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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 2.4.2.
Final event with policy makers and interest groups

WP	2
Responsible PP	Blue World Institute
Author/s	Jelena Basta
Date	12/12/2020

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SUMMARY

The ‘marGnet’ project Final event with policy makers and interest groups was organized on 10th of December 2020 at the final stage of the project implementation, as part of the project activity 2.4. Networking and transferring of approaches - Task 2.4.2.

The general aim of this event was to present the outcomes of the 'marGnet' project that started in January 2019 undertaking multiple activities with the objective to set up and test multi-level solutions to monitor, map, prevent, remove and recycle ML from sea-based sources present on the sea-floor.

The 'marGnet' project was focused on ML from sea-based sources on the sea-floor and generated by the fisheries and aquaculture activities. This includes not only abandoned, lost and otherwise discarded fishing gears (ALDFG), but also all the litter that is generated by fishing and sea food product management, including ropes, mooring points, degraded nets and their components.

This final event was primarily organized for policy makers and representatives of various interest groups with the aim to inform them on the project holistic approach, combining actions to tackle the phenomenon of ML at all phases, from reduction and prevention, through the monitoring and quantification and the removal to recycling into the second generation fuel. Thereby, merging the whole production chain of ML management – from scientific research to the development of new technological solutions for recycling. The idea was to promote project achievements to encourage their further adoption and sustainability also outside the project pilot areas.

Originally, the event was supposed to take place at the island of Lošinj, Croatia as one of the two project pilot areas. Unfortunately, due to a COVID-19 pandemic situation it was held in the form of online webinar named ‘From Marine Litter to Marine Fuel’, using FLOW platform. However, it was attended by 46 participants which met the planned indicators of the project.

The FLOW platform was chosen as the optimal tool for this event since it allowed the presenters to pre-record their presentations and have live interaction with participants during the event that was directed by the moderators.

The moderator of the event was Jelena Basta as the coordinator of the WP2 Communication and dissemination activities. After her opening words in the introduction session, project coordinator dr.sc. Fantina Madricardo from CNR-ISMAR gave short project overview that was followed by presentation of the project video.

In the second part of the project the WP3 project activities were presented. Dr.sc. Fantina Madricardo gave presentation on ‘Calibration and High-Resolution Mapping of marine litter on the seabed’. Dr.sc. Michol Ghezzo also from CNR-ISMAR presented ‘Development of a Modelling tool for simulation of dispersion of the sinking marine litter' and dr.sc. Federico Riccato from Laguna Project s.n.c. was presenting 'Sustainable practicies in marine litter removal'.

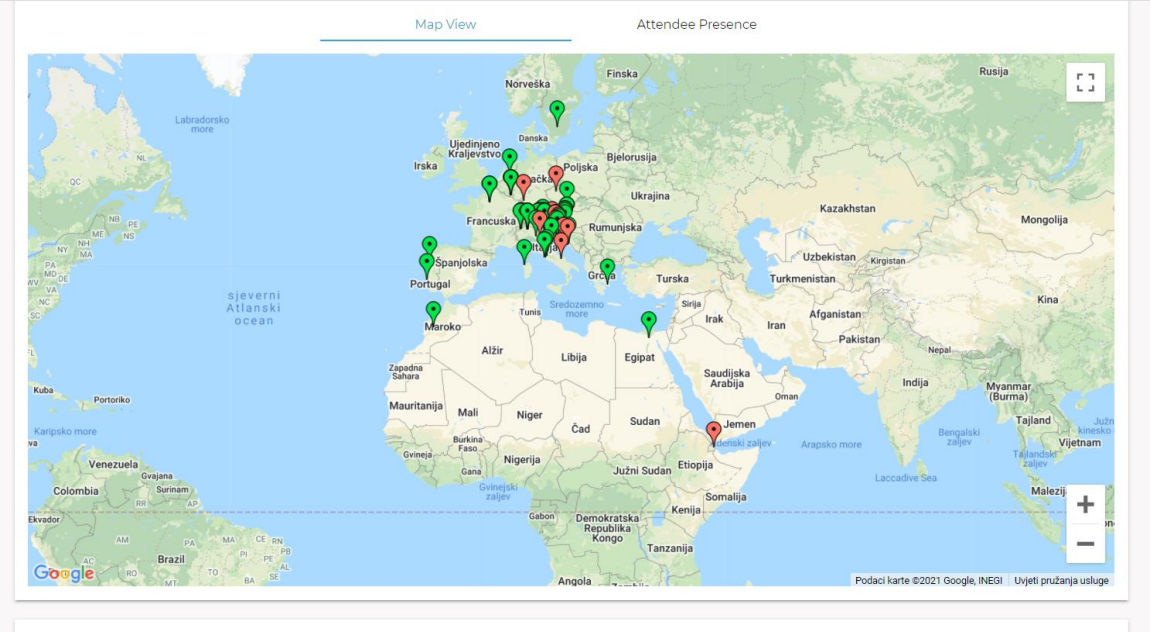
In the third part of the event dr.sc. Gianclaudio Faussone from Sintol s.r.l. presented the main outcomes of the project's WP4 in the presentation 'Low Temperature Pyrolisis to Recycle marine litter’. Valentina Zambetti from Techneprojects s.r.l.s. presented WP5 project activites ‘Mainstreaming and implementation of sustainable marine litter management practicies'.

After each presentation, a short questions and answers session was organized where the attendees had chance to communicate directly with presenters.

Finally, at the wrap up session, senior project adviser from EASME, dr.sc. Vincenzo Gente, gave a closing words about 'marGnet' project additionally presenting EASME programmes and new funding opportunities.

After a short closing panel session, documentary about the 'marGnet' project made by Euronews filming crew was presented.

Total duration of the event was 2 hours, it took place between 10.30-12.30. Although there were 73 registered participants, the event was attended by 46 of them. 63% of attendees were activly engaged through making questions, notes or reactions in the chat room.



Picture 1. Map presenting the locations from which the event was attended

After the event, a short satisfaction survey prepared using SurveyMonkey tool was sent to all the participants to evaluate the event that was ranked very high meeting their expectations. Total number of 19 attendees answered to this survey, resulting with very high overall rates. The presenters also expressed their satisfaction with the event at the post-event online meeting.

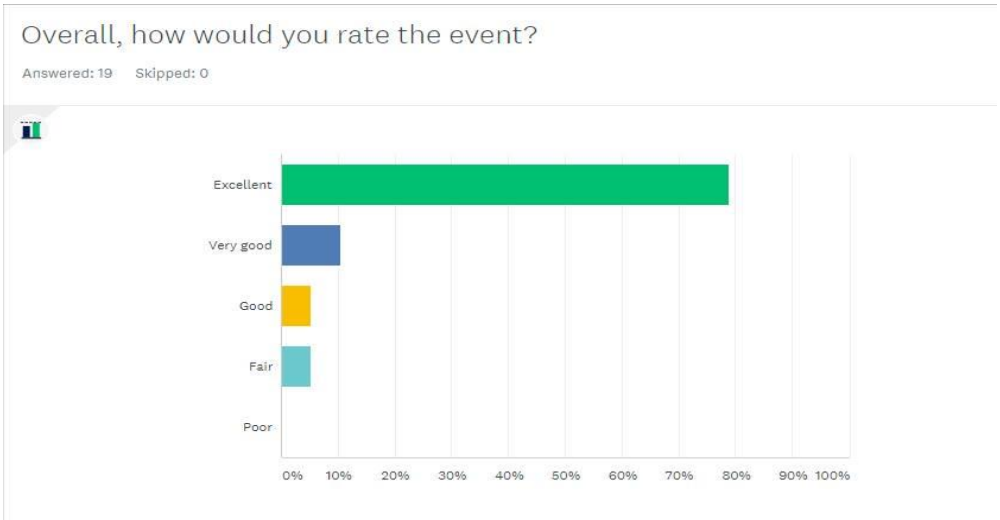


Fig 2. Selection clip from Survey Monkey satisfaction survey statistic

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Final event - 10/12/20
10.30 – 12.00

AGENDA

Introduction - Jelena Basta, Blue World Institute

Presentation of the 'marGnet' project activities & results

- **Project overview** – dr.sc. Fantina Madricardo, CNR-ISMAR, project coordinator

  'marGnet' Video- (4 min)

- **Calibration and High-Resolution Mapping of marine litter on the seabed**
  dr.sc. Fantina Madricardo, CNR-ISMAR, project coordinator Fantina Madricardo

  Q & A session 1

- **Development of a Modelling tool for simulation of dispersion of the sinking marine litter**
  dr.sc. Michol Gezzo, CNR-ISMAR

  Q & A session 2

- **Sustainable practicies in marine litter removal**

  dr.sc. Federico Riccato, Laguna project s.n.c.

  Q & A session 3

- **Low Temperature Pyrolisis to Recycle marine litter**
  dr.sc. Gianclaudio Faussone, SINTOL S.R.L.

  Q & A session 4

- **Mainstreaming and implementation of sustainable marine litter management practicies**

  Valentina Zambetti, Techneprojects s.r.l.s.

  Q & A session 5

Wrap up session

Closing words about the marGnet project – dr.sc. Vincenzo Gente, Senior Project Adviser, EASME

Final panel session with all presenters

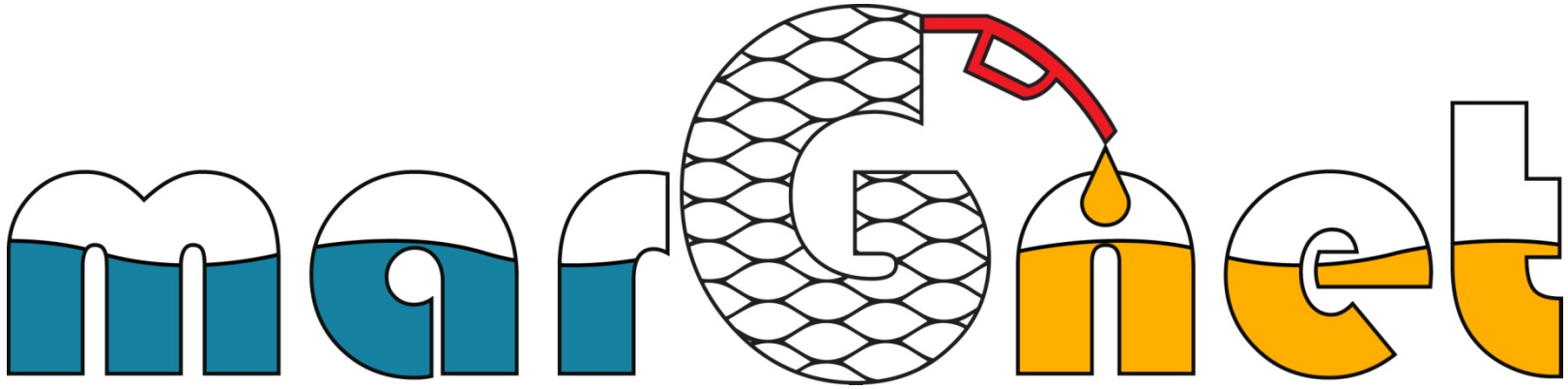
Euronews – short documentary film on 'marGnet' project (8 min)

*** Waiting room for the registered participants will be open 15 min before the event**

Picture 2. Screenshot of the final event

LIST OF ANNEXES

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



PROJECT OVERVIEW

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

Sustainable Blue Economy: Marine Litter

www.margnet.eu

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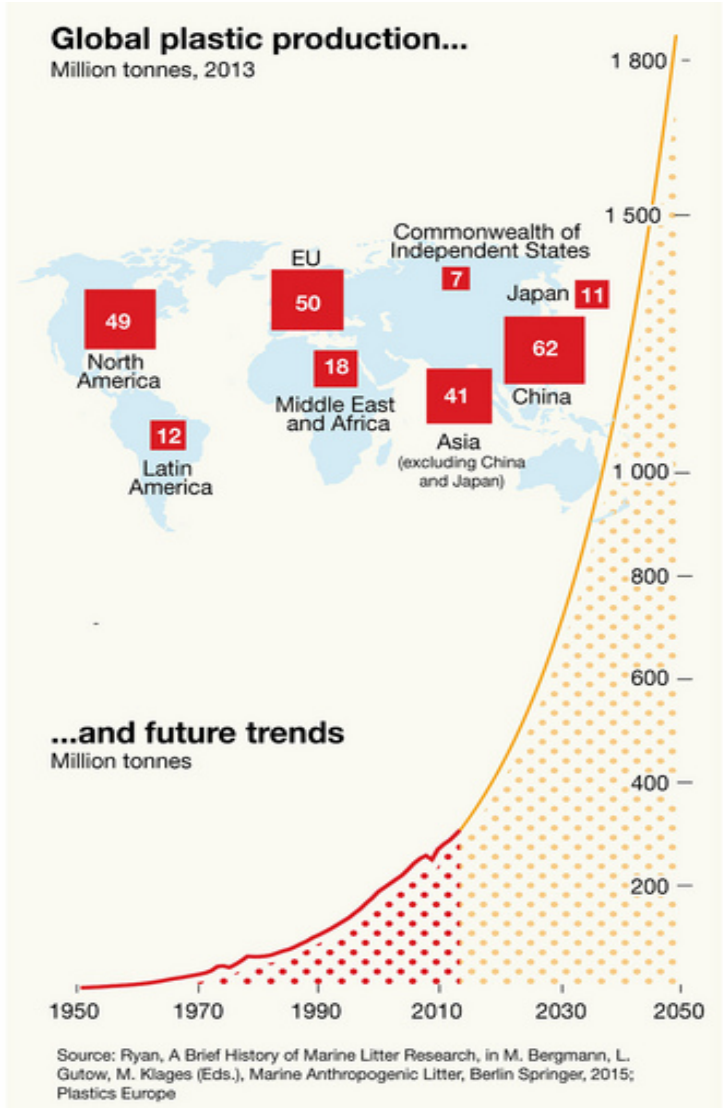
THE ML ISSUE

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

Globally, between 4 and 12 million metric tons end in the sea

Most of if ends up on the seafloor

WHAT DO WE DO ABOUT THIS LITTER?



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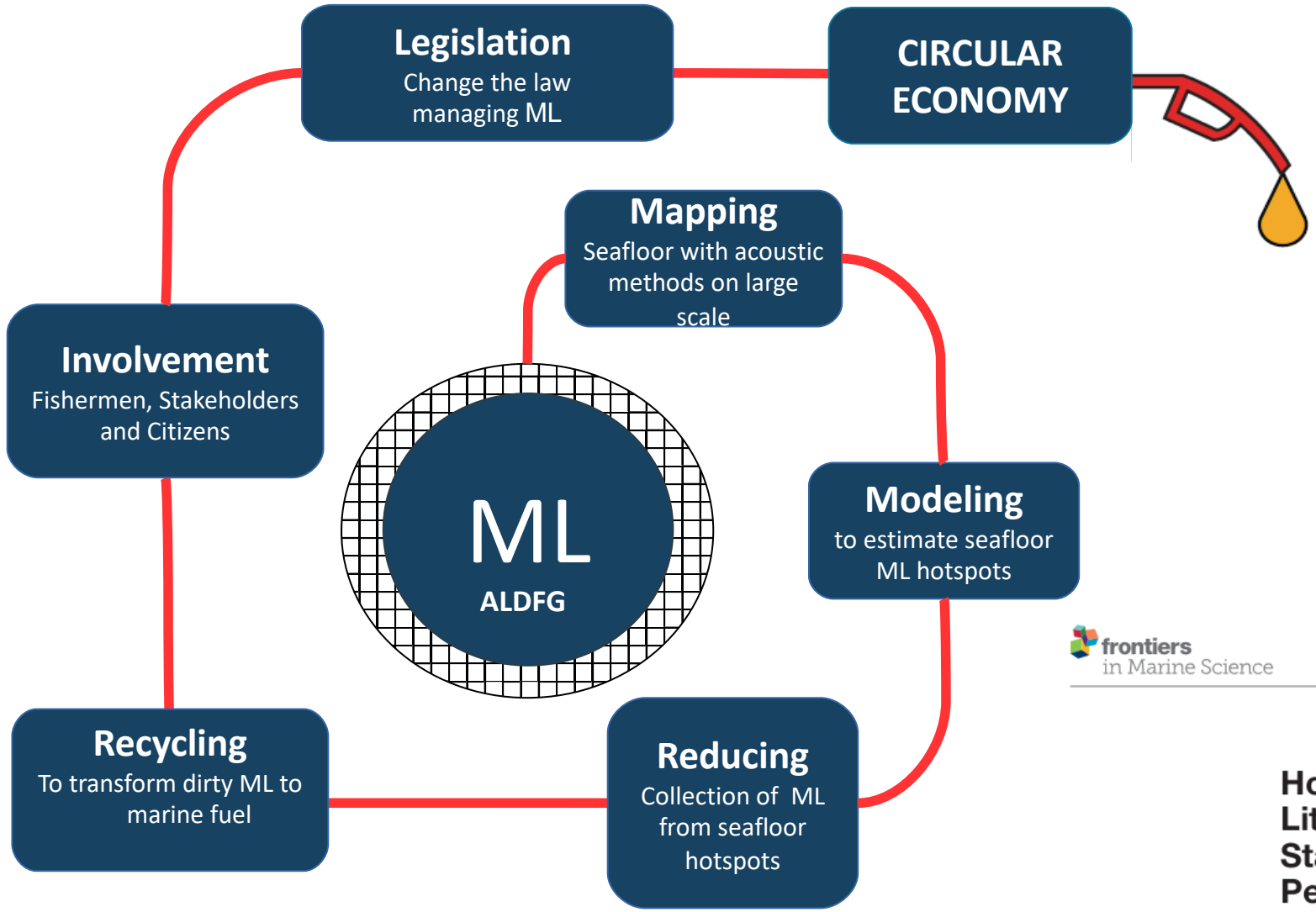
MULTILEVEL APPROACH



frontiers in Marine Science

REVIEW
published: 30 September 2020
doi: 10.3389/fmars.2020.505134

How to Deal With Seafloor Marine Litter: An Overview of the State-of-the-Art and Future Perspectives

Fantina Madricardo[1], Michol Ghezzo[1], Nicoletta Nesto[1], William Joseph Mc Kiver[1], Gian Claudio Faussone[2], Riccardo Fiorin[3], Federico Riccato[3], Peter Charles Mackelworth[4,5], Jelena Basta[4], Francesca De Pascalis[1], Aleksandra Kruss[1], Antonio Petrizzo[1] and Vanessa Moschino[1]*

[1] Istituto di Scienze Marine-Consiglio Nazionale delle Ricerche, Venice, Italy, [2] SINTOL Srl, Turin, Italy, [3] Laguna Project s.n.c, Venice, Italy, [4] Blue World Institute of Marine Research and Conservation – BWI, Veli Losinj, Croatia, [5] Institute for Tourism, Zagreb, Croatia

Legislation
Change the law managing ML

CIRCULAR ECONOMY

Mapping
Seafloor with acoustic methods on large scale

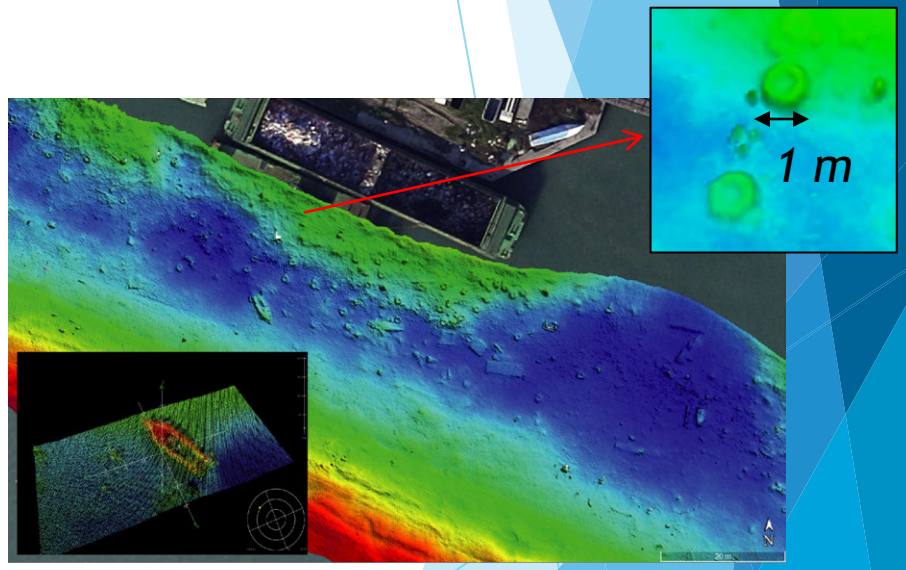
Involvement
Fishermen, Stakeholders and Citizens

ML
ALDFG

Modeling
to estimate seafloor ML hotspots

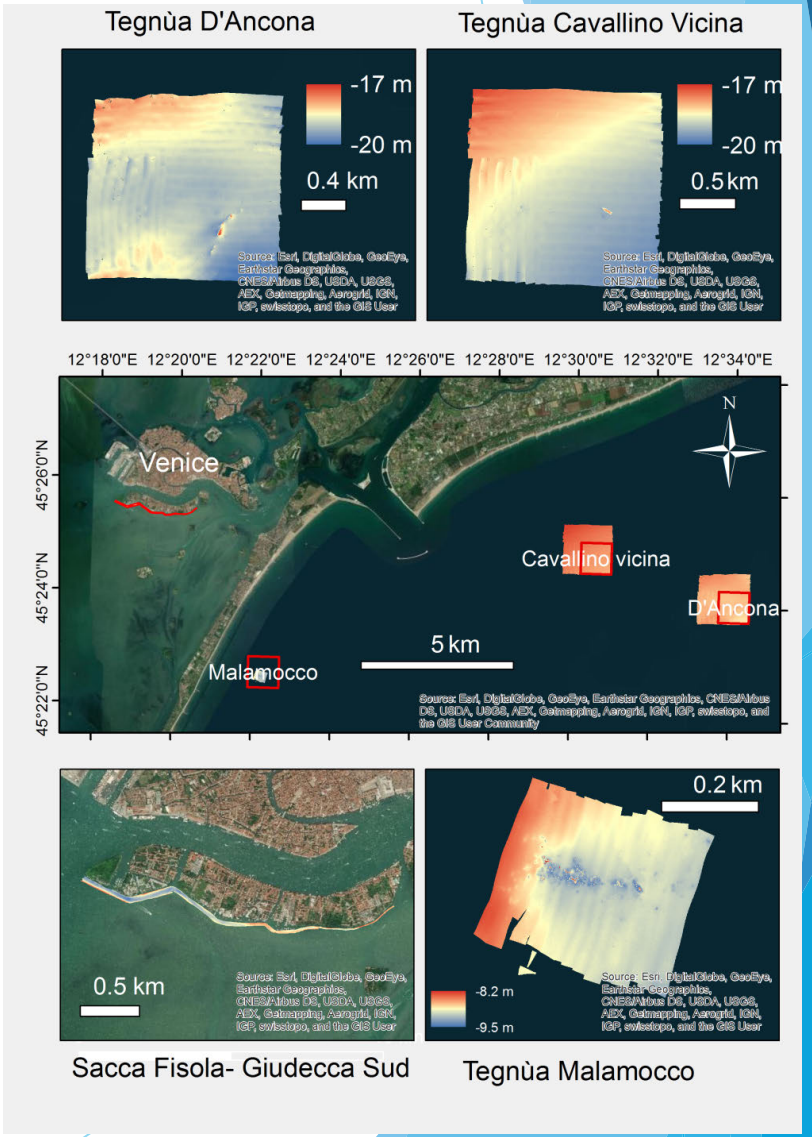
Recycling
To transform dirty ML to marine fuel

Reducing
Collection of ML from seafloor hotspots



MAPPING MAIN RESULTS

- ✓ Fast methodology to extensively map the seafloor with acostic methods and video
- ✓ 2 semiautomatic algorithms developed for automatic ML extractions (ROs)
- ✓ Total of 8 km^2 explored on soft and hard substrates in Italian and Croatian waters



MODELLING

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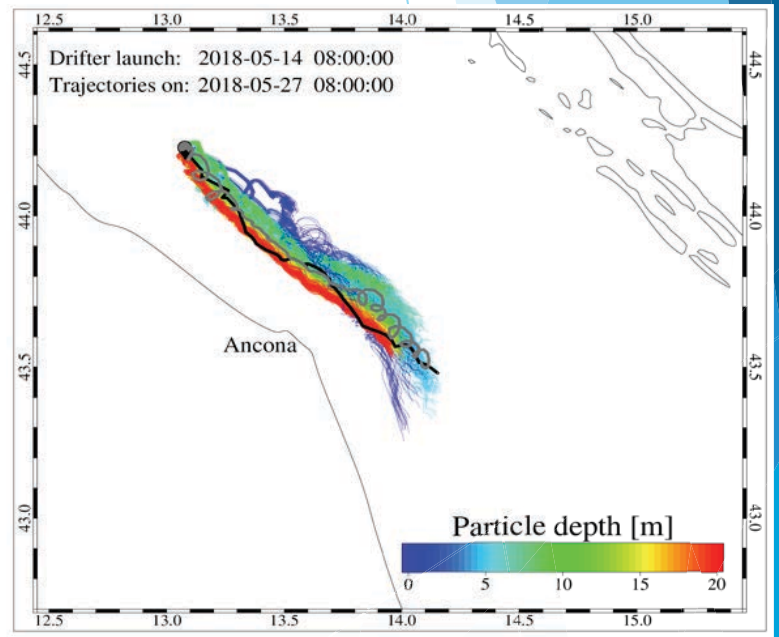
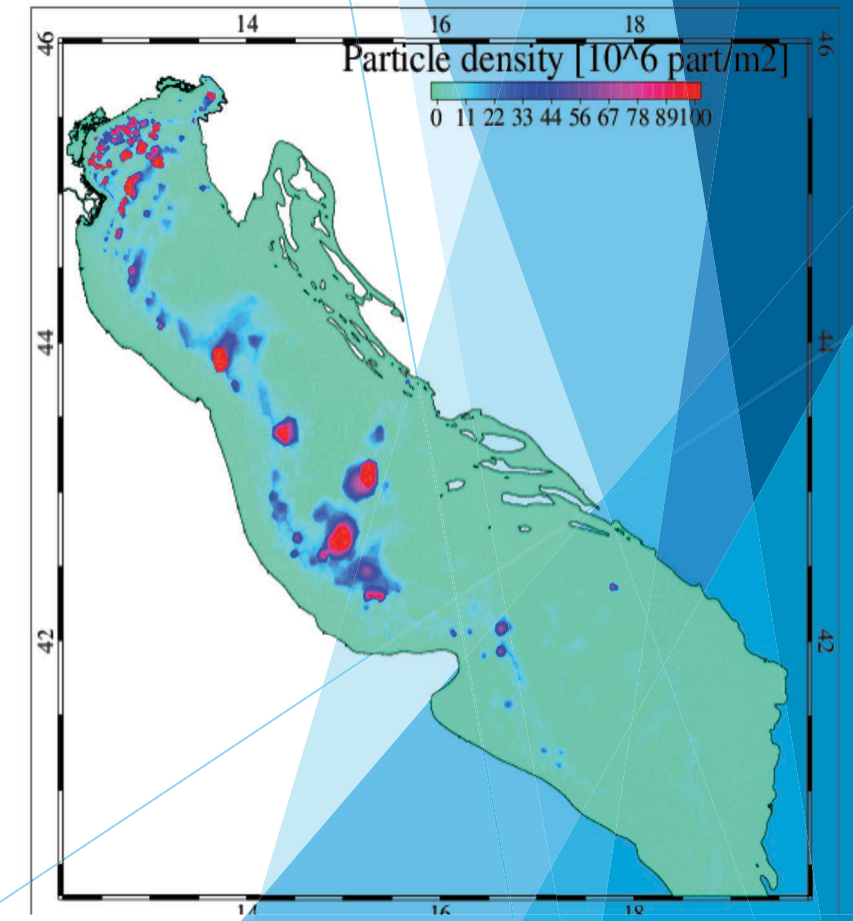


MODELLING RESULTS

- ✓ Development of a modelling tool to estimate the location of potential seafloor marine litter hotspots
- ✓ Separation of sources (aquaculture, fishery)
- ✓ Maps of ML hotspots in the Northern Adriatic Sea



REDUCING

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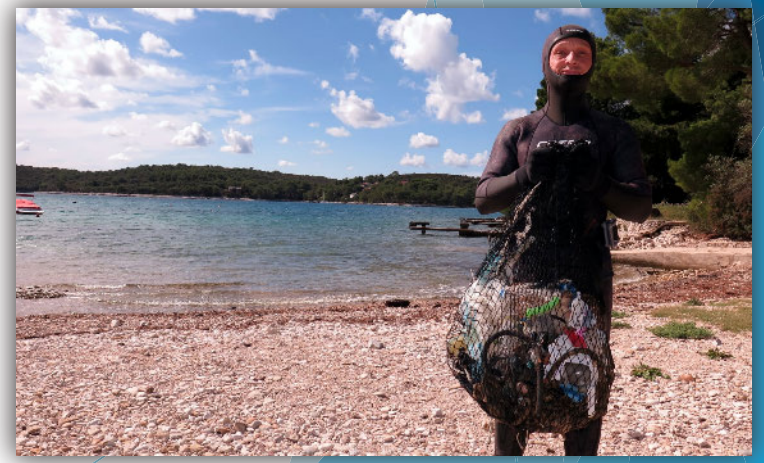
REDUCING RESULTS

- ✓ 36 dives for goundtruthing and removal activities
- ✓ More than 100kg of ML removed in Italian and Croatian waters and correctly disposed



marGnet RECYCLING

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Change the law managing ML

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RECYCLING RESULTS

- ✓ Development and test of low temperature pyrolysis prototype for ML recycling
- ✓ Over 250 Kg overall material processed without pre-treatment during project period
- ✓ Overall average products yield ML→fuels~45/50 wt%
- ✓ Reduction of 0,75 ton CO2eq/ton MGO using the prototype fuel instead of marine fuel

INVOLVEMENT

Legislation
Change the law managing ML

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INVOLVEMENT

- ✓ Fisherman involvement through infographics and questionnaire
- ✓ Involvement of citizen and stakeholders through events and exhibitions (WOD and NET, clean ups)
- ✓ Dissemination od the project at large scale events (ECOMONDO and FAIR)
- ✓ Agreement with the Chioggia Municipality to test the prototype at the fish market on February 2021

LEGISLATION

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Change the law managing ML

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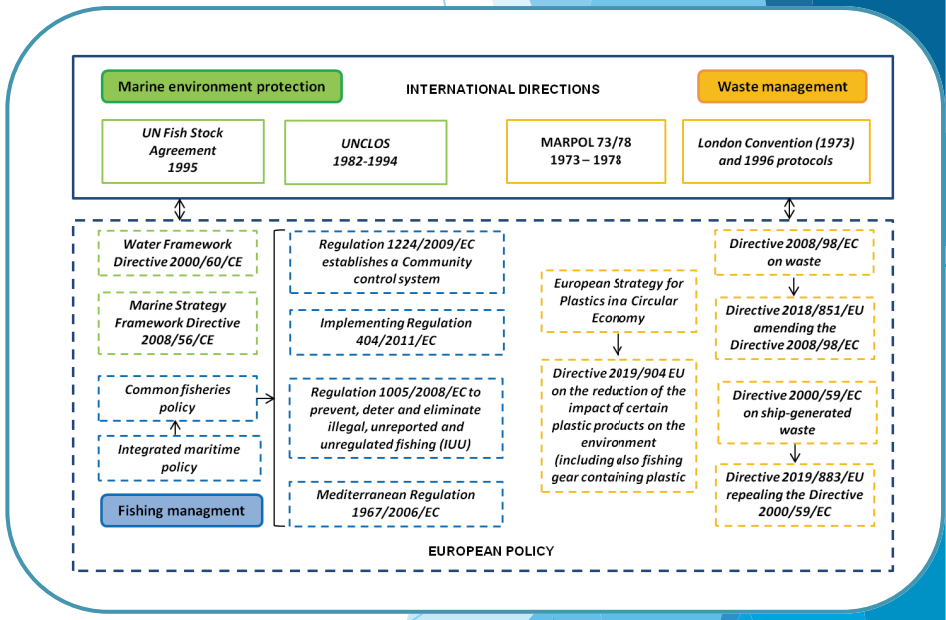
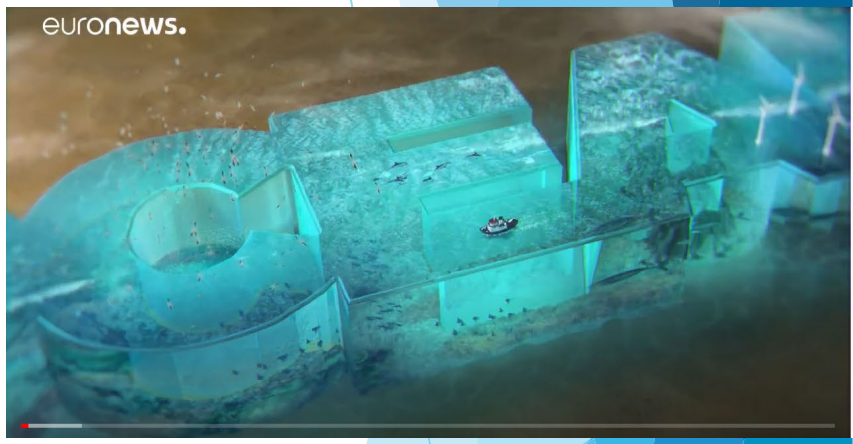
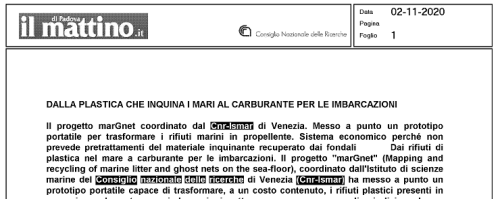


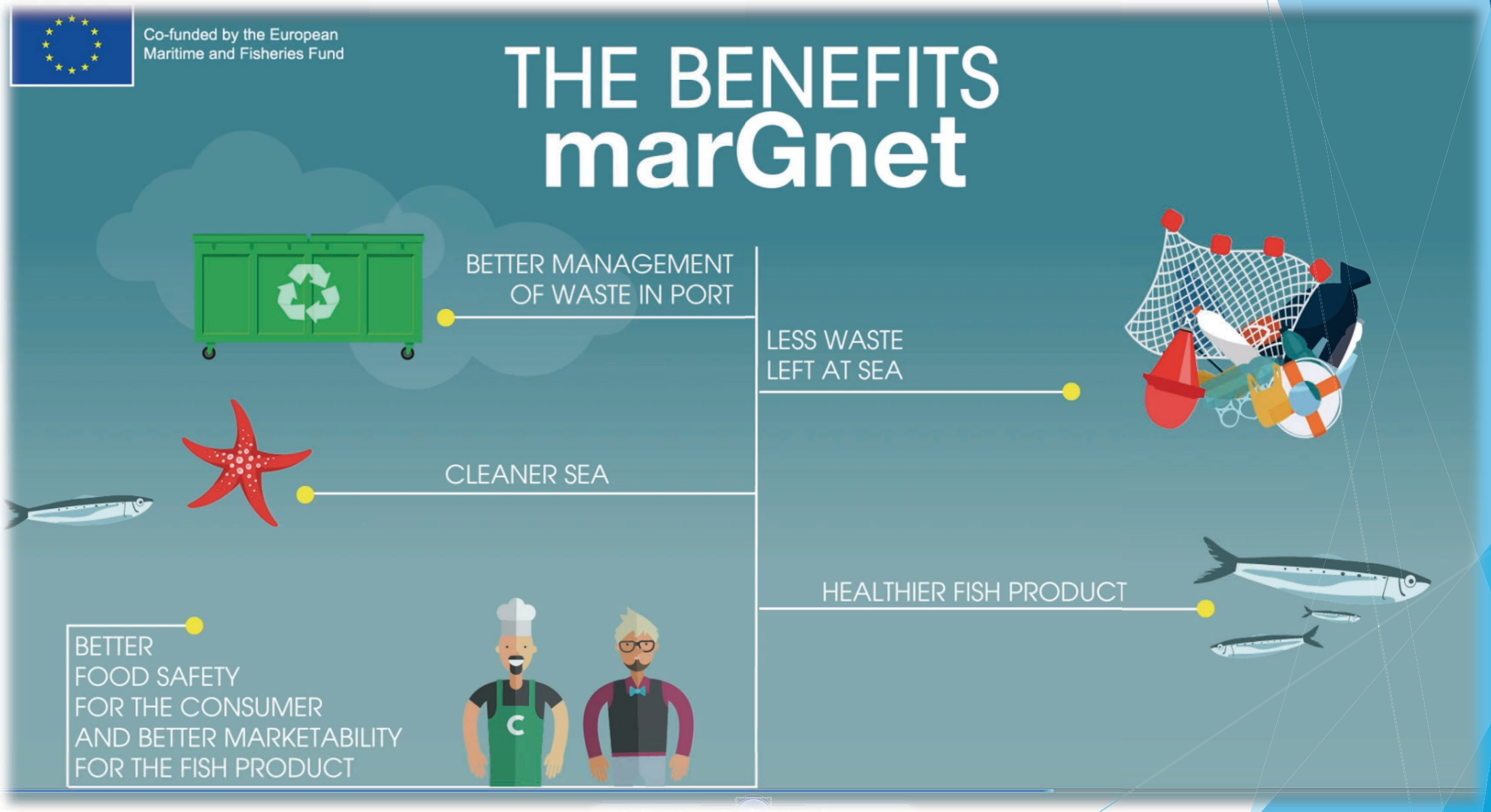
LEGISLATION

- ✓ Involvement of relevant political stakeholders to overcome legislative barriers
- ✓ On. Rocca, president of the Environment Commission of the Camera dei Deputati, Italian Paliament participated to the 3 October 2020 marGnet demostration in Venice
- ✓ Hopefully the mediatic interest awaken by marGnet will lead to legislative changes



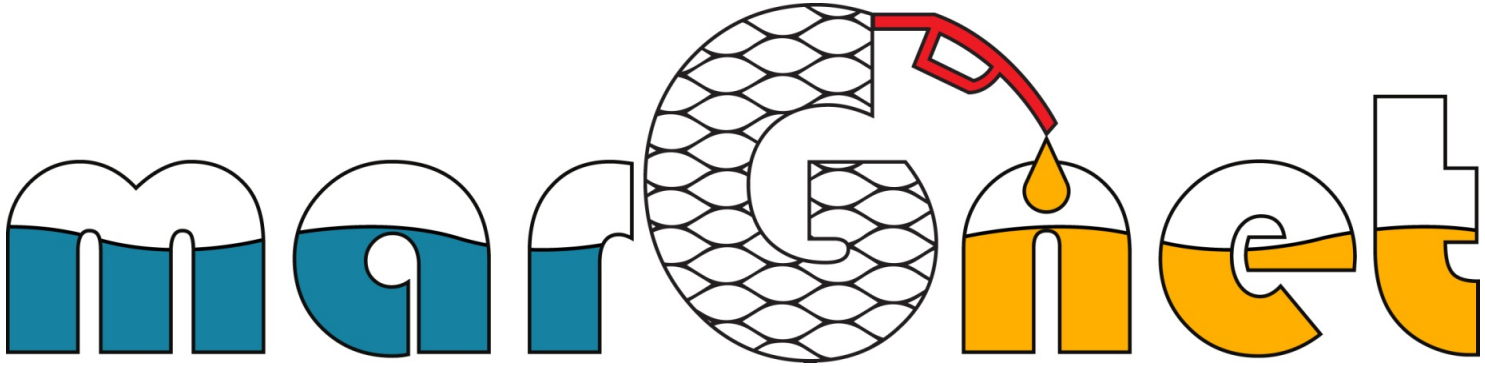


CLOSE THE CIRCLE



THANK YOU!

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



Calibration and High-Resolution Mapping of marine litter on the seabed

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Sustainable Blue Economy: Marine Litter

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MAPPING ML ON THE SEAFLOOR

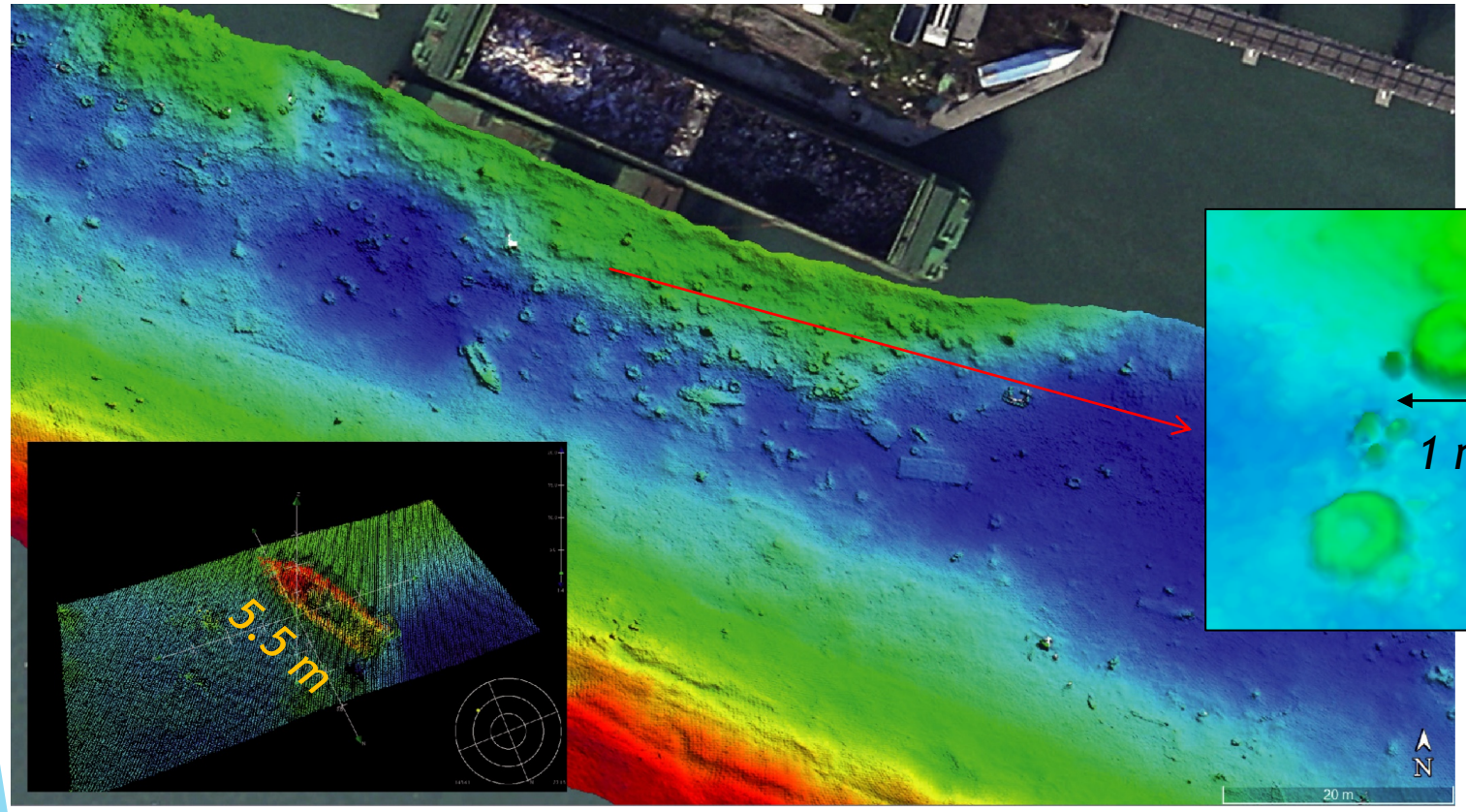
- What are the best methods to map the presence of the litter on the seafloor?

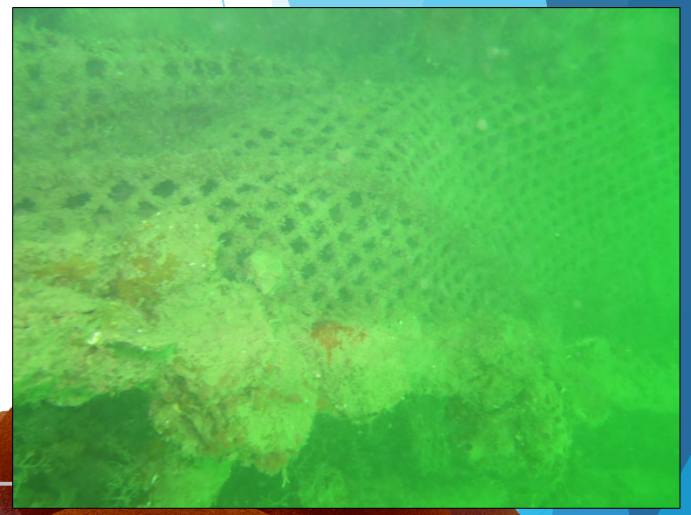
TABLE 2 | Examples of different underwater optical and acoustic methodologies reported in recent studies. The mapping rate and the detectable target dimension were estimated, where possible, from the data available in the different studies.

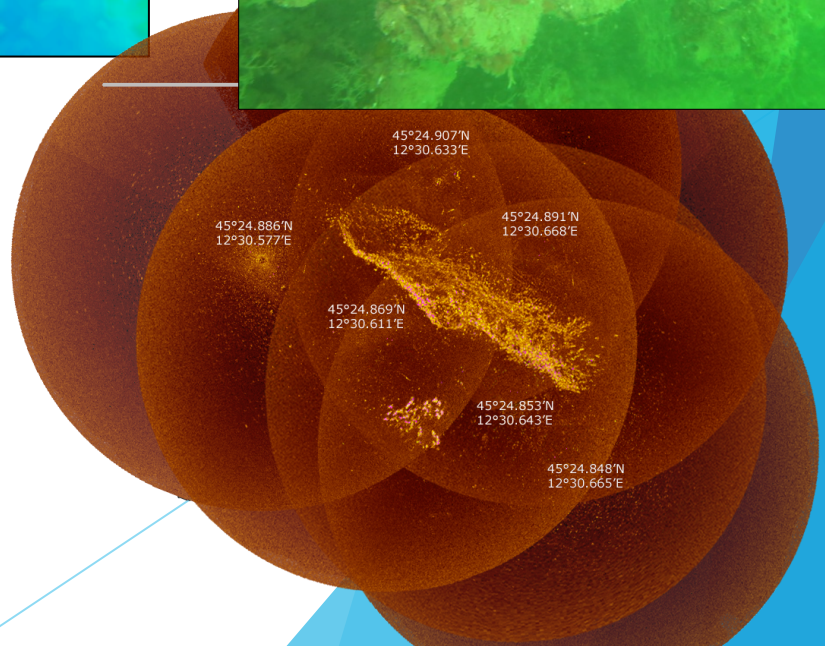
Method		Estimated mapping rate (km^2/h)	Detectable target dimension (m)	Depth (m)	Bottom type	Geographical area	Source
Optical methods	Divers	0.006	<1 m	10 m	Coral reef	Northwestern Hawaiian Islands	Donohue et al., 2001
		0.001-0.004	< 1 m	10–20	Rocky outcrop	North Adriatic Sea	Fiorin, R. (from GHOST project experience)
	Camera mounted on ROV	0.002	<1 cm	30–300	Rocky bottom	Tyrrhenian Sea	Angiolillo et al., 2015
		0.0014	<1 cm	20–30	Rocky outcrop	Northern Adriatic Sea	Melli et al., 2017
	Drifting drop frame	0.002	<10 cm	10–100	From muddy and sandy flat seafloor to bedrock and till	Bay of Fundy, Canada	Goodman et al., 2020
	UHI	0.0001	<0.8	4200	Manganese nodule field	Peru Basin (SE Pacific Ocean)	Dumke et al., 2018
		0.001	<0.8	200–400	Muddy and rocky seafloor	Bari Canyon, Adriatic Sea	Foglini et al., 2019
Acoustical methods	SSS	-	≤10 m	100–2500	-	San Francisco Bay	Chavez and Karl, 1995
		0.125	≤2 m	100–150	Soft mud seafloor	Chiniak Bay, Kodiak Island, Alaska	Stevens et al., 2000
	MBES	0.097–0.728	≤1 m (depending on the distance from seafloor)	2–20	Mostly muddy - sandy mud and rocky outcrops	North Adriatic Sea	marGnet survey - Madricardo et al., 2019
	HRSS	0.012	5 cm	10–20	Rocky outcrop and sandy seafloor	North Adriatic Sea	Fiorin, R. (from GHOST project experience)
	SAS	-	1 cm	-	Various types of seafloor	Extensive survey in different locations-	Williams, 2014
		2.25	4 cm	-	-	Southern Ionian Sea	Zwolak et al., 2020
	FLS	-	<1 cm	-	Sandy seafloor	Tank experiment	Valdenegro-Toro (2016)

from Madricardo et al., 2020

ACOUSTIC AND VIDEO MONITORING







Field experiments for acoustic data calibration

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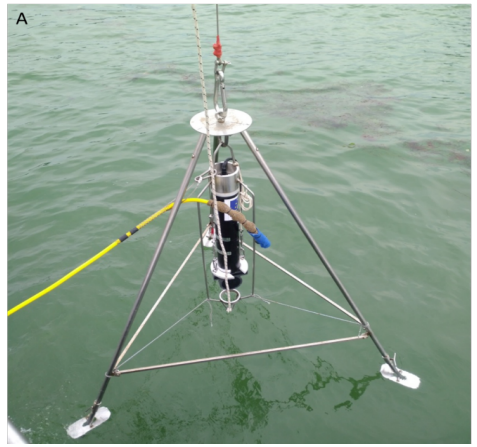
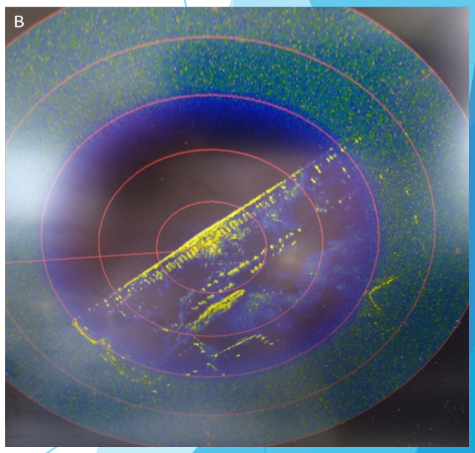
FIELD EXPERIMENTS

- 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)

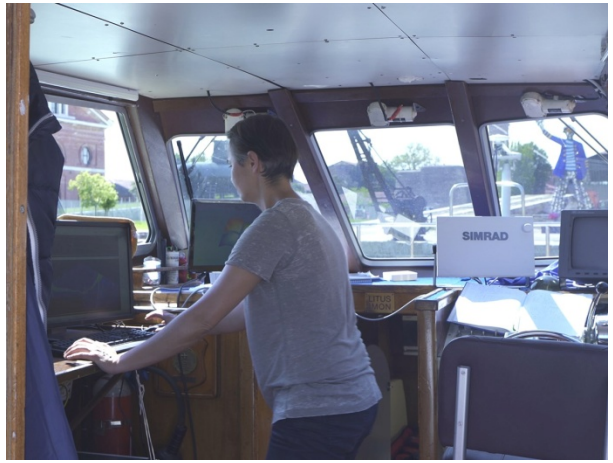
Co-funded by the European Maritime and Fisheries Fund





High resolution scanning sonar (HRSS)

FIELD EXPERIMENTS FOR ACOUSTIC DATA CALIBRATION CARRIED OUT IN JUNE 2019



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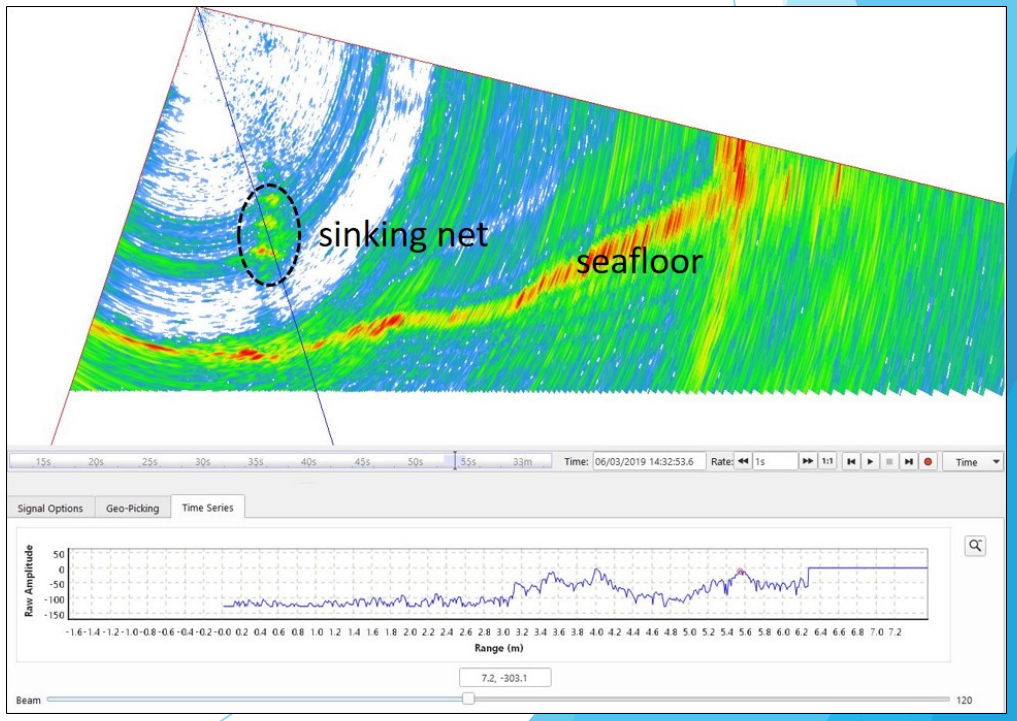

FIELD EXPERIMENTS RESULTS

- 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

RESEARCH OBJECT:
OPEN DATA AND REPRODUCIBLE ALGORITHMS
IN AGREEMENT WITH THE
FAIR PRINCIPLES

Co-funded by the European
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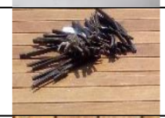
ML MEASURED SINKING VELOCITIES

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

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

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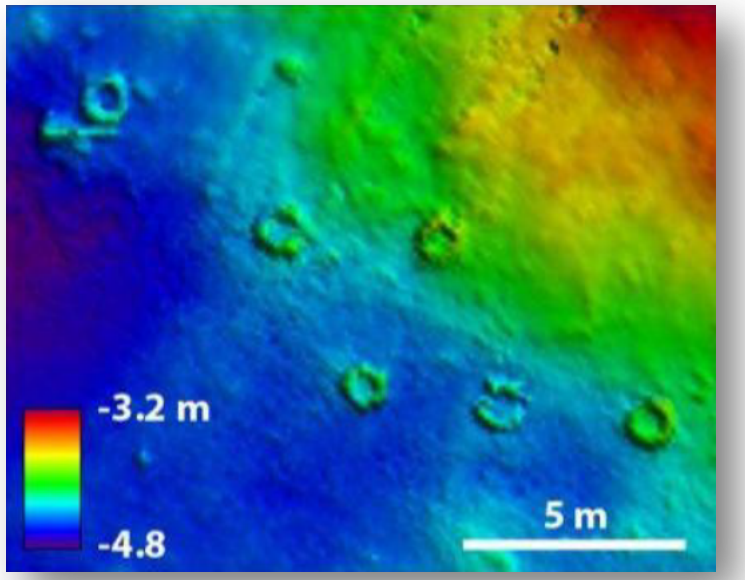
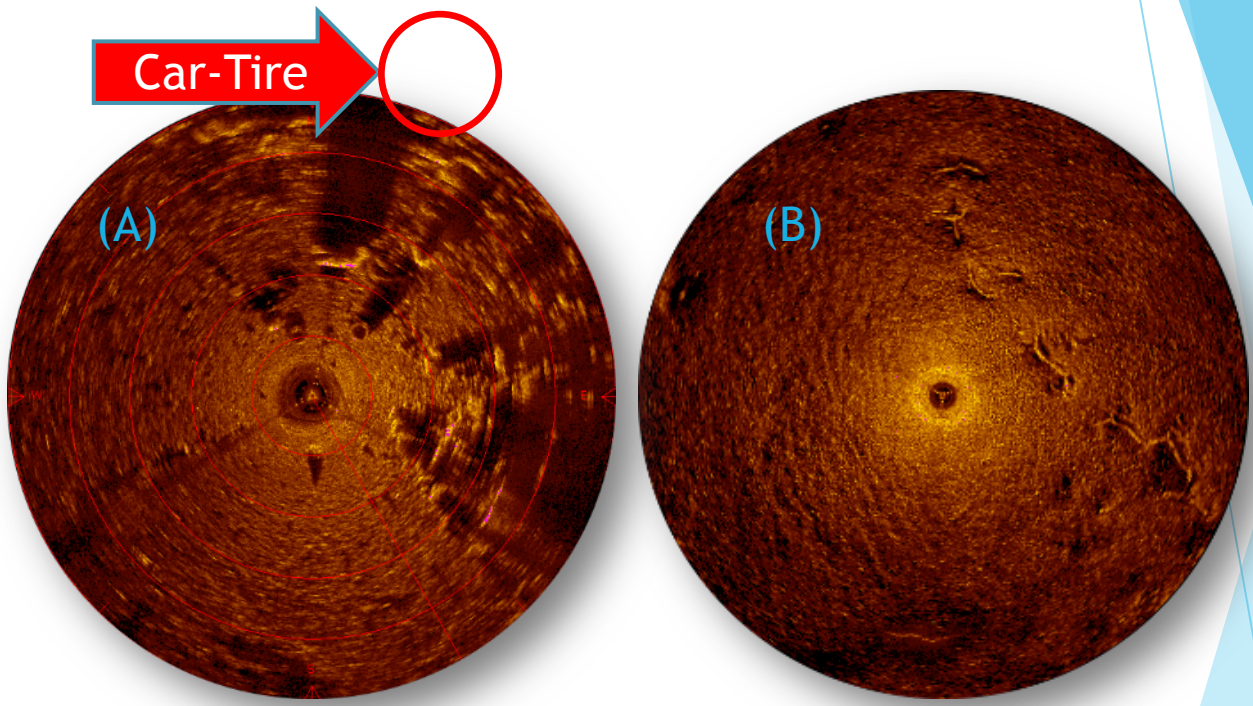
MAPPING ML ON THE SEAFLOOR



Example of tires on the Venice Lagoon seafloor mapped with a high resolution MBES



Example of a seafloor image obtained with the HRSS -MS 1000 that shows the presence of tires in Losinj island (A) and a trawling net Cable (B) outside the Venice lagoon

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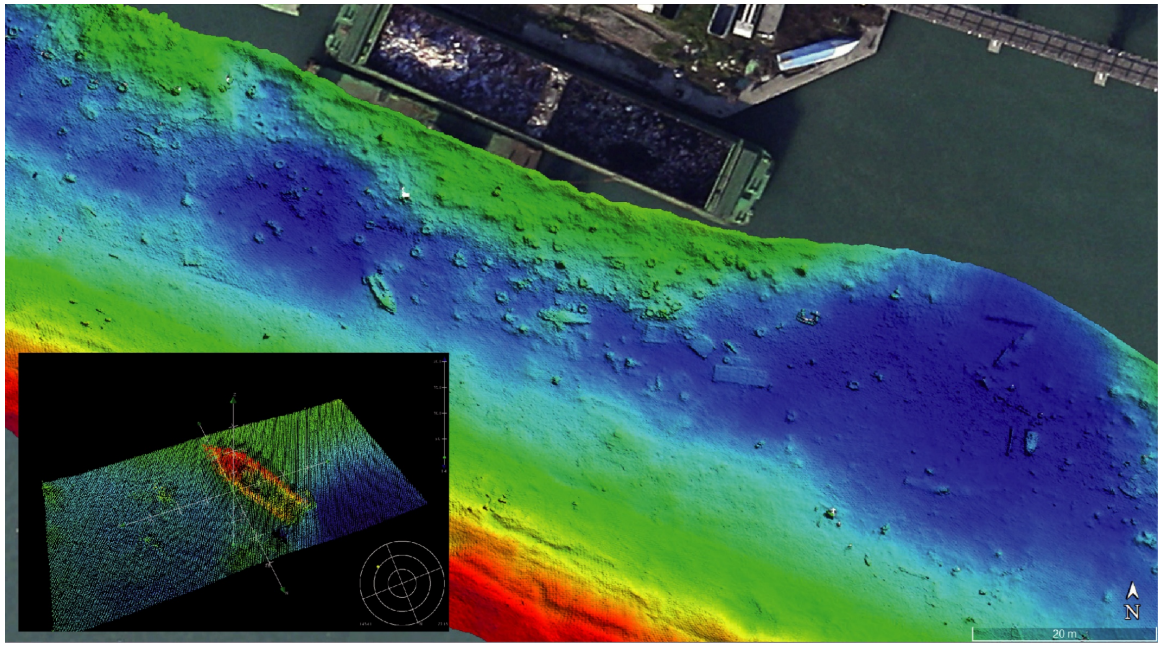
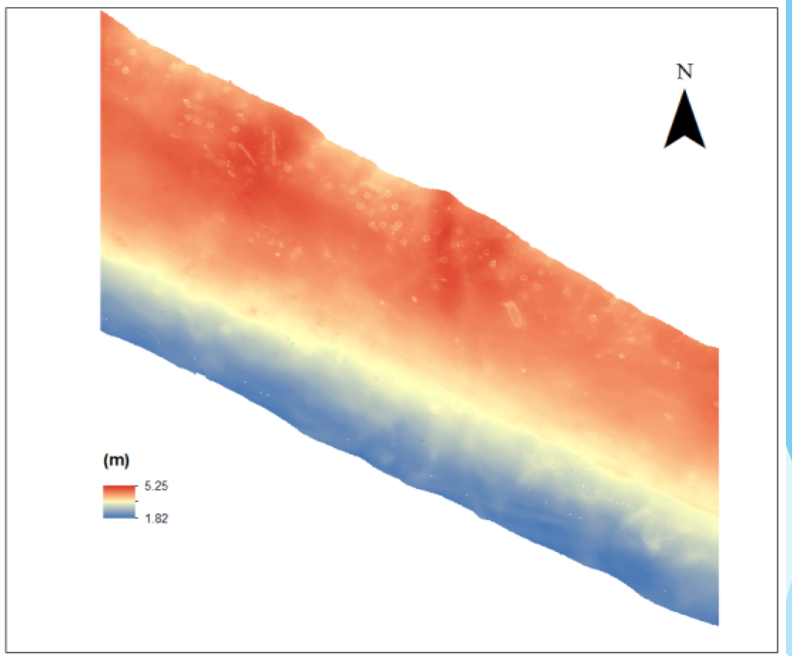
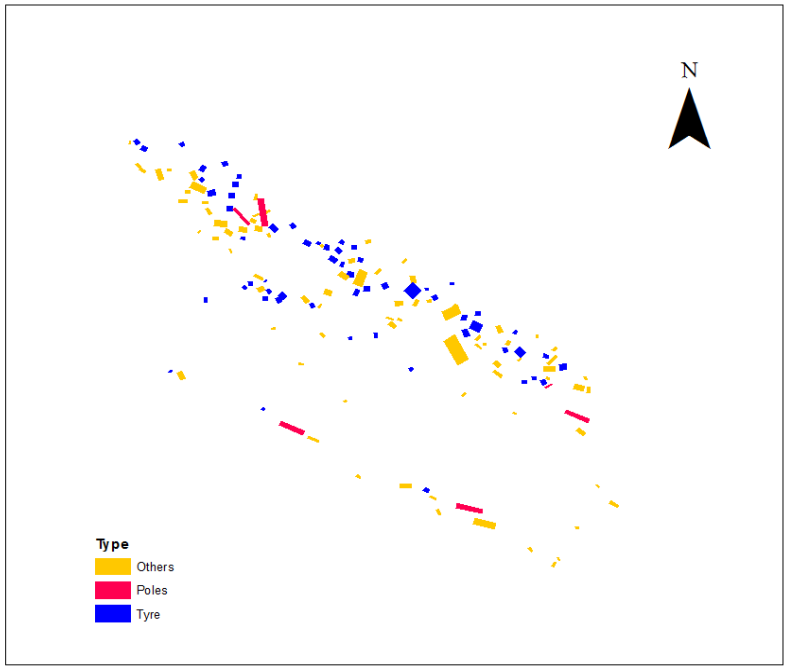
- High resolution bathymetry can be very useful to detect and classify ML







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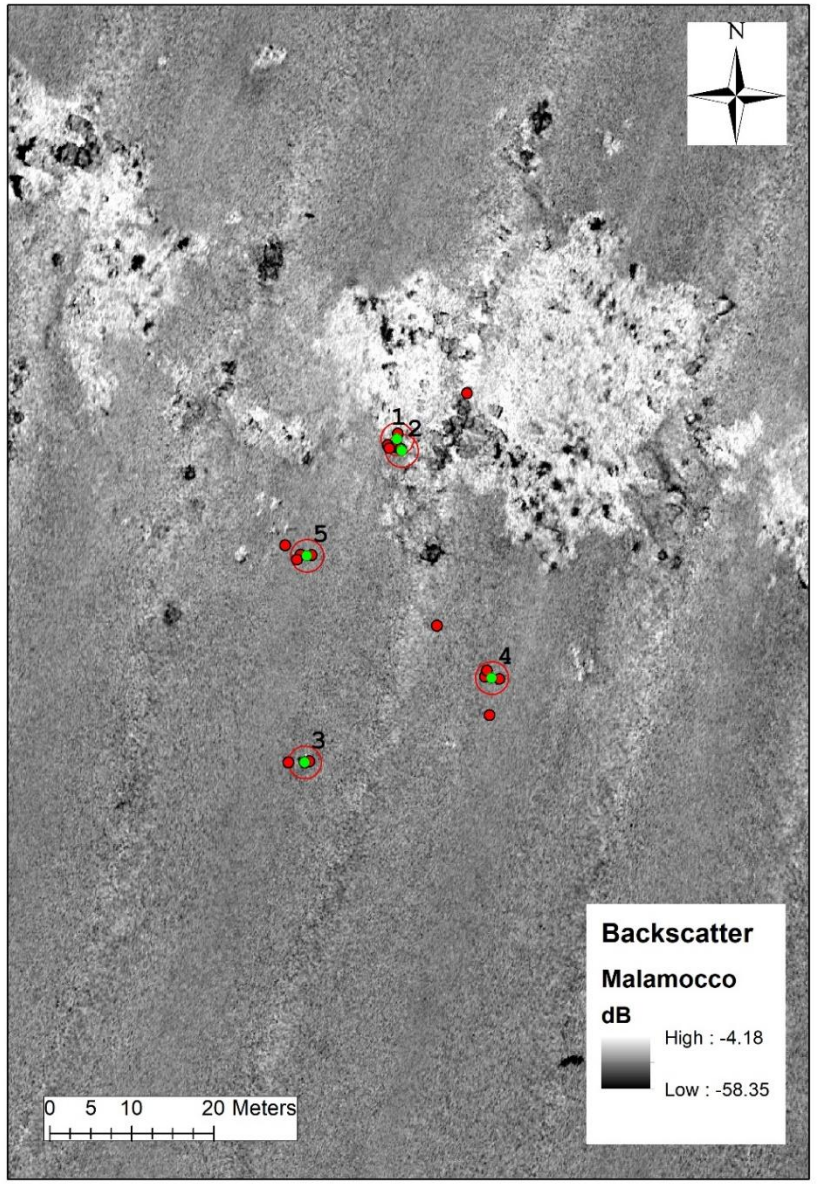
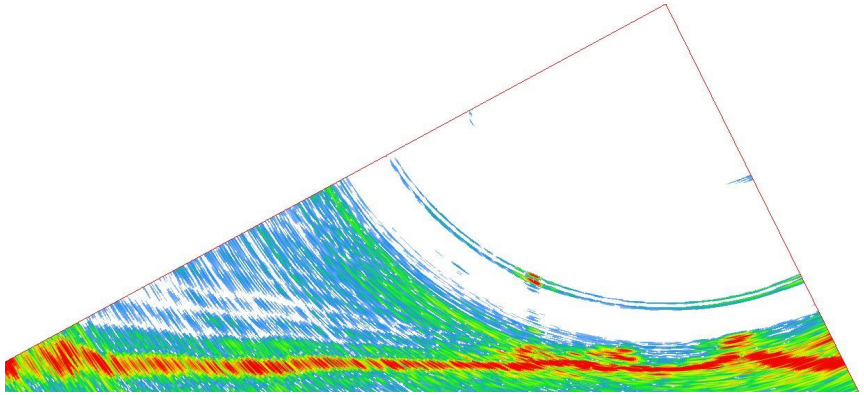
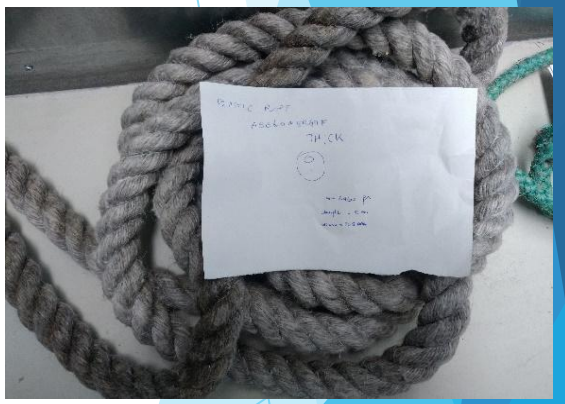
Ground truthing and removal activities



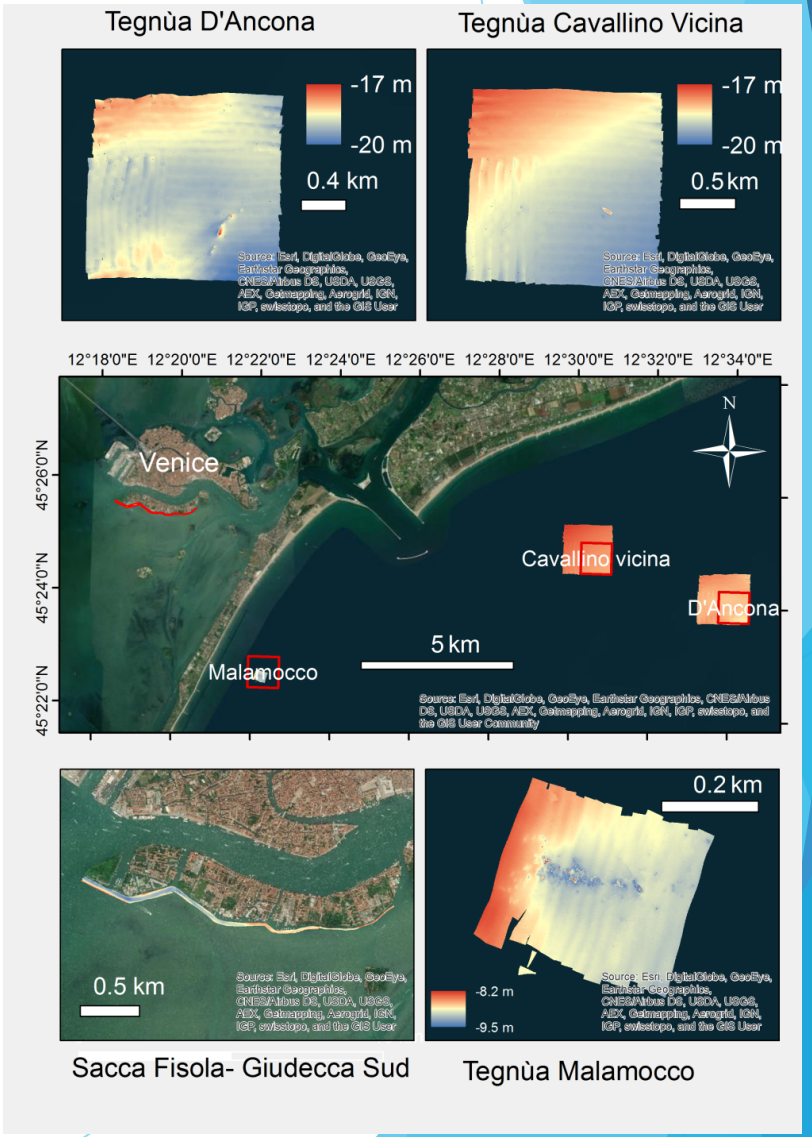




Co-funded by the European Maritime and Fisheries Fund

MAPPING MAIN RESULTS

- ✓ Fast methodology to extensively map the seafloor with acostic methods and video
- ✓ 2 semiautomatic algorithms developed for automatic ML extractions (ROs)
- ✓ Total of 8 km^2 explored on soft and hard substrates in Italian and Croatian waters



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

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

Sustainable Blue Economy: Marine Litter

Development of a modelling tool for simulation of dispersion of the sinking marine litter

Co-funded by the European Maritime and Fisheries Fund

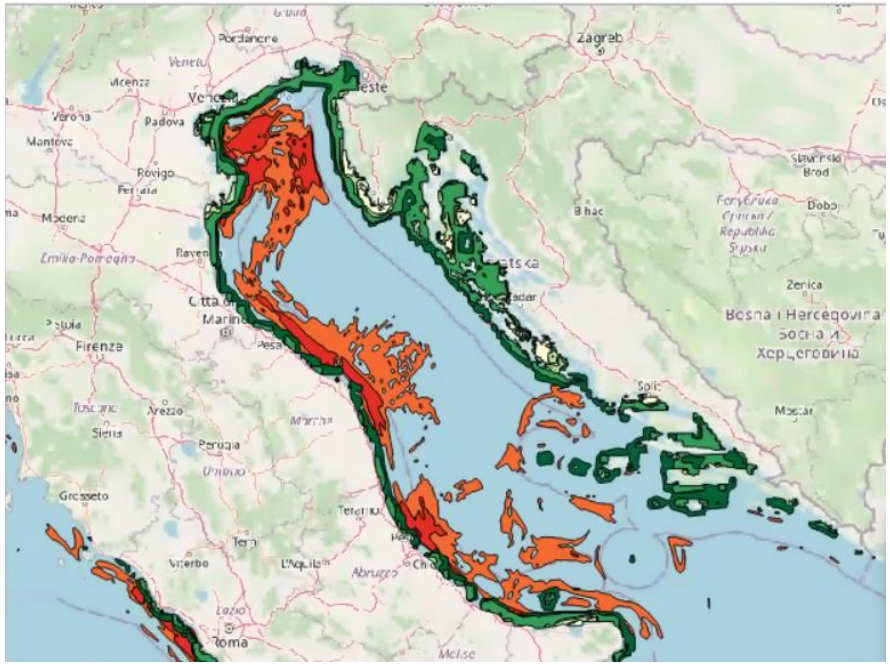
Overview:

1. Location of different sources of ML by fishing activities
2. SHYFEM model and set-up
3. ML sinking characteristics
4. Numerical experiments
5. Results: hotspots from modeling vs. field data

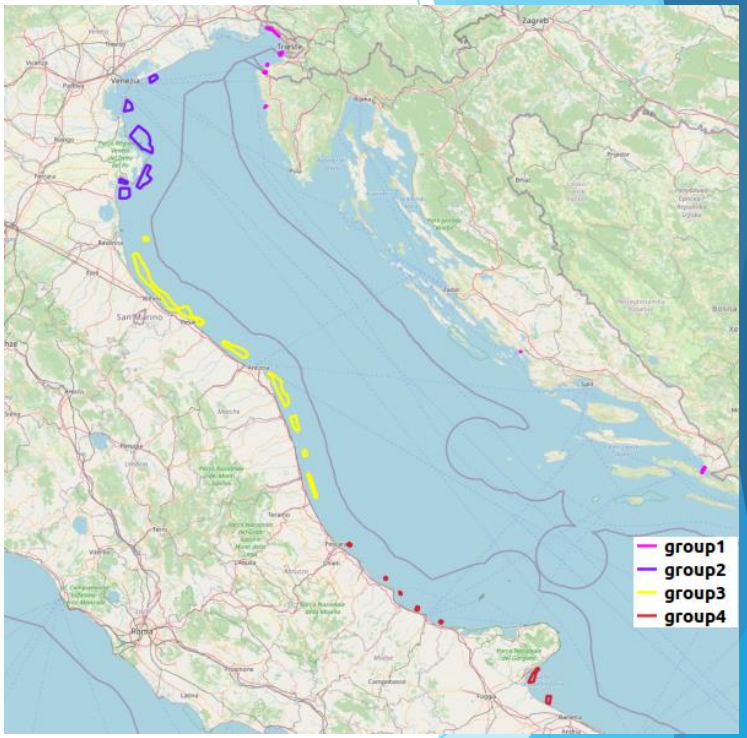
Aim: identification of potential hot spots and distribution of ML on the sea floor

Co-funded by the European Maritime and Fisheries Fund

1. Location of different sources of ML by fishing activities



Small and **medium** scale fishing



Aquacolture

Co-funded by the European
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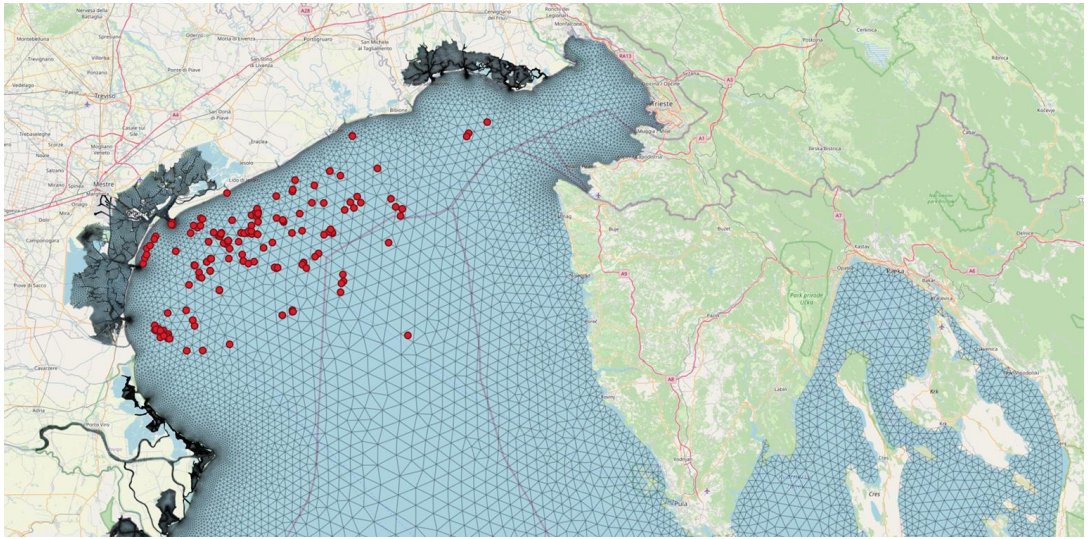
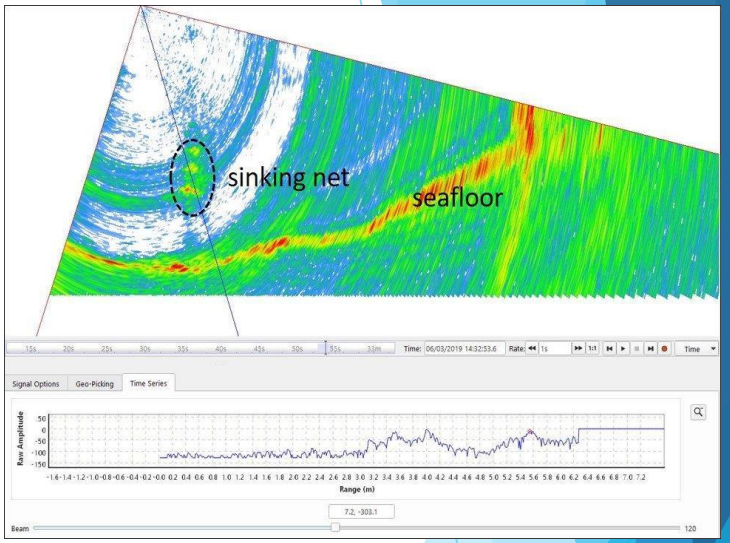
2. SHYFEM model and set-up



Finite element hydrodynamic model applied to the Adriatic Sea simulating 1 year under realistic forcing conditions.

Red points represents rocky bottom, where particles are trapped

3. ML sinking characteristics



Sinking velocity of small nets: less or equal to 0.001 m/s

Other objects sinks very fast

Co-funded by the European Maritime and Fisheries Fund

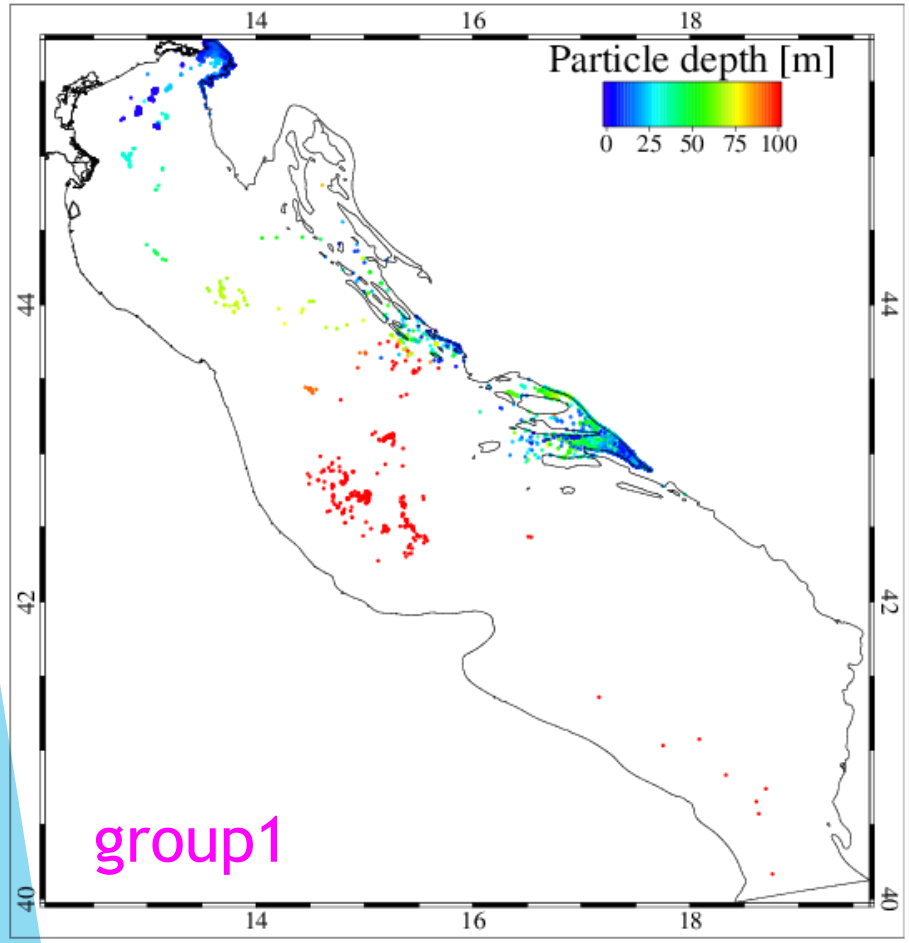
4. Numerical experiment, data elaboration

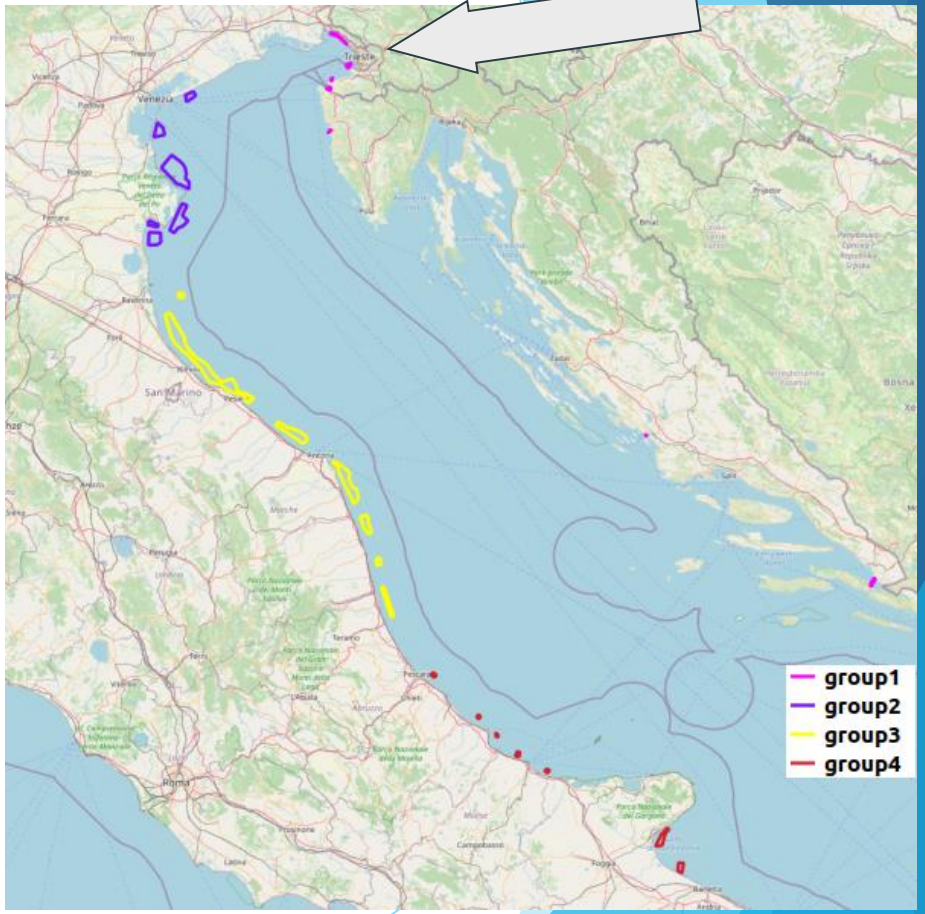
SET-UP for the SHYFEM MODEL

- 1 year long simulation, stop on rocky bottom, sinking velocity 0.0001 m/s,
- Release of particles separately form AQUACOLTURE or FISHERY AREAS every day on midnight, 1000 particles for day

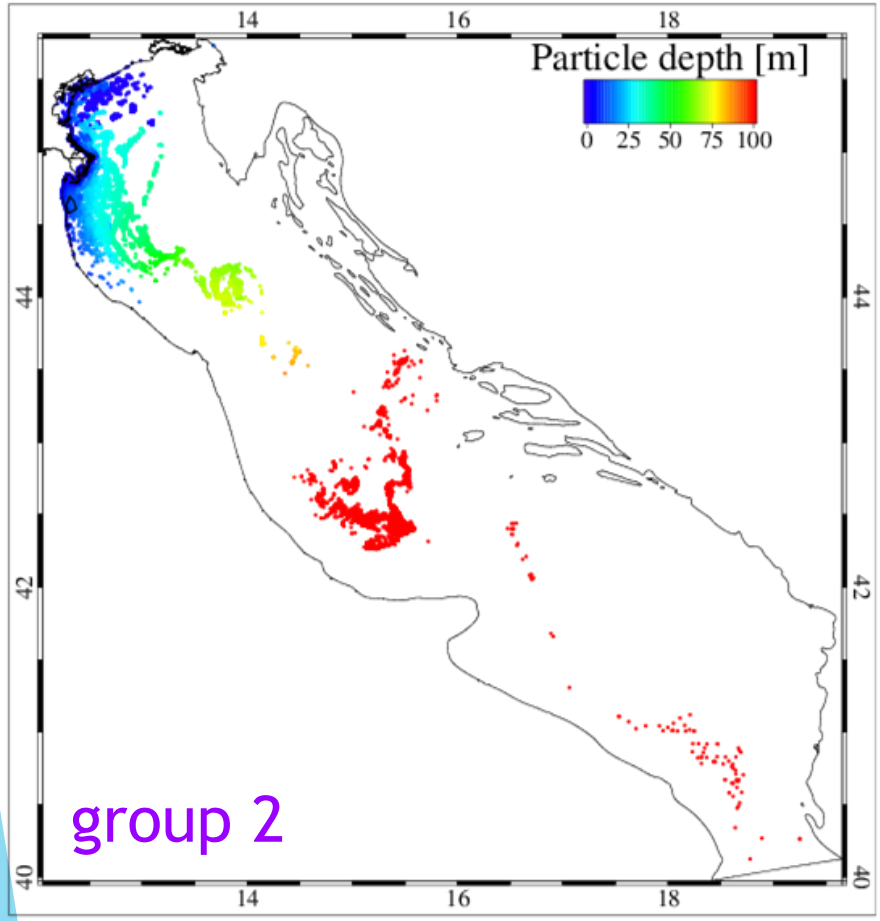
DESCRIPTORS of the SIMULATION RESULT:

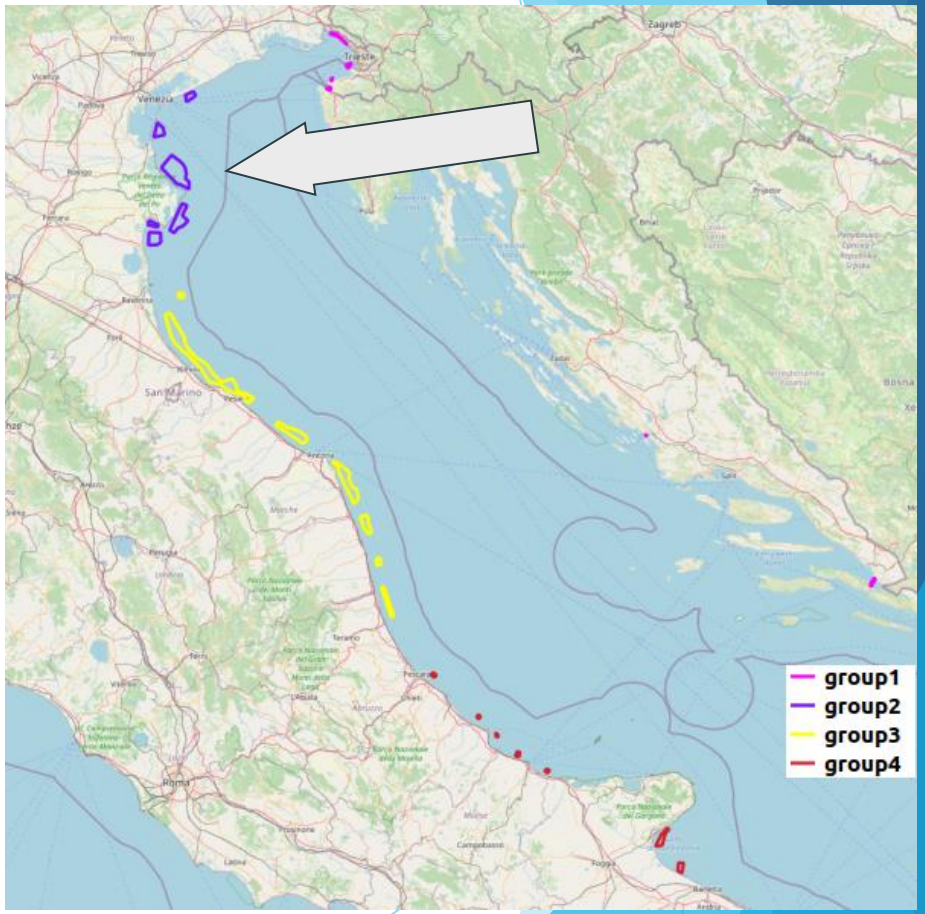
1. **Density** of particles on the bottom at the end of the simulation
2. % particles: beached, in the water column , on the bottom



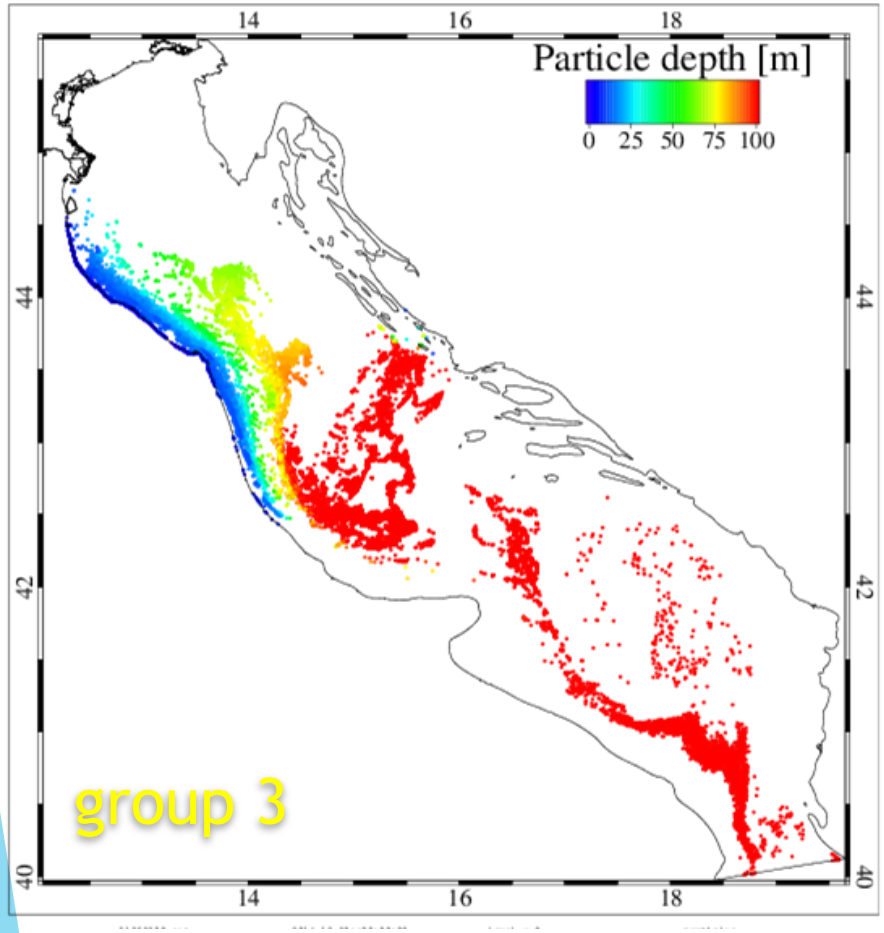


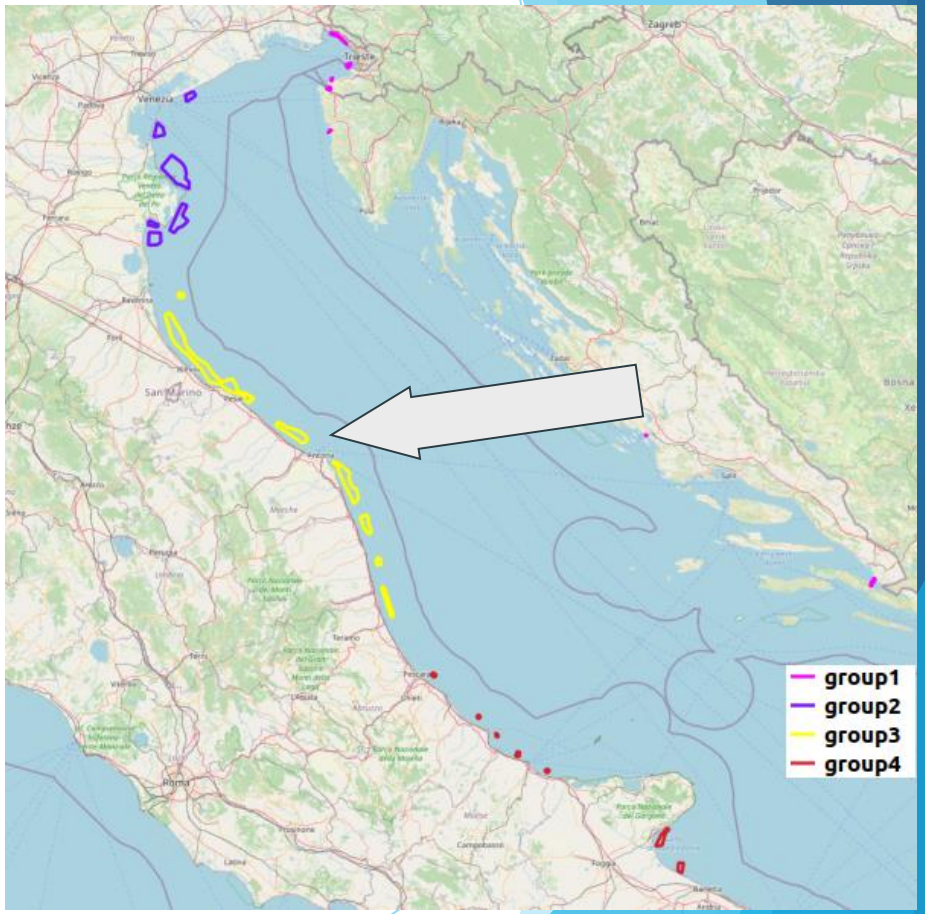
Particles beached 77.5 %



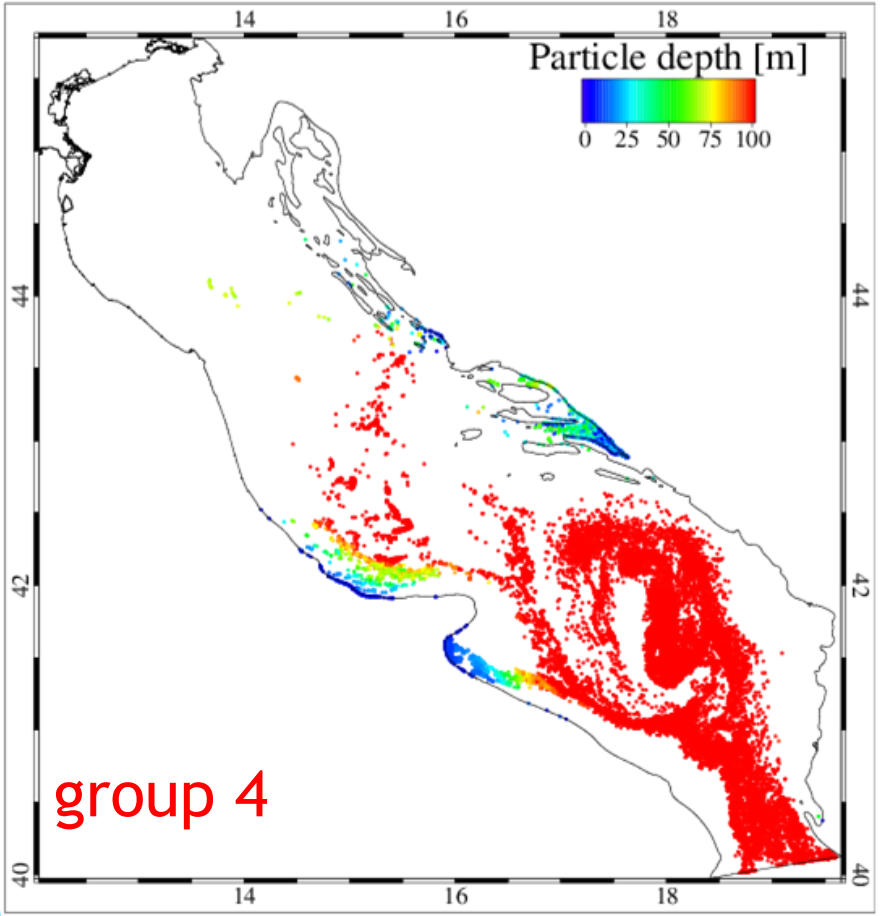


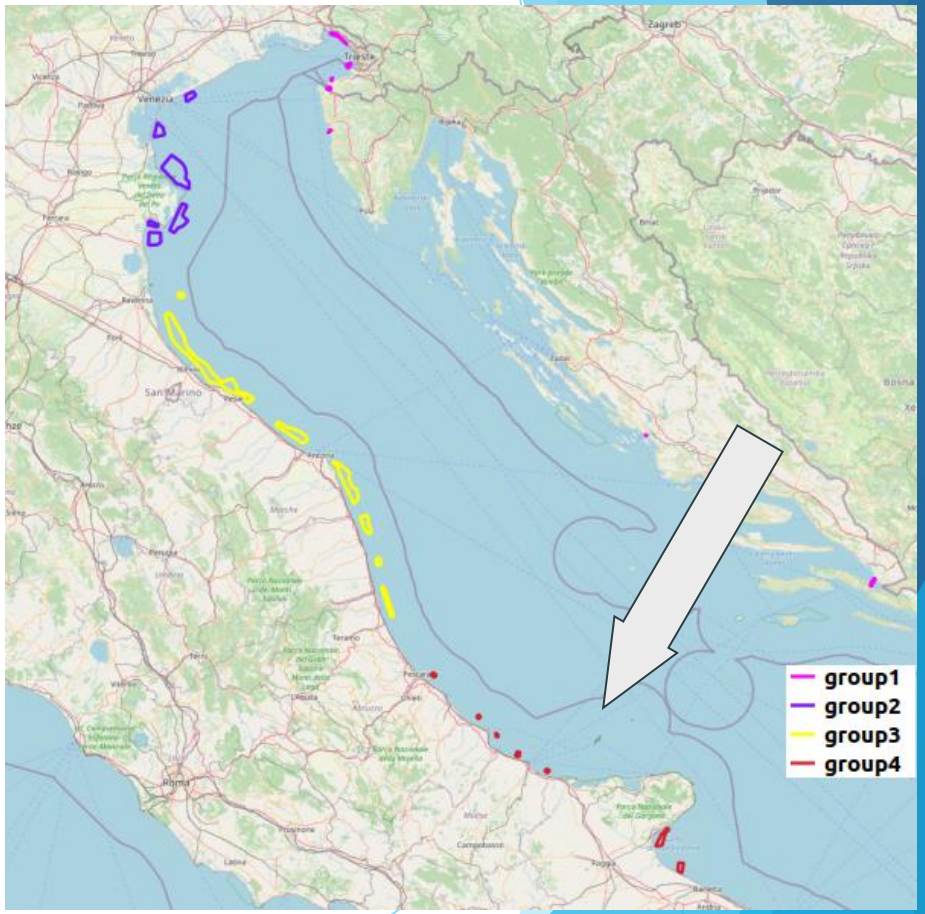
Particles beached 6.7 %





Particles beached 2.4 %

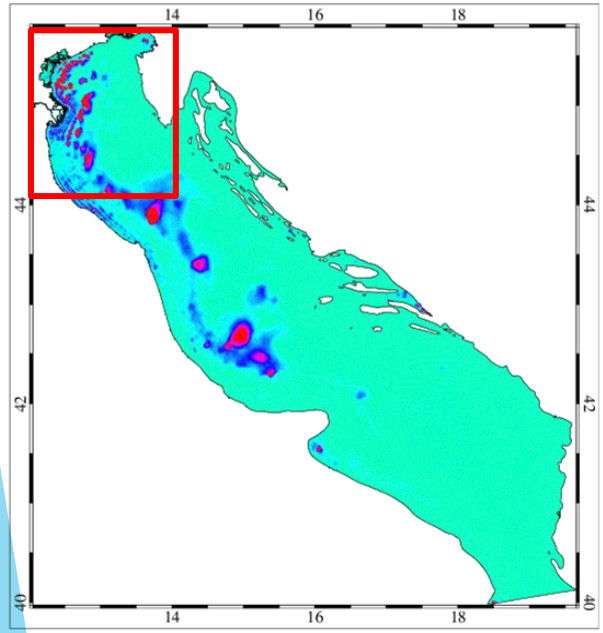


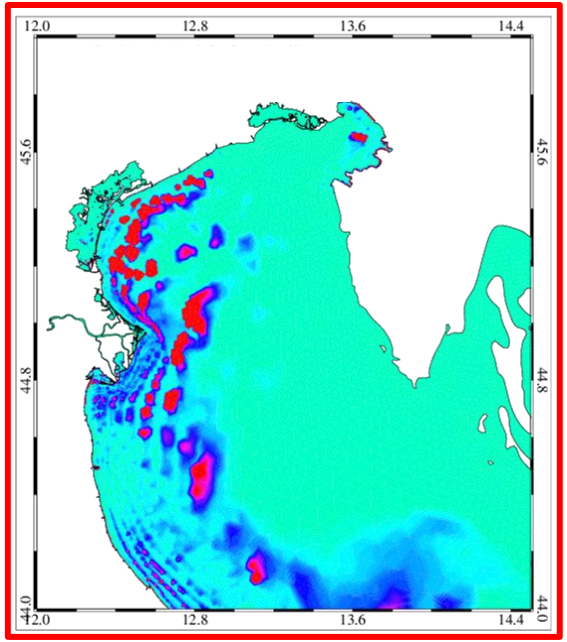


Particles beached 4.7 %

Bottom hotspots of ML from aquacolture sources

Comparison with Bottom ML distribution by literature (AQUALIT)





Particle density [10^-6 part/m2]

0 11 22 33 44 56 67 78 89 100

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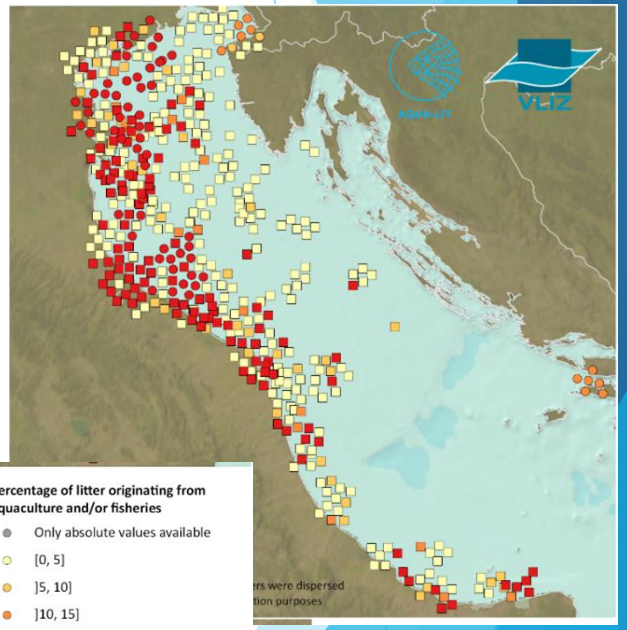


Percentage of litter originating from aquaculture and/or fisheries

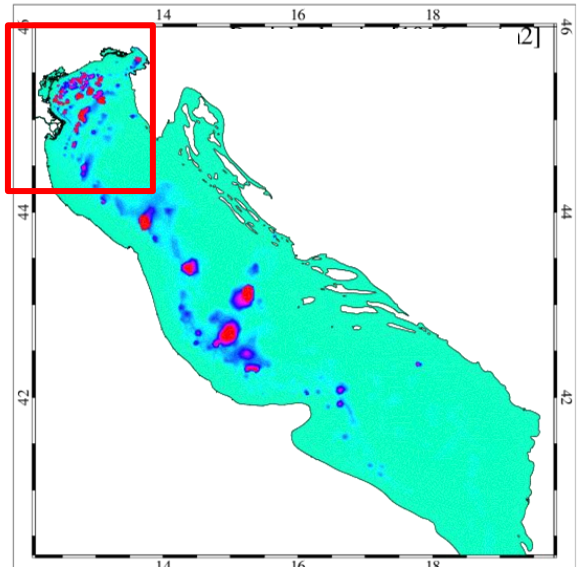
- Only absolute values available
- [0, 5]
-]5, 10]
-]10, 15]
- > 15

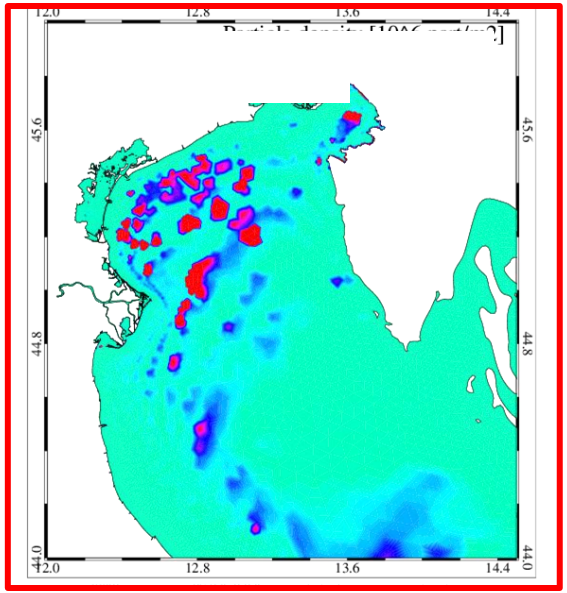
Litter source

- Aquaculture/fisheries
- Aquaculture

Created: 2019-04-10
Projection: Europe Lambert Conformal Conic
Source: GEBCO, ESRI, OSPAR, DeFishGear, Strafella et al. 2015, GHOST, Ioakeimidis et al. 2014, Melli et al. 2017, Cau et al. 2017, Fortibuoni et al. 2019

Bottom hotspots of ML from fishing activity sources





Particle density [10^-6 part/m2]

0 11 22 33 44 56 67 78 89 100

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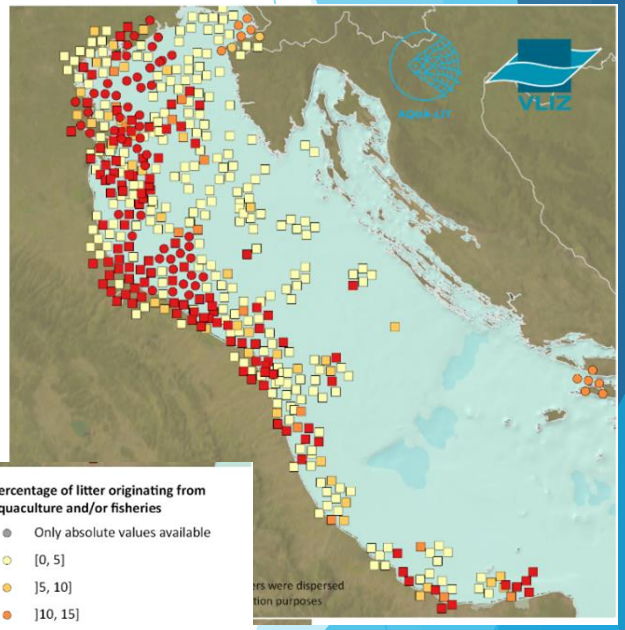
Comparison with Bottom ML distribution by literature (AQUALIT)



Conclusions

1. we developed a numerical tool to estimate the location of potential seafloor marine litter hotspots

2. despite several knowledge gaps (intensity of sources, threshold of resuspension..) the results are comparable with field data of marine litter on the sea floor at basin scale

3. the modeling helps us to assess the location of marine litter accumulation but also to evaluate the potential influence of different sources

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Thank you for your attention

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

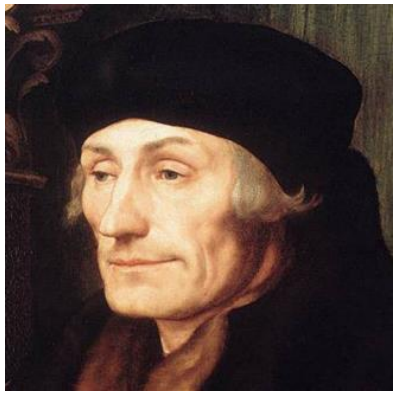
Sustainable practices in marine litter removal

EASME/EMFF/2017/1.2.1.12/S2/05/SI2.789314
Sustainable Blue Economy: Marine Litter

Dr. Federico Riccato

Co-funded by the European Maritime and Fisheries Fund

«Prevent is better than cure»



(Erasmus of Rotterdam 1467-1536)

Unfortunately removing marine litter from the sea floor it's a tricky job:

- it's time consuming (in order to find ML and to correctly plan the removal, with long stand-by periods);
- it's not cheap (activities should be carry on by specialized personell: experts in acoustic monitoring, scuba divers and sailor man with appropriate instruments);
- Unsafe (scuba activities may be conducted in turbid waters,with the presence of currents or low temperatures).

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The ML algorithm

1. Find Marine Litter;
2. Evaluate and Plan removal;
3. Remove and correctly dispose ML.






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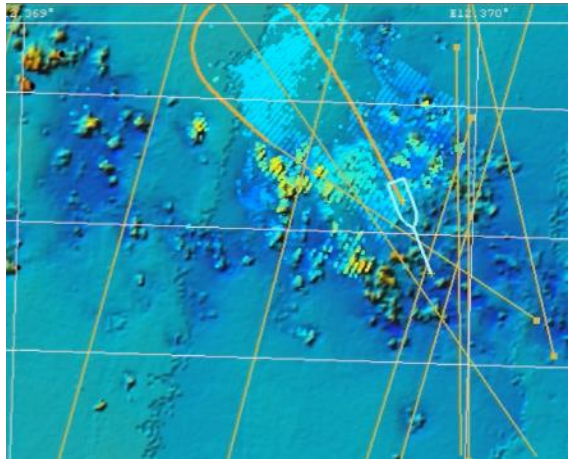
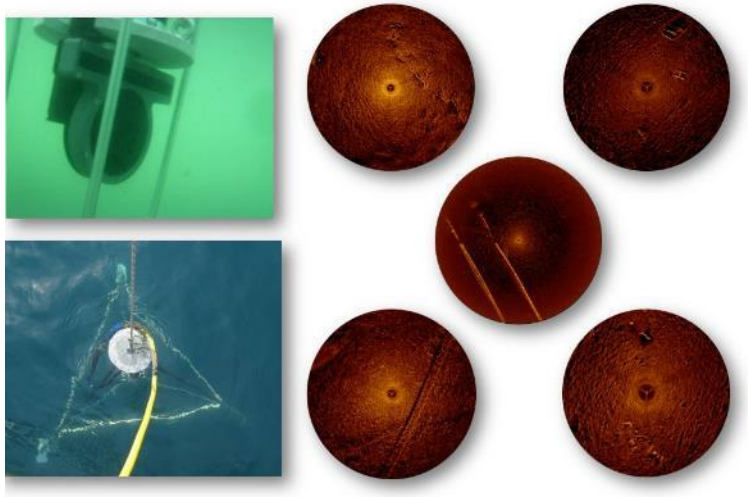
1. MONITORING or «HOW TO FIND ML»

- The marGnet fast methodology for wide scale mapping of the presence of ML by mean of combined multi-sensor high resolution acoustic mapping was successfully tested by several divers' inspections



Multibeam for expeditious monitoring of wide portion of seafloor



HRSS for detailed mapping in complex environments and turbid waters (ports, channels, rivermouths)

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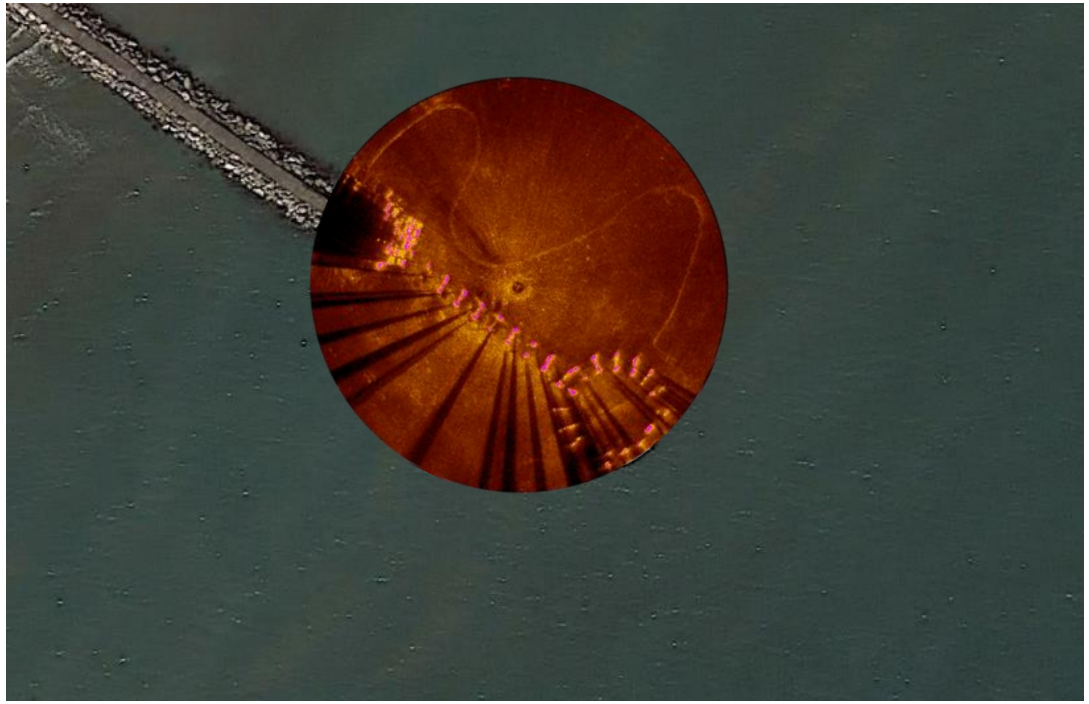
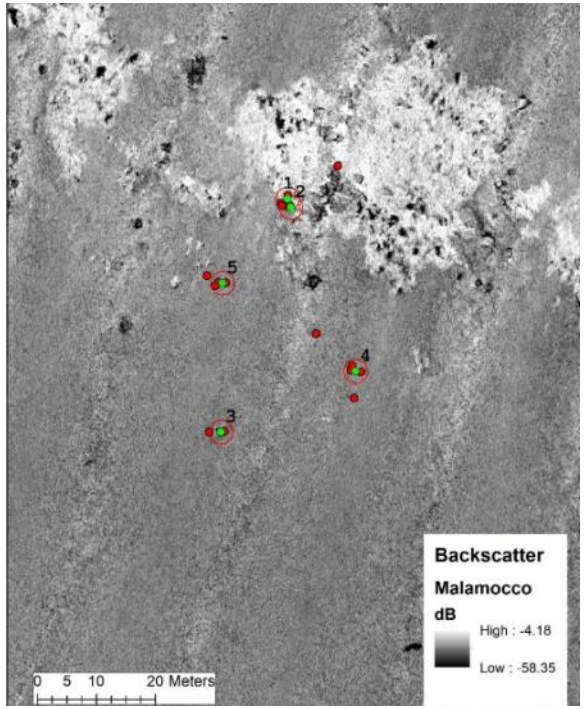
1. MONITORING or «HOW TO FIND ML»

- The presence of non-natural signals and «strange» echoes in the acoustic maps where recorded…





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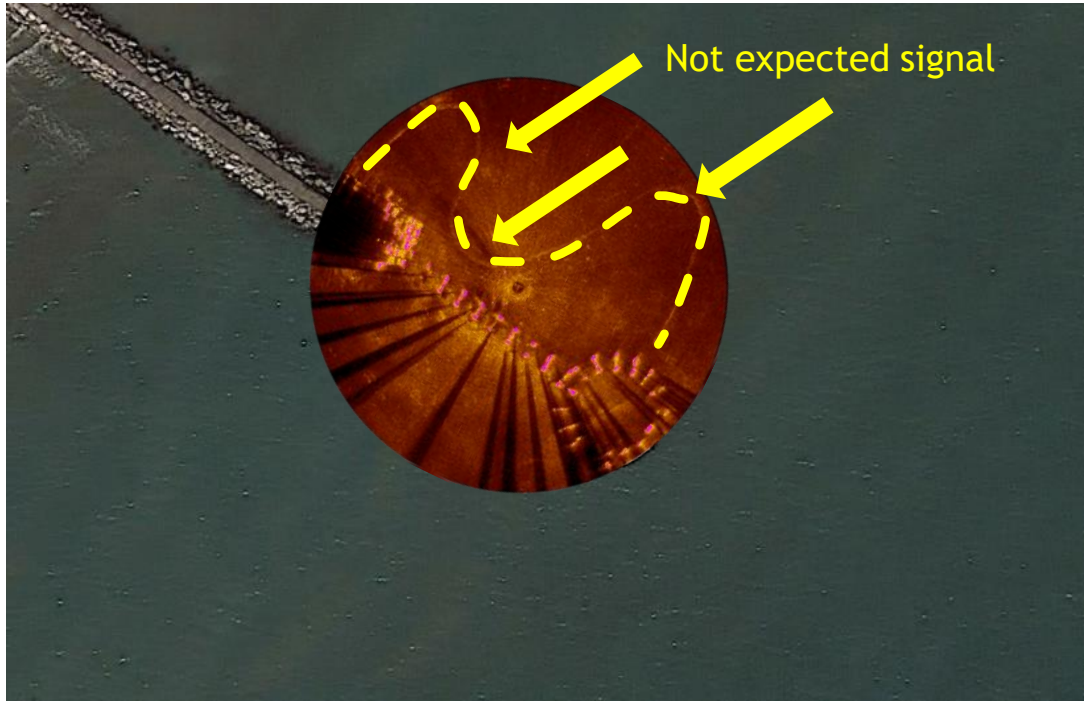

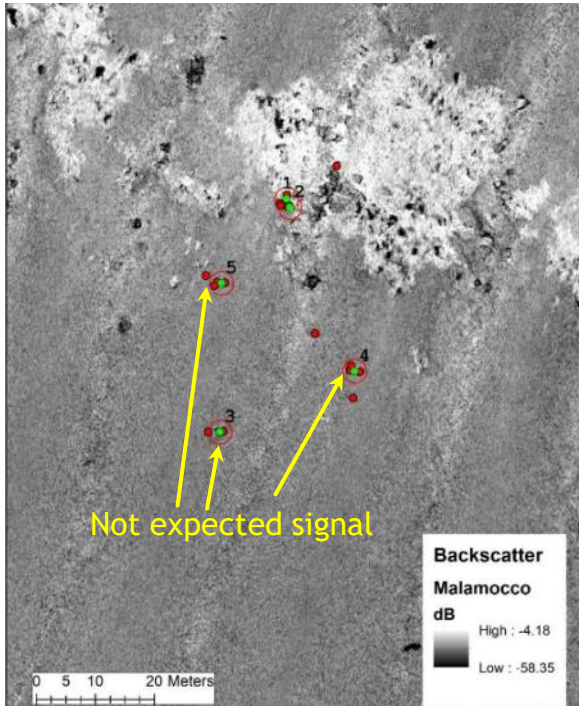

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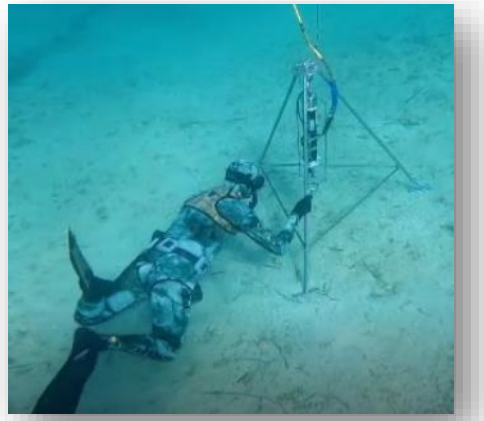
1. MONITORING or «HOW TO FIND ML»

- …and checked by scuba divers, both in Italy and Croatia.



Gulf of Venice	Losinj Island
23 dives for groundtruthing	13 dives for groundtruthing

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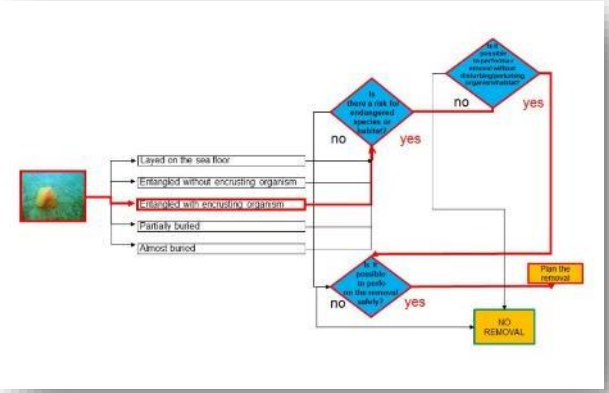
2. EVALUATE REMOVABILITY AND PLAN REMOVAL

- Once mapped the presence of ML on the sea floor a process of evaluating removability was conducted in order to:

1. Do not damage organisms (focusing on protected species) or habitat during removal;
2. Removal activities were carried out only if they were safe for the personell and for the environment;
3. Correctly identify materials and pollutants to ensure a proper disposal of removed ML.



2. EVALUATE REMOVABILITY AND PLAN REMOVAL

- Gill nets
  - Gill nets → Plastic materials: PP, PET, PE, NYLON, PL; Lead, stain.
  - Drift net → Plastic materials: PP, PET, PE, NYLON, PL
- Traps and cages
  - Cuttlefish traps → HDPE, Nylon, PP
  - Crabs and lobster traps → Plastic materials: PP, PET, PE, NYLON, PL; Metallo (ferro o acciaio)
- Trawls and active nets
  - Bottom trawls → HDPE; Nylon
  - Pelagic trawls → Plastic materials: PP, PET, PE, NYLON, PL; Metallo (ferro o acciaio)
  - Rake trawls → PP, NYLON, Metal (iron or steel)
- Fishing garbage
  - Mussel nets → Nylon
  - weights → Plastic, metal, concrete
  - Ropes → Nylon, polipropilene, polietilene, poliestere, PBO-Zylon, Dyneema, Vectran
  - Artificial baits → Nylon, acciaio, plastica

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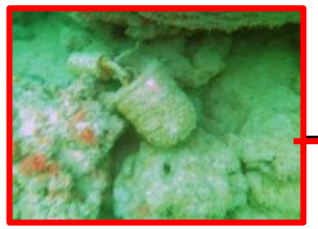

Layed on the sea floor

Entangled without encrusting organism

Entangled with encrusting organism

Partially buried

Almost buried

Is there a risk for endangered species or habitat?

no

yes

Is it possible to perform a removal without disturbing/perturbing organism/habitat?

no

Yes

Is it possible to perform the removal safely?

no

si

Plan the removal

NO REMOVAL

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2. REMOVE AND CORRECTLY DISPOSE ML

- Margnet has capitalised and strengthened the removal protocols set up in previous initiatives (LIFE-GHOST)…

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2. REMOVE AND CORRECTLY DISPOSE ML

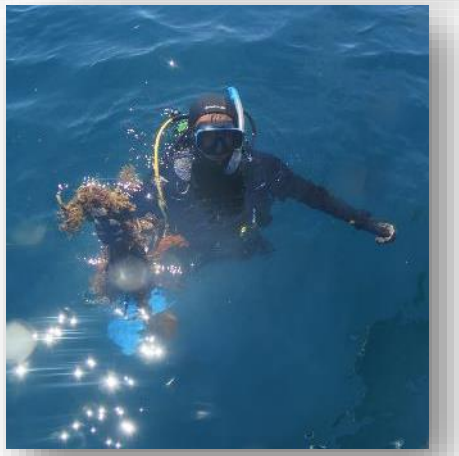
- …widening his range of action to the eastern side of the Adriatic Sea, demonstrating that the protocols and the techniques used are exportable to other Mediterranean areas and probably worldwide in shallow coastal areas.

2. REMOVE AND CORRECTLY DISPOSE ML

- The removed materials, both from the Italian and the Croatian coast were dried and prepared for “conversion”








- More than **100kg** of ML were sent to Sintol to get them transformed in to oil

Thanks for your attention!

Dr. Federico Riccato

LAGUNA PROJECT

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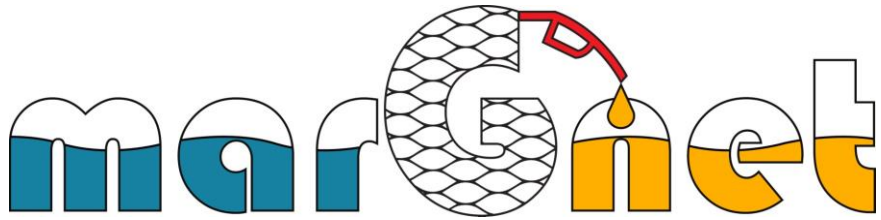
Mapping and recycling of marine litter and Ghost nets on the sea-floor



Low Temperature Pyrolysis to Recycle marine litter

Gian Claudio Faussone
(SINTOL – Torino)

Final Event, on line, December 10, 2020

EASME/EMFF/2017/1.2.1.12/S2/05/SI2.789314 Sustainable Blue Economy: Marine Litter

ISMAR BLUE WORLD INSTITUTE SINTOL LAGUNA PROJECT techneprojects GROWING UP PROJECTS

Co-funded by the European Maritime and Fisheries Fund

Marine Litter

*"Marine litter consists of items that have been deliberately discarded, unintentionally lost, or transported by winds and rivers, into the sea and on beaches. It mainly consists of plastics, wood, metals, glass, rubber, clothing and paper" **

*"Marine litter is a growing global problem which poses an increasingly serious threat to the environment, the economy and health. To rid our coasts and seas of marine litter, we need to understand its various sources, forms and impacts and come up with imaginative, concrete and ambitious solutions. Meanwhile, we must all reflect on what we choose to buy and discard to reduce the amount of litter ending up at sea" ***

* European Commission
** K. Falkenberg Director-General for Environment European Commission

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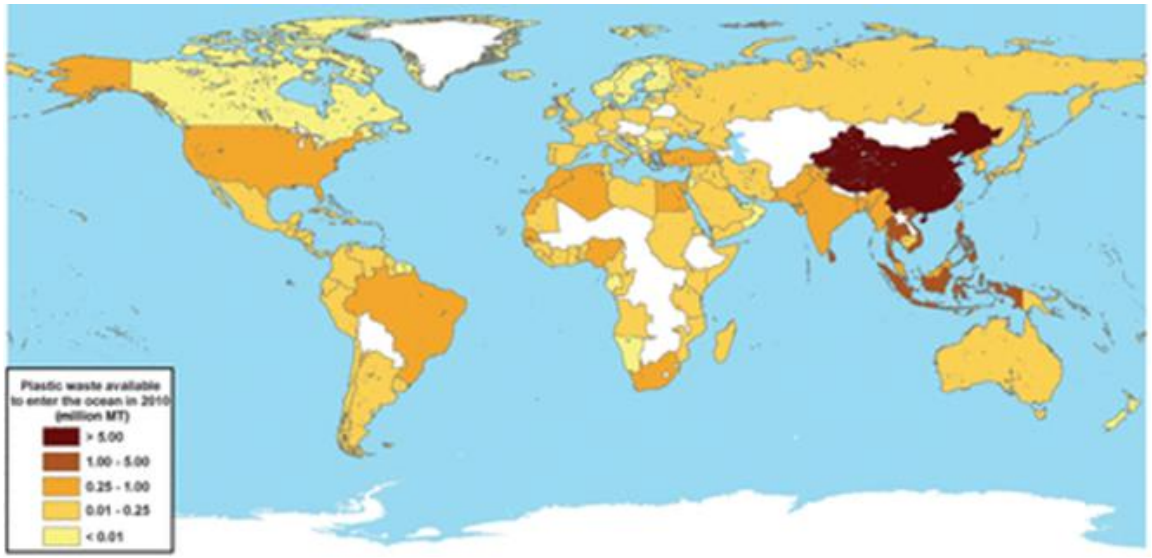
ML: a problem of waste (mis)management and lack of pragmatic solutions



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*.

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

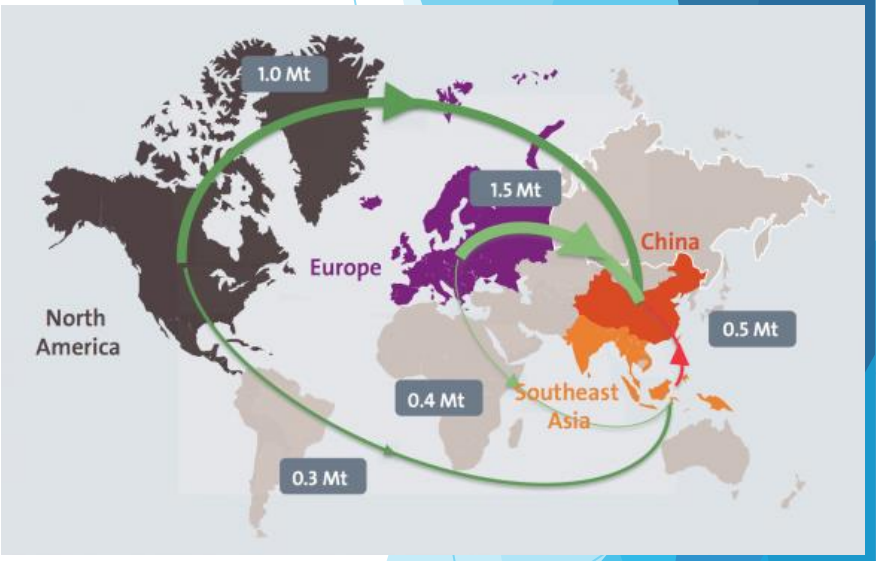
From 32 to 86 MBOE (barrel oil equivalent) flowed into the sea in 2010: an equivalent of 2 to 5 Billion USD value

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

Co-funded by the European Maritime and Fisheries Fund

«An inconvenient truth»
Some facts about plastic waste (and recycling)

- About 31% of the waste plastic collected within the EU is accounted as «recycled» the remaining 69% is burned or landfilled (1)
- When waste is accounted as «recycled» is not always true: illegal dumping in foreign Countries (Malaysia, Thailand, etc..)(2) where, by the way, most of plastic enters into the ocean (3)
- Mechanical recycling not always technically feasible for heterogeneous and contaminated waste
  - Besides….. Often «recycling» is actually «downcycling»: production of low value fibers (700.000 microfibers released during washing) (4)
- **Mechanical recycling is not a perpetual cyle: potentially possible 2/3 times, often just 1 time (5)……**
  - **……and, sooner or later every recycled item will become waste……**



(1) PlasticsEurope report 2018

(2) Greenpeace: After the Recycling myth report 2019

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

(4)Napper, I. E., & Thompson, R. C. (2016). Release of synthetic microplastic plastic fibres from domestic washing machines: Effects of fabric type and washing conditions. Marine pollution bulletin, 112(1-2), 39-45.

(5) National Geographic Society: 7 things you don't know about plastic (and recycling)

Our «Imaginative and concrete solution»: the chemical route

- Since ML is retrieved accidentally during fishing activity
- Since mechanical recycling is not an option for ML
- Via the chemical route our aim is the recovery of building blocks of matter to synthetize new useful products for stakeholders
- **Within marGnet we explored the option to convert ML into useful and readily available marine fuels compliant with ISO8217* standards via pyrolysis**
- A pragmatic approach to ML (and heterogeneous waste in general)
  - Flexible: insensitive to waste type and easy to use
  - Focus on fuels: useful products for stakeholders to get their involvement
  - Decentralized approach: appropriate for dispersed pollutant such as ML
- The ultimate goal: to trigger a virtuous cycle of depollution and sustainability through value generation

*ISO 8217:2017
Petroleum products — Fuels (class F) — Specifications of marine fuels

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marGnet depollution cycle

Turn ML into marine fuels

Use the fuel to power depollution

Reduce dispersed ML

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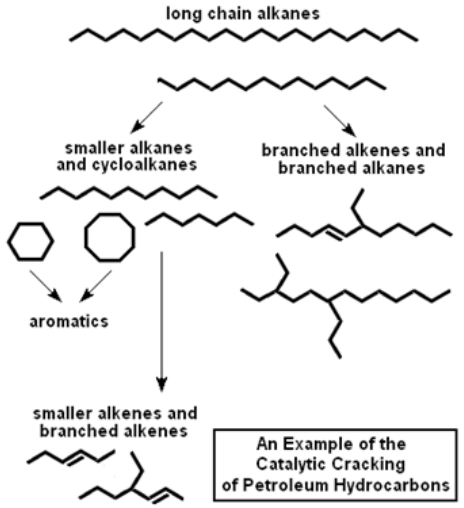
What is Pyrolysis?

- Pyrolysis is derived from the Greek pyro “fire” and lysis “separating”
- Generally speaking pyrolysis refers to a thermal irreversible decomposition in an inert atmosphere
- Pyrolysis is not combustion: by means of temperature, matter undergoes thermal degradation
- Catalysts and additives can drive the reactions towards desired outcomes

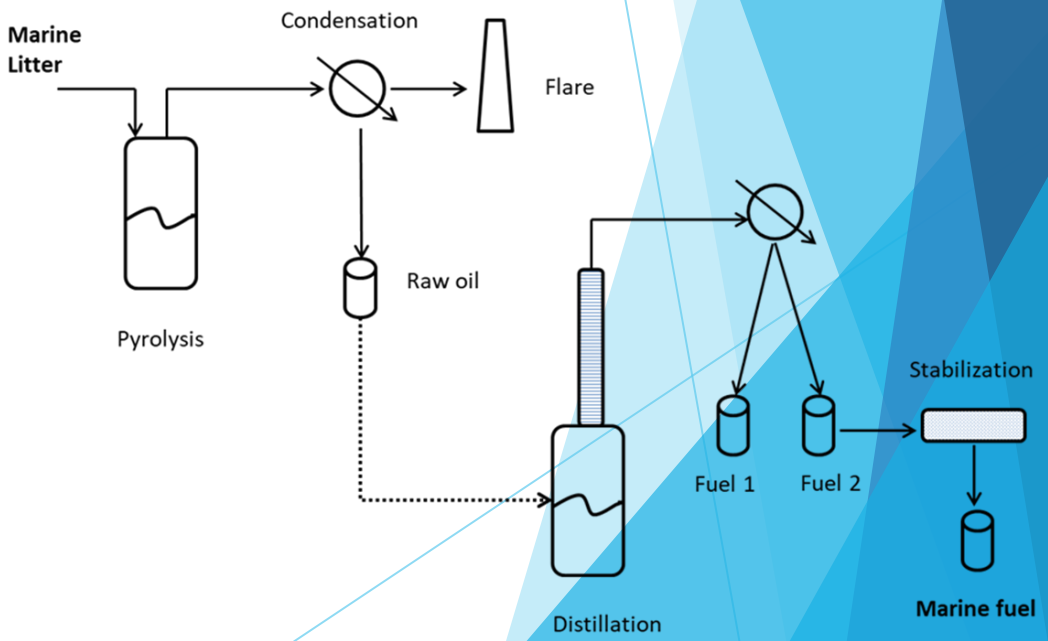
Heat

Degradation

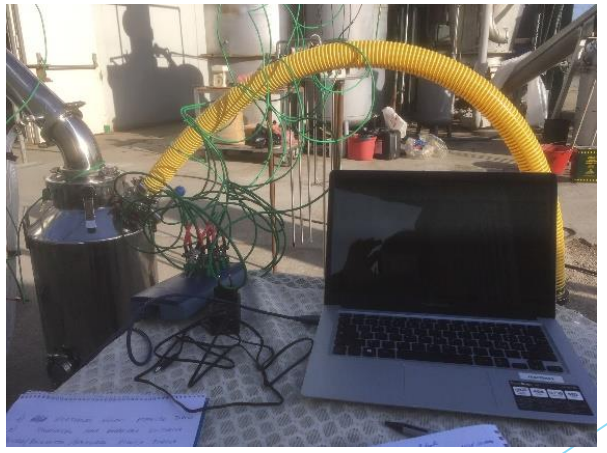


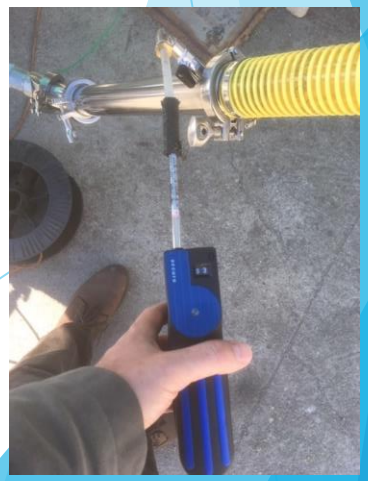
Disclaimer: It seems easy but is not!!

The prototype



Testing the prototype with actual ML





Results (1)

- Over 250 Kg overall material processed during project period
- More than 100 Kg of actual ML from Venice Lagoon processed, including fishing nets
- Overall average products yield ML→fuels ~45/50 wt%
  - Remaining is split between flammable gas (LPG) 21 wt%; and solid residue (char) 29 wt%
  - Through a simple triage is possible to get more than 60% yield (by excluding not plastic materials)
- Products:
  - Light fuel: blend for gasoline (~20/25 wt%)
  - Low Sulfur Marine Gas Oil (MGO) DMA ISO8217 compliant (~50/60 wt%)
  - IFO180 (~5/8 wt%) RMF ISO8217 compliant
  - Water (~10 wt%)
- No dangerous emissions levels detected:
  - 8 substances monitored: C5H12, H2S, HCl, SO2, NH3, HF, CO, HCN
- Approx. Avoidance of 0,75 ton CO2eq/ton MGO*

*From third party survey

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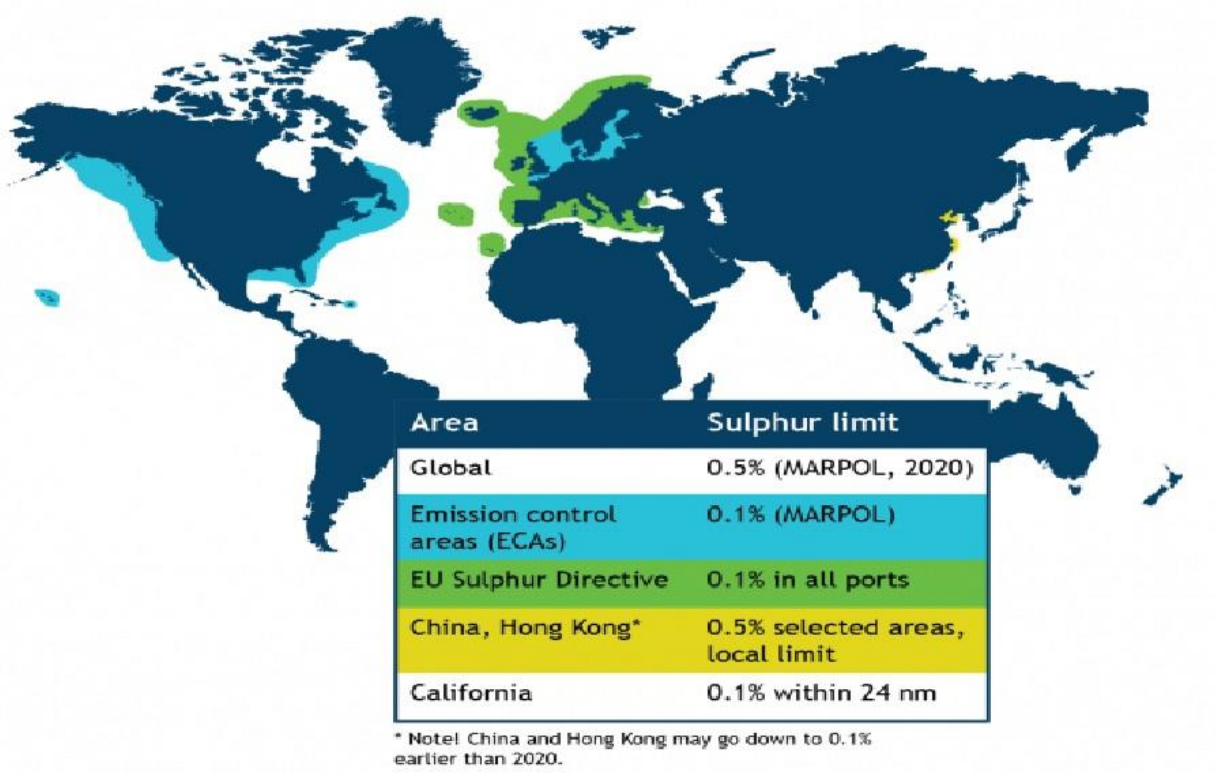
Results (2): Sulfur reduction in marine fuels*



Area	Sulphur limit
Global	0.5% (MARPOL, 2020)
Emission control areas (ECAs)	0.1% (MARPOL)
EU Sulphur Directive	0.1% in all ports
China, Hong Kong*	0.5% selected areas, local limit
California	0.1% within 24 nm

* Note! China and Hong Kong may go down to 0.1% earlier than 2020.

- Sulfur level of marGnet MGO: 0,0196 %
- Sulfur level of IFO180 marGnet fuel: 0,0034 %
- Produced fuel of marGnet can be classified as "Ultra-low sulfur fuel oil" being below 0,1 %
- Far Beyond EU and ECAs limits!
  - 80% lower for MGO
  - 96% lower for IFO
- marGnet fuel cleaner than conventional

*International Convention for the Prevention of Pollution from Ships (MARPOL)

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Regulatory barriers

- Uncertainty on legal status of ML:
  - which type of waste classification?
  - Permit for transportation? (Italian decree “Salva Mare”)
  - Who pays?
- Still uncertainty on chemical recycling regulatory framework
- End Of Waste: is the produced fuel a waste or a product?
  - If it is waste, permit from regulator authority required: fishing boats are equated to waste incinerators (!!)
- Authorized fuels (All. X d.lgs. 152/2006): second generation fuels are not included in the list
  - Even if compliant with ISO standards, they cannot be used

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Conclusions

- ML «as it is» was succesfully converted into marine fuels compliant with ISO 8217 via pyrolysis
- No significant environmental drawbacks were detected
- Oil yield can be improved by simple «triage»
- Low S content would enable easy extension «de facto» of ECAs limits
- CO2 emission reduced compared to regular MGO*
- Scale up for real application is feasible
- Portability is a key: decentralized approach and stakeholders' engagement
- Still regulatory barriers prevent chemical recycling: «EoW», «permitted fuels», etc..
- **Pragmatic solution ready today for heterogeneous waste plastics**

…….. And we need pragmatic solutions TODAY……

*From third party survey

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

Thank you!

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

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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

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

marGnet

Mainstreaming and implementation of sustainable marine litter management practicies

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

Sustainable Blue Economy: Marine Litter

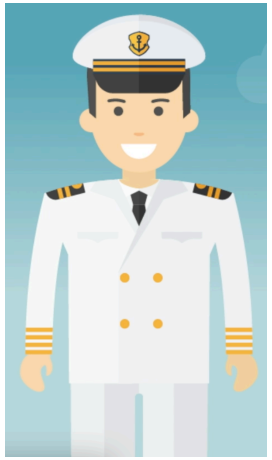
Co-funded by the European Maritime and Fisheries Fund

marGnet mainstreaming

- "following the main stream" = process whereby innovations tested in a limited field (such as a marGnet project) are incorporated into a system

CHANGING BEHAVIOURS

CHANGING RULES



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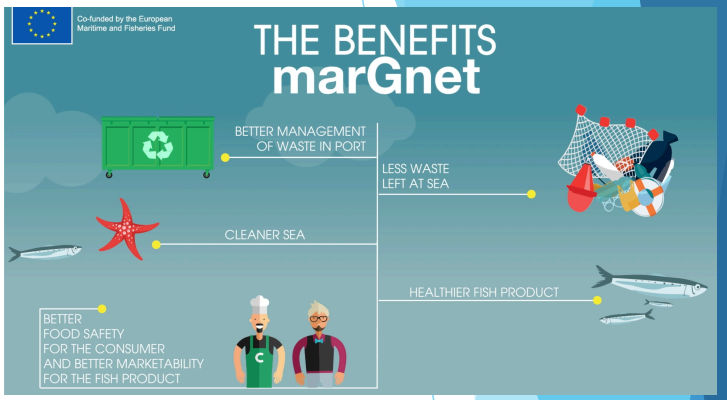
marGnet INFOGRAPHICS

- **EXPLAIN THE FUNCTIONING OF marGnet PROTOTYPE**
- **EXPLAIN THE ADVANTAGES OF marGnet PROTOTYPE**



- **COOPERATION BETWEEN FISHERMEN AND LOCAL INSTISTUTIONS**
- **IMPROVEMENT OF THE CATEGORY IMAGE**

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Collection of feedbacks

- **DISTRIBUTED TO 60 OPERATORS**
- **HAVE FEEDBACKS ON THE USABILITY OF THE PROTOTYPE**

- **GENERAL NEED OF PORT FACILITIES**
- **ENOUGH WASTE BUT ENOUGH FUEL?**

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AGREEMENT WITH CHIOGGIA

- **EFFECTIVE TEST OF PROTOTYPE IN FACTUAL CONDITIONS**
- **STUDY FOR UP-SCALING**
- **IMPORTANT INDICATIONS FOR THE REPLICATION AND FUTURE APPLICATIONS OF marGnet RESULTS**
- **HIGH DEMONSTRATIVE VALUE**

Città di Chioggia

marGnet

Cofinanziato dal Fondo europeo per gli affari marittimi e la pesca

Mercato Ittico Chioggia

ACCORDO DI COLLABORAZIONE

tra il Comune di Chioggia, SST S.p.A. in rappresentanza del Mercato Ittico di Chioggia e il partenariato di Progetto "marGnet", rappresentato dal CNR-ISMAR, per l'attuazione di un caso studio per l'up-scaling del prototipo per il riciclo dei rifiuti dell'attività di pesca e acquacoltura nell'ambito del Progetto "*marGnet – Mapping and recycling of marine litter and Ghost nets on the sea-floor*", finanziato dall'EMFF — cod. Progetto EASME/EMFF/2017/1.2.1.12/S2/05/SI2.789314

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POLICY UP-TAKE

- **STUDY FOR UP-SCALING**
- **VADEMECUM FOR POLICY MAKERS AND INSTITUTIONS**
- **PRACTICAL AND AFFORDABLE SOLUTIONS TO ADOPT THE PROVISIONS OF DIR. 2019/883 ALSO IN SMALL PORTS SUCH AS THE ADRIATIC FISHING PORTS**

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THANK YOU!

Valentina Zambetti

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