Supplementary Material

# Supplementary Methods

## Detailed Ship-board Sampling

Microplastics were collected using the non-contaminated seawater inlet at 7m below the sea surface in the hull of the *CCGS Amundsen*, during leg3b of Arctic Net 2018 (August-September). The seawater system continuously pumped water under pressure through a stainless-steel inlet at the bow of the ship and through a strainer with a mesh 20 (841µm) to keep out mesoplastics and other debris from entering the system. Temperature, salinity, and flow rate were measured with an inline thermosalinograph (TSG) and flowmeter prior to being pumped to separate lab outlets. In the laboratory, a splitter was used to divert the water through polycarbonate tubing and through a bespoke microplastics sampling system (Figure S1).

Rather than collecting microplastics through one stainless steel sieve, tubing was used to direct the flow of water down through a small opening in an otherwise sealed off cylindrical aluminium modular tower. This served to position three nylon filters of increasing pore size above one another (50, 100 and 300 µm), by clamping them between each module of the tower (Figure S1). Each filter was a square-cut 120 mm piece of nylon mesh, replaced for each transect and larger than the diameter of the modules (100 mm). The clamping of each filter between two modules was achieved by recessing the base of each module to slot inside, and screw fastening, ensuring the filters were held taut. The modules were sufficiently tall to allow some retention of water within each module should the flow rate be slow. The inline flowmeter registered the flowrate and was subsequently minute-integrated (S2, tsg data). The outlet tap was only slightly opened so that the flow rate in the laboratory was manually measured and found to be consistently 2.4 times slower than the inline flowmeter recording. This enabled the average flow rate (0.43 L/min) of water directed through the microplastic sampling system to be calculated (S1, Table 2).

At the start of each transect the polycarbonate tube was connected to the system to run continuously. Transects ended when either the water in the finest filter (50 µm) became saturated with particulate matter, evidenced by the discolouration of the filter, or by any fatiguing of the filter which may suggest retention of water in the module. This latter condition was evidenced by the overhang of the filter being reduced in size by at least 5 mm in any direction. The tubing was then disconnected, and the system left in place for any residual water to drain though. Each module was removed in sequence, from top to bottom, rinsing down the inside of each module with Mili-Q water, concentrating any residual particulate onto each respective filter. The filters were removed and handled carefully with nitrile gloves, only holding the corners, and folding together in half. These were then sealed individually in aluminum foil and each transect in sample bags and frozen at -20˚C; a quick process which limited exposure to airborne contamination.



Figure S1: Schematic sketch of the microplastics collection system. Seawater was collected from an inlet in the hull of the CCGS Amundsen, at 7m below the sea surface. The water passed through a strainer (A) and a series of instruments to measure the water’s properties, including a flowmeter (B). A pump (C) directed flow to different laboratory outlets. A splitter was used to direct flow from an outlet (D) into the microplastics sampling system via polycarbonate tubing affixed to a small opening on the otherwise, sealed system (F). The blue arrow indicates the direction of water flow, through the nylon mesh filters. The aluminium modules were inset to enable mesh filters to be clamped together and were secured with screw-holds (G). Plastic suckers (H) fastened the collection system to the basin.

## Concentration Calculations using correction factors

Concentrations of plastics have been normalized per Litre. The total concentration of plastics for each transect comprises the particle and fibre component separately as per the process below:

Plastic Particles = [Eqn 1]

Whereby:

*T otal Particle Count = Number of particles on all mesh from transect x.*

*Measured Particle Count = Number of particles measured with FTIR*

*Confirmed Plastic Particle Count = Number of particles with positive plastic identification from the measured count*

*Plastic Particle Fraction =*

*Estimated Plastic Particle Count =*

Plastic Fibre concentrations include an element of correction, owing to the presences of fibres in the procedural blank (see supplementary data, table xx) and fibres on air contamination filters.

Air contamination filters were opened and closed at the start of each laboratory day. This means that each air contamination filter represents the potential air contamination shared amongst the filters analysed in any given day. A sub-sample of fibres from the air contamination filter were measured using FTIR and were found to be a mix of plastic and cellulose derived (Table 3b). The following is assumed however:

The composition of the fibres are unknown, as with the initial total count of all fibres on each transect. Taking a precautionary approach, one assumes that all of the fibres from the contamination filter are potentially plastic and therefore must be subtracted as per equation 2 and 3:

Plastic Fibres = [Eqn 2]

Whereby:

* *Total Fibre Count = Number of fibres on all mesh from transect x.*
* *Air Contamination Factor =*
* *Procedural Blank Count = 5*
* *Corrected Count = Total Count – Air Contamination Factor– Procedural Blank Count*
* *Measured Fibre Count = Number of fibres measured with FTIR*
* *Plastic Fibre Fraction =*
* *Estimated Plastic Fibre Count = Plastic Fibre Fraction X Corrected Count*

The total plastic concentration is therefore the sum of Eqn 1 and Eqn 2. The input and outputs from these calculations are provided in tables 3a and 3b in supplementary results.

## Greywater Microfibre calculation

Using the following:

- Vard (2018) and EPA (2006) estimate that 17% of **33,438,239 L** of greywater entering the Canadian Arctic/year is laundry effluent based on 2016 figures:

**33,438,239 \* 0.17 = 5,684,510 L** of laundry effluent from Canadian Arctic Shipping in 2016.

- Napper and Thompson (2016) estimate **137,951 - 728,789 fibres** per 6kg load. The washing machine tested was chosen based on it have an energy consumption and therefore water useage representative of the average washing machine. 6kg load discharges approximately 49L of water in the load:

137,951 - 728,789 fibres/ 49 L **= 2,815** fibres/L **– 14,873** fibres/L

* To calculate minimum value we assume, based on our study that only 23.8% of fibres are plastic:

Minimum: 2,815 fibres/L \* 0.238 \* 5,684,510 L= **3,808,451,165** microfibres per year into theCanadian Arctic

* To calculate maximum value we assume all fibres are plastic:

Maximum: 14,873 fibres/L \* 5,684,510 L= **84,545,717,230** microfibres per year into the

Canadian Arctic

# Supplementary Results

## Additional Data Tables

Transect start times, finishes and intervals are provided in table 1.

Table 1: Locations and times for transect start time and finish time

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Transect | Date (ddmmyyyy) | Time (hh:mm:ss) | LAT | LON | Microplastics Sampling System |
| 1 | 18/08/2018 | 11:48:00 | 72.75007 | -96.141 | On |
| 1 | 18/08/2018 | 22:15:00 | 71.42274 | -97.8857 | Off |
| 2 | 18/08/2018 | 22:17:00 | 71.41553 | -97.897 | On |
| 2 | 19/08/2018 | 13:17:00 | 69.18326 | -100.676 | Off |
| 2 | 19/08/2018 | 17:58:00 | 69.04202 | -101.07 | On |
| 2 | 19/08/2018 | 19:45:00 | 68.71699 | -101.301 | Off |
| 3 | 19/08/2018 | 19:58:00 | 68.6714 | -101.299 | On |
| 3 | 20/08/2018 | 03:00:00 | 68.64412 | -98.4188 | Off |
| 4 | 20/08/2018 | 20:04:00 | 68.55367 | -95.8583 | On |
| 4 | 21/08/2018 | 20:36:00 | 68.79052 | -105.057 | Off |
| 5 | 23/08/2018 | 00:18:00 | 69.43489 | -100.116 | On |
| 5 | 23/08/2018 | 14:20:00 | 71.54069 | -97.5546 | Off |
| 6 | 24/08/2018 | 01:50:00 | 73.00641 | -96.2385 | On |
| 6 | 24/08/2018 | 22:45:00 | 73.24376 | -89.738 | Off |
| 7 | 25/08/2018 | 01:37:00 | 72.55693 | -90.2676 | On |
| 7 | 25/08/2018 | 12:20:00 | 69.96615 | -90.2328 | Off |
| 8 | 27/08/2018 | 03:36:00 | 74.5004 | -80.548 | On |
| 8 | 27/08/2018 | 16:05:00 | 76.21278 | -78.3426 | Off |
| 9 | 27/08/2018 | 17:55:00 | 76.45536 | -78.7292 | On |
| 9 | 28/08/2018 | 00:01:00 | 76.38463 | -77.3931 | Off |
| 9 | 28/08/2018 | 03:56:00 | 76.39956 | -77.4126 | On |
| 9 | 28/08/2018 | 15:19:00 | 77.20672 | -76.0491 | Off |
| 10 | 28/08/2018 | 15:34:00 | 77.16508 | -76.0439 | On |
| 10 | 29/08/2018 | 05:00:00 | 76.33669 | -71.2014 | Off |
| 11 | 29/08/2018 | 08:55:00 | 76.3294 | -71.137 | On |
| 11 | 29/08/2018 | 17:48:00 | 74.97209 | -69.7855 | Off |
| 12 | 30/08/2018 | 14:05:00 | 70.93536 | -66.2968 | On |
| 12 | 30/08/2018 | 22:05:00 | 69.34313 | -65.1427 | Off |
| 13 | 31/08/2018 | 00:06:00 | 69.0631 | -64.9658 | On |
| 13 | 31/08/2018 | 12:30:00 | 67.55321 | -64.0727 | Off |
| 14 | 01/09/2018 | 20:45:00 | 67.47904 | -63.507 | On |
| 14 | 02/09/2018 | 05:10:00 | 66.4982 | -60.9059 | Off |
| 15 | 02/09/2018 | 17:45:00 | 66.56015 | -61.666 | On |
| 15 | 02/09/2018 | 22:00:00 | 66.52834 | -61.631 | Off |
| 16 | 03/09/2018 | 15:16:00 | 66.42205 | -61.2734 | On |
| 16 | 03/09/2018 | 20:05:00 | 65.49683 | -61.7292 | Off |

Volumes were calculated based on the fact that the registered flowrate from the TSG\_flowmeter was 2.4 times greater than the manually measured flow from the outlet in the ship laboratory.

Table 2: Average Ocean Parameters and Ship Parameters for each transect

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Transect Number | Volume Sample (Litres) | Mean Flow Rate  (L/min) | Mean Ship speed  (knots) | Average Temp  (Deg C) | Average Salinity | Depth |
| 1 | 311.733 | 0.496 | 5.230978 | -0.64 | 23.62 | 64 |
| 2 | 627.913 | 0.622 | 5.618534 | -0.033 | 25.58 | 64 |
| 3 | 252.871 | 0.597 | 6.817182 | 3.467 | 22.09 | 35 |
| 4 | 1163.487 | 0.79 | 4.914868 | 3.418 | 22.3 | 66 |
| 5 | 634.6 | 0.753 | 5.650402 | -0.542 | 25.4 | 65 |
| 6 | 890.333 | 0.709 | 6.443504 | -0.462 | 25.93 | 53 |
| 7 | 311.483 | 0.484 | 7.780418 | 1.256 | 29.39 | 110 |
| 8 | 320.367 | 0.427 | 5.193456 | 2.246 | 31.97 | 662 |
| 9 | 289.221 | 0.275 | 3.545058 | -0.403 | 29.19 | 347 |
| 10 | 132.854 | 0.165 | 4.4461 | 1.014 | 29.57 | 352 |
| 11 | 88.363 | 0.165 | 5.15542 | 3.426 | 31.56 | 553 |
| 12 | 468.771 | 0.329 | 6.362806 | 3.541 | 30.83 | 651 |
| 13 | 196.933 | 0.264 | 3.917708 | 2.27 | 29.64 | 651 |
| 14 | 155.325 | 0.307 | 6.028706 | 1.527 | 30.12 | 680 |
| 15 | 45.808 | 0.179 | 3.316842 | 0.708 | 30.3 | 683 |
| 16 | 92.4 | 0.319 | 6.113516 | 0.976 | 30.34 | 163 |

**Table 3 Values assigned to non-numeric parameters (Ice extent, Current Strength, Shipping)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Qualitative descriptor | | | Assigned Value | | |
| Transect | Current | Traffic | Ice | Current\_1 | Traffic\_1 | Ice\_1 |
| 1 | Fair | Significant Increase | Present | 1 | 3 | 1 |
| 2 | Fair | Significant increase | Present | 1 | 3 | 1 |
| 3 | Fair | Significant increase | Absent | 1 | 3 | 0 |
| 4 | Fair | Significant increase | Absent | 1 | 3 | 1 |
| 5 | Fair | Increased | Present | 1 | 2 | 1 |
| 6 | Moderate | Increased | Present | 2 | 2 | 1 |
| 7 | Fair | Stable | Absent | 1 | 1 | 0 |
| 8 | Moderate | Increase | Present | 2 | 2 | 1 |
| 9 | Strong | Stable | Present | 3 | 1 | 1 |
| 10 | Strong | Stable | Absent | 3 | 1 | 0 |
| 11 | Fair | Stable | Absent | 1 | 1 | 0 |
| 12 | Strong | Increased | Absent | 3 | 2 | 0 |
| 13 | Moderate | Significant increase | Present | 2 | 3 | 1 |
| 14 | Moderate | Significant increase | Present | 2 | 3 | 1 |
| 15 | Moderate | Significant increase | Absent | 2 | 3 | 0 |
| 16 | Moderate | Significant increase | Absent | 2 | 3 | 0 |

Contamination from the air contamination filters and procedural blanks are listed in table 4a -c respectively.

Table 4a. Contamination from air contamination filters

|  |  |  |  |
| --- | --- | --- | --- |
| Contamination Filter | Count | Sample Meshes Measured | Air Contamination Factor |
| A | 2 | 2 | 1.000 |
| B | 7 | 11 | 0.636 |
| C | 12 | 8 | 1.500 |
| D | 1 | 7 | 0.143 |
| E | 1 | 3 | 0.333 |
| F | 2 | 2 | 1.000 |

A random sub-sample was taken and analysed using FTIR:

**Table 4b. Characteristics of air contamination fibres**

|  |  |  |  |
| --- | --- | --- | --- |
| Contamination Filter | Colour | Length (micron) | Polymer ID |
| B | Black | 400 | Cellulose-derived |
| C | Black | 200 | Polyester |
| C | Blue | 750 | Cellulose- derived |
| C | Blue | 300 | Acrylic |
| D | Blue | 1000 | Polyethylene |
| F | Black | 1100 | Nylon |

Table 4c. Air Contamination Factors for each transect

|  |  |  |
| --- | --- | --- |
| Transect | Contamination Filters | Air Contamination to be subtracted from Total Count for each transect |
| 1 | A, D | 1.143 |
| 2 | B, D | 0.779 |
| 3 | D | 0.143 |
| 4 | E, B, D | 1.112 |
| 5 | D | 0.143 |
| 6 | E, B, D | 1.112 |
| 7 | B, F | 1.636 |
| 8 | B, F | 1.636 |
| 9 | B, C | 2.136 |
| 10 | B, C | 2.136 |
| 11 | B, C | 2.136 |
| 12 | B, C, E | 2.469 |
| 13 | B, C | 2.136 |
| 14 | B, C | 2.136 |
| 15 | A, C | 2.500 |
| 16 | C, D | 1.643 |

The total concentration of plastics per Litre is provided along with the concentration of ship contamination, and cellulose derived fibres (table 4a). These numbers are calculated from the concentrations provided for particles and fibres in tables 4b and 4c respectively.

**Table 5a. Concentration of Total Plastics (particles + fibres) per litre of seawater**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Transect ID | Volume sampled (L) | Plastic Particles/L | Plastic Fibres/L | Total Plastic/L |
| 1 | 311.733 | - | 0.004 | 0.004 |
| 2 | 627.913 | 0.002 | 0.014 | 0.015 |
| 3 | 252.871 | - | 0.062 | 0.062 |
| 4 | 1163.487 | 0.002 | - | 0.002 |
| 5 | 634.600 | - | 0.014 | 0.014 |
| 6 | 890.333 | - | - | - |
| 7 | 311.483 | 0.003 | 0.003 | 0.006 |
| 8 | 320.367 | - | 0.007 | 0.007 |
| 9 | 289.221 | 0.003 | 0.003 | 0.007 |
| 10 | 132.854 | - | - | - |
| 11 | 88.363 | 0.011 | 0.271 | 0.282 |
| 12 | 468.771 | - | 0.035 | 0.035 |
| 13 | 196.933 | - | 0.017 | 0.017 |
| 14 | 155.325 | - | - | - |
| 15 | 45.808 | - | - | - |
| 16 | 92.400 | - | 0.051 | 0.051 |
| Total | 5982.462 | 0.022 | 0.481 | 0.503 |

Table 5b. Concentration of Total Plastic Particles per litre of seawater

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Transect ID | Total Count | Measured Count | Confirmed Plastic | Plastic Fraction | Estimated Plastic | Ship Contamination | Estimated Contamination |
| 1 | 9 | 9 | 0 | 0.0000 | 0.0000 | 1 | 0.0000 |
| 2 | 5 | 5 | 1 | 0.2000 | 0.0000 | 3 | 0.0000 |
| 3 | 1 | 1 | 0 | 0.0000 | 0.0000 | 1 | 0.0000 |
| 4 | 4 | 3 | 2 | 0.6667 | 0.6667 | 1 | 0.3333 |
| 5 | 17 | 4 | 0 | 0.0000 | 0.0000 | 3 | 9.7500 |
| 6 | 2 | 2 | 0 | 0.0000 | 0.0000 | 1 | 0.0000 |
| 7 | 1 | 1 | 1 | 1.0000 | 0.0000 | 0 | 0.0000 |
| 8 | 2 | 1 | 0 | 0.0000 | 0.0000 | 0 | 0.0000 |
| 9 | 6 | 6 | 1 | 0.1667 | 0.0000 | 2 | 0.0000 |
| 10 | 3 | 3 | 0 | 0.0000 | 0.0000 | 3 | 0.0000 |
| 11 | 4 | 4 | 1 | 0.2500 | 0.0000 | 0 | 0.0000 |
| 12 | 4 | 0 | 0 | - | - | 0 | - |
| 13 | 9 | 2 | 0 | 0.0000 | 0.0000 | 0 | 0.0000 |
| 14 | 15 | 1 | 0 | 0.0000 | 0.0000 | 1 | 14.0000 |
| 15 | 21 | 0 | 0 | - | - | 0 | - |
| 16 | 22 | 1 | 0 | 0.0000 | 0.0000 | 0 | 0.0000 |
| Total | 125 | 43 | 6 | 2.2833 | 0.6667 | 16 | 24.0833 |

Table 5c. Concentration of Total Plastic Fibres per litre of seawater

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Transect ID | Total Count | Air Contamination Factor | Corrected Count | Measured Fibre Count | Plastic Fibre Count | Plastic Fibre Fraction | Estimated Plastic Fibre Count |
| 1 | 10 | 1.1430 | 3.8570 | 6 | 2 | 0.3333 | 1.2857 |
| 2 | 40 | 0.7790 | 34.2210 | 8 | 2 | 0.2500 | 8.5553 |
| 3 | 42 | 0.1430 | 36.8570 | 14 | 6 | 0.4286 | 15.7959 |
| 4 | 24 | 1.1120 | 17.8880 | 8 | 0 | 0.0000 | 0.0000 |
| 5 | 14 | 0.1430 | 8.8570 | 1 | 1 | 1.0000 | 8.8570 |
| 6 | 30 | 1.1120 | 23.8880 | 7 | 0 | 0.0000 | 0.0000 |
| 7 | 13 | 1.6360 | 6.3640 | 7 | 1 | 0.1429 | 0.9091 |
| 8 | 24 | 1.6360 | 17.3640 | 8 | 1 | 0.1250 | 2.1705 |
| 9 | 11 | 2.1360 | 3.8640 | 8 | 2 | 0.2500 | 0.9660 |
| 10 | 39 | 2.1360 | 31.8640 | 6 | 0 | 0.0000 | 0.0000 |
| 11 | 55 | 2.1360 | 47.8640 | 6 | 3 | 0.5000 | 23.9320 |
| 12 | 40 | 2.4690 | 32.5310 | 8 | 4 | 0.5000 | 16.2655 |
| 13 | 24 | 2.1360 | 16.8640 | 5 | 1 | 0.2000 | 3.3728 |
| 14 | 11 | 2.1360 | 3.8640 | 4 | 0 | 0.0000 | 0.0000 |
| 15 | 19 | 2.5000 | 11.5000 | 3 | 0 | 0.0000 | 0.0000 |
| 16 | 16 | 1.6430 | 9.3570 | 2 | 1 | 0.5000 | 4.6785 |
| Total | 412 | 24.9960 | 307.0040 | 101 | 24 | 4.2298 | 86.7882 |

Table 5d. Concentration of Total Cellulosic Derived Fibres

|  |  |  |  |
| --- | --- | --- | --- |
| Transect ID | Cellulosics | Cellulosic Fibre Fraction | Estimated Cellulosics |
| 1 | 0 | 0.0000 | 0.0000 |
| 2 | 4 | 0.5000 | 17.1105 |
| 3 | 5 | 0.3571 | 13.1632 |
| 4 | 4 | 0.5000 | 8.9440 |
| 5 | 0 | 0.0000 | 0.0000 |
| 6 | 1 | 0.1429 | 3.4126 |
| 7 | 5 | 0.7143 | 4.5457 |
| 8 | 7 | 0.8750 | 15.1935 |
| 9 | 6 | 0.7500 | 2.8980 |
| 10 | 6 | 1.0000 | 31.8640 |
| 11 | 3 | 0.5000 | 23.9320 |
| 12 | 4 | 0.5000 | 16.2655 |
| 13 | 4 | 0.8000 | 13.4912 |
| 14 | 4 | 1.0000 | 3.8640 |
| 15 | 3 | 1.0000 | 11.5000 |
| 16 | 1 | 0.5000 | 4.6785 |
| Total | 57 | 9.1393 | 170.8627 |

Summary tables giving an overview of the proportion of all fibres and particles which are measured (table 6a) and have positive plastic identification, negative identification (fibres = cellulose, particles = non plastic) and those which were ship derived (table 6b). The total number of different plastic polymers are provided in table 6c.

Table 6a. Summary of the proportion of Putative Plastics undergoing FTIR analysis

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Type | Mesh | Total Frequency | FTIR Analysis | Fraction of total analysed with FTIR |
| Fibre | 300 | 12 | 12 | 1 |
| Fibre | 100 | 255 | 54 | 0.21 |
| Fibre | 50 | 145 | 35 | 0.24 |
| Total Fibre | - | 412 | 101 | 0.25 |
| Particle | 300 | 19 | 17 | 0.90 |
| Particle | 100 | 45 | 12 | 0.27 |
| Particle | 50 | 61 | 14 | 0.23 |
| Total Particle | - | 125 | 43 | 0.34 |
| TOTAL | - | 537 | 144 | 0.27 |

Table 6b. Summary of the proportion of putative plastics with positive polymer identifications

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Type | Positive | Negative/Cellulose derived | Ship Contamination | Unidentified |
| Fibre | 24 | 58 | 0 | 19 |
| Particle | 6 | 22 | 11 | 4 |
| TOTAL | **30** | **80** | **11** | **23** |

Table 6c. Summary Table of the polymer composition of confirmed plastic fibres and particles

|  |  |  |
| --- | --- | --- |
| Polymer | Frequency | Fraction of Total |
| Polyamide | 6 | 0.20 |
| Propylene/Ethylene Co-polymer | 2 | 0.07 |
| Polyethylene | 1 | 0.03 |
| Polyester | 12 | 0.40 |
| Acrylic | 5 | 0.17 |
| Unidentified Polymer | 4 | 0.13 |
| Total | **30** | **-** |

**Table 7a: Overview Results for Microplastics Concentrations (n/L) across transects**

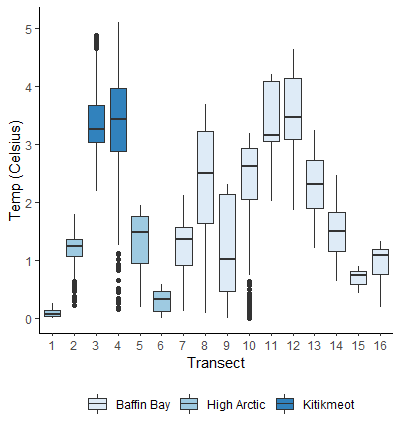
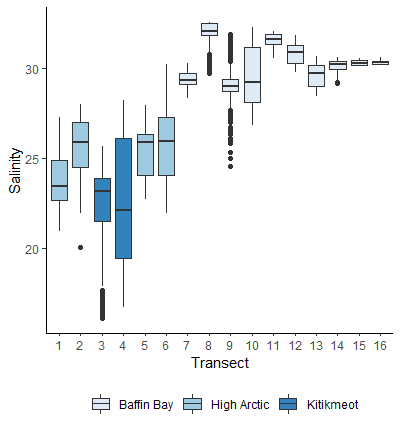
|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Type** | **Min** | **Max** | **Mean** | **SD** | **SE** |
| **Fibres** | 0 | 0.271 | 0.030 | 0.067 | 0.017 |
| **Particles** | 0 | 0.011 | 0.001 | 0.003 | 0.001 |
| **Total** | **0** | **0.282** | **0.031** | **0.069** | **0.017** |

**Table 7b: Overview Results for Microplastics Concentrations (n/L) between regions**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Region** | **Min** | **Max** | **Sum** | **Mean** | **SD** | **SE** |
| **Baffin Bay** | 0 | 0.282 | 0.405 | 0.041 | 0.087 | 0.028 |
| **High Arctic** | 0 | 0.015 | 0.033 | 0.008 | 0.007 | 0.004 |
| **Kitikmeot** | 0.002 | 0.062 | 0.064 | 0.032 | 0.042 | 0.03 |

## Statistics

Boxplots indicating variance in temperature and salinity between sites (1 min time integrations based on tsg\_data in S2):



To test for associations between microplastic concentration and ship variables (water flow rate, volume sampled, ship speed) and environmental variables (Temp, Salinity, Depth), Kendall Tau was initially used:

**Table 8: Kendall Tau Results**

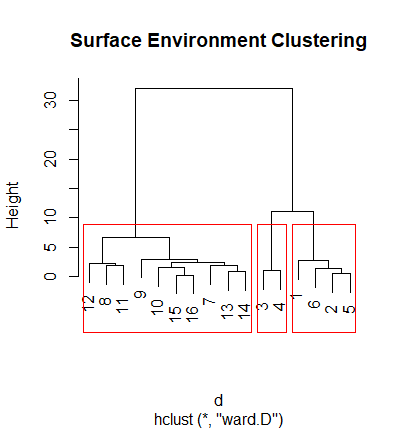
|  |  |  |
| --- | --- | --- |
| Explanatory Variable | p-value | tau |
| Water flow rate | 0.7158 | -0.06898859 |
| Volume sampled | 0.5544 | -0.1116384 |
| ship speed | 0.3396 | 0.1803389 |
| Temperature | 0.09249 | 0.31774 |
| Salinity | 0.5544 | 0.1116384 |
| Depth | 0.5537 | -0.1125805 |

Kruskal- Wallis was used to determine whether groupings of transects based on ice extent, level of traffic, current, or regime could explain differences between in microplastic concentration:

**Table 9: Kruskal- Wallis Results**

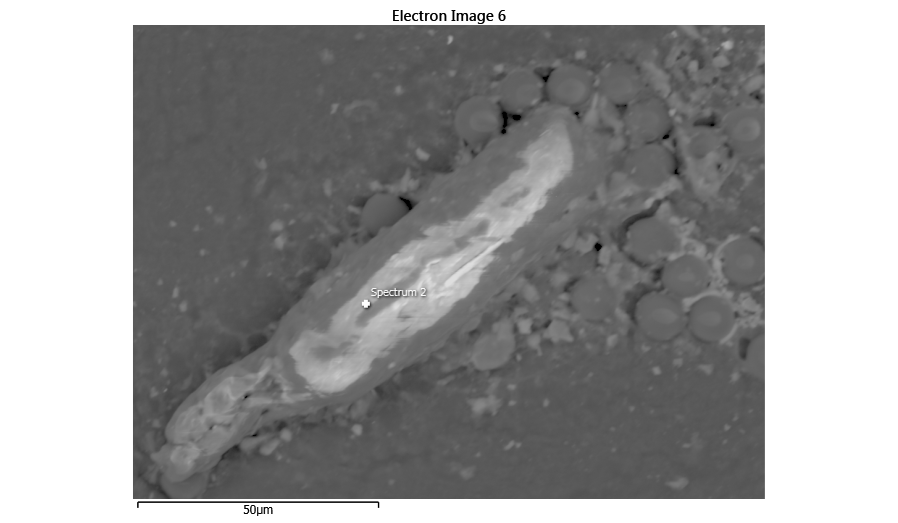
|  |  |  |  |
| --- | --- | --- | --- |
| Type | Grouping | Chi-squared | p-value |
| Total Microplastic | Ice | 1.2562 | 0.5336 |
| Total Microplastic | Current | 1.3453 | 0.5104 |
| Total Microplastic | Shipping | 1.009 | 0.6038 |
| Total Microplastic | High Arc/KK/Eastern | 0.4389 | 0.803 |
| Irregular Particles | Ice | 0.29184 | 0.8642 |
| Irregular Particles | Current | 4.3122 | 0.1158 |
| Irregular Particles | Shipping | 3.0998 | 0.2123 |
| Irregular Particles | High Arc/KK/Eastern | 0.30049 | 0.8605 |
| Microfibres | Ice | 1.5723 | 0.4556 |
| Microfibres | Current | 1.1604 | 0.5598 |
| Microfibres | Shipping | 0.78267 | 0.6762 |
| Microfibres | High Arc/KK/Eastern | 0.072948 | 0.9642 |

Instead, cluster analysis of the surface parameters (ice, temperature, salinity, current) using hierarchical clustering with the Ward method based on Euclidean distances, stipulating 3 groups, defined three regions:



# Supplementary Information

A sample of the recurring black particles were isolated for elemental investigation using a Hitachi TM3000 Scanning electron microscope and Energy Dispersive X-Ray spectroscopy via the Oxford Instrument Aztec One software. An example of particle SEM image is provided below, with the raw output of elemental and oxide ratios.



|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Element** | **Line Type** | **Weight %** | **Weight % Sigma** | **Atomic %** | **Oxide** | **Oxide %** | **Oxide % Sigma** |
| Cl | K series | 2.82 | 0.36 | 1.86 |  | 0.00 | 0.36 |
| F | K series | 6.01 | 1.88 | 7.40 |  | 0.00 | 1.88 |
| Mg | K series | 0.74 | 0.48 | 0.71 | MgO | 1.22 | 0.80 |
| Zr | L series | 0.72 | 1.55 | 0.19 | ZrO2 | 0.98 | 2.09 |
| Ti | K series | 0.00 | 0.43 | 0.00 | TiO2 | 0.00 | 0.72 |
| Si | K series | 4.64 | 0.47 | 3.86 | SiO2 | 9.92 | 1.00 |
| Al | K series | 3.16 | 0.43 | 2.74 | Al2O3 | 5.96 | 0.81 |
| Sr | L series | 1.62 | 1.34 | 0.43 | SrO | 1.91 | 1.58 |
|  |  |  |  |  |  |  |  |
| Ca | K series | 2.39 | 0.42 | 1.40 | CaO | 3.35 | 0.58 |
| K | K series | 19.90 | 0.94 | 11.91 | K2O | 23.97 | 1.13 |
| Na | K series | 28.65 | 1.28 | 29.17 | Na2O | 38.62 | 1.73 |
| Y | L series | 0.64 | 1.88 | 0.17 | Y2O3 | 0.81 | 2.38 |
| Fe | K series | 0.63 | 0.61 | 0.26 | FeO | 0.81 | 0.78 |
| Mn | K series | 0.12 | 0.56 | 0.05 | MnO | 0.15 | 0.72 |
| P | K series | 1.24 | 0.43 | 0.94 | P2O5 | 2.84 | 0.99 |
| S | K series | 0.25 | 0.33 | 0.18 | SO3 | 0.63 | 0.82 |
| O | K series | 26.48 | 1.71 | 38.73 |  |  |  |
| Total |  | 100.00 |  | 100.00 |  | 91.17 |  |