Joint Programming Initiative Healthy and Productive Seas and Oceans – JPI-Oceans

By Isabelle Schulz, Dr.
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The Science of Microplastics in the World Ocean,
Woods Hole, October 15-18, 2019

An introduction to JPI Oceans

- What is Joint Programming?
- How does it work?
- JPI Oceans current actions

Research funding in Europe

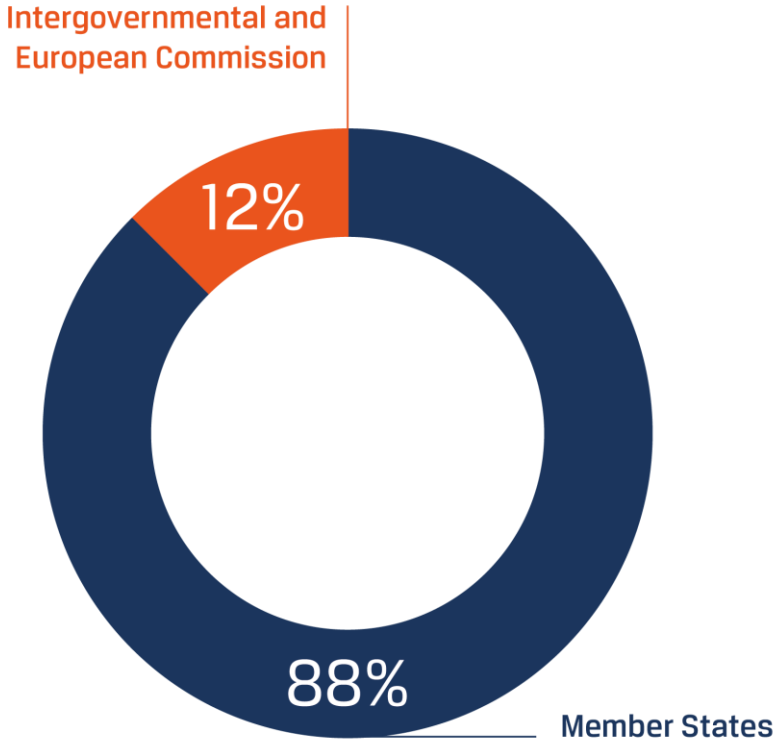
Majority of funding through national research budgets

Basic principle of joint programming:

- to increase research impact by aligning national research investments

Aim:

- to pool national research efforts in order to make better use of Europe's research and development resources and tackle common European challenges more effectively.



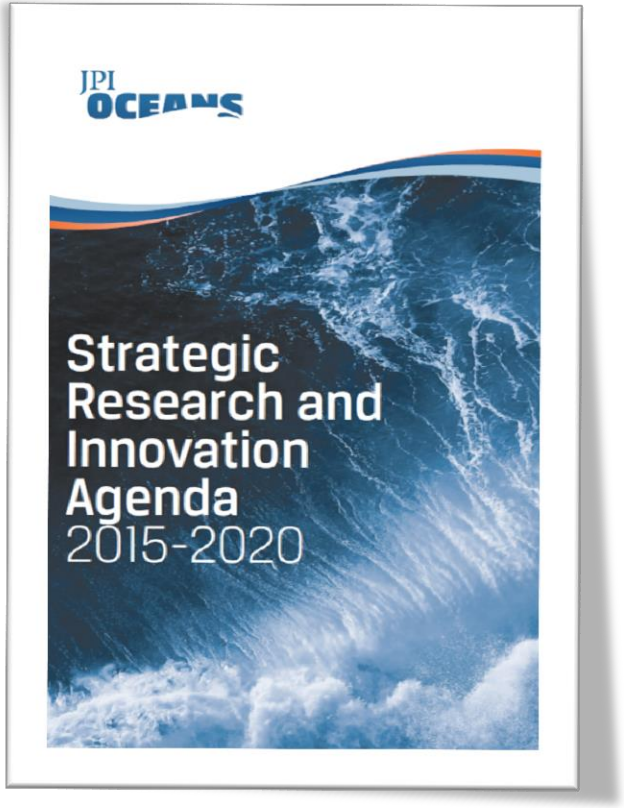
What is Joint Programming?

- In total ten JPI's focusing on climate, ocean, water, food & agriculture, human health aspects

- Strategic research and innovation agenda based on priorities put forward by member states, focusing on societal challenges that cannot be solved at national level

How does Joint Programming work?

- **Joint Actions** are initiated to implement the Strategic Research and Innovation (R&I) Agenda
- Actions are proposed by **a lead country** (or countries). To be a JPI Oceans Action at least four member countries need to be involved
- Joint Actions are **flexible**: Member countries can decide for each action whether to participate
- Open to wider **international** collaboration



JPI Oceans - About

- Fostering the health and productivity of seas and oceans
- Increasing the impact of national investments in marine and maritime research and innovation
- 20 member countries represented by a ministry or funding agency

Increasing value and impact

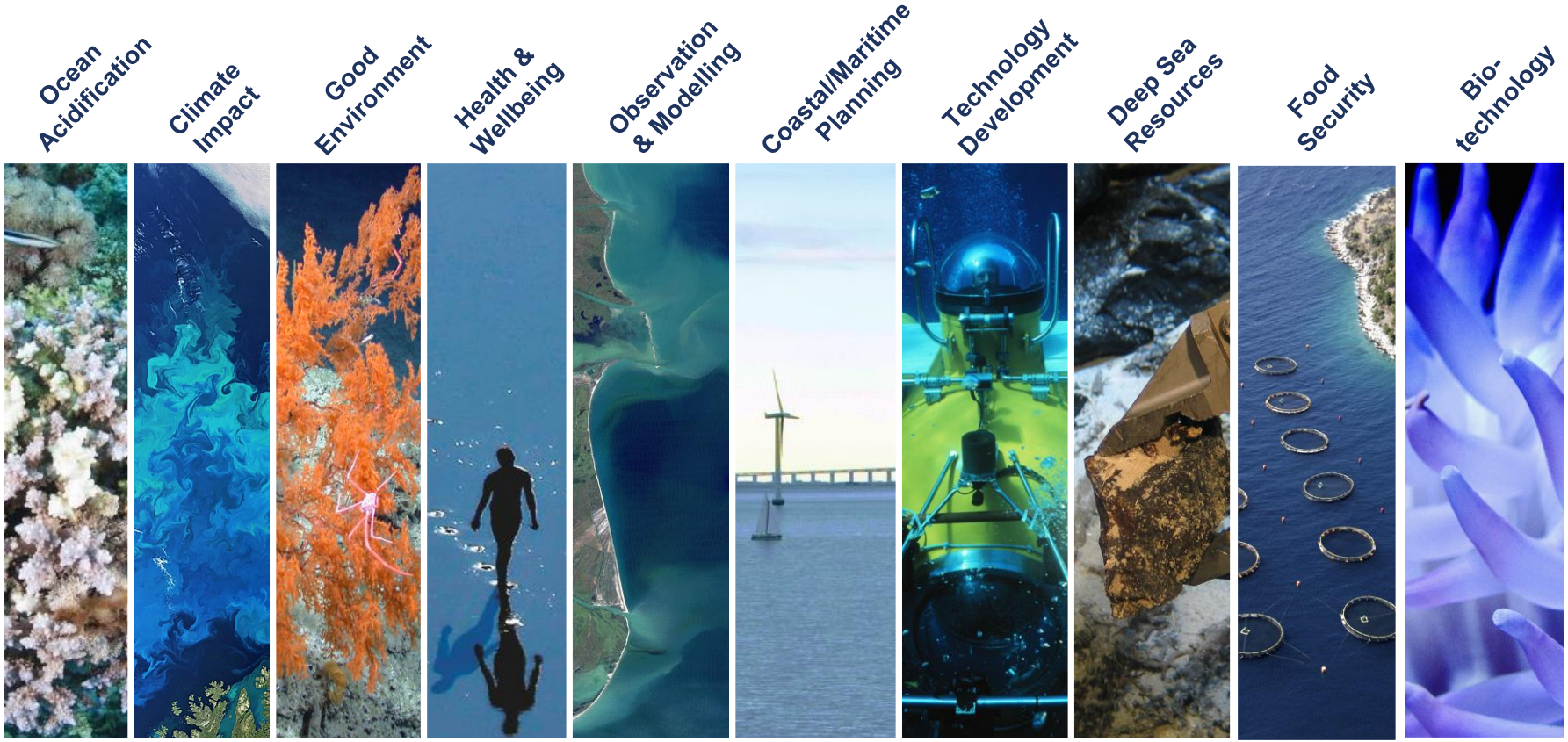
... by aligning and implementing national R&I priorities

... to inform decision making and

... to help countries meet their policy obligations.

JPI-Oceans: A continuum from

protecting the marine environment *to* **developing the blue economy**



Recent joint international R&I calls

France, Germany, Iceland, Australia, Brazil, India, Japan, Norway, Philippines, Saudi Arabia, South Africa, Sweden, US

Ocean Sustainability
(jointly with Belmont Forum and Future Earth)
16 million EUR
Closed: 31 January 2019

Maritime and Marine Technologies
15.4 million EUR
Closed: 29 March 2019

Belarus, Belgium, France, Germany, Ireland, Latvia, Malta, Norway, Poland, Romania, Spain, Turkey, Sweden

Belgium, Croatia, Denmark, Estonia, Finland, Germany, Greece, Iceland, Ireland, Italy, Malta, Norway, Portugal, Romania, Spain, Sweden

Blue Bioeconomy Cofund
29.25 million EUR
Call closed: 17 March 2019

Microplastics 2nd Call
10.5 million EUR
Closed: 29 February 2019

Belgium, Brazil, Denmark, Estonia, Estonia, France, Germany, Iceland, Ireland, Ireland, Italy, Latvia, Malta, Norway, Portugal, Spain, Sweden

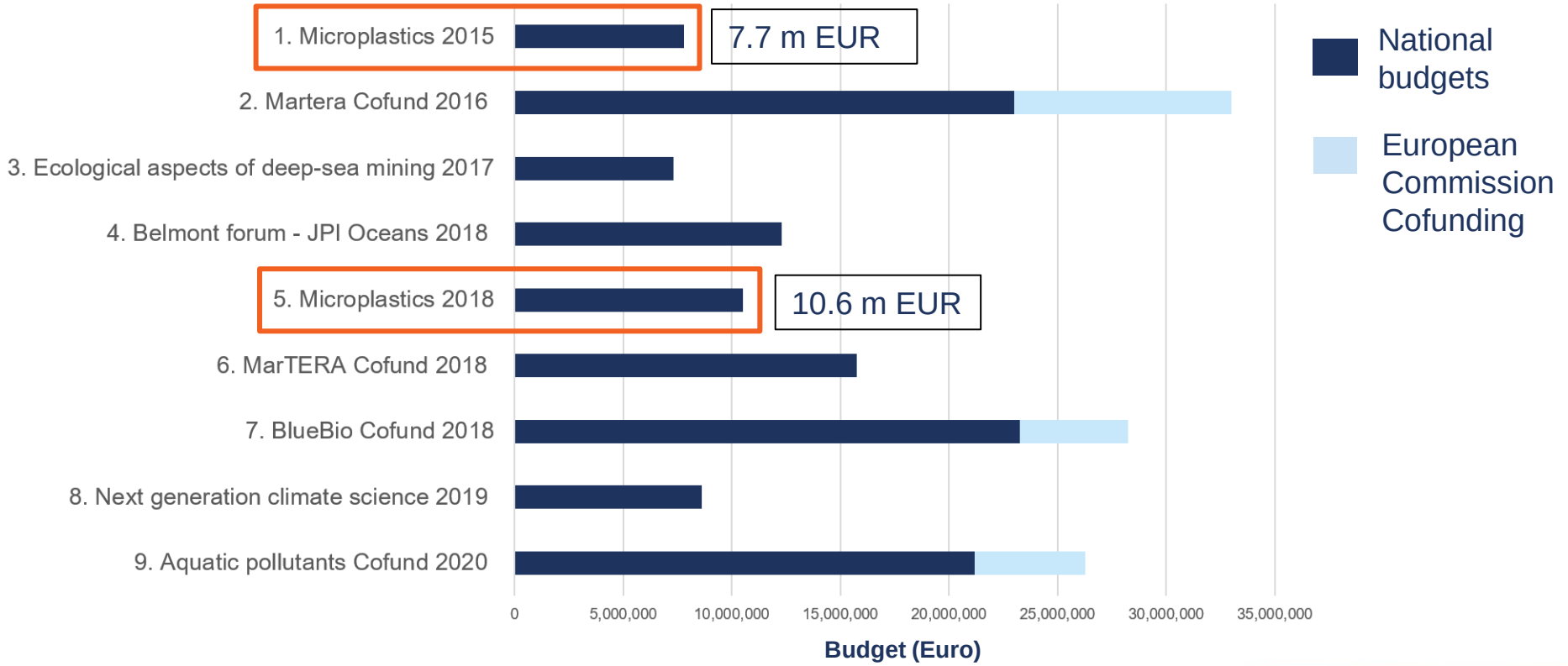
Valuing priorities and capacities of each participating country:

- **flexible geometry of participation**
- **allowing cash or in-kind contribution**
- **ensuring fair return on investment**

Overview joint calls

Sum of Pre-Call Budget (€) by Call

Total national pre-call budget: 129 million Euro



Contribution to EU and global policies

EU Bioeconomy Strategy

The EU Plastics Strategy

EU-South Atlantic Cooperation

Marine Strategy Framework Directive

UN Sustainable Development Goals

EU Food2030

G7 Ocean Plastics Charter

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“Ecological aspects of microplastics in the marine environment”

1st Microplastics Call: 2016-2018

Ecological aspects of microplastics

10 participating countries

Total budget of 7.7 million EUR
Four funded projects

Action period January 2016
– December 2018 (three year period)

Presentation of final results
at MICRO 2018 conference in Lanzarote

Currently 15 publications
in high-quality, peer-reviewed journals

Ecological aspects of microplastics

- Four projects with over 50 partners were selected for funding from 2016
- New insights on:
  - methodology,
  - ecotoxicology,
  - adsorption & desorption,
  - food web transfer,
  - weathering & degradation

BASEMAN
MICROPLASTICS ANALYSES IN EUROPEAN WATERS

EPHEMARE
ECOTOXICOLOGICAL EFFECTS OF MICROPLASTICS IN MARINE ECOSYSTEMS

PLASTOX

WEATHER-MIC

JPI OCEANS

Defining the baselines and standards for microplastics analyses in European waters

Problem:

- No standardized methods for
  - Sampling
  - Extraction
  - Purification

Aim:

- Interdisciplinary and international collaborative research project, was to overcome the problem of none standardized methods, through a profound and detailed comparison and
  1) The validation and harmonization of analytical methods which is indispensable for
  2) the Identification and quantification of MP

Coordinator: Dr Gunnar Gerdts
e-mail: gunnar.gerdts@awi.de
More information:
http://www.jpi-oceans.eu/baseman/main-page

28 partners in 10 EU countries

Ecotoxicological effects of Microplastics in Marine Ecosystems

Aims & Objectives

- To examine the potential role of microplastics as vectors of model Persistent Pollutants that readily adsorb to their surfaces. The following model contaminants were tested: PAHs (Phe, Pyr, BaP), PFOS, Cr, Cd, phthalates, triclosan, bisphenol A, BDE-94 (PBDE).

- To assess by means of internationally recognized standards and methods whether microplastic accumulation leads to detrimental effects at molecular, cellular, physiological and organism levels.

- To test the suitability of exposure and effect biochemical, cellular and physiological biomarkers and cutting edge methods to trace microplastics exposure.

Coordinator: **Dr. Ricardo Beiras**
e-Mail: rbeiras@uvigo.es
More information: http://www.jpi-oceans.eu/ephemare/about

Ecotoxicological effects of Microplastics in Marine Ecosystems

Results

Standard protocol for extraction and characterisation of microplastics from biota and extensive field work validates that plastics of different sizes are everywhere in the marine environment.

New, promising models, endpoints, and methods for ecotoxicological characterisation of microplastics beyond the state of current standard approaches.

Chemical additives and associated pollutants are potentially more toxic than the polymer itself. The current composition of additives of any plastic object remains unknown.

Coordinator: **Dr. Ricardo Beiras**
e-Mail: rbeiras@uvigo.es
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Direct and indirect ecotoxicological impacts of microplastics on marine organisms

The PLASTOX project investigated the ingestion, food-web transfer, and ecotoxicological impact of microplastics (MPs), together with the persistent organic pollutants (POPs), metals and plastic additive chemicals associated with them, on key European marine species and ecosystems.

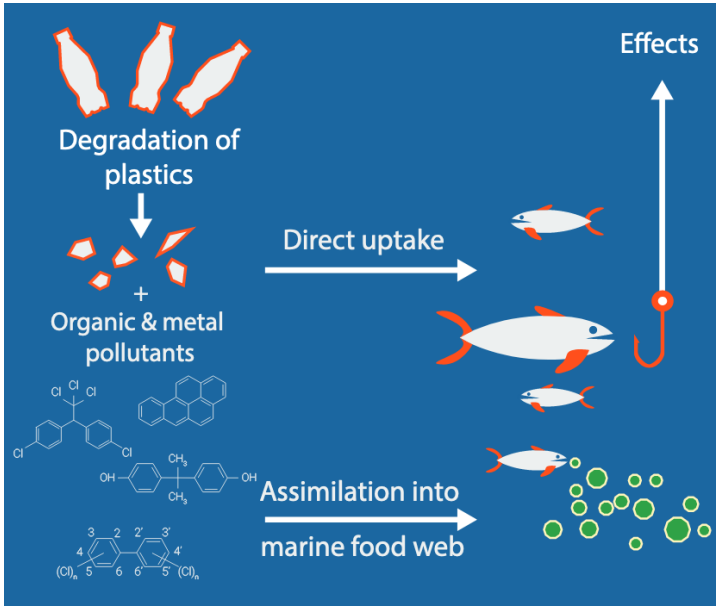


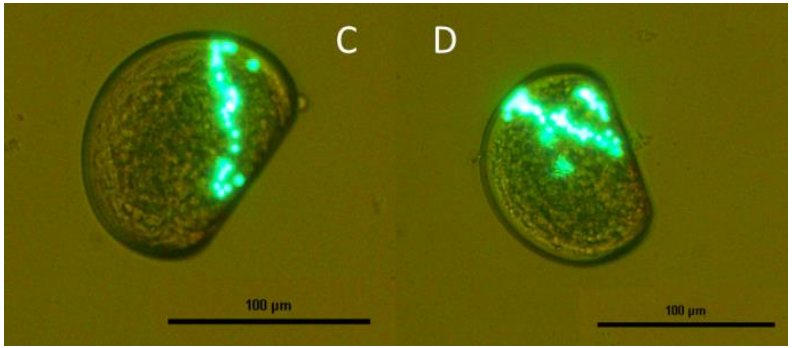
Fig. 1. Schematic of PLASTOX project structure.

Coordinator: **Dr Andy Booth**
e-mail: andy.booth@sintef.no
More information: http://www.jpi-oceans.eu/plastox

Results

Toxic effects of MP on marine organisms from different trophic levels

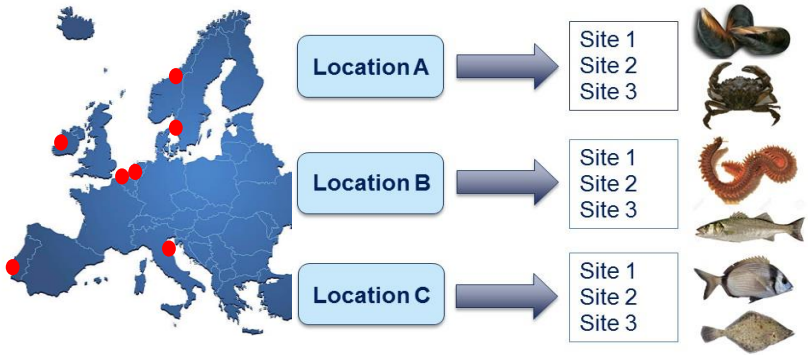
- In short- and long-term studies, MPs rapidly ingested in a dose-dependent way by plankton, bivalves, fish larvae/juveniles.
- No lethality occurred in any test species, but a range of species-specific sublethal effects were observed.
- Early life stages and adult mussels (*M. galloprovincialis*), accumulated smaller MP and NP particles (NP) in specific organs.



Fluorescent MPs ingested by D-Shaped veligers of M. galloprovincialis led to impacts on morphological development.

MP in pelagic and benthic species from different trophic levels

- MP occurrence was low and variable between individuals, species, locations; did not reflect environmental levels.
- In lab and field studies showed selection for small particles (<50 µm) in lower trophic level organisms.
- MP >20 µm do not accumulate and excreted rapidly by most organisms; indicate limited transfer to higher trophic levels.



Sampling locations and examples of species studied.

Biological Effects of virgin and weathered Microplastic Particles and their Leachates

- WEATHER-MIC assessed the impacts that weathering e.g.,
  - UV light,
  - mechanical stress,
  - salinity and
  - biofilm growth, may have on the fate and effects of MP particles and their leachates.

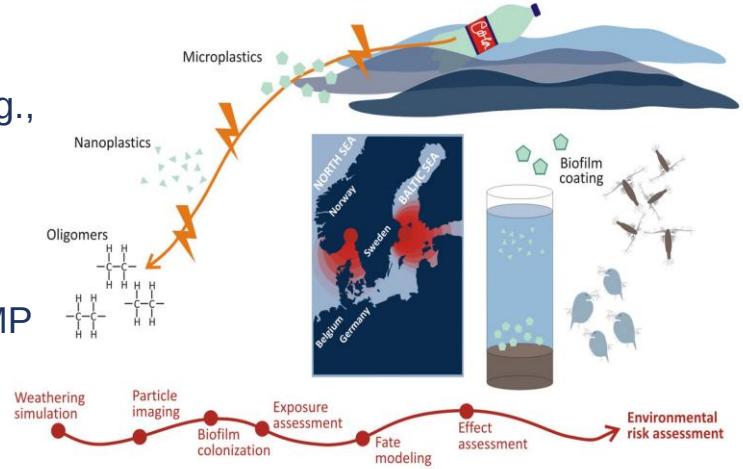


Fig. 1. Schematic of WHEATHER-MIC project structure.

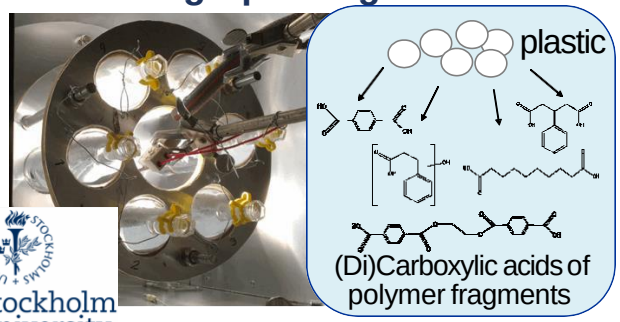
- Results focus on three main topics:
  - (i) The influence of weathering on the sinking behavior of microplastic;
  - (ii) Characterization and effect testing of leachates liberated during weathering of polymers induced by UV exposure;
  - (iii) Ecological relevance of microplastic effect testing with a focus on weathering.

Coordinator: **Dr. Dana Kühnel**
e-Mail: dana.kuehnel@ufz.de

More information: http://www.jpi-oceans.eu/weather-mic/about

Biological Effects of virgin and weathered Microplastic Particles and their Leachates

Artificial aging and fingerprinting



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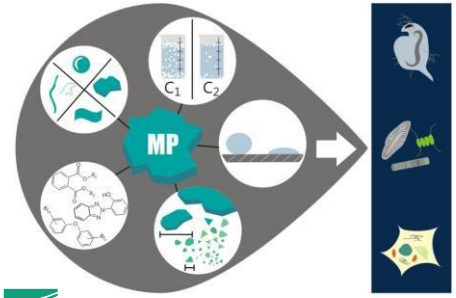
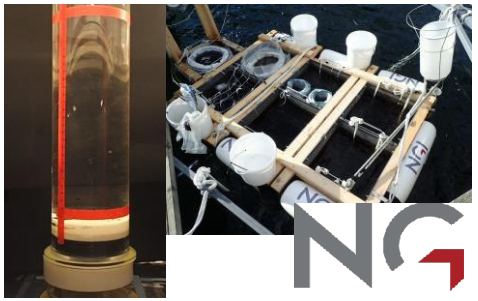
Particle characterization



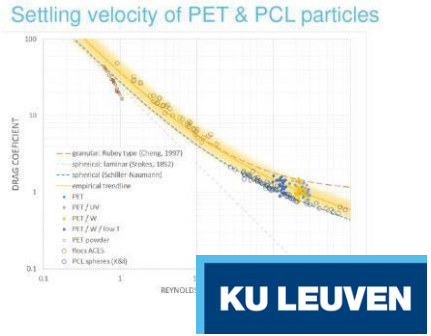
Fraunhofer IKTS

Sinking rates: virgin vs. aged microplastic



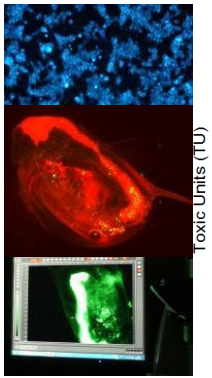
NGI

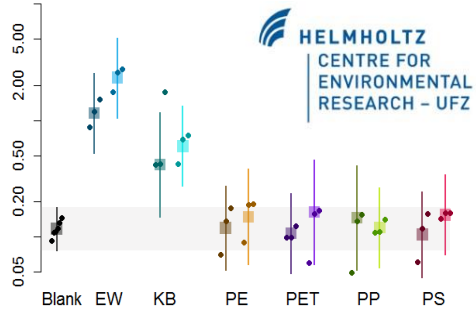
Models for weathering particles

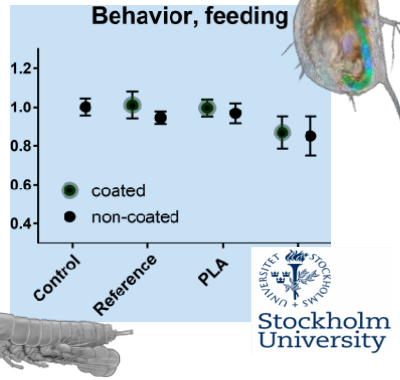


KU LEUVEN

Effect testing







Stockholm University

Gewert et al. *Environ. Sci. Technol. Letters* **2018**, 5, 272.

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“Sources, distribution & impact of microplastics in the marine environment”

2nd Microplastics Call – 2018

Ecological aspects of microplastics

2nd call opened on 20 November 2018
with budget of 10.6 million EUR

15 participating countries:

Deadline: 28 February 2019

Topics of the call - 2018

1. Identification, characterization and quantification of the major microplastic sources, especially mechanisms and time scales of macroplastic fragmentation

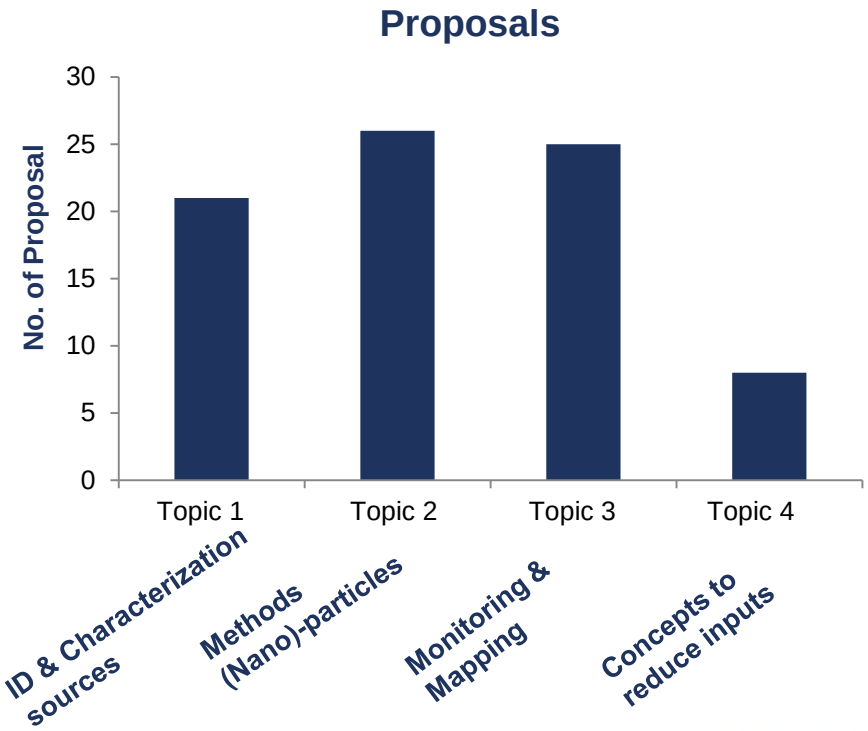
2. New sampling and analytical methodologies - focusing on the smaller (nano-)particles and in situ measurement methods for all matrices (water, sediment, biota)

3. Monitoring and mapping of microplastics in the marine environment including its effects on the marine environment

4. Concepts to reduce inputs of plastics into the marine environment including through new recycling methods, raising public awareness, promoting behavioural change, socio-economic analyses

Submission of proposals – 2018

- 38 proposals were submitted
- requesting in total 42m EUR



- Research partners from at least three participating countries
- Research partners from other countries welcome – need to bring their own resources
- Project duration of maximum three years
- Maximum requested funding per proposal is 2.0m EUR
- Eligibility check by Call Secretariat and national funding organisations
- Peer review by independent experts
- Evaluation Panel ranks the proposal

Brief introduction of projects – 2nd microplastics call

- **ANDROMEDA** - Analysis techniques for quantifying nano-and microplastic particles and their degradation in the marine environment.
  Coordinator: **Dr Richard Sempéré**, Université d'Aix-Marseille, France

- **HOTMIC** - Horizontal and vertical oceanic distribution, transport, and impact of microplastics.
  Coordinator: **Dr Mark Lenz**, GEOMAR Helmholtz-Zentrum für Ozeanforschung Kiel, Germany

- **FACTS** - Fluxes and Fate of Microplastics in Northern European Waters.
  Coordinator: **Prof Jes Vollertsen**, Aalborg University, Denmark

- **microplastiX** - Integrated approach on the fate of MicroPlastics (MPs) towards healthy marine ecosystems.
  Coordinator: **Prof Luca Brandt,** KTH, Royal Institute of Technology, Sweden

- **i-plastic** - Dispersion and impacts of micro- and nano-plastics in the tropical and temperate oceans: from regional land-ocean interface to the open ocean.
  Coordinator**: Prof Patrizia Ziveri**, Universitat Autònoma de Barcelona, Spain

FACTS - Fluxes and Fate of Microplastics in Northern European Waters

Objectives:

- To gain an understanding on the processes driving large scale horizontal transport of MP from northern Europe to the Arctic
- To evaluate the input of microplastics from the atmosphere
- To correlate physical MP trends in water and sediment with accumulation in predatory benthic fish

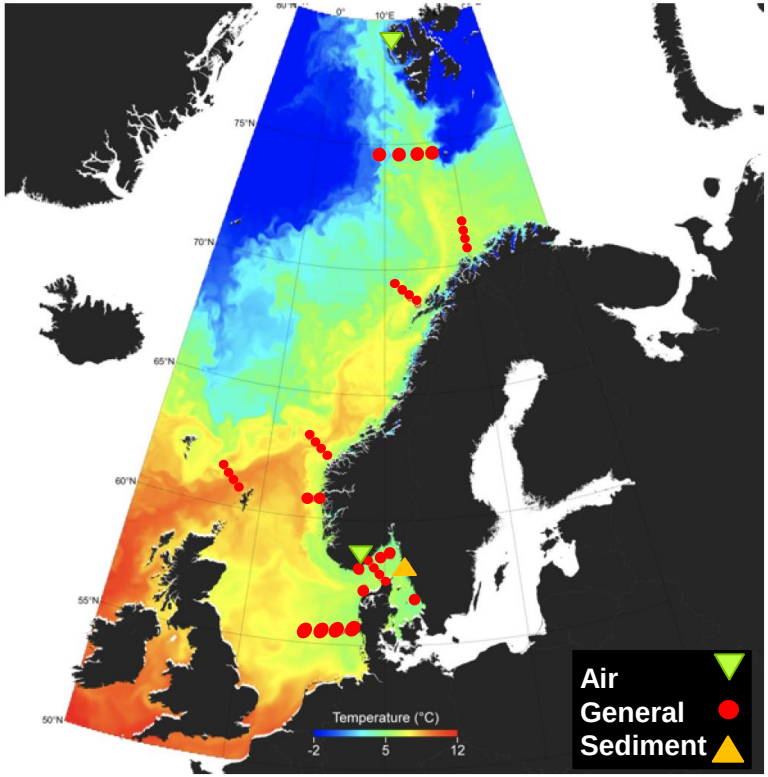


Figure 1: Region of interest: southern North Sea to the Arctic. Map shows envisioned sampling transects and locations.

Coordinator: **Dr. Jes Vollersten**
e-mail: jv@civil.aau.dk

microplastiX - Integrated approach on the fate of Microplastics towards healthy marine ecosystems

Objective:
Improve understanding of degradation mechanisms affecting microplastics in environmental conditions

Holistic Approach:

- combining field data with laboratory experiments
- evaluating MP interaction with biota (including release of plastic chemicals
- Assessing MP abundance, distribution pathways and transport processes in different geographical areas in the Atlantic Ocean and Mediterranean Sea, with importance given to case studies in upwelling regions

Coordinator: **Dr. Luca Brandt**
e-mail: luca@mech.kth.se

ANDROMEDA - Analysis techniques for quantifying nano-and microplastic particles and their degradation in the marine environment

WP 2: In situ and cost-effective methods

- Develop and deploy in-situ methods for detection of mesoplastics and large microplastics
- Develop and optimize cost-effective techniques based on hyperspectral imaging, chemical markers, fluorochrome detection,

WP 3: Advanced analytical techniques

- Establish robust and validated methods for microplastic characterization from 1µm to 10 µm
- Develop specific tools for tire wear particles, synthetic fibers and paint flakes

WP 4: Advanced analytical techniques

- Selection of physical/chemical descriptors for studying microplastics, nanoplastics and additive release
- Conduct in situ microplastic degradation experiments in shallow and deep sea
- Study UV degradation of microplastics

Coordinator: **Dr. Richard Sempéré**
e-mail: richard.sempere@mio.osupytheas.fr

HOTMIC - Horizontal and vertical oceanic distribution, transport, and impact of microplastics

Research Questions:

1. What is the lateral flux of MP from Western European coastal waters to the North Atlantic open ocean gyre, and what mechanisms drive this transport?

2. What is the vertical flux of MP from the surface to the deep ocean, and what is the resultant accumulation of MP in deep sea sediments?

3. What is the role of biota in formation, alteration, and transport of MP? And how are they affected by ingestion of MP particles?

Coordinator: **Dr. Mark Lenz**
e-mail: mlenz@geomar.de

HOTMIC - Horizontal and vertical oceanic distribution, transport, and impact of microplastics

Aim:
- to build a mechanistic understanding o MP transport and its biological impact reaching from coastal seas via the accumulation spots in the open ocean gyres to its eventual final sink at the seabed (Fig. 1).

Integrates:
- coastal field work,
- open ocean research cruises,
- experimental investigations

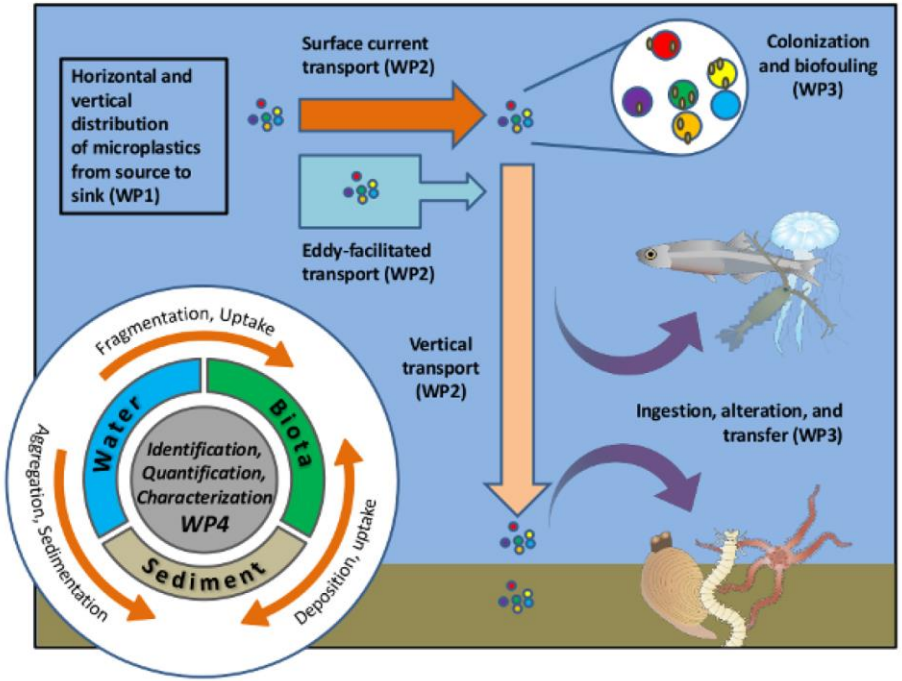


Fig. 1. Schematic of HOTMIC project structure.

Coordinator: **Dr. Mark Lenz**
e-mail: mlenz@geomar.de

i-plastic - Dispersion and impacts of micro- and nano-plastics in the tropical and temperate oceans: from regional land-ocean interface to the open ocean.

i-plastic aims to understand and predict the dispersion, accumulation and impacts of microplastics and nanoplastics (NPs) in marine environments from tropical and temperate land-ocean interface to the open ocean.

- the identification, characterization and quantification of MP particles before and after weathering in marine systems
- the investigation of ingested MPs inside marine organisms and marine systems (water, sediment, biota)
- the quantification, identification and characterization of MP particles < 10 µm (incl. NPs)
- spatial distribution of MP litter, supported by modelling studies

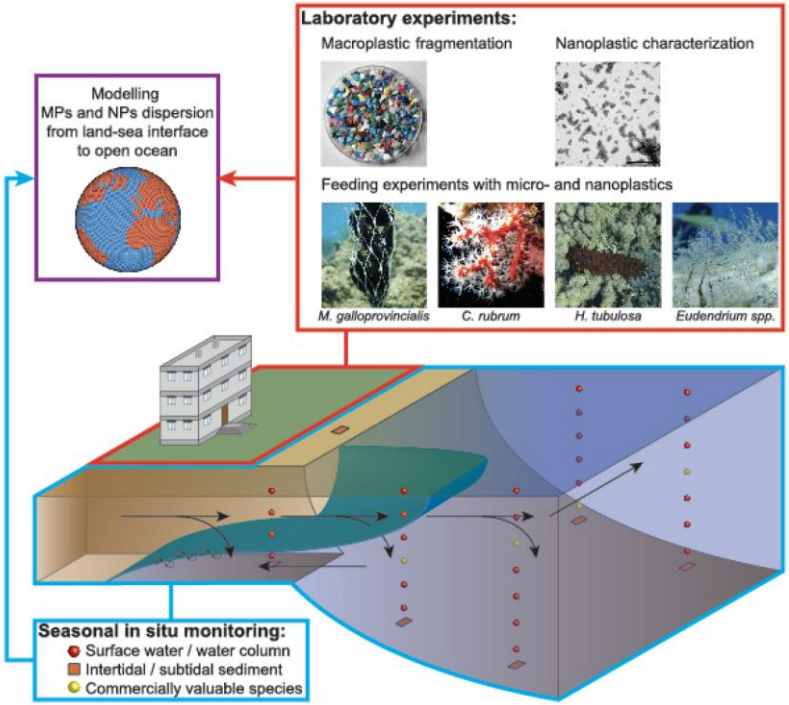


Fig. 1. Schematic of i-plastic project structure.

Coordinator: **Dr. Patrizia Ziveri**
E-mail: Patrizia.Ziveri@uab.cat

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Thank you for your attention

JPI OCEANS

THANK YOU

Ecotoxicological effects of Microplastics in Marine Ecosystems

Results:

1. MP of environmentally relevant shape (Fig. 1a) are easily ingested, but also easily egested by filter-feeders and predators. In mussels (Fig. 1b):
   - Excreted through feces (large ones) or translocated from digestive gland into the gills (smaller ones) and further excreted.
   - Once data fit uptake and distribution models, models predict that there is no accumulation of MP in mussels exposed to environmental concentrations (confirmed by field samples).

Fig. 1a

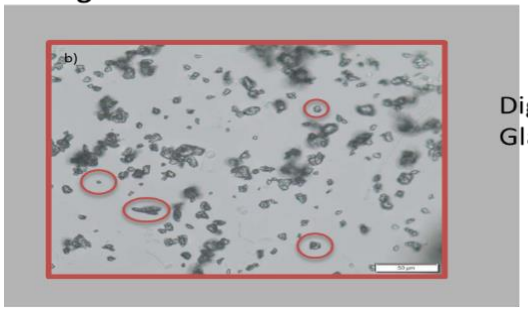
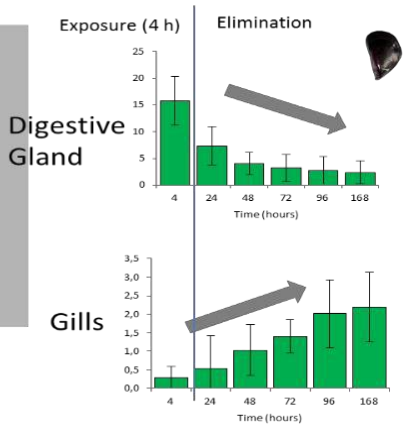


Fig. 1b



Contact person: Ricardo Beiras
e-Mail: rbeiras@uvigo.es
More information: http://www.jpi-oceans.eu/ephemare/about

2. MP are transferred from prey to predators, but they are egested and do not bioaccumulate in predators.

3. Conventional acute toxicity end-points are not sensitive enough and not appropriate for MP risk assessment, which should be based on long-term reproductive, immune and behavioural endpoints.

Ecotoxicological effects of Microplastics in Marine Ecosystems

Results:

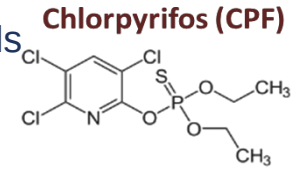
4. MP may act as vectors of pollutants but they do not increase bioavailability and effects of model chemicals compared to natural particulate matter.

Fig. 2 shows an example studying the accumulation in the mussel of the hydrophobic organic pesticide chlorpyrifos in absence of particles and in presence of microalgae and MP.

5. EPHEMARE developed methods **(Fig. 3)** based on chronic effects using early life stages of fish suitable to assess the toxicity of microplastics.

These methods can be useful for industry (to develop environmentally friendly materials) and regulatory agencies.

Fig. 2



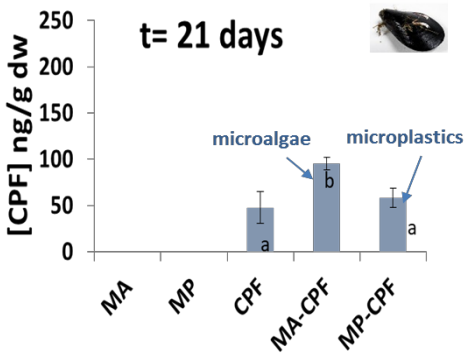
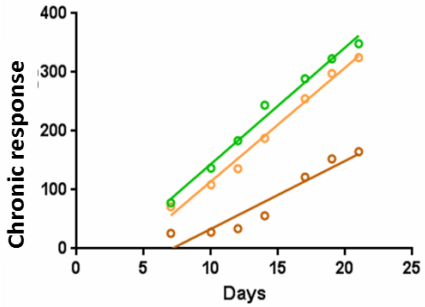


Fig. 3



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Participating Institutions - 2018

Belgium

France

Latvia

Germany

Iceland

Portugal

Italy

Sweden

Ireland

Ireland

Estonia

Estonia

Denmark

Malta

Brazil

Spain

Norway