WEATHER-MIC – How MICroplastic WEATHERing changes its transport, fate and toxicity in the marine environment

Annika Jahnke, Matthew MacLeod, Hans Peter H. Arp, Annegret Potthoff, Erik Toorman

Planetary boundaries

Rockström et al. defined nine planetary boundaries that, if exceeded, could disrupt **vital processes** that **keep Earth in a stable condition**.

Rockström et al. *Nature* **2009**, 461, 472.

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Planetary boundaries

"Chemical pollution" amended to "Novel entities" is **poorly quantified**.

Three conditions have to be met:

- global exposure
- poorly reversible
- affecting an Earth system process

Persson et al. *Environ. Sci. Technol.* **2013**, 47, 12619.
MacLeod et al. *Environ. Sci. Technol*. **2014**, 48, 11057.

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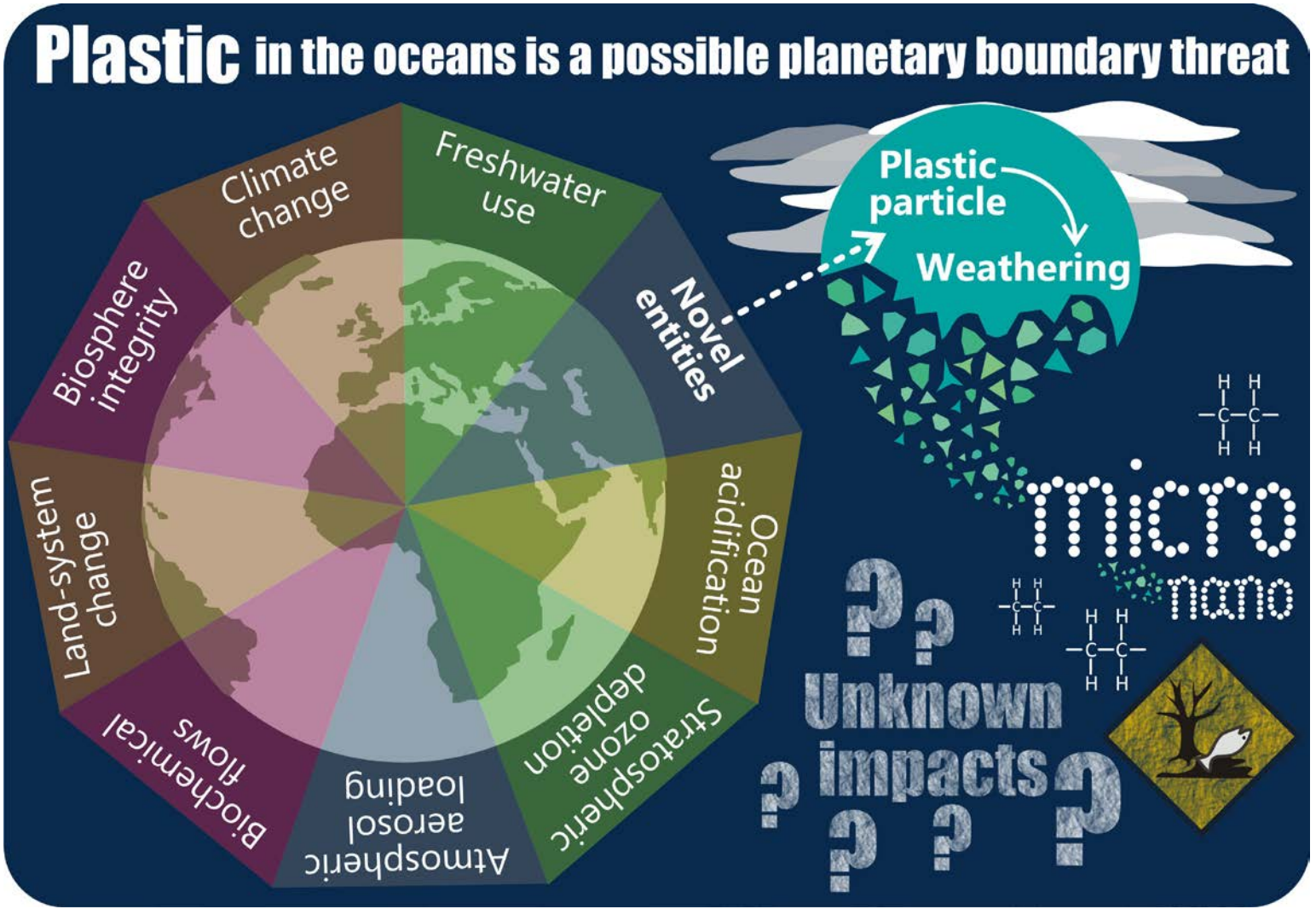

Jahnke et al. *Environ. Sci. Technol. Letters* **2017**, 4, 85.

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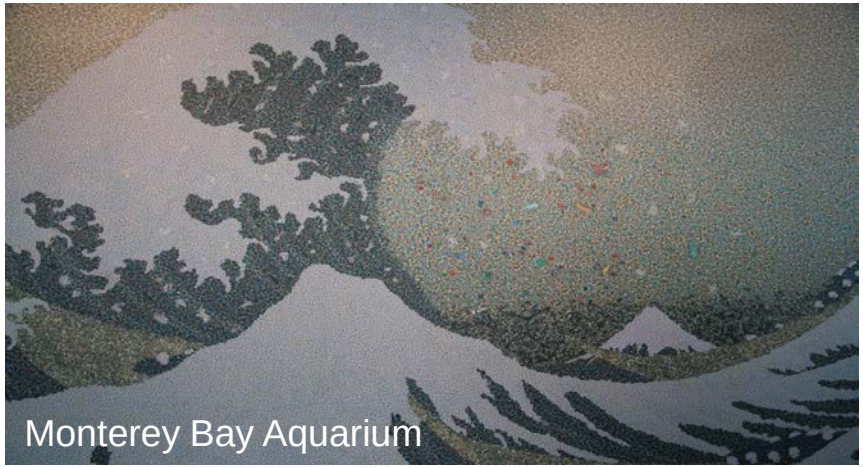
Why is weathering of plastic important to understand?

Plastic is persistent waste

«Accumulation Rate» = «Emission Rate» - «Complete Mineralisation Rate»

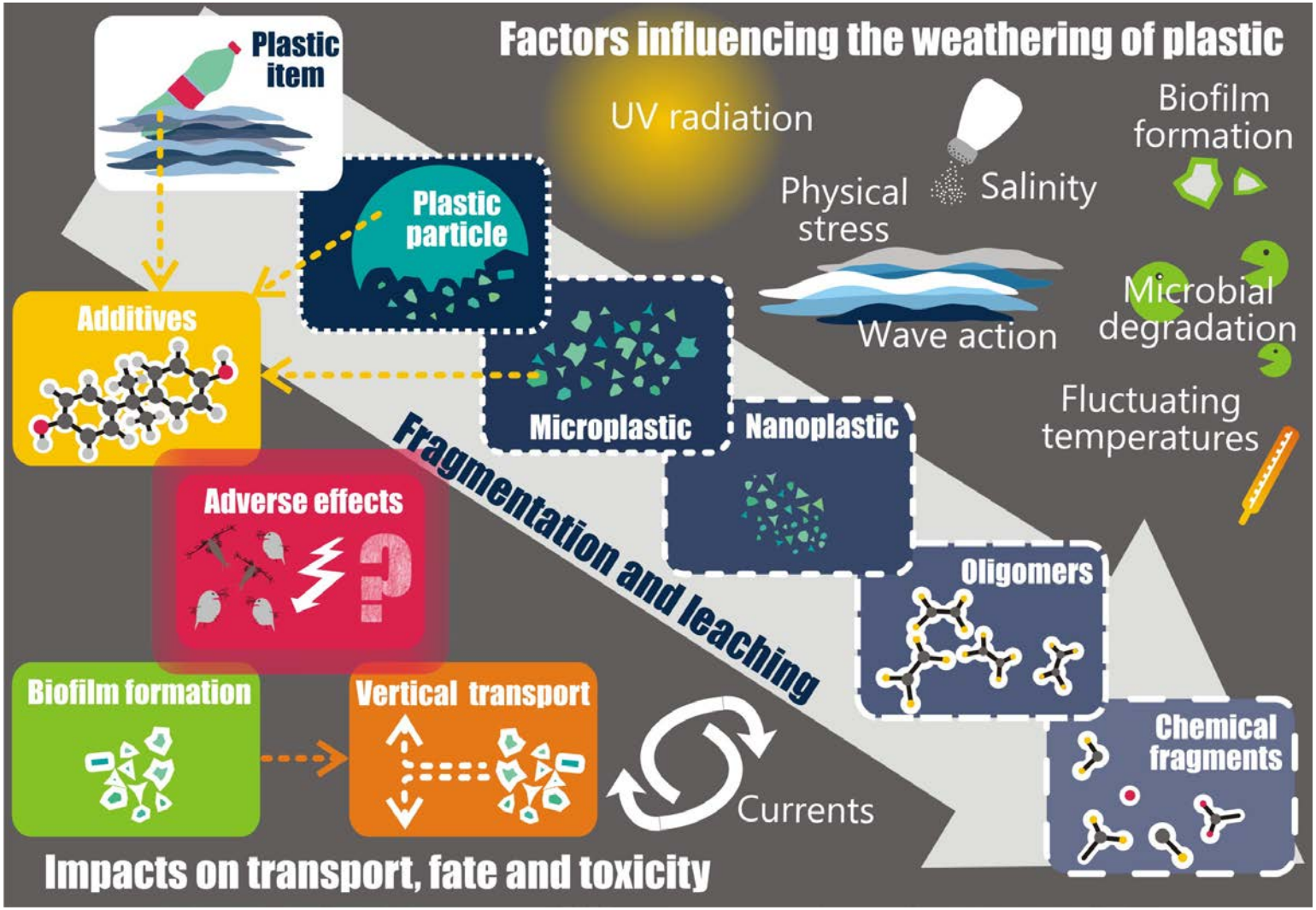
Relevant factors with impacts that are poorly understood

- UV exposure
- Physical stress
- Biofilm and biological degradation


Monterey Bay Aquarium

Effects

- Changes in size, shape, structure, etc.
- Increase in density
- Aggregation and sedimentation
- Sorption and leaching of contaminants

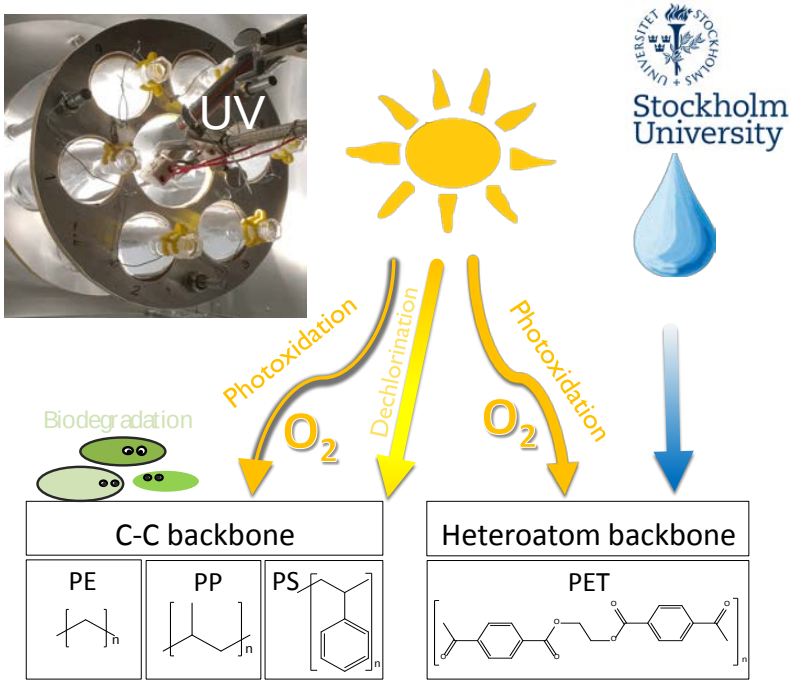


Jahnke et al. *Environ. Sci. Technol. Letters* **2017**, 4, 85.

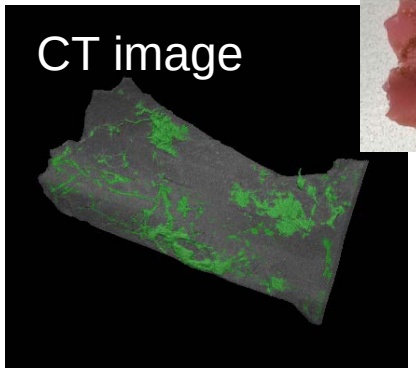
Research priorities I

Multiple **factors influencing the weathering process** by characterization of plastic particles over time, including degradation products

Artificial aging and fingerprinting



LC/Orbitrap suspect screening



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Particle characterization

- Particle numbers and size distribution
- Particle shape and density
- Surface properties
- Crystallinity

Gewert et al. *Environ. Sci.: Processes Impacts* **2015**, 17, 1513.

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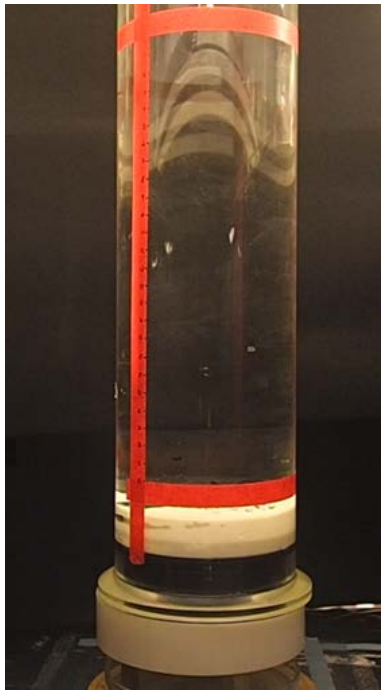
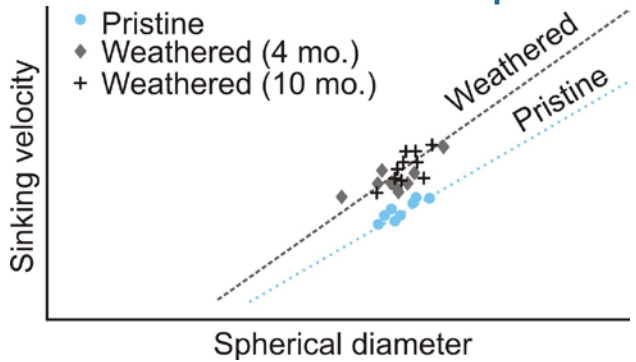
Research priorities II

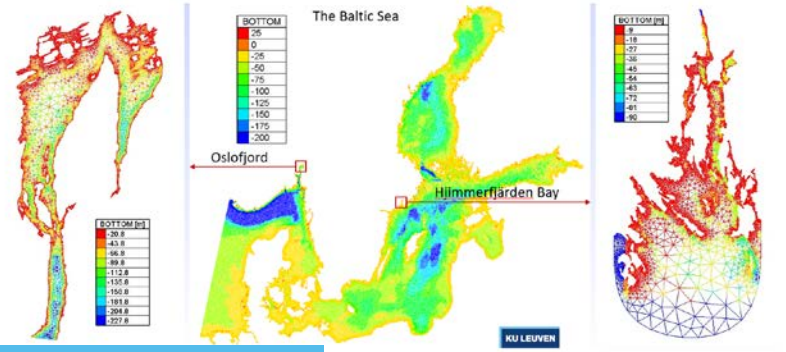
Effects of weathering on the **spatial and temporal distribution** of plastic debris, incl. microplastic particles

Sinking rates of virgin vs. aged microplastic





Models for weathering particles



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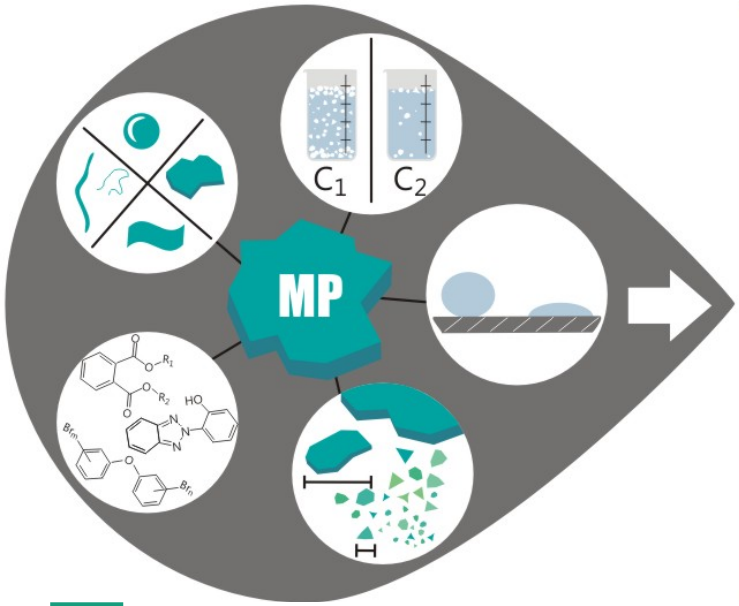
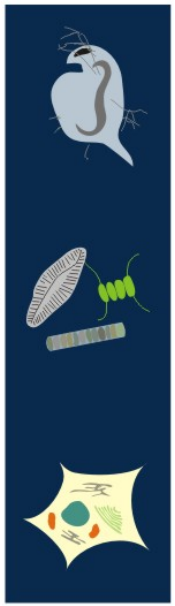
Research priorities III

Identify the **adverse effects** and mechanisms by which plastic particles and their degradation products affect **biological systems** (cell-based, organism and community assays across trophic levels)





Fraunhofer IKTS

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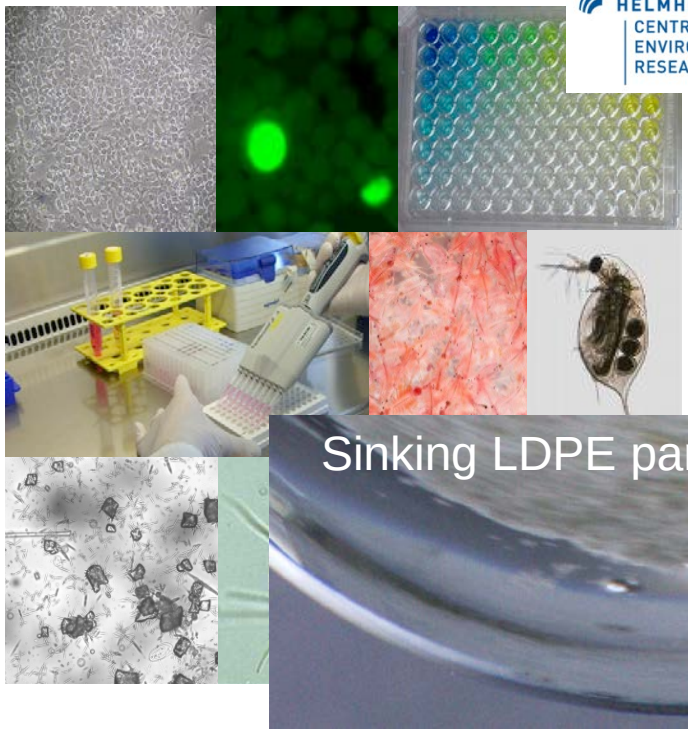

Potthoff et al. *Integr. Environ. Assess. Manage.* **2017**, 13, 500.

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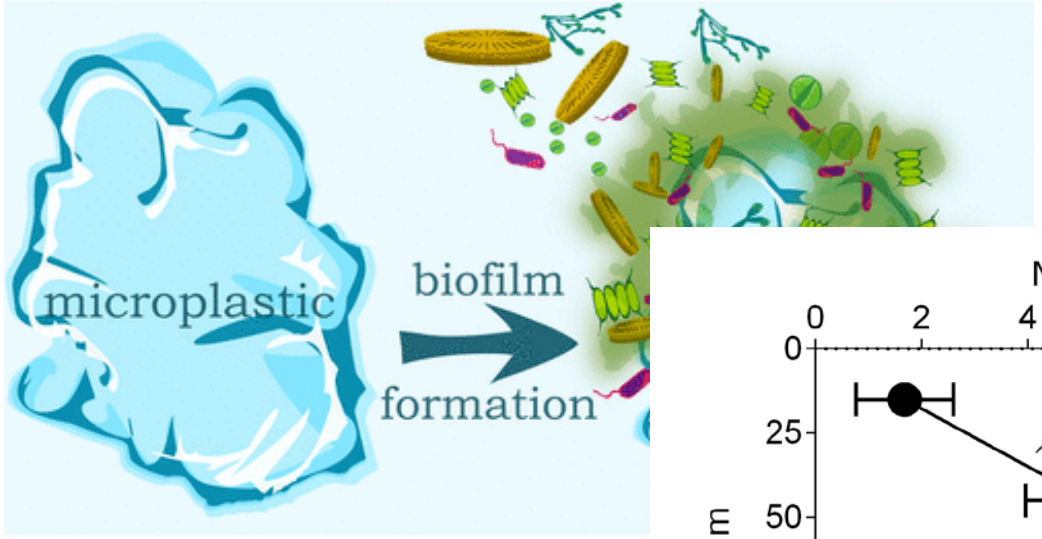
Research priorities IV

Elucidate the **role of biofilms** in aggregation, sedimentation, exposure, uptake and effects of plastic particles in marine organisms



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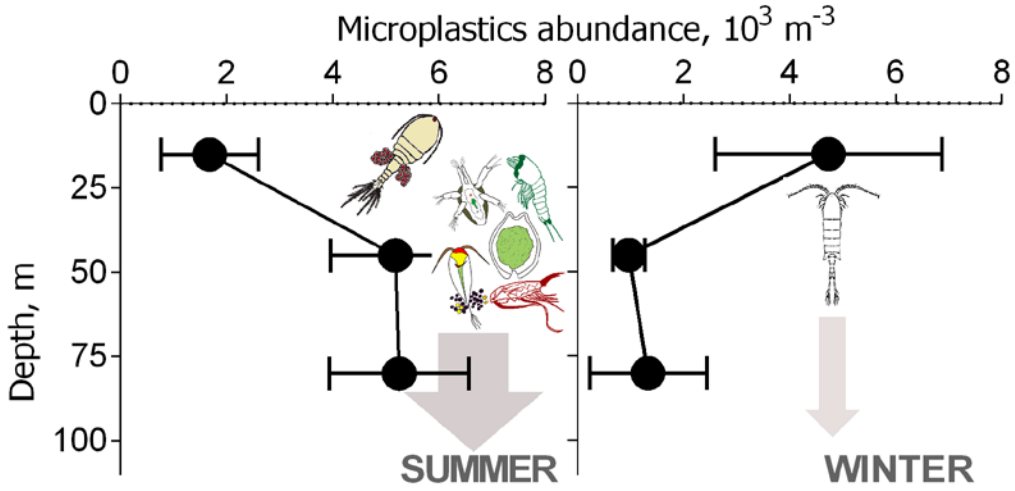

Stockholm University

Rummel et al. *Environ. Sci. Technol. Lett.* **2017**, 4, 258.
Gorokhova *Mar. Pollut. Bull*. **2015**, 99, 271.

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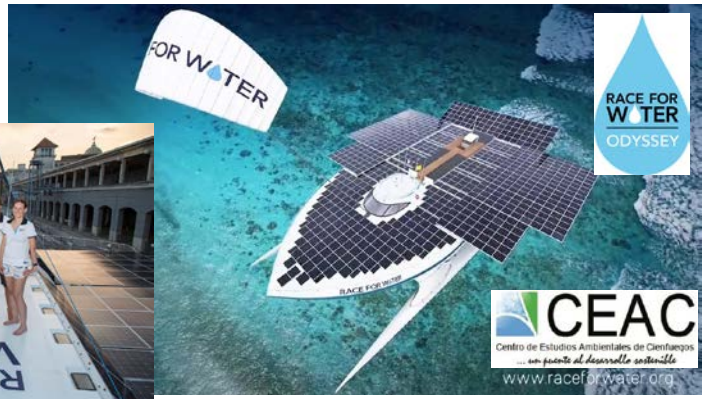
Impact

Training and contributions to regulations, policies & management practices

- **Postdoctoral fellow**: Qilong Bi (KUL)
- **PhD students**: Christoph Rummel (UFZ), Kathrin Oehlschlägel (IKTS), Berit Gewert (ACES), Zandra Gerdes (ACES), Samor Wongsoredjo (KUL)
- **Master's theses** and projects
- Inclusion in regular **teaching**
- Short course at the Society of Environmental Toxicology and Chemistry (**SETAC**) Young Environmental Scientist (YES) Conference in Stockholm
- **Microplastic & Medusae** at two universities in Berlin
- Participation in the **Race for Water Odyssey**
- Report to relevant **stakeholders** (contribution to regulation, policies and management practices)



Dissemination & outreach

Websites, presentations, social media, exhibitions, conferences & papers

- Project **websites** on http://www.jpi-oceans.eu, ResearchGate and youtube
- Project presentations at **UN Oceans Conference** and **ICES** Annual Scientific Workshop
- Contributions on **television** and **radio**
- Social media: facebook and twitter
- **Researcher Night** events in Sweden and Germany
- **Ocean Plastics Lab** (contribution of exhibits)
- Numerous posters and presentations at **conferences**
- Multiple peer-reviewed **scientific papers**

More information: Please have a look at our posters!

Acknowledgements

- **JPI-Oceans**
- German Federal Ministry of Education and Research (**BMBF** Grants 03F0733A+B)
- Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning (**FORMAS**, Project Grant 942-2015-1866)
- Research Council of Norway (**RCN**, Project Grant 257433/E40)
- Belgian Federal Science Policy Office (**BELSPO**, Project Grant BR/154/A1/WEATHERMIC)
- **YOU** for your kind attention

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THANK YOU

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