Topic	H2020 – INFRAIA-2018-2020
Short Title	Eurofleets+
Title	An alliance of European marine research infrastructures to meet the evolving requirements of the research and industrial communities
Project Number	824077
Delivery Date	31.07.2022
Deliverable No	D9.8
Lead Beneficiary	CSIC
Dissemination Level	Public

Report on JRA Activities Special Science Session

Document information	
Document Name	Report on JRA Activities Special Science Session
Document ID	Eurofleets+_D9.8_ Report on JRA Activities Special Science Session _V3
Revision	V3.0
Revision Date	12.07.2022
Author	Arturo Castellon Masalles (CSIC) & Niamh Flavin (MI)
Security	Public

Approvals			
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History			
Revision	**Date**	**Modification**	**Author**
1.0	27/06/2022	First Draft	Niamh Flavin
2.0	29/06/2022	Review	Arturo Castellon Masalles
2.1	05/07/2022	EMRA Additions and full review	Rafael Garcia & Sandra Sa
3.0	12/07/2022	Final Update	Niamh Flavin/ Arturo Castellon Masalles

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1. Introduction

In Eurofleets+ (EF+) project **Joint Research Activities,** three main areas of research have been prioritised in order to develop new tools for European research vessels (RVs) that advance their capabilities to explore the oceans, manage the data obtained and facilitate access to these data. Researchers from both academia and industry worked closely together to develop new tools and technologies to deliver enhanced interoperability and improved capability across the fleet and associated services and equipment.

JRA **3.1** focused on **advancing shipboard data management systems and data access** in-line with user-requirements, and integration across the fleet of participating vessels. As part of the predecessor Eurofleets 2 project, a prototype data management system was developed consisting of the European Virtual Infrastructure in Ocean Research portal (EVIOR), integrated in the Eurofleets+ website, and the Eurofleets Automatic Reporting System (EARS), a suite of software and services that can be installed and configured on board research vessels for data collection and management. Eurofleets+ proposed to advance the state of the art system in several ways. To advance the previous EARS system from Technology Readiness Level (TRL) 4-5 to at a minimum of TRL 7, which has been achieved.

This large step involved extra developments on the software suite adding functionality e.g. for reporting, improving functional integration of modules, adding support for other acquisition equipment, improving graphical user interfaces for users, easing installation and configuration, securing the web services (authentication and authorization), drafting technical documentation and guidance, and undertaking a series of tests with research vessels of the software developers and of other Eurofleets+ partners. In addition, the system has been installed on-board EF+ Transnational Access (TA) cruises, with a goal to install the software on all EF+ RVs. This will enable valorisation of the on-board data, broadening of access and enable use of data routinely collected on-board the vessels.

JRA **3.2** focused on investigating and developing **equipment innovations for deep sea operations from research vessels.** The aim of this activity is to improve facilitation of deep sea exploration (tools and rigging), allowing configuration for different vessels. Tools and rigging for deployment and recovery of equipment like Remotely Operated Vehicles (ROVs) or Autonomous Underwater Vehicles (AUVs), or on-board equipment operations (winches, gantries and cranes) have changed significantly in recent years and continue to develop. Improving interoperability of this equipment has been a primary aim of Eurofleets+, especially in terms of improvement and standardisation of tools/rigging and more efficient operation. Reducing the number of tools/rigging systems on-board with the aim of achieving improved efficiency is also a challenge within the current fleet (mainly in medium and small vessels).

JRA **3.3** focused on **intelligent robot exploration**. The use of robotics where applicable allows for lower costs for exploration and obtaining samples as well as data in some instances with more precision and resolution. Achieving greater autonomy in the decision-making of AUVs ensures that explorations are more efficient (in terms of data analysis and scientific person-time) with predetermined objectives (mapping). Surface unmanned vehicles (ASV), in guidance navigation and cooperative navigation, also manage to optimize the explorations since they allow the RV to carry out other activities simultaneously without having to be stationed alongside or over the AUV. The ambition beyond the state of the art was to increase autonomy and reduce costs. The project aimed to increase the TRL of such a system from small scale prototype (TRL3-4) to demonstration system (TRL6-7).

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Focusing on disseminating the scientific activities and results of the three aspects of Joint Research Activities (WP3); enhanced data analytics, technologies used to support deep ocean research, the advances in underwater autonomous vehicles including cooperative navigation would be showcased at dedicated “Science Sessions” during relevant workshops or conferences.

Task 9.3 activity to date has been characterised by close collaboration with all WP3 Task Leaders and work package beneficiaries. Although the European and International workshop, conference and event landscape changed dramatically during the period 2020 to 2022 in response to the curtailment of travel due to the COVID-19 two dedicated Science Sessions took place to showcase the JRA innovations. In addition, members of the project actively participated in major European and international conferences, workshops, and events, predominately virtually but also in person when it was safe to do so. A full list of presentations can be found in Section 3, which outlines all events at which Eurofleets+ participated with a focus on JRA.

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2. Eurofleets+ Science Sessions

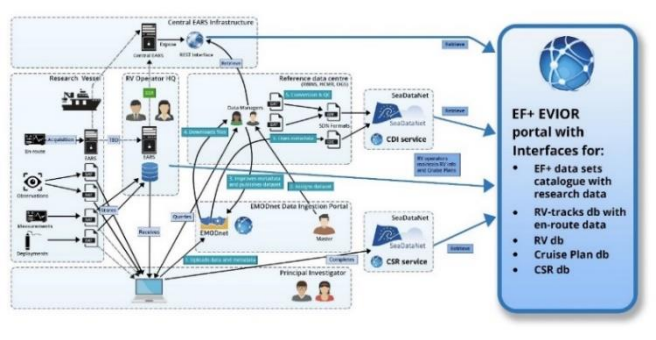
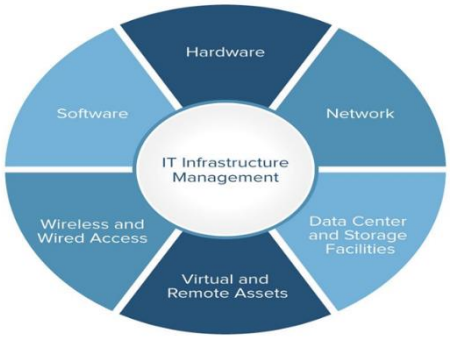
Two Eurofleets+ Science Sessions took place in June 2021 and 2022. The decision was made to split the sessions so that the innovations could be presented to key stakeholders based on areas of activity. Timing was also a crucial factor as the activities of each of the JRA progressed as different times.

2.1. Eurofleets Science Session 1

The first Eurofleets+ "Science Session" took place during the 23rd European Research Vessels Operators Group (ERVO) Annual meeting, held on 02nd June 2021 highlighting the innovative product solutions being developed by the project Joint Research Activities. The dedicated one-hour "Science Session" took place on day two of the ERVO meeting and was moderated by Colm Mulcahy, CEO of Voyager IP (Eurofleets+ beneficiary) and chair of the Eurofleets+ Industry Platform established in WP 7.

A number of the project initiatives being developed which had reached design, implementation or deployment phase and were presented to the wider ERVO group as key stakeholders and for feedback.

Table 1: Presentations made during the first Science Session

Presentation Name	
Eurofleets Automatic Reporting System (EARS) Eurofleets+ Data Management System (JRA 3.1)	
Optimizing solutions for telepresence and real-time data transfer. (JRA 3.1)	

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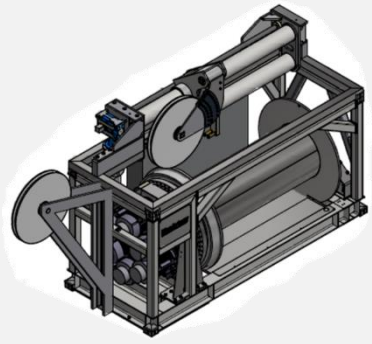
EFs+ Portable Electric Deep Sea Winch Design. (JRA 3.2)	
Dual Mode Handling System (DMHS) designed by SEAONICS (JRA3.2)	

The presentations featured live polls and question-and-answer sessions after each presentation, with the audience reaching 55 attendees during the event. The presentations are available at the ERVO website here: https://www.ervo-group.eu/np4/np4/np4/46.html

The ERVO annual workshop was chosen as the European Research Vessel operators manage more than 100 Research Vessels operating in Europe and thus are the ideal market for the innovations being developed within the Eurofleets+ project. The live polls allowed for real-time feedback on the innovations to inform upcoming or future iterations so deliver improvements to better meet the needs of the target users.

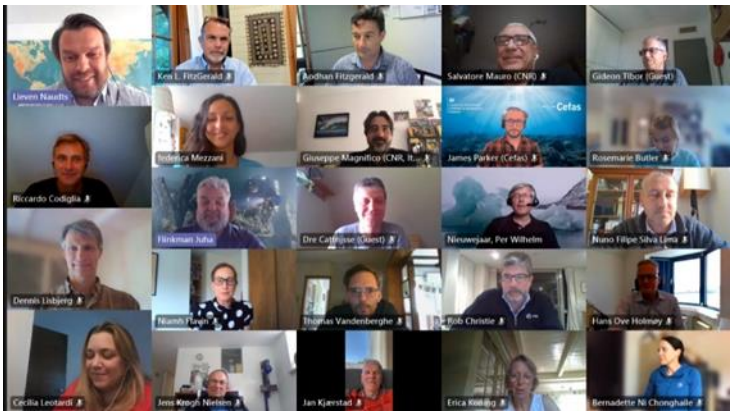


Image 1 23rd ERVO Meeting Group Picture

Engagement of Participants

- During the Outreach session 55 participants remained engaged with the webinar Outreach session. (63 participants at the peak) Of these participants up to 30% engaged with the On line poll.
- MacArtney had 33 responses to 5 Questions
- Voyager IP had 63 responses to 7 Questions
- RBINS had 62 responses to 6 Questions

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– These participant responses provided key information further pinpointing what was important to the market and where the real challenges exist.

On Line Poll Questionnaires

– The results of the questionnaire were shared with the individual industry partners and have proved to be an excellent source of feedback enabling industry representatives understand the day to day challenges experienced by researchers and vessel operators. Implementing a Live Poll approach was a first and a highly effective method of securing engagement. (The on line questions are attached in the annex.)

Table: 2 Outcome from the Session

Table 2: Analysis of the On Line Poll results**Presentation Name**	**Outcome and follow up**
EFs+ Portable Electric Deep Sea Winch Design	• Payloads are mainly CTD or Corer, preferred communication protocol is by Ethenet, the most important utility of a remote control is wireless operation and maximised data display, that video monitoring is a very important feature and that remote operations from shore or other is not in demand yet. • These findings are driving MacArtney to work on incorporating these findings in product development.
Optimizing solutions for telepresence and real-time data transfer	• The majority of participants who responded used VSat and cellular broadband, but that quality of the service experienced on board was generally poor due to bandwidth constraints. • These finding are driving VIP to work on alternative Innovative Pooled broadband approaches for vessels.
Eurofleets Automatic Reporting System (EARS) Eurofleets+ Data Management System (JRA 3.1)	• All respondents use Event logging software extensively, EARS highly regarded among both Eurofleets users and others, ease of use and interoperable integration was very important. • These findings are driving RBINS to work on incorporating these findings in product development

2.2. Eurofleets+ Special Science Session 2

Eurofleets+ participated in the 2022 European Marine Robotics & Applications Workshop (EMRA2022) hosted by the National Oceanography Centre (NOC) on the 15th - 16th June as a hybrid event. The annual workshop aims to bring together a diverse range of speakers from ongoing EU funded research projects, industry stakeholders, policy makers and end users. It provides an excellent opportunity for networking, dissemination of research projects and cross-fertilisation of ideas in marine robotics, enabling innovative technologies and applications. It is also the key annual networking opportunity for European marine robotics researchers to come together showcase what they have been working on and discuss new projects.

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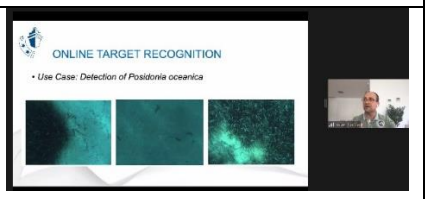
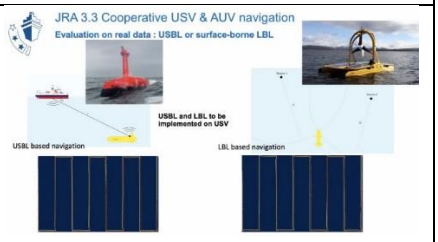
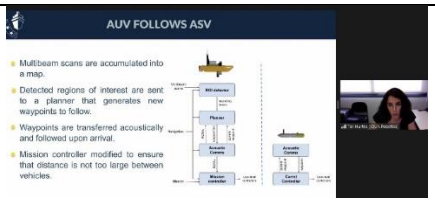
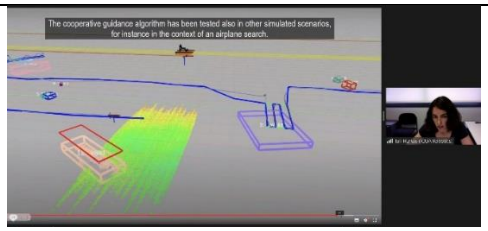
The dedicated Eurofleets+ "Science Sessions" *Eurofleets+ Joint Research Activities: Intelligent Robot Exploration,* (duration 1hr and 20mins) presented the work carried out by the project and included updates on:

Table 3: Presentations made during the second Science Session

Presentation Name		
Intelligent AUV Mapping, presented by Rafael Garcia - UdG,		
USV & AUV cooperation for optimised deep-sea navigation, presented by Jan Opderbecke Ifremer.		
AUV-ASV cooperation, presented by Natalia Hurtos - IQUA		

An overview of the Eurofleets+ project and progress to date was also provided by Niamh Flavin and included the promotion of upcoming Blue Skills Labs training opportunities within the Eurofleets+ project in 2022. The session was interactive, with questions from the audience welcomed.

The event was chosen as it was an ideal platform from which to highlight the achievements of Eurofleets+ JRA3.3 Intelligent Robot Exploration as it was attended by and featured presentations from key industry developers such as Ocean Infinity and Sonardyne and other key H2020 Robotics project such as European Marine Robots (EUMR) and Robotic Survey, Repair & Agile Manufacture (RESURGAM).

The event was attended by 60 online and 40 in person attendees inclusive of students, early career scientists, academics and industry representatives with each presentation generating a high level of interest with questions from both the in-person attendees and virtual participants.

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Outcome from the Session:

Table4: Outcomes from the second Science session

Presentation Name	Outcome and follow up
Eurofleets+ Overview	The overview presentation highlighted some of the Eurofleets Transnational Access funded projects which involved Marine Robotics. This promoted a question from the audience in relation to Transnational Access (TA) funded and the future of such programmes. Users found the opportunity to access TA funding through projects such as Eurofleets+ and EUMR H2020 projects very beneficial to progress their research. This interest will be include in the outcome of Eurofleets+ project with respect to the establishment of a Eurofleets RI.
Intelligent AUV Mapping	The presentation showed a use case of intelligent robot behaviour for Posidonia mapping. The participants acknowledged how an AUV carrying out replanning on the fly can map an interest area in a more effective way in terms of time and energy budget, with respect to state-of-the-art lawn mower mapping surveys.
USV & AUV cooperation for optimised deep-sea navigation	A question on whether the for the positioning of AUVs, LBL techniques with moored transponders would not be a simple and efficient solution emerged. LBL (conventional high-observability LBL fields with 3 transponders in reach at all times, and more recent sparse LBL fields with a reduced number of transponders) require a considerable amount of hardware, personnel on ship and ship-time in order to plan, deploy, calibrate and recover transponders. This is widely used in the offshore industry, with LBL fields of several dozens of moorings deployed in a work area: calibration can take days or weeks and a LBL field remains in place for months or years. In Ocean science, especially exploration tasks, the investigated area changes from day to day in order to cover a very wide surface over time. The process of LBL operation then exceeds the suitable effort in ship time and can even be technically unsatisfying (e.g. a long single rectilinear AUV transect). Research AUV operators have in the vast majority of time converted to USBL continuous positioning when high quality geo-referencing is required (e.g. for multiple dataset mapping integration), hence involving the surface vessel for the complete AUV dive. AUV-USV cooperation in the presented work is investigated in this context.
AUV-ASV cooperation	The cooperative framework presented generated a lot of interest from the participants and led to queries as to whether the developed system could be used or extended to monitor and command more than one AUV at a time with one ASV. First impressions are that this would difficult with the current design and would require the system to be adapted and re-thought in a different way. Representatives from NOC and from University of Zagreb expressed interest in following up on the systems for more in-depth analysis.

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3. Additional Eurofleets JRA Activities

In addition to the dedicated Science Sessions, the following Eurofleets+ JRA dissemination activities were also implemented up to July 2022 to ensure that the innovations being developed were communicated as widely as possible.

2019

- 22nd ERVO Meeting, June 2019 (Presentation)
- IRSO Meeting (Presentation) (JRA 3.1), September 2019
- Marine Autonomous Technology Showcase Conference and Exhibition Southampton (Exhibition) (All JRA), November,2019

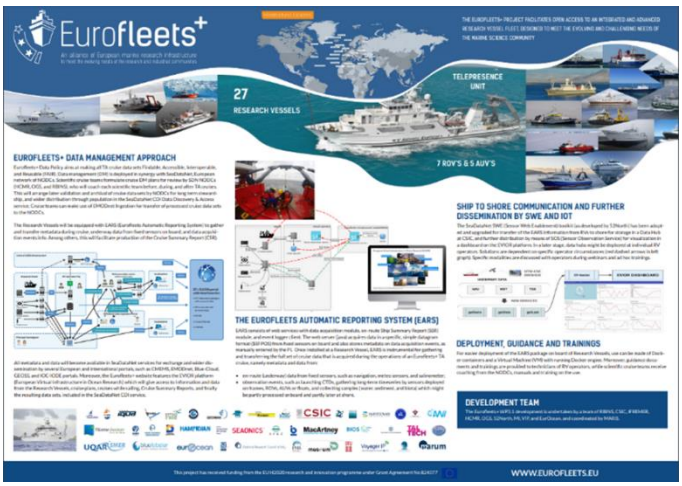

Image 2 Eurofleets JRA 3.1 Poster

2020

- Data management for European fleet of research vessels in EUROFLEETS+" to both Sea Tech Week and Eurogoos Ocean Technology Forum being held in parallel which will be held virtually (JRA3.1), October 2020
- IRSO Online Presentation, October 2020

2021

- European research infrastructure synergies EUMR (Workshop) (JRA3.3), April 2021
- International Conference on Marine Data and Information Systems (IMDIS) (Poster), April 2021
- Eurogoos Conference – Ocean Observing Technologies (Paper and Presentation JRA3.2), May 2021
- EMODnet Open Conference (Poster) (JRA3.1), June 2021
- EMRA(Presentation) JRA3.3, July 2021
- Oceans 21(Presentation) JRA3.3, September 2021

2022

- Oceanology International March, 2022 (JRA3.1)

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4. Annexes

4.1.23rd ERVO Annual Meeting Agenda

23rd ERVO Annual Meeting – June 01st - 02nd, 2021
Online meeting

Tuesday 01st June 2021 (indicated times are CEST)		
14:00	ERVO Annual Meeting: Opening & Introduction	L. Naudts
	Theme 1: RV builds, Modifications and performance	
14:15	Status and plans for a new coastal research vessel	P. Nieuwejaar
14:30	RV Tom Crean update on project progress	A. Fitzgerald
14:45	The second life of the RRS Ernest Shackleton ... the RV Laura Bassi becomes a multipurpose research polar ship	R. Codiglia
15:05	RV Aranda – New Technologies on 30 years young vessel	J. Haukilehto
15:20	New RV for IEO	J. Sorribas Cervantes
15:35	RV Svea - experiences after the first 20 months of operation	B. Lindell
16:00	Coffee break	
16:10	Building of the new, multi-purpose, Greek Research Vessel - Hellenic Centre for Marine Research	D. Sakellariou
16:30	RV Mário Ruivo: performance after the modifications	M. Carapuço
16:50	Replacement of RV Kaharoa	R. Christie
17:05	A Growing Community of Philanthropic RV Support Throughout Europe+	E. King
17:20	The new RV Belgica	L. Naudts
	Theme 2: Manning, Safety and training	
17:40	Operations during a pandemic, the Marine Institute experience	A. Fitzgerald
17:50	STCW light education for scientists that get onboard Dana	J. Sandager
18:05	End Day 1	

Wednesday 02nd June 2021 (indicated times are CEST)		
14:00	Introduction to day 2	L. Naudts
	Theme 3: Common issues around research vessels	
14:05	Proposal for a new *ad-hoc* ERVO Working Group: European RVs economics, management processes and spare capacity	G. Magnifico
14:15	Dipclear incident R/V Bat Galim in Cyprus EEZ	G. Tibor
	Theme 4: Cooperation and Outreach	
14:25	Update ARICE project	V. Willmott
14:40	EurOcean RID	S. Sa
14:55	Exploring collaboration opportunities among RV operators: from Italian EEZ to Med Sea	L. Evangelista
15:10	EUROFLEETS RI: progress made in EFs+ WP8 "Foresight: Legacy and Roadmap" towards a long-term sustainable coordination model for the European RVs	O. Lefort
15:25	RVONZA (Research Vessels Of New Zealand and Australia)	R. Christie
	Theme 5: Remote Operations incl. Operations with Autonomous Vehicles	
15:40	Procurement of two AUV Munin and two USV Sounder	P. Nieuwejaar
15:55	A new concept project: Surface UnmaNned Multipurpose reseArch maRine vEhicle (SUNMARE)	F. Mezzani
16:10	Coffee break	
	Theme 4: Cooperation and Outreach – Eurofleets+ JRA session	
16:25	Introduction	C. Mulcahy
16:30	JRA 3.1 EARS	T. Vandenberghe
16:40	JRA 3.1 VSAT Comms	C. Mulcahy
16:50	JRA 3.2 Deep Sea Portable Electric Winch Design	L. Jørgensen
17:00	JRA 3.2 Moonpool and/or Over the side	J. Ødegård
17:10	Panel/Group Discussion	C. Mulcahy
17:25	Closing of ERVO 2021	L. Naudts
17:30	End Day 2	

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4.2. European Marine Robotics & Applications Workshop (EMRA) 2022 Agenda

EMRA Day 1

	15th June
09:00	**REGISTRATION** - Good morning coffee
09:30	**WELCOME** Maaten Furlong, Head of MARS, NOC
09:40	**Key Note** Ocean Infinity - Latest trials of their Autonomous Vehicles Michael King
10:10	**Equinor - AUVROVA - Autonomous low-cost resident inspection/survey drones concept** Kjetil Eik
10:30	**RESURGAM - ROBOTIC SURVEY, REPAIR & AGILE MANUFACTURE** Anthony Weir
10:50	**COFFEE BREAK**
11:10	**State of the art navigation for Marine Robotics - Sonardyne Sponsor** Rolf Christensen
11:30	**SUNMARE (Surface UNmanned multipurpose research MARine vEhicle): preliminary results** Alec Malito
11:50	**PLOME - Platform for Long-lasting Observation of Marine Ecosystems** Francisco Bonin
12:10	**EUMR: lessons learned and overview to EMRA** João Sousa
12:30	**LUNCH BREAK**
13:40	**MONUSEN project** Igor Radusinovic
14:00	**UBC Sail boat - Raye, is an 18 foot fully autonomous sailboat** Asvin Sankaran

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14:20 14:40 15:00	**Euro Fleets Presentations** 1. Eurofleets+ Project Overview and Update (Niamh Flavin – Marine Institute) 2. Intelligent AUV Mapping (Rafael Garcia - UdG) 3. AUV-ASV cooperation (Natalia Hurtos - IQUA) 4. USV & AUV cooperation for optimised deep-sea navigation (Cyrille Gomez - Ifremer)
15:30	**COFFEE BREAK**
16:00	**Human-machine teaming in the maritime environment** See Byte & Heriot-Watt University TBC
16:20 16:40 17:00	Virtual Tours for those remote & in person tours of for those in attendance Tour Locations: – Autosub Long Range Hanger Glider Lab Deep Submergence Hanger (ROV ISIS & Autosub 5)
17:00	**END OF DAY ONE VIRTUAL COVERAGE**
17:00:00 - Late	**SPONSORS NETWORKING DINNER AND DRINKS EVENT**

EMRA Day 2

09:00	**16th June** **Arrival** - Good morning coffee
09:30	**Key Note** Alex Phillips, Head of MARS Development, NOC Autosub Long range - the first presentation of the recently competed 1700km 5 week autonomous deployment
10:00	**Robotics for Marine Litter removal and separation in the context of the MAELSTROM H2020 Project - www.maelstrom-h2020.eu** Damien Sallé
10:20	**INFORE (Interactive Extreme-Scale Analytics and Forecasting) - https://www.infore-project.eu/** **METRICS (Metrological Evaluation and Testing of Robotics in International Competitions)** Gabrielle Ferri
10:50	**NTNU's AURLab EU projects"**

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	Antonio Vasilijevic
11:10	**COFFEE BREAK**
11:20	**Blue RoSES - Blue robotics for sustainable eco-friendly services aimed at innovative marinas & leisure boats** Massimo Caccia
11:40	**ECOSUB & HUDSON Project** Iain Vincent & Georgios Salavasidis
12:00	**Autonaut EE project - the 115 day 4,000 nautical mile op from Oban to Penzance** Mike Poole
12:20	**Ocean Scan - CoMap - Cooperative Autonomous Multi-Vehicle Mapping System** José Pinto
12:40	**DeeperSense - Deep-Learning for Multimodal Sensor Fusion** Bilal Wehbe
13:00	**Groom 2** Alvaro Lorenzo
13:20	**LUNCH BREAK**
14:20	**END OF DAY TWO**

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