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Agreement EASME/EMFF/2017/1.2.1.12/S2/05/SI2.789314

Mapping and recycling of marine litter and Ghost nets on the sea-floor

marGnet

DELIVERABLE 2.4.1
Report on Mid-term Event targeted to scientists and researches

WP	2
Responsible PP	CNR-ISMAR
Author/s	Nicoletta Nesto
Date	February 2020

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SUMMARY

The Mid-Term event of the marGnet project was held on 05 February 2020 in Venice (Italy), at CNR-ISMAR premises (Tesa 102-Arsenale, Castello 2737/F).

The meeting was an important opportunity to present both the methodological approach identified by marGnet Consortium to tackle marine litter from the sea-floor and the results obtained after the first year of activity. The meeting main aim was to start a critical discussion with the scientific community and to receive the first feedbacks on the proposed solutions together with suggestions and inputs for their improvement and future development.

Overall, 56 people attended the event. The agenda of the meeting is attached in Annex 1.

After the welcome greetings from the marGnet Coordinator Dr Fantina Madricardo and from Dr Angela Pomaro on behalf of the CNR-ISMAR Director (Dr Rosalia Santoleri), Dr Vincenzo Gente (EASME officer) illustrated the European Maritime and Fisheries Fund Programme, implemented by the Executive Agency for Small and Medium-sized Enterprises (EASME) which is the funding Programme for the MarGnet Project.

During the first session of the meeting, marGnet team speakers and external international experts illustrated general aspects of the marine litter issue, the solutions proposed by the marGnet project and the specific methodologies adopted worldwide to identify and recycle this type of waste.

The invited speaker Dr Thomais Vlachogianni (Environmental Chemist & Ecotoxicologist, MSc MIO-ECSDE Programme/Policy Officer) opened the meeting with a key lecture on the marine litter issues, giving an interesting overview on the main source, composition, impact and the management strategies in force within the Mediterranean Region (Annex 2).

Dr Fantina Madricardo (Researcher at CNR-ISMAR Venice and Coordinator of marGnet project) presented the main objectives of the marGnet project, highlighting the technologies used to map the marine litter on the seabed, to predict the accumulation hotspots and to recycle plastic recovered materials as well as the results obtained after the first year of activity (Annex 3).

After the coffee break, the plenary session continued with three more specific speeches aimed at exploring the state of the art and the most innovative technical approaches recognized worldwide for modelling, mapping and recycling the material recovered from the seabed.

In particular, the invited speaker Dr Veerle Huveen (Team Leader -Seafloor and Habitat Mapping, National Ocenography Center, Southampton, UK) illustrated the most innovative methods to map the seafloor through the use of optical mapping tools (photographs, videos, hyperspectral camera), acoustic mapping tools (ultra-high resolution multibeam, high-resolution sidescan sonar, synthetic aperture sonar) and predicting tools (deterministic/mechanistic modeling, statistical distribution modeling, machine learning & artificial intelligence), giving for each methodology a critical review (Annex 4).

The invited speakers Dr Isabel Jalon Rojas (Coastal physical oceanographer at the EPOC laboratory, team METHYS, University of Bordeaux, France) presented how modelling the marine litter hotspots on the sea-floor through some specific aapproaches commonly used for understanding the trajectory and accumulation patterns of microplastics (i.e. the Eularian approach which is based on changes in particles concentration and the Lagrangian approach which is based on changes in particles position) as well as the most recent progress (the 3D numerical modeling TrackMPD) which takes into account a more complete number of parameters (advection, horizontal dispersion, vertical mixing, beaching, washing-off, sinking and resuspension/Deposition) (Annex 5).

Due to the impossibility for the invited speakers Dr Maria Cristina Lavagnolo (University of Padova, Italy) to be present at the meeting for sudden and serious family problems, the presentation on the recycling methods for marine litter was held by Dr Gian Claudio Faussone (Engineer and representative for Sintol Partner of marGnet Consortium), who illustrated the state of the art of marine litter recycling, the main problems to be addressed and the solutions proposed within marGnet project, which are specifically focused on the use of low temperature pyrolisis, giving an overview of the implemented prototype and the first results (Annex 6).

After the lunch break, three specific working groups were organized with the aim to open a discussion on the approaches and the technical solutions adopted within marGnet Project to model (Annex 7), map (Annex 8), recycle and properly manage marine litter with the interested participants. The fruitful sharing of experience and knowledge allowed marGnet team to collect feedbacks, suggestions and inputs by the participants to delineate shared and effective strategies for an eco-sustainable marine litter management and to create useful links with Institutions and Projects for future collaborations.

The mail outcomes from the three working groups were then illustrated within a final plenary session:

<u>Mapping WG -</u> The acoustic methods adopted by marGnet rose a lot of interest, especially for the part concerning the measurements of the sinking velocity. New specific dedicated experiments were suggested to include the deterioration of plastic in the measurement of sinking velocity. The acoustic mapping of the seafloor was shown to have a strong potential, especially in areas of soft sediment where the shape of the objects are easier to recognize. Concerning the hard seafloor, it was agreed that it is necessary to combine the acoustic method with video or photo samples collected in correspondence of the acoustic targets. Different collaboration started during the workshop with ENI spa and the company iXBLUE that offered to make some trials together and with the University of Southampton to perform new experiments together in Venice.

<u>Modelling WG -</u> The numerical approach to marine litter transport and sinking resulted very similar to the one adopted for the sediment transport. This can be true for the smallest part of macrolitter. The objects considered in the marGnet project are very different form small macrolitter, so it would be possible to group them on the basis of their behavior in water as already tested during the field experiments. Each object has to be considered as a virtual particle associated to the sinking velocity measured during the experiments. Moreover the representation by the model of the velocity field on the bottom and their interaction with litter objects needs a careful evaluation.

<u>Recycling & Policy WG</u> – The recycling solution proposed by marGnet project was recognized to be extremely interesting, also considering its potential future developments, being the production of marine fuel only one of the possible products that can be obtained with pyrolysis process. However due to the presence of regulatory obstacles at national level which did not allow to obtain authorizations for the recycling of marine litter within pyrolysis plants, further clarifications on authorization processes would be needed. It would also be useful to catalog the European legislation and how it is declined at the local level, because, for example, the marine litter accidentally collected by fishermen continued to be locally managed in different ways.

The meeting ended at 06:00 pm with the Coordinator's thanks to all the Participants followed by a networking aperitif.

A social dinner for the marGnet team and the invited external speakers was then arranged in a typical Venetian restaurant.

Venice, 15th February, 2020.

PHOTOS OF THE EVENTS

Dr Fantina Madricardo (on the right) and Dr Angela Pomaro (on the left) at the meeting opening.

Dr Vincenzo Gente (EASME officer) during his presentation on the European Maritime and Fisheries Fund Programme.

Dr. Thomais Vlachogianni (Environmental Chemist & Ecotoxicologist, MSc MIO-ECSDE Programme/Policy Officer) (on the left) during her presentation on the marine litter issues.

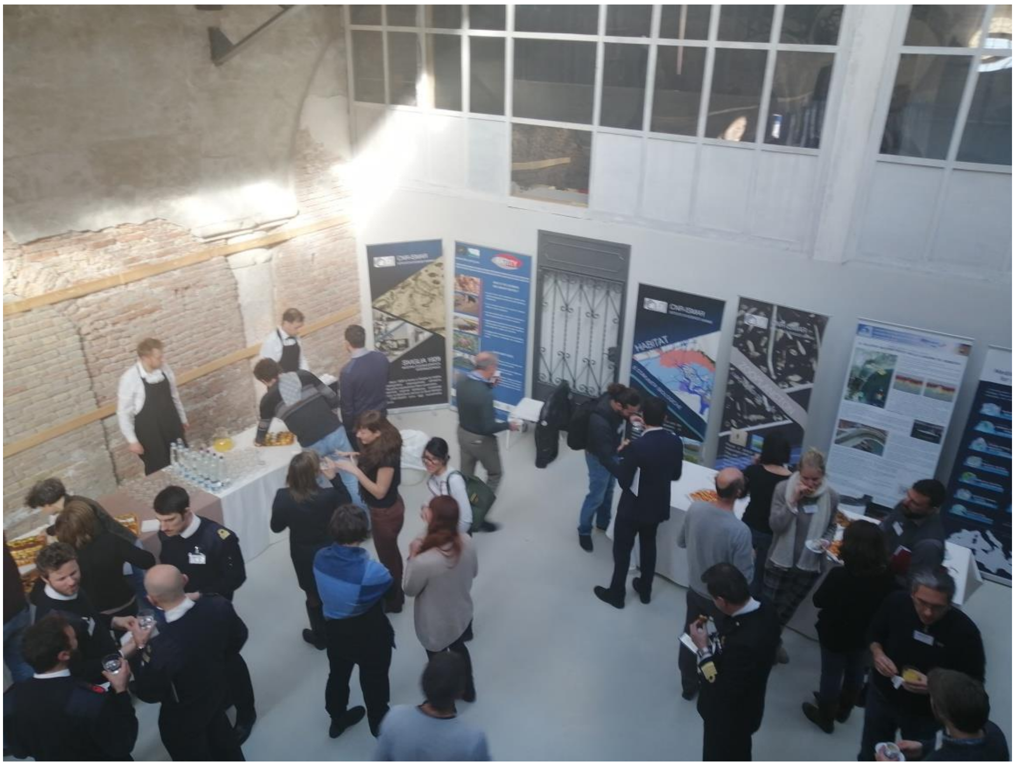
Dr Fantina Madricardo (Researcher at CNR-ISMAR, Venice, and Coordinator of MarGnet project) during her presentation on the marGnet project.

Dr Veerle Huveen (Team Leader - Seafloor and Habitat Mapping, National Ocenography Center, Southampton, UK) (on the left) during her presentation on the most innovative methods to map the seafloor.

Dr Isabel Jalon Rojas (coastal physical oceanographer at the EPOC laboratory, team METHYS, University of Bordeaux, France) during her presentation on how modelling the marine litter hotspots on the sea-floor.

Dr Gian Claudio Faussone (Engineer and representative for Sintol Partner of marGnet Consortium) (on the right) during his presentation on the solutions proposed within marGnet project for recycling marine litter.

Recycling & Policy working group.



Networking aperitif.

MarGnet mid-term Scientific meeting REPORT

Annex 1

www.margnet.eu

BLUE WORLD INSTITUTE

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Agreement EASME/EMFF/2017/1.2.1.12/S2/05/SI2.789314

MID-TERM SCIENTIFIC MEETING

AGENDA

5 February 2020	Venue: Arsenale - Tesa 104, Castello 2737/F, 30122 Venice
9:00	**Registration**
9:30	**Welcome and Institutional greetings** CNR-ISMAR Director: Dr Rosalia Santoleri EASME officer: Dr Vincenzo Gente
10:00	**Key note lecture: General introduction on the ML issue** Dr Thomais Vlachogianni (MIO-ECSDE)
10:30	**The marGnet project** Dr Fantina Madricardo (CNR-ISMAR)
11:00	Coffee break
11:30	**Mapping of ML on the sea-floor** Dr Veerle Huvenne (National Oceanography Centre, Southampton, UK)
12:00	**Modelling of ML hotspots on the sea-floor** Dr Isabel Jalon Rojas (UNSW Canberra, Australia)
12:30	**Recycling of ML** Prof. Maria Cristina Lavagnolo (Università di Padova)
13:00	Lunch break
14:30	**Parallel working groups on Mapping, Modelling, Recycling & Policy**
16:30	**Discussion and Conclusions**
18:00	Networking aperitif

registration link to the event

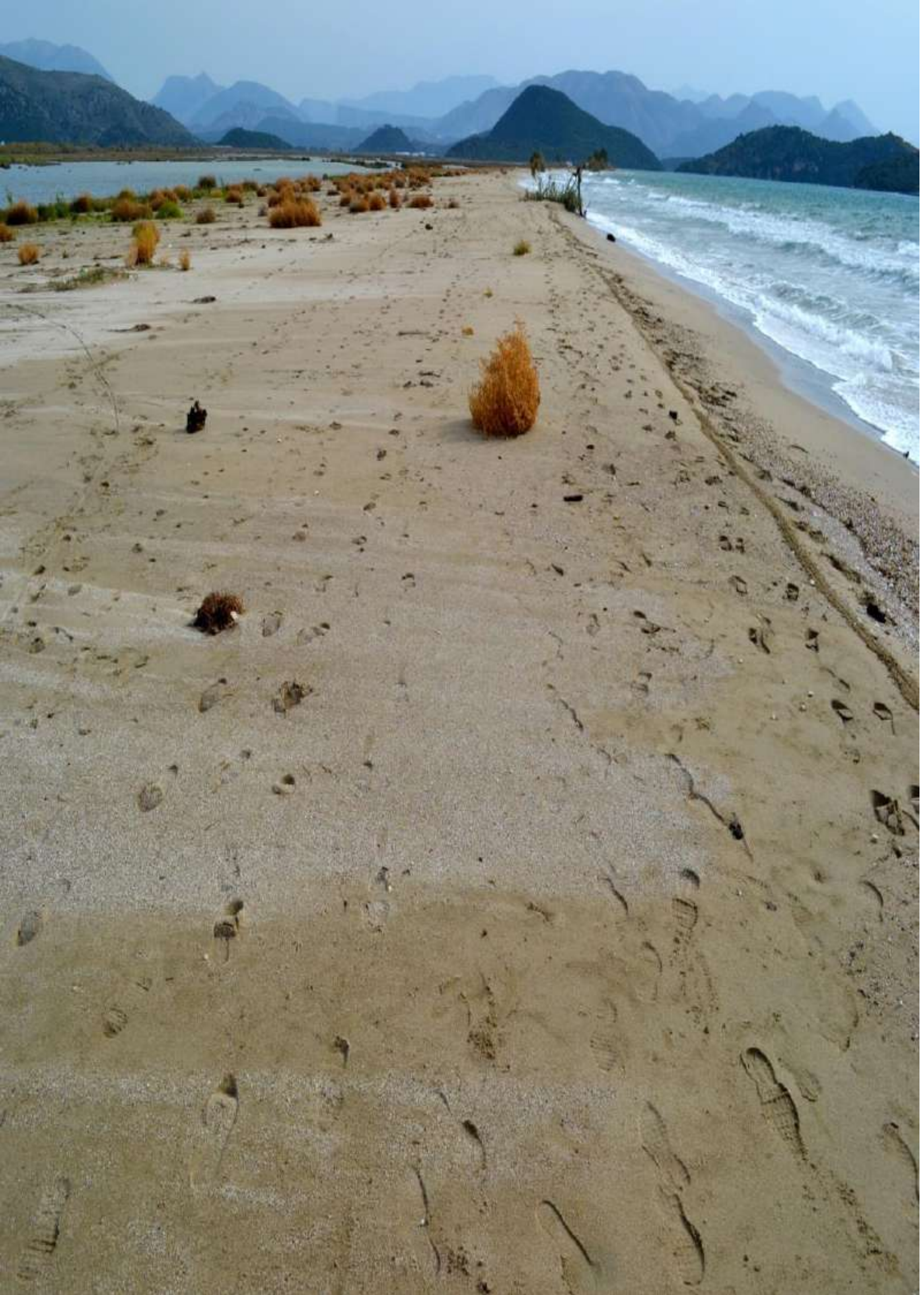
https://forms.gle/GW7uiaqa5ErvJ7XJA

MarGnet mid-term Scientific meeting REPORT

Annex 2

www.margnet.eu

Co-funded by the European Maritime and Fisheries Fund



Marine Litter in the Mediterranean

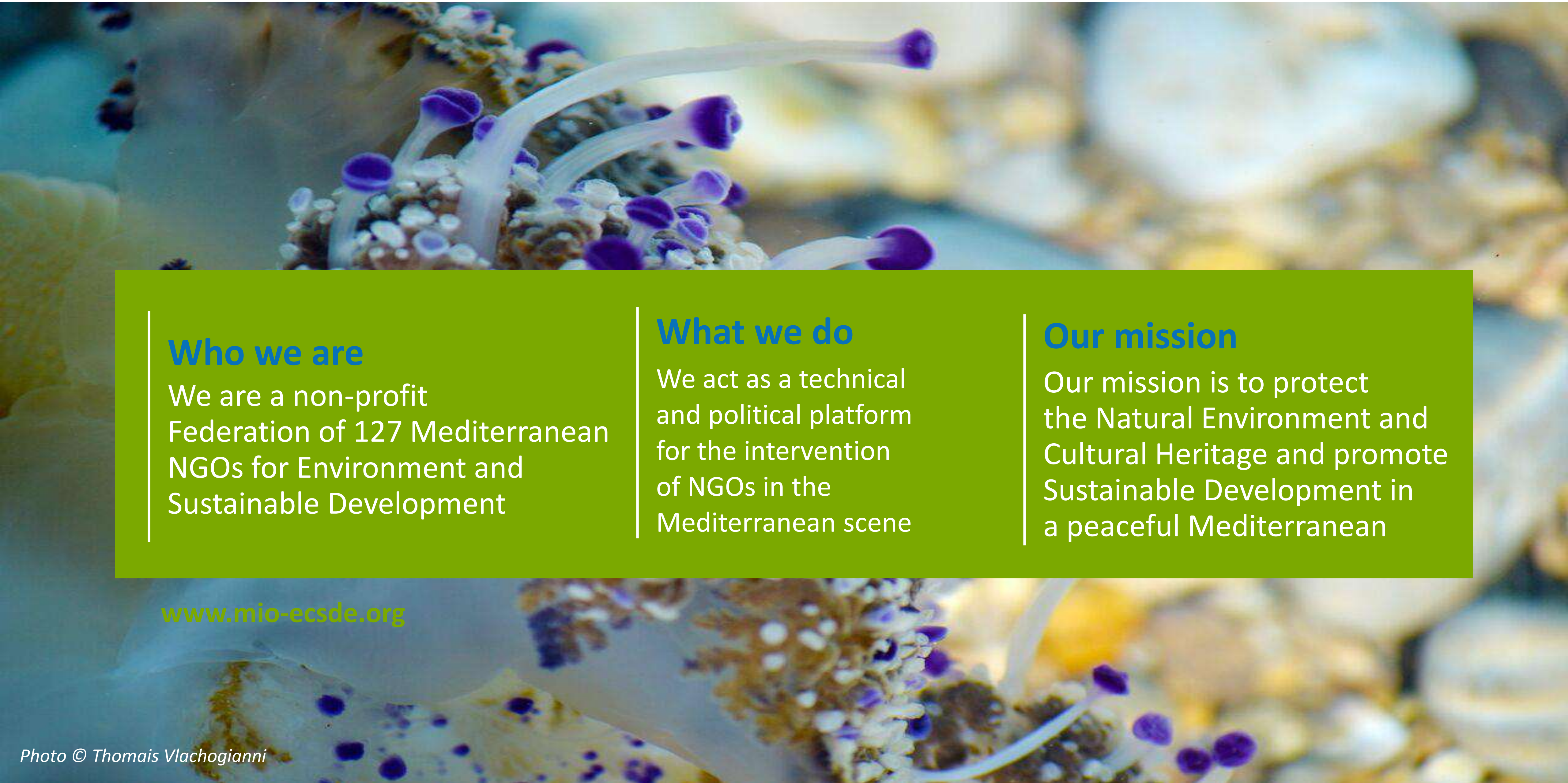
Thomais Vlachogianni
Environmental Chemist & Ecotoxicologist | PhD, MSc
MIO-ECSDE Programme/Policy Officer

Member of the MSFD Technical Group on Marine Litter
Member of the UNEP/MAP CORMON Group
WPs Leader of the Plastic Busters MPAs
Marine Litter Expert of WES

MIO-ECSDE

For more than twenty years
joining forces & building bridges
in the Euro-Mediterranean area

MIO-ECSDE AT A GLANCE



Who we are

We are a non-profit Federation of 127 Mediterranean NGOs for Environment and Sustainable Development

What we do

We act as a technical and political platform for the intervention of NGOs in the Mediterranean scene

Our mission

Our mission is to protect the Natural Environment and Cultural Heritage and promote Sustainable Development in a peaceful Mediterranean

www.mio-ecsde.org

Photo © Thomais Vlachogianni

MIO-ECSDE's KEY ROLE IN ADDRESSING MARINE LITTER IN THE MEDITERRANEAN

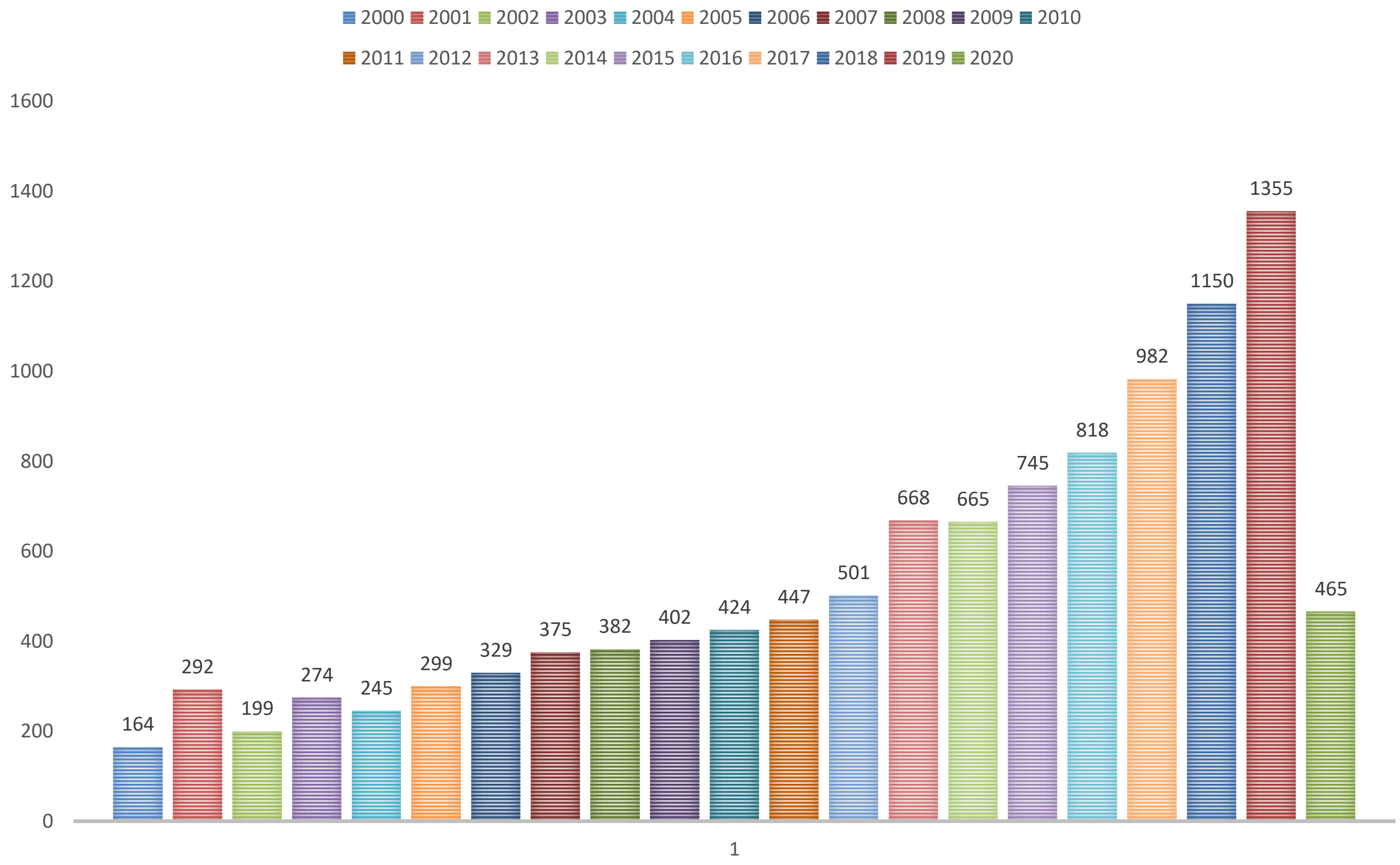
OUR RECENT PROJECTS ON MARINE LITTER & PLASTIC POLLUTION

- EU-funded Water and Environment programme (2019-2023)
- LIFE+ OPERATING GRANT FOR NGOs (2018-2019)
- Interreg Med PlasticBusters MPAs (2018-2022)
- Interreg Med ACT4LITTER (2017-2018)
- EU SWIM-H2020 SM (2017-2019)
- IPA-Adriatic DeFishGear (2013-2016)

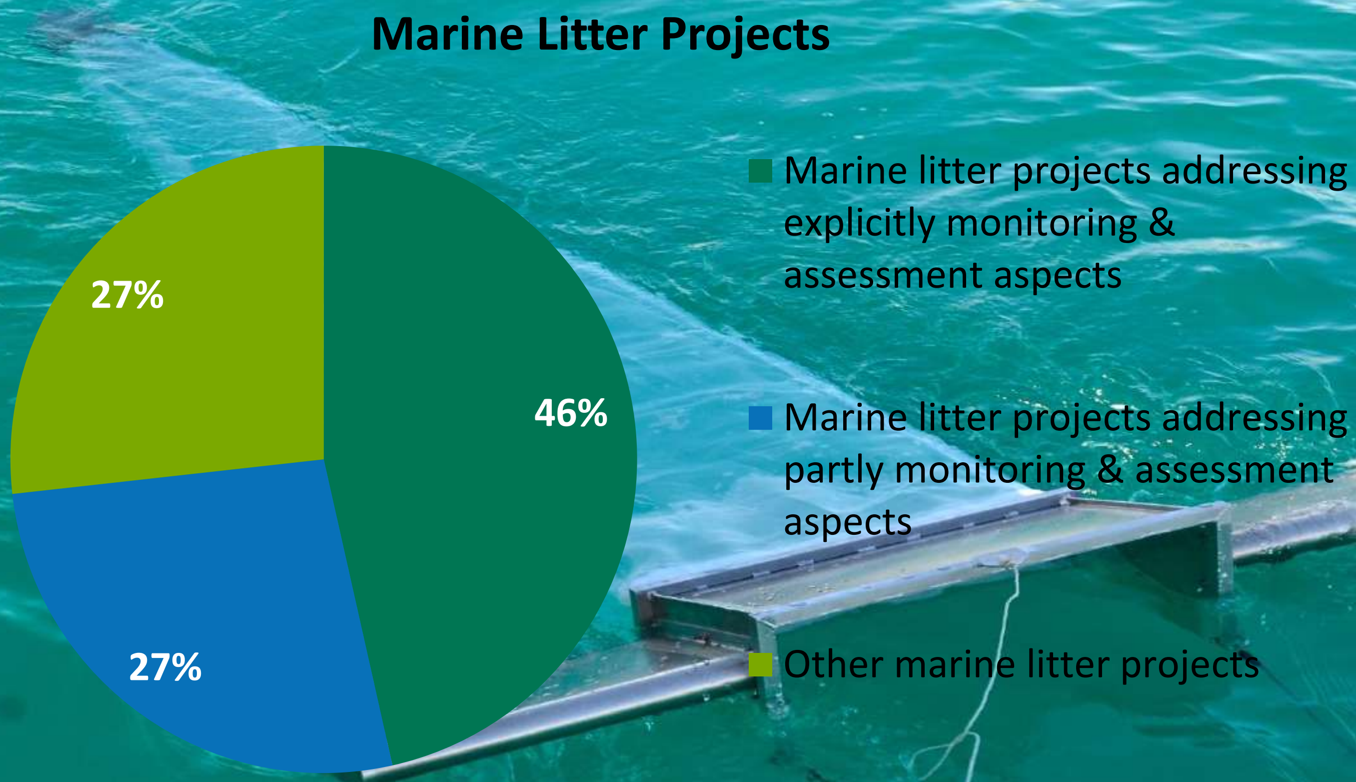
© Thomais Vlachogianni

MARINE LITTER | AN INDISPUTABLE GLOBAL THREAT THAT IS GROWING

Some 11,000 research articles have been published in the last 20 years documenting the marine litter threat



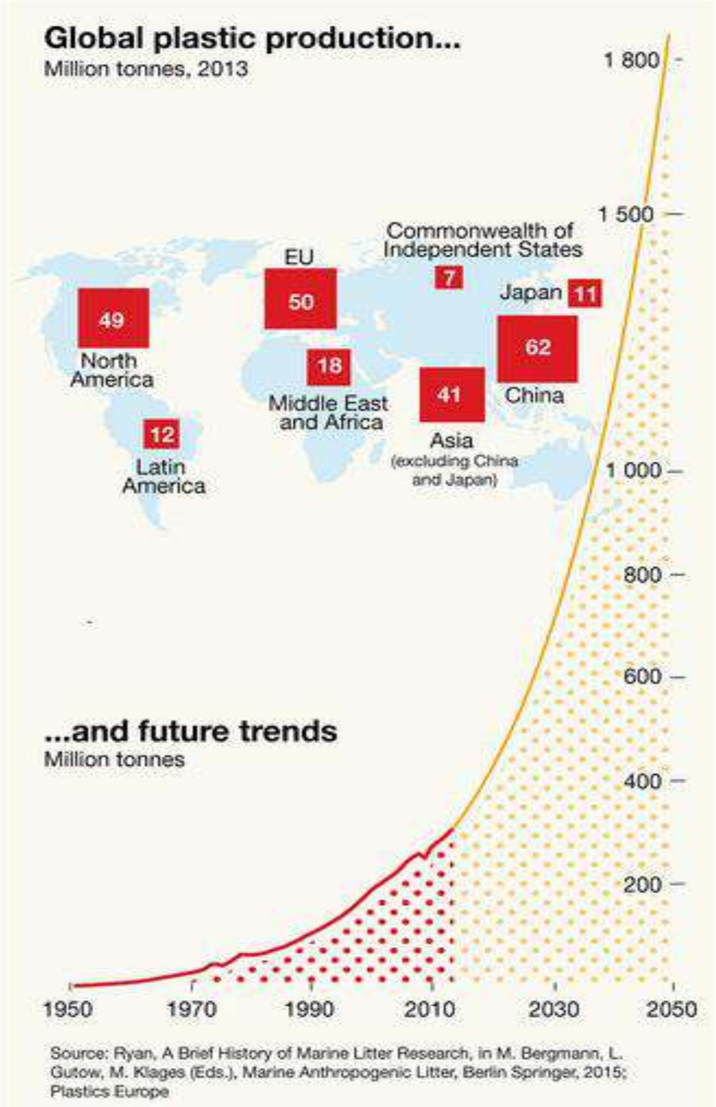
MARINE LITTER MONITORING & ASSESSMENT PROJECTS IN EUROPE



Source: *MSFD TG ML, 2019. List of marine litter projects relevant to the Marine Strategy Framework Directive.*

Photo © Thomais Vlachogianni

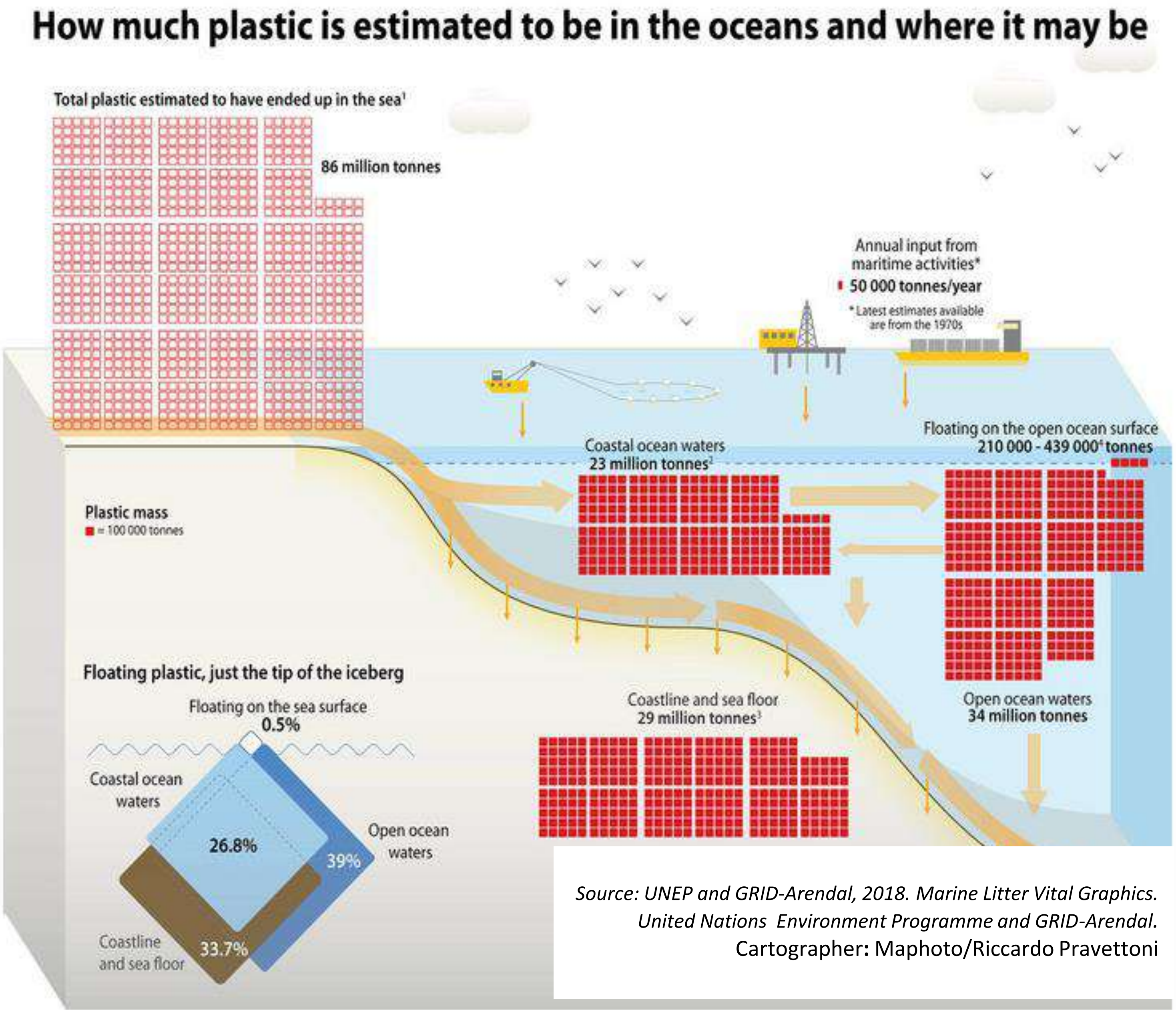
GLOBAL PLASTIC PRODUCTION & FUTURE TRENDS



Cartographer: Maphoto/Riccardo Pravettoni

In 2018, world plastics production totaled around 359 million metric tons

WHERE DOES ALL THE PLASTIC WASTE WIND UP?



Source: UNEP and GRID-Arendal, 2018. Marine Litter Vital Graphics. United Nations Environment Programme and GRID-Arendal.
Cartographer: Maphoto/Riccardo Pravettoni


Port of Izmir, Turkey
Archipelago of Lavezzi, France
THE MEDITERRANEAN SEA ONE OF THE MOST AFFECTED AREAS BY MARINE LITTER WORDLWIDE
Athens Marina, Greece
Tangier, Morocco
Photos © Thomais Vlachogianni

THE CERTAINTIES & UNCERTAINTIES ALONG THE MAMAGEMENT CYCLE OF MARINE LITTER

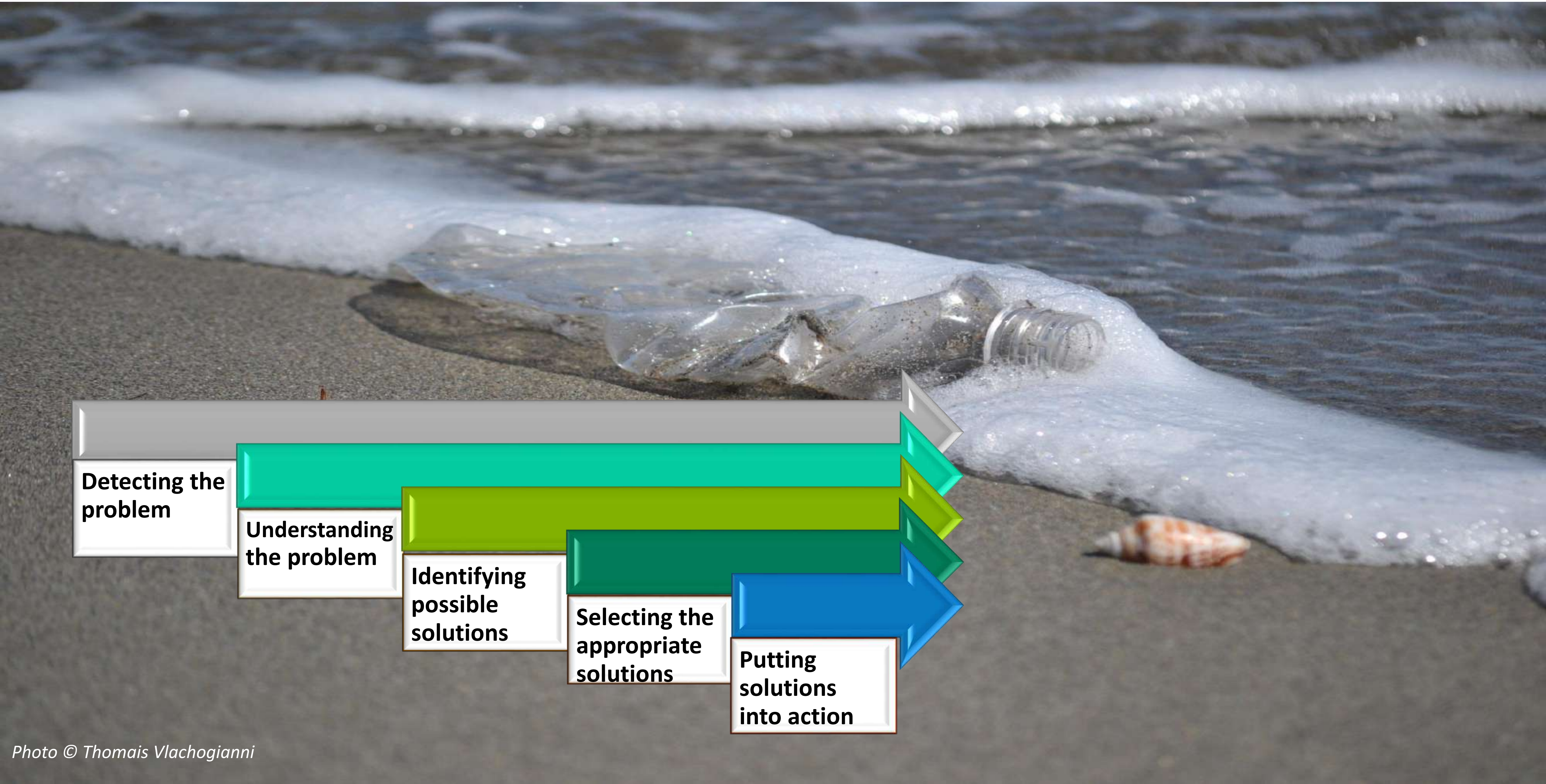
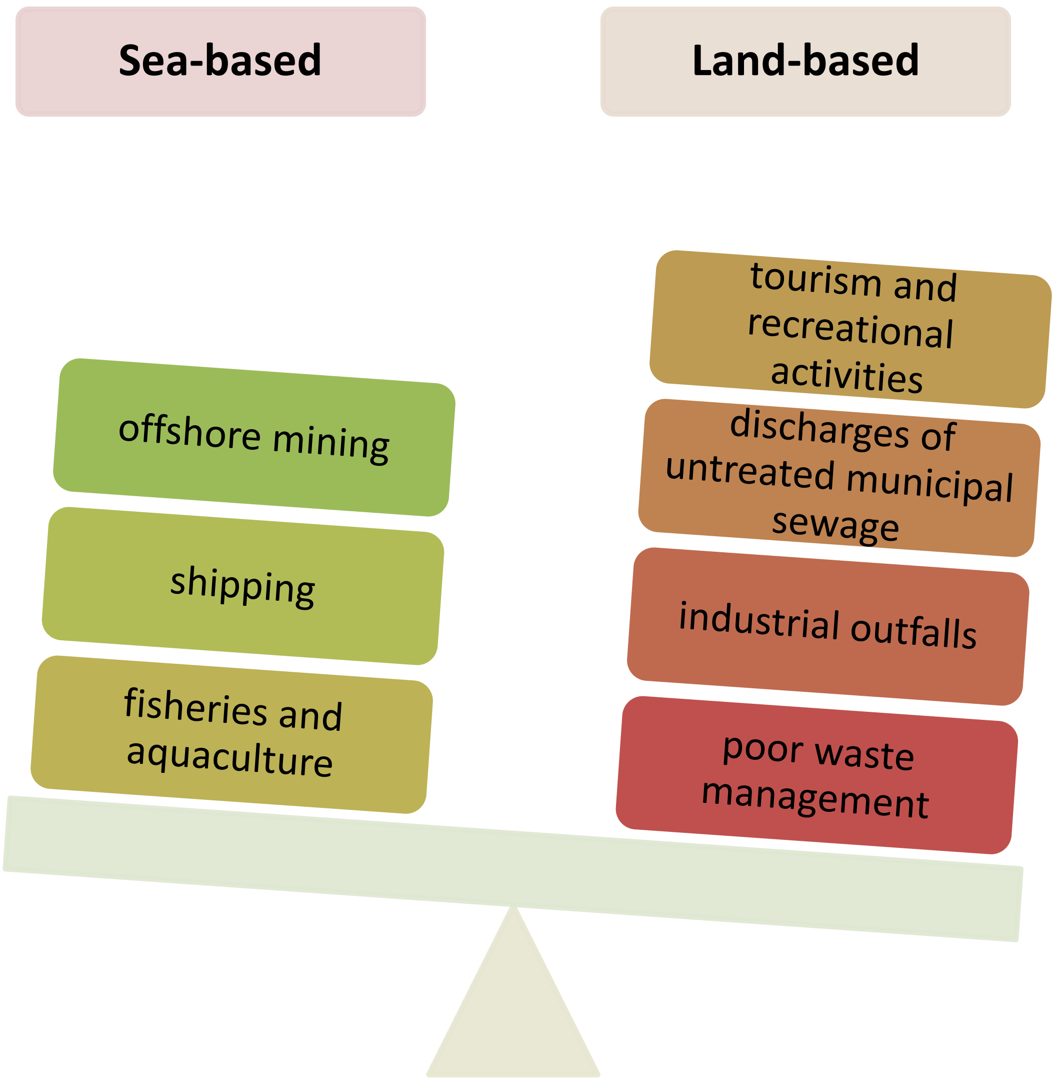


Photo © Thomais Vlachogianni

MARINE LITTER SOURCES

- ✓ Assessing the relative importance of the different sources is challenging given that a considerable percentage of litter items cannot be attributed to a specific source.
- ✓ Beach litter research results are biased towards reflecting marine litter inputs from tourism and recreational activities as most beach litter surveys are carried out in tourism destinations.
- ✓ The origin (transboundary effect) of marine litter is difficult to be determined.
- ✓ The riverine inputs of marine litter are substantial.



MARINE LITTER COMPOSITION

- ✓ Plastics are ubiquitous in the coastal and marine environment accounting for some 70-90% of all litter items found. Leakage' of plastics into the ocean can occur at all stages of the production-use-disposal cycle.
- ✓ A large amount of litter items found in the Mediterranean are single-use plastic items.
- ✓ Fishing and aquaculture related items account for some 37.5% of total items recorded in certain areas of the Mediterranean (Vlachogianni et al., 2018).
- ✓ There are no reliable estimates of the microplastics quantities entering the marine environment.
- ✓ Microplastics greatly outnumber large plastic items in marine systems. Even if all releases of plastic to the environment were to cease immediately, the number of microplastics in the ocean would be expected to continue to increase as a result of continuing fragmentation.

The beaches of the Lavezzi island –located in the Natural Reserve of the Strait of Bonifacio- polluted by 'mermaids' tears' and mussel nets. All beaches of the island were cleaned up a week ago and now they are back to square one.

MARINE LITTER IMPACTS

- ✓ Uncertainties remain regarding the extent of harm caused to marine species by ingestion of microplastics and their exposure to hazardous chemicals leaching from or adsorbed on microplastics.
- ✓ Currently there is no evidence to support or refute potential bio-magnification of particles or associated chemicals.
- ✓ Basic toxicological data on the consumption of micro- and nano-plastics by humans for a food risk safety assessment are lacking.
- ✓ Measuring the full economic cost of marine litter e.g. including the inhibition of the proper functioning of marine ecosystems is not possible.

Upper photo: stomach contents of sea turtles that were dissected at the Talamone Sea Turtles Rescue Centre located in south Tuscany

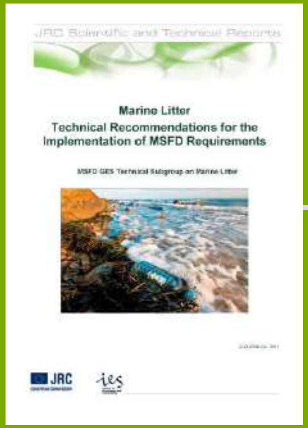
MARINE LITTER MEASURES

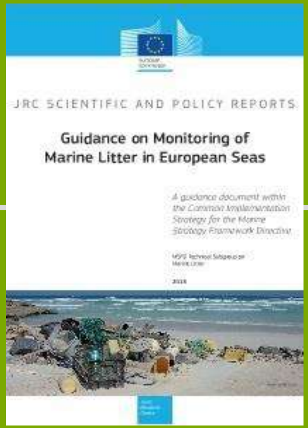
- ✓ Substituting 'conventional' plastics with biobased plastics is merely a distraction to the marine litter issue.
- ✓ Biodegradable and compostable plastics pollute our coasts and seas just like conventional plastics, as they behave quite differently in the marine environment than in a terrestrial setting (landfill, composter) where the conditions required for rapid biodegradation are unlikely to occur. In addition, mixing of such plastics with normal plastics in the recycling stream may compromise the properties of the newly synthesised polymer.
- ✓ End-of-pipe solutions such as cleanup operations cannot address the issue.

COMBATING MARINE LITTER AT EU LEVEL |
THE MARINE STRATEGY FRAMEWORK DIRECTIVE

- 11 Descriptors
- Monitoring Programmes
- Programmes of Measures
- Baseline & threshold values

TECHNICAL GROUP ON MARINE LITTER





NEW WASTE LEGISLATION

- ✓ **New targets**
  - ➢ Higher recycling for municipal waste: 55% by 2025, 60% by 2030; 65% by 2035
  - ➢ New recycling targets for packaging waste: 65% for all packaging by 2025; 70% for 2030
  - ➢ Phasing out landfilling, by 2035 the amount of municipal waste landfilled must be reduced to 10% or less of the total amount of municipal waste generated

THE EUROPEAN PLASTICS STRATEGY

SINGLE-USE PLASTICS | NEW EU RULES

Source: Joint Research Centre, European Commission (2017)

- ✓ Plastic ban in certain products
- ✓ Consumption reduction targets
- ✓ Obligations for producers
- ✓ Collection targets
- ✓ Labelling Requirements
- ✓ Awareness-raising measures
- ✓ Complete the existing policy framework with producer responsibility schemes for plastic fishing gear

Combating ML at the Mediterranean coasts and sea

The Regional Plan for Marine Litter Management in the Mediterranean of the Barcelona Convention (Decision IG.21/7)

Main objectives

- ✓ **Prevent** and **reduce** to the minimum marine litter pollution in the Mediterranean and its impact on ecosystem services, habitats, species in particular the endangered species, public health and safety;
- ✓ **Remove** to the extent possible marine litter by using environmentally respectful methods;
- ✓ **Enhance knowledge** on marine litter;
- ✓ Achieve that its management is performed **in accordance with accepted international standards** and approaches.

MEASURES TO TACKLE MARINE LITTER

- EXTENDED PRODUCER RESPONSIBILTY
- WASTE PREVENTION
- DESIGN FOR LIFE CYCLE
- WASTE REDUCTION
- WORKING AT ALL LEVELS
- IMPROVED WASTE MANAGEMENT
- AWARENESS RAISING & EDUCATION

KEY PROJECTS COMBATING MARINE LITTER

WES &
SWIM-H2020 SM

SEIS

H2020 SEA LITTER CRITTERS, UPCYCLING THE OCEANS, CLAIM

INDICIT

IPA-ADRIATIC DEFISHGEAR

LIFE+
SMILE, AMMOS, GHOST ,DEBAG, MERMAIDS

MARINE LITTER MED
ECAP

FP7 CLEANSEA
FP7 MARLISCO
FP7 PERSEUS

Interreg Med projects

ACT4LITER

AMARE

MED
SEALITTER

PLASTIC BUSTERS MPAS

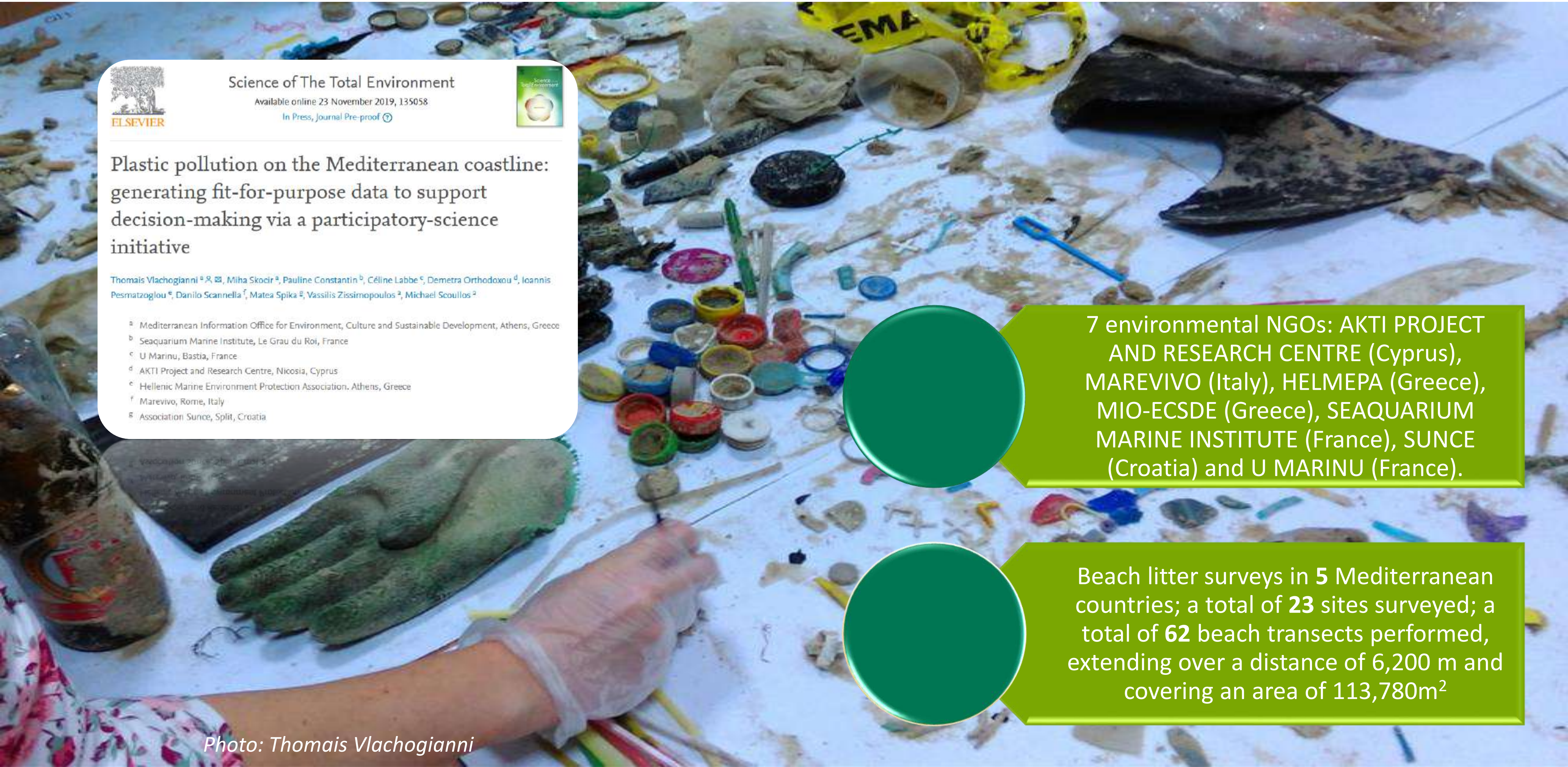
MED
BLUEISLANDS

MELTEMI

COMMON

marGnet

PLASTIC POLLUTION ON THE MEDITERRANEAN COASTLINE | GENERATING FIT-FOR-PURPOSE DATA TO SUPPORT DECISION-MAKING VIA PARTICIPATORY-SCIENCE



ELSEVIER

Science of The Total Environment

Available online 23 November 2019, 135058

In Press, Journal Pre-proof

Plastic pollution on the Mediterranean coastline: generating fit-for-purpose data to support decision-making via a participatory-science initiative

Thomais Vlachogianni [a], Miha Skocir [a], Pauline Constantin [b], Céline Labbe [c], Demetra Orthodoxou [d], Ioannis Pesmatzoglou [e], Danilo Scannella [f], Matea Spika [g], Vassilis Zissimopoulos [a], Michael Scoullos [a]

[a] Mediterranean Information Office for Environment, Culture and Sustainable Development, Athens, Greece
[b] Seaquarium Marine Institute, Le Grau du Roi, France
[c] U Marinu, Bastia, France
[d] AKTI Project and Research Centre, Nicosia, Cyprus
[e] Hellenic Marine Environment Protection Association. Athens, Greece
[f] Marevivo, Rome, Italy
[g] Association Sunce, Split, Croatia

7 environmental NGOs: AKTI PROJECT AND RESEARCH CENTRE (Cyprus), MAREVIVO (Italy), HELMEPA (Greece), MIO-ECSDE (Greece), SEAQUARIUM MARINE INSTITUTE (France), SUNCE (Croatia) and U MARINU (France).

Beach litter surveys in **5** Mediterranean countries; a total of **23** sites surveyed; a total of **62** beach transects performed, extending over a distance of 6,200 m and covering an area of 113,780m^2

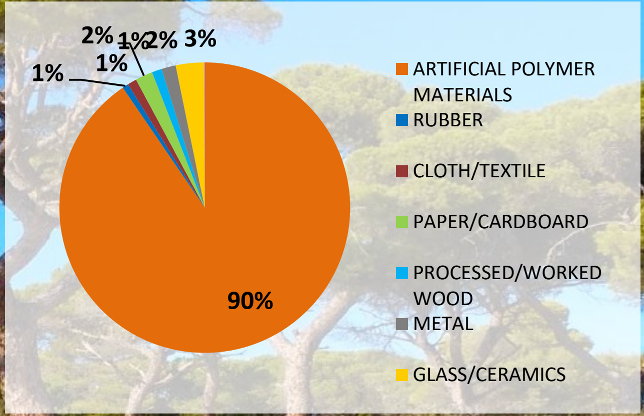
Photo: Thomais Vlachogianni

STUDY AIMS

- Assess the occurrence, composition and sources of marine macro-litter on beaches of the Mediterranean
- Generate fit-for-purpose data on marine litter, in particular plastics and single-use plastics through the use of a harmonized protocol and via a participatory-science initiative
- Provide baseline information and supporting evidence for the EU Single-Use Plastics Directive and the EU Plastics Strategy, as well as the MSFFD and the Barcelona Convention RPMLM

Photo © Thomais Vlachogianni

COMPOSITION OF MARINE LITTER



	Item code	Item name	%
1	G79	Plastic pieces 2.5 cm > < 50cm	26
2	G27	Cigarette butts and filters	12
3	G21	Plastic caps/lids from drinks	8.1
4	G95	Cotton bud sticks	6.3
5	G82	Polystyrene pieces 2.5 cm > < 50cm	5.8
6	G35	Straws and stirrers	3.0
7	G80	Plastic pieces > 50 cm	2.2
8	G83	Polystyrene pieces > 50 cm	2.0
9	G200	Bottles, including pieces	1.8
10	G30	Crisps packets/sweets wrappers	1.7

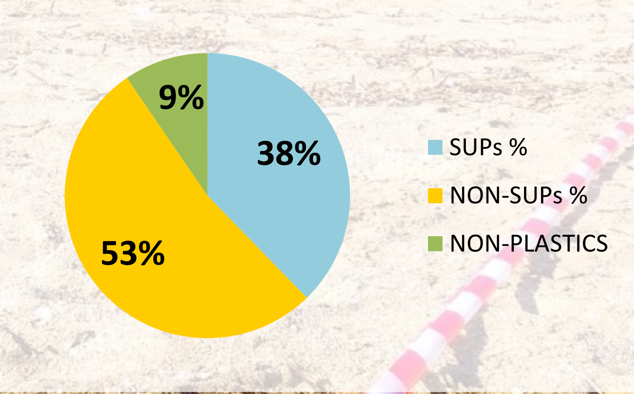
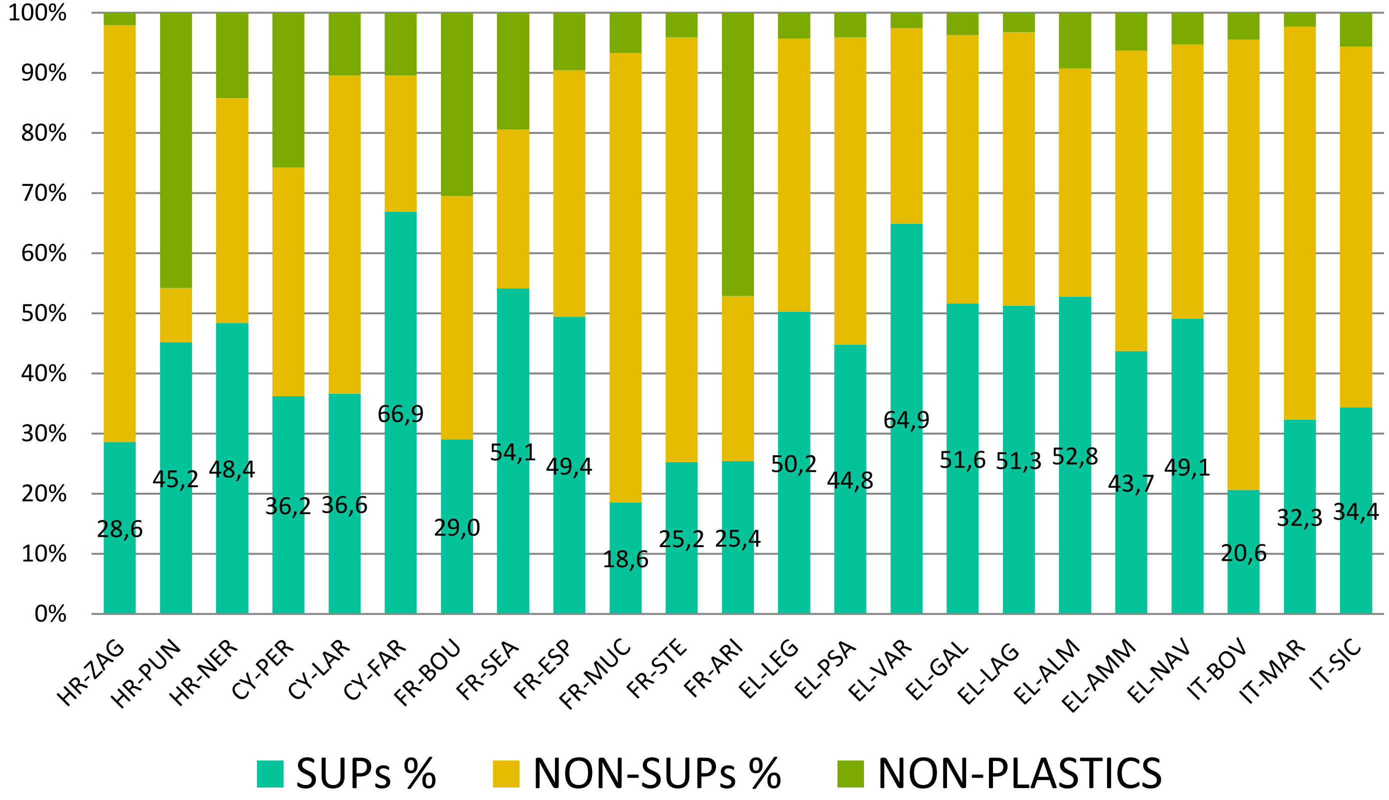


Photo © Thomais Vlachogianni

SINGLE-USE PLASTICS AT BEACH LEVEL



Plastic pieces 2.5 cm > < 50cm (G79)

Cigarette butts and filters (G27)

Plastic caps/lids from drinks (G21)

Cotton bud sticks (G95)

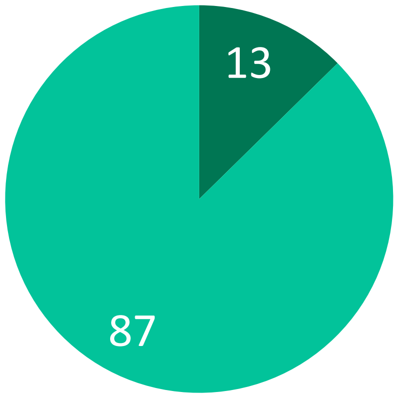
Straws and stirrers (G35)

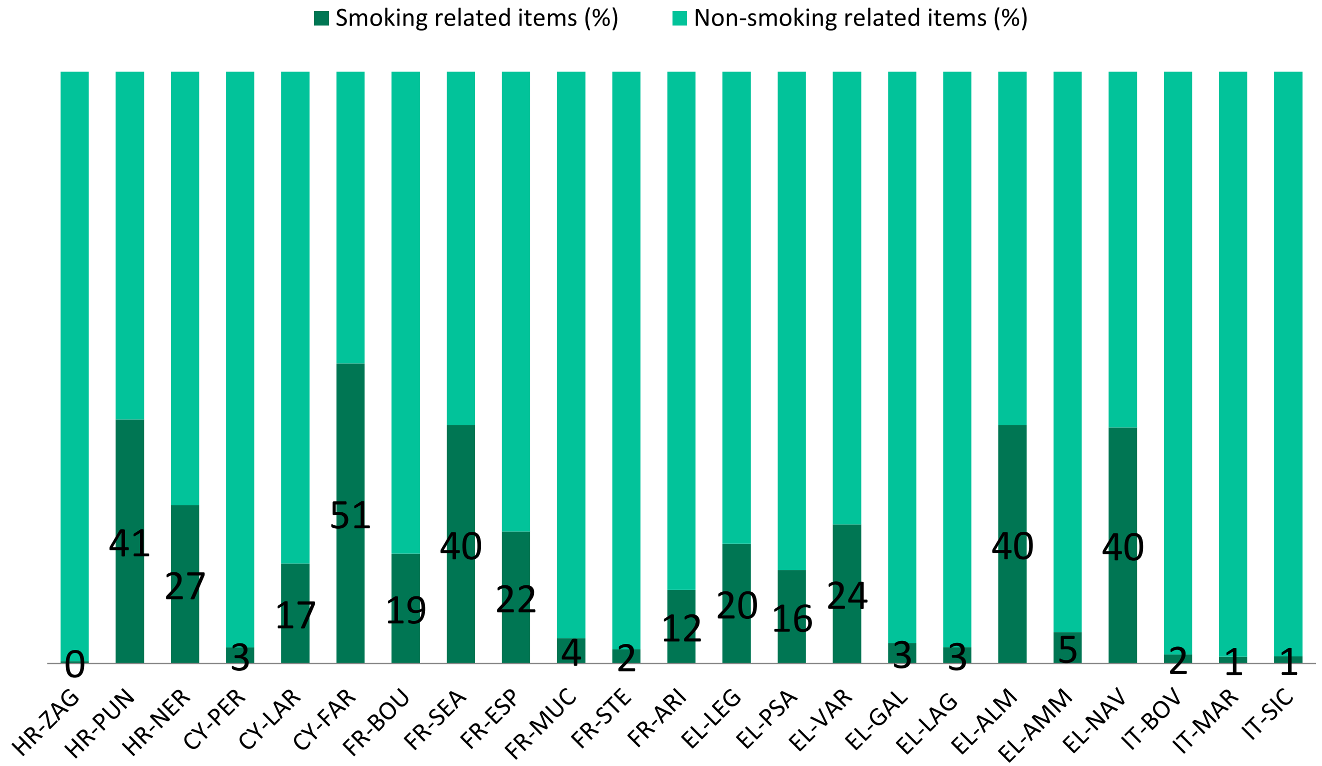
Glass bottles (G200)

Crisps packets/sweets wrappers (G30)

String and cord (diameter less than 1cm) (G50)

SMOKING RELATED ITEMS

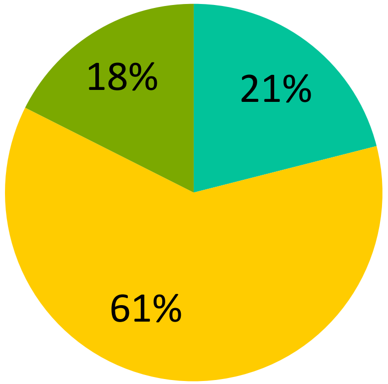


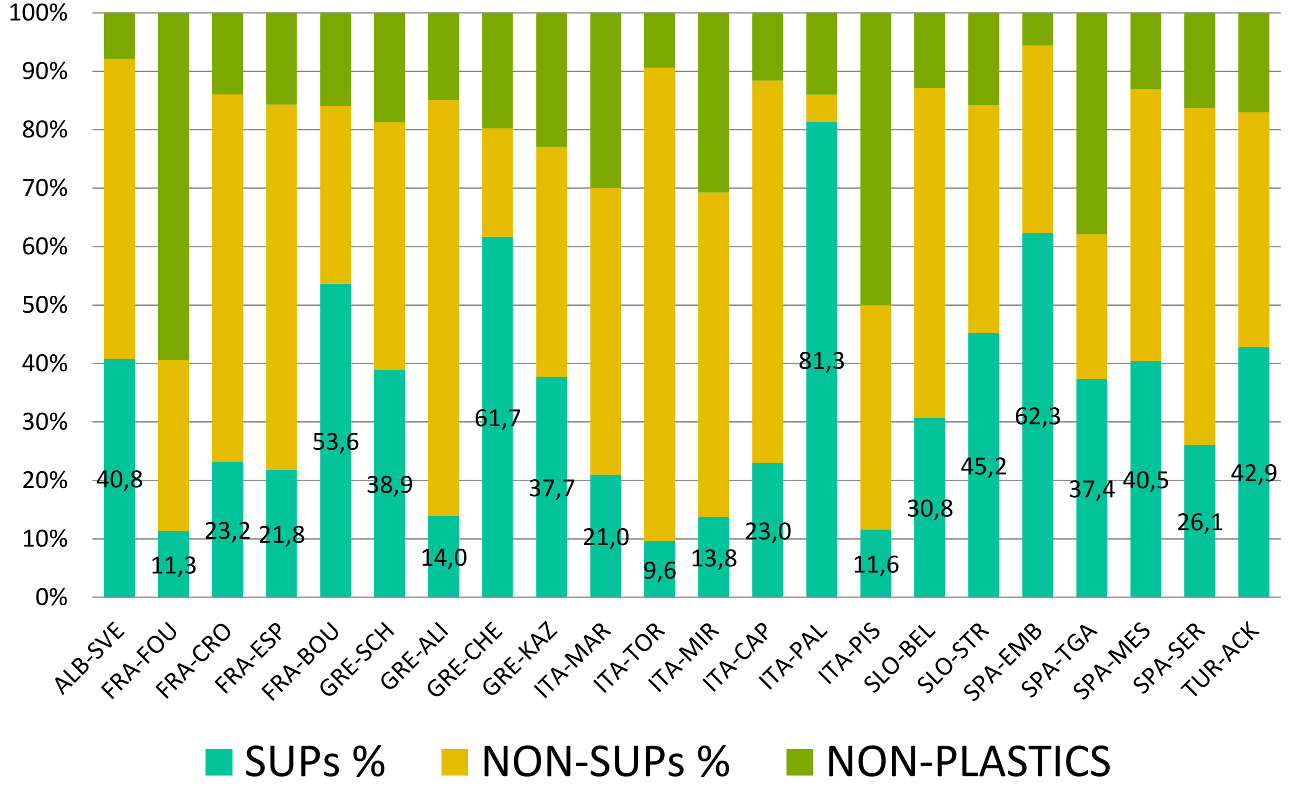


PROFILES OF THE STUDIED BEACHES

Surveyed Site	Country	Beach type	River in the vicinity	Economic Activities				
				Tourism & recreation	Fisheries	Aquaculture	Shipping	Agriculture
Pervola	Cyprus	semi-rural	no	medium/low	medium/low	n/a	n/a	high
Lara	Cyprus	remote/natural	no	n/a	n/a	n/a	n/a	n/a
Faros	Cyprus	urban	yes	high	n/a	n/a	n/a	n/a
Legrena - Saronikos Gulf	Greece	semi-rural	no	high	medium/low	medium/low	high	n/a
Psatha - Korinthian Gulf	Greece	semi-rural	no	high	high	n/a	medium/low	n/a
Varnavas - Evoikos Gulf	Greece	semi-rural	no	medium/low	medium/low	n/a	medium/low	n/a
Galazia Akti - Saronikos Gulf	Greece	urban	no	high	n/a	n/a	n/a	n/a
Lagonisi - Saronikos Gulf	Greece	urban	no	high	n/a	n/a	n/a	n/a
Almyros (Agios Nikolaos) - Crete	Greece	urban	yes	high	n/a	n/a	n/a	n/a
Ammoudara (Malevizi)-Crete	Greece	urban	no	high	n/a	n/a	n/a	n/a
Navarchou Nearchou - Crete	Greece	urban	no	high	n/a	n/a	n/a	n/a
Zaglav - Island Vis	Croatia	semi-rural	no	medium/low	medium/low	medium/low	medium/low	medium/low
Punta - Omis	Croatia	semi-urban	yes	high	medium/low	medium/low	medium/low	medium/low
Neretva river delta	Croatia	semi-rural	yes	high	medium/low	medium/low	medium/low	medium/low
Bovo Marina	Italy	remote/natural	yes	medium/low	n/a	n/a	n/a	n/a
San Marco	Italy	semi-urban	no	high	medium/low	n/a	n/a	medium/low
Siculiana Marina	Italy	semi-rural	no	medium/low	n/a	n/a	n/a	medium/low
Boucanet	France	semi-urban	yes	high	medium/low	n/a	medium/low	n/a
Seaquarium	France	urban	no	high	medium/low	n/a	medium/low	n/a
Espiguette	France	remote/natural	no	high	high	n/a	medium/low	medium/low
Mucchiatana	France	semi-rural	yes	medium/low	n/a	n/a	n/a	medium/low
Stella Mare	France	semi-rural	no	medium/low	n/a	n/a	n/a	medium/low
Arinella	France	semi-urban	no	high	medium/low	n/a	high	medium/low

BEACH LITTER SURVEYS IN MPAs





STRENTHENING THE SCIENCE-POLICY INTERFACE | THE DEFISHGEAR PROJECT

Pilot surveys in a harmonized way

Modeling marine debris movement and transport

Making data accessible via a GIS database

Assessing the socio-economic implications

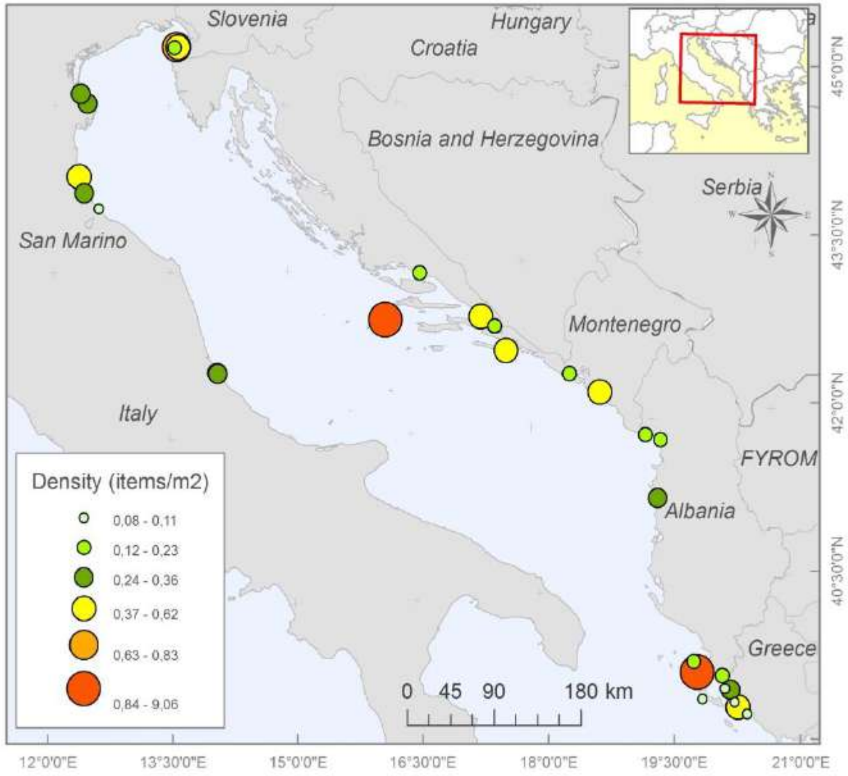
Piloting measures

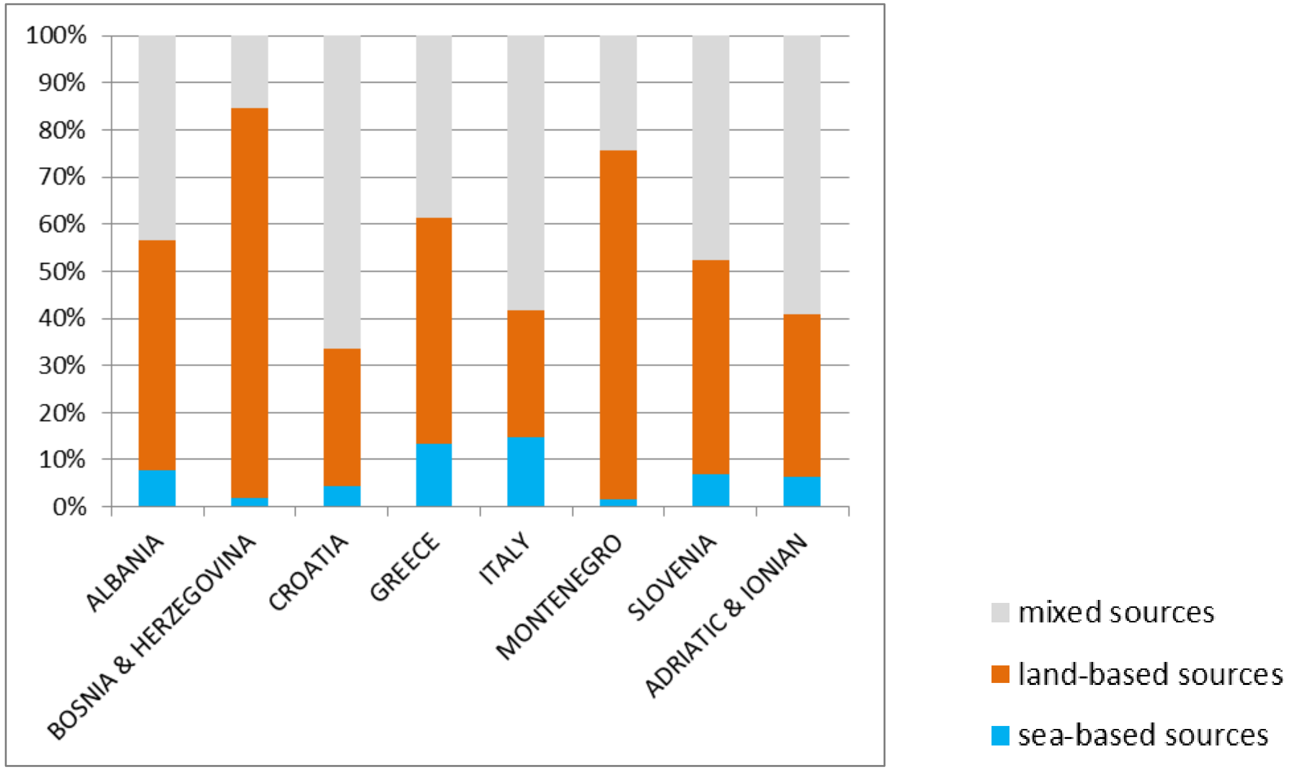
DeFishGear
www.defishgear.net

The project is co-funded by the European Union, Instrument for Pre-Accession Assistance

Let's grow up together
Adriatic IPA
Cross Border Cooperation 2007-2013

MARINE LITTER ON BEACHES





- ✓ **31 study sites** located on the coastline of the Adriatic and Ionian Seas
- ✓ **180 beach transects** were surveyed, covering ~ **33,200 m²** and extending over **18 km** of coastline
- ✓ Average beach litter density: **0.67 items/m²**

MARINE LITTER ON BEACHES

TOP 20	Code	Items name	Total counts	%
1	G79	Plastic pieces 2.5 cm > < 50 cm	14,040	19.89
2	G82	Polystyrene pieces 2.5 cm > < 50 cm	8,422	11.93
3	G95	Cotton bud sticks	6,475	9.17
4	G21	Plastic caps/lids from drinks	4,705	6.67
5	G27	Cigarette butts and filters	4,660	6.60
6	G23	Plastic caps/lids unidentified	1,743	2.47
7	G45	Mussel nets, Oyster nets	1,716	2.43
8	G30	Crisps packets/sweets wrappers	1,492	2.11
9	G208	Glass or ceramic fragments >2.5 cm	1,368	1.94
10	G124	Other plastic/polystyrene items (identifiable)	1,350	1.91
11	G67	Sheets, industrial packaging, plastic sheeting	1,336	1.89
12	G10	Food containers incl. fast food containers	1,332	1.89
13	G35	Straws and stirrers	1,273	1.80
14	G33	Cups and cup lids	1,161	1.65
15	G22	Plastic caps/lids from chemicals, detergents	1,058	1.50
16	G3	Shopping bags, incl. pieces	974	1.38
17	G7	Drink bottles <=0.5 l	872	1.24
18	G8	Drink bottles >0.5 l	794	1.13
19	G24	Plastic rings from bottle caps/lids	770	1.09
20	G50	String and cord (diameter less than 1 cm)	748	1.06

THE DEFISHGEAR CONTRIBUTION TO ENHANCING THE MARINE LITTER KNOWLEDGE BASIS IN THE ADRIATIC & IONIAN SEAS

Marine Pollution Bulletin 131 (2018) 745–756

Contents lists available at ScienceDirect

Marine Pollution Bulletin

journal homepage: www.elsevier.com/locate/marpolbul

Marine litter on the beaches of the Adriatic and Ionian Seas: An assessment of their abundance, composition and sources

Thomais Vlachogianni, Tomaso Fortibuoni, Francesca Ronchi, Christina Zeri, Cristina Mazziotti, Pero Tutman, Dubravka Bojanić Varezić, Andreja Palatinus, Štefan Trdan, Monika Peterlin, Milica Mandić, Olivera Markovic, Mosor Prvan, Helen Kaberi, Michael Prevenios, Jerina Kolitari, Gulielm Kroqi, Marina Fusco, Evangelos Kalampokis, Michael Scoullos

ARTICLE INFO

Keywords:
Marine litter
Debris
Monitoring
Beaches
Adriatic and Ionian Seas
Plastics

ABSTRACT

The abundance, composition and sources of marine litter were determined on beaches located in the seven countries of the Adriatic-Ionian macroregion, namely Albania, Bosnia and Herzegovina, Croatia, Greece, Italy, Montenegro and Slovenia. A total of 70,581 marine litter items were classified and recorded through one-year long surveys carried out in 31 sites. The average litter density of 0.67 items/m^2 found within this study is considered to be relatively high. The beaches investigated differed in terms of human-induced pressures; their majority is classified either as semi-urban or semi-rural, while very few beaches could be characterized as urban or remote/natural. The majority of litter items were made of artificial/anthropogenic polymer materials accounting for 91.1% of all litter. Litter from shoreline sources accounted for 33.4% of all litter collected. The amount of litter from sea-based sources ranged in the different countries from 1.54% to 14.84%, with an average of 6.30% at regional level.

Marine Pollution Bulletin 136 (2018) 341–350

Contents lists available at ScienceDirect

Marine Pollution Bulletin

journal homepage: www.elsevier.com/locate/marpolbul

Floating plastics in Adriatic waters (Mediterranean Sea): From the macro- to the micro-scale

C. Zeri, A. Adamopoulou, D. Bojanić Varezić, T. Fortibuoni, M. Kovač Viršek, A. Kržan, M. Mandic, C. Mazziotti, A. Palatinus, M. Peterlin, M. Prvan, F. Ronchi, J. Siljic, P. Tutman, Th. Vlachogianni

ARTICLE INFO

Keywords:
Marine litter
Microplastics
Spatial distribution
Polymers
Fragmentation
Mediterranean Sea

ABSTRACT

Macro- and microplastics abundances were determined in the Adriatic Sea following the MSFD TG10 protocol. The studied areas included populated gulfs, river outlets and offshore waters in five Adriatic countries. The use of small ships enabled us to detect small sized plastics (2.5–5 cm) and record average macroplastics densities of 251 ± 601 items km^{-2}, one order of magnitude higher than previously considered. Results from manta net tows for microplastics revealed an average abundance of 315,009 ± 568,578 items km^{-2} (217 ± 575 g km^{-2}). We found significantly higher microplastics abundances in nearshore (≤4 km) than in offshore waters (> 4 km) and this trend seems to affect also the small sized macro plastic fragments (2.5–5 cm). The dominant polymers were polyethylene and polypropylene while the presence of some rare polymers and waxes used in food and dentistry indicated waste water treatment plants as potential sources of microplastics.

Marine Pollution Bulletin 139 (2019) 412–426

Contents lists available at ScienceDirect

Marine Pollution Bulletin

journal homepage: www.elsevier.com/locate/marpolbul

A harmonized and coordinated assessment of the abundance and composition of seafloor litter in the Adriatic-Ionian macroregion (Mediterranean Sea)

Tomaso Fortibuoni, Francesca Ronchi, Vesna Mačić, Milica Mandić, Cristina Mazziotti, Monika Peterlin, Michael Prevenios, Mosor Prvan, Stelios Somarakis, Pero Tutman, Dubravka Bojanić Varezić, Manca Kovac Virsek, Thomais Vlachogianni, Christina Zeri

ARTICLE INFO

Keywords:
Seafloor litter
Single-use plastic
Mussel nets
Trawl survey
Scuba visual survey
EU plastics strategy

ABSTRACT

Marine litter is a threat to marine life and an economic burden for coastal communities, but efforts to address the issue are hampered by the lack of data for many countries. We performed the first harmonized assessment of seafloor litter (trawl and visual surveys) in six countries of the Adriatic-Ionian macroregion. Seafloor litter showed an uneven distribution throughout the area, with large differences in litter densities and composition among countries and locations. An emerging problem in the area resulted in short-term & single-use objects that represented the largest fraction of litter. Packaging was the economic sector contributing most to seafloor litter on the continental shelf and upper slope, while in some areas aquaculture (mussel farming) represented a key activity producing marine litter. In coastal areas and bays (e.g. Boka Kotorska bay, Montenegro), seafloor litter was mainly related to construction activities and electronic goods, which are a consequence of fly-tipping/illegal dumping.

SOCIOECONOMIC IMPLICATIONS OF ML

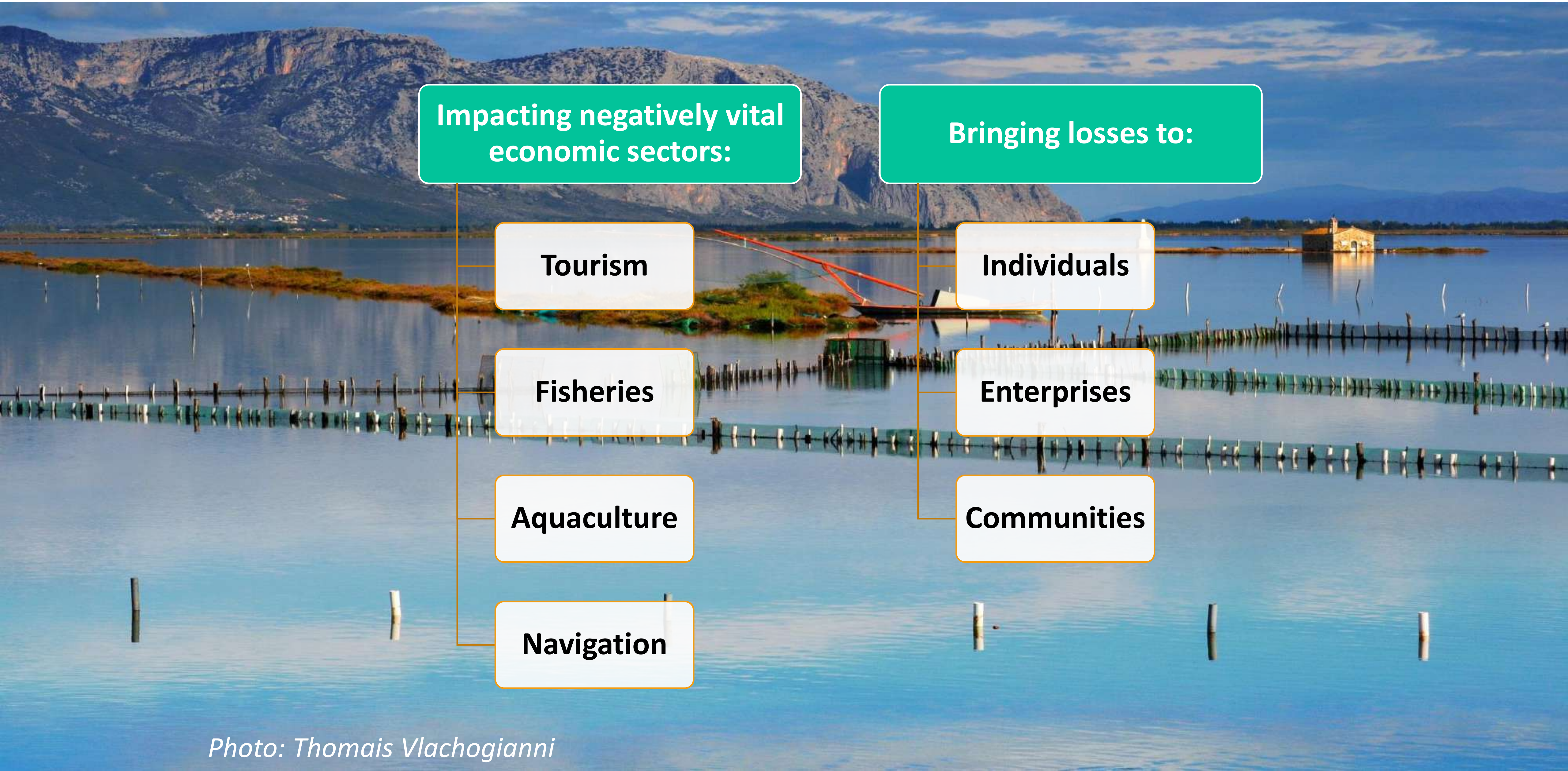


Photo: Thomais Vlachogianni

ASSESSING THE SOCIO-ECONOMIC IMPACTS OF MARINE LITTER

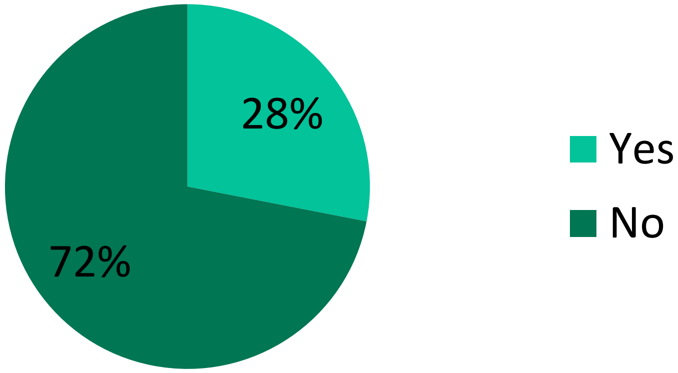
[Understanding the socio-economic implications of marine litter in the Adriatic-Ionian macroregion. IPA-Adriatic DeFishGear project and MIO-ECSDE, 2017.]

548 completed surveys

DIRECT & INDIRECT COSTS OF ML IN THE ADRIATIC – IONIAN SEA

- ✓ For the fisheries sector the average annual cost of marine litter per vessel reaches **€ 5,378** (cost of repairs of damages, loss of revenue due to the smaller catch, loss of time spent on clearing and repairing nets, etc., reported by fishermen per fishing vessel per year). Given this, the total losses to the fisheries sector in the Adriatic-Ionian macroregion were calculated to be € 18.19 million per year, which represents one third of the marine litter costs to the EU fishing fleet (€ 61.7 million per annum).
- ✓ On average, the annual direct and indirect marine litter related costs for the aquaculture sector were assessed to be **€ 3,228** per aquaculture farm unit.
- ✓ The total annual cost of managing marine litter reported by 38 harbours and marinas in the Adriatic-Ionian macroregion was **€ 323,550** with an average annual cost of **€ 8,518** per harbour.
- ✓ The average annual amount per tourism related business of varying size and type was calculated to be **€ 5,685** per year, which can be considered as a substantial expense.
- ✓ The total cost of removing beach litter reported by the 32 municipalities was € 6,724,530 per year, with an average of **€ 216,920** per year per municipality. On average, the municipalities spent some 5% of their budget for marine litter cleanup operations.

IDENTIFYING ACCUMULATION AREAS OF GHOST NETS



Have you observed any areas where ghost nets accumulate?

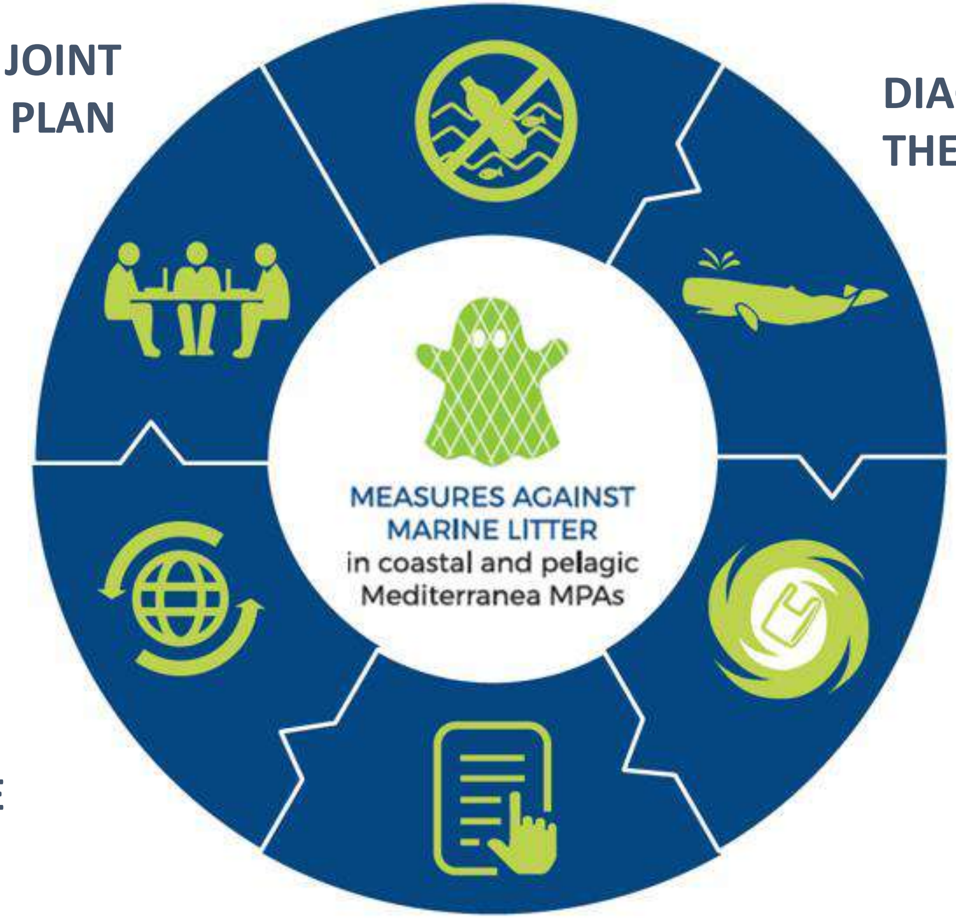
Country	Accumulation areas of ghost nets
Croatia	Dugi Otok island, between the islands of Korcula and Jabuka island, south of Lastovo island, shipwreck at Szent Istvan, south of Mljet island, shipwrecks at Lagnjici islets, Rt Barjaci, Komiza cave near the island Vis, Vis aquatorium, Lastovo aquatorium.
Greece	In the vicinity of the port of Pargas (1.5 km away), near Gouvia at Corfu, Diapontian islands, Othoni Island, Potami, Messonghi.
Italy	Gulf of Trieste, delta of river Po, Chioggia inlet, Tegnùe of Chioggia.
Montenegro	In the vicinity of Kumbor, Petrovac, Cape Volujica, near Buna/Bojana river, Cape Djeram near Ulcinj, around islands nearby Perast, Platamuni near Budva, area between Budva and Sveti Stefan, the most inner part of Kotor Bay, Cape Ostra, Kamenari.
Slovenia	In the vicinity of Rex between Koper and Izola, at Izola Dockyard.

THE PLASTIC BUSTERS MPAS

HARMONIZED MONITORING

SETTING UP A JOINT GOVERNANCE PLAN

DIAGNOSING THE IMPACTS



BUILDING CAPACITIES AND TRANSFERRING KNOWLEDGE

IDENTIFYING MARINE LITTER HOTSPOTS

SHOWCASING PREVENTION AND MITIGATION MEASURES

Interreg Mediterranean PLASTIC BUSTERS MPAs

The **PlasticBusters MPAs** is an Interreg Med funded project aiming to contribute to maintaining biodiversity and preserving natural ecosystems in pelagic and coastal MPAs, **by defining and implementing a harmonized approach against marine litter**. The project entails actions that address **the whole management cycle of marine litter**, from monitoring and surveillance to prevention and mitigation actions.

AN INCONVENIENT TRUTH!

Photo © Thomais Vlachogianni

TURNING SCIENCE INTO POLICY & ACTIONS | THE MAIN CHALLENGE OF OUR ERA

- Despite the ongoing efforts and initiatives to harmonize beach litter monitoring, the heterogeneity of the source data still represents a major challenge.
- The large amount of SUPs found on beaches underlines the urgency of implementing targeted measures to address them effectively; the SUPs Directive is expected to have a big impact.
- Reversing the cycle of decline of the coastal and marine environment requires a paradigm shift in our lifestyles and a transformation of the way we think and act. To this end ocean literacy and education for sustainable development are key!
- Marine litter is an example of a problem that does not have a "one solution fits all". It requires a combination of multi-stakeholder and multi-sectorial efforts across nations and disciplines in order to address it effectively.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Ocean and Coastal Management xxx (xxxx) xxx

Contents lists available at ScienceDirect

Ocean and Coastal Management

journal homepage: http://www.elsevier.com/locate/ocecoaman

ELSEVIER

Assessing and mitigating the harmful effects of plastic pollution: the collective multi-stakeholder driven Euro-Mediterranean response

Maria Cristina Fossi [a,*], Thomais Vlachogianni [b], Francois Galgani [c], Francesco Degli Innocenti [d], Giorgio Zampetti [e], Gaetano Leone [f]

Photo © Thomais Vlachogianni

For more than twenty five years joining forces & building bridges in the Euro-Mediterranean area

THANK YOU FOR YOUR ATTENTION!

Thomais Vlachogianni
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Twitter: #Mio_Ecsde

Photo © Thomais Vlachogianni

MarGnet mid-term Scientific meeting REPORT

Annex 3

www.margnet.eu

BLUE WORLD INSTITUTE

Co-funded by the European Maritime and Fisheries Fund

Mapping and recycling of marine litter and Ghost nets on the sea-floor

Fantina Madricardo (CNR – ISMAR Venice, Italy)

EASME/EMFF/2017/1.2.1.12/S2/05/SI2.789314

Sustainable Blue Economy: Marine Litter

5th of February 2020, Venice, Italy

www.margnet.eu

ISMAR BLUE WORLD INSTITUTE SINTOL LAGUNA PROJECT techneprojects GROWING UP PROJECTS

Co-funded by the European Maritime and Fisheries Fund

PARTNERS

1. LP–CNR – ISMAR, Italy
2. Laguna Project s.n.c.,Italy
3. BWI, Croatia
4. Sintol srl, Italy
5. Techneprojects srl, Italy

BUDGET AND DURATION

Costs of the project action - 611,792 €

EU contribution granted -
488,575 € (80%)

Project start 01/01/2019
Project end 31/12/2020

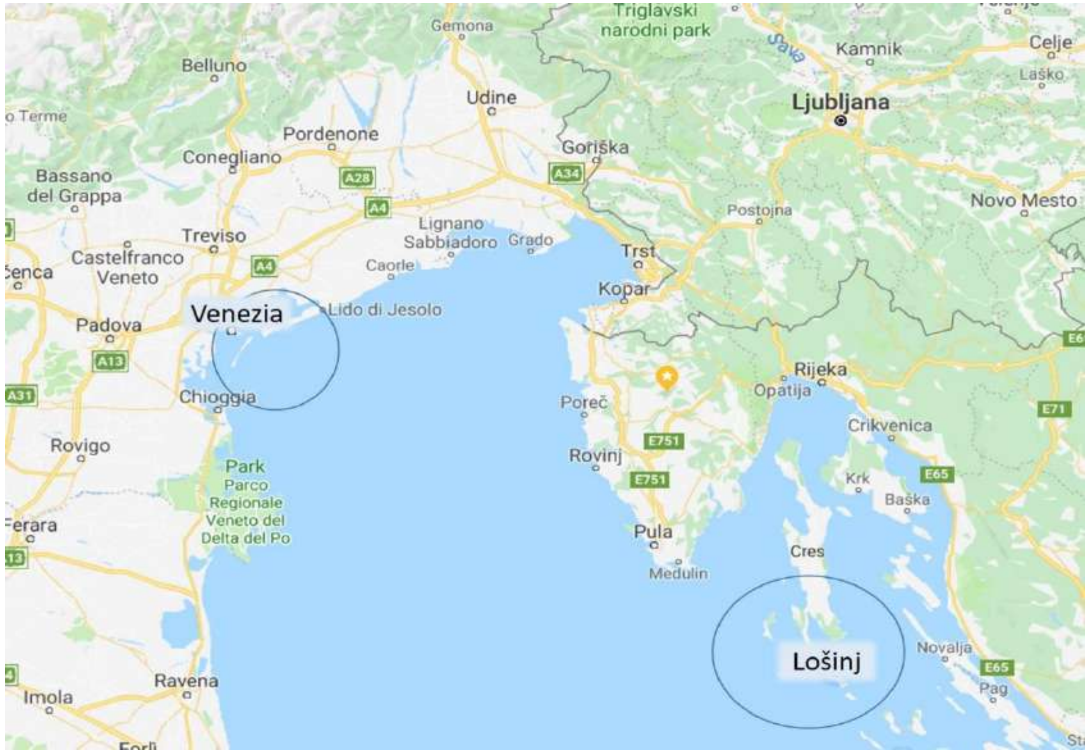
Duration 24 months

Co-funded by the European Maritime and Fisheries Fund

PROJECT LOCATION

2 PILOT SITES:

- **VENETO REGION (ITALY) – sandy seabed (M2-M10)**
- **LOŠINJ ARCHIPELAGO (CROATIA) – rocky sea floor (M15-M20)**



Co-funded by the European Maritime and Fisheries Fund

BACKGROUND

- Changes in the composition, abundance and distribution of marine litter (ML) on the seafloor is, at the moment, much less widely investigated than sea surface patterns.

- To monitor and quantify the ML on the sea floor are often cost-prohibitive for the authorities and not efficient to map large areas

- The different experiences in recycling shows the need of a pre-treatment of the ML used for the various recycling options

Co-funded by the European Maritime and Fisheries Fund

BACKGROUND

- marGnet builds on the experience of the Life Project **GHOST (2013-2016)**

  Technique to reduce the impact of ghost fishing gears and to improve biodiversity in North Adriatic Coastal Areas

- GHOST promoted concrete measures to preserve and improve the ecological status of the rocky habitats (*Tegnùe*) in the north Adriatic sea.

GHOST

TECHNIQUES TO REDUCE THE IMPACT OF GHOST FISHING GEARS AND TO IMPROVE BIODIVERSITY IN NORTH ADRIATIC COASTAL AREAS

www.facebook.com/progettoghost

www.life-ghost.eu

ISMAR

IUAV Università Iuav di Venezia

LAGUNA PROJECT

Co-funded by the European Maritime and Fisheries Fund

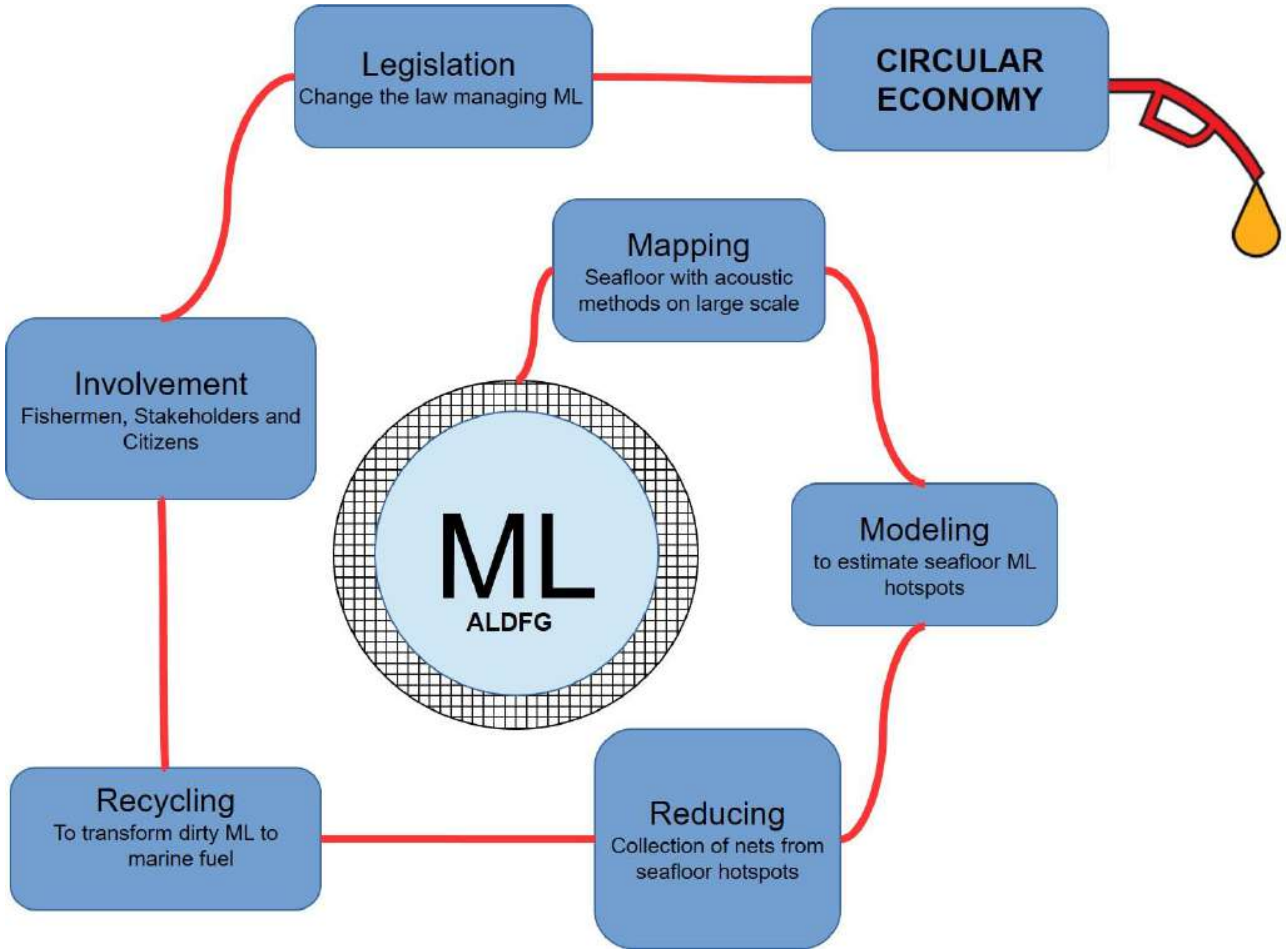
GENERAL OBJECTIVE

To set up and test multi-level solutions oriented to

- monitor and map marine litter on the sea floor
- prevent, remove and recycle marine litter from sea-based sources

Co-funded by the European Maritime and Fisheries Fund

PROJECT CONCEPT



Co-funded by the European Maritime and Fisheries Fund

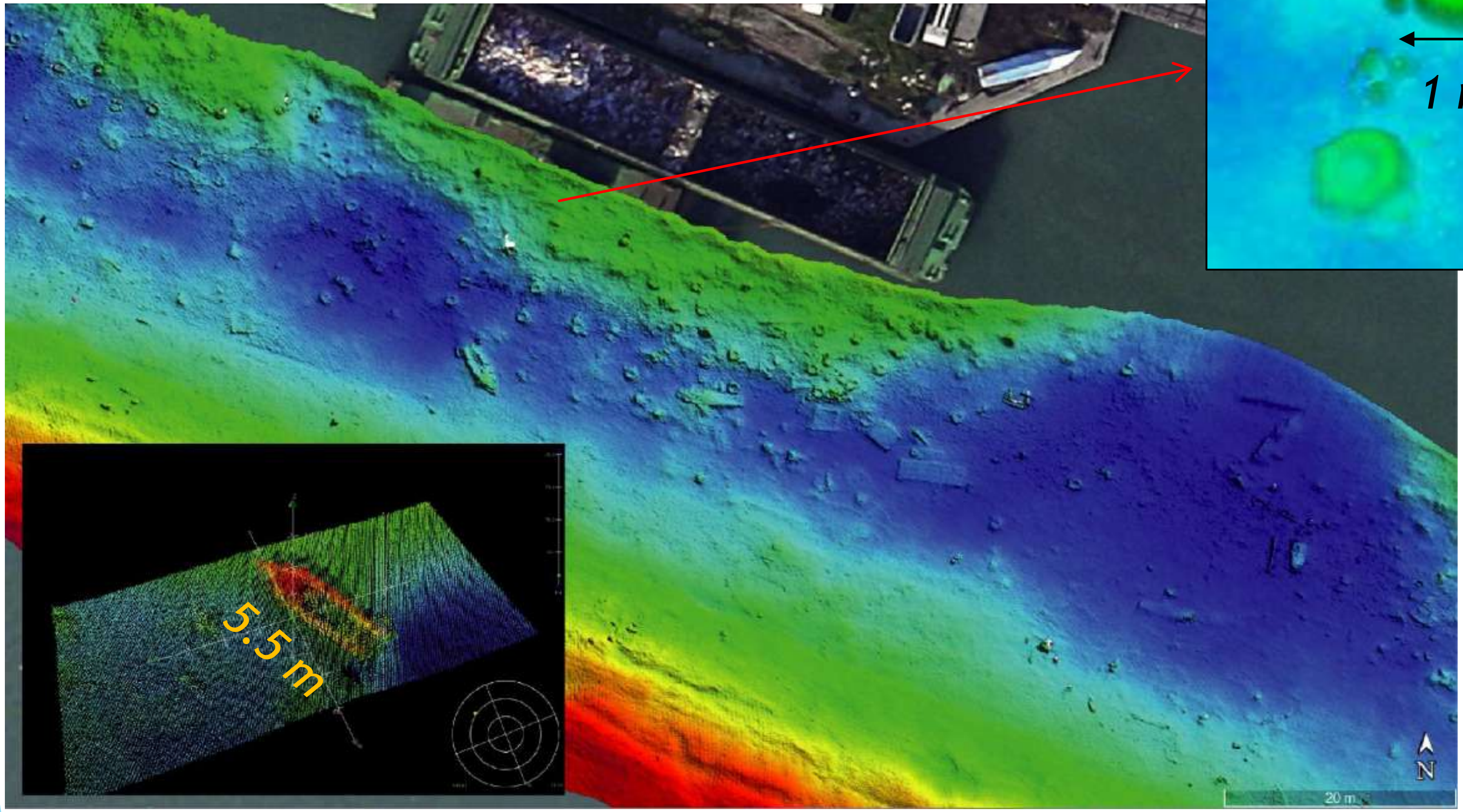
MAPPING

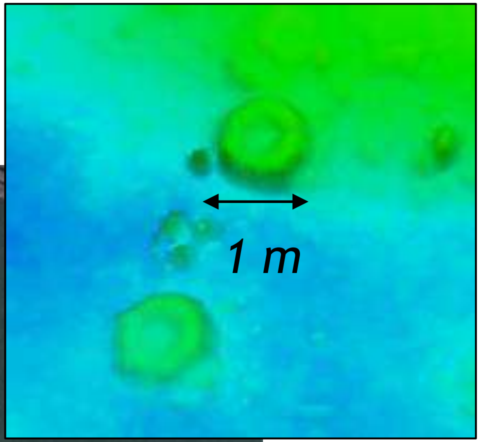
- Mapping the presence of ML from sea-based sources, especially from fisheries and aquaculture activities, by means of combined multi-sensor high resolution acoustic mapping, data analysis, field measurements

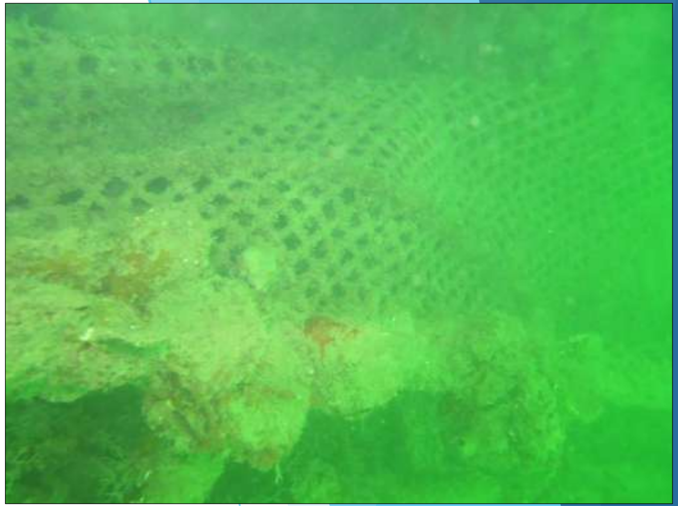
- marGnet project will develop a fast methodology for wide scale monitoring of ML on sea floor (M2-M20)

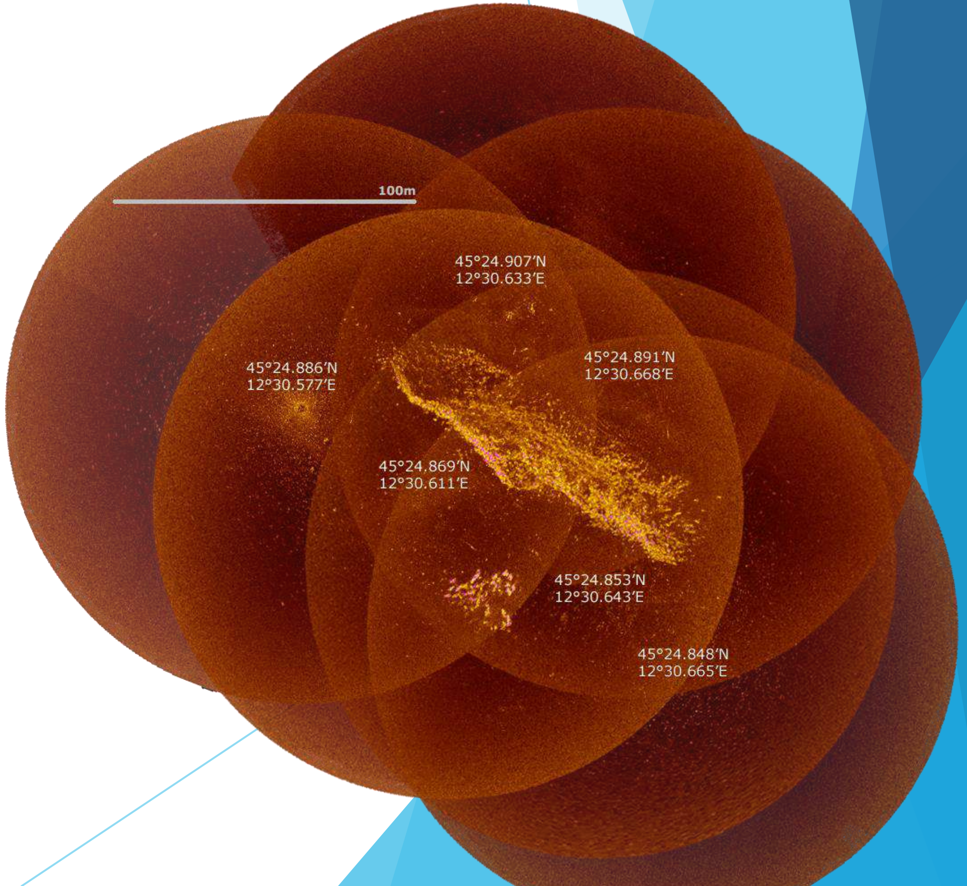
Co-funded by the European Maritime and Fisheries Fund

ACOUSTIC AND VIDEO MONITORING









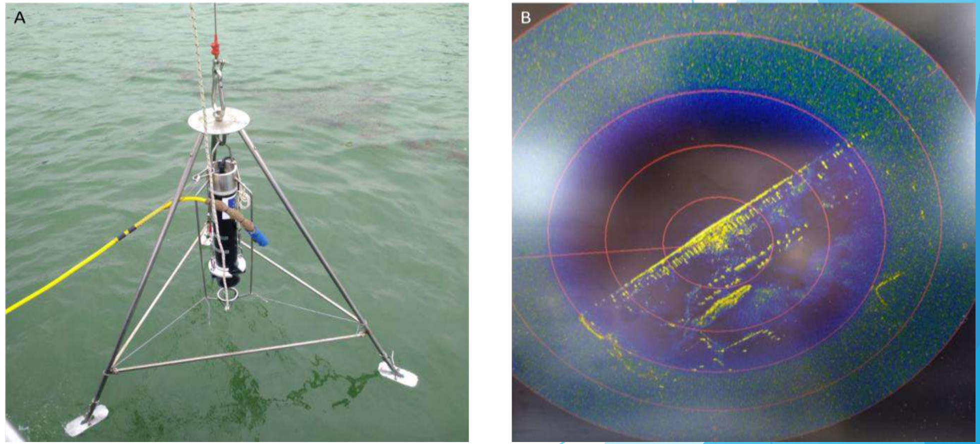
Field experiments for acoustic data calibration (M4-M10)

Co-funded by the European
Maritime and Fisheries Fund

FIELD EXPERIMENTS

- To measure sinking velocity for modelling
- To assess the potential of acoustic instruments to detect litter and nets
- To develop new algorithms for acoustic data analysis and ML detection

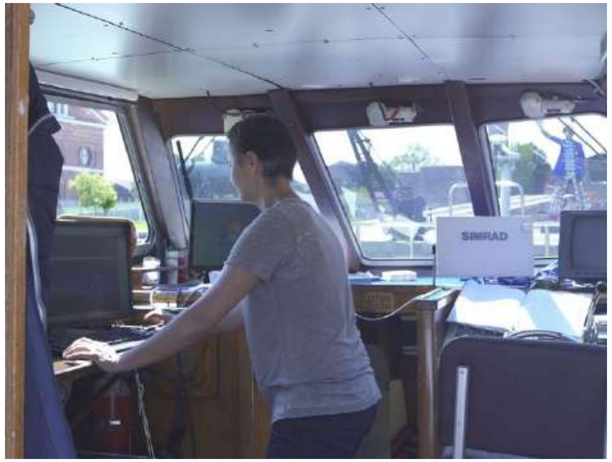
Kongsberg EM2040DC Multibeam echosounder system (MBES)

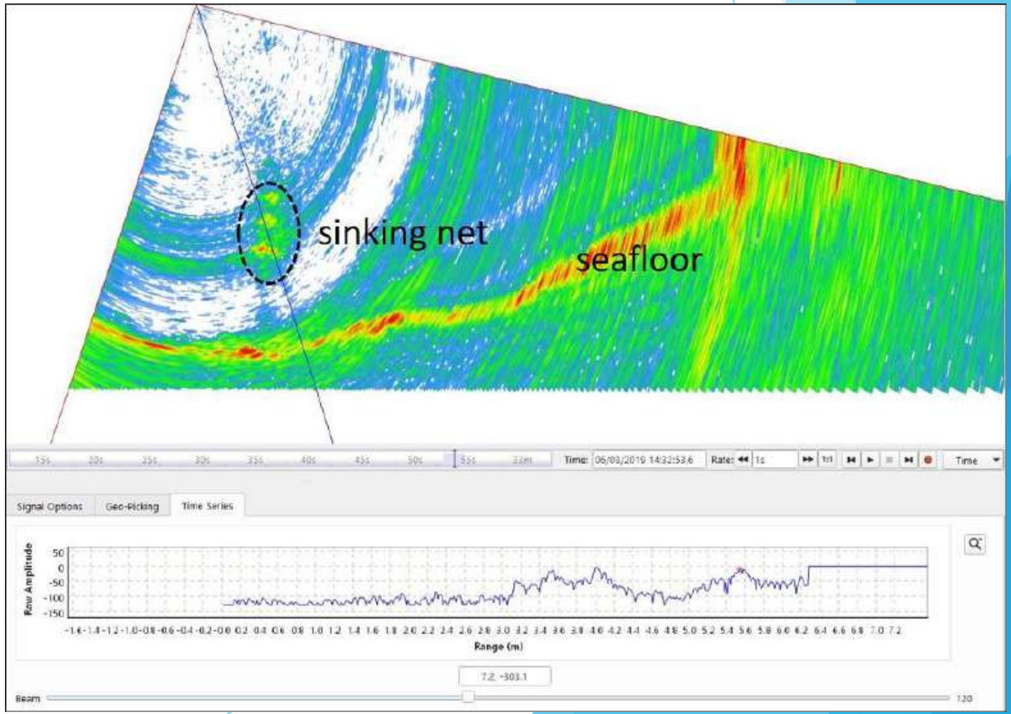


High resolution scanning sonar (HRSS)

Co-funded by the European Maritime and Fisheries Fund

FIELD EXPERIMENTS FOR ACOUSTIC DATA CALIBRATION CARRIED OUT IN JUNE 2019





Co-funded by the European
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FIELD EXPERIMENTS RESULTS

- MBES can detect ML and nets in the water column BS
- Development of **2 Research Objects** to extract the sinking velocity of the different types of ML and the BS signal

Co-funded by the European Maritime and Fisheries Fund

FIELD EXPERIMENTS RESULTS

- MBES can detect ML and nets in the water column BS
- Development of **2 Research Objects** to extract the sinking velocity of the different types of ML and the BS signal

RESEARCH OBJECT:

OPEN DATA AND REPRODUCIBLE ALGORITHMS

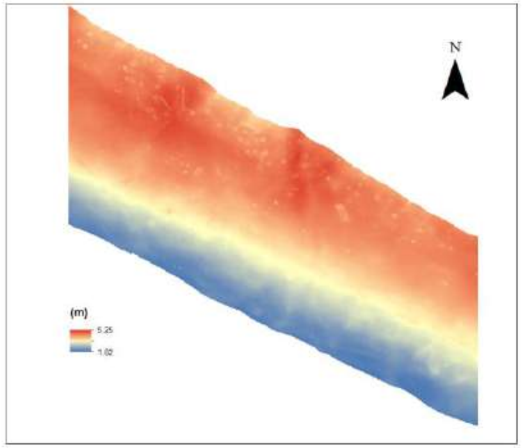
IN AGREEMENT WITH THE

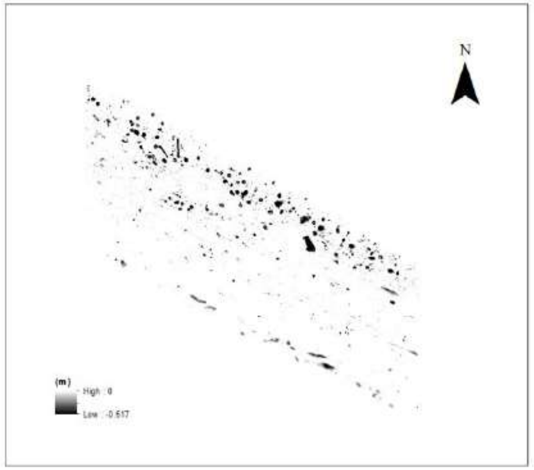
FAIR PRINCIPLES

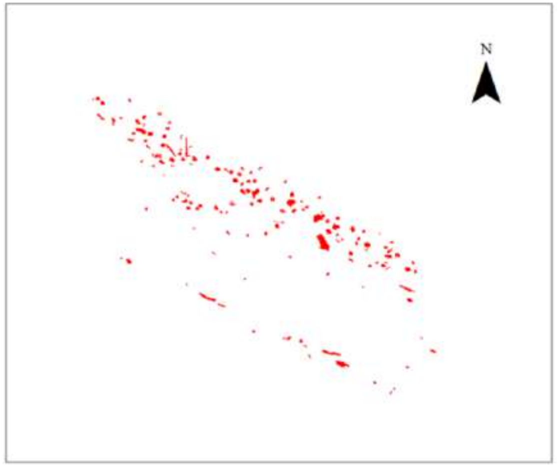
Co-funded by the European Maritime and Fisheries Fund

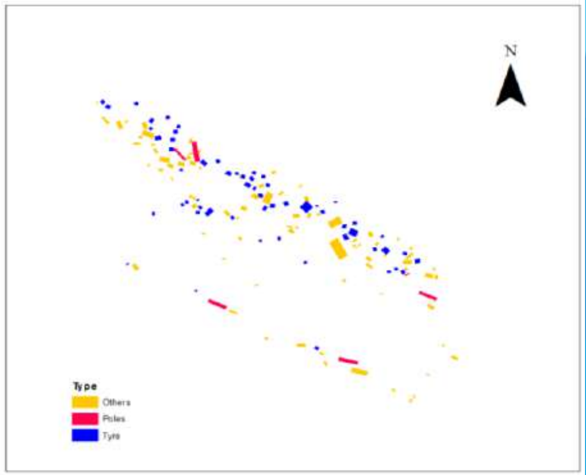
FIELD EXPERIMENTS RESULTS

- MBES can detect macro-litter on the seafloor, but it is difficult to recognize nets only from the seafloor BS
- Specific workflows developed in ArcGIS and E-Cognition to isolate the single ML types









Co-funded by the European Maritime and Fisheries Fund

FIELD EXPERIMENTS DATA POST PROCESSING ALGORITHMS

Water column backscatter	• RO to extract sinking velocity • RO to extract BS value
Seafloor backscatter	• GLCM and textural analysis • E-cognition template matching
Bathymetry	• ArcGIS workflow

Co-funded by the European Maritime and Fisheries Fund

Water column backscatter

- RO to extract sinking velocity
- RO to extract BS value

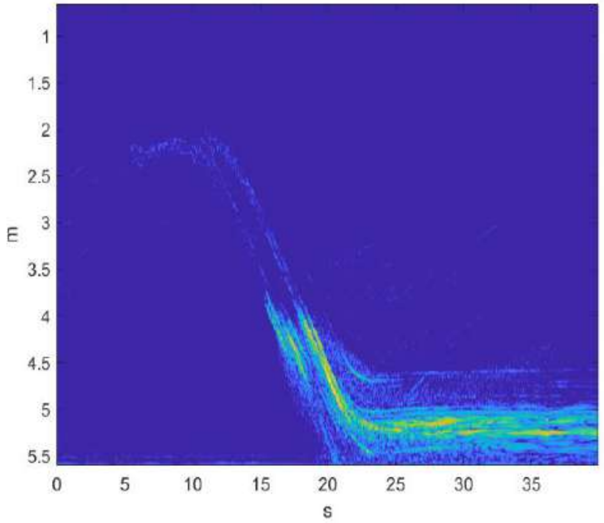
The research objects published on the EVEREST platform and associated with a DOI number:

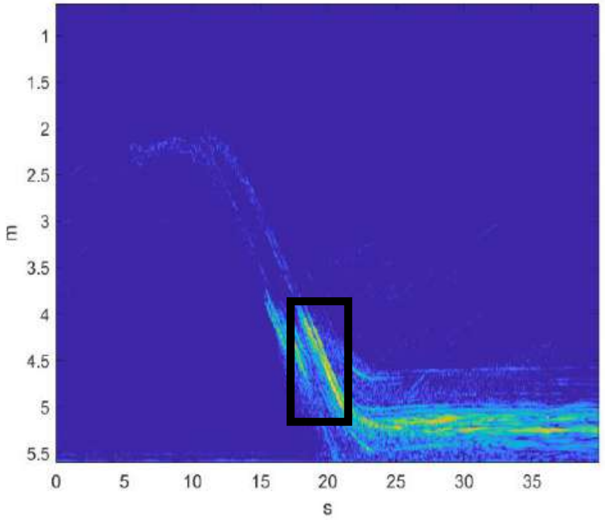
RO1 SinkVel: https://doi.org/10.24424/ro-id.IKMY8URJ9Q
RO2 SinkTrack: https://doi.org/10.24424/ro-id.EHMJMDN68Q

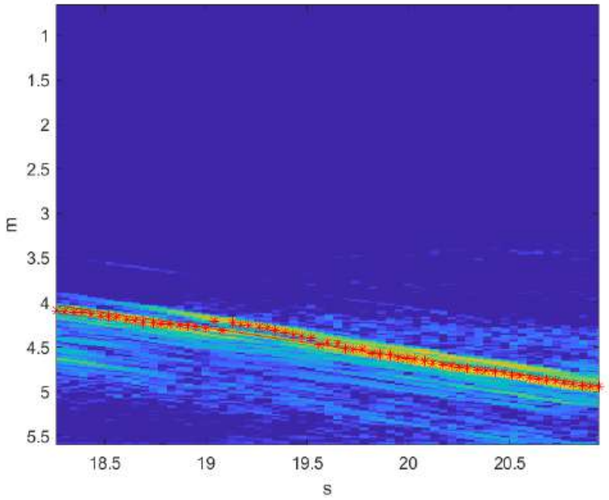
Co-funded by the European Maritime and Fisheries Fund

Water column backscatter

- RO to extract sinking velocity







Interpolating the position of the ML over time we obtained the sinking velocity

Co-funded by the European Maritime and Fisheries Fund

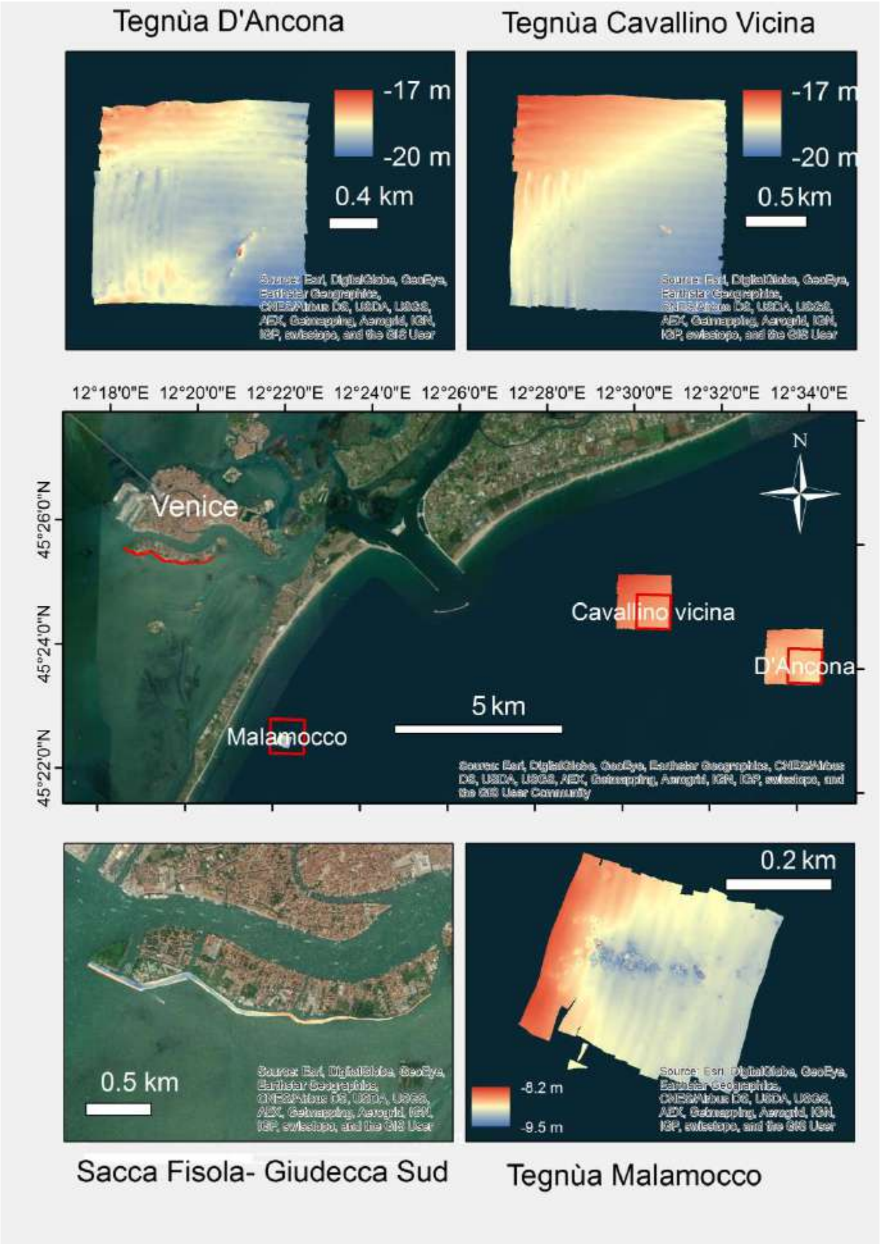
ML MEASURED SINKING VELOCITIES

Number	ML type	Dimension	Weight	Picture	Sinking Velocity (m/s)
1	Mussel farming net	1.3 m x 0.02 m	23 g		0.082
2	Mussel farming net	2.8 m x 0.02 m	98 g		0.104
3	Trammel net	1.4 m x 0.5 m 0.18 m	6220 g		0.259
4	Trawling net piece	1.8 m x 0.6 m	180 g		*Did not sink*
5	Trowling net piece	1.95 m x 0.015 m	260 g		0.035
6	Trowling net piece	larger dimension depending on the availability	3760 g		*Did not sink*
7	Trap for cuttlefish (*Sepia officinalis*)	2 m x 0.8m	1400 g		0.113
8	Trap for *Squilla mantis*	0.32 m x 0.335 m x 0.135 m	660 g		0.101

Number	ML type	Dimension	Weight	Picture	Sinking Velocity (m/s)
9	Plastic rope agglomerate (related to fishing activity)	0.5 m x 0.05 m	2460 g		0.308
10	Plastic rope agglomerate (related to fishing activity)	0.3 m x 0.03 m	225 g		0.220
11	Elastic straps (from trawiling nets)	0.30 m x 0.39 x 0.03	1590 g		0.170
12	Plastic bottle	21 cm x 5.6 m	526g		0.014
13	Plastic bag	0.45 m x 0.25 m	10 g		*Did not sink*
14	Substitute of no 6, that was not sinking	0.8 m x 0.65 m x 0.5 m	9950 g		0.091
15	tire	0.32m x 0.045m x 0.045 m	590 g		0.219

Co-funded by the European Maritime and Fisheries Fund

SURVEY CARRIED OUT IN ITALIAN WATERS

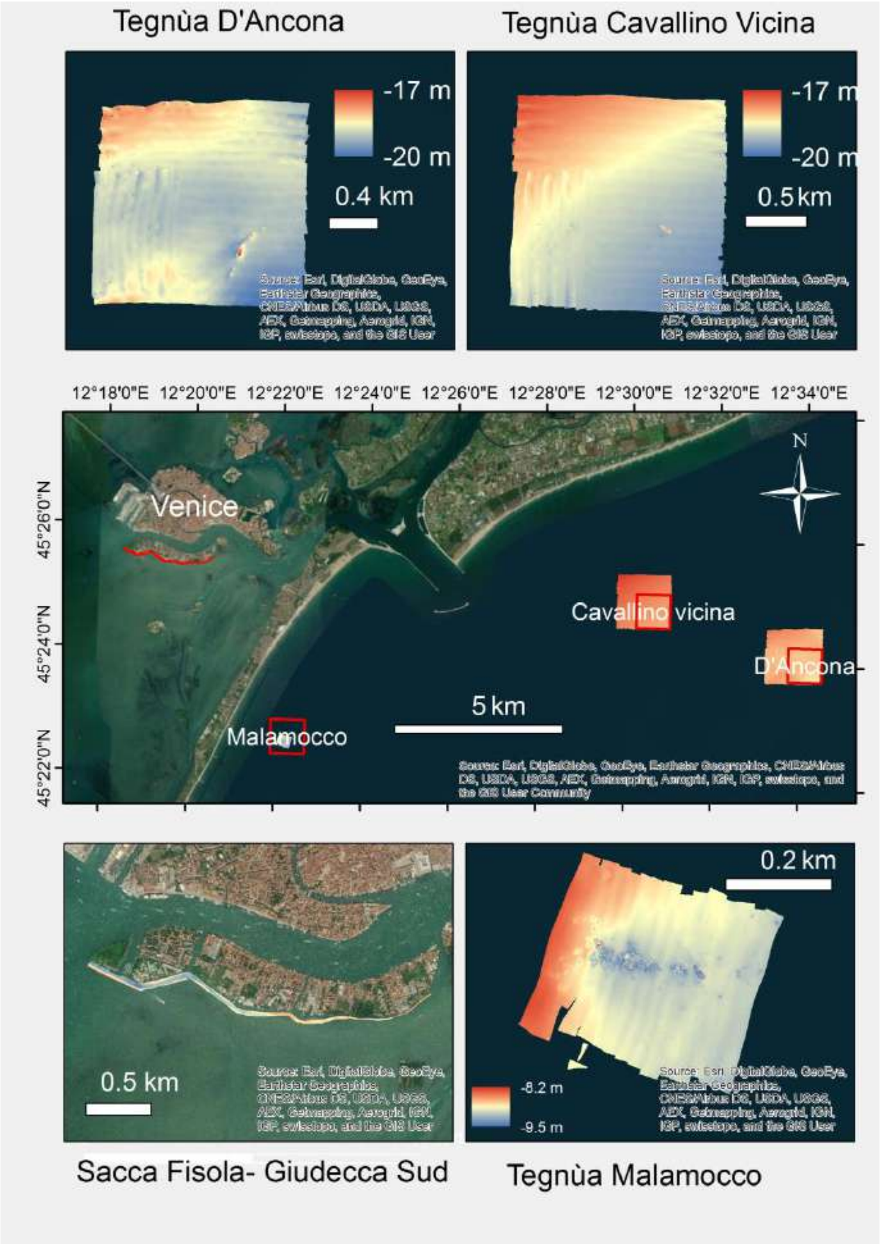


Tegnùa Malamocco;

- *Tegnùa* Cavallino Vicina
- *Tegnùa* D'ancona
- *Area south of Giudecca*

Total of 5.7 km^2 explored

SURVEY CARRIED OUT IN ITALIAN WATERS



Tegnùa Malamocco;

- *Tegnùa* Cavallino Vicina
- *Tegnùa* D'ancona
- *Area south of Giudecca*

Total of 5.7 km^2 explored

Underwater mapping methodology	Average surveyed area/day (km^2/day)	Source
Divers	0.001-0.004	Fiorin, R. (from GHOST project experience)
HRSS	0.012	Fiorin, R. (from GHOST project experience)
ROV	0.05	Angiolillo et al., 2015
Drifting drop frame	0.016	Goodman et al., 2020
MBES	0.56-0.58	marGnet survey - Madricardo et al., 2019

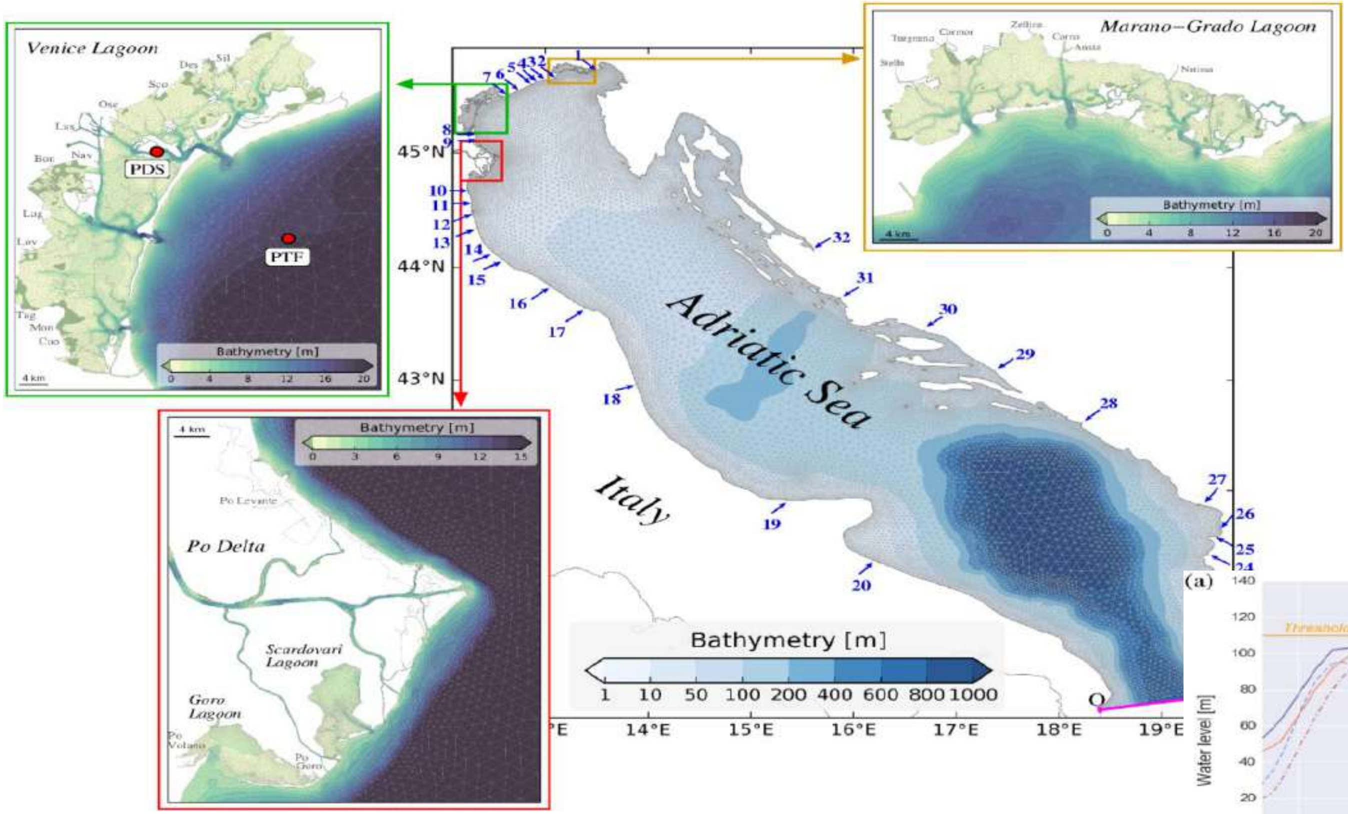
MODELLING

- Modelling and mapping the presence of hotspots of ML on the sea floor especially from fisheries and aquaculture activities on a wide scale through the development of predictive model, able to simulate dispersion of **sinking ML**
- MarGnet will provide maps of potential distribution of ML hotspots in the Northern Adriatic Sea (M2 - M18)

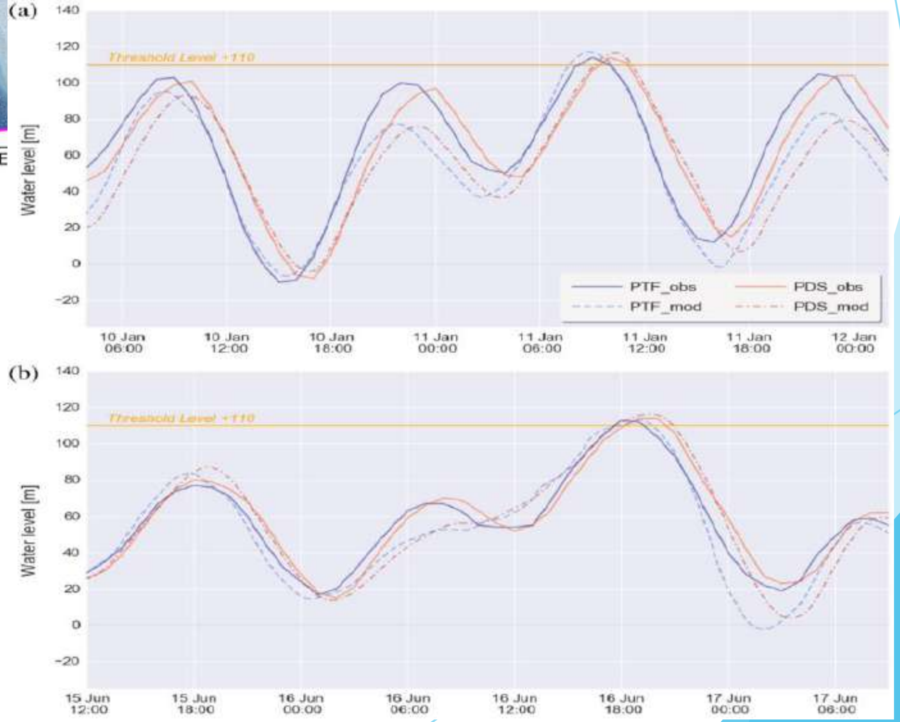
Co-funded by the European Maritime and Fisheries Fund

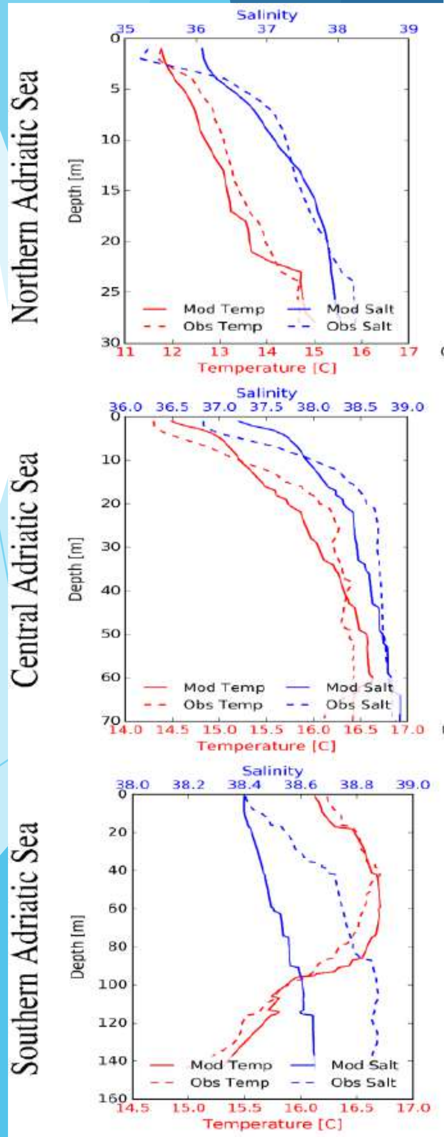
HYDRODYNAMIC MODELLING for the Northern Adriatic Sea with the SHYFEM model:

www.ismar.cnr.it/shyfem



Water level, temperature and salinity validation



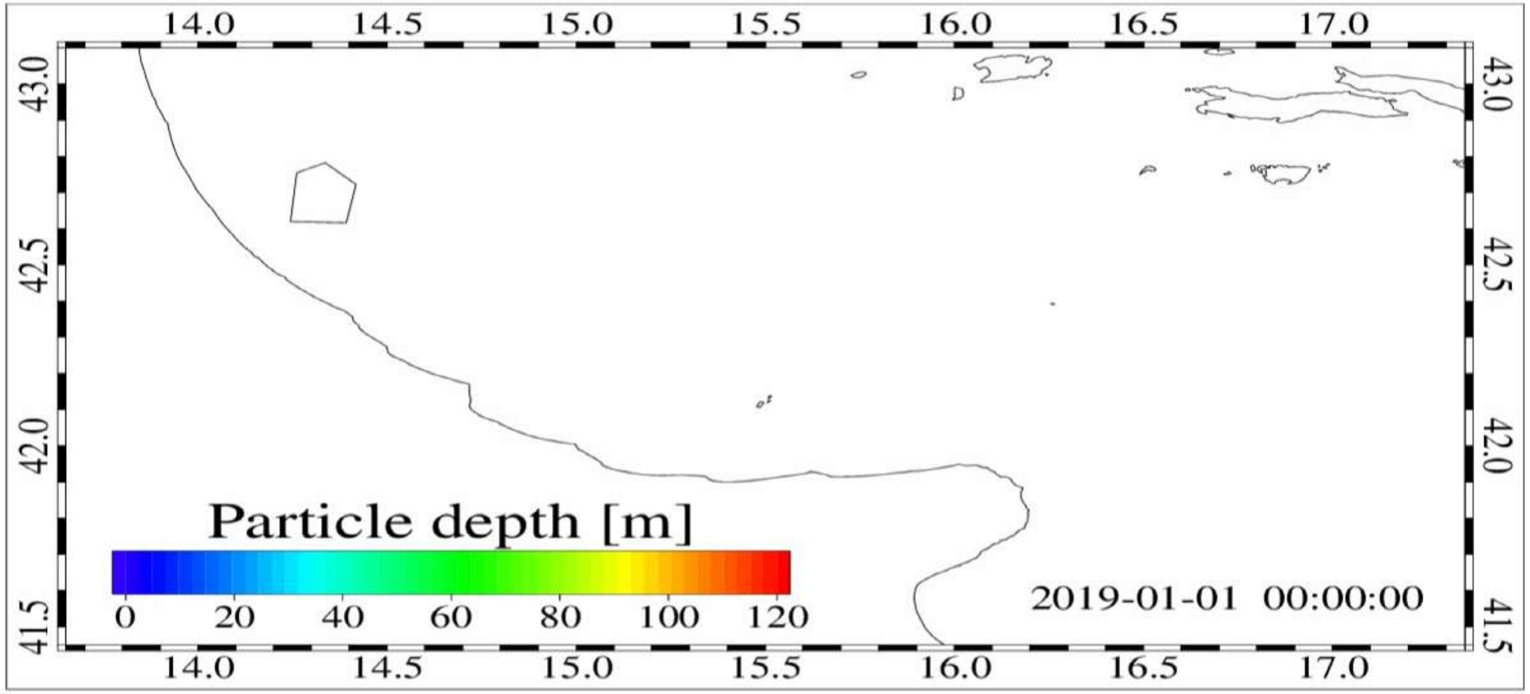


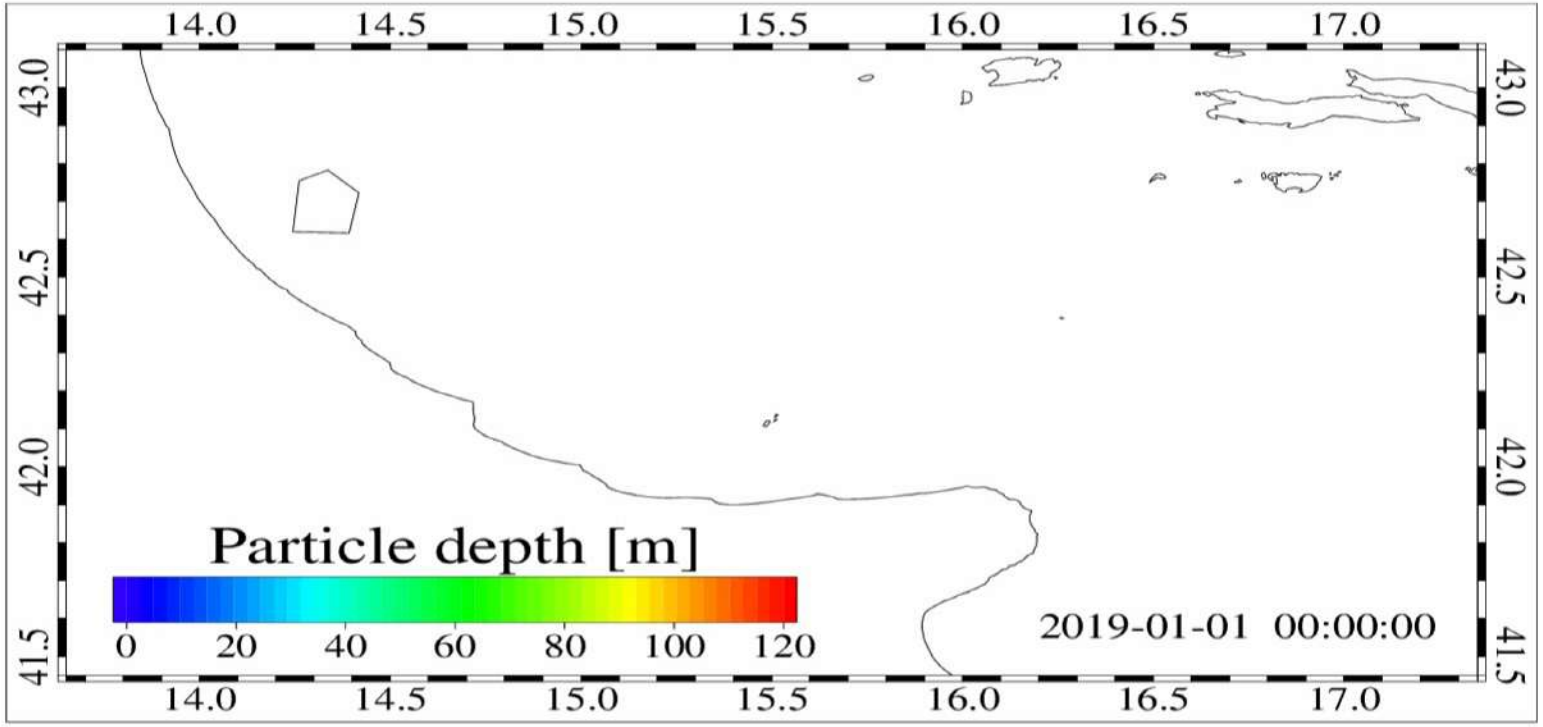
- ➢Numerical grid with variable spatial resolution, including rivers and main lagoons.
- ➢110.000 elements ranging from 7 km in open sea to few hundred meters in lagoons.
- ➢Vertically 38 Z-layers, variable thickness from 1 m n the topmost 10 m, 100 m in deepest areas

Ferrarin et al. 2019

EXAMPLE

NO SINKING VELOCITY



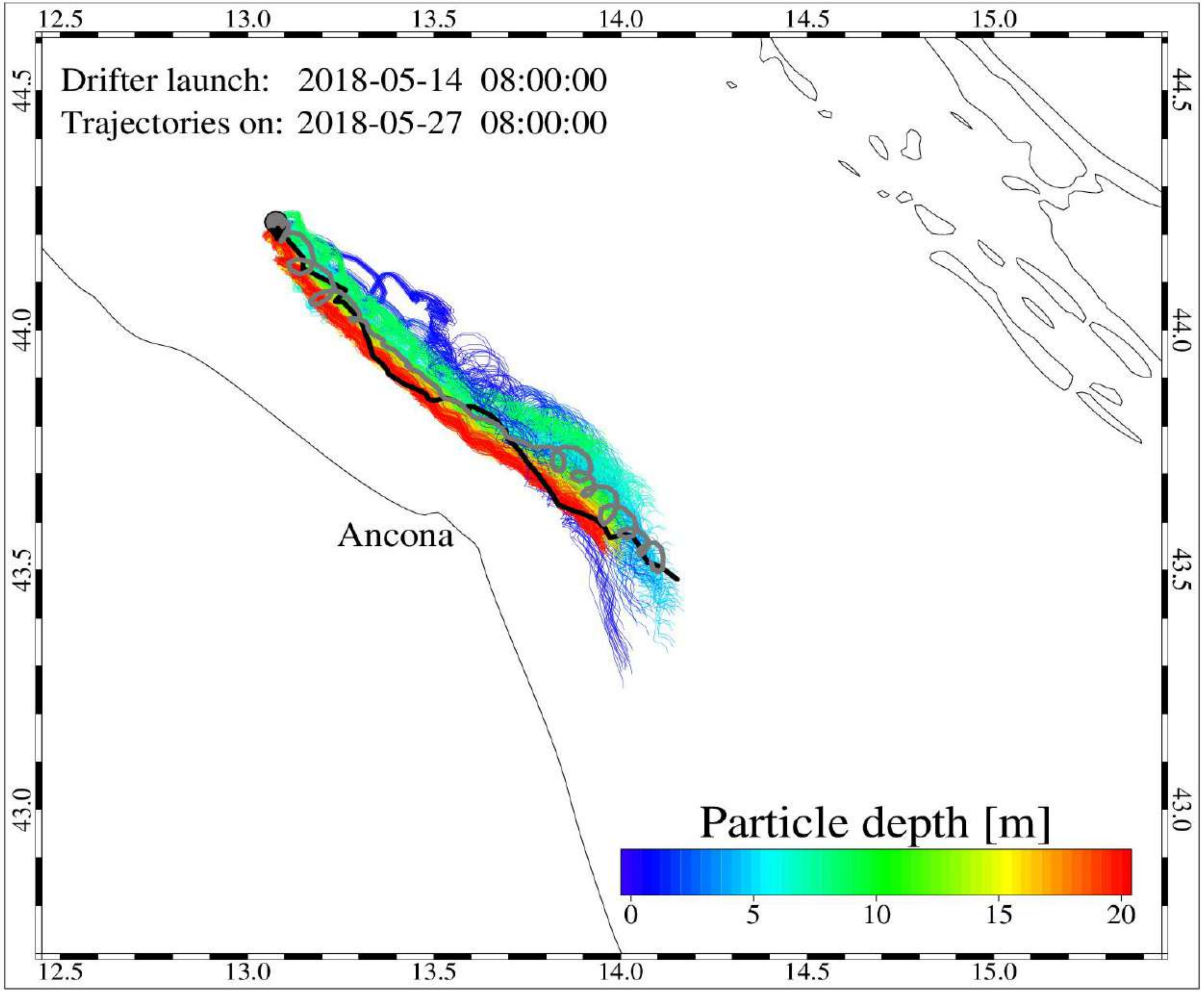


LOW SINKING VELOCITY
0.01 m/s

from PORTODIMARE PROJECT -

PARTICLE TRACKING MODULE:

The particles are released on different depth and their trajectories (rainbow lines) are compared with drifter data (black line) . The average trajectory (grey line) has good fit with the field data.



RECYCLING

- Improvement of the environmental sustainability and efficiency of recycling process of ML
- marGnet has developed a **portable prototype** that exploits low temperature pyrolysis to transform the ML in certified marine fuel at a reasonable cost (M1-M19)

Co-funded by the European Maritime and Fisheries Fund

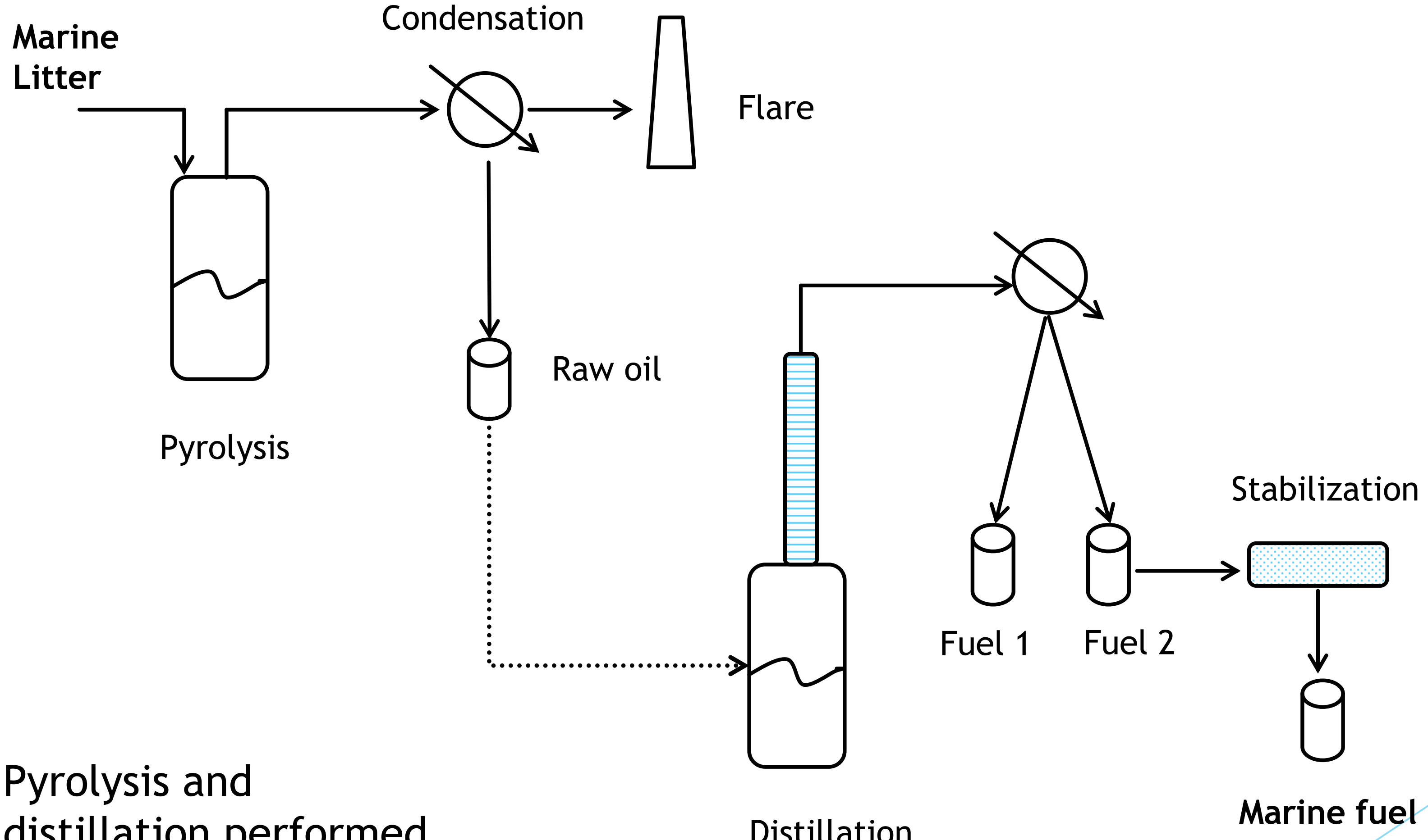
RECYCLING

Marine Litter

- «Chemical recycling» approach to ML **(No need for pre-treatment)**
- Pyrolysis: thermal decomposition without combustion
- Approx. 30 Kg ML processed per cycle
- Approx. 50 % wt useful fuel (15 Kg) out of ML for each cycle
- **<u>ISO 8217 DMA produced fuel a.k.a. Marine Gasoil</u>**
- Approx. 10% wt residue
- <u>Approx. 0.5 tCO2 avoided for each ton of produced fuel</u>

Co-funded by the European Maritime and Fisheries Fund

From Marine Litter to Marine Fuel : prototype design



Pyrolysis and distillation performed discontinuosly

REALIZED PROTOTYPE

Co-funded by the European Maritime and Fisheries Fund

REALIZED PROTOTYPE TESTING - ONGOING

- Analysis of fuel and yield
- Gaseous emission analysis
- Solid residues characterization
- CO_2 equivalent impact
- *Demonstrate the feasibility*

Co-funded by the European Maritime and Fisheries Fund

RECYCLING DEMOSTRATION (M17-M20) AT THE 2020 VENICE NAUTICAL SALON (3-7 JUNE)

Co-funded by the European Maritime and Fisheries Fund

REDUCING

- Reducement of the quantity of ML from fisheries and aquaculture activities by testing the described prototype in fishing port areas demonstrating its easy-usability and therefore, convenience for fishermen and general public
- marGnet promotes a change in behaviour of fishermen towards sustainable practices

Co-funded by the European Maritime and Fisheries Fund

MANAGING

- Improving the governance framework for the management of ML by providing decision supporting tools and best experience to policy makers to orient the policy making process (M18-M23)

Co-funded by the European Maritime and Fisheries Fund

PROMOTION

- Promotion of sustainable removal of sea floor ML in pursuit of Good Environmental Status
- marGnet will capitalize on the GHOST project results to strengthen the use of the secure removal protocols (M1-M24)

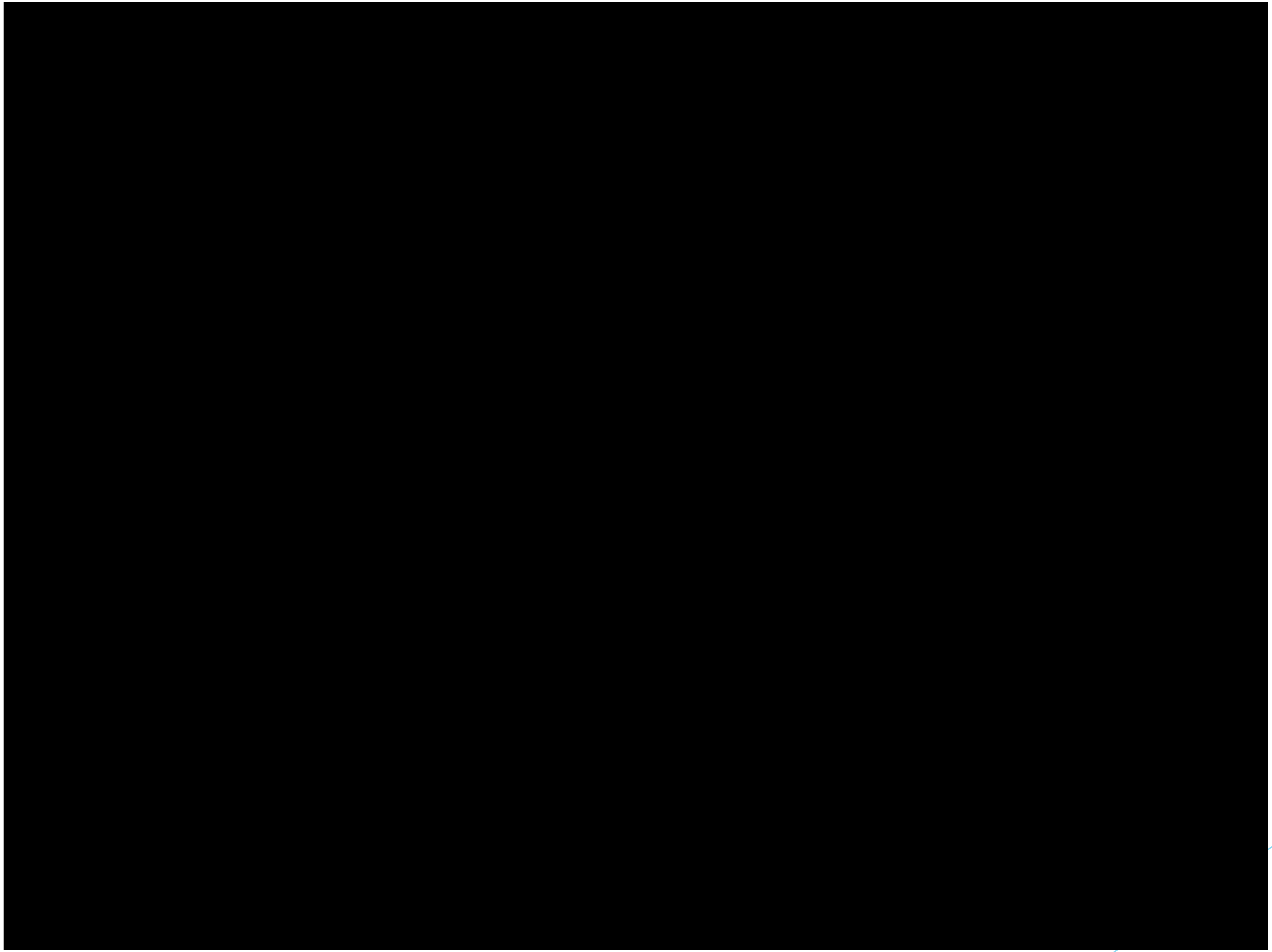
Co-funded by the European Maritime and Fisheries Fund

PROMOTION : Sea-floor clean up activies and public events

WOD 2019

ECOMONDO 2019

MAKER FAIR 2019



THANK YOU!

MarGnet mid-term Scientific meeting REPORT

Annex 4

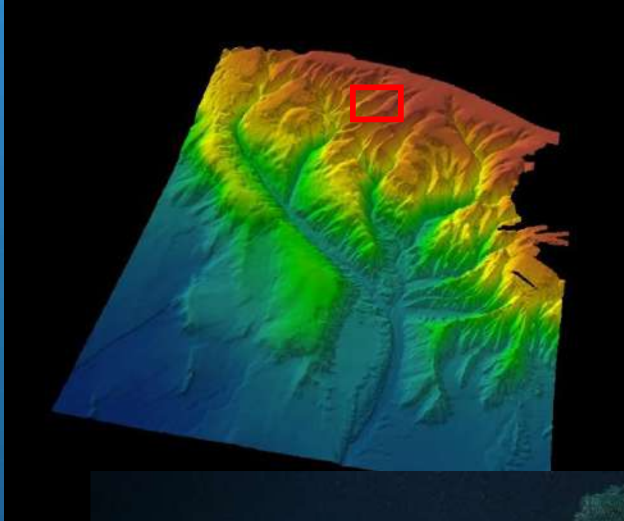
www.margnet.eu

ISMAR BLUE WORLD INSTITUTE SINTOL LAGUNA PROJECT techneprojects GROWING UP PROJECTS

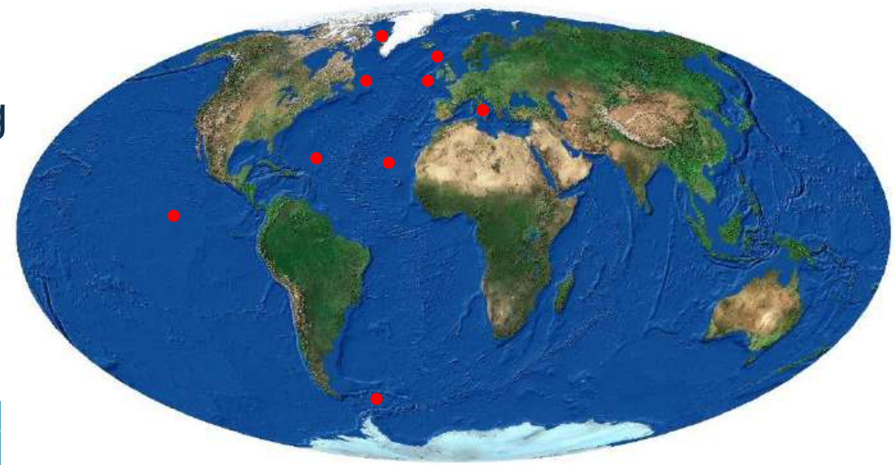
Co-funded by the European Maritime and Fisheries Fund

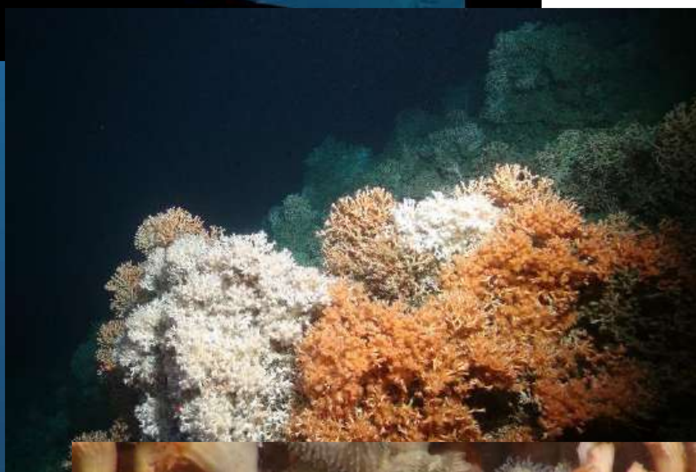
Mapping marine litter on the seafloor

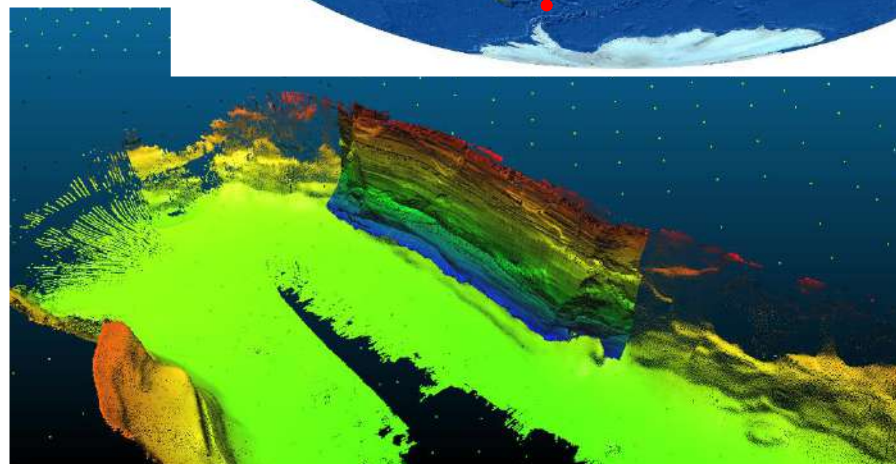
Dr ir Veerle Huvenne
Team Leader
Seafloor and Habitat Mapping
vaih@noc.ac.uk



My background: Habitat mapping of complex deep-sea environments





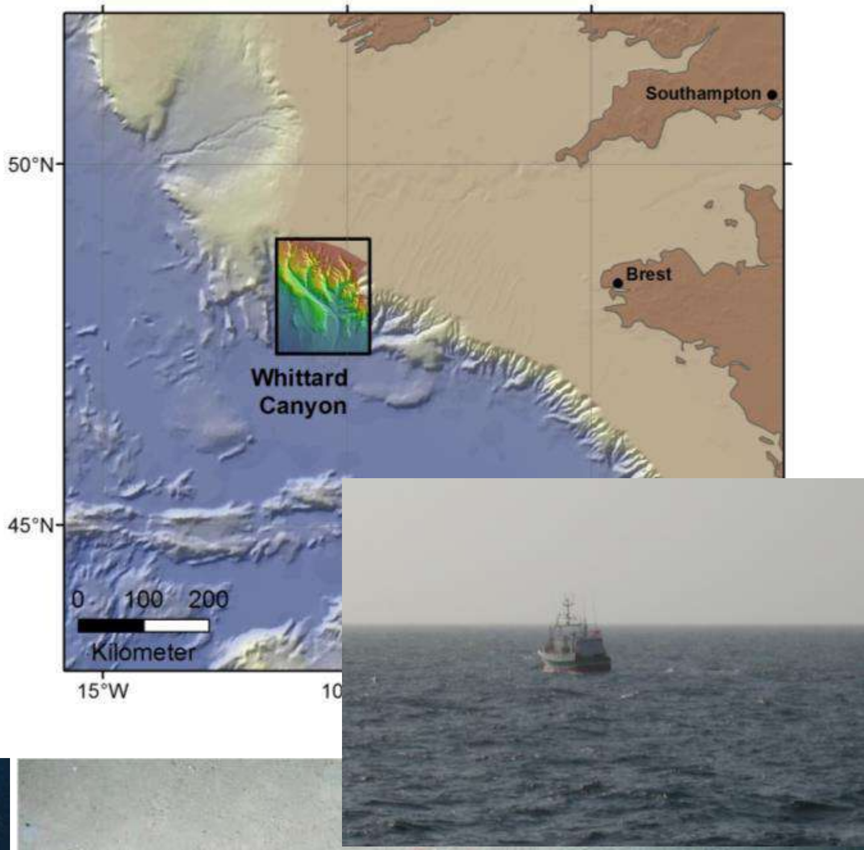


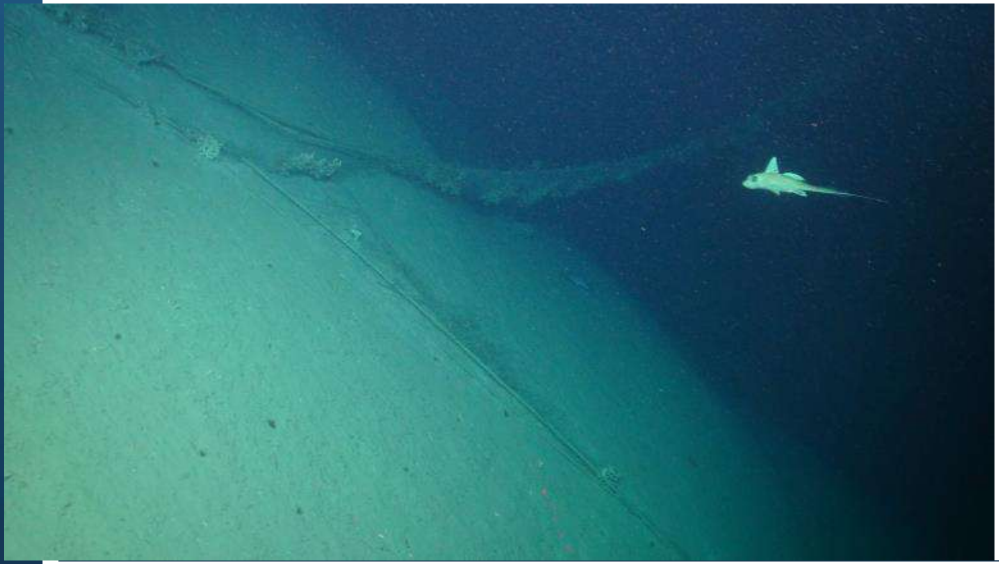
How to map marine litter?

1. Observe
   - Optical mapping:
     - Photographs
     - Video
     - Hyperspectral camera

Whittard Canyon

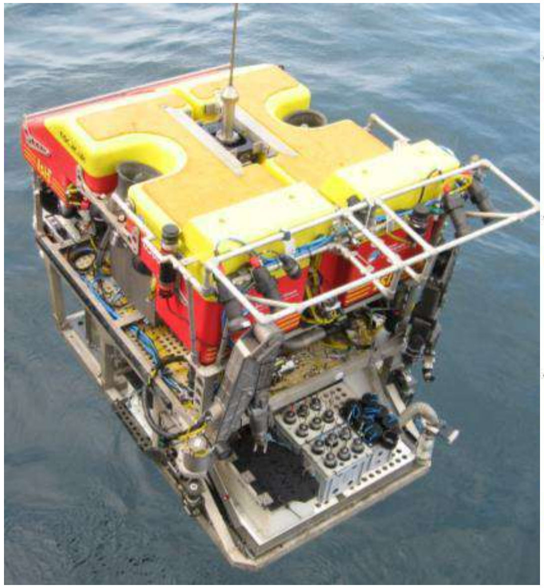
- Type II: shelf-incising, no river connection: 200nm from land
- 200 - >4300m depth
- The Canyons Marine Conservation Zone
- Intense fishing: trawling & longlining

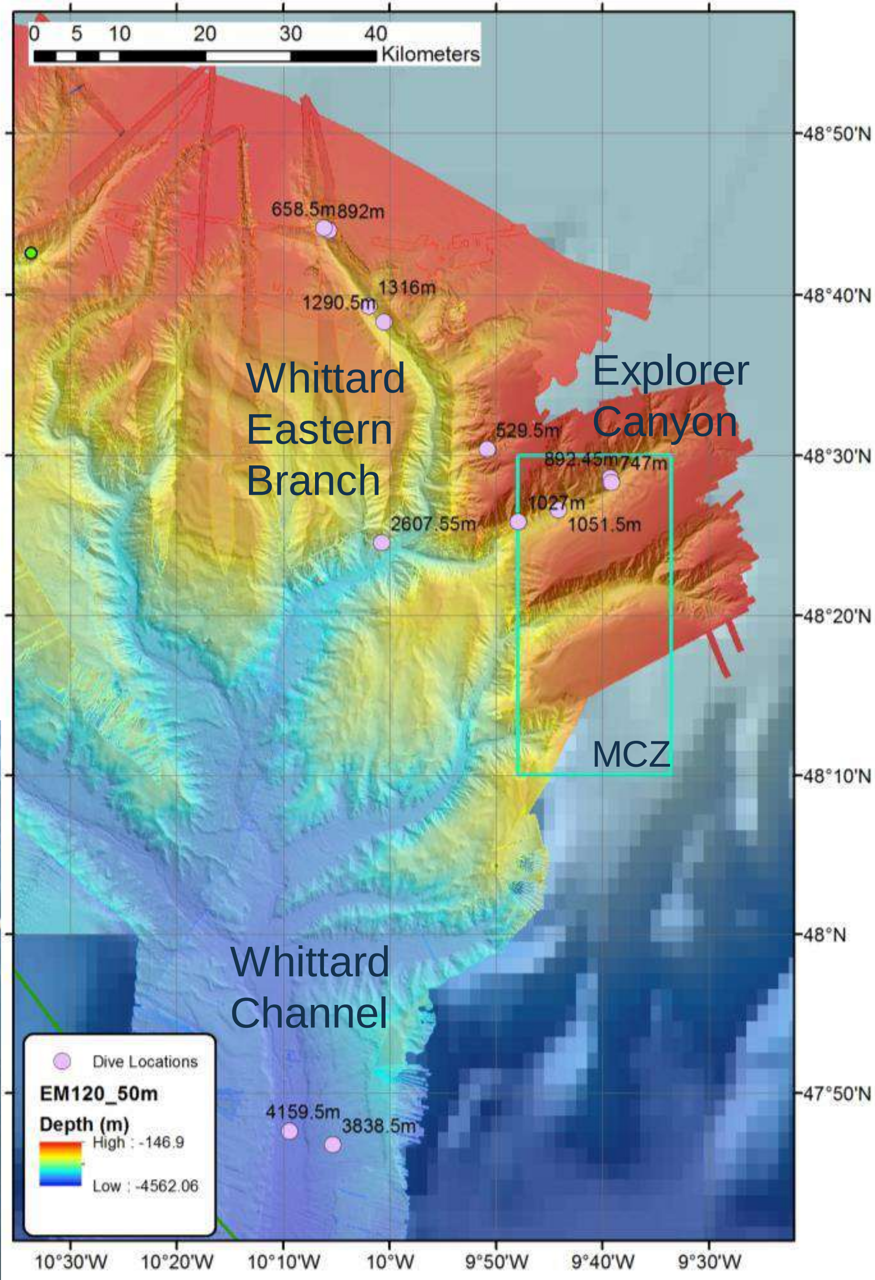




Whittard litter study

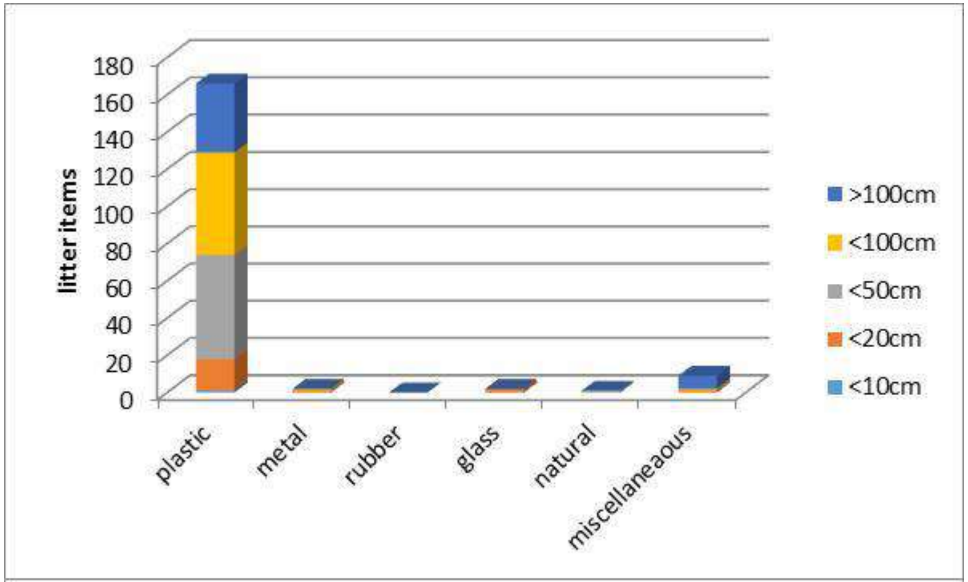
- Whittard Eastern Branch, Explorer Canyon, Whittard Channel
- Data collected in 2015 & 2018
- ROV Isis – HD video camera & lasers
- 21km of transect, 5.3ha
- 12 Dives, 529 – 4160m

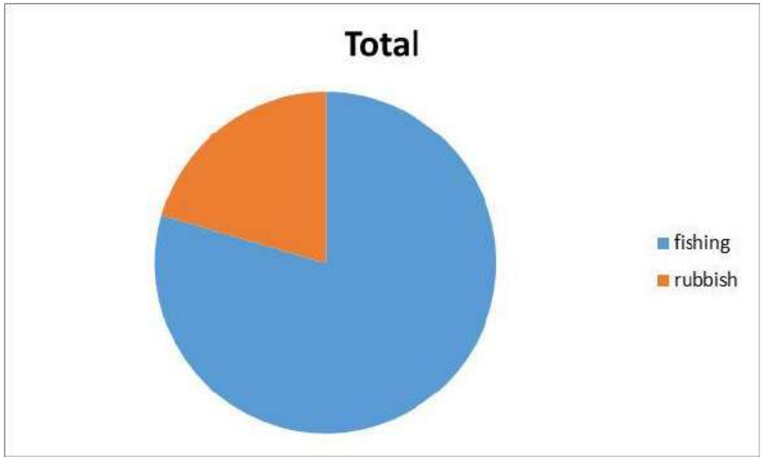


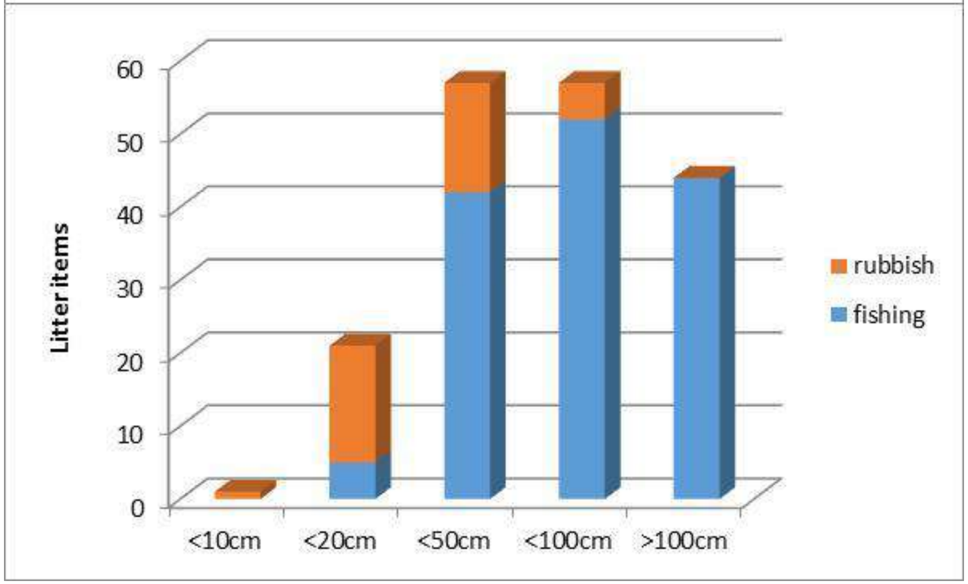


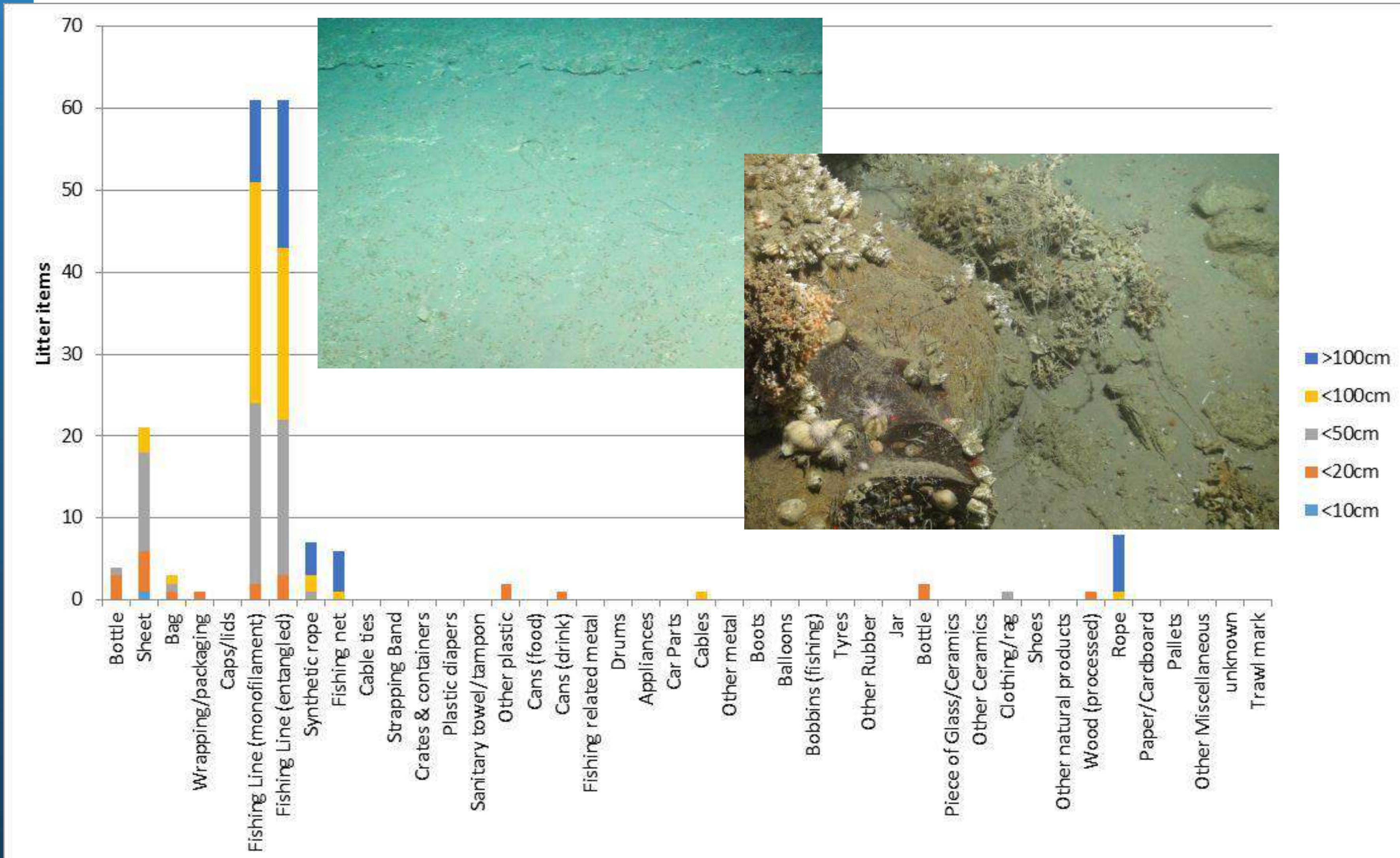
Results

- 180 items of litter over 5.3 ha = 33.7 items/ha
- 92.2% plastics (166 items)
- 79.4% fishing-related (143 items) – mainly the larger items





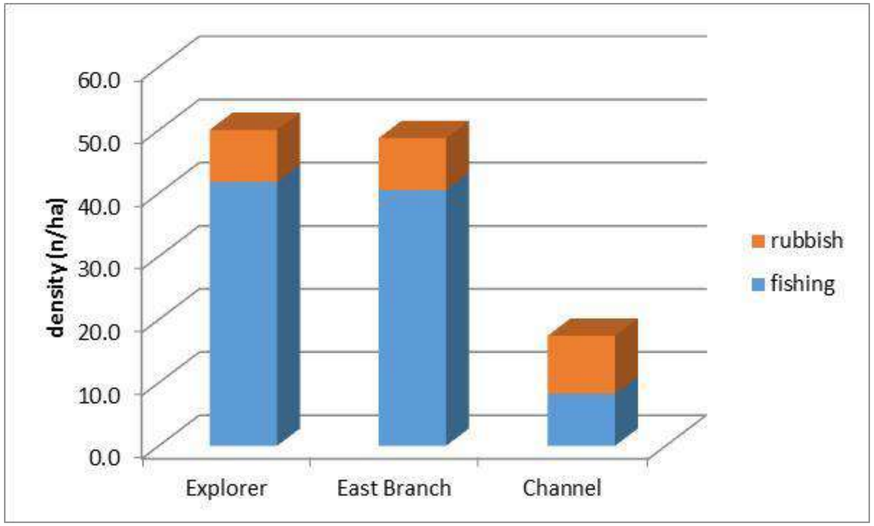


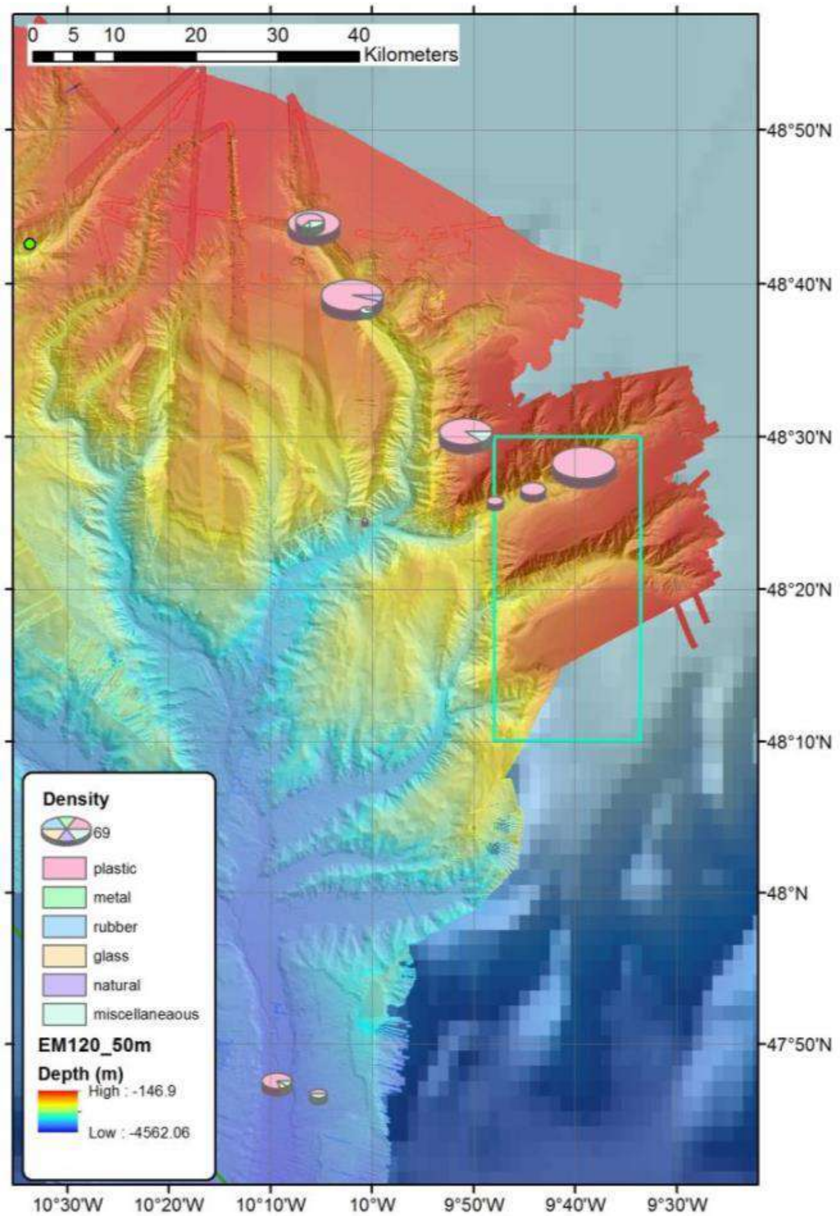


Litter categories according to EU MSFD technical guidelines (2013)

Results

- Litter densities and patterns very similar for Explorer Canyon and Whittard Eastern Branch (500-1500m depth)
- Less litter and less fishing gear in Lower Eastern Branch & Whittard Channel (1500-4200m)





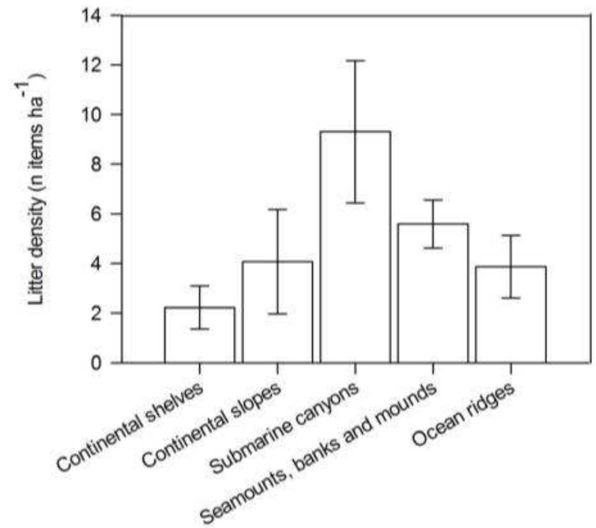
- Cold-water corals act as litter traps
- Cables & ropes act as substratum for coral growth
- No ‘litter clusters’

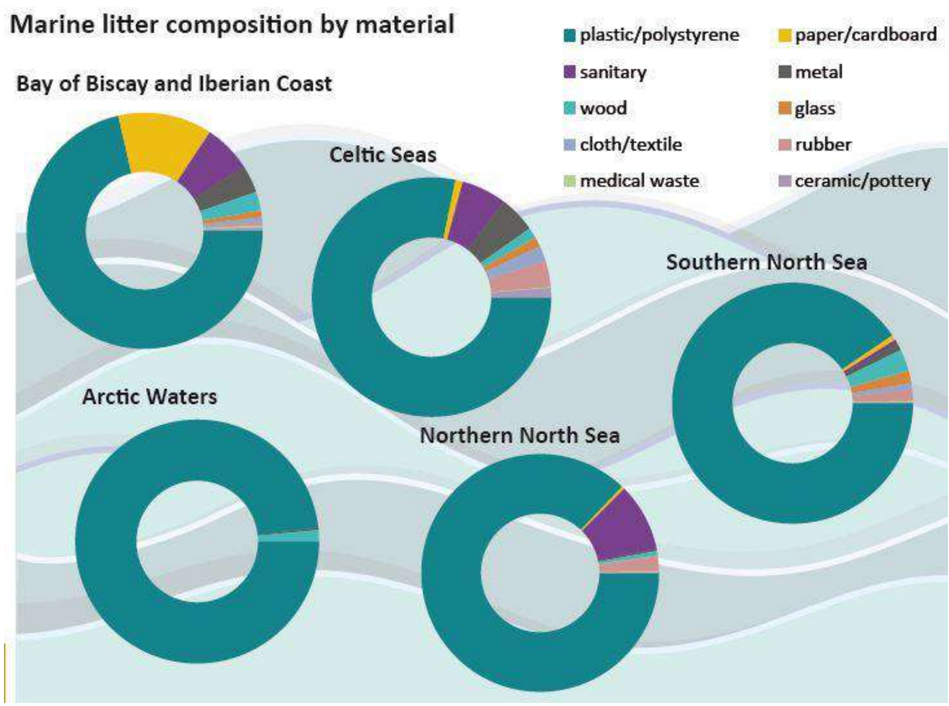
    - Dive locations focus on CWC and vertical walls
    - Limited surveying of canyon floor
    - Whittard Canyon activity: internal-tide driven, limited number of gravity flows

Marine Litter in submarine canyons

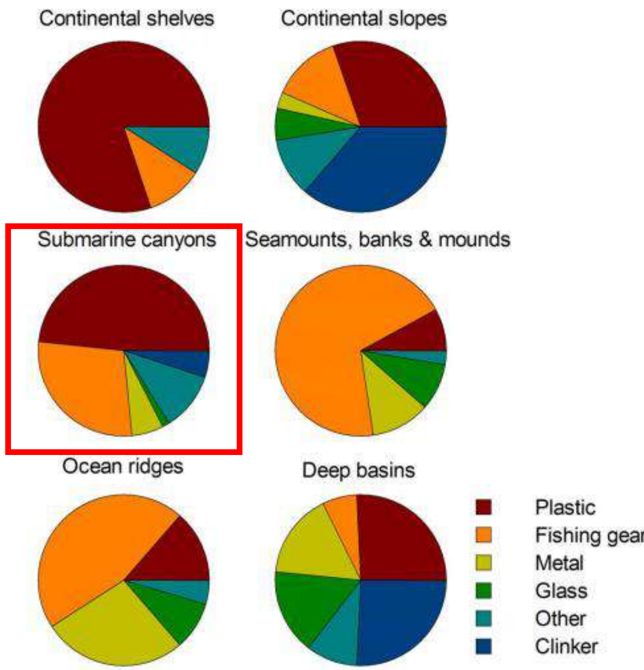
Benthic litter in European Seas *(Pham et al., 2014)*

- Highest litter density in canyons
- Mostly plastic and fishing gear



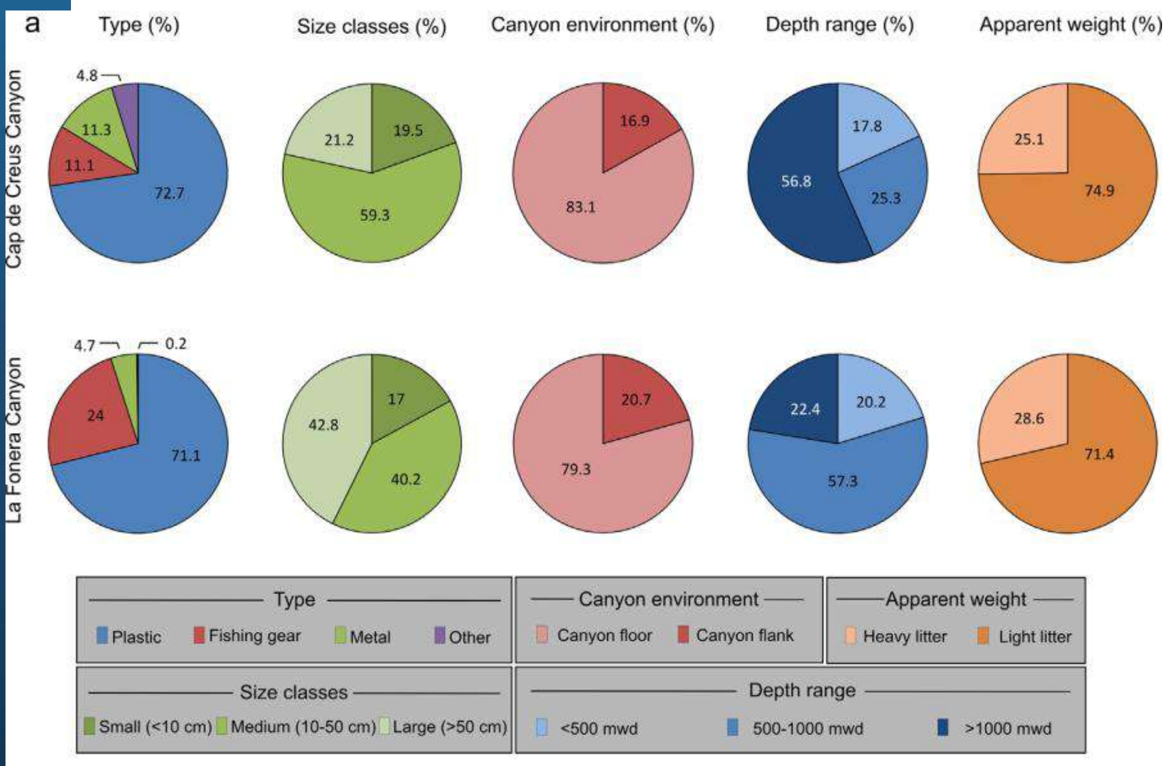


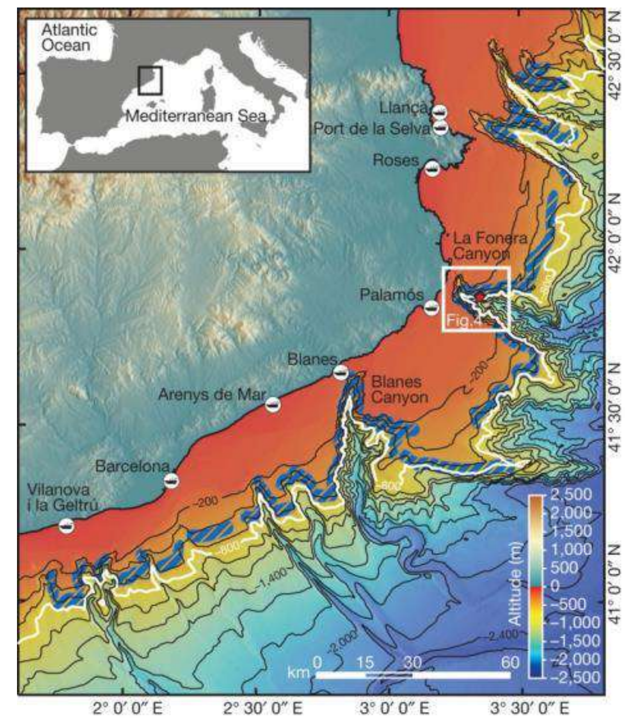
OSPAR website

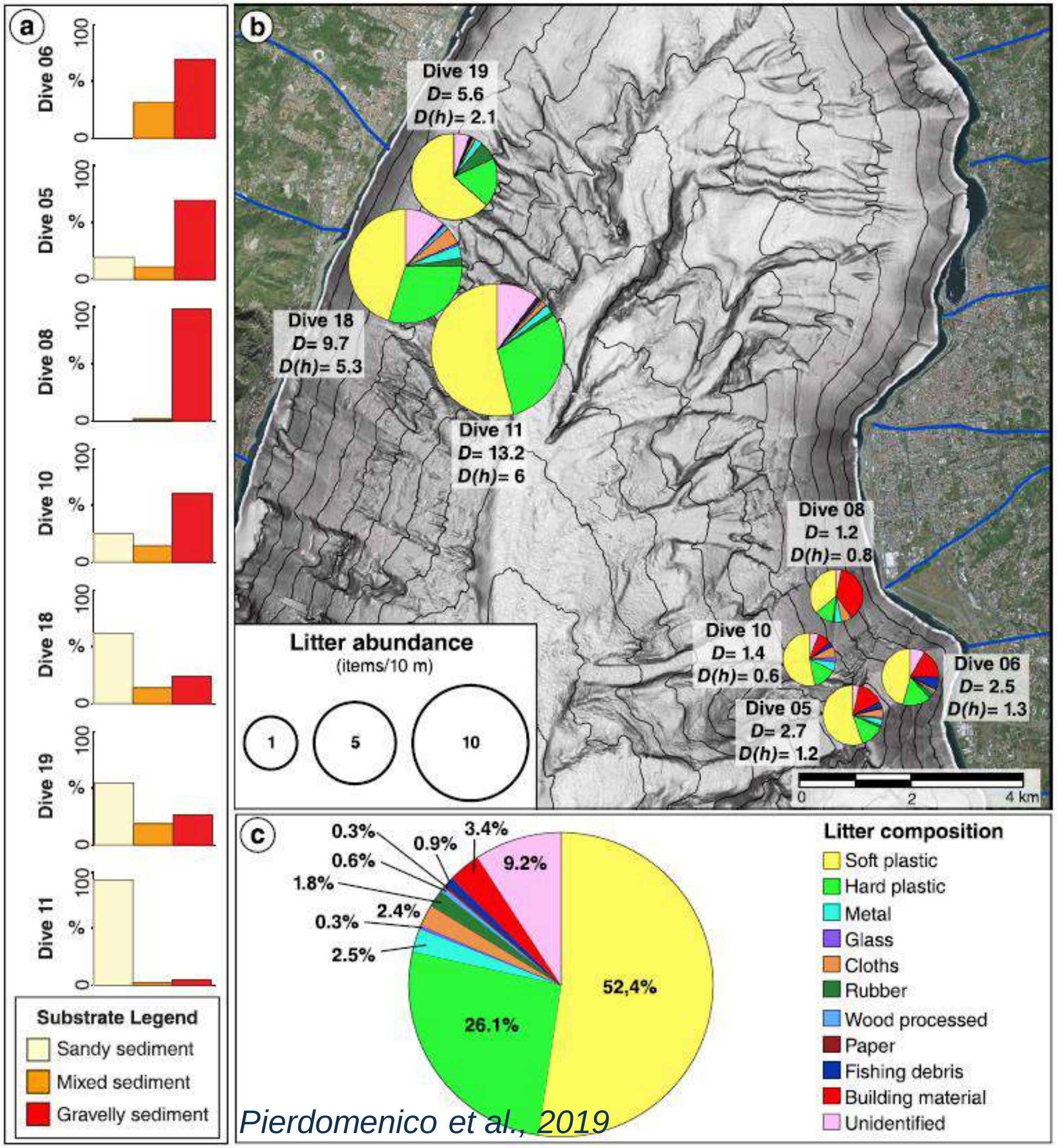


Litter in Type I Canyons (shelf-incising, close to shore, river-connected) *Tubau et al. (2015)*

- Mostly plastic and fishing gear
- Mostly lighter items
- Litter ‘clusters’

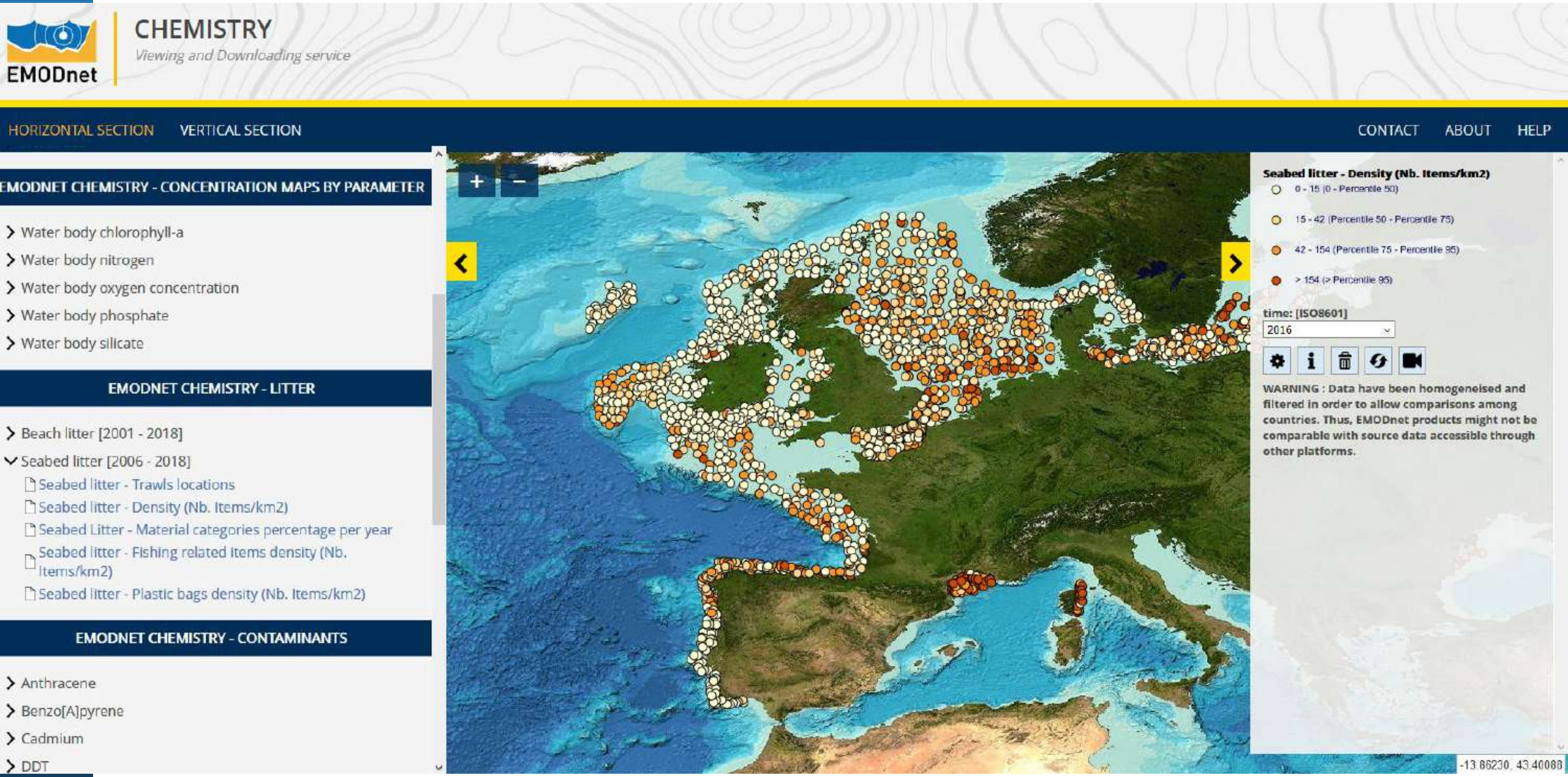






Pierdomenico et al., 2019

International databases



How to map marine litter?

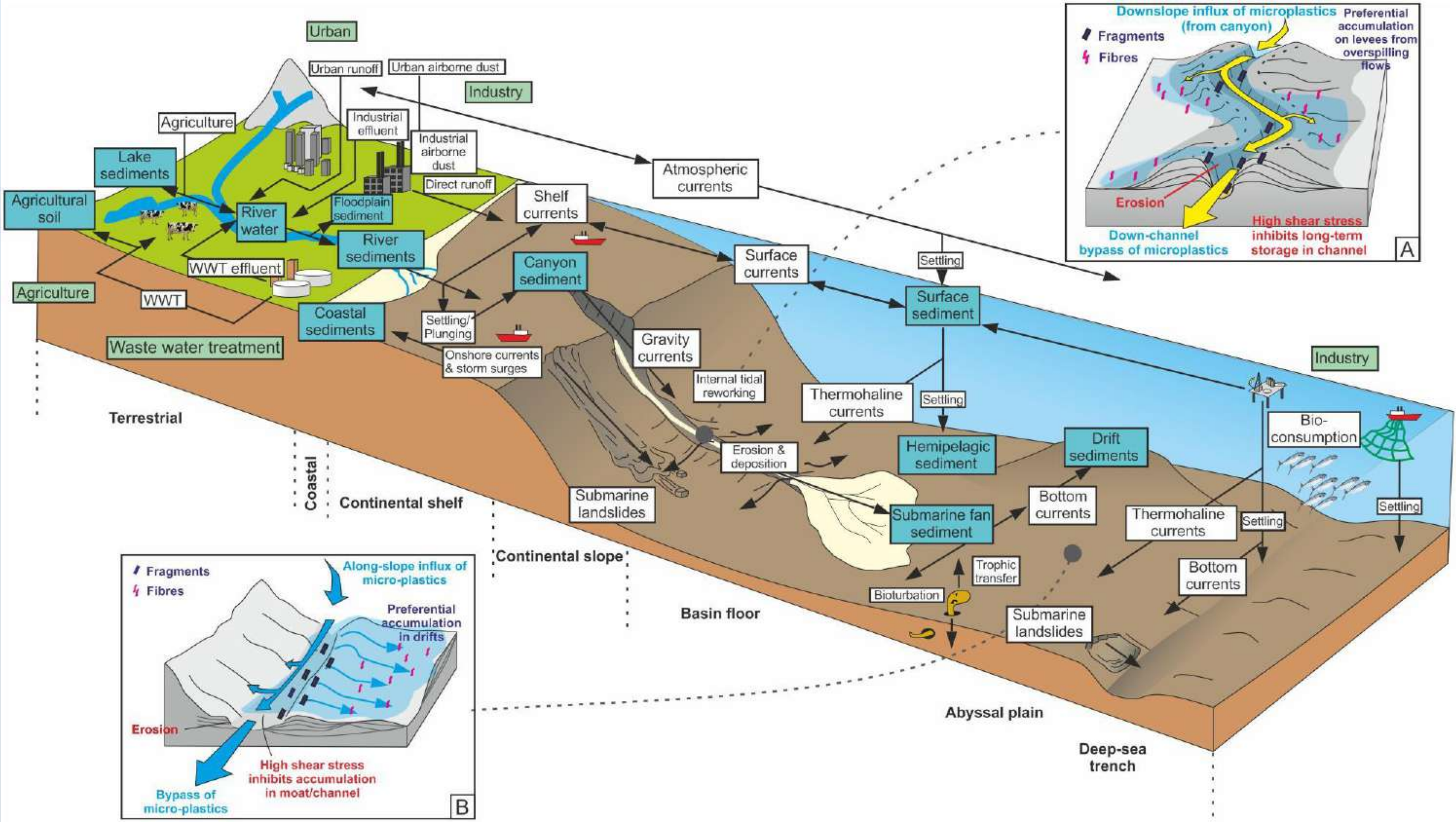
1. Observe
    - Optical mapping:
        - Photographs
        - Video
        - Hyperspectral camera

How to map marine litter?

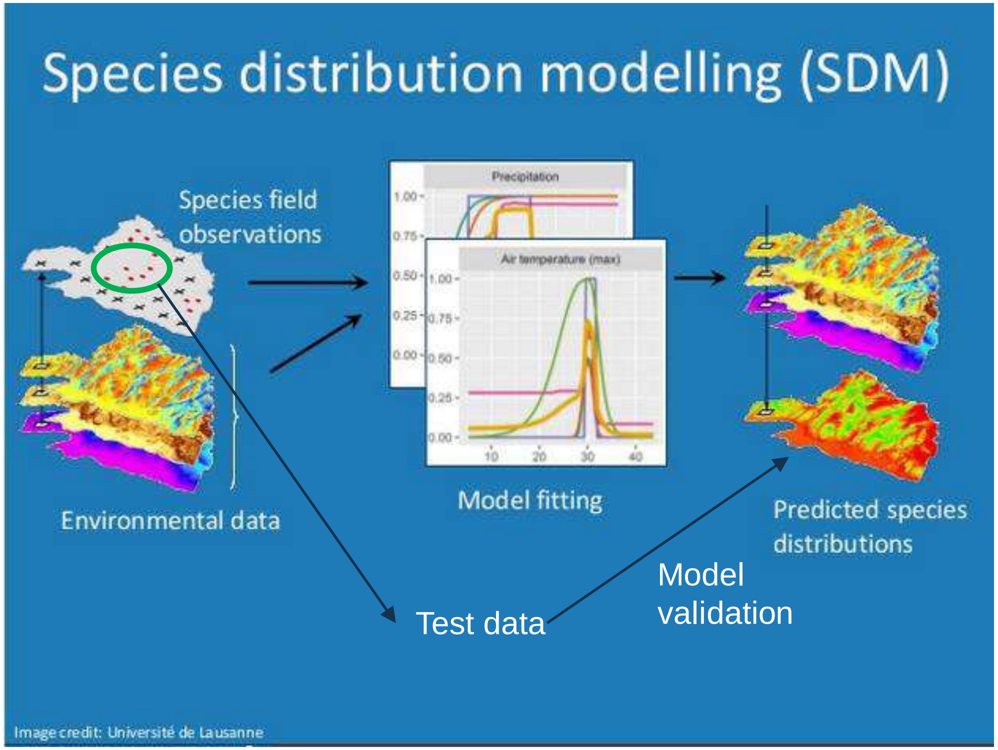
1. Observe
   - Optical mapping: detail, but lacks coverage
     - Photographs
     - Video
     - Hyperspectral camera

2. Predict (extrapolate observations)
   - Deterministic/mechanistic modelling
   - Statistical distribution modelling
     - GAMs, GLMs,…
   - Machine learning & artificial intelligence
     - Random Forest
     - Distributed Neural Networks

Conceptual & mechanistic models of (micro)plastics transport & distribution



Kane & Clare (2019)

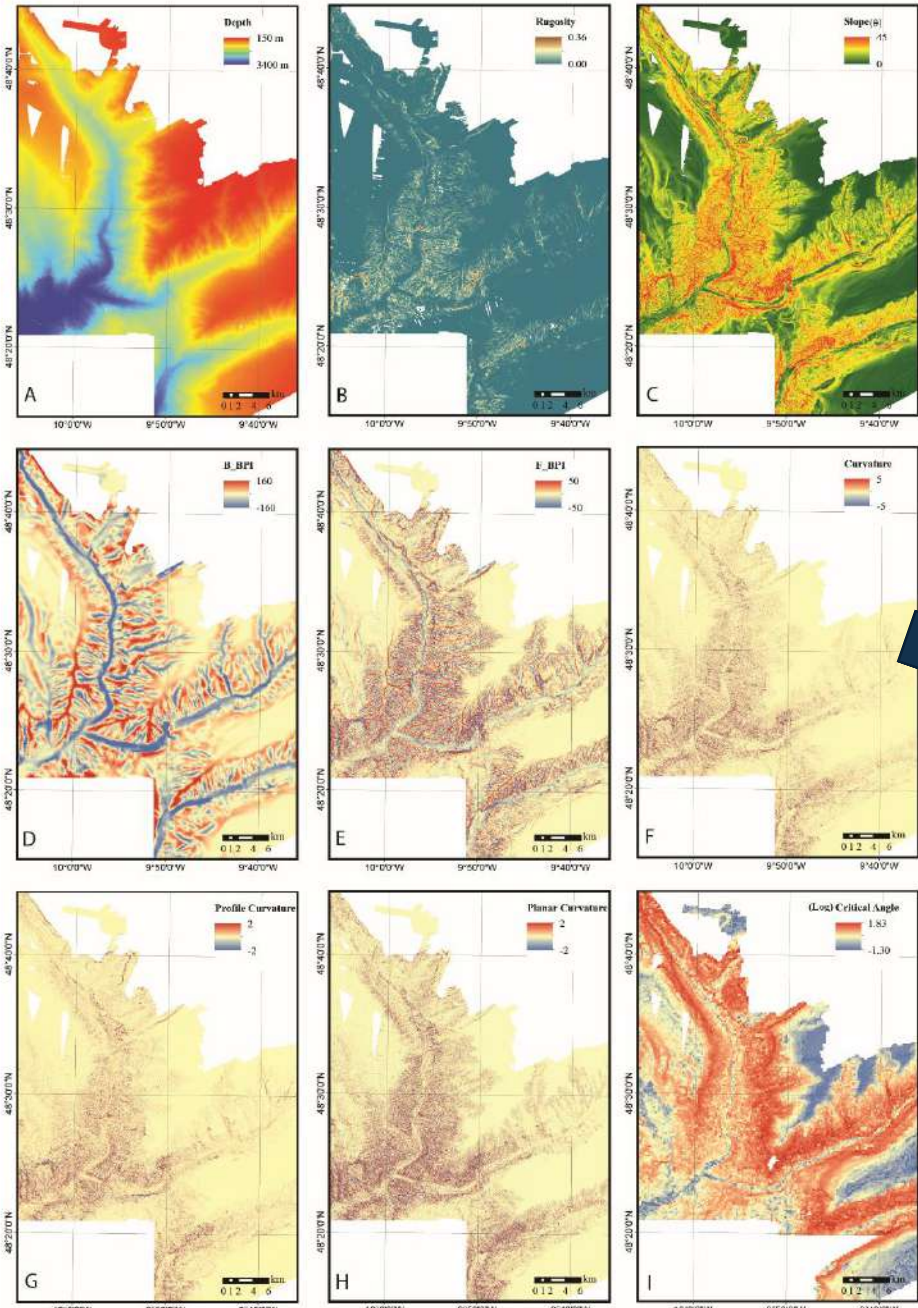


- GLMs: Generalised Linear Models
- GAMs: Generalised Additive Models
- ENFA: Environmental Niche Factor Analysis
- MaxEnt: Maximum Entropy
- BRT: Boosted Regression Trees
- RF: Random Forest
- …

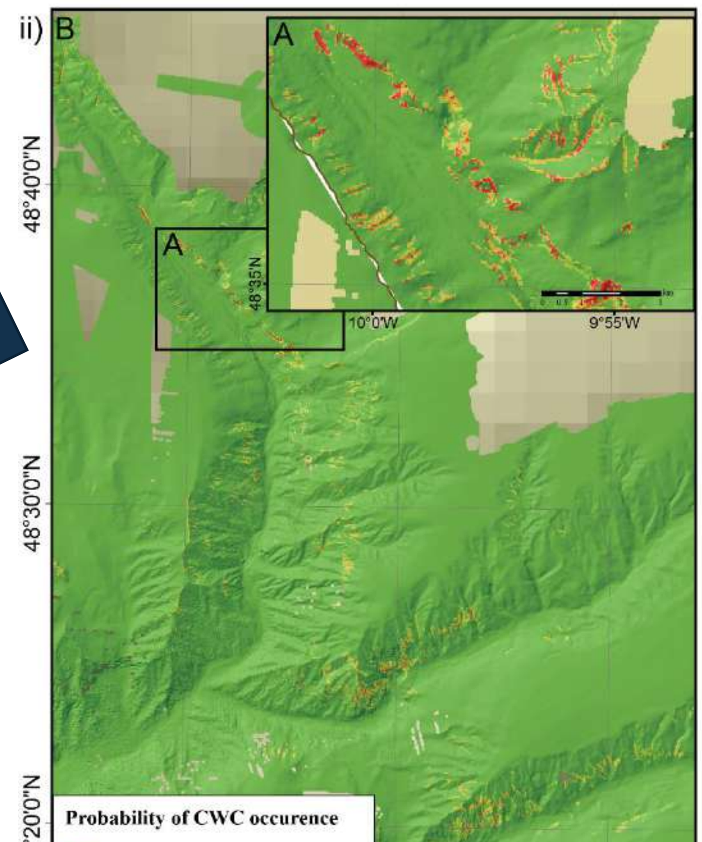
Input:

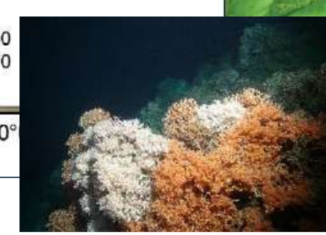
- Species (Litter) presence/absence or presence only data
- Relevant environmental information
    - Bathymetry & derivatives (slope, roughness…)
    - Current information
    - Distance from shore
    - …
- Understanding of species (Litter) – environment relationships

Predictive mapping



Ensemble model predicting cold-water coral occurrence
(Pearman et al., subm.)





How to map marine litter?

1. Observe
   - Optical mapping: detail, but lacks coverage
     - Photographs
     - Video
     - Hyperspectral camera
   - Acoustic mapping: coverage, but lacks detail
     - Ultra-high resolution multibeam
     - High-resolution sidescan sonar
     - Synthetic Aperture sonar

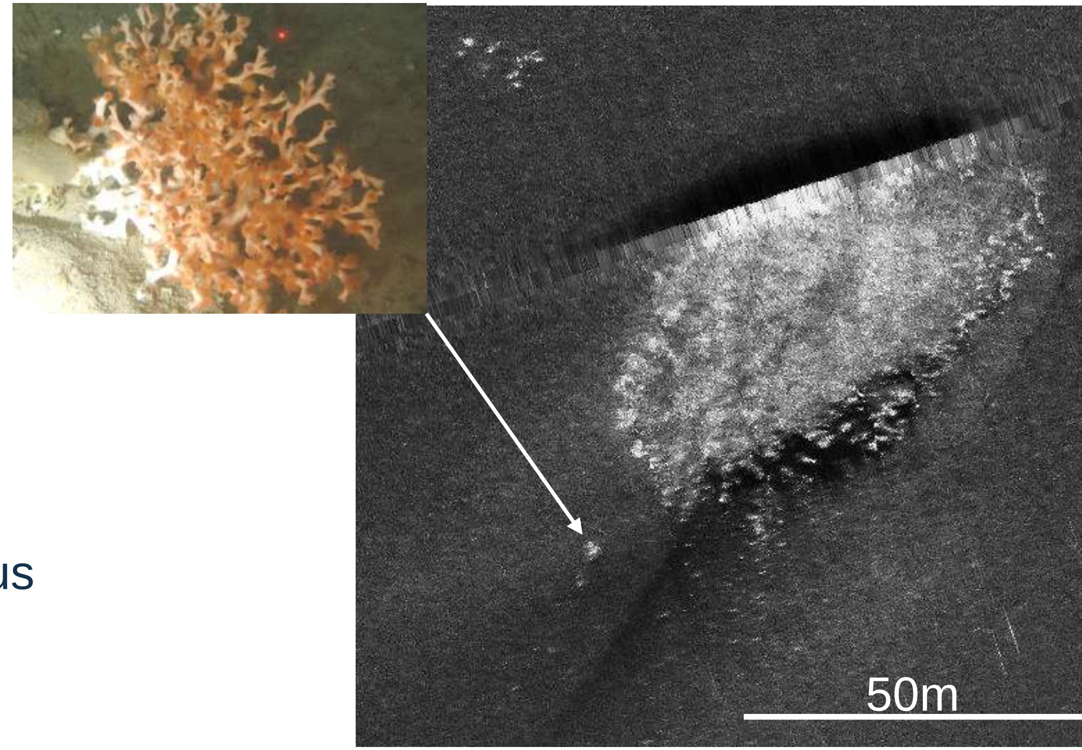
Autonomous technology & Automated interpretation techniques

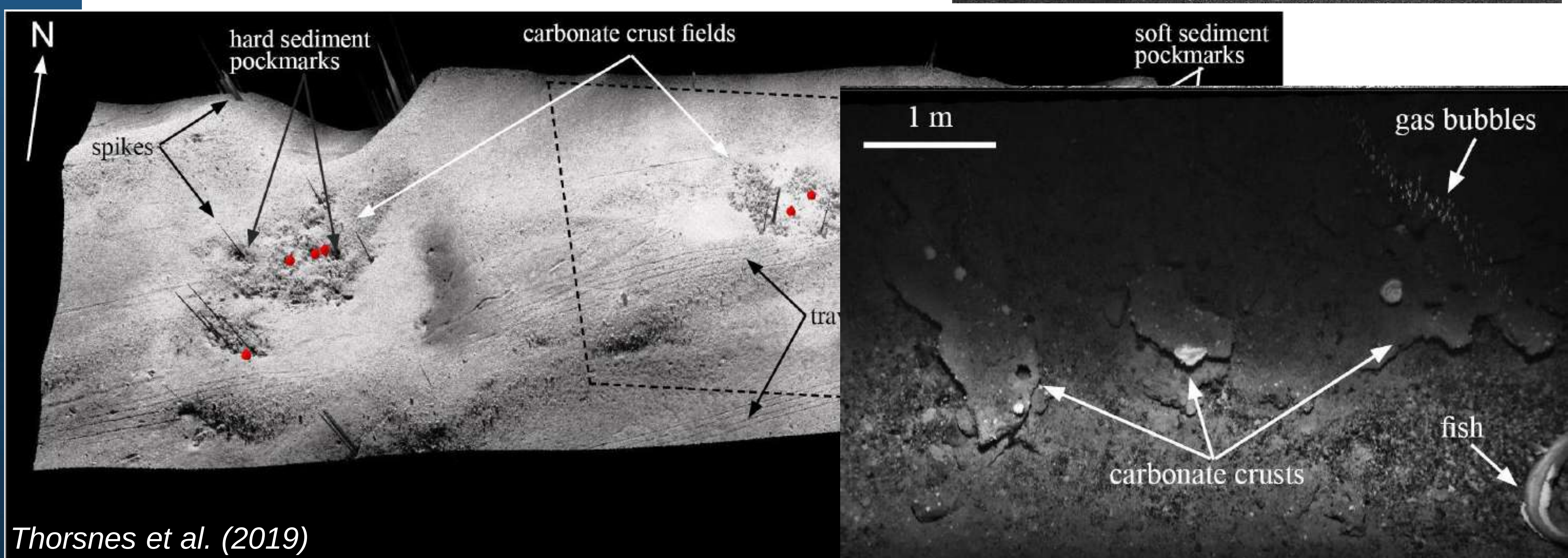
2. Predict (extrapolate observations)
   - Deterministic/mechanistic modelling
   - Statistical distribution modelling
     - GAMs, GLMs,…
   - Machine learning & artificial intelligence
     - Random Forest
     - Distributed Neural Networks

Acoustic mapping

High-frequency, high-resolution systems:

- Sidescan sonar (>400kHz)
- Synthetic Aperture Sonar (SAS)
- Increasing use of Autonomous Underwater Vehicles





Thorsnes et al. (2019)

Automated mapping of seabed habitats & features

Darwin Mounds
Marine Protected Area:

- Small cold-water coral mounds: 75m Ø, 5m high
- 1000m water depth

•Autosub6000 AUV with EdgeTech 410 kHz sidescan sonar

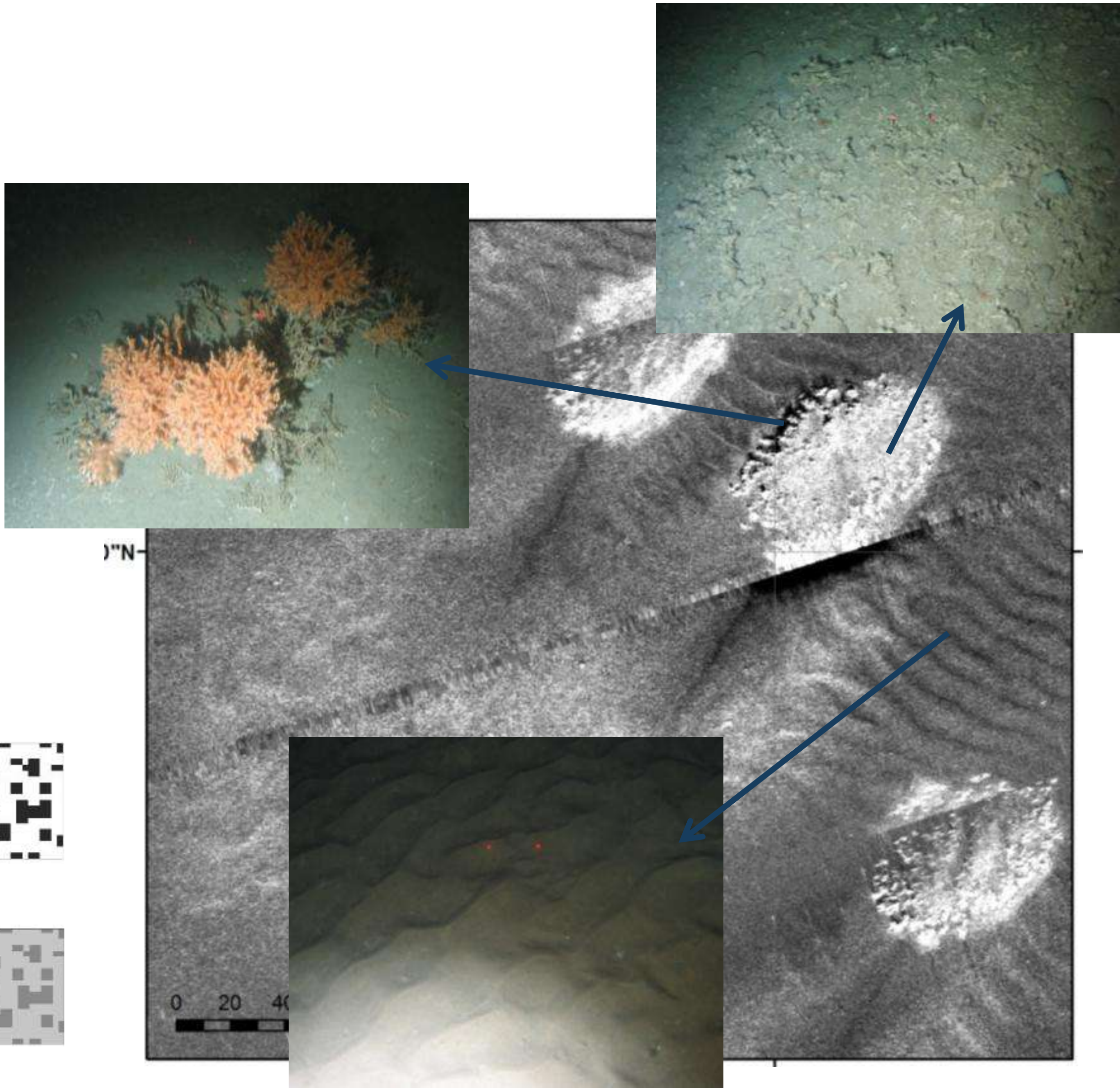
•Data processing with NOC package *PRISM*

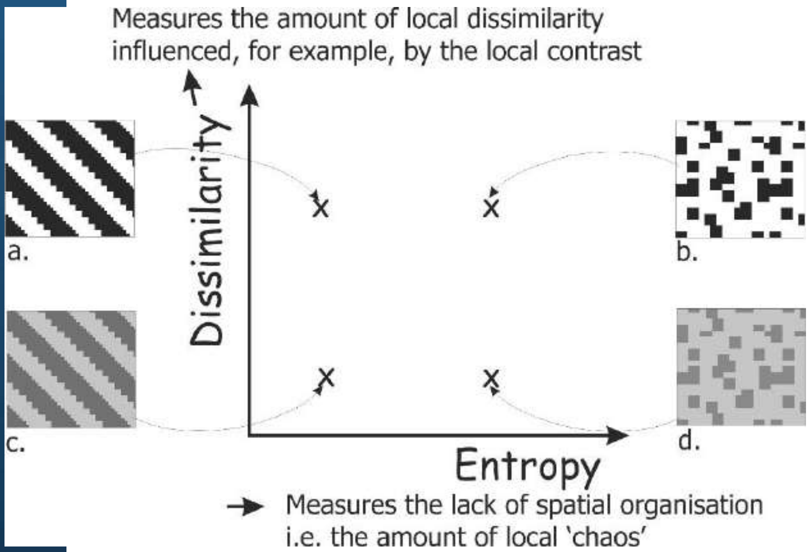
•Resulting mosaics 20x20cm or 50x50cm pixel

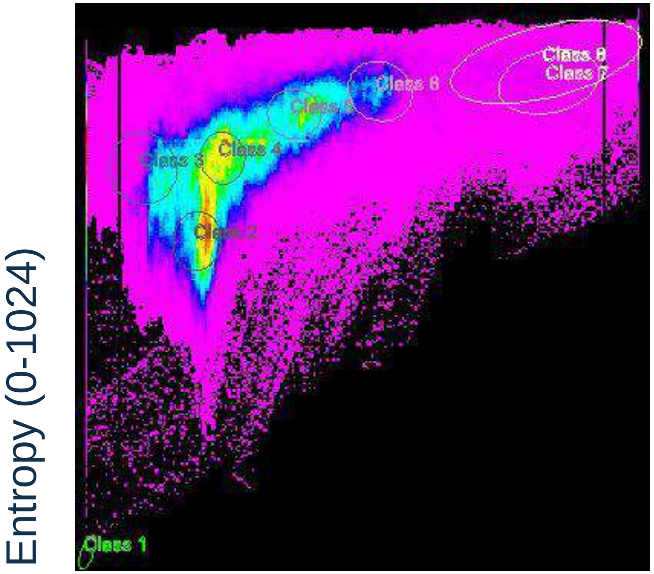
•Groundtruthing: ROV Lynx for video and stills

Automated mapping of seabed habitats & features

- Map CWC colonies by image texture
- Measured by: Grey-level Co-Occurence Matrices (GLCMs)
- Looking at: pixel arrangement in moving windows



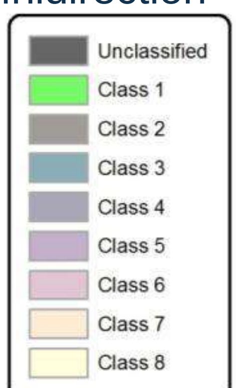


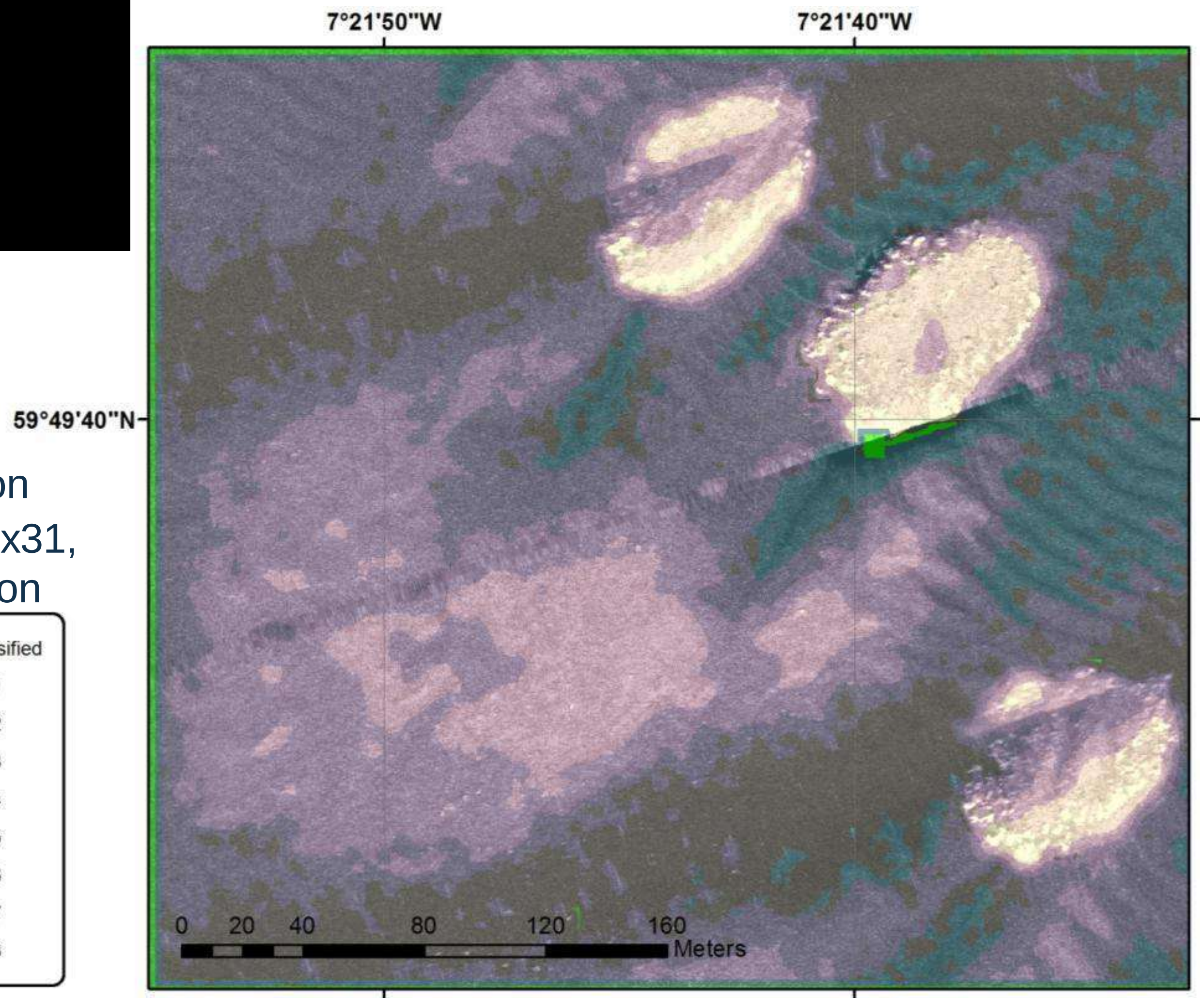


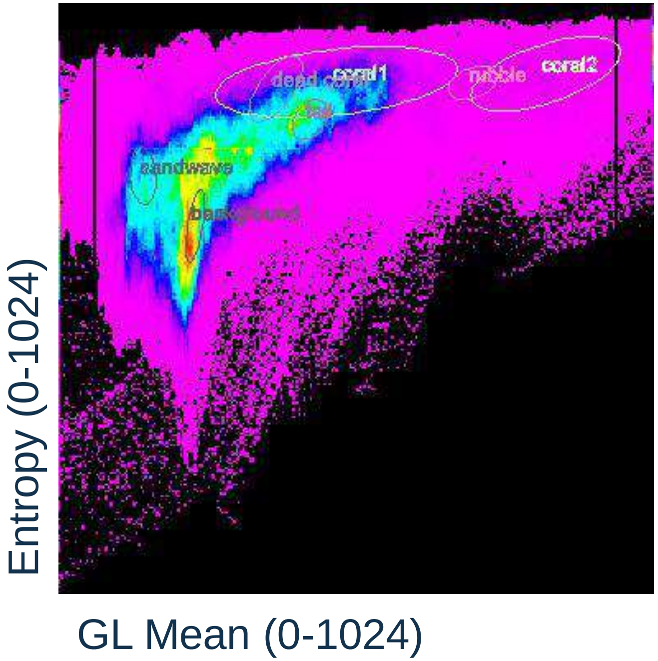
Darwin Mounds, NE Atlantic, 1000m depth

Unsupervised K-means clustering

- •GL Euclidian distance 51x51
- •GL Variance 51x51
- •GLCM Entropy 31x31, 64GL, d15,omnidirection
- •GLCM Dissimilarity 31x31, 64GL, d15, omnidirection

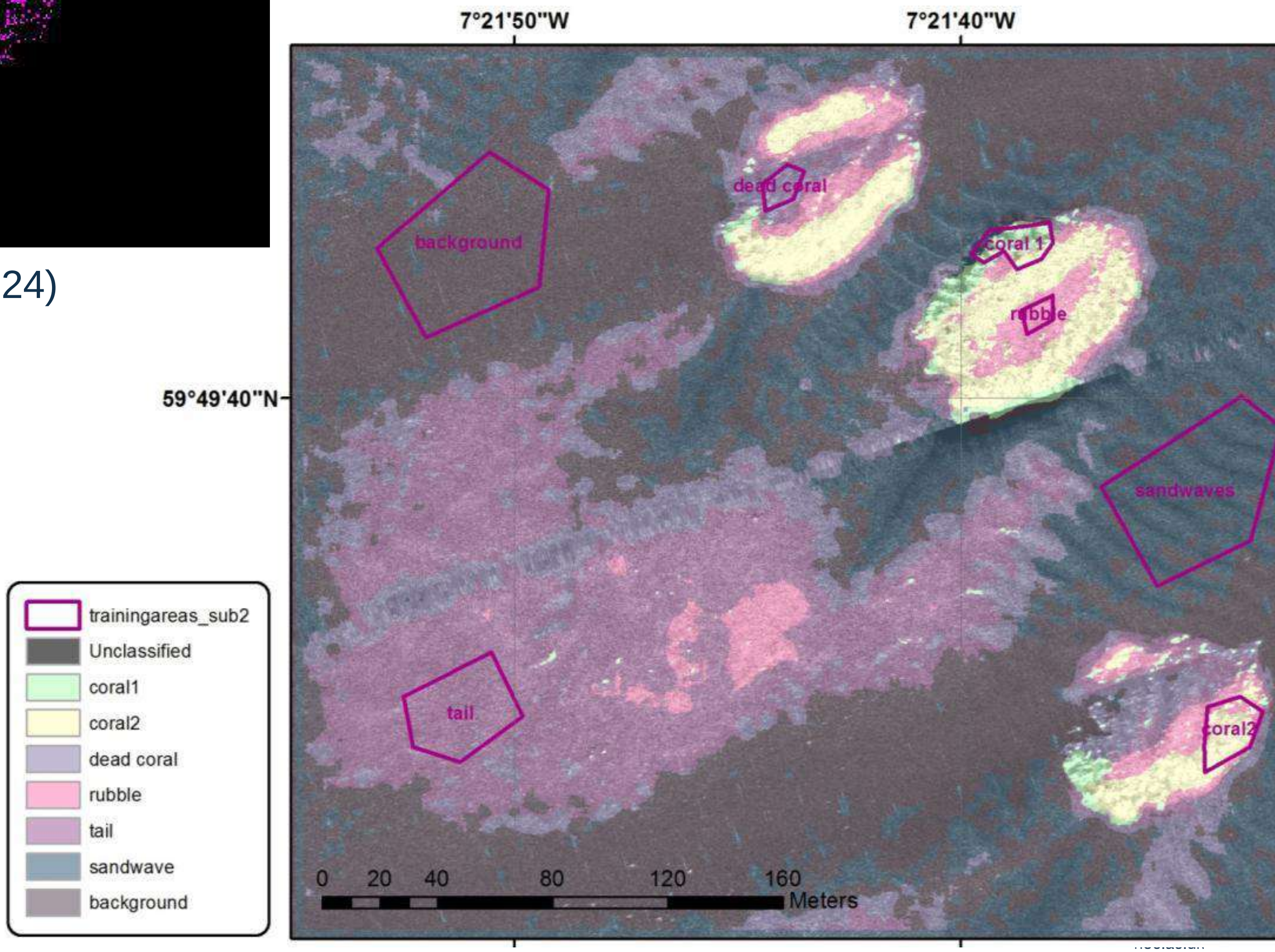






Darwin Mounds, NE Atlantic, 1000m depth

ISODATA Supervised clustering (fuzzy, min. dist.)



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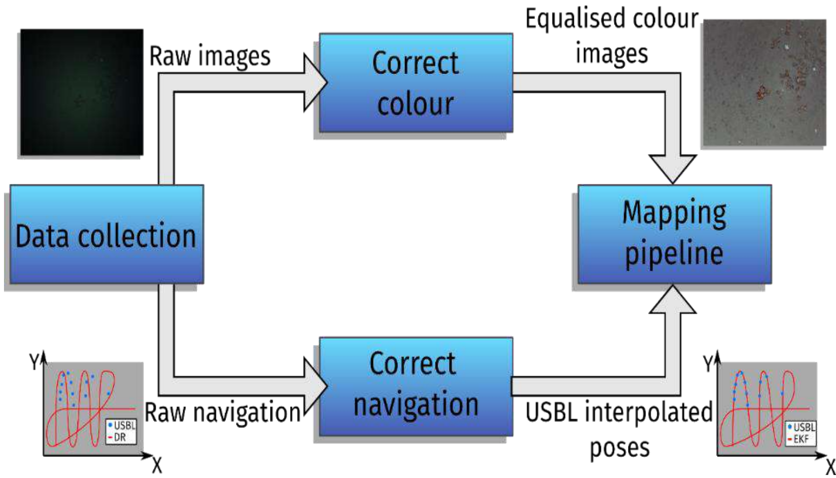
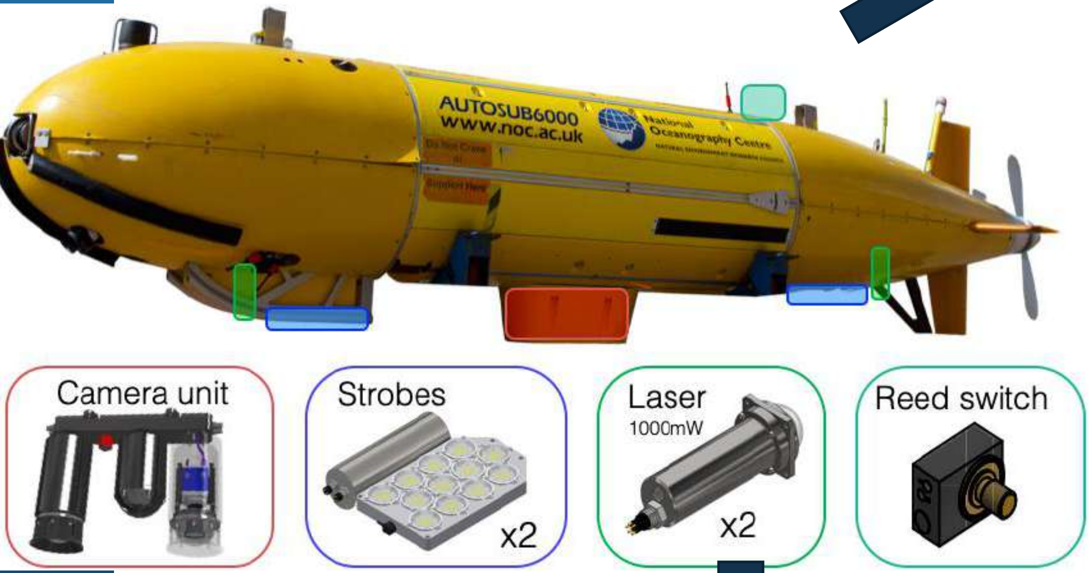
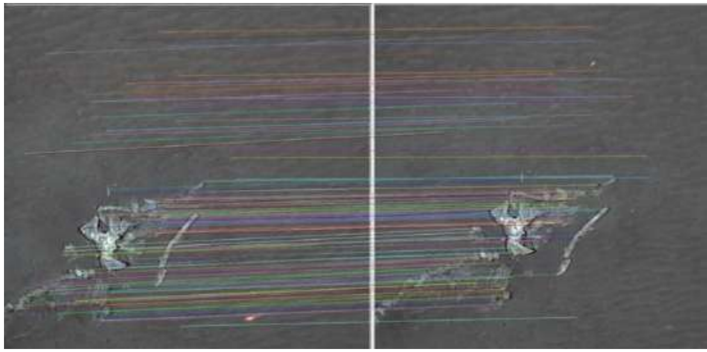
BioCam

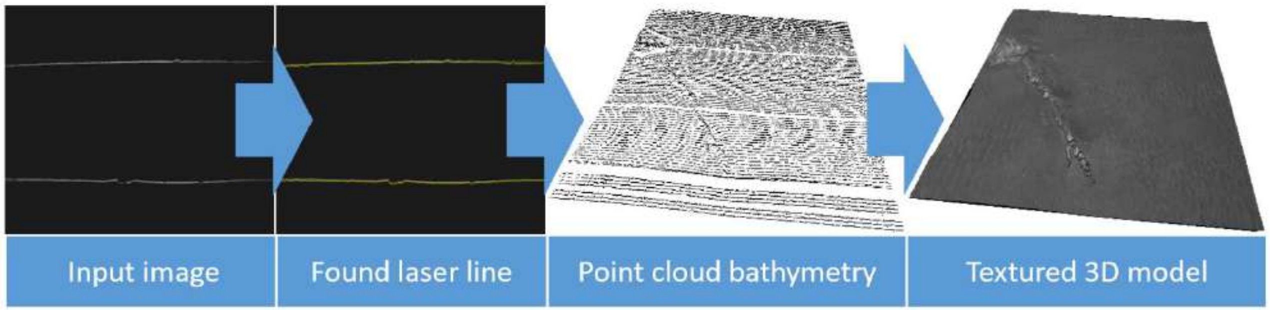


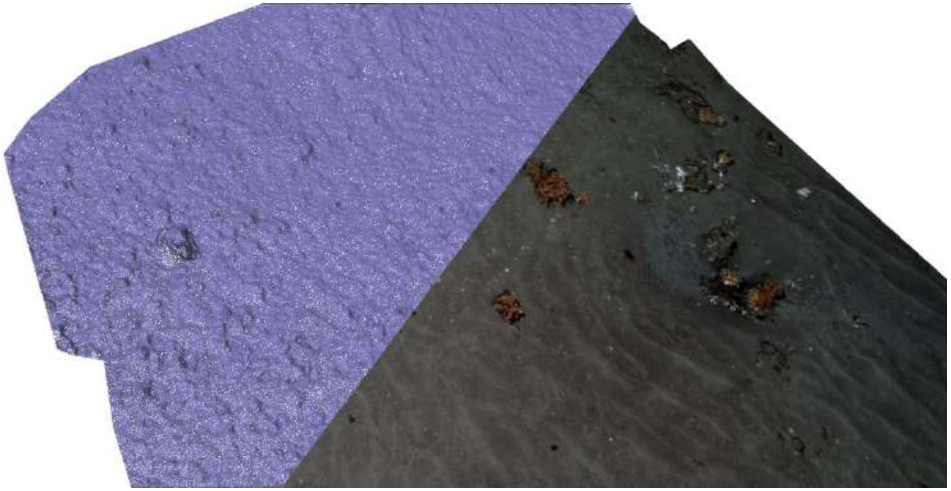




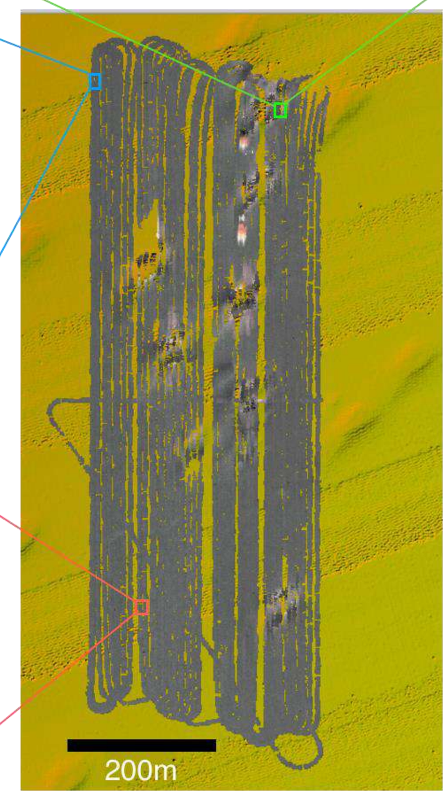
Structure from motion photogrammetry

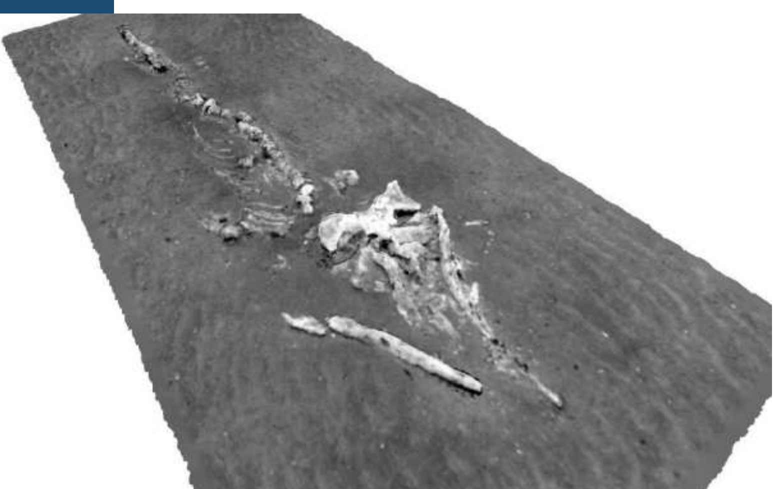
UNIVERSITY OF Southampton





16 September 2019:
24h Autosub Biocam survey
@5m altitude:
350mx900m 3D photomosaic
42000 picture pairs





How to map marine litter?

1. Observe
   - Optical mapping: detail, but lacks coverage
     - Photographs
     - Video
     - Hyperspectral camera
   - Acoustic mapping: coverage, but lacks detail
     - Ultra-high resolution multibeam
     - High-resolution sidescan sonar
     - Synthetic Aperture sonar

Autonomous technology & Automated interpretation techniques

2. Predict (extrapolate observations)
   - Deterministic/mechanistic modelling
   - Statistical distribution modelling
     - GAMs, GLMs,…
   - Machine learning & artificial intelligence
     - Random Forest
     - Distributed Neural Networks

National Oceanography Centre

Thank you!
Any questions?

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CLASS
CLIMATE LINKED ATLANTIC SECTOR SCIENCE

erc
CODE MAP

MAREMAP
Marine Environmental Mapping Programme

Making Sense of Changing Seas

NOC MAIL

MarGnet mid-term Scientific meeting REPORT

Annex 5

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Co-funded by the European Maritime and Fisheries Fund

marGnet

Mid-term scientific meeting

15 February 2020
Venice
Italy

Modelling of marine litter hotspots on the sea-floor

Isabel Jalón-Rojas

CNRS - UMR5805 EPOC

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cnrs

Background and challenges

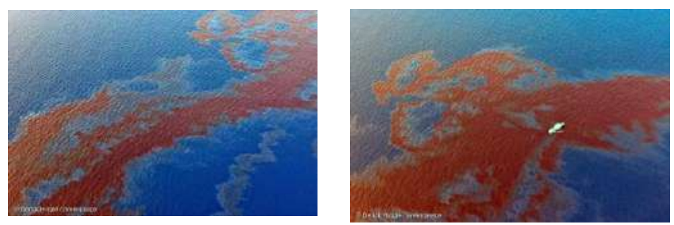
Importance

To understand the trajectory and accumulation patterns
- ‘fill in the gaps’ between observations
- test the hypothesis about particles behaviour and transport trends

Approaches

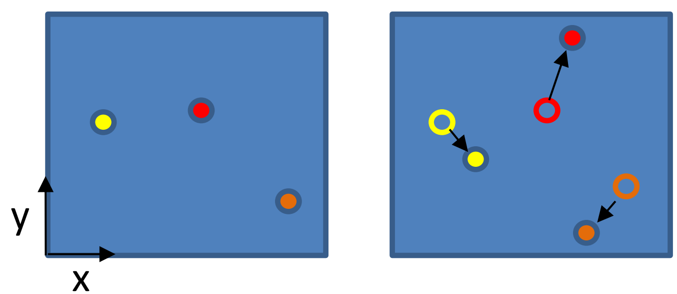
time t | *time t+Δt*

Eularian approach
(changes in concentration)



$$\frac{\partial c}{\partial t} + \mathrm{U}\frac{\partial c}{\partial x} = K\frac{\partial^2 c}{\partial x^2}$$

Lagrangian approach
(changes in particles position)



$$X(t+\boldsymbol{\Delta} t) = X(t) + U\,\boldsymbol{\Delta} t + R\sqrt{\mathbf{2K\Delta t}}$$

Background and challenges

Importance

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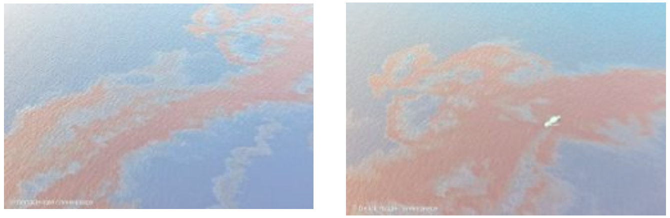

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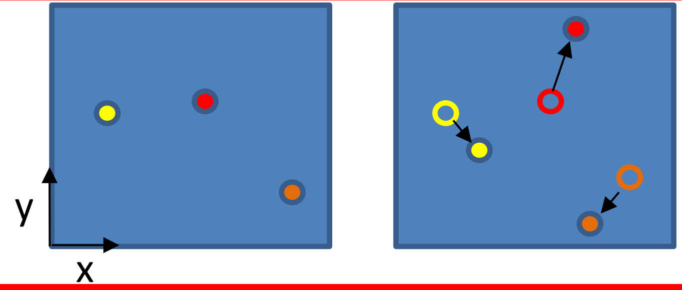

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Background and challenges

Lagragnian approach

$$X(t+\Delta t) = X(t) + \underbrace{U\,\Delta t}_{advection} + \underbrace{R\sqrt{2K\Delta t}}_{dispersion}$$

$\overline{X}=(x,y,z)$	Position
$\overline{U}=(u,v,w)$	Velocity field
$K=(K_h,K_v)$	Dispersion coefficient
$R=[0\text{-}1]$	Random number

Background and challenges

Lagragnian approach

$$X(t+\Delta t) = X(t) + \overbrace{U\Delta t}^{advection} + \overbrace{R\sqrt{2K\Delta t}}^{dispersion}$$

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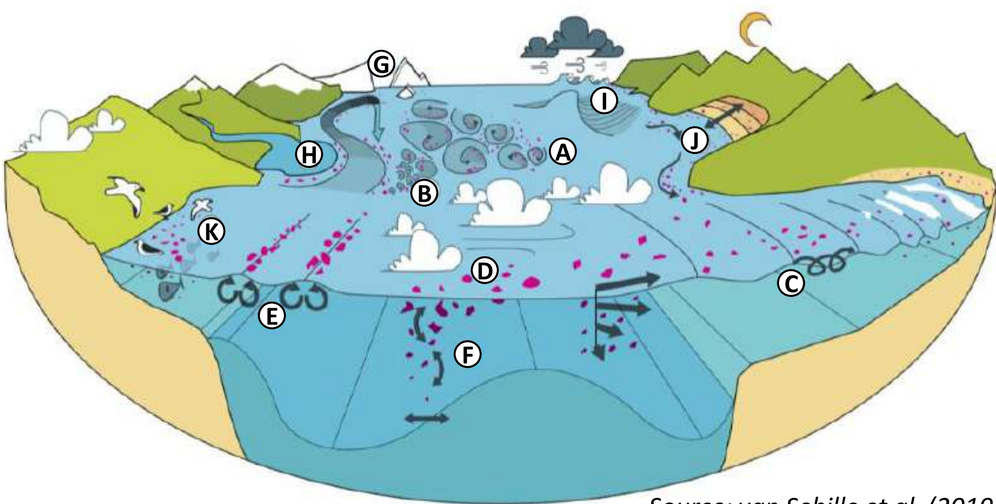
PHYSICAL PROCESSES

A	Large-scale open ocean processes
B	Submesoscale open ocean processes
C	Open ocean Stokes drift
D	Direct wind transport (windage)
E	Langmuir circulation
G	Ice formation, melting and drift
H	River plumes and coastal fronts
I	Coastal currents, surface waves and beaching
J	Extreme events
K	*Transport by organisms*

Hydrodynamic numerical model

(e.g. FVCOM, ROMS, POM, HYCOM, etc.)



Source: van Sebille et al. (2019)

Background and challenges

Lagragnian approach

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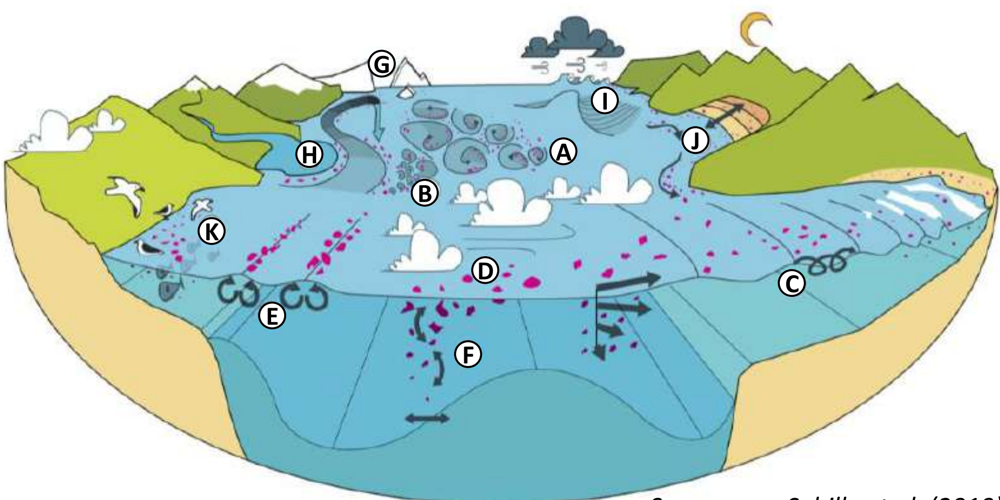
Ocean General Circulation Model (OGCM)

(e.g. FVCOM, ROMS, POM, HYCOM, etc.)

F Horizontal dispersion and vertical mixing

Observations
OGCM



Source: van Sebille et al. (2019)

Background and challenges

Challenge 1: Modelling all the significant ocean physical processes (validated OGCM)

PHYSICAL PROCESSES

A Large-scale open ocean processes
B Submesoscale open ocean processes
C Open ocean Stokes drift
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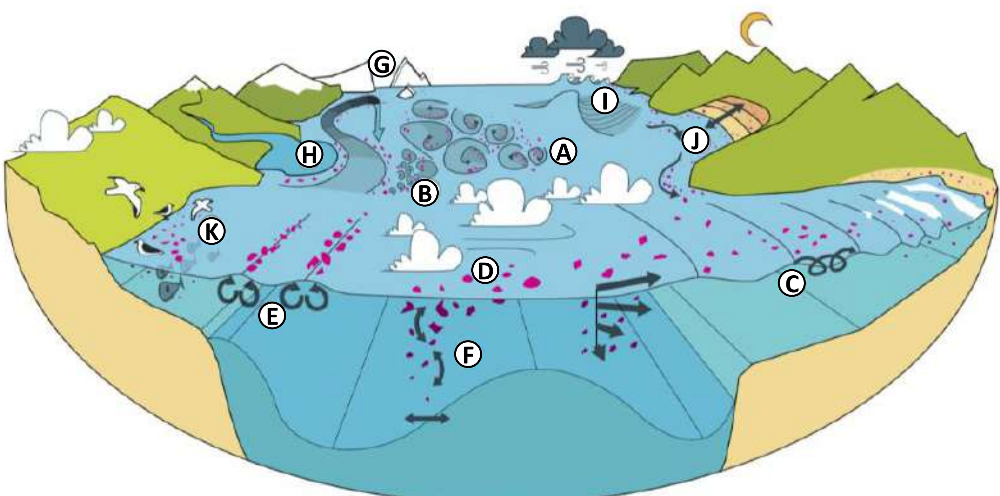


Source: van Sebille et al. (2019)

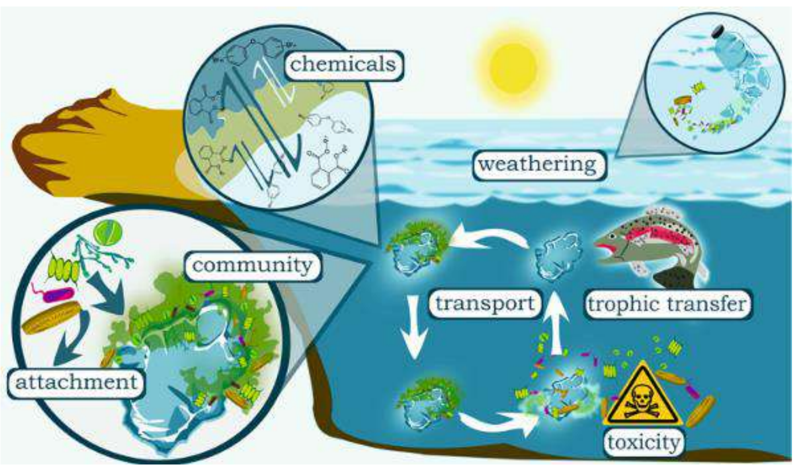
Background and challenges

Lagragnian approach

$$X(t+\Delta t) = X(t) + \underbrace{U\,\Delta t}_{\textit{advection}} + \underbrace{R\sqrt{2K\Delta t}}_{\textit{dispersion}}$$

→ **Not enough!**

The complex behaviour of microplastics



Rummel et al (2017)

Density, size shape

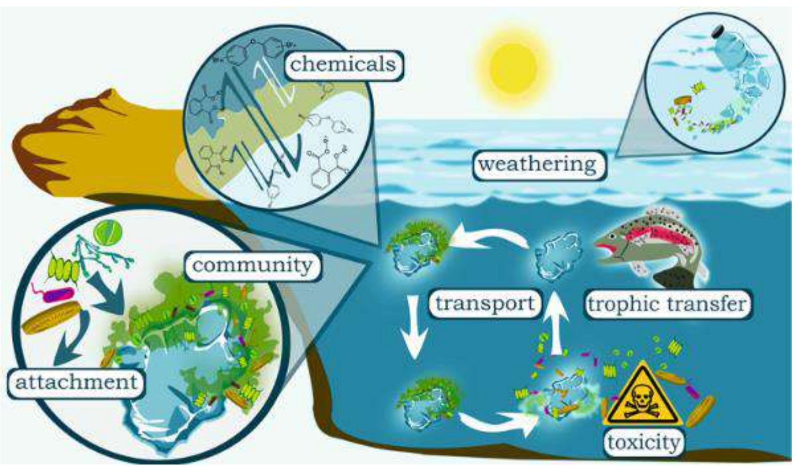
- **Settling**
- Resuspension
- Beaching

- Adhesion of molecules
- Aggregation with particles
- Biofouling
- Weathering/Degradation

Background and challenges

Challenge 2: Modelling the ML behaviour and all the significant transport processes (validated transport model)

The complex behaviour of microplastics



Rummel et al (2017)

Settling
Resuspension
Beaching

Density, size shape

Adhesion of molecules
Aggregation with particles
Biofouling
Weathering/Degradation

State of art: 2D numerical modelling

Challenge 1: Modelling all the significant ocean physical processes (validated OGCM)

Challenge 2: Modelling the ML behaviour and all the significant transport processes (validated transport model)

Most numerical studies/models

(a) Marine litter = buoyant passive particles

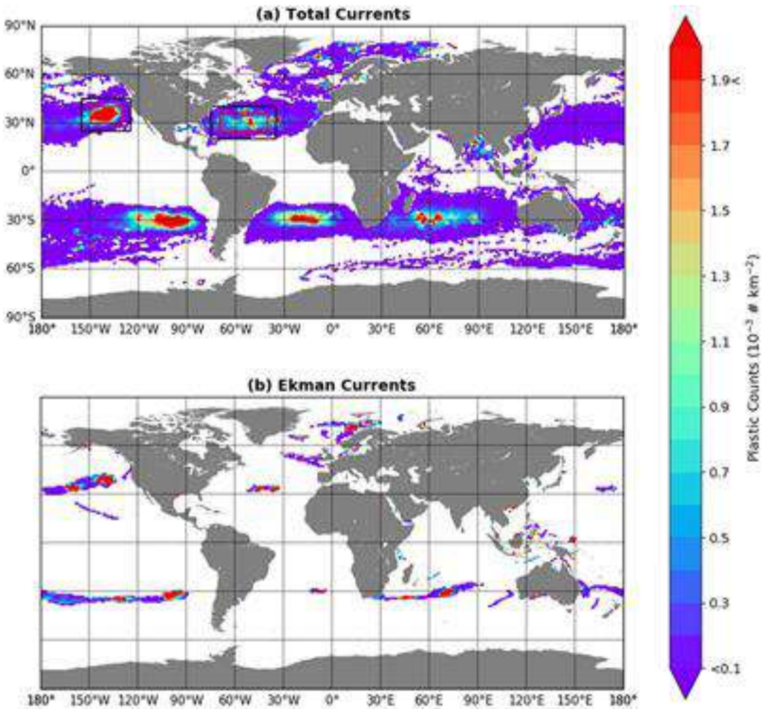
NO VERTICAL OCEAN PROCESSES
(2D modelling of hydrodynamics)

NO BEHAVIOUR

NO BED TRANSPORT PROCESSES
(2D modelling of ML transport)

(b) Particle tracking model + specific OGCM model

NO FLEXIBLE



e.g. Onik et al. (2019)

Recent progress: 3D numerical modelling

Challenge 1: Modelling all the significant ocean physical processes (validated OGCM)

Challenge 2: Modelling the ML behaviour and all the significant transport processes (validated transport model)

Most numerical studies/models

(a) Marine litter = buoyant passive particles

NO VERTICAL OCEAN PROCESSES
(2D modelling of hydrodynamics)

NO BEHAVIOUR

NO BED TRANSPORT PROCESSES
(2D modelling of ML transport)

(b) Particle tracking model + specific OGCM model

NO FLEXIBLE

TRACKMPD (Jalón-Rojas et al., 2019)

(a) Marine litter has physical properties

VERTICAL OCEAN PROCESSES
(2D modelling of hydrodynamics)

BEHAVIOUR

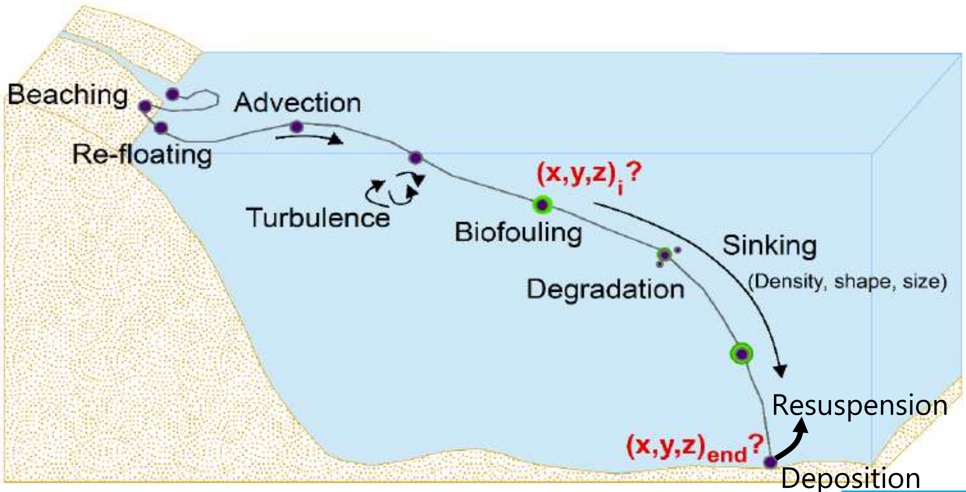
BED TRANSPORT PROCESSES
(3D modelling of ML transport)

(b) Compatible with different OGCM
(e.g. POM, FVCOM, MOHID, TELEMAC)

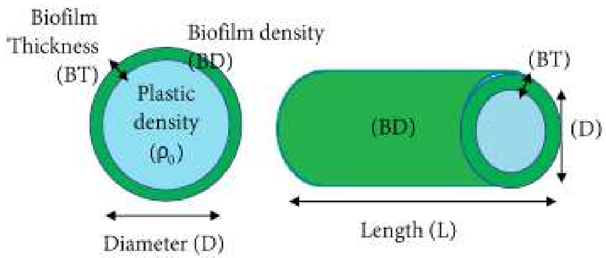
FLEXIBLE
User-friendly

Recent progress: 3D numerical modelling

TrackMPD (Jalón-Rojas et al., 2019)



- Advection
- Horizontal dispersion
- Vertical mixing
- Beaching
- Washing-off
- Sinking
  - Macrodebris/Microplastics: setting velocity
    - Constant
    - Increasing rate (e.g. biofouling)
  - Microplastics: estimated settling velocity (drag model)
    - Density
    - Size
    - Shape
    - Degradation
    - Biofouling

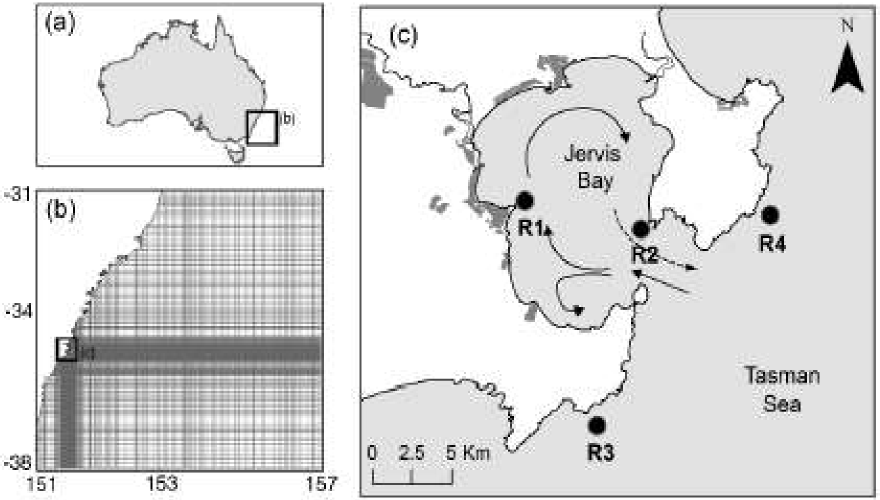


- Resuspension/Deposition (testing version! Soon on GitHub!)

Recent progress: 3D numerical modelling

Research Question: how do the physical properties of particles and bio-physical processes affect the transport and fate of microplastics ?

SENSITIVITY ANALYSIS (Jalón-Rojas et al., 2019)



- Jervis Bay (SE Australia)
- POM hydrodynamic outputs
  - Simulation period characterized by the typical circulation pattern (Sun et al., 2017)
- 4 seeding locations
- Tens particles at each seeding location
- 12 days simulation

Recent progress: 3D numerical modelling

Research Question: how do the physical properties of particles and bio-physical processes affect the transport and fate of microplastics?

44 scenarios

Control scenario: passive particles (only advection-dispersion)

Each scenario represents the impact of one model parameter with one value

Parameters represent potential values referred to in the literature

Process/Behaviour		Model parameter	
Advection		-	
Dispersion	Horizontal dispersion	Horizontal dispersion coefficient	(K_h, $m^2 s^{-1}$)
	Vertical dispersion	Vertical dispersion coefficient	(K_v, $m^2 s^{-1}$)
Re-floating/Beaching		Particles half-live on land before re-floating	(Tw, days)
Sinking/ Behaviour	Physical properties	Density	(ρ, $g\ cm^{-3}$)
		Shape	
		Size	(D or L, mm)
	Biofouling	Biofouling Thickness	(BT, $g\ cm^{-3}$)
		Biofouling Density	(BD, $g\ cm^{-3}$)
		Biofouling Rate	(BR, mm/days)

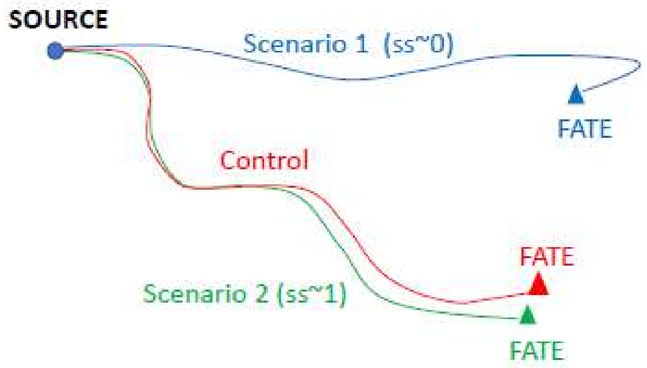
Recent progress: 3D numerical modelling

Sensitivity analysis

Impact of each parameter –> Comparison of trajectories of each scenario with the trajectories of the control scenario

(1) Visual and descriptive comparison of trajectories and fate

(2) Dimensionless dynamical skill score (ss) (Liu and Weisberg, 2001)



ss →0 bad agreement between with the control scenario → **High impact of the parameter value**
ss →1 good agreement with the control scenario → **No impact of the parameter value**

Recent progress: 3D numerical modelling

Relative impact of physical processes

Sinking/Behaviour ss=0.01-0.68 >Impact **Turbulent dispersion** ss=0.37-0.92 >Impact **Re-floating** ss=0.81-0.99

Polymer Density ss=0.01-0.64 spheres ≈cylinder ≈Impact **Size** ss=0.01-0.64 spheres ≠ cylinder ≈ Impact **Biofouling parameters** ss=0.01-0.68 spheres ≈ cylinder

Recent progress: 3D numerical modelling

Relative impact

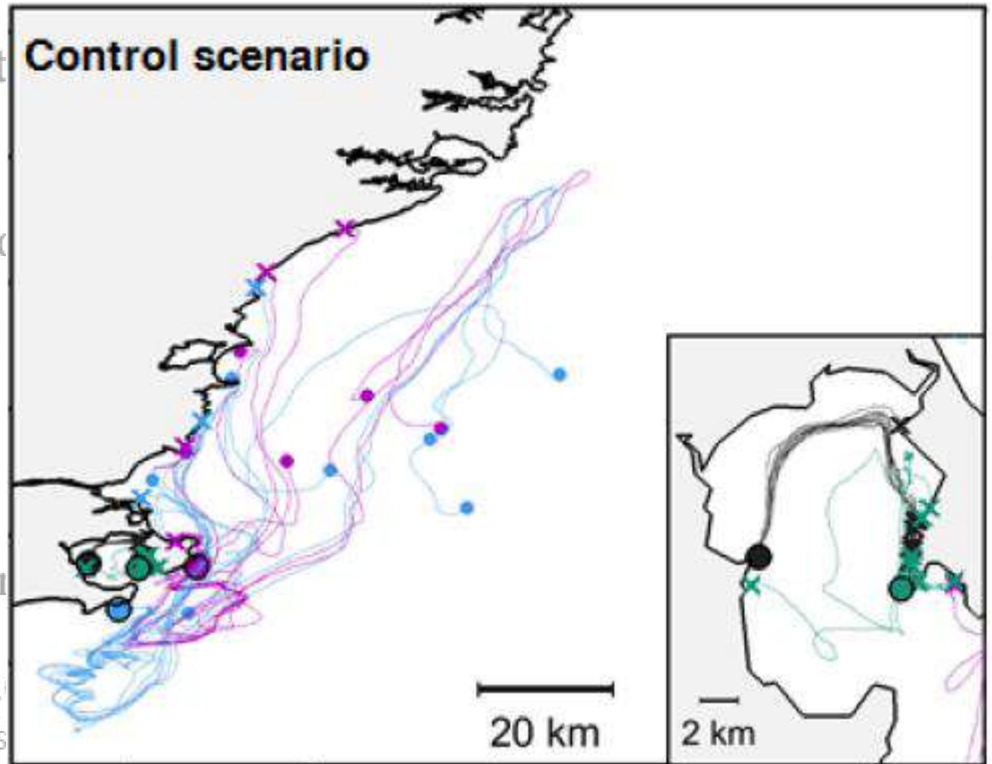
Sinking/Behavi

ss=0.01-0.68

Poly

ss=0.

spheres



Re-floating

ss=0.81-0.99

Biofouling parameters

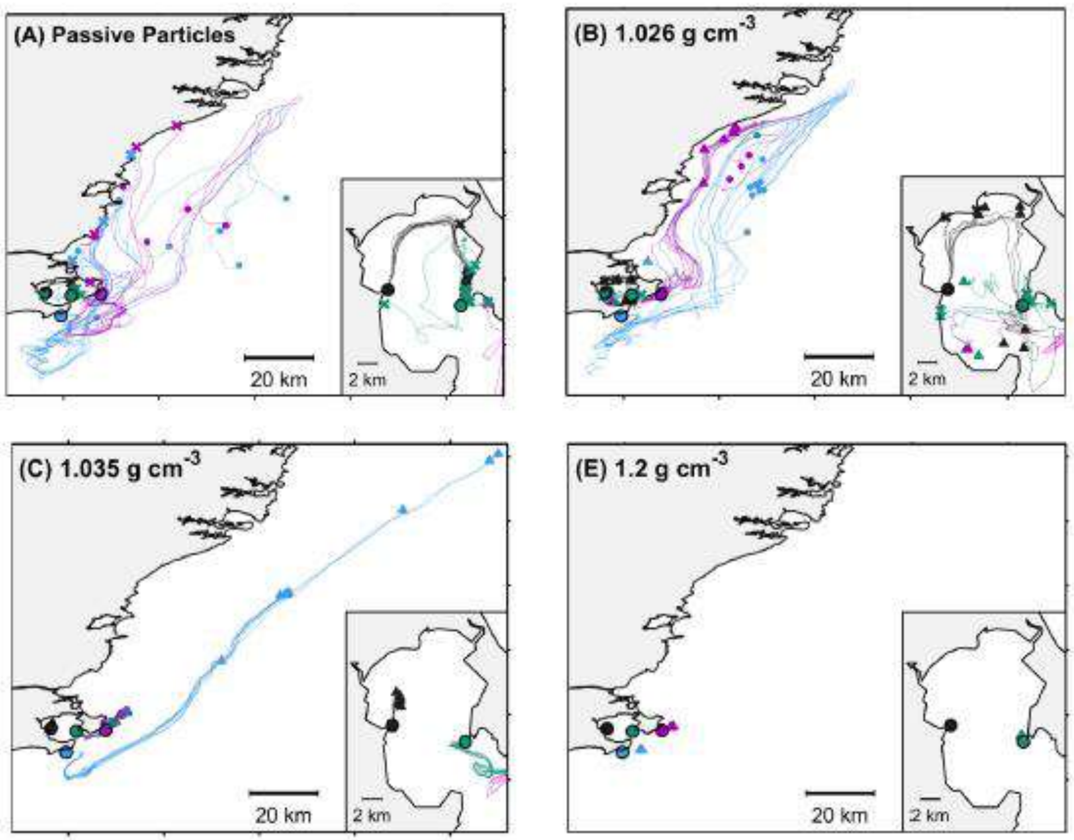
ss=0.01-0.68

spheres ≈ cylinder

Recent progress: 3D numerical modelling

Impact of density (sphere)

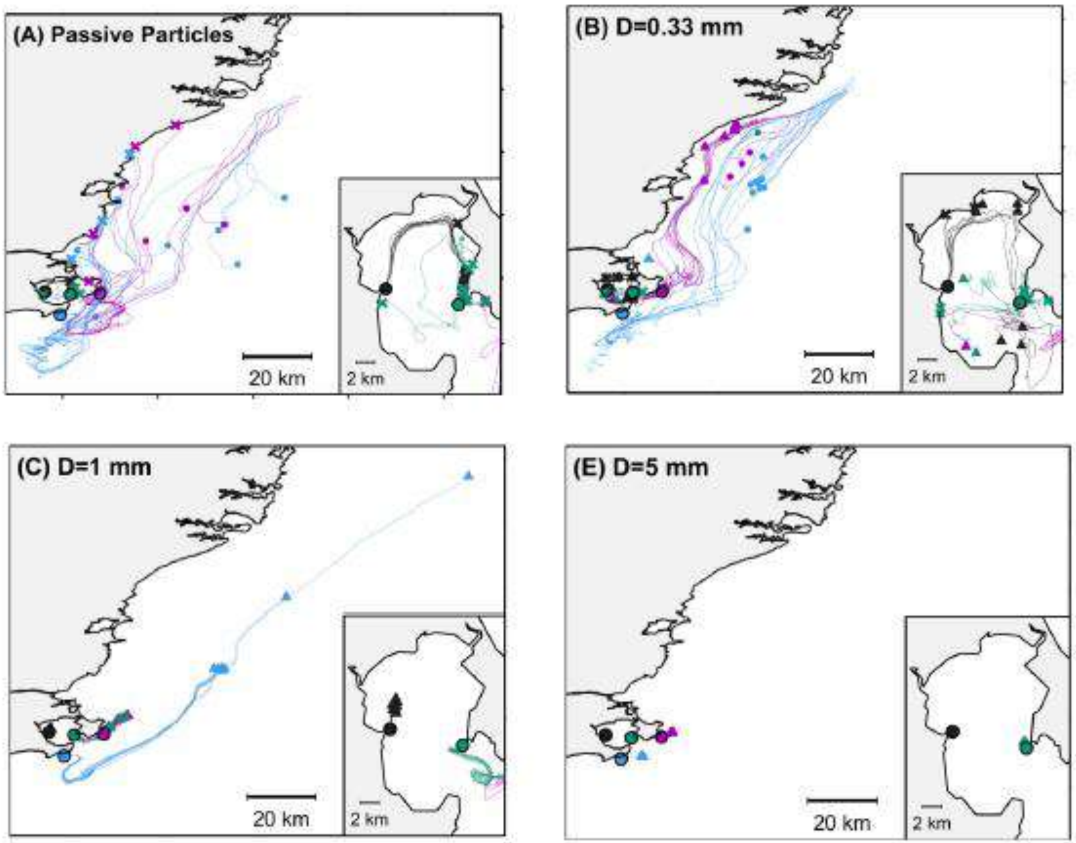
Control scenario



Recent progress: 3D numerical modelling

Impact of size (spheres)

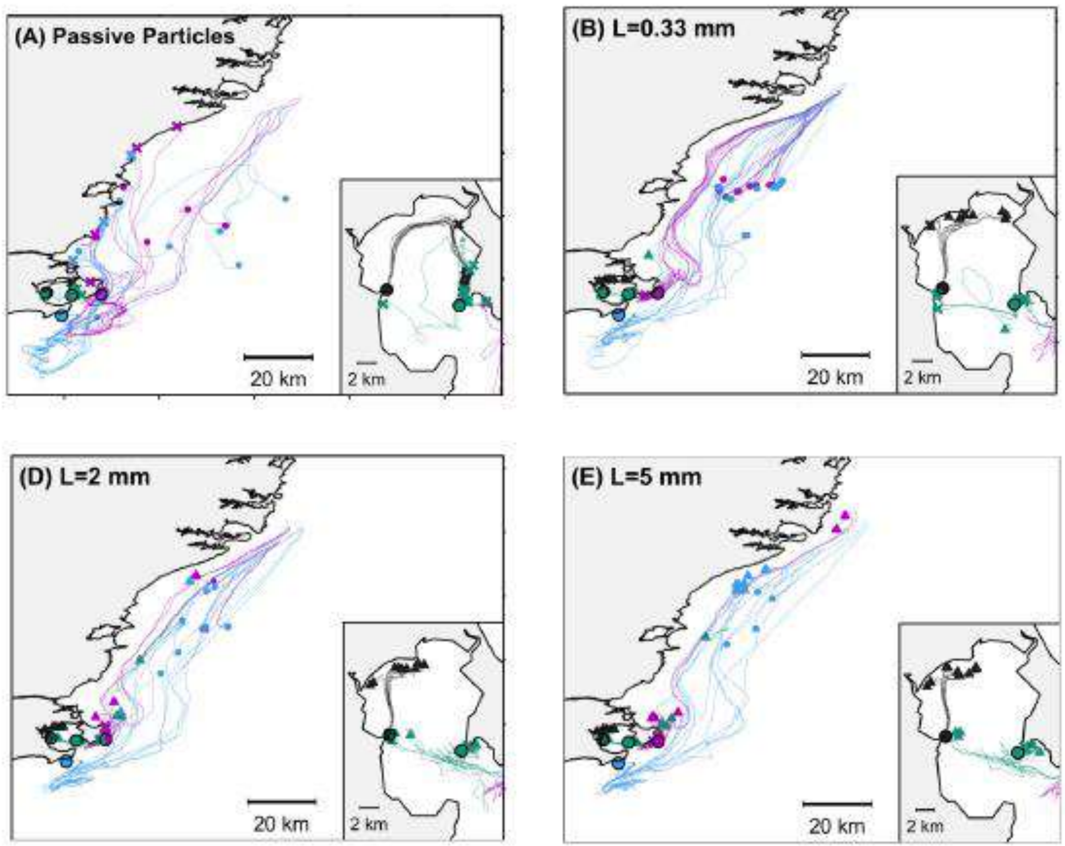
Control scenario



Recent progress: 3D numerical modelling

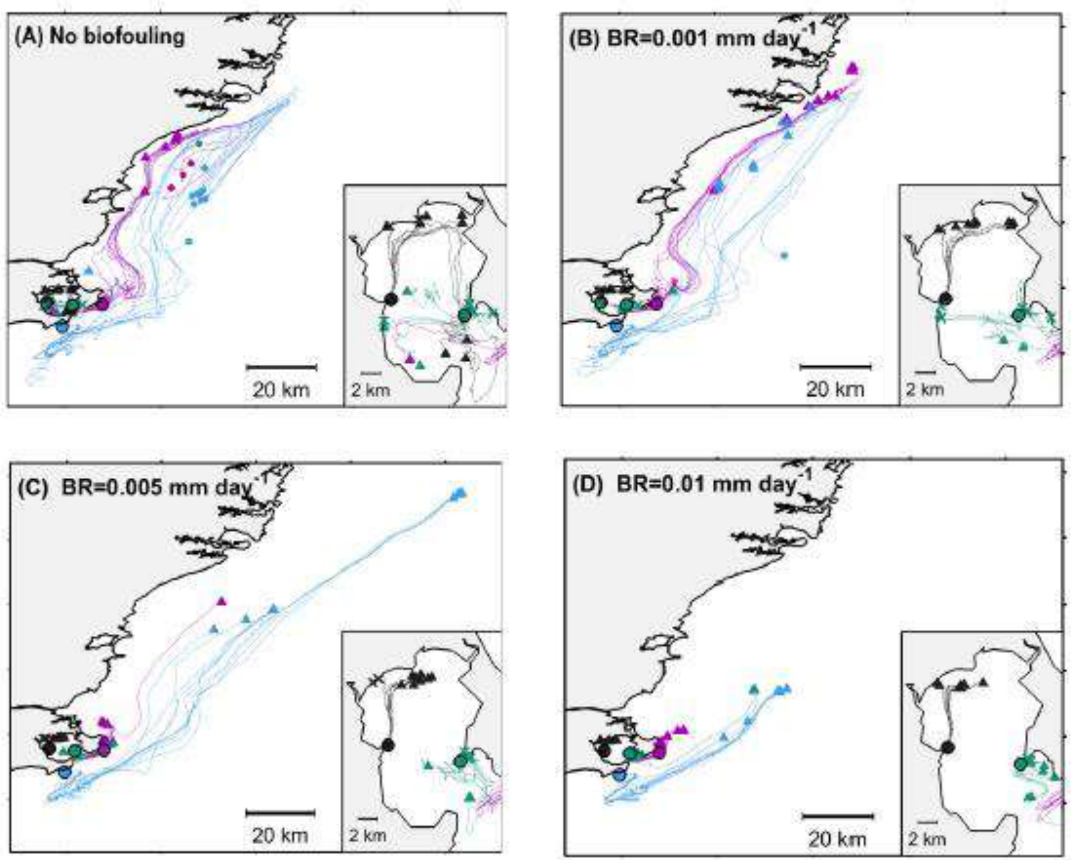
Impact of size (cylinder)

Control scenario



Recent progress: 3D numerical modelling

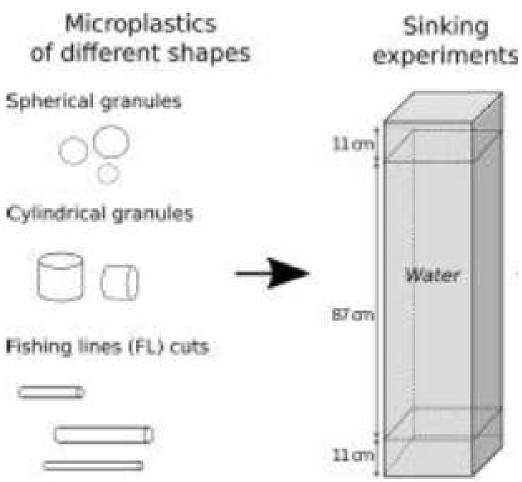
Impact of biofouling: biofilm rate



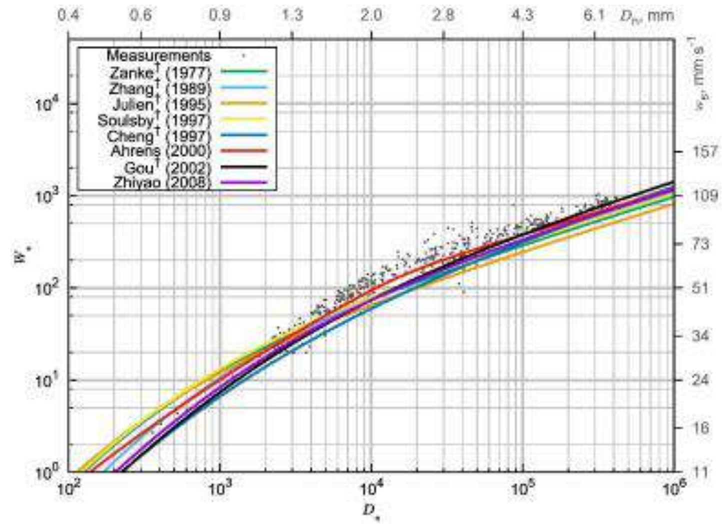
Recent progress: experimental research

Settling/Raising velocity

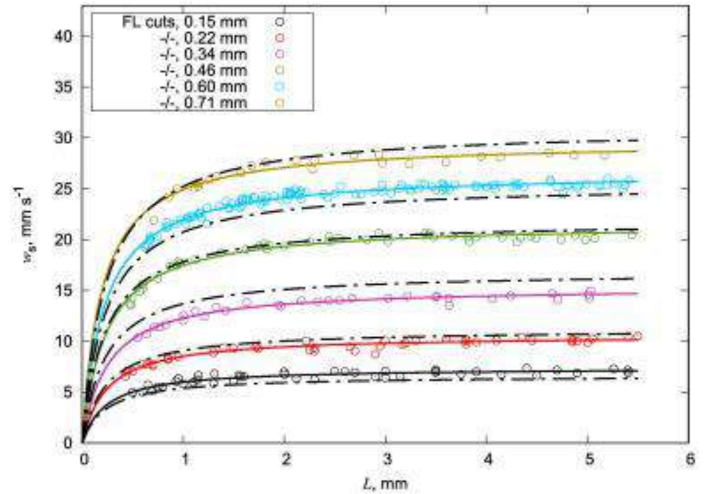
Khatmullina and Isochenko (2017)



Spheres/short cylinders: good correlation



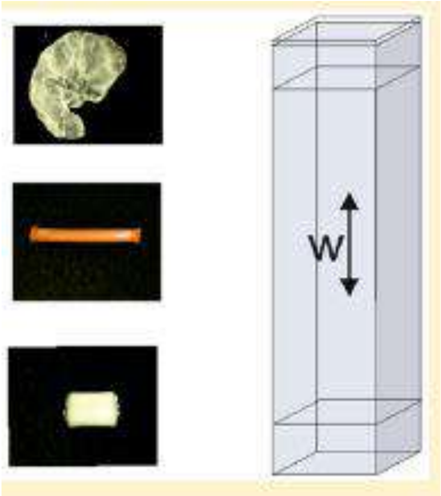
Long cylinders: new formulation

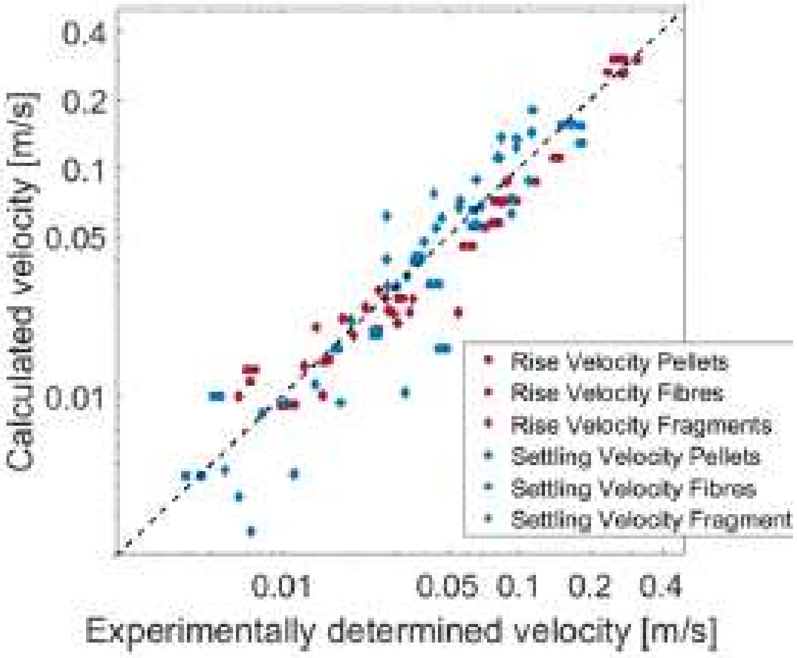


Recent progress: experimental research

Settling/Raising velocity

Waldschläger and Schüttrumpf (2019)





Recent progress: experimental research

Resuspension

Erosion chamber : bed shear stress (*Ballent et al., 2012*)

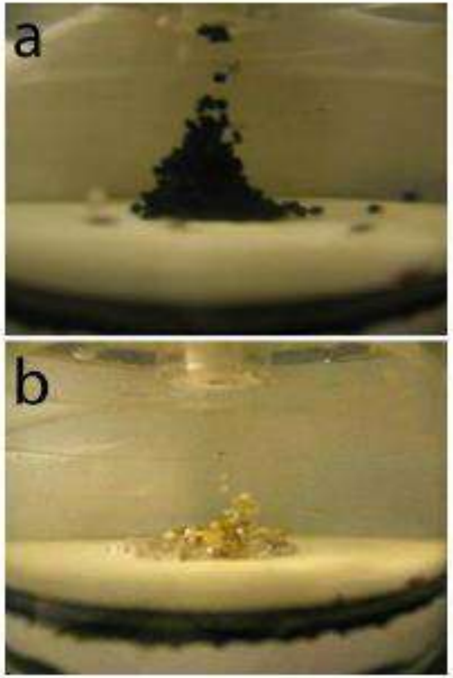


Fig. 6. (a) HD black pellets and (b) HD opaque/transparent pellets in erosion chamber each during step 7 ($\tau = 0.18\,\mathrm{N\,m^{-2}}$) of replicate run 4. Still image extracted from video recording.

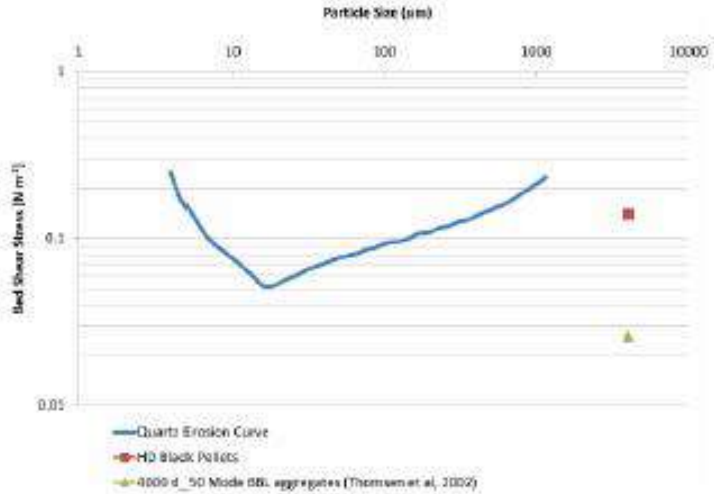


Fig. 11. The critical bed shear stress erosion curve for quartz relates particle (sediment) size to critical shear stress, τ_{cr}, and includes average diameter (d_{50}) 4 mm benthic boundary layer aggregate data point (Thomsen et al., 2002). The mean HD black pellet size ($d_{50} \sim 4$ mm) and τ_{cr} is plotted over the curve for comparison of aggregate and plastic erosional behavior.

Needs and challenges for modelling ML hotspots on the sea-floor

Needs		**Challenges**
- 3D modelling of ocean currents	→	Modelling complex physical processes (e.g. Langmuir circulation)
- 3D particle-tracking model	→	Computational time
- Parametrize sinking behaviour	→	In-situ measurements? Drag model for macro debris? Universal or local drag models?
- Parametrize Biofouling	→	Formulations for macro debris?
	→	Variability at different time scales?

Mid-term scientific meeting

Modelling of marine litter hotspots on the sea-floor

15 February 2020
Venice
Italy

Thank you for your attention!

¡Gracias!   Grazie!

Isabel Jalón-Rojas

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MarGnet mid-term Scientific meeting REPORT

Annex 6

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ISMAR
BLUE WORLD INSTITUTE
SINTOL
LAGUNA PROJECT
techneprojects GROWING UP PROJECTS
Co-funded by the European Maritime and Fisheries Fund

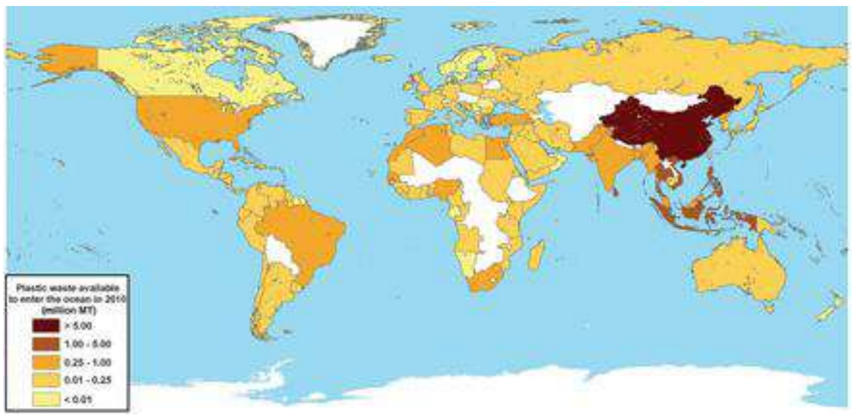
marGnet mid-term Scientific Meeting
Recycling & Policy Working Group

Gian Claudio Faussone

5th of February 2020, Venice, Italy
Institute of Marine Sciences - CNR-ISMAR

Co-funded by the European Maritime and Fisheries Fund

Plastic flowing into the Oceans: waste mismanagement



275 million metric tons (MT) of plastic waste was generated in 192 coastal countries in 2010, with 4.8 to 12.7 million MT entering the ocean*.

From 32 to 86 MBOE (barrel oil equivalent) flowed into the sea in 2010: an equivalent of 2 to 5 Billion USD value

Without waste management infrastructure improvements, the cumulative quantity of plastic waste available to enter the ocean from land is predicted to increase by an order of magnitude by 2025

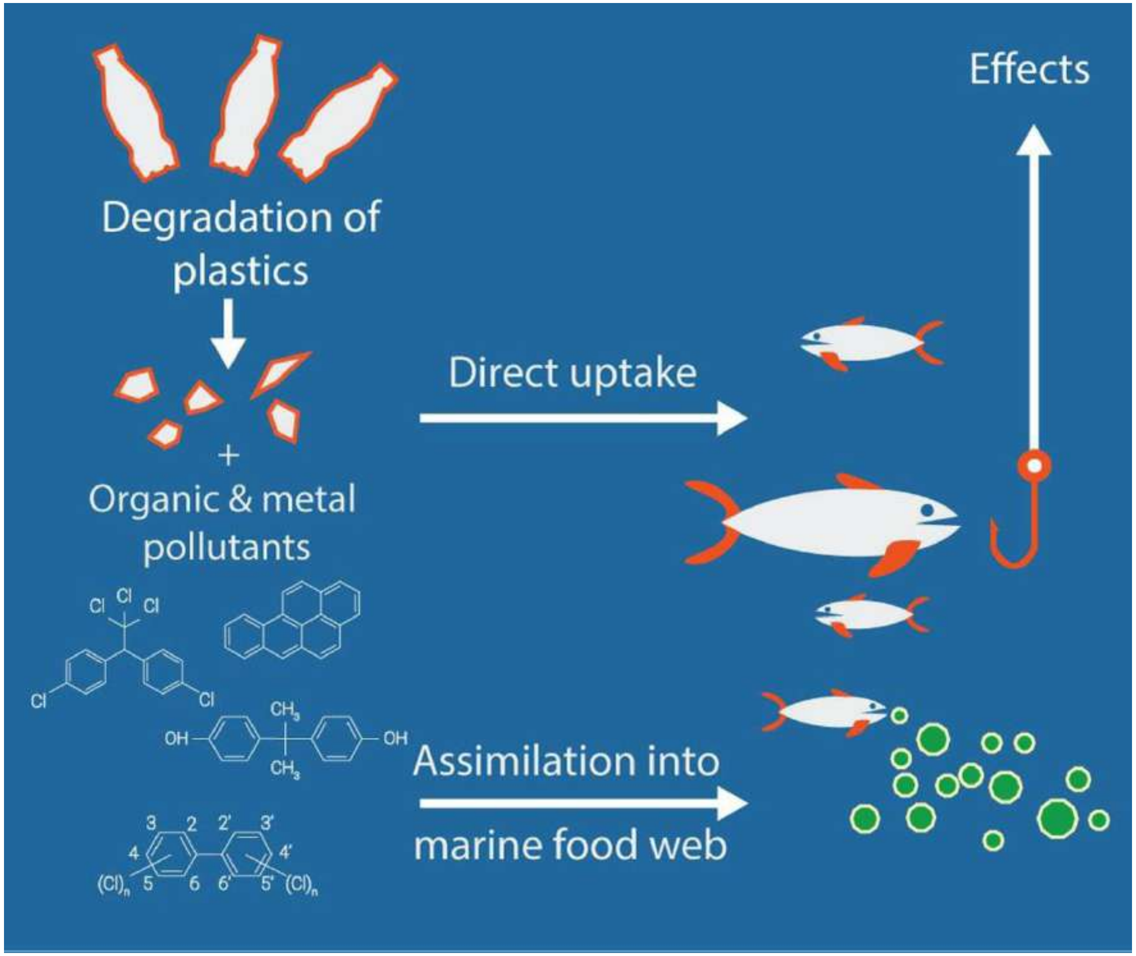
**Jambeck, Jenna R., et al. "Plastic waste inputs from land into the ocean." Science 347.6223 (2015): 768-771.*

Plastics in the Oceans: wide family

- Floating or stranded macroplastics (PE, PP)
- Ghost nets, fishing gears, acquaculture (nylon, PE)
- Plastic debris from few µm to few mm (microplastics)
- Sunk plastics (thermosets, resins, etc..)

- Contaminated feedstock difficult to recover and recycle
- It is litterally a sunk cost

Direct and indirect ecotoxicology



All plastic is generated on land

In 2015, 4.1 million tons of plastic "bags, sacks, and wraps" were generated (including PS, PP, HDPE, PVC, & LDPE) in USA with a recycling rate of just 12.8%*

In 2016, 27,1 million tons of plastic waste were reclaimed in EU with a recycling rate of 31%**

The Gulf of Mexico contains some of the highest concentrations of microplastics worldwide, with the majority of which being plastic microfibers. Researchers hypothesize the large drainage basin of the Mississippi River, which outflows into the Gulf, is the main transporter of land based plastics***

*US EPA. 2018. Advancing Sustainable Materials Management 2015 Tables and Figures: Assessing Trends in Material Generation, Recycling, Composting, Combustion with Energy Recovery and Landfilling in the United States. Pp. 9

**PlasticsEurope report 2018

***Abundant plankton-sized microplastic particles in shelf water of the northern Gulf of Mexico, Rosana Di Mauro, Matthew J. Kupchik, and Mark C. Benfield, Environmental Pollution November 2017: 230, 798-809.

Recycled plastic's fate

31.1 % Recycled*

ARE WE SURE ??

37% outside EU

63% inside EU

Malaysia
Plastic pollution: One town smothered by 17,000 tonnes of rubbish
By Yvette Tan
BBC News, Jenjarom
February 13, 2019

America's grungy 'recycled' plastic is creating wastelands in Asia
PRI's The World
June 13, 2019 · 9:00 AM EDT
By Patrick Winn

Greenpeace After 'The Recycling Myth' Report: Updates from the Field
Kedah
April 18, 2019

*Sources: PlasticsEurope report 2018

Main problems to address

- **Technical challenge to recycle ML**
- Mechanical recycling cannot be widely applied to ML -and in most cases also to terrestrial-: (need for washing, cleaning, etc..)
- Large volume solutions required: not to shift one problem to another
- **Economic challenge**
- How to create value ? «Circular Economy» concept set by EU
- **New challenges:**
- 700,000 fibers could be released from an average 6 kg wash load of acrylic fabric (Napper et al, 2016)

- Besides prevention, **making fuel is part of the answer today** (chemical recycling)

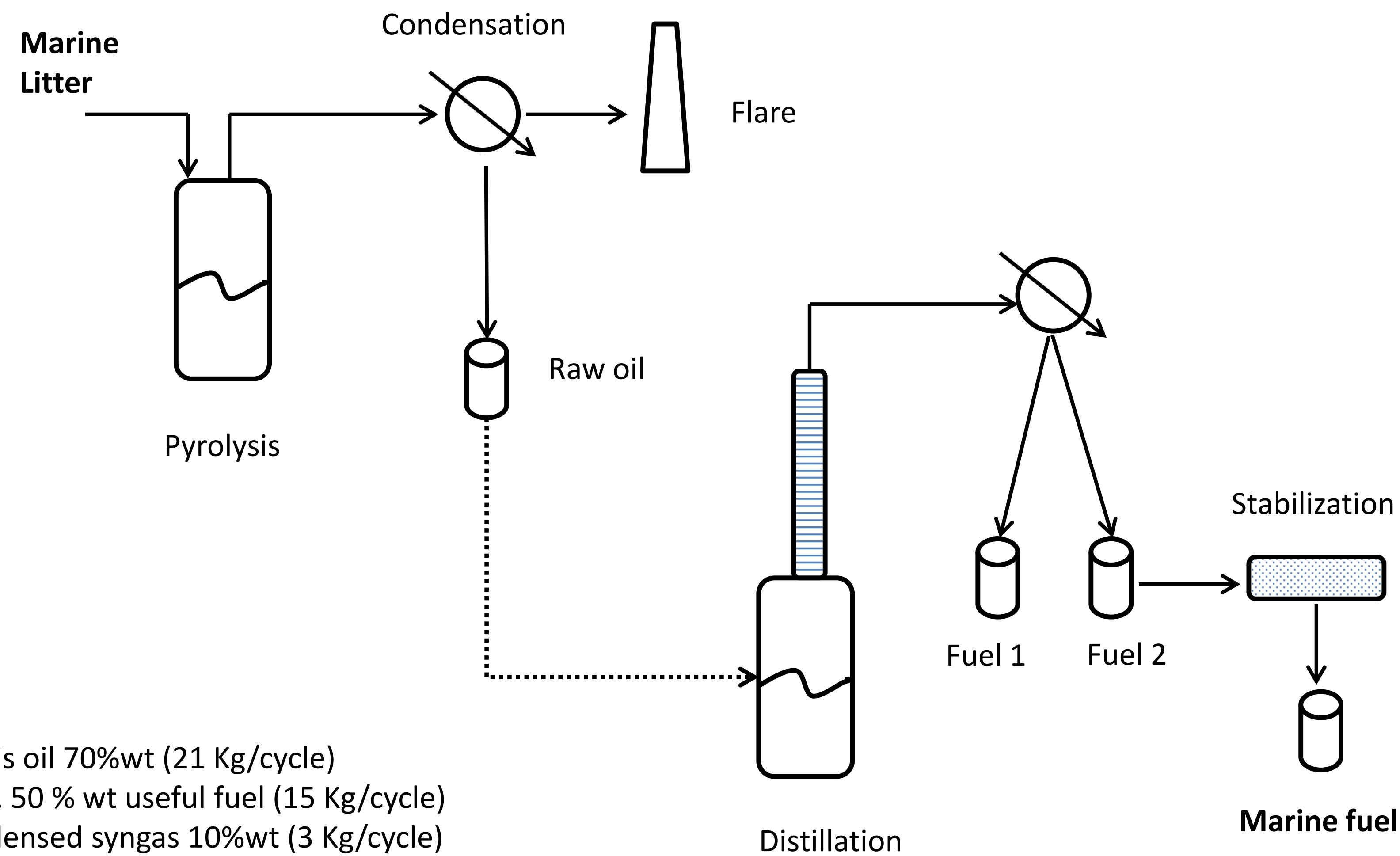
marGnet WP4: recycling

Marine Litter

Global annual marine fuel demand is >400 Mton

Marine Fuel

Low temperature pyrolysis



- Pyrolysis oil 70%wt (21 Kg/cycle)
- Approx. 50 % wt useful fuel (15 Kg/cycle)
- Uncondensed syngas 10%wt (3 Kg/cycle)
- Char (solid residue) 20%wt (6 Kg/cycle)

Produced fuel* (expected)

Parameter	Value	Unit	Limits ISO 8217	
			DMA (ECAs)	DMB (ECAs)
Cetane number	60.7	--	--	--
Cetane index	66.7	--	--	--
Density @ 15 °C	802.7	kg/m^3	<890	<900
S	42.9	mg/kg	<10000 (1000)	<10000 (1000)
Flash point	48	°C	>60	>60
Carbon residue	0.05	% (w/w)	<0.3	<0.3
Ash	<0.005	% (w/w)	<0.01	<0.01
Lubricity @60 °C (HFRR)	276	µm	<520	<520
Cinematic viscosity @40C	2.3	mm^2/s	>2; <6	>2; <11
Pour point	-6	°C	0	6
% recovered @ 250C	36.3	% (V/V)	--	--
% recovered @ 350C	93.8	% (V/V)	--	--
95 % (V/V)	354.5	°C	--	--

<u>Marine Gas Oil (DMA) average quotation (Sept. 24 2019): 672,5 USD/ton **</u>

Low S fuel demand growing due to IMO ANNEX VI: max 1000 ppm ECAs areas

*Values obtained by processing unsorted plastic waste mined from landfill

**source: Ship&Bunker.com

Produced fuels

WP4 year 2: testing

- Analysis of fuel and yield
- Gaseous emission analysis
- Solid residues characterization
- CO2 equivalent impact
- *Demonstrate the feasibility →promote virtuous behavior of third parties*

WP4 year 2: testing (Jan 2020)

WP4 year 2: testing (Jan 2020)

Take home message

- Fuels production is a pragmatic approach to deal with ML today:
  - Circular economy concept and value generation
  - Marine fuel market volume matches available feedstock
  - Sustainable: depollution cycle w/o public subsidies
- Fuel's quality: low S fuels
  - Meet environmental policies at no extra cost
- **If feasibility is proven: trigger depollution practice**

Acknowledgment

marGnet has received funding from the European Union’s EASME-EMFF funding program – Sustainable Blue Economy Call under agreement n. EASME/EMFF/2017/1.2.1.12/S2/05/SI2.789314

Thank you!

“There could be more plastic than fish in the ocean by 2050”*

Gian Claudio Faussone
gianclaudio@sintol.it

www.margnet.eu

Sewage surfer © Justin Hofman. Wildlife Photographer of the Year 2017
*Ellen MacArthur Foundation, World Economic Forum Dec.2017

MarGnet mid-term Scientific meeting REPORT

Annex 7

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MarGnet mid-term Scientific meeting
Mapping and removing working group

Fantina Madricardo (CNR – ISMAR Venice, Italy)

EASME/EMFF/2017/1.2.1.12/S2/05/SI2.789314

Sustainable Blue Economy: Marine Litter

5th of February 2020, Venice, Italy

www.margnet.eu

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LAGUNA PROJECT

techneprojects GROWING UP PROJECTS

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MAPPING&REMOVING

- What are the best methods to map the presence of the litter on the seafloor?

- What are the methods to remove it?

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MAPPING

- What do you think of the results presented?
- Is there anyway we could improve them?
- Further questions about the marGnet experiment?

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REMOVING

- It is very costly and the legislation currently does not allow the collection and disposal
- The possibility of using trawling is enviromentally sustainable?
- What is the way forward?

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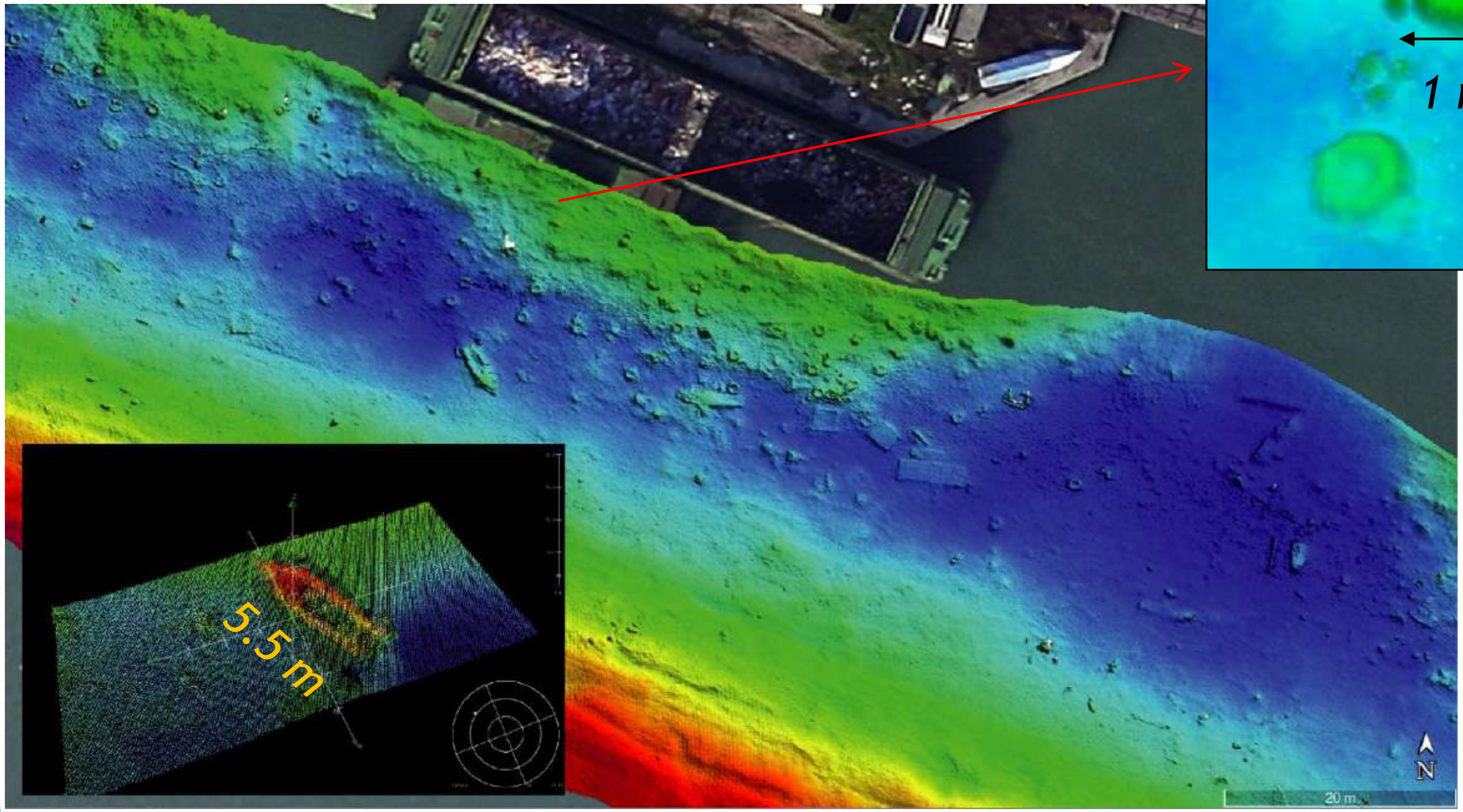
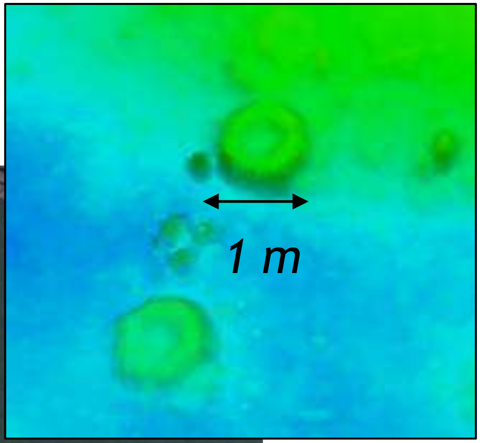
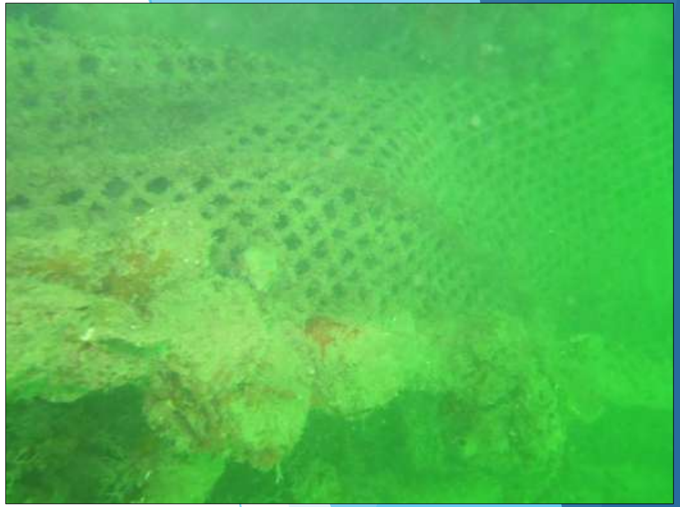
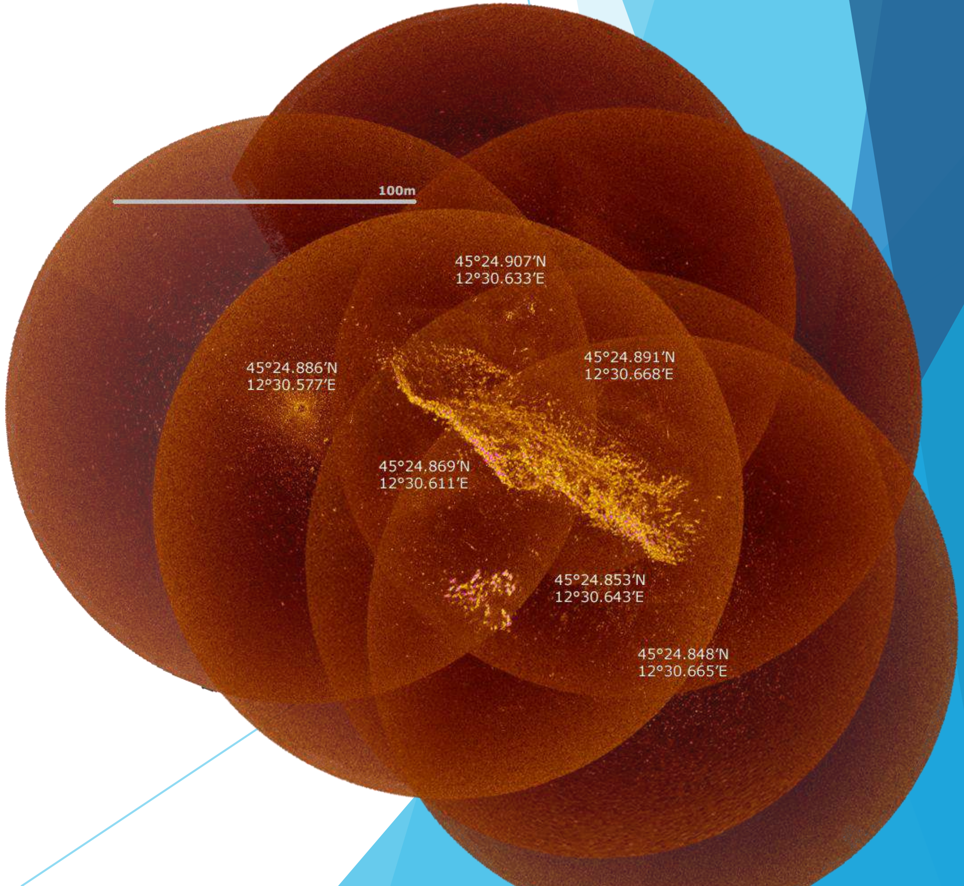
ACOUSTIC AND VIDEO MONITORING









Field experiments for acoustic data calibration (M4-M10)

Co-funded by the European
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FIELD EXPERIMENTS

- To measure sinking velocity for modelling
- To assess the potential of acoustic instruments to detect litter and nets
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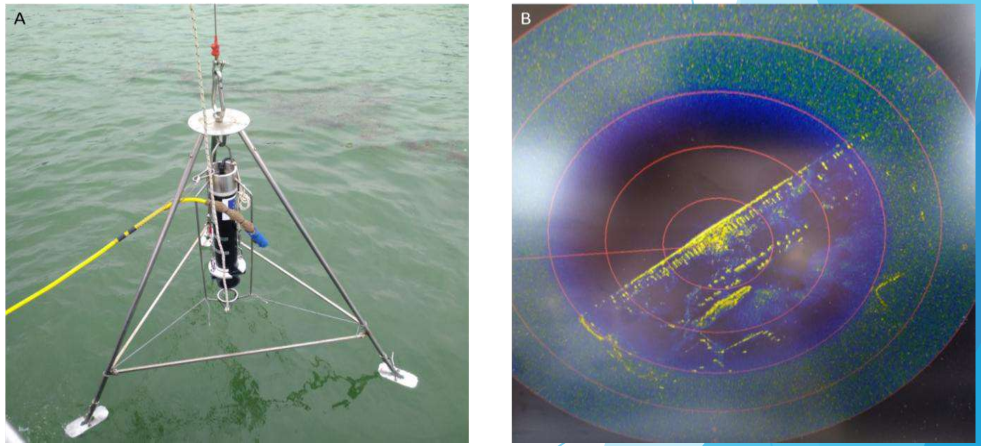
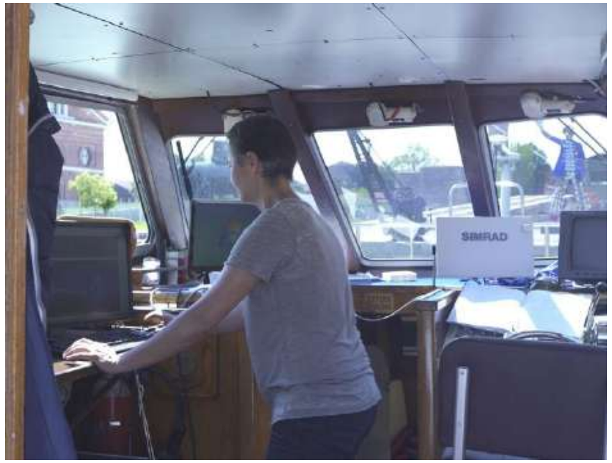
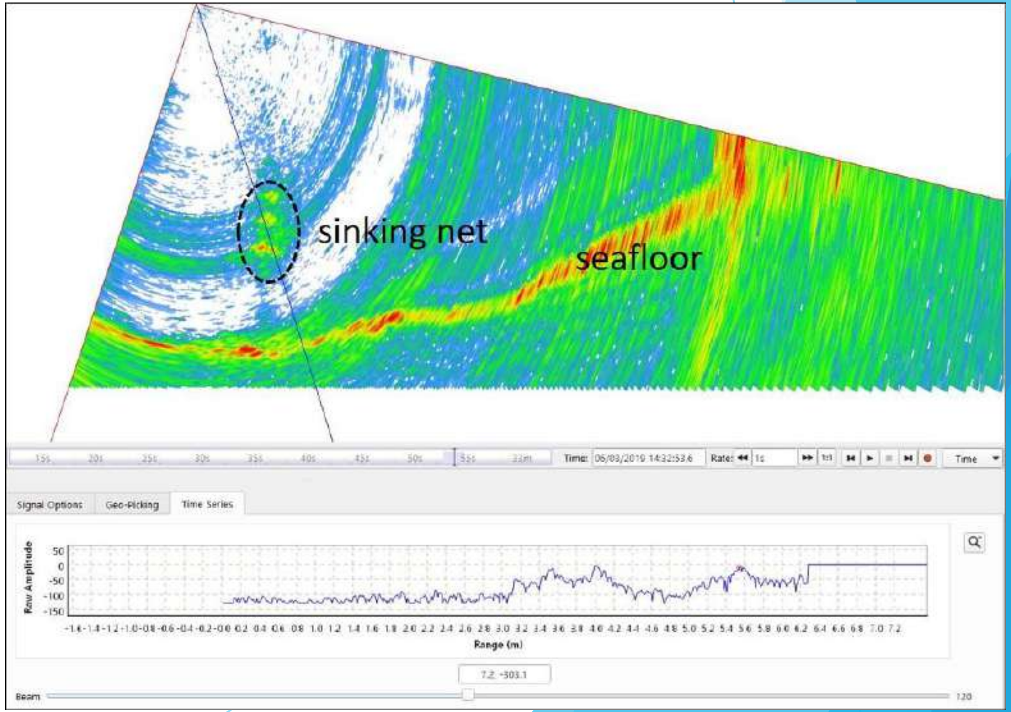


High resolution scanning sonar (HRSS)

FIELD EXPERIMENTS FOR ACOUSTIC DATA CALIBRATION CARRIED OUT IN JUNE 2019





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FIELD EXPERIMENTS RESULTS

- MBES can detect ML and nets in the water column BS
- Development of **2 Research Objects** to extract the sinking velocity of the different types of ML and the BS signal

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- MBES can detect ML and nets in the water column BS
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RESEARCH OBJECT:

OPEN DATA AND REPRODUCIBLE ALGORITHMS

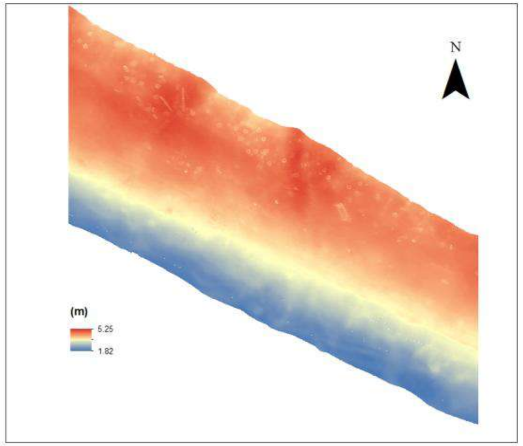
IN AGREEMENT WITH THE

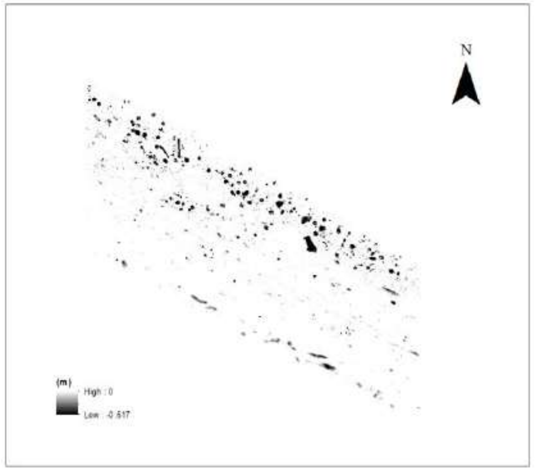
FAIR PRINCIPLES

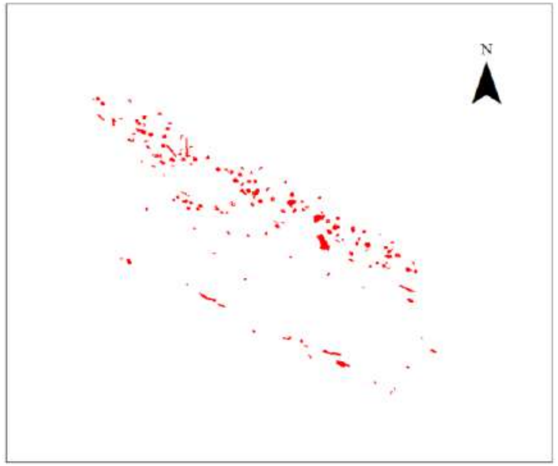
Co-funded by the European Maritime and Fisheries Fund

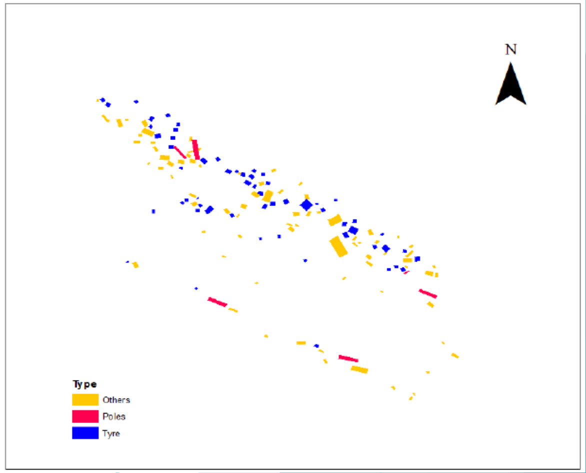
FIELD EXPERIMENTS RESULTS

- MBES can detect macro-litter on the seafloor, but it is difficult to recognize nets only from the seafloor BS
- Specific workflows developed in ArcGIS and E-Cognition to isolate the single ML types









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FIELD EXPERIMENTS DATA POST PROCESSING ALGORITHMS

Water column backscatter	• RO to extract sinking velocity • RO to extract BS value
Seafloor backscatter	• GLCM and textural analysis • E-cognition template matching
Bathymetry	• ArcGIS workflow

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Water column backscatter

- RO to extract sinking velocity
- RO to extract BS value

The research objects published on the EVEREST platform and associated with a DOI number:

RO1 SinkVel: https://doi.org/10.24424/ro-id.IKMY8URJ9Q
RO2 SinkTrack: https://doi.org/10.24424/ro-id.EHMJMDN68Q

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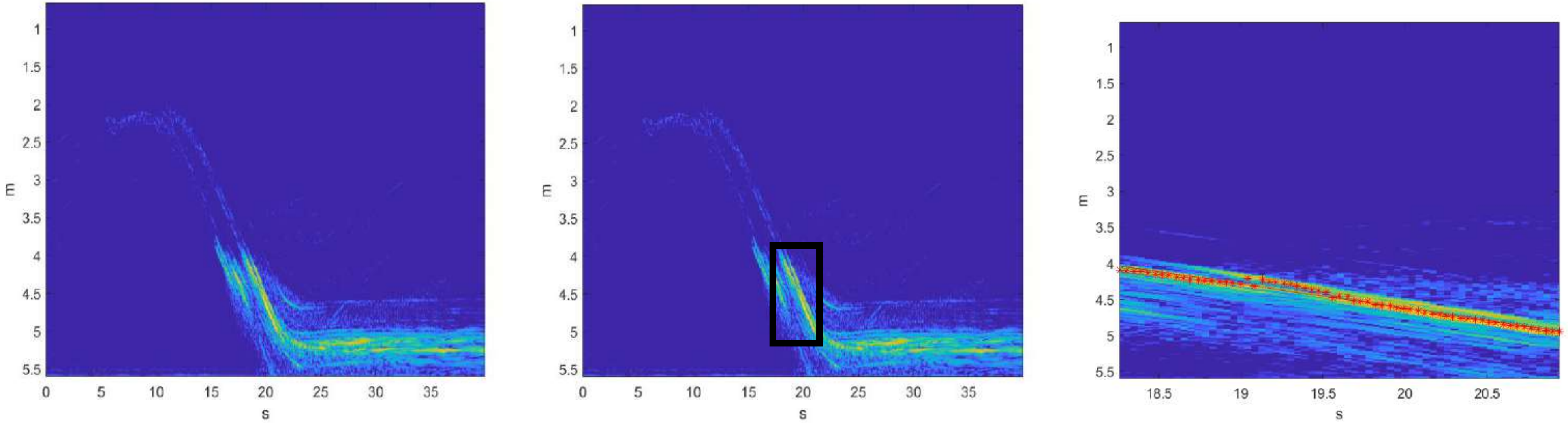
Water column backscatter

- RO to extract sinking velocity



Interpolating the position of the ML over time we obtained the sinking velocity

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ML MEASURED SINKING VELOCITIES

Number	ML type	Dimension	Weight	Picture	Sinking Velocity (m/s)
1	Mussel farming net	1.3 m x 0.02 m	23 g		0.082
2	Mussel farming net	2.8 m x 0.02 m	98 g		0.104
3	Trammel net	1.4 m x 0.5 m 0.18 m	6220 g		0.259
4	Trawling net piece	1.8 m x 0.6 m	180 g		*Did not sink*
5	Trawling net piece	1.95 m x 0.015 m	260 g		0.035
6	Trawling net piece	larger dimension depending on the availability	3760 g		*Did not sink*
7	Trap for cuttlefish (*Sepia officinalis*)	2 m x 0.8m	1400 g		0.113
8	Trap for *Squilla mantis*	0.32 m x 0.335 m x 0.135 m	660 g		0.101
9	Plastic rope agglomerate (related to fishing activity)	0.5 m x 0.05 m	2460 g		0.308
10	Plastic rope agglomerate (related to fishing activity)	0.3 m x 0.03 m	225 g		0.220
11	Elastic straps (from trawling nets)	0.30 m x 0.39 x 0.03	1590 g		0.170
12	Plastic bottle	21 cm x 5.6 m	526g		0.014
13	Plastic bag	0.45 m x 0.25 m	10 g		*Did not sink*
14	Substitute of no 6, that was not sinking	0.8 m x 0.65 m x 0.5 m	9950 g		0.091
15	tire	0.32m x 0.045m x 0.045 m	590 g		0.219

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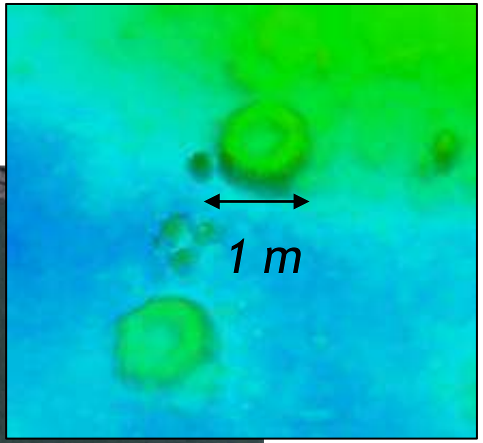
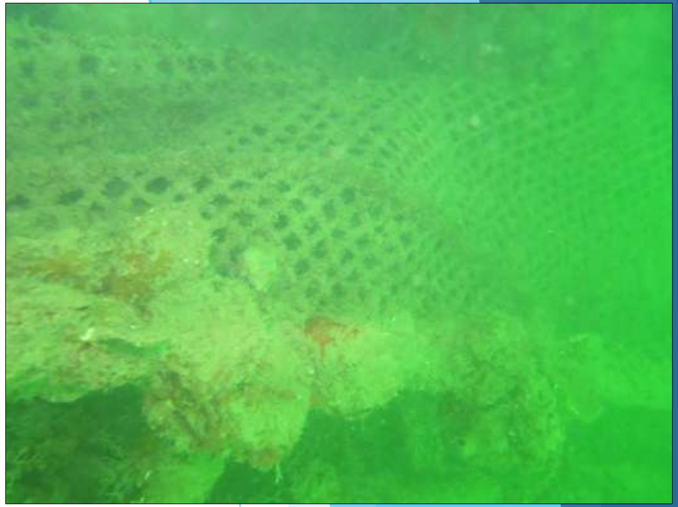
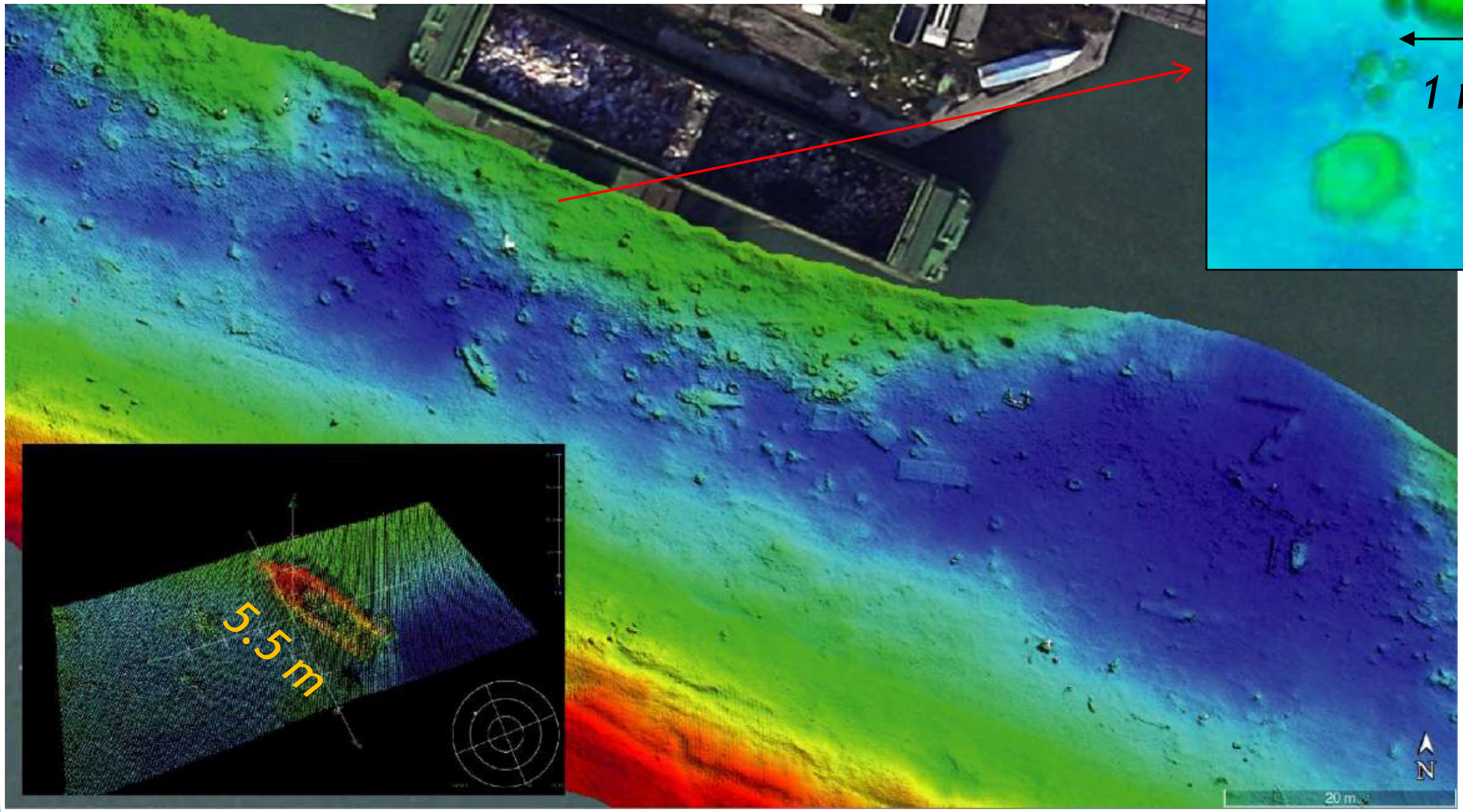
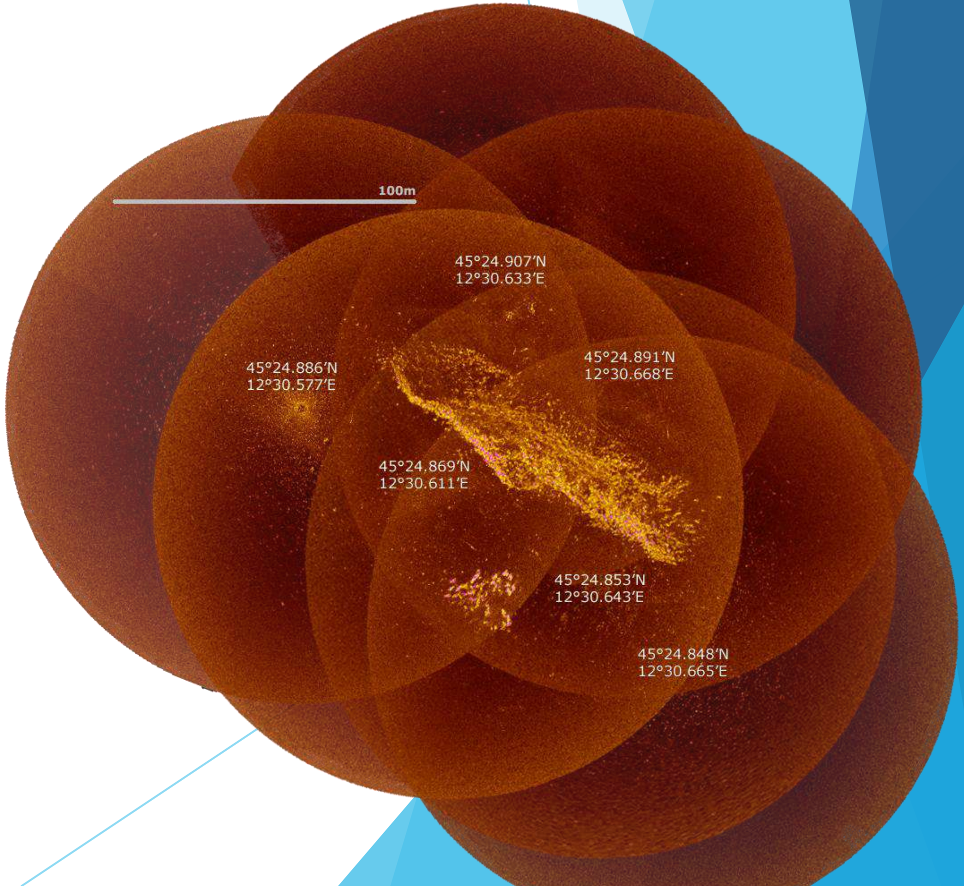
ACOUSTIC AND VIDEO MONITORING









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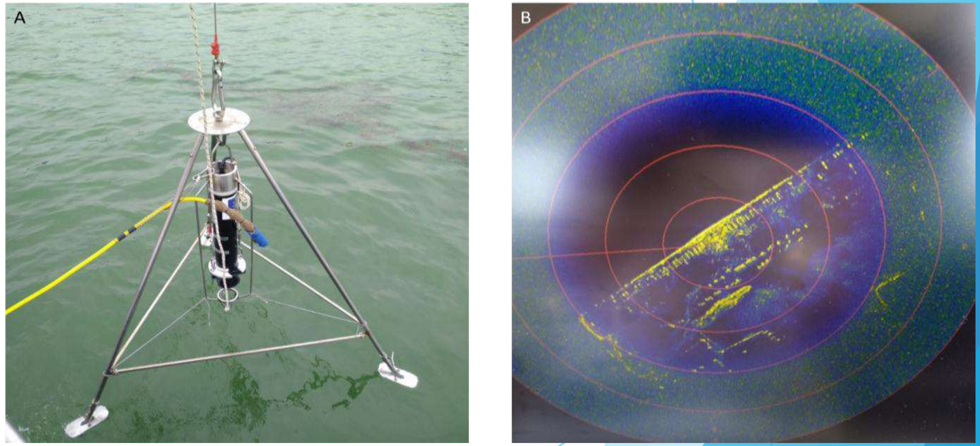

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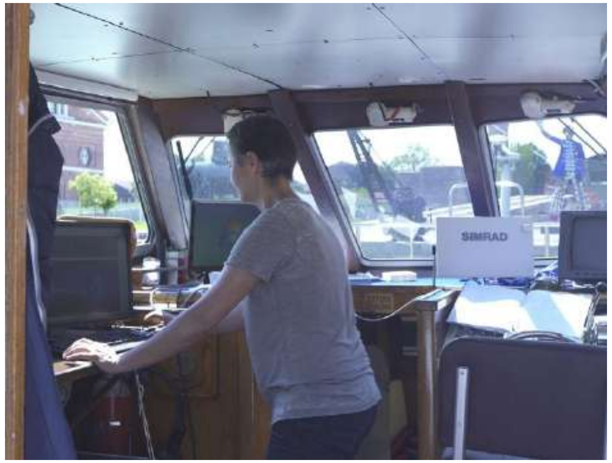

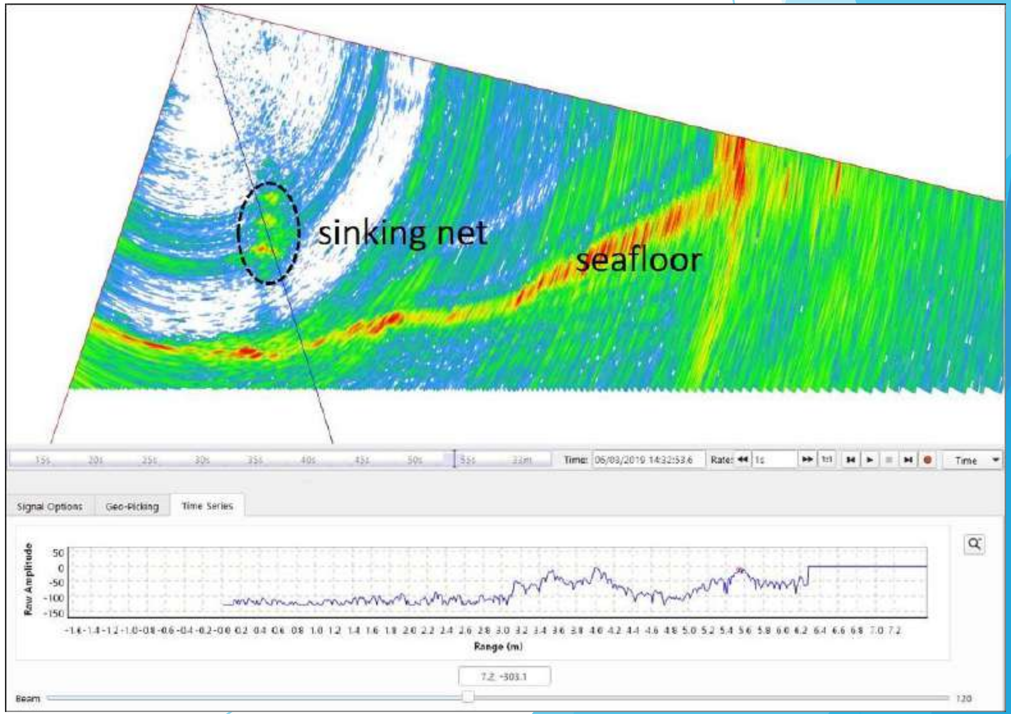

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- RO to extract BS value

Seafloor backscatter
- GLCM and textural analysis
- E-cognition template matching

Bathymetry
- ArcGIS workflow

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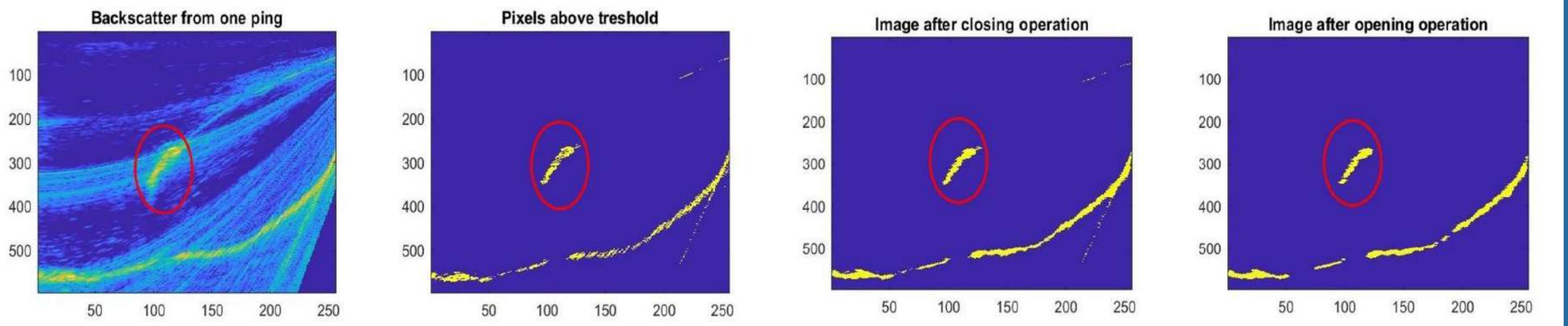
Maritime and Fisheries Fund

Water column backscatter

- RO to extract BS value



Algorithm in Matlab to read each MBES ping and perform a image analysis to recognize the ML moving in the water

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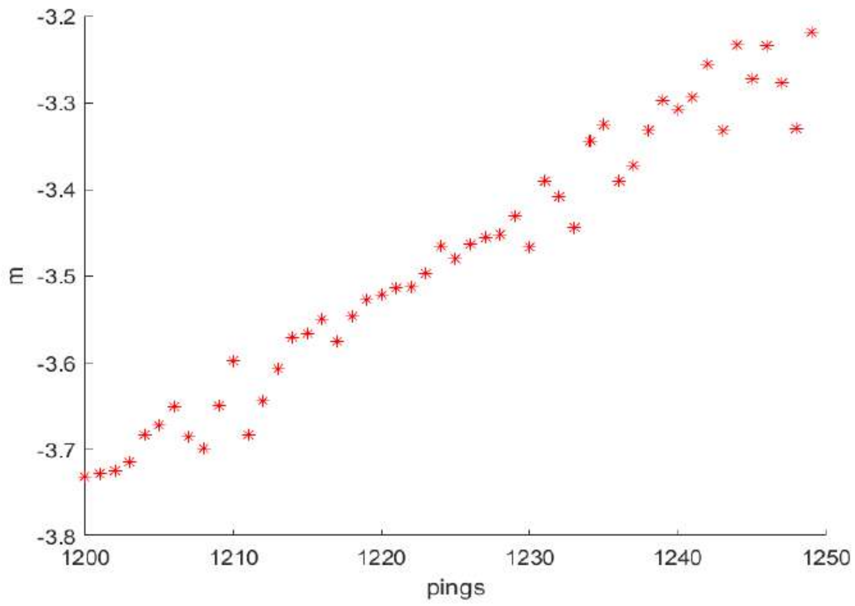
Water column backscatter

- RO to extract BS value



ML trajectory: ML depth vs time

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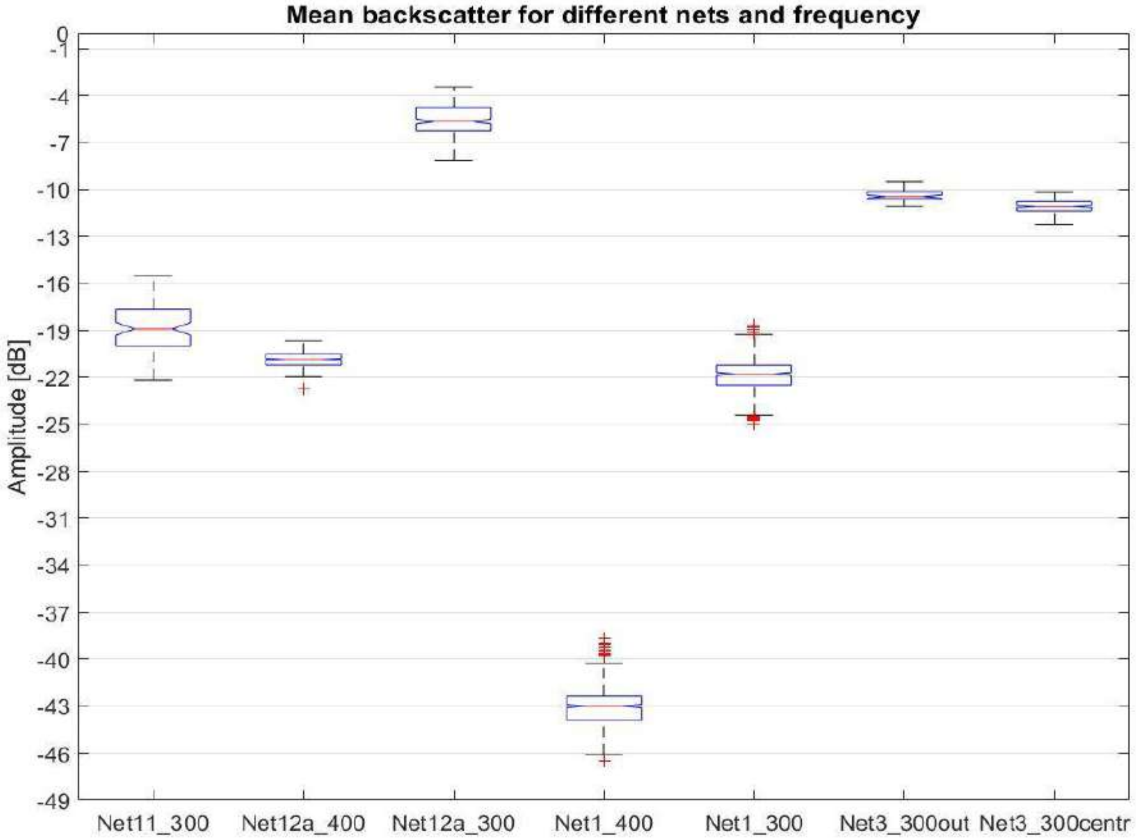
Water column backscatter

- RO to extract BS value



Extraction of the mean BS for different ML type

- with different MBES frequencies
- at different angles (central and outer beams)

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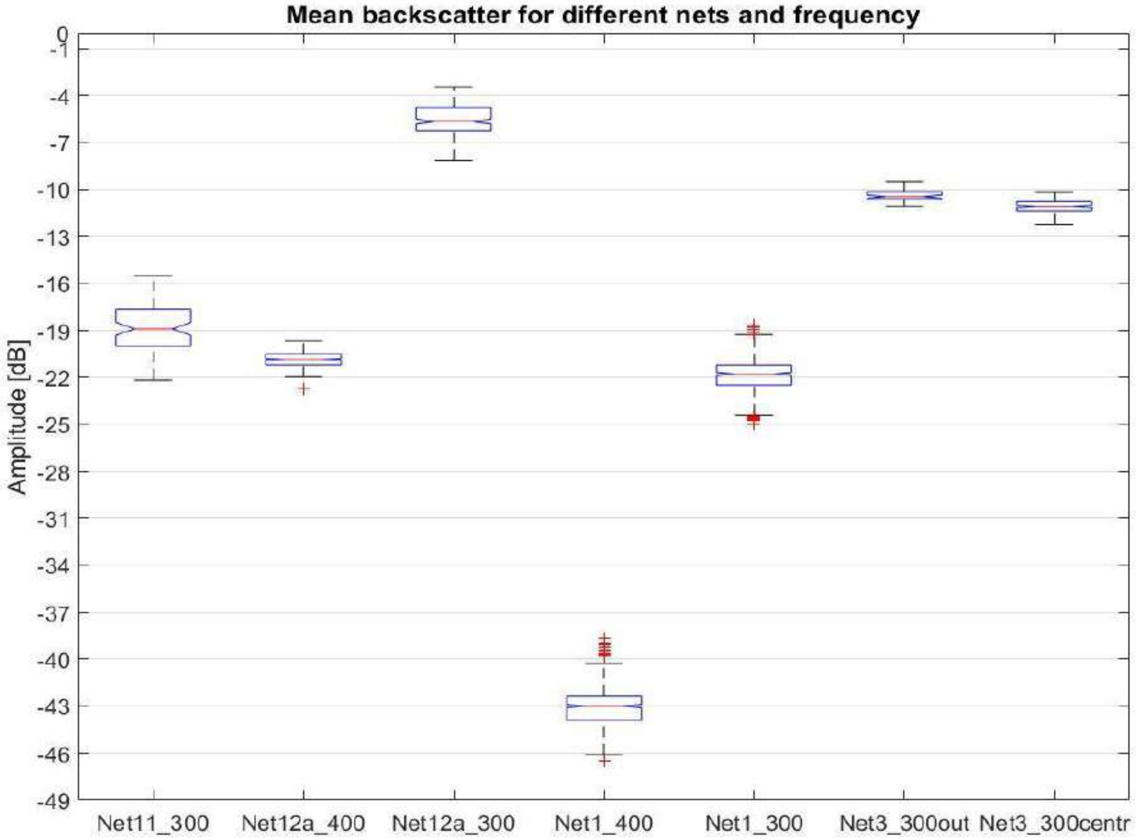
Water column backscatter

- RO to extract BS value



Extraction of the mean BS for different ML type

- with different MBES frequencies
- at different angles (central and outer beams)

Best frequency for detection
300 kHz

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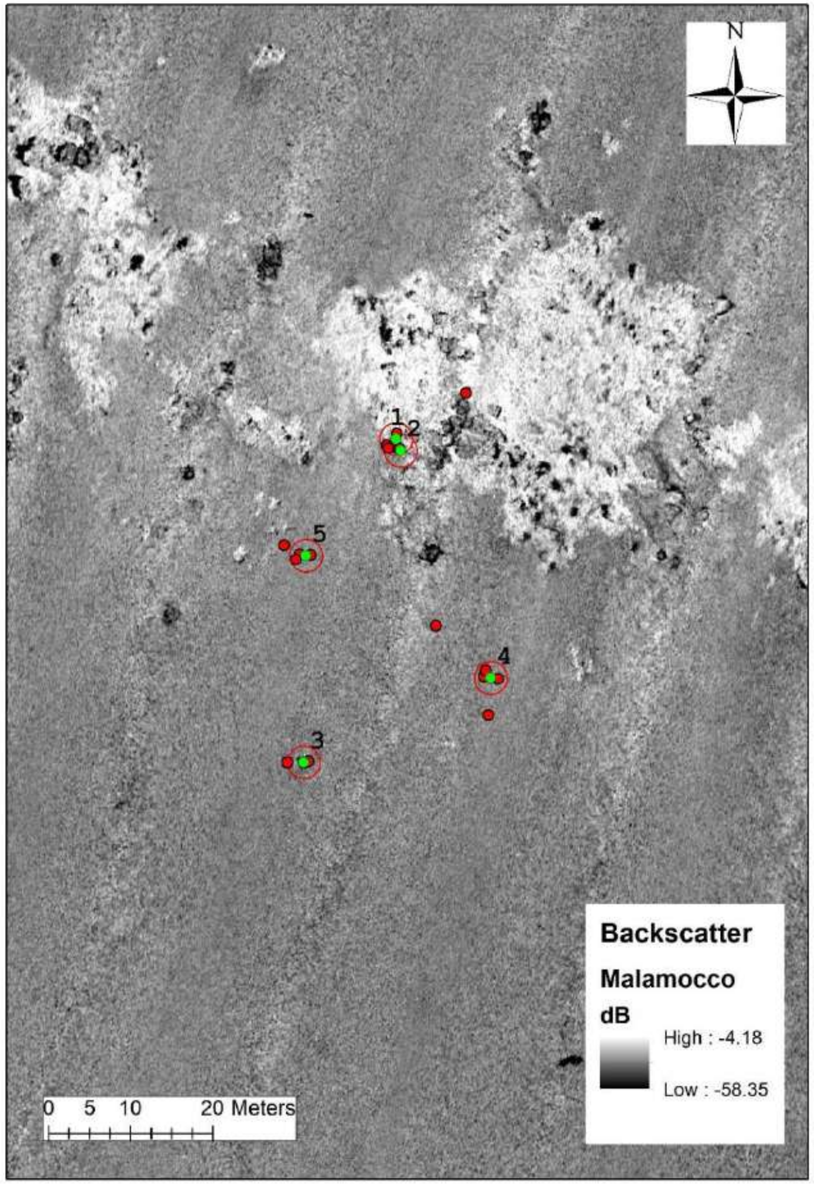

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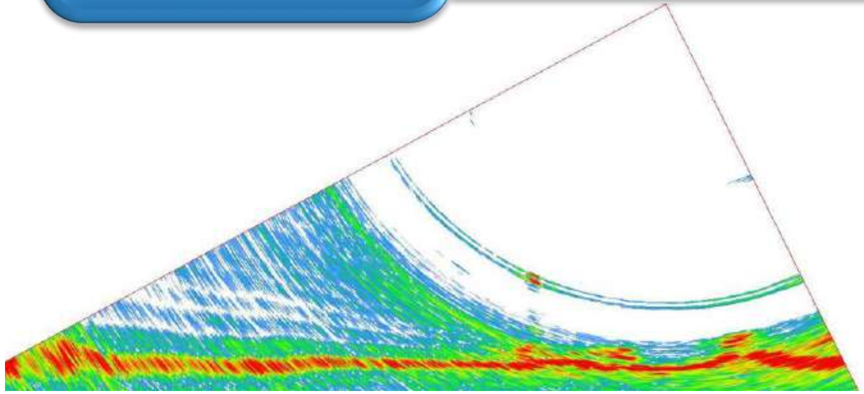
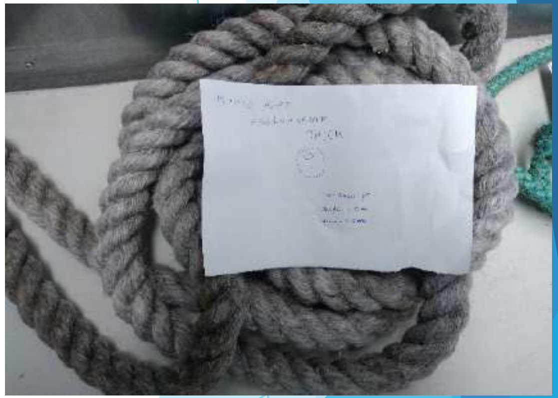
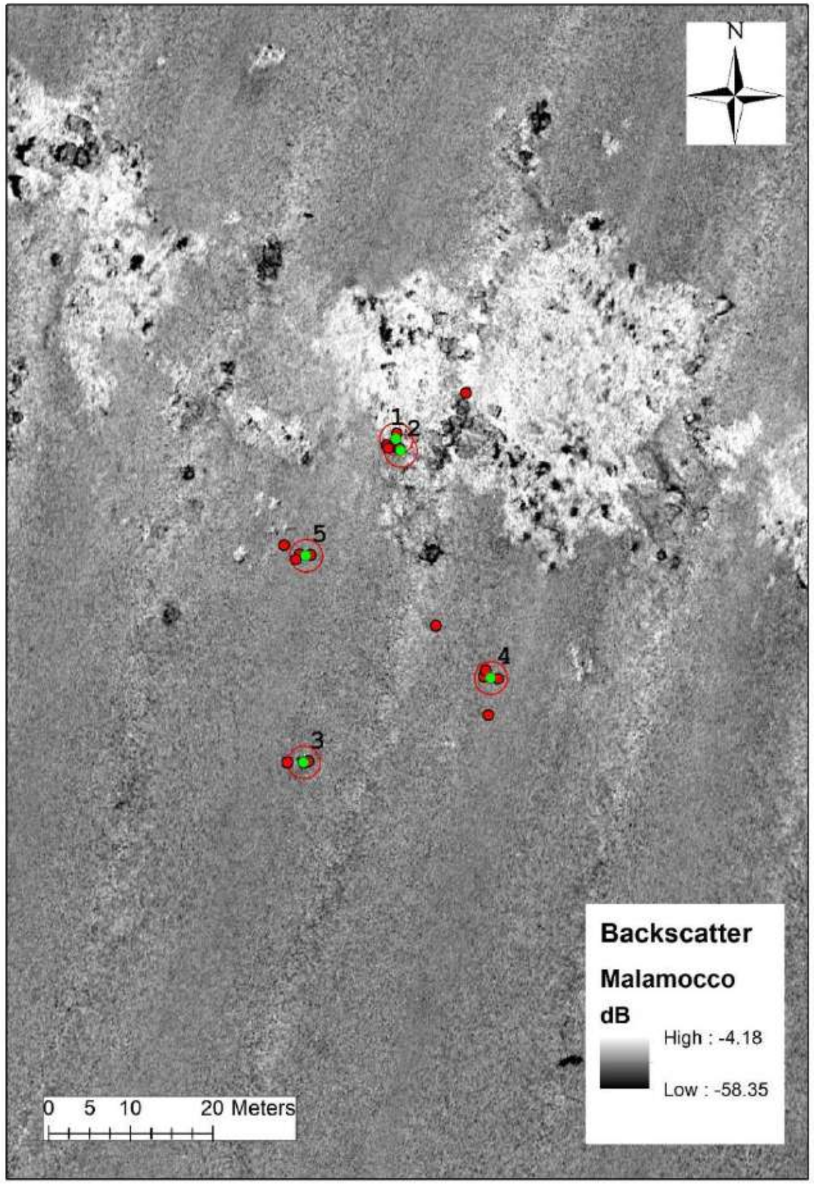
Seafloor backscatter

- GLCM and textural analysis

Comparison of BS with and without ML







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Seafloor backscatter

- GLCM and textural analysis

Calculation of mean BS and textural analysis does not provide significant diferences with or without nets

Is there another way out?

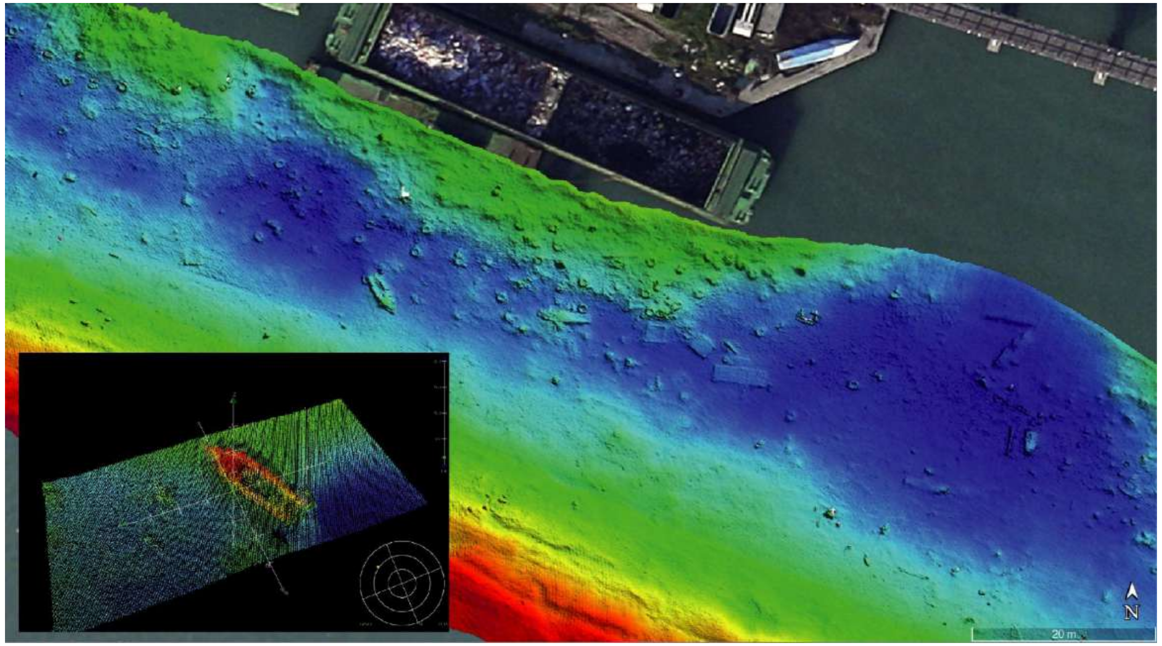
Do the images of HRSS provide more info?

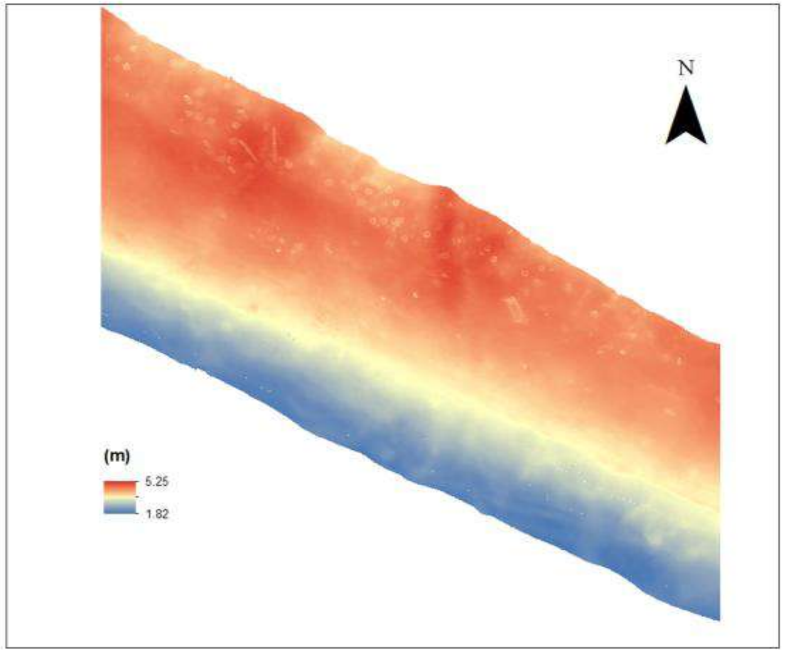
Shall we use MBES as a reference for very accurate positioned video survey?

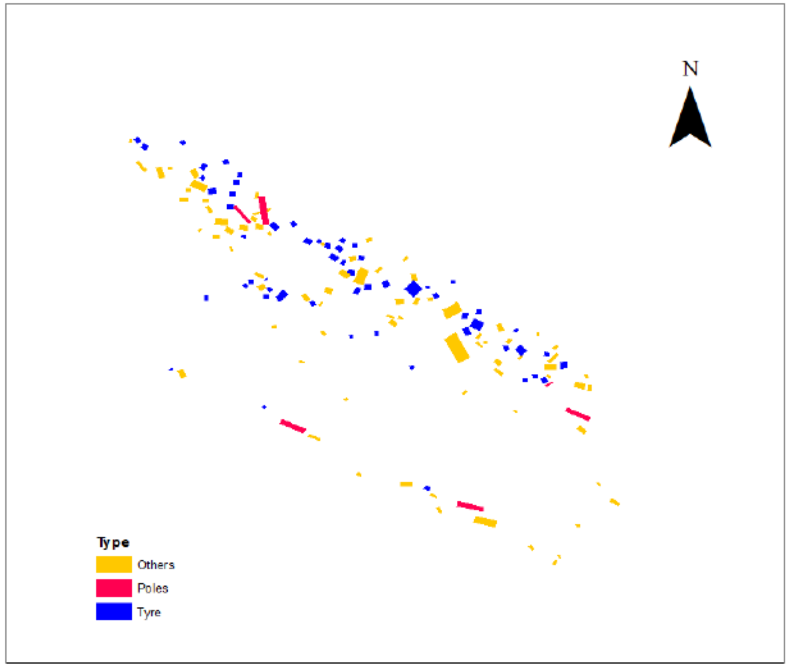
Bathymetry

- ArcGIS workflow

➢ High resolution bathymetry can be very useful to detect and classify ML with a defined geometric shap







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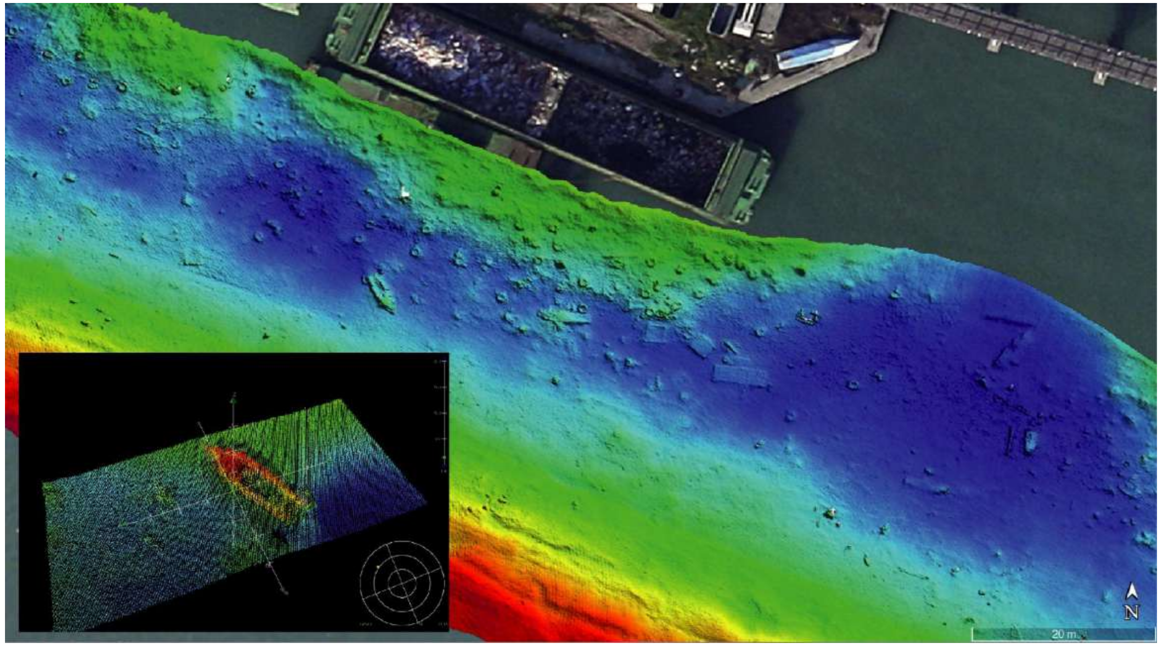
Bathymetry

- ArcGIS workflow

- High resolution bathymetry can be very useful to detect ML with a defined geometric shape



- Are there better ways?

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SURVEY CARRIED OUT IN ITALIAN WATERS

Underwater mapping methodology	Advantages/disadvantages
Divers	High res- low coverage-limited by visibility
ROV	High res- low coverage-limited by visibility
Drifting drop frame	High res- low coverage-limited by visibility, not very accurate position
MBES	Low res-, high coverage, limited by the depth (footprint)

Need of combining technologies and automtize data processing

MarGnet mid-term Scientific meeting REPORT

Annex 8

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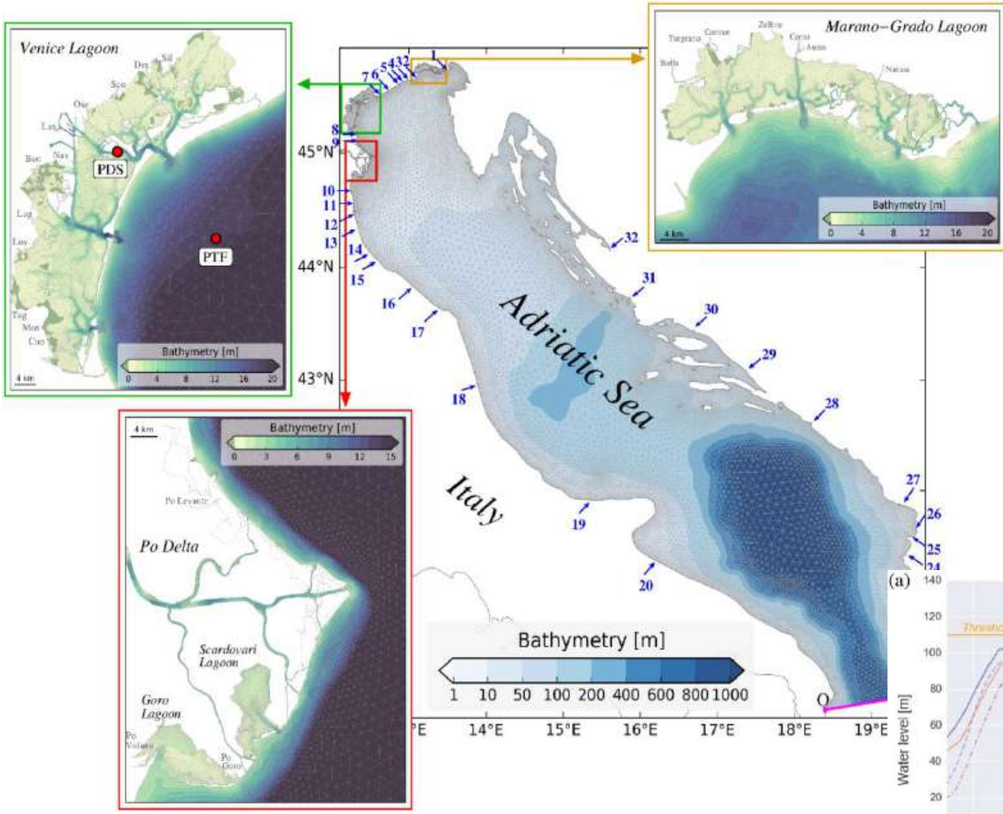
LAGUNA PROJECT

techneprojects
GROWING UP PROJECTS

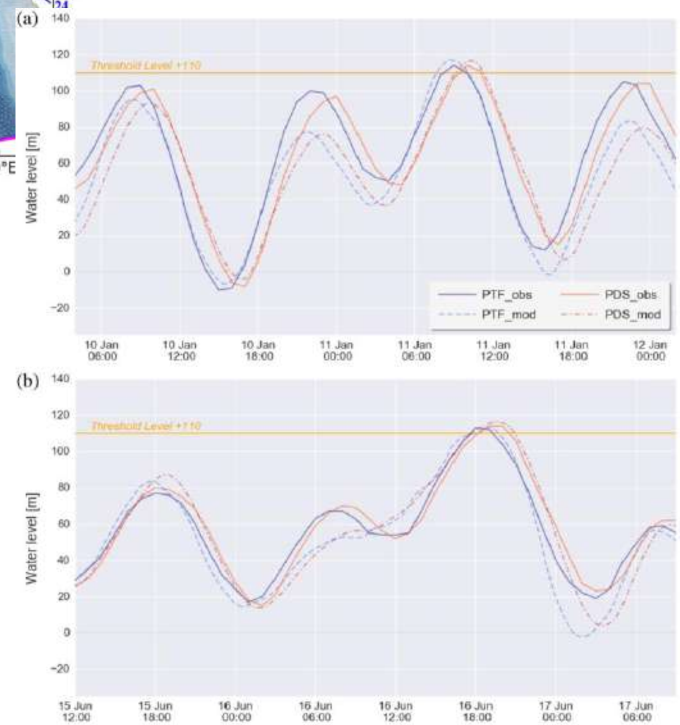
Co-funded by the European Maritime and Fisheries Fund

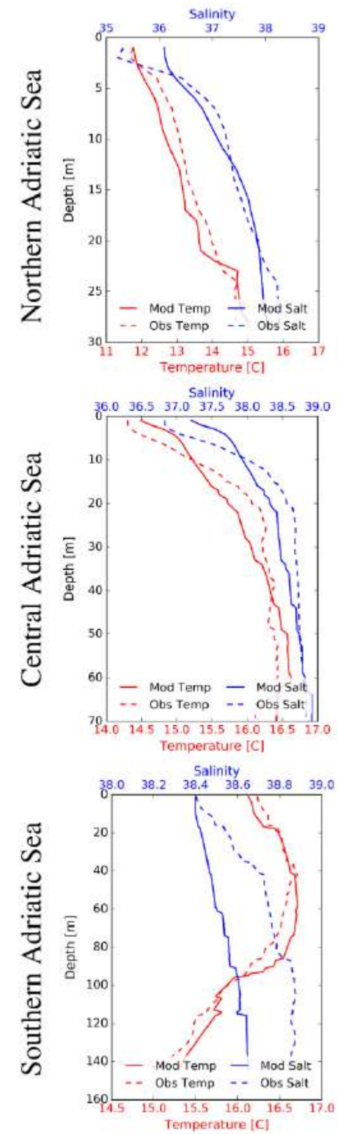
HYDRODYNAMIC MODELLING for the Northern Adriatic Sea with the SHYFEM model:

www.ismar.cnr.it/shyfem



Water level, temperature and salinity validation



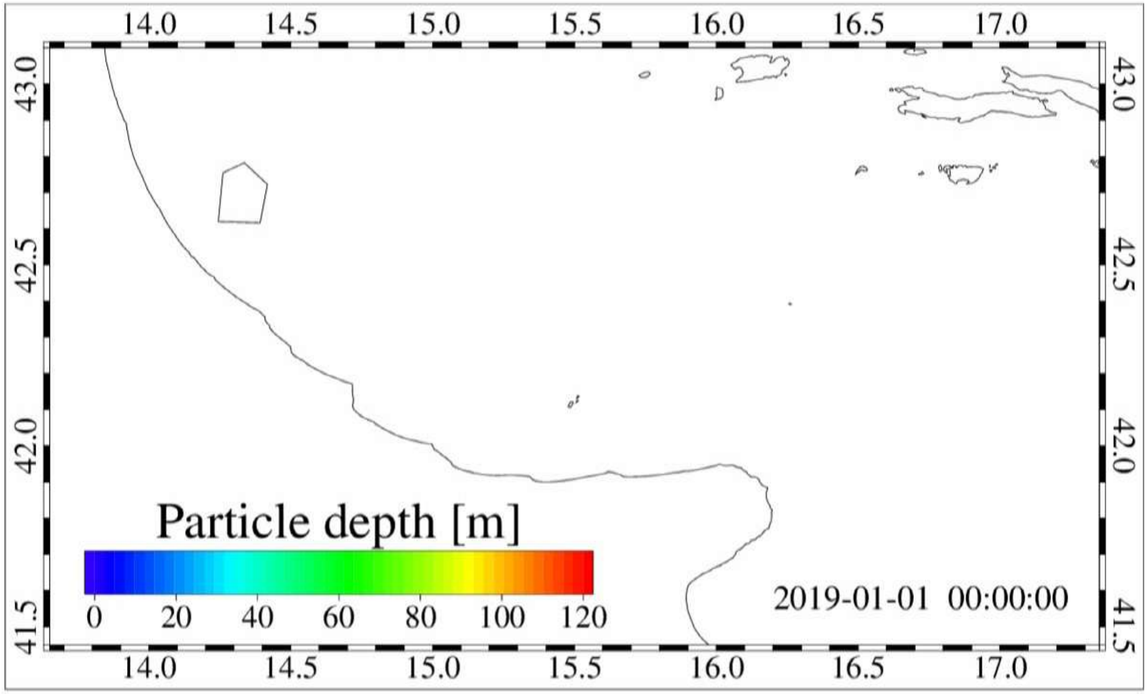


Numerical grid with variable spatial resolution, including rivers and main lagoons. 110.000 elements ranging from 7 km in open sea to few hundred meters in lagoons. Vertically 38 Z-layers , variable thickness from 1 m n the topmost 10 m, 100 m in deepest areas,

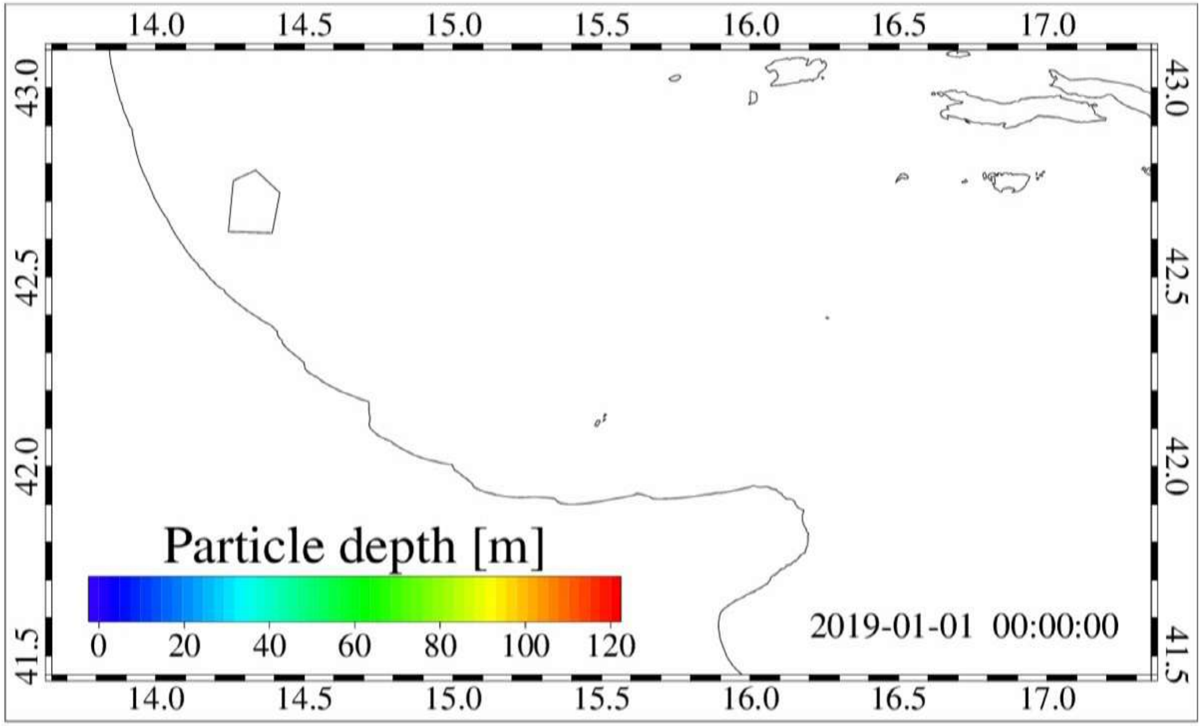
Ferrarin et al. 2019

EXAMPLE

NO SINKING VELOCITY



LOW SINKING VELOCITY
0.01 m/s



By PORTODIMARE PROJECT -