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Ship coatings are the principal source of North Sea marine microplastics, finds study

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Contact:
Barbara M. Scholz-Böttcher,
bsb@icbm.de

Much discarded plastic enters our oceans via pathways such as littering, drainage, sewage systems, and mismanaged disposal, and fragments to form 'microplastics' — particles of under 5 millimetres (mm) in size. A study assesses the distribution, variation, composition, concentration and sources of microplastics in the German Bight. It finds different types of microplastics in coastal, central and estuarine areas, and suggests that antifouling coatings on ships are a prominent, but underestimated, source of microplastic pollution in the area.

Microplastics are a complex class of contaminants that are currently receiving much attention from policymakers worldwide, including via the EU's strategy on plastics and the European Chemicals Agency's assessment for a wide-ranging restriction on intentionally-added microplastics in products. Plastics are versatile and prevalent, making it especially difficult to determine their sources and ascertain how they enter and disperse through marine environments. Most (i.e. 80%) marine plastics are assumed to come from land-based sources such as via rivers, with the remainder being marine-based debris. However, data on microplastics in some marine environments is sparse.

This is the case for the North Sea and German Bight, the geographical focus of this study. The researchers explored near-surface water samples (from a fixed depth of 2.5 metres) — acquired in October 2016 and 2017 from 24 locations with different potential impacts and sources of microplastic, such as riverine input, high shipping traffic and tourism — via the analytical methodology of 'pyrolysis-gas chromatography coupled to mass spectrometry' (Py-GC/MS). This technique has shown potential in simultaneously identifying and characterising polymers in environmental samples. The study aimed to map particle distributions, properties, trends and concentrations; and to identify possible land- and marine-based sources of 10 commonly used plastic polymers[1].

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Ship coatings are the principal source of North Sea marine microplastics, finds study (continued)

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The microplastics detected were almost exclusively under 1 mm in size. Of the 10 polymer types sought, seven were detected, with the most prominent belonging to the 'PMMA cluster' (quantified as polymethyl methacrylate (PMMA)), the 'PVC cluster' (quantified as polyvinyl chloride (PVC)) and in a smaller share to the 'PC cluster' (quantified as polycarbonate (PC)). These three polymer clusters accounted for 80% of the total microplastic share for various samples indicating that mismanaged packaging plastics — which are typically dominated by other plastics — are unlikely to be a major microplastic source for North Sea waters.

Microplastic concentrations, spatial distributions, and different types were highly variable across the region. Concentrations were elevated in coastal areas, in particular in the Elbe estuary, reflecting the many terrestrial plastic sources that find their way into the ocean. However, also areas far away from the coastline revealed raised loads. Samples taken closer to coastal areas showed elevated proportions of polymers typically used for consumer plastics (PE, polypropylene (PP) and polyethylene terephthalate (PET))— something the researchers suggest could be due to high on- and off-shore tourism activities or uncontrolled waste along highly frequented shipping routes.

Fishing activity was identified as a key source of anthropogenic floating debris in the North Sea, with high amounts of plastics commonly used for fishing nets, ropes, twines, and boxes used to transport seafood. High industrial fishing activity was recorded near the East and North Frisian Islands during the survey period. Notably, a cluster of polymers predominantly used in long-lasting applications (e.g. construction) and antifouling ship coatings dominated in the cross-section slicing from south-east to north-west, aligning closely with major commercial shipping lanes.

Overall, protective ship coatings and related gear are an obvious and plausible source for the polymer patterns observed in this study, say the researchers, rather than conventional polymer consumer products. There are many possible polymer and binder combinations used in antifouling coatings, they highlight, requiring further study to quantify the coatings' contribution to the respective detected polymer clusters and resulting microplastic loads in marine environments. The findings invert the assumption that most marine microplastics come from land-based sources, instead indicating that in parts of the German Bight and attached estuaries, marine sources (shipping) far outweigh those based on land (packaging).

1. Polyethylene (PE), polypropylene (PP), poly(ethylene terephthalate) (PET), polystyrene (PS), poly- (vinyl chloride) (PVC), polycarbonate (PC), poly(methyl methacrylate) (PMMA), polyamide 6 (PA6), polyamide 66 (PA66) and methylene diphenyl diisocyanate polyurethane (MDI-PUR). Together, these represent well over 80% of global annual plastic demand.