Supplementary Material

Supplementary Methods

SI 1: Transfer from silver filter to Anodisc

Carefully handled using forceps, the silver filter was flushed with 0.2 µm filtered MilliQ water using a narrow spout to have pressurised water flow across the filter surface. The container used to store the filter was also rinsed inside five times. A total of 50ml of water was used to concentrate the sample from its previous substrate to the Anodisc®. The underside of the funnel, contacting the outer rim of the filter surface, was also "cleaned" by adding 50% ethanol with a micropipette and removing any residual particulate matter and depositing it onto the Anodisc®. To ensure the samples were completely dry, the Anodisc® filter was then picked up and placed onto a slide and dried for 30 minutes on a hot plate (50°C) and subsequently in a desiccant chamber for > 48 hours, with the container case on top covering the filter. Three laboratory blanks were carried out to determine the possible introduction of contamination during this step and any sample loss.

SI 2: Anti-contamination Protocol

In the Field "Laboratory"

Footfall within the laboratory was restricted to the researcher, and cotton laboratory coats were worn at all times. All instruments and containers were acid washed before first use and were covered with aluminium foil during processing.

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Aluminium foil was used during filtering, and glass lids were used during the drying process. A bespoke Perspex shield was fitted around the FTIR stage to prevent airborne contamination during infrared analysis. The laboratory was thoroughly cleaned, and surfaces were wiped down with an ethanol dilution between each sample processing and analysis. Negative procedural blanks were taken to measure the introduction of contamination at any of these stages and positive blanks, to measure the loss of sample during processing.

SI 3: Contamination Library

Fibre samples were collected from the garments worn by each person present in the field and the laboratory, with particles from additional possible sources of plastic pollution also collected from the field camp (table S4). These samples were analysed using attenuated total reflection using a mobile Agilent FTIR. Spectra were collected and were measured against the existing spectral reference library using the siMPle software. Hierarchical cluster analysis was carried out according to Primpke et al. 2018 using the Hellinger Distance for the calculation of the resemblance matrix (Primer 6 and Permanova, Primer-E) was performed to identify the primary polymer composition of these samples (table S4) by their similarity to existing database entries (Figure S1) and inform, post-hoc, on possible sources of contamination.

SI 4: Procedural blanks

Procedural Blanks – Negative blanks

Procedural blanks were run in triplicate. Two separate sets of blanks were carried out. The first type, the "Full Procedural Blank," replicated the complete procedure from collection to analysis, as per all other snow samples. A separate ECOtanka™ was used to collect 250ml of 0.2 µm filtered "clean water" and was processed in the same manner, i.e., filtering onto a silver filter in the field laboratory and subsequently transferred onto an Anodisc® filter for FTIR analysis. Each blank was carried out on the same day that samples were processed in the field laboratory (n =3). In addition, a secondary set of procedural blanks was taken to inform on contamination introduced during the transference step from silver filter to Anodisc®. These blanks, "Lab Blanks," replicate the procedure carried out in the Cambridge Laboratory, using 200 ml of 0.2µm filtered Milli-Q water, filtered onto a silver filter and subsequently removed using 50ml of Milli-Q water onto an Anodisc® and 10ml of 30% Ethanol to help remove any residual filtrate.

The concentration of each polymer type was averaged from the three “Full Procedure” blanks and subtracted from each sample concentration (figure 3, result 1). The concentration recorded in the lab blank (figure 3, result 2) was used only to inform what proportion may have been introduced in the laboratory. The fraction likely introduced during field processing was calculated by subtracting the “Lab Result” from the “Full Result” (figure 3, result 3).

Recovery Test- Positive Blanks

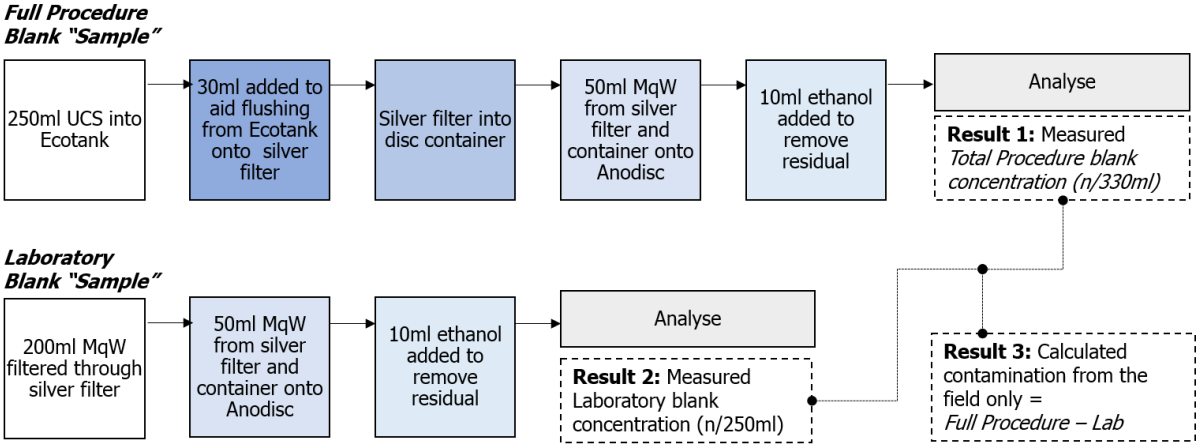

Figure 1 Schematic of procedures and calculations to obtain the negative blank results.

Recovery tests were implemented to determine whether there was any substantial material loss during the transference step from silver filter to Anodisc®. These recovery tests were carried out in triplicate, using Nylon fibres stained with Nile Red. A fluorescent microscope was used to count fibres once dry. Following this, the sample was enclosed in its case. It was shaken to mimic the disturbance of the sample within the case that was potentially encountered during transit. The sample was then removed, filtered onto the Anodisc® ® filter, and counts made again. For both counts, photographs were also taken across the entire area of the filter to validate counts.

In addition, one of the recovery tests was subsequently analysed using FTIR to compare the manual counts with those counted by the software. Assuming the largest fibre was 250 µm, the smallest fibres (16 microns) were eliminated from the final count. All others were included as, despite the stated length, fibre diameter was more indicative of the spiked sample, and therefore, all fibres that could conceivably measure more than the thinnest fibres were included. Average laboratory blank nylon fibres (n=3) were subtracted from the final count.

Table S1 Methods Overview

Method	Stage	Information Reported	
Sampling	Sampling Methods	Sampler Description	Snow collected in 0.8L stainless steel tankards from snow pits dug up to 40cm below surface.
		Location	Collected from areas of human presence (Union Glacier Camp and South Pole Camp) and remote sites with no known human presence.
		Date Collected	05/12-10/12/19
		Height of sample	Elevation reported and all samples collected up to 40cm depth.
	Sampling Duration		Single point-in-time measurements.
	Sample Processing and Storage	Processing	Snow melted, volume reported, and filtered onto 5-micron silver filters.
		Storage	Filters stored individually in sealed shallow cases in a cool dark environment.
Contamination Mitigation	Laboratory Preparation		Cotton Lab coats worn.
		Plastic avoided where possible in the protocol	Plastic used: Polycarbonate tubing to connect vacuum pump to flask, rubber bung for flask, plastic cases for transport.

	Equipment and lab surfaces cleaned and wiped down	Including shields surrounding the benchtop for filters being analysed with IR.
	Lab equipment cleaned and rinsed	Dilute hydrochloric acid (0.1M) was used to clean all lab equipment beforehand and at Cambridge in between samples. Lab equipment cleaned with 0.2 micron filtered ultrapure water. In the field lab, there was no access to ultrapure water. "Clean" water for rinsing was made by collecting snow from upwind of the camp and filtered twice through 0.2micron filters.
Clean Air conditions	Lab access limited	Access to lab prohibited to persons not involved in the processing and analysis.
	Samples covered	All samples and containers covered with aluminum foil. A small containerized/shielded area was used for the transfer/manipulation of filters in preparation for FTIR analysis.
Negative control (blanks)	Field controls	Carried out in triplicate, implementing the full procedure from collection to analysis as per all other samples. Sample concentrations blank-corrected using this number.
	Laboratory controls	Carried out in triplicate, implementing the procedure from transference from silver filter to Anodisc® and analysis.

Sample handling	Positive control	Nylon fibre controls	Nylon fibres stained with Nile red used to measure recovery rate from transference step.
	Sample Treatment	No sample treatment was deemed necessary	30% ethanol (0.2 micron filtered) was added to the filter funnel's rim using a micropipette to remove any extraneous sample.
Microplastic Characterisation	Filter composition	Silver Filter	Sample originally collected on 5-micron Sterlitech silver filter (25mm)
		Anodisc® Filter	Sample transferred to 0.2micorn Anodisc® (25mm)
		Barium Fluoride slide	2mm thick barium fluoride slide placed on top of Anodisc filter to "compress" fibres
	Polymer Identification	FTIR analysis	Agilent 670 Fourier Transform Infrared (FTIR) spectrometer equipped with a cryogenically cooled mercury cadmium telluride (MCT) detector and coupled to an Agilent 620 microscope with an automated xyz-stage and 128 x 128 focal plane array (FPA) detector.
		Automated approach	100% of the filter area scanned using automated software (simple version 1.1.beta).
		Concentrations reported	Particles, fibres, size distribution. Concentrations reported as particle number per litre and ug/L.

Supplementary Results

Table S2 Table of normalised polymer concentrations of all samples.

Sample	ABS	Acrylates/ PUR Varnish	CMC	EVA	Nitrile	[illegible]**	PA	PC**	PCL**	PE	PET	PLA**	POM**	PP	PS	PVC	Synthetic Rubber	Total Polymer
SG1	0	20.8	*	6.25	0.19		75.85	0	0.09	155.4	122.92	0	0	2.4	2.21	0	*	386.11
SG2	0	1.49	*	0	*		6.71	0	*	16.58	43.4	0	0	*	1.84	2.94	*	72.96
SG3	0	81.98	11.52	3.13	0.09		1097.98	0	0	146.88	124.84	0	0	5.62	0	0	*	1472.03
SG4	0	30.93	165.78	0	0		2185.48	0	1.14	315.53	59.47	0	0	8.96	0.13	0	30.18	2797.6
SP1	0	2.02	*	3.03	0		69.7	0	0	18.18	30.3	0	0	19.19	0	0	10.1	152.53
SP2	0	88.09			0.84		100.31		11.6	23.51	266.74	0	3.45	126.79	*	20.69	23.58	665.59
SP3	0	186.46	21.21	2.78	*		72.73	0	12.83	65.4	210.03	2.78	5.56	52.85	1.52	0	7.68	641.82
UG1	0	32.53	*	2.86	0		4.62	*	*	*	0.49	0	0	99.77	1.67	8.57	0	150.51
UG2	0	44.48	19.35	3.13	3.31		1500.76	0	3.22	452.27	163.45	3.13	0	0.28	0	0	905.93	3099.31
UG3	0	*	*	0	0		66.36	0	0	*	18.38	0	0	0.3	0.3	0	*	85.35
UG4	0	45.8	*	3.13	0		41.48	0	0	3.98	64.74	0	0	3.22	*	3.13	*	165.47
UG5	0	*	*	0	0		78.98	0	3.13	*	34.12	0	0	0.09	0	0	*	116.32
Clean Snow[1]	3.23	154.63	*	19.35	0.2		51.06	0.2	19.55	59.53	283.55	0		2.8	2.41	229.03	62.14	884.44
Control[2]	0	*	0	0	0		*	0	0	*	*	0	4.17	25.76	0.13	0	*	30.05
SP3a[3]	0	7.68	0	0	0		0	0	1.97	61.37	93.11	0	0	10.43	0	0	7.68	182.24

SP3b[3]	0	178.79	21.21	2.78	0	72.73	0	10.86	4.04	116.92	2.78	5.56	42.42	1.52	0	0	459.61

* Zero after normalisation (Raw polymer concentration < Blank polymer concentration)

** Classified as “Other”

[1] Clean Snow sample taken from the “clean snow” area – prior to filtering with 0.2-micron filter

[2] Control sample

[3] South Pole technical replicates

Table S3 Concentration of microplastic particles and fibres in each sample

Site	Sample	Fibres (MP L^{-1})	Particles (MP L^{-1})	Total MP (MP L^{-1})
Schanz Glacier	SG1	60	326	386
	SG2	0	73	73
	SG3	237	1235	1472
	SG4	618	2180	2798
South Pole	SP1	38	114	153
	SP2	160	505	666
	SP3*	75	246	321
Union Glacier	UG1	36	115	151
	UG2	638	2462	3099
	UG3	17	68	85
	UG4	25	140	165
	UG5	34	82	116
Clean Snow”		217	671	888
Control		14	16	30

Table S4 Contamination Library with assigned clusters. Material and identity method

Item	Assigned Cluster	Material	Identified
Blue Notebook	-	Unassigned	No Match
Blue tote bag	-	Unassigned	No Match
Flags	7	Polyamide	Cluster Match
Buchner, sample 1	-	Unassigned	No Match
Buchner, sample 2	-	Unassigned	No Match
Buchner, sample 3	28	Synthetic Rubber	Cluster Match
Foot warmers	11	PET	Cluster Match
Hand warmers	7	Polyamide	Cluster Match
Tucker rope	4	Polypropylene	Cluster Match
Lab waste, sample 1	4	Polypropylene	Cluster Match
Lab waste, sample 2	-	Unassigned	No Match
Snowmelt box	1	Polyethylene	Cluster Match

Baffin boots		10	Nitrile Rubber	Cluster Match
Nalgene bottle	-		Unassigned	No Match
Lab pen		1	Polyethylene	Cluster Match
Lab pen blue	-		Unassigned	No Match
Ribbed Hoodie		5	Polystyrene	Cluster Match
Baselayer Top		11	PET	Cluster Match
Grey shirt		11	PET	Cluster Match
Black pants		-	Cellulose	Visual Match
Black Trousers		7	PA	Cluster Match
Sunglass strap		11	PET	Cluster Match
Yellow Hat		12	Acrylates/ PUR Varnish	Cluster Match
Black jacket, shiny fabric	-		Natural Polyamide	Visual Match
Black jacket, dull fabric		7	PA	Cluster Match
Black jacket, fleece fabric		11	PET	Cluster Match
Black Glove palm		11	PET	Cluster Match
Black Glove backhand		11	PET	Cluster Match
Yellow Fleece Pants		11	PET	Cluster Match
Black Trousers		11	PET	Cluster Match
Hairband		7	PA	Cluster Match
Grey buff		-	Cellulose	Visual Match
Camera Case		-	PET	Visual Match
Black Bag		7	PA	Cluster Match
Grey Baselayer		12	Acrylates/ PUR Varnish	Cluster Match
Green Baselayer	-		Natural Polyamide	Visual Match
Green midlayer		-	Cellulose	Visual Match
Mask strap		-	Natural Polyamide	Visual Match
Buff		11	PET	Cluster Match
Grey baselayer		11	PET	Cluster Match
Red baselayer	-		Natural Polyamide	Visual Match
Boot sample 1		11	PET	Cluster Match
Blue Buff	-		Unassigned	No Match
Blue Baselayer	-		Unassigned	No Match
Yellow Buff	-		Natural Polyamide	Visual Match

Black Nylon Trousers, sample 1	11	PET	Cluster Match
Black Nylon Trousers sample 2	7	PA	Cluster Match
Black Nylon Trousers sample 3	7	PA	Cluster Match
Rubber patch	7	PA	Cluster Match
Blue jacket	12	Acrylates/ PUR Varnish	Cluster Match
Lab gloves	-	Unassigned	Cluster Match
Snow Boot	11	PET	Cluster Match
Ultra clean water bottle	5	ABS	Visual Match
Baseball cap	11	PET	Cluster Match
Blue coat	1	Polyethylene	Cluster Match

Successful Cluster Match marked in yellow. Cluster match refers to automatic assignment to hierarchical cluster using FTIR as well as the PRIMER, siMPle and OriginPro software according to Primpke et al., 2018. Visual match refers to item spectra matching key spectral peaks and having high similarity according to polymer spectra of the database, but not assigned based on current software configuration. Unassigned clusters showed no significant similarity to the polymer database.

Total Samples: 55 | Cluster Match: 36 | Visual Match: 10 | No Match: 9

Table S5 Concentrations of all material in Procedural Blanks

Procedure	Blank ID	Source	Fibre	Particle	Total MP
Full	fb01	Natural	300	897	1197
	fb01	Plastic	79	185	264
	fb02	Natural	264	655	918
	fb02	Plastic	61	252	312
	fb03	Natural	273	606	879
	fb03	Plastic	42	103	145
Lab	lb01	Natural	1208	5104	6312
	lb01	Plastic	40	96	136
	lb02	Natural	172	532	704
	lb02	Plastic	36	104	140
	lb03	Natural	144	268	412
	lb03	Plastic	20	80	100

Table S6 Measured concentration of polymers in each blank and calculated concentration of field blank

Polymer	Measured concentration (n L^{-1})		Calculated concentration (n L^{-1})	Primary Source*
	Full Procedural Blank	Lab Procedural Blank	Field	
ABS	0	0	0	-
Acrylates/PUR Varnish	13	8	5	Lab
CMC	20	4	**16**	**Field**
EVA	0	4	0	Lab
Nitrile Rubber	3	0	**3**	**Field**
PA	39	20	19	Field & Lab
PC	3	0	**3**	**Field**
PCL	3	0	**3**	**Field**
PE	19	7	**12**	**Field**
PET	10	17	-8	Lab
POM	0	4	0	Lab
PP	5	12	-7	Lab
PS	4	4	0	Lab
PVC	0	0	0	-
Synthetic Rubber	27	22	5	Lab
Total	**168**	**102**	**66**	**Lab**

**Primary source of contamination estimated based on the concentration of the laboratory blank as a fraction of the full procedural blank*

Table S7 - Correlation between wind speed on the day and microplastic characteristics

	p-value (kendall Tau) – Correlation with wind speed on day	p-value (kendall Tau) – Correlation with lab blank
MP Concentration (nL-1)	0.3486	0.4918
MP Concentration (µgL-1)	0.5164	NA
S (Polymer Richness)	0.3078	NA
H'(Diversity Indices)	0.3859	NA
Acrylates/PUR Varnish	0.469	-
ABS	-	-
CMC	0.444	-
EVA	0.75	-
Nitrile Rubber	0.483	-
PA	0.719	0.396
PCL	0.483	-
PET	0.719	0.465
PE	1	0.247
PLA	1	-
POM	-	-
PP	0.272	-
PS	1	-
PVC	1	-
Synthetic Rubber	0.0041	0.938
Natural Polyamides	0.719	0.247
Quartz	0.469	0.631
Natural Cellulose	0.444	0.938
Charcoal	0.719	0.617
Chitin	0.227	0.247
Coal	1	-

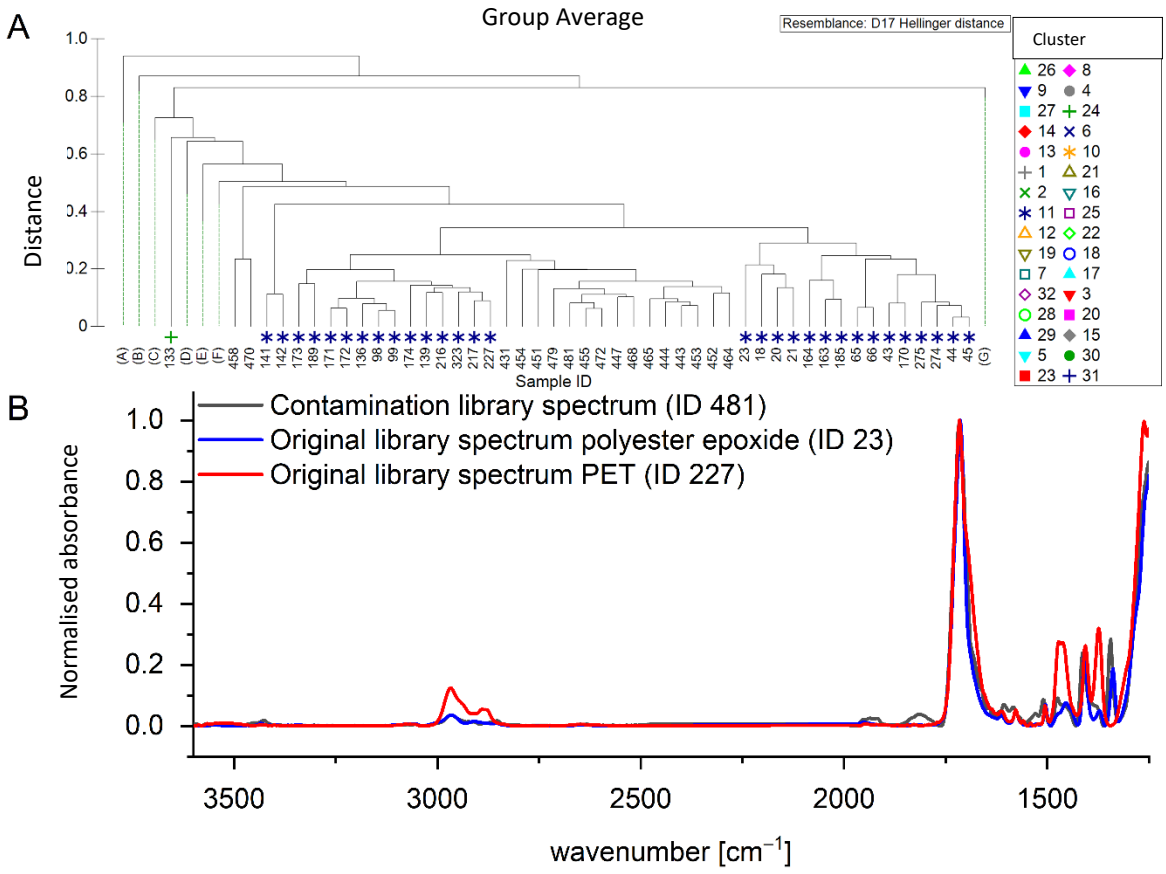

Figure S1: Example for polymer groups assignment after hierarchical cluster analysis for the cluster 11, polyester (A). Whilst the polymers show well matching similarities (B) still some differences can be found which cannot be separated in the following automated analysis; PET: polyethylene terephthalate.