Supplementary Material for

Floating microplastic inventories in the southern Beaufort Sea, Arctic Ocean

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Note S1. Laboratory analysis

To avoid external contamination in the laboratory, lab coats were 100% cotton, without plastic fibers, and work surfaces were pre-cleaned. Samples were processed in a laminar flow hood. The samples were digested with 30% H_2O_2 for 7 d at room temperature (Hurley et al., 2018). All particles that were potentially plastic were manually pulled from the samples using forceps under a dissecting stereomicroscope (SZX16; Olympus, Tokyo, Japan) and transferred to glass multi-well plates with glass lids. The particles were dried for 3 d at room temperature, photographed using a camera (DP74; Olympus) mounted on the microscope, and classified by shape into "fragments" (a mixture of hard fragments and film) and "lines" (thread-like materials excluding textile microfibers). Each particle was measured for length and width using imaging software (cellSens Dimension 2.1; Olympus). Because of potential airborne contamination by microfibers from clothing during sampling or processing (Foekema et al., 2013; Cózar et al., 2014) or from paint flakes from the research vessel during observations, textile microfibers and paint flakes were excluded from our analyses.

We used Fourier transform infrared (FTIR) spectroscopy with single-reflection diamond attenuated total reflection (ATR) (Nicolet iS5; Thermo Fisher Scientific, Waltham, MA, USA) to determine the polymer types in each sorted plastic-like particle based on a method described previously (Nakajima et al., 2022). Spectra were collected at 4 cm^{-1} spectral resolution by co-adding 16 scans per sample and compared to multiple spectral database libraries containing both synthetic polymers and non-synthetic materials (Omnic 9; Thermo Fisher Scientific). A hit quality >60% was used as the threshold for polymer types (Galgani et al., 2013).

Particles identified as plastic were transferred to pre-weighed paraffin paper and then weighed on an electronic balance (BM-252; A&D Company, Tokyo, Japan). The individual micro- and mesoplastic particles in each sample were counted, and concentrations (number of pieces m^{-3}) were calculated from the volume of water sampled as estimated from the mouth-opening area of the neuston net and the towed distance measured by the flow meter. For sample blanks, we placed wide-mouth glass bottles containing 100 mL of ultrapure water in each of the workspaces (i.e., in the laminar-flow hood and near the stereomicroscope and FTIR) for 30 min.

Note S2. Particle and mass concentrations

The concentrations of micro- and mesoplastic particles during the sampling period ranged from 3.0 to 17×10^{-3} pieces m^{-3} (mean ± standard deviation, $8.5 \pm 4.2 \times 10^{-3}$ pieces m^{-3}). Particle concentrations exceeding 10×10^{-3} pieces m^{-3} were found at stations (Stns.) 13 and 24 off Utqiaġvik and at Stn. 18 off the mouth of the Mackenzie River, with the highest concentration at 17×10^{-3} pieces m^{-3} at Stn. 13. The mass concentration of micro- and mesoplastic particles ranged from 0.23 to 14 µg m^{-3} (3.3 ± 5.1 µg m^{-3}). The first and second highest mass concentrations were observed at coastal Stns. 20 and 13, both of which had mesoplastics. There was little difference in concentrations among the other stations.

Table S1. Micro- and mesoplastic particle counts and masses in neuston-net tow samples and their concentrations in the surface waters of the southern Beaufort Sea from 30 August to 10 September 2022.

Station	Mesoplastic count (pieces sample^{-1})	Microplastic count (pieces sample^{-1})	Micro- and mesoplastic mass (mg sample^{-1})	Micro- and mesoplastic particle concentration ($\times 10^{-3}$ pieces m^{-3})	Micro- and mesoplastic mass concentration (µg m^{-3})
13	1	4	5.31	12	13
15	0	5	0.28	5.9	0.33
16	0	6	0.30	8.2	0.41
18	0	10	2.22	13	2.8
19	0	7	0.24	7.3	0.25
20	1	1	8.18	3.4	14
22	0	2	0.25	3.0	0.37
24	0	11	0.48	17	0.75
26	0	4	0.15	6.0	0.23
27	0	6	0.65	9.3	1.0

Table S2. Shapes, polymers, and maximum lengths of micro- and mesoplastic particles in the surface waters of the southern Beaufort Sea.

Station	Sample serial number	Shape	Polymer	Abbreviation	Maximum length (mm)
13	1	Fragment	Polyester	PE	7.27
13	2	Fragment	Polydimethylsiloxane	PDMS	0.75
13	3	Fragment	Polyurethane	PU	0.51
13	4	Fragment	Polyethylene	PE	0.72
13	5	Fragment	Polydimethylsiloxane	PDMS	1.59
15	6	Fragment	Polyethylene	PE	2.34
15	7	Fragment	Polydimethylsiloxane	PDMS	1.66
15	8	Fragment	Polydimethylsiloxane	PDMS	0.31
15	9	Line	Polyamide	PA	2.19
15	10	Fragment	Polydimethylsiloxane	PDMS	0.59
16	11	Fragment	Polydimethylsiloxane	PDMS	0.63
16	12	Fragment	Polyurethane	PU	0.59
16	13	Fragment	Polyurethane	PU	0.57
16	14	Fragment	Polyvinyl chloride	PVC	1.37
16	15	Fragment	Polyethylene terephthalate	PET	0.91
16	16	Fragment	Polyethylene terephthalate	PET	1.13
18	17	Fragment	Polyethylene propylene diene	EPDM	0.53
18	18	Fragment	Polyethylene	PE	4.70
18	19	Fragment	Polyethylene	PE	1.98
18	20	Fragment	Polyethylene	PE	0.55
18	21	Fragment	Polyethylene	PE	1.88
18	22	Fragment	Polyethylene	PE	1.14
18	23	Fragment	Polydimethylsiloxane	PDMS	1.10
18	24	Fragment	Polyvinyl chloride	PVC	1.24
18	25	Fragment	Polydimethylsiloxane	PDMS	1.08
18	26	Fragment	Polydimethylsiloxane	PDMS	1.26
19	27	Fragment	Polydimethylsiloxane	PDMS	0.76
19	28	Fragment	Polydimethylsiloxane	PDMS	0.79
19	29	Fragment	Polyurethane	PU	0.68
19	30	Fragment	Polyethylene terephthalate	PET	0.88
19	31	Fragment	Polycarbonate	PC	0.75
19	32	Fragment	Polyethylene	PE	1.84
19	33	Fragment	Polyethylene	PE	3.34
20	34	Fragment	Polydimethylsiloxane	PDMS	6.01
20	35	Fragment	Polyethylene terephthalate	PET	1.31
22	36	Fragment	Polyethylene	PE	0.64
22	37	Fragment	Polydimethylsiloxane	PDMS	2.05

Table S2. (continued)

Station	Sample serial number	Shape	Polymer	Abbreviation	Maximum length (mm)
24	38	Fragment	Polydimethylsiloxane	PDMS	1.90
24	39	Fragment	Polyethylene terephthalate	PET	0.76
24	40	Fragment	Polydimethylsiloxane	PDMS	1.70
24	41	Fragment	Polydimethylsiloxane	PDMS	2.46
24	42	Fragment	Polydimethylsiloxane	PDMS	0.51
24	43	Fragment	Polyurethane	PU	0.89
24	44	Line	Polyamide	PA	1.64
24	45	Fragment	Polyvinyl acetate	PVAc	3.22
24	46	Fragment	Polyethylene	PE	0.43
24	47	Fragment	Polyurethane	PU	1.03
24	48	Fragment	Polydimethylsiloxane	SI	1.26
26	49	Fragment	Polyethylene	PE	1.29
26	50	Fragment	Polyethylene	PE	0.99
26	51	Fragment	Polydimethylsiloxane	PDMS	0.71
26	52	Fragment	Polydimethylsiloxane	PDMS	0.53
27	53	Fragment	Polyurethane	PU	0.38
27	54	Fragment	Polyethylene	PE	1.07
27	55	Fragment	Polyethylene	PE	1.96
27	56	Fragment	Polyurethane	PU	0.51
27	57	Fragment	Polydimethylsiloxane	PDMS	0.71
27	58	Fragment	Polyethylene	PE	0.35

Table S3. Fractions of sea-ice meltwater and other freshwaters in the topmost 4.5 m of the water column in the Beaufort Sea.

Station	pCO_2 (µatm)	TCO_2 (µmol kg^{-1})	Temperature (°C)	Salinity	Total alkalinity (µmol kg^{-1})	Sea-ice meltwater (%)	Other freshwater (%)
13	362	1943	4.3	27.6	2049	5.9	9.8
15	398	1826	3.4	24.0	1894	11.9	15.8
16	417	1800	4.3	22.9	1861	12.8	18.4
18	399	1786	5.7	19.0	1847	14.4	28.8
19	418	1859	7.7	18.2	1927	9.1	36.2
20	410	1887	5.2	23.1	1963	6.0	23.7
22	404	1817	4.1	23.5	1884	12.0	17.1
24	367	1909	3.4	26.7	2002	7.9	10.8
26	378	1769	1.0	24.1	1827	16.8	11.0
27	357	1900	3.2	26.8	1995	8.6	10.0

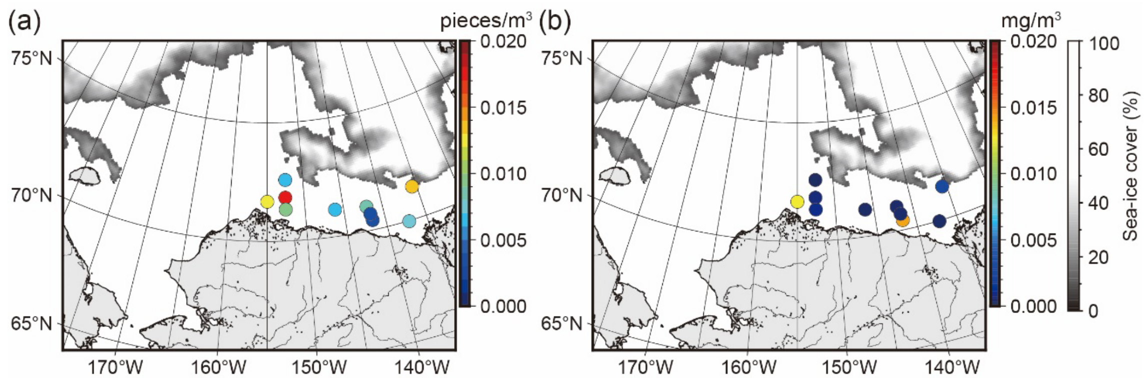

Figure S1. Concentrations of micro- and mesoplastics in surface waters at sampling stations in the southern Beaufort Sea from 30 August to 10 September 2022. (a) Particle concentrations; (b) mass concentrations. Grey shading shows the average sea-ice cover observed by the Advanced Microwave Scanning Radiometer 2 during the sampling periods from 30 August to 10 September 2022.

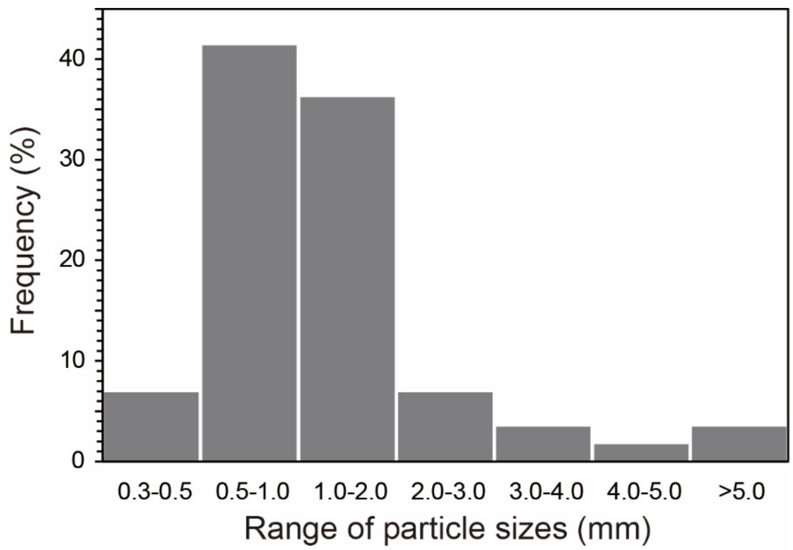

Figure S2. Size distribution of micro- and mesoplastic particles in the surface waters of the southern Beaufort Sea collected from 30 August to 10 September 2022.

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