MICROPLASTIC ABUNDANCE AND DISTRIBUTION IN GERMAN BIGHT SURFACE WATERS

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Introduction

Microplastics (MP), particles ranging from 1 µm to 5 mm, are ubiquitous pollutants in the marine environment. Particle number and size related data are a common measure and highly relevant for ecotoxicological studies, whereas complementary mass related data enable geospatial or temporal studies independent of any particle appearance or size. To gather such information for defined regions, an area-wide approach is necessary. So far, MP data for the North Sea is restricted to few particle count data.

Method and Aim

In this study the spatial MP load in surface waters of the German Bight as well as its potential sources and temporal variation were comprehensively examined. For this purpose between 51 and 335 L of water from 2.5 m depth were sampled during two cruises (HE473, October 2016 & HE498, October 2017) covering the Ems, Weser and Elbe estuary as well as transects parallel to the coast and in NW/SE directions (Fig. 1). The water samples were filtered to receive two particle size fractions (20 to 125 µm and >125 µm). Observed MP particles sizes in the samples did not exceed 1 mm except for some fibers.

The most relevant consumer plastics (polyethylene (PE), polypropylene (PP), polystyrene (PS), polyethylene terephthalate (PET), polyvinylchloride (PVC), poly(methyl methacrylate) (PMMA), polycarbonate (PC), polyamide (PA) and polyurethane (MDI-PUR)) were analyzed using py-GCMS/thermochemolysis (Fischer and Scholz-Böttcher, 2017). Py-GCMS is an excellent method for qualitative and trace level polymer specific mass quantitative analysis. This method is especially suitable for small MP particles and does not require preliminary optical detection or mechanical separation, only preconcentration and MP purification steps (H2O2 treatment, density separation).

Complementary to common particle count related data py-GCMS provides MP mass concentrations. This is the first mass related survey of MP in surface waters of the North Sea. Besides the general plastic load and MP composition they enable data comparison on a spatial and temporal scale.

Results and Discussion

The overall MP concentration in surface waters of the German Bight ranges between 2 and 2000 ng m⁻³. Neither MP concentration nor type distribution is homogenous. Based on MP type composition different sources, namely long distance transport, coastal tourism activities, commercial shipping routes and riverine urban and industrial input could be distinguished on a spatial scale (Fig. 1). These sources remain visible between the sampled years, although annual absolute concentrations vary strongly. In 2017 the MP concentration of the fraction
<125 µm exceeds >125 µm particle fraction concentrations by far. This was not observed in 2016. Actual

Figure 1: Relative MP composition in German Bight surface waters [%] for transects from October 2016 (unframed pie charts, white arrows) & 2017 (red framed pie charts & arrows). Green framed pie charts indicate incomplete samples from 2016, all other samples include fractions <125 µm and >125 µm. Transects were grouped according to common microplastic sources. Distinguished MP sources: a) long distance transport & coastal tourism activities, b) commercial shipping, c) riverine urban and industrial input, d) mixed signal.

currents strongly influence these concentrations on a temporal scale as could be shown for the 2017 NW-SE transect.

Conclusions

MP mass load in North Sea surface water range from ppt to lower ppb levels, This is comparable to concentrations of other environmental pollutants. The qualitative spatial MP composition could be related to different sources, whereas meteorological as well as oceanographical conditions seem to have substantial influence on absolute spatial and temporal mass load.

References