WEATHER-MIC

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

JPI OCEANS

Project factsheet

Project Description

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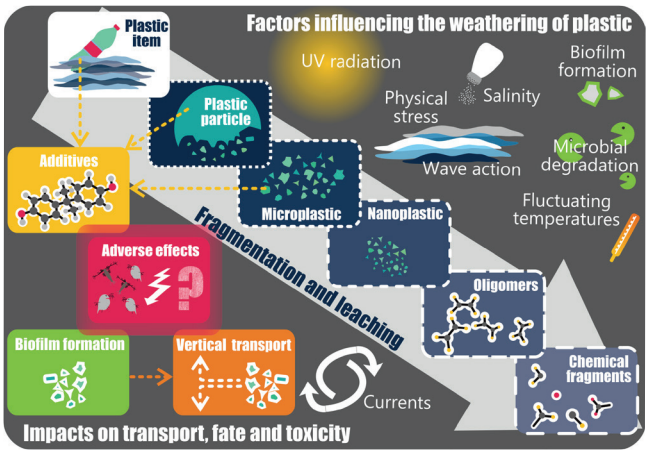

Jahnke et al., Environ. Sci. Technol. Lett., 2017, 4, 85–90, DOI: 10.1021/acs.estlett.7b00008

WEATHER-MIC assesses how microplastic weathering changes its transport, fate and toxicity in the marine environment. In the oceans, microplastic particles are exposed to factors including UV light, physical stress and biofilm growth on their surface. Those lead to their fragmentation and degradation and have an impact on their density, their environmental fate and chances of being ingested by biota. Despite these important aging processes and their impacts, the hazards associated with weathered microplastic are to date barely understood. The project carries out a variety of research activities with plastic material that is artificially aged to simulate months to years of environmental weathering, and develops models to put the results into the context of real world observations. These research activities include:

- Development of a liquid chromatography/high-resolution mass spectrometry fingerprinting protocol to trace likely sources of microplastic. The project also develops approaches for characterizing polymer types and physical properties, particle shape and size as well as surface charge to characterize the changing properties of microplastic during weathering.

- Investigation of the impact of weathering on the aggregation and settling behavior of microplastic, tested in column experiments that allow for isolating single environmental factors (e.g., UV light, turbulence, salinity) and hence for investigating their relative influence. The results are used to develop a model for settling particles.

- Examination of the effects of biofilm formation on the surface of microplastic particles on their vertical distribution and trophic transfer. Project partners perform feeding experiments with pelagic filtrators exposed to microplastic with and without biofilm coating and investigate their life history responses and swimming behavior. The mechanisms of these effects are investigated using biochemical, behavioral and life-history endpoints.

- Adaptation of hydrodynamic models generated for inert particles to be suitable for weathering microplastic particles with variable properties over time, based on the laboratory observations. Partners study effects of currents and waves on the fate of microplastic in marine environments. The models are developed for field sites with wastewater treatment plants as the main microplastic sources.

- Collection and analysis of field samples (water, plankton, sediment) for their microplastic content to compare the field observations with the laboratory results and model predictions. Sampling sites are the Oslo Harbor, the Sargasso Sea and the Baltic Sea. The project develops laboratory digestion protocols to isolate the microplastic fraction from the bulk of biological material.

- Toxicological assessment of microplastic particles at different stages of aging and of the leachates that remain after removing the particles by filtering. WEATHER-MIC uses modified OECD guidelines for the particles and leachates and a battery of cell-based reporter gene bioassays for leachates. Changes in biofilm communities as a result of weathering are also studied.

- Estimation of the environmental risk posed by pristine and weathered microplastic and their leachates. The project will combine the data on exposure and effects to provide insight into the most critical properties of the particles after weathering, e.g., shape or the most toxic size fraction.

The harm microplastic causes is triggering societal action to eliminate marine litter. However, even if we managed to eliminate sources of marine litter and other sources of microplastic, we still have to face the consequences of that material that is already in the oceans. Much of this plastic will persist for at least the decades to come. The outcome of WEATHER-MIC will lead to better risk management and environmental adaptation strategies for the microplastic present in the ocean.

In order to maximize the impact and outreach, WEATHER-MIC provides an up-to-date project website including teaching material, such as classroom experiments and videos about what happens to microplastic in the ocean: http://www.jpi-oceans.eu/weather-mic/about

Consortium

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