Supplement for: Bioaerosols as indicators of central Arctic ice nucleating particle sources

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Text S1

INP concentrations reported herein for filter-based collections and processing are typically higher than previously published MOSAiC INP concentrations based on DRUM size-segregated samples (Fig. S6: (Creamean et al., 2022)). For the DRUM data that represent an integration of all size stages (0.15-12 µm), seasonally-averaged concentrations for INPs active at -15 °C were as follows: fall=1.8×10^{-5} L^{-1}; winter=6.1×10^{-5} L^{-1}; spring=6.3×10^{-5} L^{-1}; summer=1.1×10^{-3} L^{-1}. Seasonal averages for the polycarbonate filters were 4.4×10^{-3} L^{-1}, 1.1×10^{-3} L^{-1}, 1.1×10^{-3} L^{-1}, and 1.9×10^{-1} L^{-1}. Similar seasonality trends were detected in both data sets, although with 1-3 orders of magnitude lower concentrations for the integrated DRUM samples for INP activation temperatures warmer than -20 °C (Fig. S6). There are several potential explanations for the discrepancies observed, such as differences in sampling inlets (Creamean et al., 2022), aerosol collection size range, sample integration time differences (24- versus 72-hour), inefficient collection (e.g. potential particle bounce in cold environments) and removal of particles during analysis, and certain samples (and stages) subjected to a different cooling rate than others during analysis of DRUM samples (Between 0-8 °C min^{-1}). Comparison tests and investigations of this unexpected result are ongoing. Overall, the INPs from the DRUM and cold plate analysis should be viewed as a lower bound or subset of observed total aerosol INPs.

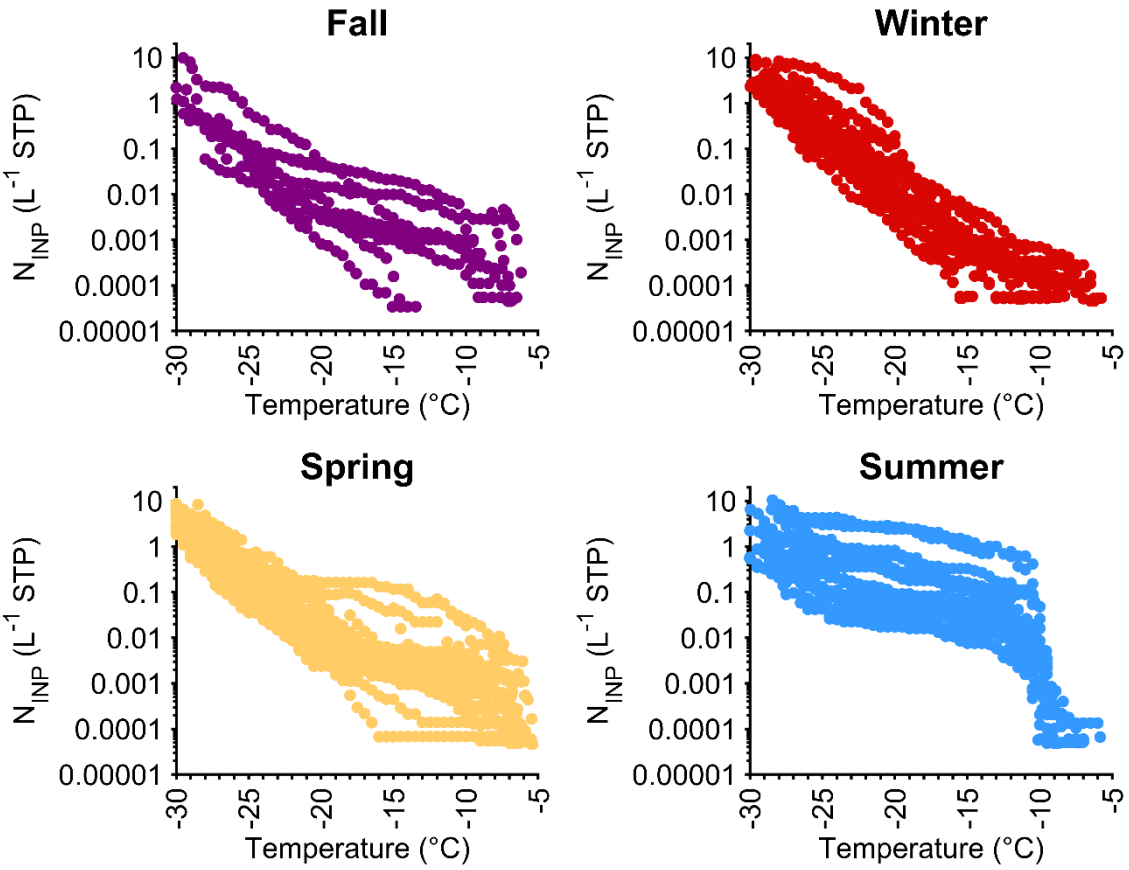

Figure S1: Cumulative INP-temperature spectra, colored by season. Fall (Purple: September, October, November), Winter (Red: December, January, February), Spring (Yellow: March, April, May), Summer (Blue: June, July, August).

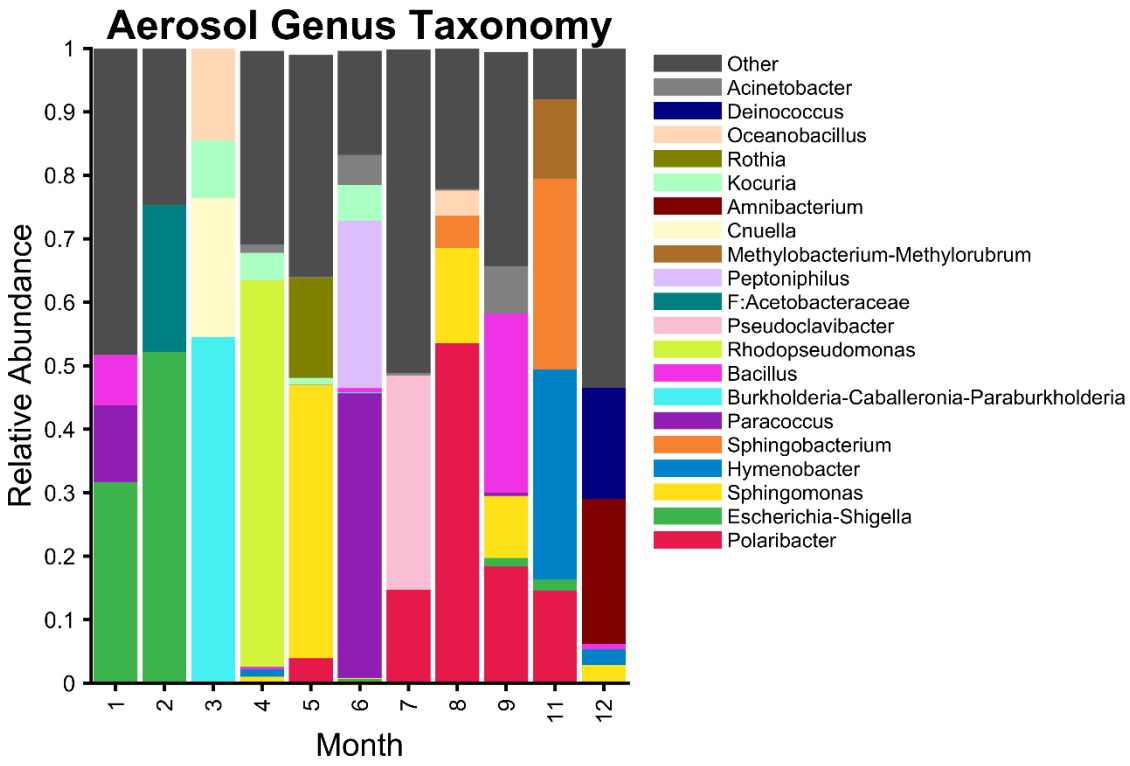

Figure S2: Pooled monthly aerosol bacterial taxonomy plot, colored by the top 20 genera. Any taxa contributing less than 0.1% relative abundance were excluded from the analysis.

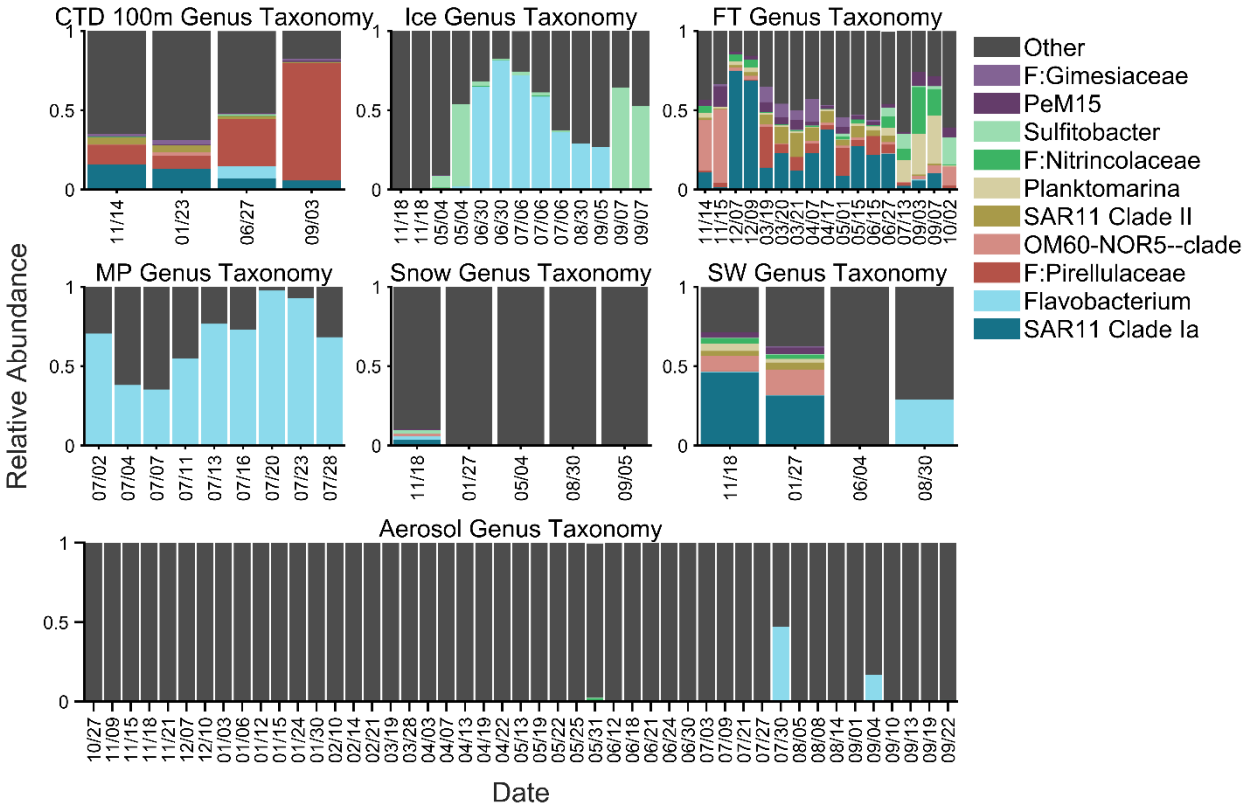

Figure S3: Bacterial genus level relative abundance taxonomy for the different potential local sources and aerosol as a function of month collected. FT=Flowthrough; MP=Melt pond; SW=Lead water. The samples are colored by the top 10 genera for all source samples combined, with family (F) given if not resolved at the genus level.

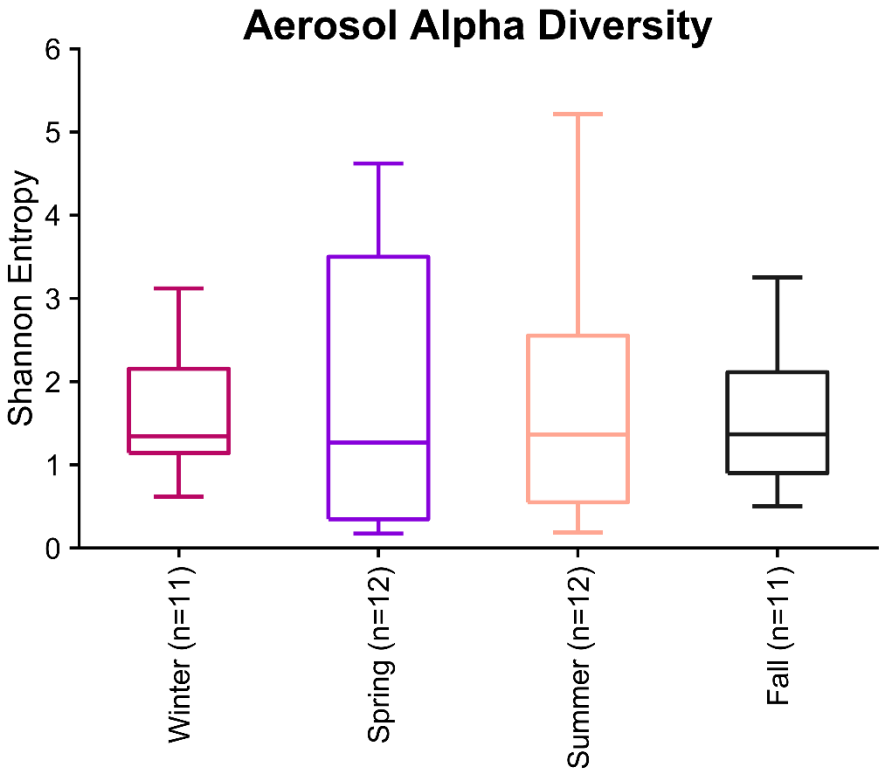

Figure S4: Alpha diversity (Shannon entropy) as a function of season for the bacterial aerosol samples. Number of samples (n=) is given.

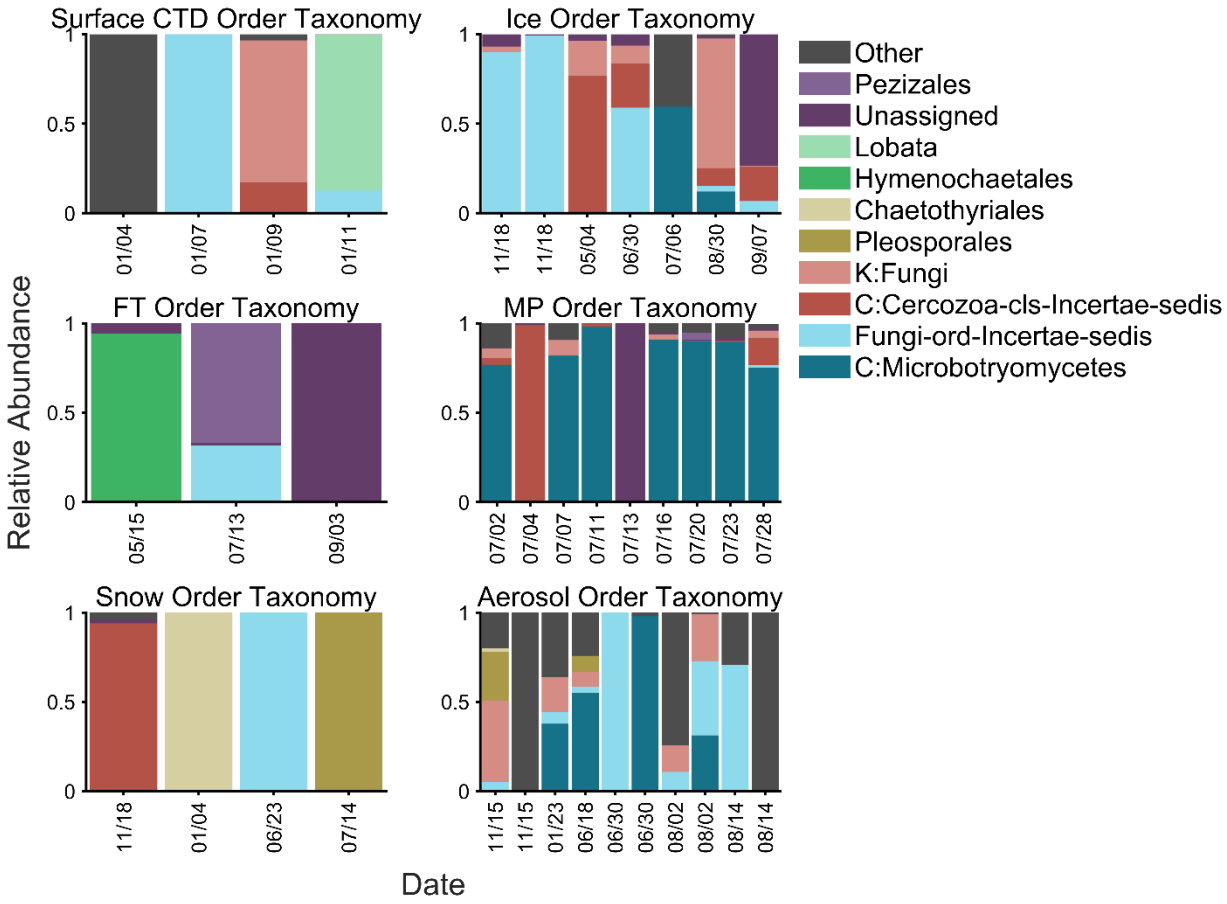

Figure S5: Fungal order level relative abundance taxonomy for the different potential local sources and aerosol as a function of month collected. FT=Flowthrough; MP=Melt pond; SW=Lead water. The samples are colored by the top 10 genera for all sources combined, with kingdom (K), phylum (P), and class (C) given if not resolved at the genus level.

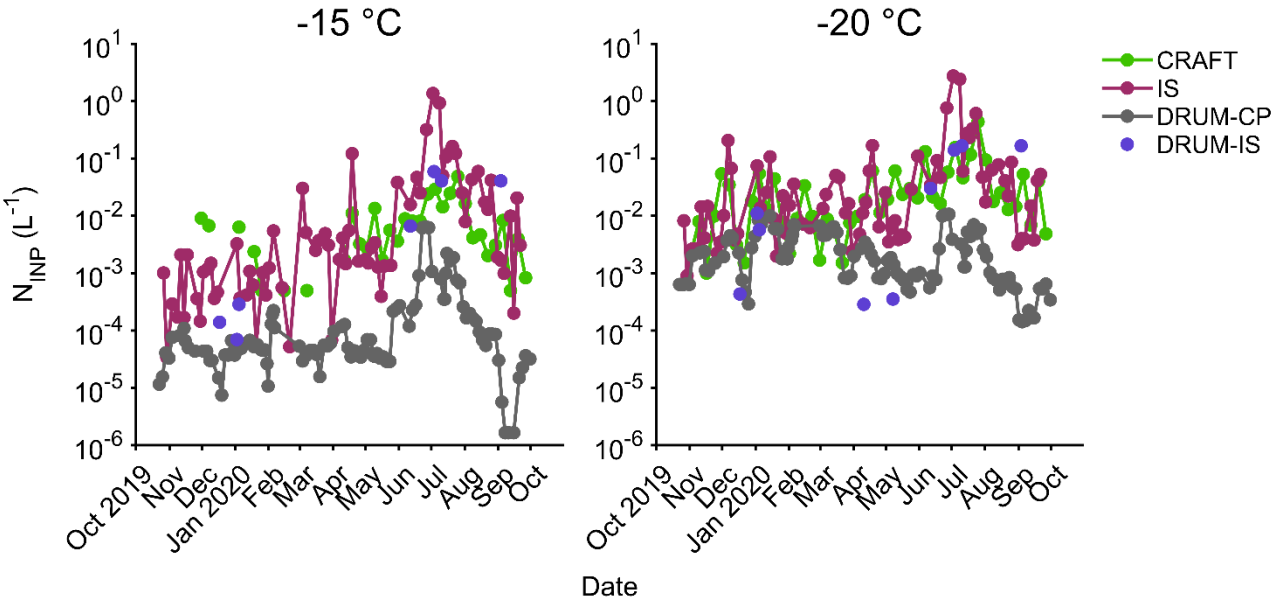

Figure S6: INP concentration time series during the MOSAiC campaign at -15 °C (left) and -20 °C (right). CRAFT (green) refers to data take at Zeppelin Observatory at Svalbard (Pereira Freitas et al., 2023; Tobo et al., 2024); IS (purple) refers to filter samples analyzed with the Ice Spectrometer; DRUM-CP (gray) refers to the total DRUM samples analyzed on the cold plate; and DRUM-IS (blue) refers to select total DRUM samples analyzed on the Ice Spectrometer. Size resolved aerosol for INP analyses were collected with a 4-stage Davis Rotating-drum Unit for Monitoring cascade impactor (DRUM) with the AOS inlet (Creamean et al., 2022).

Type	Collection Date (UTC)	Latitude (°N)	Longitude (°E)	Depth (m)
Snow	10/25/2019 12:00	85.436900	128.146900	0.26
FT	11/14/2019 6:30	86.188309	118.416527	11
CTD	11/14/2019 12:00	86.153053	118.109711	100
CTD	11/14/2019 12:00	86.153053	118.109711	10
CTD	11/14/2019 12:00	86.153053	118.109711	200
CTD	11/14/2019 12:00	86.153053	118.109711	20
CTD	11/14/2019 12:00	86.153053	118.109711	2
FT	11/15/2019 12:00	86.174263	118.245308	11
Ice	11/18/2019 12:00	85.849571	120.581451	Bottom 0-5 cm
Ice	11/18/2019 12:00	85.849571	120.581451	Bottom 5-10 cm
Snow	11/18/2019 12:00	85.849571	120.581451	0
SW	11/18/2019 12:00	85.849571	120.581451	0
CTD	12/6/2019 12:00	86.140556	122.196701	10
FT	12/7/2019 10:00	86.161652	122.141006	11
FT	12/9/2019 9:30	86.401390	120.931358	11
CTD	1/23/2020 12:00	87.446587	94.088547	100

CTD	1/23/2020 12:00	87.446587	94.088547	10
CTD	1/23/2020 12:00	87.446587	94.088547	200
CTD	1/23/2020 12:00	87.446587	94.088547	20
CTD	1/23/2020 12:00	87.446587	94.088547	2
CTD	1/23/2020 12:00	87.446587	94.088547	50
CTD	1/23/2020 12:00	87.446587	94.088547	75
Snow	1/27/2020 12:00	87.445847	95.670288	0
SW	1/27/2020 12:00	87.445847	95.670288	0
FT	3/19/2020 19:38	86.466080	13.943270	11
FT	3/20/2020 11:57	86.330116	14.791050	11
FT	3/21/2020 18:42	86.246986	15.426960	11
Snow	3/22/2020 12:00	86.230000	15.751200	0.215-0.24
FT	4/7/2020 14:58	84.496758	14.549860	11
CTD	4/17/2020 12:00	84.409119	13.652770	2
CTD	4/17/2020 12:00	84.409119	13.652770	20
FT	4/17/2020 18:58	84.428001	13.761420	11
FT	5/1/2020 17:30	83.922569	17.615120	11
Ice	5/4/2020 12:00	83.886208	18.240580	Top 0-10 cm
Ice	5/4/2020 12:00	83.886009	18.314541	Top 30-40 cm
Snow	5/4/2020 12:00	83.886208	18.240580	0
SW	5/4/2020 12:00	83.886208	18.240580	0
FT	5/15/2020 16:30	83.392342	9.178190	11
FT	6/15/2020 19:10	82.218620	8.210060	11
Snow	6/23/2020 12:00	81.998700	9.696600	0.3-0.32
CTD	6/27/2020 12:00	81.955391	9.903160	100
CTD	6/27/2020 12:00	81.955391	9.903160	10
CTD	6/27/2020 12:00	81.955391	9.903160	2
CTD	6/27/2020 12:00	81.955391	9.903160	50
CTD	6/27/2020 12:00	81.955391	9.903160	NA
CTD	6/27/2020 12:00	81.955391	9.903160	150
FT	6/27/2020 16:30	81.918716	9.770960	11
Ice	6/30/2020 12:00	81.783981	8.948390	Bottom 0-5 cm
Ice	6/30/2020 12:00	81.783981	8.948390	Bottom 5-10 cm
MP	7/2/2020 12:00	NA	NA	0
MP	7/4/2020 12:00	NA	NA	0
Ice	7/6/2020 12:00	81.674088	5.190190	NA
Ice	7/6/2020 12:00	81.673447	5.171660	Bottom 5-10 cm
Ice	7/6/2020 12:00	81.673447	5.171660	Bottom 0-5 cm
MP	7/7/2020 12:00	NA	NA	0

MP	7/11/2020 12:00	NA	NA	0
MP	7/13/2020 12:00	NA	NA	0
FT	7/13/2020 21:02	81.406662	0.257950	11
CTD	7/16/2020 12:00	81.230972	0.298100	2
CTD	7/16/2020 12:00	81.230972	0.298100	11
MP	7/16/2020 12:00	NA	NA	0
MP	7/20/2020 12:00	NA	NA	0
MP	7/23/2020 12:00	NA	NA	0
MP	7/28/2020 12:00	NA	NA	0
Lead Ice	8/30/2020 12:00	NA	NA	0
SW	8/30/2020 12:00	NA	NA	0
Snow	8/30/2020 12:00	NA	NA	0
CTD	9/3/2020 12:00	88.560738	119.607590	100
CTD	9/3/2020 12:00	88.560738	119.607590	10
CTD	9/3/2020 12:00	88.560738	119.607590	200
CTD	9/3/2020 12:00	88.560738	119.607590	2
CTD	9/3/2020 12:00	88.560738	119.607590	50
CTD	9/3/2020 12:00	88.560738	119.607590	20
FT	9/3/2020 12:23	88.602692	120.106117	11
Lead Ice	9/5/2020 12:00	NA	NA	0
Snow	9/5/2020 12:00	NA	NA	0
Ice	9/7/2020 12:00	88.722420	112.059280	Top 0-10 cm
Ice	9/7/2020 12:00	88.722420	112.059280	Top 10-20 cm
FT	9/7/2020 13:30	88.688126	111.565254	11
FT	10/2/2020 12:00	NA	NA	11

Table S1: List of potential source samples sequenced with Type (FT=Flowthrough seawater samples; CTD=seawater samples collected on a Conductivity, Temperature, and Depth rosette; SW=Surface or lead seawater samples; MP=Melt pond freshwater samples); Source tracking category; Collection date in UTC (12:00 given if no specific time recorded); Collection latitude in degrees, Collection longitude in degrees; and approximate collection depth in meters. Not available (NA) is indicated, and a default time of "12:00" is given if one was not recorded.