FACTS Fluxes and Fate of Microplastics in Northern European Waters

Coordinator: Jes Vollertsen, Aalborg University, Denmark

The consortium

Organization	Country	PI
Aalborg University, Department of the Build Environment	Denmark	Jes Vollertsen
Alfred-Wegener-Institut, Helmholtz Zentrum für Polar und Meeresforshung, AWI Helgoland	Germany	Gunnar Gerdts
Norwegian Institute of Air research Environmental Chemistry	Norway	Dorte Herzke
ICBM, Institute for Chemistry and Biology of the Marine Environment, University of Oldenburg	Germany	Barbara Scholz-Böttcher
National Research Council of Italy Institute Marine Science	Italy	Stefano Aliani
Institute of Marine Research, Contaminants and Biohazards	Norway	Tanja Kögel
Norwegian Research Center, Environment Department	Norway	Alessio Gomiero
GEOMAR Helmholtz Zentrum für Ozeanforschung, Marine Biogeochemistry	Germany	Anja Engel
University of Gothenburg, Marine Sciences	Sweden	Martin Hassellöv
Technische Universität Berlin, Institute of Environmental Science & Technology	Germany	Andreas Held
Sigray	USA	Sylvia Lewis
Universitet i Bergen, Department of Mathematics	Norway	Guttorm Alendal
Continental Reifen Deutschland GmbH, Quality Management & Environment, Tires	Germany	Silke Krömer
Ocean Scientific International Limited	UK	lain White
Heriot-Watt University, Mechanical, Process and Energy Engineering	UK	Tony Gutierrez

The objective

- Understanding the sources, transport, occurrence, and fate of
 - small microplastics <500 μ m
 - in the northern marine waters



The approach

- Address the geographical issue of MP transport
 - from the temperate waters of the southern North Sea
 - to the arctic waters of the Barents Sea
- Include the physical distribution of MP
 - different temporal an spatial scales
 - their vertical transport in the water column
- Target new challenges of
 - determining and quantifying nanoplastics and
 - tyre particles in the marine environment

The structure

- Sampling campaigns reaching from the German Bight to Svalbard
 - samples are collected from all types of vessels
- Represent the whole water column
 - from the interface with the atmosphere to the sediments
 - at some sites benthic fish are caught wild
 - at some sites atmospheric deposition is sampled and analysed
- Sea surface microlayer and marine snow are sampled
 - to improve the understanding of 3-dimensional transport of MP and NP

WP I

Large Scale Transport – South to North



Large scale horizontal transport from northern Europe to the Arctic High-resolution transport of surface MP

Surface drift trajectories will be modelled based on empirical oceanographic data

This will lay the ground for designing the large-scale sampling campaign





Planed for summer 2021, 1 month with the Heincke research vessel

And samples from other cruises made available for FACTS

maphhouse.co.uk

To quantify sedimentation rates in the Skagerrak

Water from the south of the North Sea flows into the Skagerak, carrying large amounts of plastic debris

The Skagerak is known to act as sink for many anthropogenic pollutants

It is hypothesized that this is also the case for MP

Sediment and water will be sampled along the Baltic current and the strong accumulation zone of the North East Skagerak



The input of microplastics from the atmosphere

Improve the understanding of the role of long distance atmospheric transport of MP to the artic

We will amongst others:

- Investigate microplastics in snow and rain at a near urban area and at remote site
- Continuously sample MP in air along the FACTS south-north sampling transect
- Investigate the sea surface layer as gateway for atmospheric MPs to marine waters

The results will be used to adapt an existing air transport model for MP



Evaluate if the physical distribution of MP is reflected in biota

Sample the benthic fish Cusk (Brosme brosme) and Cod (Gadus morhua) to cover the whole study region

Sampling is done by ecosystem cruises, commercial fishermen, and private fishermen

Focus on edible parts of the fish and the liver





Intermediate scale transport and fate

Bergen fjord



To understand the distribution, vertical movement and deposition of MP in an intermediate scale fjord

A hydrodynamic model of Byfjorden will be used to define sites of interest for MP distribution and deposition

Water column, marine snow, sediments, and biota will be collected

Data will be used to improve and evaluate deposition models



To elucidate the relative importance of local input versus long-range transport

A preliminary 3D model will be further developed to find procedures that more reliable can predict areas of MP accumulation

It will incorporate data and process understanding from several WPs

It will be tested against sampling data applying e.g. Monte Carlo simulation techniques



Vertical transport in the water column



Study coagulation efficiency of plastic particles in the ocean

What controls nano- and microplastics aggregations dynamics?

Develop a methodology that allows empirical determination of MP and NP coagulation efficiencies

Compare results to field studies of marine snow aggregates from the water column



Vertical distribution of MP and association with natural particles

Sample and isolate plastics from large volumes of seawater

and from sinking particulate matter

Sampling from the North Sea to the Barents Sea



https://osil.com/product/microplastics-sampler/

Accumulation of MP in sediments

A station with especially well-defined sediment accumulation and background knowledge is utilized (Gullmar Fjord, Swedish west coast)

The sediments at the site reflect local conditions as well as Baltic water, its protected from trawling and other marine activities

Other sites from other WPs will also be included in the work



New challenges



One of our students having fun

11014

to st

Going towards the nano's

Detection, identification and quantification of NP in the environment is among the great challenges in the research field

Assess adequate purification and concentration methods

Assess detection limits

Test the developed analytical concepts on selected matrices from selected sites





Tyre wear particles – the tricky ones

Tyre wear particles probably are a substantial source for microplastics in the environment

This has though not been shown in field studies

They are tricky to measure, spectroscopic methods don't see them

Here we improve pyrolysis GC-MS techniques to quantify these particles





Coordinated sampling, extraction, analysis

We coordinate sampling protocols We coordinate extraction protocols We coordinate analysis protocols

We coordinate QA/QC during sampling We coordinate QA/QC during extraction We coordinate QA/QC during analysis

We intercalibrate to ensure comparable data We evaluate differences caused due to different instruments We apply this to yield homogeneous datasets for modeling and risk assessment

Project, coordination, integration, synthesis

We critically evaluate identification and quantification approaches We critically evaluate modeling of MP in the light of the obtained data We critically review problems during sample treatment and measurement

We distill a suite of best practices / best compromises to guide EU member states, stakeholders, policy makers

We of course we coordinate the project and our activities

Thanks for your attention