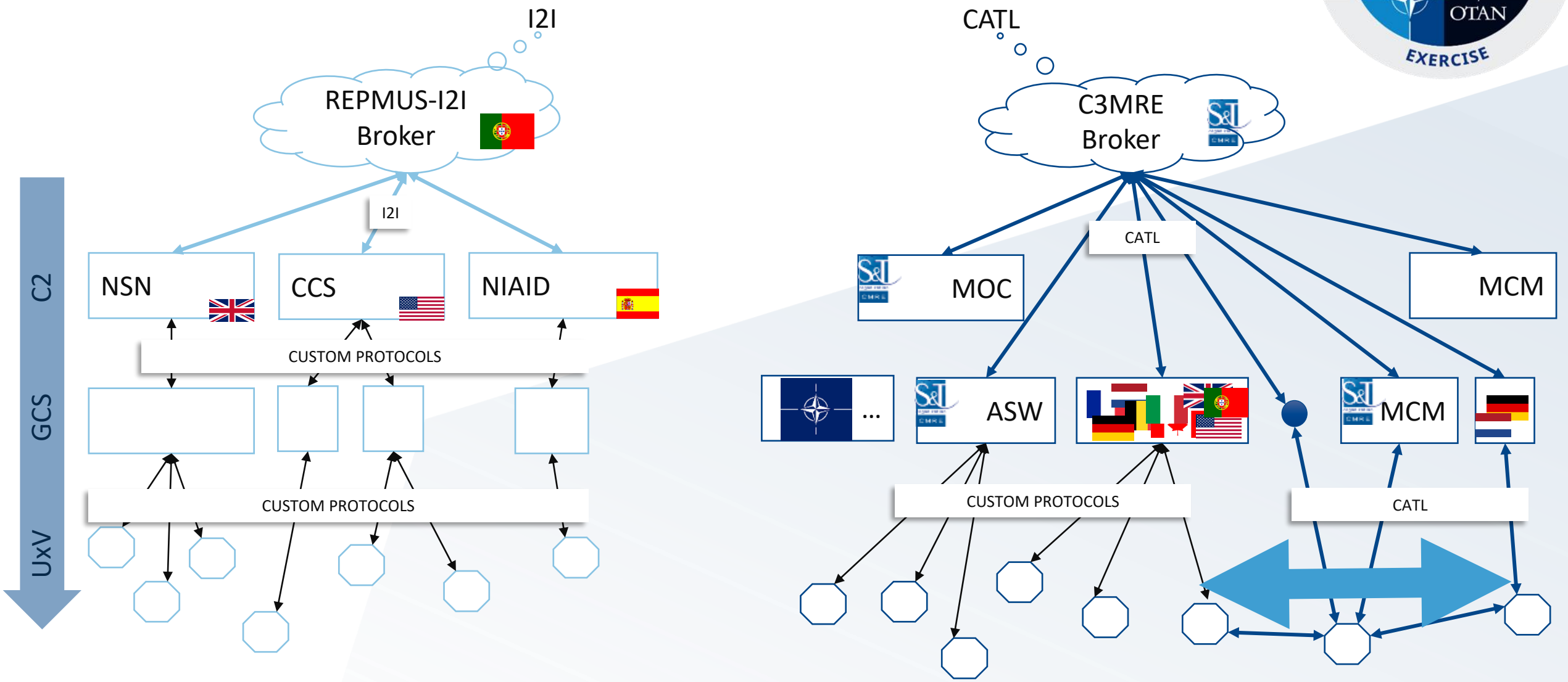
NMW Results during DYMS22

NMW Analysis and Assessment

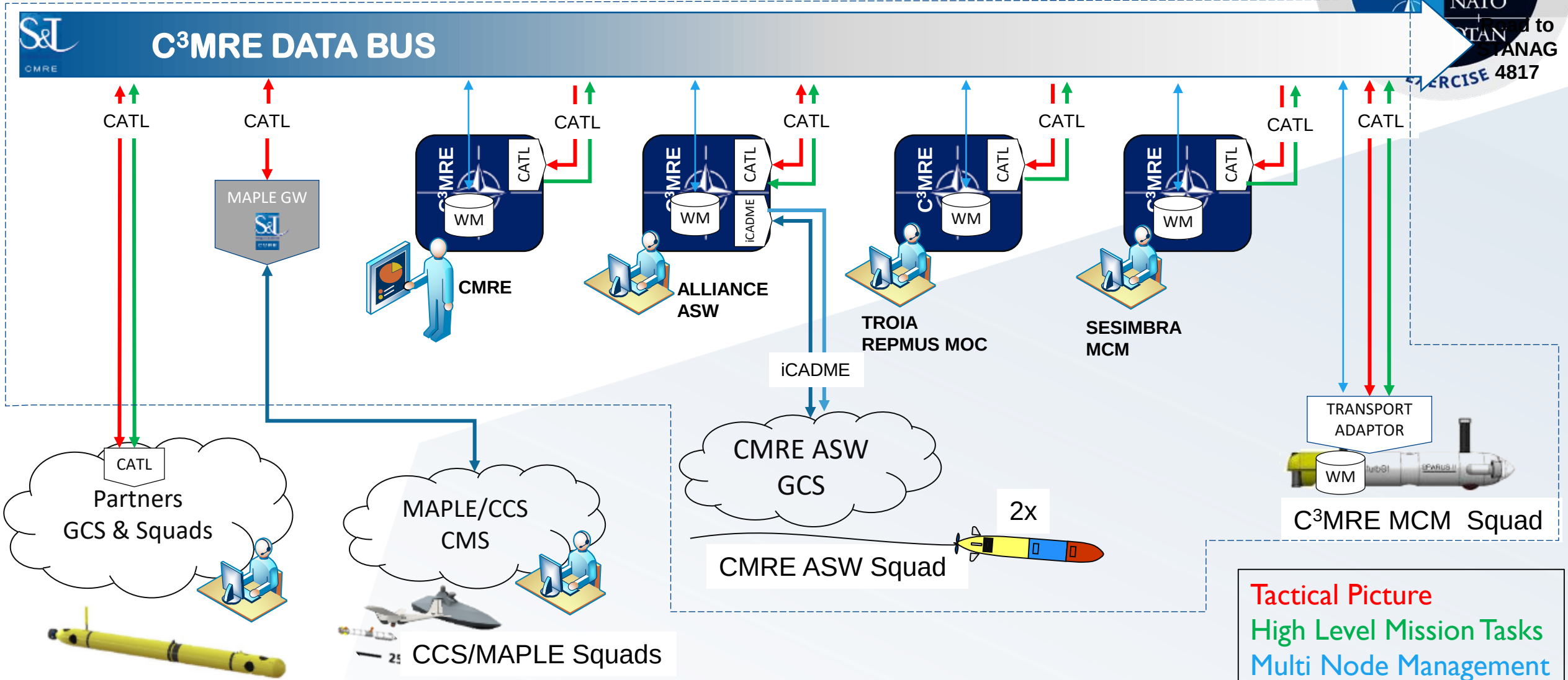
- Quantitative analysis of mission outputs



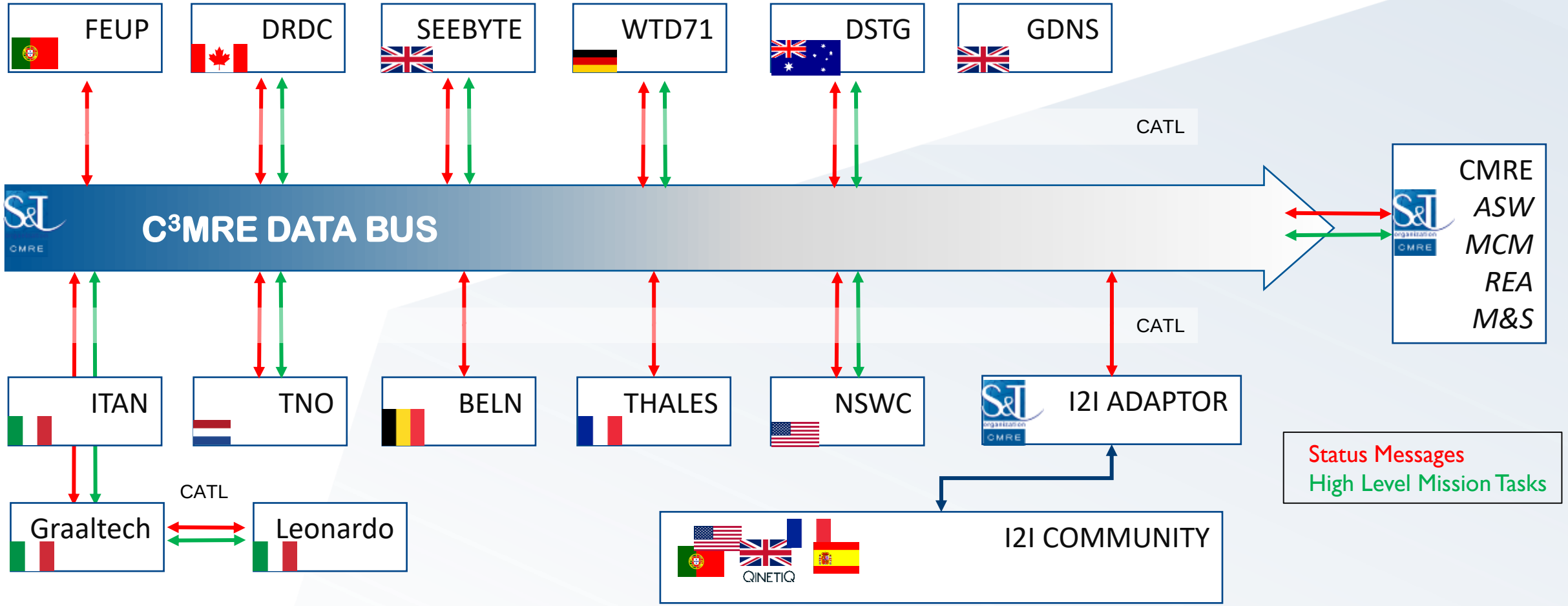
C4 Force Offerings



CMRE C4 Force Offering



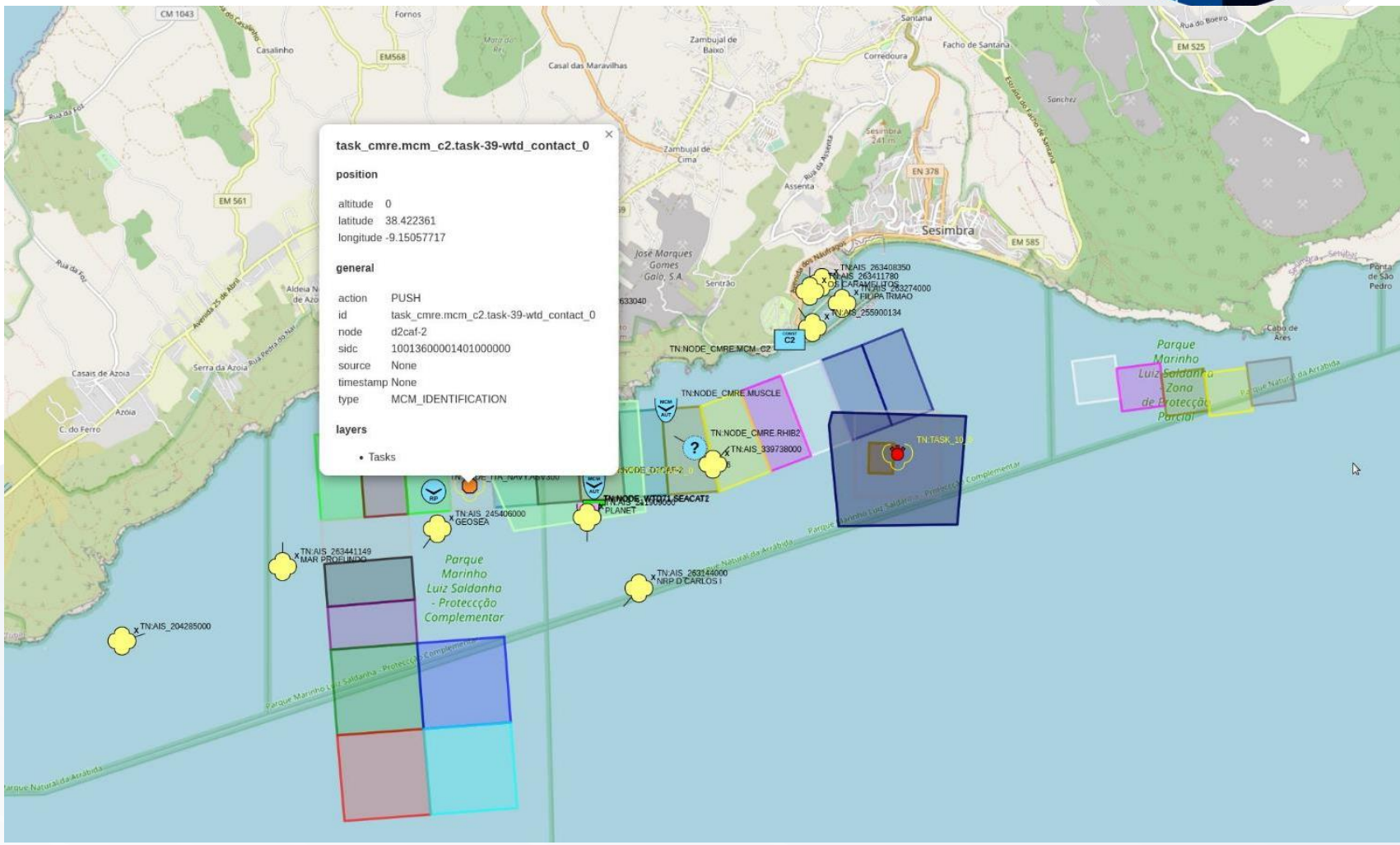
C3MRE Network



C3MRE Results during DYMS22

Situational Awareness in Sesimbra

- BLUFOR positions
- Status of missions and tasking



C3MRE Results during DYMS22

Situational Awareness OPAREA

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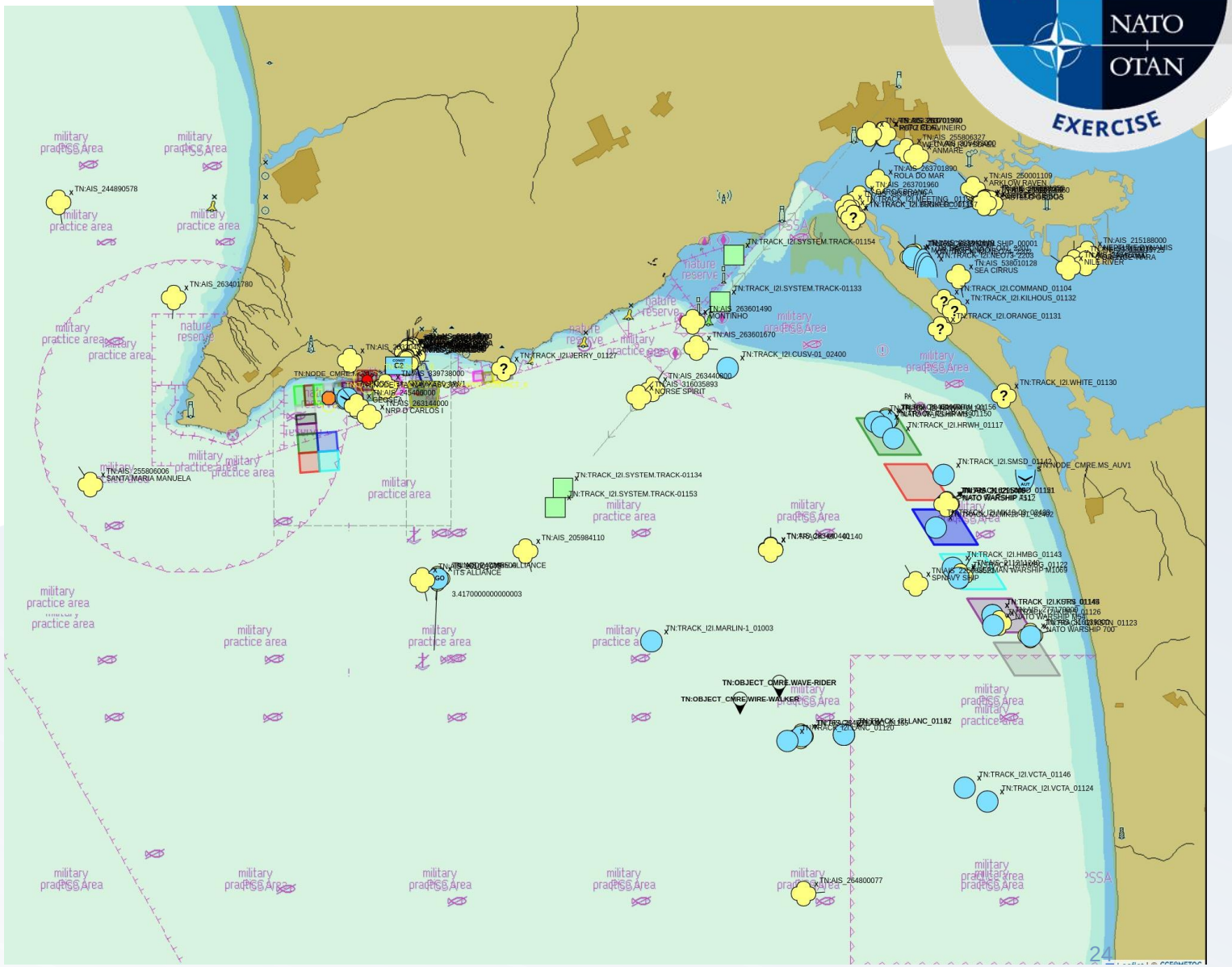

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  - ✓ Demonstrated Machine to Machine tasking of small UUV BIONDo for Mine ID using CATL

C4 Interoperability

- ✓ Provided C3MRE interoperability platform in MOC Collected, managed and distributed CATL messages
  - ✓ 30 federates from 11 Institutions
- ✓ Exchanged C4 information with I2I network

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REA

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- ✓ Utilized SSP to estimate ASW performance
- ✓ Shared data to MGEOMETOC COE

DYMS22 Exercise: Near-term MUS Development Areas

Overall

- C2 - Development of CONUSE/Doctrine
- C4I - Integrate MUS with CTG – STANAG 4817
- Provide LINK16-grade tracking to support engagement
- NATO network - standards
- Planning and decision support tools for sensor deployment and de-confliction
- Data fusion at MOC or higher
- Improve detection asset payload
- AI to integrate information

ASW and MCM

- Continue to improve sensors, processing chain
- Continue to develop and exploit edge AI and Autonomy

MSO/MIO

- BLOS comms
- Radar payloads

REA

- Improve the overall integration level with warfare areas
- Assimilate glider measurements into ocean models
- Develop on board vehicle intelligence & reactive behaviors

NATO OTAN

Centre for Maritime Research & Experimentation

La Spezia | Italy

Questions