



Supplement of

Marine carbohydrates in Arctic aerosol particles and fog – diversity of oceanic sources and atmospheric transformations

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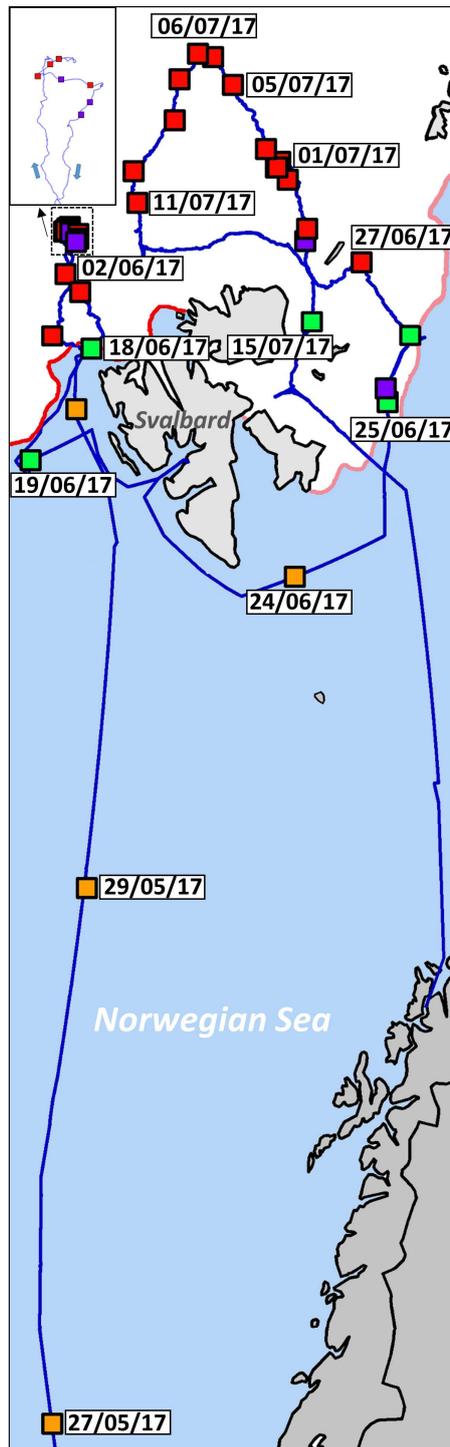


Figure S1. Cruise track during PS106 (blue), accompanied by a zoom-in view of the ice floe camp from 5 to 14 June 2017. Squares represent surface water sampling events (orange: ice-free ocean; red: open leads and polynyas within the pack ice; purple: melt ponds; green: MIZ) The red lines represent the ice edges on 07 June 2017 (west of Svalbard) and 07 July 2017 (east of Svalbard).

Table S1. Detailed information about size-resolved aerosol particle sampling during PS106 campaign.

Start sampling ^a	Stop sampling ^a	Location	Relative residence time of air masses 12 h before sampling ^b				Wind speed (m s ⁻¹) ^c	Air temperature (°C) ^c	Relative humidity (%) ^c	Percentage frequency of occurrence of fog ^{c,d} (%)	Na ⁺ _{aer,PM10} (ng m ⁻³) ^e	CCHO _{aer,PM10} (ng m ⁻³) ^e	$\frac{Na^+_{aer,PM10}}{CCHO_{aer,PM10}}$
			Ice-free (%)	MIZ (%)	Pack ice (%)	Land (%)							
24/05/17 20:49	26/05/17 16:34	North Sea	100	0	0	0	7.0±2.4	10.5±0.4	97±3	14.9	463	4.42	9.6×10 ⁻³
26/05/17 19:34	29/05/17 11:33	Norwegian Sea	100	0	0	0	9.1±2.3	5.4±3.3	83±18	35.0	765	3.15	4.1×10 ⁻³
29/05/17 12:46	01/06/17 08:28	Greenland Sea/ Fram Strait	50	9	29	13	9.9±3.8	-0.1±3.7	77±15	0.0	651	1.60	2.5×10 ⁻³
01/06/17 09:35	04/06/17 08:06	Fram Strait/ Arctic Ocean (west and northwest of Svalbard)	3	20	76	0	7.2±3.0	-2.7±1.1	94±4	11.2	108	3.22	3.0×10 ⁻²
04/06/17 10:57	07/06/17 08:08		0	1	99	0	5.2±2.1	-3.1±0.8	93±4	2.4	37	0.71	1.9×10 ⁻²
07/06/17 09:39	10/06/17 08:29		0	1	99	0	4.5±1.6	-3.1±2.9	95±3	2.1	79	3.35	4.2×10 ⁻²
10/06/17 09:25	13/06/17 11:23		0	0	100	0	6.2±3.0	-0.6±0.8	98±5	32.8	27	4.66	1.7×10 ⁻¹
13/06/17 12:36	16/06/17 08:18		0	0	100	0	4.3±1.5	-1.3±0.7	95±3	8.8	12	1.03	8.6×10 ⁻²
16/06/17 09:13	19/06/17 09:03		2	42	56	0	4.0±1.3	-1.2±1.1	89±5	0.4	40	2.19	5.4×10 ⁻²
19/06/17 10:00	25/06/17 09:30		Greenland Sea/Barents Sea	47	20	11	23	5.5±2.5	1.8±1.9	87±8	0.8	230	0.66
25/06/17 11:40	28/06/17 09:20	Barents Sea/ Arctic Ocean (north and northeast of Svalbard)	11	35	54	0	6.2±2.5	-0.6±0.5	89±5	0.0	89	1.19	1.3×10 ⁻²
28/06/17 10:20	04/07/17 08:55		2	5	93	1	6.0±1.7	-1.8±1.5	94±4	4.6	40	0.50	1.3×10 ⁻²
04/07/17 10:25	07/07/17 08:45		0	0	100	0	5.9±1.3	-1.5±0.9	98±2	11.5	39	1.04	2.7×10 ⁻²
07/07/17 09:50	13/07/17 09:00		0	9	87	4	6.9±2.1	-0.4±0.8	98±2	22.5	29	2.83	9.8×10 ⁻²
13/07/17 10:05	16/07/17 10:35		10	42	40	8	7.7±3.5	0.5±1.1	95±6	8.0	269	3.14	1.2×10 ⁻²

^a date/time format: dd/mm/yy hh:mm (UTC); ^b residence time of air masses over certain Earth surfaces were calculated based on back-trajectories and sea ice maps using R; ^c meteorological data (mean ± standard deviation over sampling time) calculated from the quality controlled data archived in the PANGAEA network (Schmithüsen, 2018, 2019); ^d here, fog occurrence was defined based on two operational meteorological thresholds: visibility≤1500 m & relative humidity ≥98%; ^e values as the sum of all five Berner stages, size-resolved information is available on PANGAEA.

Table S2. Fog sampling during the PS106 campaign and average meteorological conditions at the sampling site calculated from the quality-controlled data archived in the PANGAEA network (Schmithüsen, 2018, 2019); n.d.=not determined.

Start sampling ^a	Stop sampling ^a	Location	Time with fog events ^b (min)	Average wind speed during fog events (m s ⁻¹)	Average air temperature during fog events (°C)	pH	Na ⁺ _{fog,liquid} (mg L ⁻¹)	Na ⁺ _{fog,atmos} (ng m ⁻³)	CCHO _{fog,liquid} (µg L ⁻¹)	CCHO _{fog,atmos} (ng m ⁻³)	dFCHO _{fog,liquid} (µg L ⁻¹)
26/05/17 04:33	26/05/17 12:27	North Sea	140	4.1	9.9	n.d.	91	61183	1976	1331.0	1539.4
26/05/17 18:48	27/05/17 12:26	Norwegian Sea	1030	7.9	9.1	5.72	61	n.d.	456	n.d.	416.6
27/05/17 12:46	27/05/17 20:39		240	8.2	9.1	5.74	23	22985	129	128.0	59.5
27/05/17 20:56	28/05/17 06:15		110	8.4	7.8	6.23	13	2823	153	32.9	104.9
01/06/17 13:15	02/06/17 16:37	Fram Strait/Arctic Ocean (west and northwest of Svalbard)	480	8.1	-1.1	6.41	903	150343	283	47.1	98.3
10/06/17 20:30	13/06/17 09:58		1410	3.9	-0.4	5.85	80	3723	186	8.7	104.3
23/06/17 10:00	25/06/17 10:10	Greenland Sea	30	4.4	-1.0	n.d.	448	72589	1542	250.1	233.5
25/06/17 10:30	29/06/17 10:34	Barents Sea/Arctic Ocean (north and northeast of Svalbard)	190	2.9	0.0	n.d.	393	n.d.	726	n.d.	93.9
29/06/17 10:45	01/07/17 10:25		190	5.6	-0.2	n.d.	374	73568	21818	4293.4	270.5
01/07/17 10:38	06/07/17 10:30		210	6.7	-1.5	n.d.	98	3902	467	18.7	40.4
06/07/17 10:45	07/07/17 11:10		280	5.6	-1.2	n.d.	90	7410	495	40.9	26.2
07/07/17 11:25	08/07/17 11:15		980	3.8	-0.4	6.44	30	377	322	4.1	488.0
08/07/17 11:30	08/07/17 22:20		240	6.8	-0.5	6.53	13	120	392	3.7	260.8
08/07/17 22:40	09/07/17 16:35		30	9.2	-2.9	n.d.	2.7	n.d.	363	n.d.	208.2
09/07/17 17:00	10/07/17 11:00		330	8.1	-0.6	6.75	5.1	185	81	3.0	84.1
10/07/17 11:15	11/07/17 11:00		250	9.0	0.0	6.26	19	1164	336	20.1	61.3

11/07/17 11:15	14/07/17 10:25	Barents Sea/Arctic Ocean (north and northeast of Svalbard)	200	7.3	-0.5	6.08	5.1	392	66	5.1	19.5
14/07/17 10:38	15/07/17 10:45		10	13.5	-0.1	6.12	7.6	2196	67	19.3	13.6
15/07/17 10:52	16/07/17 10:20		230	4.4	-0.2	6.14	18	3213	64	11.5	11.1
16/07/17 10:30	16/07/17 22:15		100	7.1	1.2	6.18	1.7	n.d.	18	n.d.	2.7
16/07/17 22:30	17/07/17 10:20		220	9.8	1.6	6.02	59	n.d.	103	n.d.	23.3
17/07/17 10:30	17/07/17 14:00		210	8.5	1.4	5.68	101	n.d.	321	n.d.	170.8

^a date/time format: dd/mm/yy hh:mm (UTC). ^b here, fog occurrence was defined based on two operational meteorological thresholds: visibility \leq 1500 m & relative humidity \geq 98%.

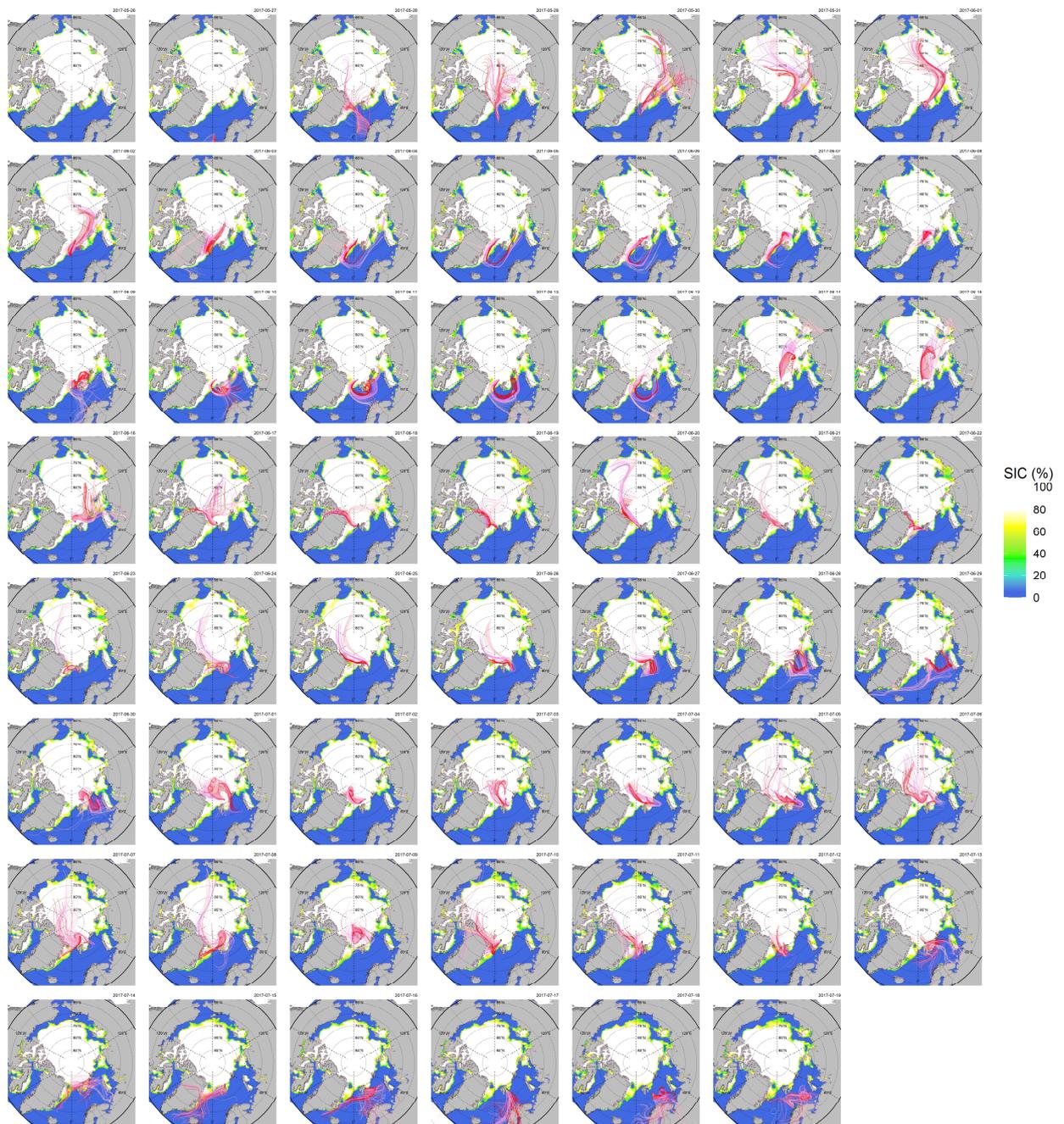


Figure S2. Daily sea ice maps for PS106 showing sea ice concentrations (SIC) and 120 h back-trajectories on an hourly basis at three arrival heights (red: 50 m, purple: 250 m and pink: 1000 m). A high-resolution animation can be viewed at the following link: <https://doi.org/10.5446/62589>

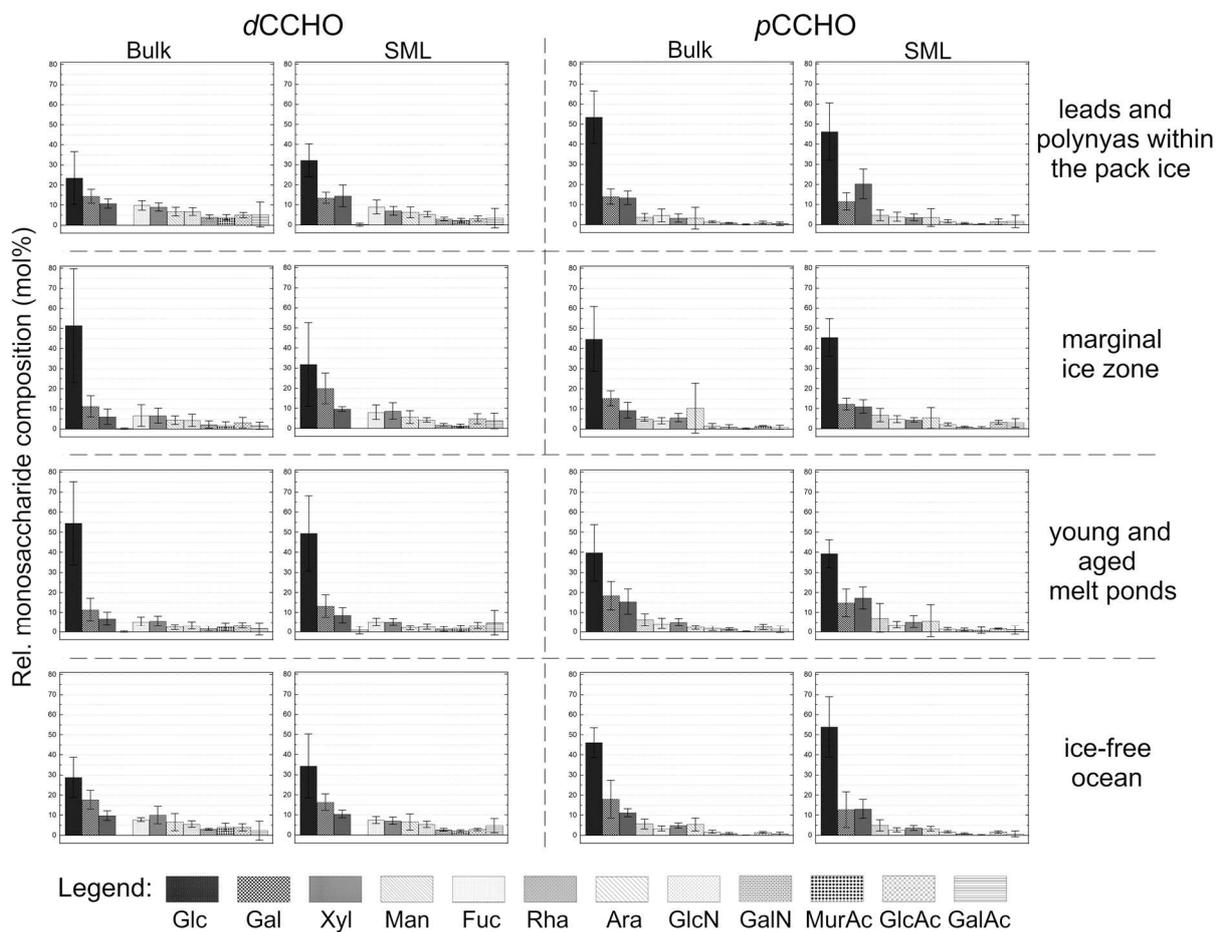


Figure S3. Relative monosaccharide composition of dissolved (*dCCHO*) and particulate combined carbohydrates (*pCCHO*) after acid hydrolysis in bulk and SML samples from the leads and polynyas within the pack ice, the marginal ice zone (MIZ), the ice-free ocean and young and aged melt ponds. The bar charts show the averages and standard deviations of the relative contributions.