WEATHER-MIC

How microplastic weathering changes its transport, fate and toxicity in the marine environment

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JPI OCEANS

Poster# 91388

Background

Understanding the hazards posed by microplastics in the sea requires understanding the changes they undergo as a result of environmental weathering processes, like **UV exposure**, **biofilm growth** and **physical stress**.

These processes influence their brittleness, density, size, shape and surface charge. The resulting changes can in turn affect their **environmental fate** as the microplastics undergo **fragmentation, aggregation and ultimately sedimentation or mineralization**. As these processes occur, there are a series of **tradeoffs of hazard** to the marine environment and changes that influence the microplastics' **mobility**.

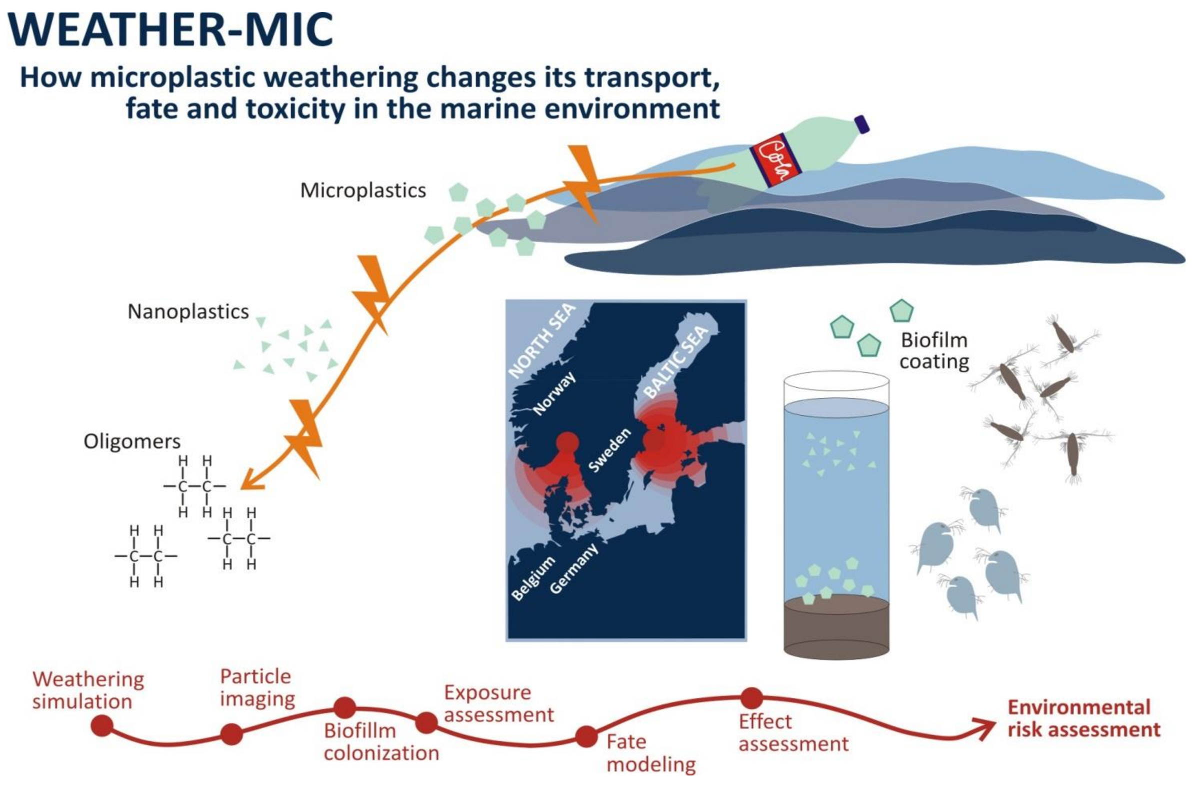

Figure 1. Graphical abstract

Toolbox

WEATHER-MIC will develop novel tools for tackling the complex implications of weathering of microplastics including

- "fingerprinting" methods to track microplastic weathering
- advanced particle imaging to investigate size distribution and morphological changes with weathering
- improved understanding regarding the biofilm growing on microplastics and its trophic transfer
- numerical particle transport models to account for changes in sedimentation and dispersion with microplastic fragmentation-aggregation
- (eco)toxicity profiles for weathered microplastics and their leachates

Current activities and first results

The initial efforts within WEATHER-MIC have focused on

(i) Weathering studies

- development of a protocol for **artificial aging** (Figure 2) using UV light (SU)
- LC-Orbitrap MS **screening of plastic leachates** (SU)
- **column weathering experiments** (NGI & IKTS)
- **surface imaging** of field-aged plastic particles (Figures 3 and 4, IKTS)

(ii) Studies including biota

- **biofilm** grown on plastic material (Figure 5, UFZ) and its characterisation (SU & UFZ)
- **Daphnia feeding experiments** with PCB-contaminated microplastics (Figure 6, SU)

(iii) Modelling

- assembling a **hydrodynamic model** that covers Oslo Harbor and the Stockholm Archipelago of the Baltic Sea (Figure 7)

(iv) Field work

- **field weathering of plastic materials** has been started (NGI in collaboration with PLASTOX)
- initial **field sampling** in Oslo Harbor and the Baltic Sea (Figure 8, NGI & SU)

Figure 2. Artificial aging of PE, PP, PS and PET granules

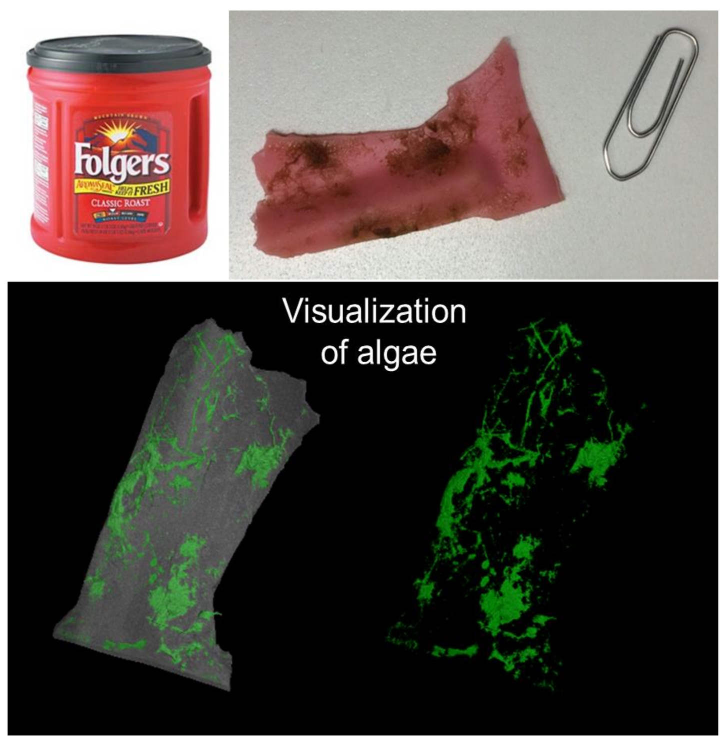

Figure 3. Computer tomography of field-aged plastic particles

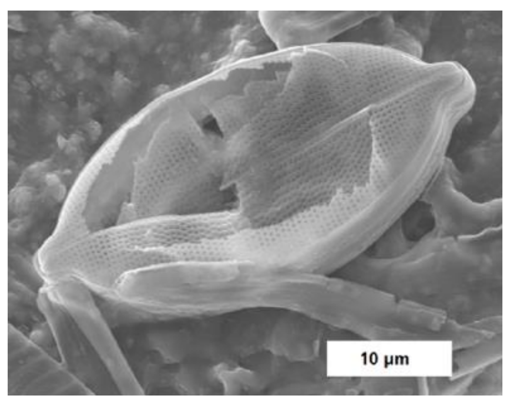

Figure 4. Electron microscopy of a diatom growing on field plastics

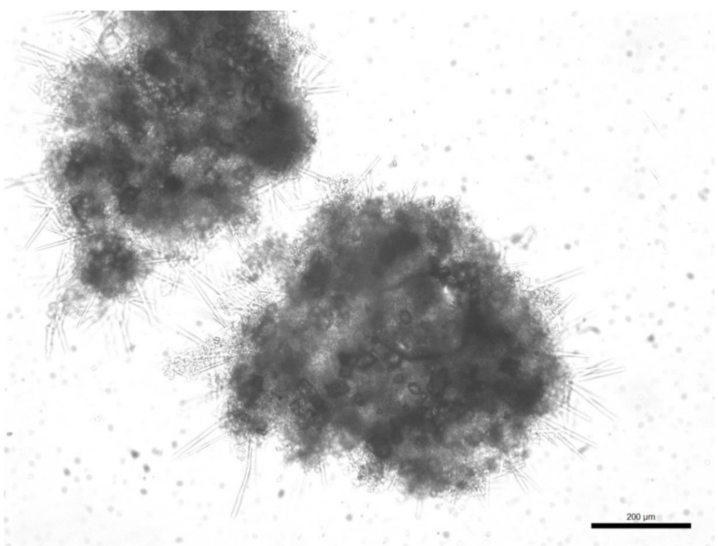

Figure 5. Mixed species biofilm grown on plastic surfaces

Figure 6. Daphnid feeding on fluorescent PE microspheres

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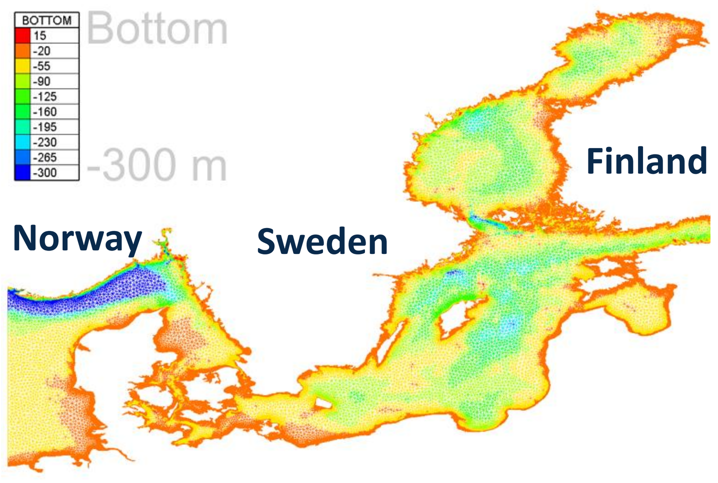

Figure 7. Bathymetric data mapped for the Baltic Sea

Figure 8. Sampling in Oslo Harbor at different depths (NGI), plastics from the Baltic Sea (SU)

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Acknowledgements

We kindly acknowledge Alexandra ter Halle (7th Continent expedition, Université Paul Sabatier) for providing field-aged plastic material from the mid-Atlantic Ocean. This project has been funded in the framework of JPI Oceans via the respective funding agencies in Germany, Sweden, Norway and Belgium.

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