



Supplement of

Terrestrial or marine – indications towards the origin of ice-nucleating particles during melt season in the European Arctic up to 83.7° N

Markus Hartmann et al.

Correspondence to: Markus Hartmann (markus.hartmann@tropos.de)

The copyright of individual parts of the supplement might differ from the article licence.

S1 Meteorology during PS106

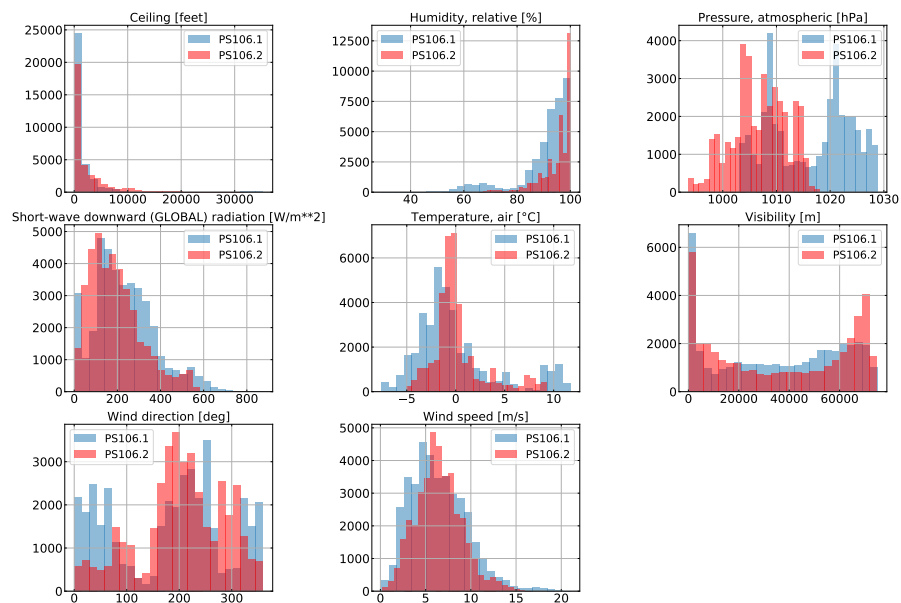


Figure S1. Frequency distributions of meteorological parameters measured during leg 1 (blue) and leg 2 (red) of PS106. Data from Schmithüsen (2018, 2019)

S2 Filtered Seawater Samples

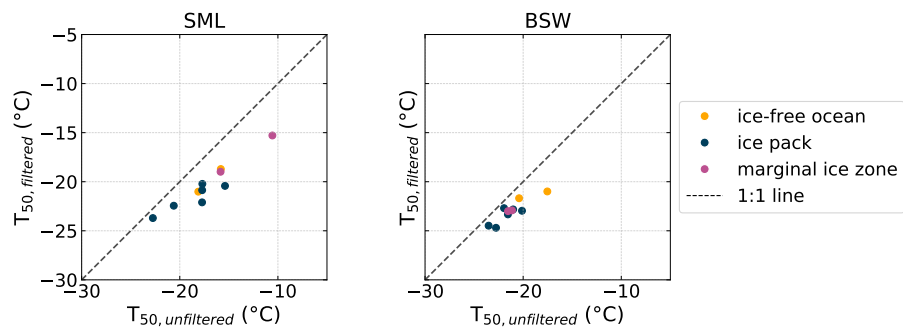


Figure S2. Comparison of filtered and unfiltered SML and BSW samples. Shown are the T_{50} values for corresponding samples. Symbols below the 1:1 line indicate that the filtered sample is less ice active.

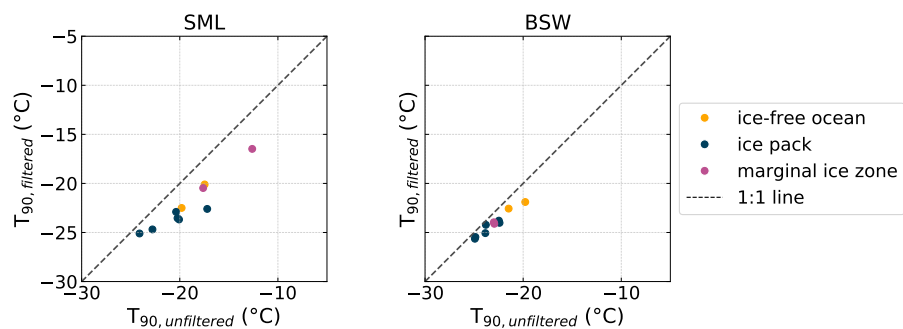


Figure S3. Comparison of filtered and unfiltered SML and BSW samples. Shown are the T_{90} values for corresponding samples. Symbols below the 1:1 line indicate that the filtered sample is less ice active.

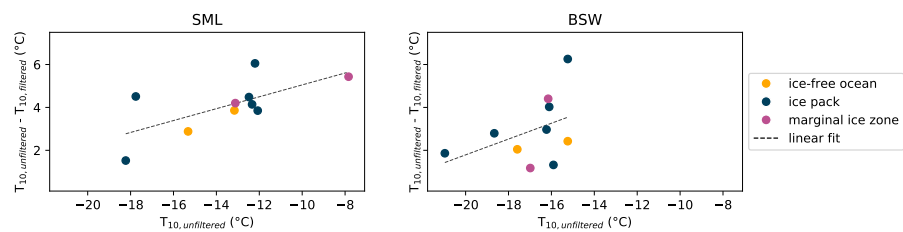


Figure S4. Difference in T_{10} of filtered and unfiltered sample plotted against T_{10} of the unfiltered sample for SML and BSW samples. The dashed line represents a linear fit.

S3 Chlorophyll in the investigation region

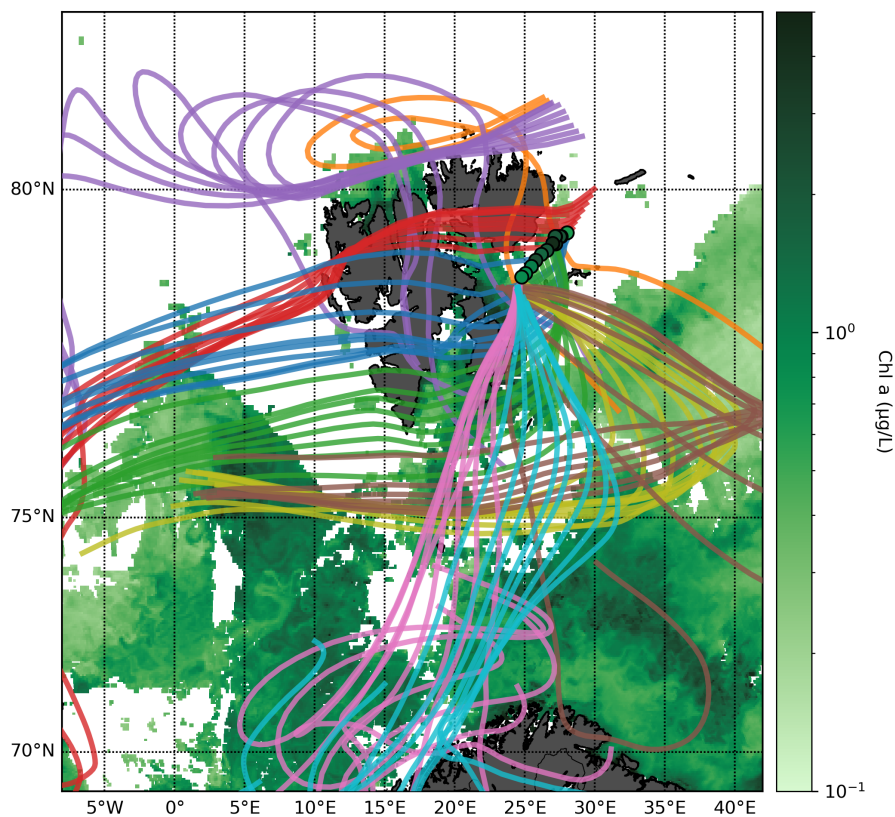


Figure S5. Map of chlorophyll-a measured by satellite and the Ferrybox system of the Polarstern, along with hourly backtrajectories. Dots east of Svalbard show the chlorophyll-a concentration measured by the Ferrybox system for the time period when the peak in chlorophyll-a concentration occurred (sampling period of LV194 and LV195). The chlorophyll-a concentration measured by satellite (Aqua MODIS, NPP, L3SMI, Global, 4km, Science Quality, 2003-present, 8 Day Composite (July 8 to July 16)) is shown as well. The hourly backtrajectories are identical to the Fig. 13 in the main manuscript.

Fig. S5 shows a map of chlorophyll-a measured by satellite and the Ferrybox system of the Polarstern, along with hourly backtrajectories. Dots show the chlorophyll-a concentration measured by the Ferrybox system for the time period when the peak in chlorophyll-a concentration occurred (sampling period of LV194 and LV195). The chlorophyll-a concentration measured by satellite (Aqua MODIS, NPP, L3SMI, Global, 4km, Science Quality, 2003-present, 8 Day Composite (July 8 to July 16)) is shown as well. The hourly backtrajectories are identical to the Fig. 13. It can be seen that several patches of higher chlorophyll-a concentration are present in region where our case study took place. Also several trajectories travel over the areas with increased chlorophyll-a concentration. This makes it possible that the corresponding air masses picked up particles emitted from those areas. However, it has to be kept in mind that backtrajectories also have spatial uncertainties and should be merely

seen as indicator for the areas where air masses came from and should not be used to pinpoint features with exact location. Therefore the Fig. S5 shall only elucidate that the air masses we investigate in this case study have the possibility to transport INPs from a local marine source to our measurement site, but it is not possible to further narrow down the most likely source

15 area.

S4 Sample list of filter samples

Table S1: Information on the filter samples including sample ID, start and end date/time of sample collection, and the INP measurement related parameters V_{drop} , V_{wash} and V_{air} .

Sample ID	Start Date/Time	End Date/Time	V_{drop} (m ³)	V_{wash} (m ³)	V_{air} (m ³)
LV1	2017-05-24 18:44:05	2017-05-25 02:44:05	1.00E-09	1.50E-06	13.364
LV2	2017-05-25 02:44:05	2017-05-25 10:44:05	1.00E-09	1.50E-06	13.8766
LV3	2017-05-25 10:44:05	2017-05-25 18:44:05	2.00E-09	1.00E-06	13.7338
LV4	2017-05-25 18:44:06	2017-05-26 02:44:06	1.00E-09	1.00E-06	13.7241
LV5	2017-05-26 02:44:05	2017-05-26 10:44:05	1.00E-09	1.00E-06	13.0346
LV6	2017-05-26 10:44:05	2017-05-26 18:44:05	2.00E-09	1.00E-06	13.6037
LV7	2017-05-26 18:44:05	2017-05-27 02:44:05	1.00E-09	1.00E-06	12.7998
LV8	2017-05-27 02:44:05	2017-05-27 10:44:05	1.00E-09	1.00E-06	13.1622
LV9	2017-05-27 10:44:06	2017-05-27 18:44:06	2.00E-09	1.00E-06	13.4232
LV10	2017-05-27 18:44:05	2017-05-28 02:44:05	1.00E-09	1.00E-06	13.5014
LV11	2017-05-28 02:44:05	2017-05-28 10:44:05	1.00E-09	1.00E-06	13.7333
LV12	2017-05-28 10:44:05	2017-05-28 18:44:05	2.00E-09	1.00E-06	13.5444
LV13	2017-05-28 18:44:06	2017-05-29 02:44:06	1.00E-09	3.00E-06	13.665
LV14	2017-05-29 02:44:06	2017-05-29 10:44:06	1.00E-09	1.00E-06	13.5393
LV15	2017-05-29 10:44:06	2017-05-29 18:44:06	2.00E-09	1.00E-06	13.3834
LV17	2017-05-29 18:44:05	2017-05-30 02:44:05	1.00E-09	3.00E-06	13.6367
LV18	2017-05-30 02:44:06	2017-05-30 10:44:06	1.00E-09	1.00E-06	13.482
LV19	2017-05-30 10:44:06	2017-05-30 18:44:06	2.00E-09	1.00E-06	13.2745
LV20	2017-05-30 18:44:05	2017-05-31 02:44:05	1.00E-09	3.00E-06	13.4347
LV21	2017-05-31 02:44:06	2017-05-31 10:44:06	1.00E-09	1.00E-06	13.5989
LV22	2017-05-31 10:44:06	2017-05-31 18:44:06	2.00E-09	1.00E-06	13.402
LV23	2017-05-31 18:44:05	2017-06-01 02:44:05	1.00E-09	6.00E-06	13.4593
LV24	2017-06-01 02:44:06	2017-06-01 10:44:06	1.00E-09	1.00E-06	13.6141
LV25	2017-06-01 10:44:06	2017-06-01 18:44:06	2.00E-09	1.00E-06	13.2211
LV26	2017-06-01 18:44:05	2017-06-02 02:44:05	1.00E-09	3.00E-06	13.4625
LV27	2017-06-02 02:44:05	2017-06-02 10:44:05	1.00E-09	1.00E-06	13.2275
LV28	2017-06-02 10:44:05	2017-06-02 18:44:05	2.00E-09	1.00E-06	13.4415
LV29	2017-06-02 18:44:06	2017-06-03 02:44:06	1.00E-09	3.00E-06	13.1189
LV30	2017-06-03 02:44:05	2017-06-03 10:44:05	1.00E-09	1.00E-06	13.3567

Table S1 continued from previous page

LV31	2017-06-03 10:44:06	2017-06-03 18:44:06	1.00E-09	1.00E-06	13.4868
LV32	2017-06-03 18:44:05	2017-06-04 02:44:05	1.00E-09	3.00E-06	13.5722
LV33	2017-06-04 02:44:05	2017-06-04 10:44:05	1.00E-09	1.00E-06	13.5453
LV34	2017-06-04 10:44:05	2017-06-04 18:44:05	1.00E-09	1.00E-06	13.3867
LV35	2017-06-04 18:44:06	2017-06-05 02:44:06	1.00E-09	3.00E-06	13.2561
LV36	2017-06-05 02:44:06	2017-06-05 10:44:06	1.00E-09	3.00E-06	13.494
LV37	2017-06-05 10:44:06	2017-06-05 18:44:06	1.00E-09	1.00E-06	13.3424
LV38	2017-06-05 18:44:05	2017-06-06 02:44:05	1.00E-09	3.00E-06	13.571
LV39	2017-06-06 02:44:05	2017-06-06 10:44:05	1.00E-09	3.00E-06	13.516
LV40	2017-06-06 10:44:05	2017-06-06 18:44:05	1.00E-09	1.00E-06	13.5603
LV41	2017-06-06 18:44:06	2017-06-06 20:44:06	1.00E-09	1.00E-06	3.3556
LV42	2017-06-06 20:44:05	2017-06-06 22:44:05	1.00E-09	1.00E-06	3.3702
LV43	2017-06-06 22:44:05	2017-06-07 00:44:05	1.00E-09	1.00E-06	3.3766
LV44	2017-06-07 00:44:05	2017-06-07 02:44:05	1.00E-09	1.00E-06	3.2937
LV45	2017-06-07 02:44:06	2017-06-07 04:44:06	1.00E-09	1.00E-06	3.3518
LV46	2017-06-07 04:44:06	2017-06-07 06:44:06	1.00E-09	1.00E-06	3.3215
LV47	2017-06-07 06:44:06	2017-06-07 08:44:06	1.00E-09	1.00E-06	3.3867
LV48	2017-06-07 08:44:05	2017-06-07 10:44:05	1.00E-09	1.00E-06	3.3306
LV49	2017-06-07 10:44:06	2017-06-07 12:44:06	1.00E-09	1.00E-06	3.265
LV50	2017-06-07 12:44:06	2017-06-07 14:44:06	1.00E-09	1.00E-06	3.3574
LV51	2017-06-07 14:44:05	2017-06-07 16:44:05	1.00E-09	1.00E-06	3.3382
LV52	2017-06-07 16:44:06	2017-06-07 18:44:06	1.00E-09	1.00E-06	3.3593
LV53	2017-06-07 18:44:06	2017-06-08 02:44:06	1.00E-09	1.00E-06	13.3844
LV54	2017-06-08 02:44:05	2017-06-08 10:44:05	1.00E-09	3.00E-06	13.4333
LV55	2017-06-08 10:44:05	2017-06-08 18:44:05	1.00E-09	1.00E-06	13.3914
LV56	2017-06-08 18:44:05	2017-06-09 02:44:05	1.00E-09	3.00E-06	13.3852
LV57	2017-06-09 02:44:06	2017-06-09 10:44:06	1.00E-09	3.00E-06	13.5345
LV58	2017-06-09 10:44:05	2017-06-09 18:44:05	1.00E-09	1.00E-06	13.303
LV59	2017-06-09 18:44:06	2017-06-10 02:44:06	1.00E-09	3.00E-06	13.2808
LV60	2017-06-10 02:44:05	2017-06-10 10:44:05	1.00E-09	3.00E-06	13.336
LV61	2017-06-10 10:44:05	2017-06-10 18:44:05	1.00E-09	1.00E-06	13.4814
LV62	2017-06-10 18:44:05	2017-06-11 02:44:05	1.00E-09	3.00E-06	13.4903
LV63	2017-06-11 02:44:05	2017-06-11 10:44:05	1.00E-09	3.00E-06	13.6937
LV64	2017-06-11 10:44:05	2017-06-11 18:44:05	1.00E-09	1.00E-06	13.8514

Table S1 continued from previous page

LV65	2017-06-11 18:44:06	2017-06-12 02:44:06	1.00E-09	3.00E-06	13.7736
LV66	2017-06-12 02:44:05	2017-06-12 10:44:05	1.00E-09	3.00E-06	13.4469
LV67	2017-06-12 10:44:06	2017-06-12 18:44:06	1.00E-09	1.00E-06	13.6985
LV68	2017-06-12 18:44:06	2017-06-13 02:44:06	1.00E-09	3.00E-06	13.6218
LV69	2017-06-13 02:44:06	2017-06-13 10:44:06	1.00E-09	3.00E-06	13.9241
LV70	2017-06-13 10:44:05	2017-06-13 18:44:05	1.00E-09	1.00E-06	13.7261
LV71	2017-06-13 18:44:05	2017-06-14 02:44:05	1.00E-09	3.00E-06	13.4597
LV72	2017-06-14 02:44:06	2017-06-14 10:44:06	1.00E-09	3.00E-06	13.4823
LV73	2017-06-14 10:44:05	2017-06-14 18:44:05	1.00E-09	1.00E-06	13.3676
LV74	2017-06-14 18:44:06	2017-06-15 02:44:06	1.00E-09	3.00E-06	13.315
LV75	2017-06-15 02:44:05	2017-06-15 10:44:05	1.00E-09	3.00E-06	13.5743
LV76	2017-06-15 10:44:06	2017-06-15 18:44:06	1.00E-09	1.00E-06	13.5022
LV77	2017-06-15 18:44:06	2017-06-16 02:44:06	1.00E-09	3.00E-06	13.6143
LV78	2017-06-16 02:44:05	2017-06-16 10:44:05	1.00E-09	3.00E-06	13.6673
LV79	2017-06-16 10:44:05	2017-06-16 18:44:05	1.00E-09	1.00E-06	13.8151
LV80	2017-06-16 18:44:06	2017-06-17 02:44:06	1.00E-09	3.00E-06	13.6382
LV81	2017-06-17 02:44:05	2017-06-17 10:44:05	1.00E-09	3.00E-06	13.5365
LV82	2017-06-17 10:44:05	2017-06-17 18:44:05	1.00E-09	1.00E-06	13.4833
LV83	2017-06-17 18:44:05	2017-06-18 02:44:05	1.00E-09	3.00E-06	13.3616
LV84	2017-06-18 02:44:05	2017-06-18 10:44:05	1.00E-09	3.00E-06	13.2425
LV85	2017-06-18 10:44:06	2017-06-18 18:44:06	1.00E-09	1.00E-06	13.4102
LV86	2017-06-18 18:44:06	2017-06-19 02:44:06	1.00E-09	3.00E-06	13.2994
LV87	2017-06-19 02:44:05	2017-06-19 10:44:05	1.00E-09	3.00E-06	13.2843
LV88	2017-06-19 10:44:05	2017-06-19 18:44:05	1.00E-09	1.00E-06	13.3801
LV90	2017-06-20 02:44:05	2017-06-20 10:44:05	1.00E-09	3.00E-06	13.4782
LV91	2017-06-20 10:44:05	2017-06-20 18:44:05	1.00E-09	1.00E-06	13.3972
LV92	2017-06-20 18:44:06	2017-06-21 02:44:06	1.00E-09	3.00E-06	13.4854
LV93	2017-06-21 02:44:05	2017-06-21 10:44:05	1.00E-09	3.00E-06	13.8507
LV94	2017-06-21 10:44:06	2017-06-21 18:44:06	2.00E-09	1.00E-05	13.9159
LV95	2017-06-21 18:44:06	2017-06-22 02:44:06	1.00E-09	3.00E-06	13.8086
LV96	2017-06-22 02:44:05	2017-06-22 10:44:05	1.00E-09	3.00E-06	13.6727
LV97	2017-06-22 10:44:05	2017-06-22 18:44:05	2.00E-09	1.00E-05	13.6527
LV98	2017-06-22 18:44:06	2017-06-23 02:44:06	1.00E-09	3.00E-06	13.6263
LV99	2017-06-23 02:44:06	2017-06-23 10:44:06	1.00E-09	3.00E-06	13.358

Table S1 continued from previous page

LV100	2017-06-23 10:44:05	2017-06-23 18:44:05	2.00E-09	1.00E-05	13.4249
LV101	2017-06-23 18:44:06	2017-06-24 02:44:06	1.00E-09	3.00E-06	13.4252
LV102	2017-06-24 02:44:05	2017-06-24 10:44:05	1.00E-09	3.00E-06	13.4035
LV103	2017-06-24 10:13:20	2017-06-24 18:13:20	2.00E-09	1.00E-05	12.5126
LV104	2017-06-24 18:13:19	2017-06-24 20:13:19	1.00E-09	3.00E-06	3.3784
LV105	2017-06-24 20:13:18	2017-06-24 22:13:18	1.00E-09	3.00E-06	3.3901
LV106	2017-06-24 22:13:19	2017-06-25 00:13:19	1.00E-09	3.00E-06	3.3629
LV107	2017-06-25 00:13:19	2017-06-25 02:13:19	1.00E-09	3.00E-06	3.3526
LV108	2017-06-25 02:13:18	2017-06-25 04:13:18	1.00E-09	3.00E-06	3.3495
LV109	2017-06-25 04:13:18	2017-06-25 06:13:18	1.00E-09	3.00E-06	3.3401
LV110	2017-06-25 06:13:18	2017-06-25 08:13:18	1.00E-09	3.00E-06	3.3844
LV111	2017-06-25 08:13:18	2017-06-25 10:13:18	1.00E-09	3.00E-06	3.3324
LV112	2017-06-25 10:13:19	2017-06-25 12:13:19	1.00E-09	3.00E-06	3.3575
LV113	2017-06-25 12:13:18	2017-06-25 14:13:18	1.00E-09	3.00E-06	3.3444
LV114	2017-06-25 14:13:19	2017-06-25 16:13:19	1.00E-09	3.00E-06	3.3243
LV115	2017-06-25 16:13:19	2017-06-25 18:13:19	1.00E-09	3.00E-06	3.3739
LV116	2017-06-25 18:13:18	2017-06-26 02:13:18	1.00E-09	3.00E-06	13.4297
LV117	2017-06-26 02:13:19	2017-06-26 10:13:19	1.00E-09	3.00E-06	13.3875
LV118	2017-06-26 10:13:18	2017-06-26 18:13:18	1.00E-09	1.00E-05	13.4147
LV119	2017-06-26 18:13:18	2017-06-27 02:13:18	1.00E-09	3.00E-06	13.3293
LV120	2017-06-27 02:13:19	2017-06-27 10:13:19	1.00E-09	3.00E-06	13.512
LV121	2017-06-27 10:13:19	2017-06-27 18:13:19	1.00E-09	1.00E-05	13.3159
LV122	2017-06-27 18:13:18	2017-06-28 02:13:18	1.00E-09	3.00E-06	13.3833
LV123	2017-06-28 02:13:18	2017-06-28 10:13:18	1.00E-09	3.00E-06	13.4953
LV124	2017-06-28 10:13:18	2017-06-28 18:13:18	1.00E-09	1.00E-05	13.4132
LV125	2017-06-28 18:13:18	2017-06-29 02:13:18	1.00E-09	3.00E-06	13.382
LV126	2017-06-29 02:13:18	2017-06-29 10:13:18	1.00E-09	3.00E-06	13.4051
LV127	2017-06-29 10:13:19	2017-06-29 18:13:19	1.00E-09	1.00E-05	13.425
LV128	2017-06-29 18:13:19	2017-06-30 02:13:19	1.00E-09	3.00E-06	13.2653
LV129	2017-06-30 02:13:18	2017-06-30 10:13:18	1.00E-09	3.00E-06	13.5042
LV130	2017-06-30 10:13:19	2017-06-30 18:13:19	1.00E-09	1.00E-05	13.1151
LV131	2017-06-30 18:13:19	2017-07-01 02:13:19	1.00E-09	3.00E-06	13.0522
LV132	2017-07-01 02:13:19	2017-07-01 10:13:19	1.00E-09	3.00E-06	13.1088
LV133	2017-07-01 10:13:19	2017-07-01 18:13:19	1.00E-09	1.00E-05	13.1199

Table S1 continued from previous page

LV134	2017-07-01 18:13:18	2017-07-02 02:13:18	1.00E-09	3.00E-06	13.0771
LV135	2017-07-02 02:13:19	2017-07-02 10:13:19	1.00E-09	3.00E-06	13.1196
LV136	2017-07-02 10:13:19	2017-07-02 18:13:19	1.00E-09	1.00E-05	13.2351
LV137	2017-07-02 18:13:19	2017-07-03 02:13:19	1.00E-09	3.00E-06	12.9632
LV138	2017-07-03 02:13:18	2017-07-03 10:13:18	1.00E-09	3.00E-06	12.9771
LV139	2017-07-03 10:13:18	2017-07-03 18:13:18	1.00E-09	1.00E-05	13.2915
LV153	2017-07-05 02:13:19	2017-07-05 10:13:19	1.00E-09	3.00E-06	13.3439
LV154	2017-07-05 10:13:19	2017-07-05 18:13:19	1.00E-09	1.00E-05	12.9859
LV156	2017-07-06 02:13:19	2017-07-06 10:13:19	1.00E-09	3.00E-06	13.2444
LV157	2017-07-06 10:13:19	2017-07-06 18:13:19	1.00E-09	1.00E-05	13.1926
LV158	2017-07-06 18:13:18	2017-07-07 02:13:18	1.00E-09	3.00E-06	13.2601
LV159	2017-07-07 02:13:18	2017-07-07 10:13:18	1.00E-09	3.00E-06	13.2437
LV160	2017-07-07 10:13:18	2017-07-07 18:13:18	1.00E-09	1.00E-05	12.9855
LV161	2017-07-07 18:13:18	2017-07-08 02:13:18	1.00E-09	3.00E-06	13.0379
LV162	2017-07-08 02:13:18	2017-07-08 10:13:18	1.00E-09	3.00E-06	13.1561
LV163	2017-07-08 10:13:18	2017-07-08 18:13:18	1.00E-09	1.00E-05	13.1462
LV164	2017-07-08 18:13:19	2017-07-09 02:13:19	1.00E-09	3.00E-06	13.4222
LV165	2017-07-09 02:13:18	2017-07-09 10:13:18	1.00E-09	3.00E-06	13.0372
LV166	2017-07-09 10:13:19	2017-07-09 18:13:19	1.00E-09	1.00E-05	13.0227
LV167	2017-07-09 18:13:19	2017-07-10 02:13:19	1.00E-09	3.00E-06	13.3225
LV168	2017-07-10 02:13:19	2017-07-10 10:13:19	1.00E-09	3.00E-06	13.1759
LV169	2017-07-10 10:13:18	2017-07-10 18:13:18	1.00E-09	6.00E-06	13.2474
LV170	2017-07-10 18:13:18	2017-07-11 02:13:18	1.00E-09	3.00E-06	13.2873
LV171	2017-07-11 02:13:18	2017-07-11 10:13:18	1.00E-09	3.00E-06	13.0063
LV172	2017-07-11 10:13:18	2017-07-11 18:13:18	1.00E-09	6.00E-06	13.3026
LV173	2017-07-11 18:13:18	2017-07-12 02:13:18	1.00E-09	3.00E-06	13.2725
LV174	2017-07-12 02:13:19	2017-07-12 10:13:19	1.00E-09	3.00E-06	13.0801
LV176	2017-07-12 10:13:18	2017-07-12 18:13:18	1.00E-09	6.00E-06	13.3052
LV177	2017-07-12 18:13:18	2017-07-13 02:13:18	1.00E-09	3.00E-06	13.2656
LV178	2017-07-13 02:13:18	2017-07-13 10:13:18	1.00E-09	3.00E-06	13.102
LV179	2017-07-13 10:17:06	2017-07-13 12:17:06	1.00E-09	3.00E-06	3.3933
LV180	2017-07-13 12:17:06	2017-07-13 14:17:06	1.00E-09	3.00E-06	3.2698
LV181	2017-07-13 14:17:06	2017-07-13 16:17:06	1.00E-09	3.00E-06	3.2428
LV182	2017-07-13 16:17:05	2017-07-13 18:17:05	1.00E-09	3.00E-06	3.3187

Table S1 continued from previous page

LV183	2017-07-13 18:17:06	2017-07-13 20:17:06	1.00E-09	3.00E-06	3.2542
LV184	2017-07-13 20:17:06	2017-07-13 22:17:06	1.00E-09	3.00E-06	3.2868
LV185	2017-07-13 22:17:05	2017-07-14 00:17:05	1.00E-09	3.00E-06	3.3509
LV186	2017-07-14 00:17:06	2017-07-14 02:17:06	1.00E-09	3.00E-06	3.354
LV187	2017-07-14 02:17:05	2017-07-14 04:17:05	1.00E-09	3.00E-06	3.4633
LV188	2017-07-14 04:17:06	2017-07-14 06:17:06	1.00E-09	3.00E-06	3.3949
LV189	2017-07-14 06:17:06	2017-07-14 08:17:06	1.00E-09	3.00E-06	3.3921
LV190	2017-07-14 08:17:06	2017-07-14 10:17:06	1.00E-09	3.00E-06	3.3731
LV191	2017-07-14 10:17:05	2017-07-14 18:17:05	1.00E-09	6.00E-06	13.6913
LV193	2017-07-15 02:17:05	2017-07-15 10:17:05	1.00E-09	3.00E-06	13.3896
LV194	2017-07-15 10:17:06	2017-07-15 18:17:06	1.00E-09	6.00E-06	13.513
LV195	2017-07-15 18:17:06	2017-07-16 02:17:06	1.00E-09	3.00E-06	13.6538
LV196	2017-07-16 02:17:06	2017-07-16 10:17:06	1.00E-09	3.00E-06	13.5267
LV197	2017-07-16 10:17:05	2017-07-16 18:17:05	1.00E-09	6.00E-06	13.5701
LV198	2017-07-16 18:17:06	2017-07-17 02:17:06	1.00E-09	3.00E-06	13.5233
LV199	2017-07-17 02:17:05	2017-07-17 10:17:05	1.00E-09	3.00E-06	13.5925

S5 Sample list of seawater samples

Table S2: Information on the seawater samples including sample ID, sample collection date and time, latitude and longitude, the environment the sample was taken from, and the freezing point depression the INP measurements were corrected for.

Sample ID	Sample Date/Time	Latitude	Longitude	Environment	freezing point depression (°C)
BulkS1	2017-05-25 11:00:00	57° 17.28'N	005° 12.75'E	ice-free ocean	-2
SMLS1	2017-05-25 11:00:00	57° 17.28'N	005° 12.75'E	ice-free ocean	-2.1
BulkS2	2017-05-26 11:00:00	61° 06.6'N	003° 17.97'E	ice-free ocean	-2
SMLS2	2017-05-26 11:00:00	61° 06.6'N	003° 17.97'E	ice-free ocean	-2.1
Bulk1	2017-05-27 09:00:00	64° 41.19'N	002° 44.55'E	ice-free ocean	-2.2
SML1	2017-05-27 09:00:00	64° 41.19'N	002° 44.55'E	ice-free ocean	-2.2
Bulk2	2017-05-29 08:30:00	72° 24.72'N	005° 35.69'E	ice-free ocean	-2
SML2	2017-05-29 08:30:00	72° 24.72'N	005° 35.69'E	ice-free ocean	-2.2
Bulk3	2017-05-31 08:20:00	79° 19.16'N	008° 24.6'E	ice-free ocean	-2.1
SML3	2017-05-31 08:20:00	79° 19.16'N	008° 24.6'E	ice-free ocean	-2.1
Bulk4	2017-06-01 10:30:00	80° 25.55'N	007° 15.88'E	ice pack	-2
SML4	2017-06-01 10:30:00	80° 25.55'N	007° 15.88'E	ice pack	-2.1
Bulk5	2017-06-02 12:00:00	81° 17.39'N	009° 17.82'E	ice pack	-2
SML5	2017-06-02 12:00:00	81° 17.39'N	009° 17.82'E	ice pack	-2.1
Bulk6	2017-06-04 17:00:00	81° 57.0'N	010° 30.0'E	ice pack	-2.1
SML6	2017-06-04 17:00:00	81° 57.0'N	010° 30.0'E	ice pack	-2.1
Bulk7	2017-06-07 08:00:00	81° 56.205'N	010° 15.057'E	ice pack	-2
SML7	2017-06-07 08:00:00	81° 56.205'N	010° 15.057'E	ice pack	-2.1
Bulk8	2017-06-08 12:00:00	81° 53.94' N	009° 51.46' E	ice pack	-2
SML8	2017-06-08 12:00:00	81° 53.94' N	009° 51.46' E	ice pack	-2
BulkS3	2017-06-09 08:00:00	82° 54.50'N	010° 00.74'E	ice pack	-2
SMLS3	2017-06-09 08:00:00	82° 54.50'N	010° 00.74'E	ice pack	-2.1
Bulk9	2017-06-10 15:00:00	81° 52.32'N	010° 27.59'E	melt pond	-1.2
SML9	2017-06-10 15:00:00	81° 52.32'N	010° 27.59'E	melt pond	-0.8
Bulk10	2017-06-11 14:00:00	81° 49.69'N	011° 12.45'E	ice pack	-2.1
SML10	2017-06-11 14:00:00	81° 49.69'N	011° 12.45'E	ice pack	-2.1
Bulk11	2017-06-14 13:00:00	81° 45.87'N	011° 07.09'E	melt pond	-1.1
SML11	2017-06-14 13:00:00	81° 45.87'N	011° 07.09'E	melt pond	-1
Bulk12	2017-06-15 11:30:00	81° 43.33'N	010° 49.11' E	melt pond	-0.8

Table S2 continued from previous page

SML12	2017-06-15 11:30:00	81° 43.33' N	010° 49.11' E	melt pond	-0.8
Bulk13	2017-06-17 12:30:00	80° 59.59' N	010° 21.70' E	ice pack	-2.1
SML13	2017-06-17 12:30:00	80° 59.59' N	010° 21.70' E	ice pack	-2.1
Bulk14	2017-06-18 11:00:00	80° 08.82' N	010° 25.68' E	marginal ice zone	-2.1
SML14	2017-06-18 11:00:00	80° 08.82' N	010° 25.68' E	marginal ice zone	-2.1
Bulk15	2017-06-19 14:00:00	78° 39.50' N	004° 33.23' E	marginal ice zone	-2
SML15	2017-06-19 14:00:00	78° 39.50' N	004° 33.23' E	marginal ice zone	-1.6
Bulk16	2017-06-24 10:00:00	76° 10.62' N	019° 58.16' E	ice-free ocean	-1.9
SML16	2017-06-24 10:00:00	76° 10.62' N	019° 58.16' E	ice-free ocean	-2.1
Bulk17	2017-06-25 10:45:00	77° 54.19' N	030° 05.20' E	marginal ice zone	-2
SML17	2017-06-25 10:45:00	77° 54.19' N	030° 05.20' E	marginal ice zone	-1.9
Bulk18	2017-06-25 19:00:00	78° 05.40' N	030° 27.58' E	melt pond	-0.6
SML18	2017-06-25 19:00:00	78° 05.40' N	030° 27.58' E	melt pond	-0.5
Bulk19	2017-06-25 21:50:00	78° 05.40' N	030° 27.58' E	melt pond	-1.9
SML19	2017-06-25 21:50:00	78° 05.40' N	030° 27.58' E	melt pond	-0.3
Bulk20	2017-06-26 10:30:00	78° 33.33' N	033° 57.9' E	marginal ice zone	-1.9
SML20	2017-06-26 10:30:00	78° 33.33' N	033° 57.9' E	marginal ice zone	-2
Bulk21	2017-06-27 13:00:00	79° 50.11' N	034° 02.4' E	ice pack	-2
SML21	2017-06-27 13:00:00	79° 50.11' N	034° 02.4' E	ice pack	-2
Bulk22	2017-06-28 23:30:00	80° 32.01' N	030° 58.15' E	melt pond	-0.4
SML22	2017-06-28 23:30:00	80° 32.01' N	030° 58.15' E	melt pond	-0.3
Bulk23	2017-06-29 11:00:00	80° 39.93' N	031° 40.74' E	ice pack	-2
SML23	2017-06-29 11:00:00	80° 39.93' N	031° 40.74' E	ice pack	-2.1
Bulk24	2017-06-30 11:45:00	81° 41.73' N	032° 55.28' E	ice pack	-2
SML24	2017-06-30 11:45:00	81° 41.73' N	032° 55.28' E	ice pack	-2
Bulk25	2017-07-01 16:10:00	81° 25.39' N	032° 34.6' E	ice pack	-2.1
SML25	2017-07-01 16:10:00	81° 25.39' N	032° 34.6' E	ice pack	-2.1
Bulk26	2017-07-02 12:45:00	81° 39.87' N	032° 14.67' E	ice pack	-2
SML26	2017-07-02 12:45:00	81° 39.87' N	032° 14.67' E	ice pack	-2
BulkS4	2017-07-02 20:00:00	81° 38.99' N	032° 21.97' E	ice pack	-2
Bulk27	2017-07-03 13:30:00	81° 57.92' N	032° 25.44' E	ice pack	-2
SML27	2017-07-03 13:30:00	81° 57.92' N	032° 25.44' E	ice pack	-2.1
Bulk28	2017-07-05 10:30:00	83° 00.3' N	033° 11.57' E	ice pack	-2

Table S2 continued from previous page

SML28	2017-07-05 10:30:00	83° 00.3'N	033°11.57'E	ice pack	-2
Bulk29	2017-07-06 13:30:00	83° 30.02'N	032° 59.1' E	ice pack	-2.1
SML29	2017-07-06 13:30:00	83° 30.02'N	032° 59.1' E	ice pack	-2.1
Bulk30	2017-07-06 22:45:00	83° 39.68'N	031° 34.83'E	ice pack	-2
SML30	2017-07-06 22:45:00	83° 39.68'N	031° 34.83'E	ice pack	-2.1
BulkS5	2017-07-06 22:45:00	83° 39.68'N	031° 34.83'E	melt pond	-1
SMLS5	2017-07-06 22:45:00	83° 39.68'N	031° 34.83'E	melt pond	-1
Bulk31	2017-07-08 10:45:00	83° 28.18'N	027° 54.75'E	ice pack	-2.1
SML31	2017-07-08 10:45:00	83° 28.18'N	027° 54.75'E	ice pack	-2.1
Bulk32	2017-07-09 12:45:00	82° 58.00'N	025° 08.30'E	ice pack	-2.1
SML32	2017-07-09 12:45:00	82° 58.00'N	025° 08.30'E	ice pack	-2
Bulk33	2017-07-10 10:45:00	82° 30.27'N	018° 36. 77'E	ice pack	-2
SML33	2017-07-10 10:45:00	82° 30.27'N	018° 36. 77'E	ice pack	-2
Bulk34	2017-07-11 10:00:00	82° 02.91'N	017°55.77'E	ice pack	-2.1
SML34	2017-07-11 10:00:00	82° 02.91'N	017°55.77'E	ice pack	-2
Bulk35	2017-07-13 11:10:00	81° 13.74'N	018° 44.63'E	ice pack	-2
SML35	2017-07-13 11:10:00	81° 13.74'N	018° 44.63'E	ice pack	-1.9
Bulk36	2017-07-14 11:20:00	81° 00.92'N	026° 52.96'E	ice pack	-2.1
SML36	2017-07-14 11:20:00	81° 00.92'N	026° 52.96'E	ice pack	-2
Bulk37	2017-07-15 10:50:00	79° 27.45'N	028° 07.14' E	marginal ice zone	-2
SML37	2017-07-15 10:50:00	79° 27.45'N	028° 07.14' E	marginal ice zone	-2
SMLS6	2017-07-15 10:50:00	79° 27.45'N	028° 07.14' E	marginal ice zone	-2

S6 Test for heat-labile INP

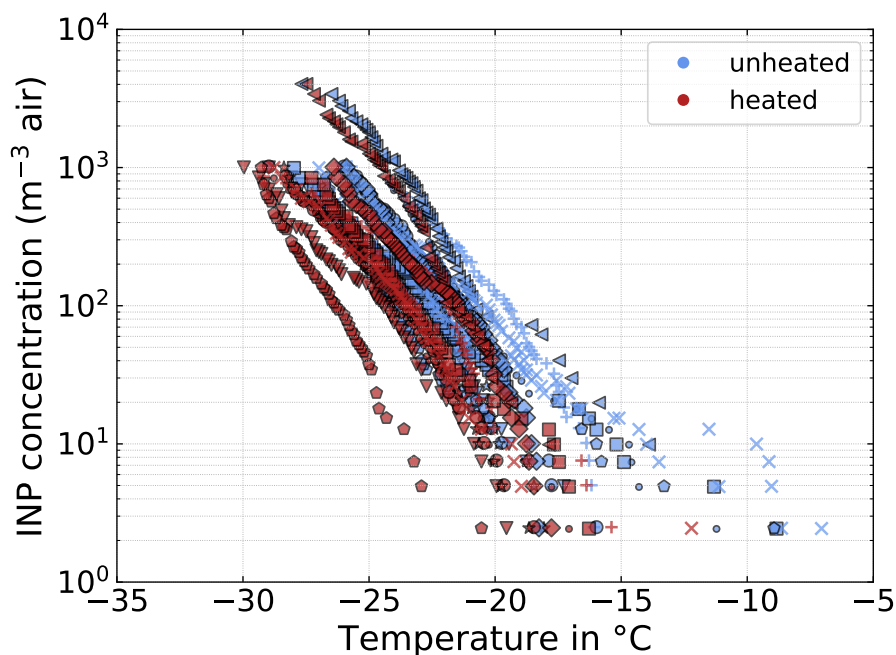


Figure S6. Comparison of heated (red symbols) and unheated (blue symbols) filter samples. The same samples have the same symbol.

After the initial measurement arbitrarily selected samples were chosen to test for the presence of heat-labile INPs in the samples. The sample solution was sealed in a centrifuge tube and placed in an oven. The sample was heated at 95°C for 1 h and subsequently analysed with the LINA device. In Fig. S6 it can be seen that the ice activity of all samples was reduced. The strongest reduction occurred with INPs, which were originally active at temperatures above -16°C and are now no longer present after heating. This indicates that these INPs were biogenic and proteinaceous.

Fig S7 shows a box plot of the decrease in N_{INP} after the heat treatment at selected temperatures of all samples that were heated. Boxes represent the 25% and 75% quartile. The horizontal line represents the median and the green triangle the mean. The whiskers have the length of 1.5 * IQR (interquartile range) and data points outside the range of the whiskers is shown with diamond markers. It can be seen that the decrease is most pronounced for the warmer temperatures, but is present throughout the whole temperature range. For temperatures of -16°C and above, the decrease almost always 100%, which indicates that all samples contained heat-labile INP at these temperatures. At temperatures of -18°C and below, the variability in the decrease becomes higher, which indicates that at the lower temperatures some samples still contain mostly heat-labile INP, while in other samples also more heat-stable INP are present.

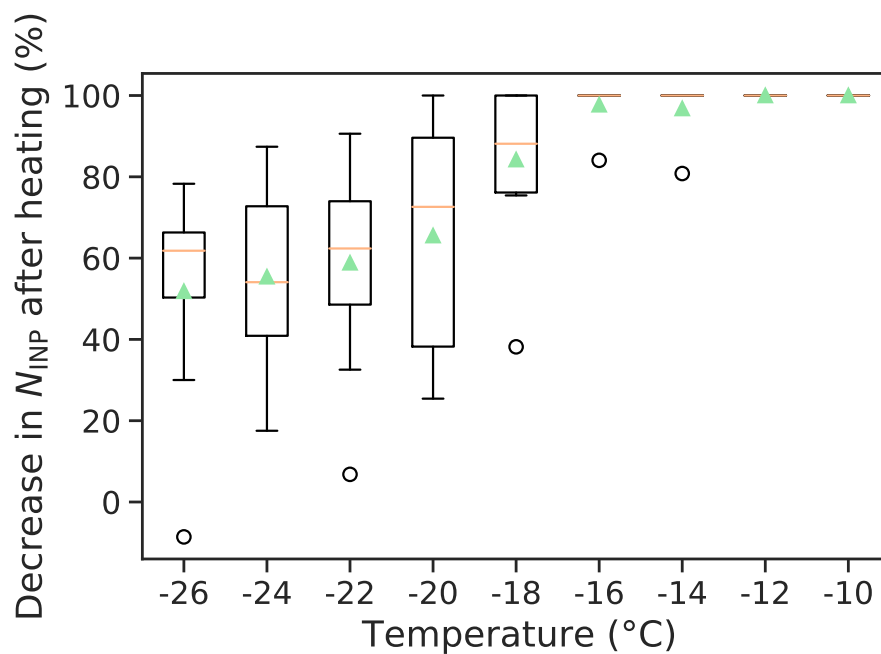


Figure S7. Box plot of the decrease in N_{INP} after the heat treatment. Boxes represent the 25% and 75% quartile. The horizontal line represents the median and the green triangle the mean. The whiskers have the length of $1.5 \cdot \text{IQR}$ (interquartile range) and data points outside the range of the whiskers is shown with diamond markers.

S7 Sample list of fog samples

Table S3. Information on the fog samples including sample ID, start and end date/time of sample collection.

Sample ID	Start Date	Start Time	Stop Date	Stop Time
WW1	2017-05-26	04:33:00	2017-05-26	12:27:00
WW3	2017-05-27	12:46:00	2017-05-27	20:39:00
WW4	2017-05-27	20:56:00	2017-05-28	06:15:00
WW5	2017-06-01	13:15:00	2017-06-02	16:37:00
WW6	2017-06-10	20:30:00	2017-06-13	09:58:00
WW7	2017-06-23	10:00:00	2017-06-25	10:10:00
WW9	2017-06-29	10:45:00	2017-07-01	10:25:00
WW10	2017-07-01	10:38:00	2017-07-06	10:30:00
WW11	2017-07-06	10:45:00	2017-07-07	11:10:00
WW12	2017-07-07	11:25:00	2017-07-08	11:15:00
WW13	2017-07-08	11:30:00	2017-07-08	22:20:00
WW15	2017-07-09	17:00:00	2017-07-10	11:00:00
WW16	2017-07-10	11:15:00	2017-07-11	11:00:00
WW17	2017-07-11	11:15:00	2017-07-14	10:25:00
WW18	2017-07-14	10:38:00	2017-07-15	10:45:00
WW19	2017-07-15	10:52:00	2017-07-16	10:20:00
WW20	2017-07-16	10:30:00	2017-07-16	22:15:00
WW21	2017-07-16	22:30:00	2017-07-17	10:20:00
WW22	2017-07-17	10:30:00	2017-07-17	14:00:00

S8 Freezing spectra of the filter samples

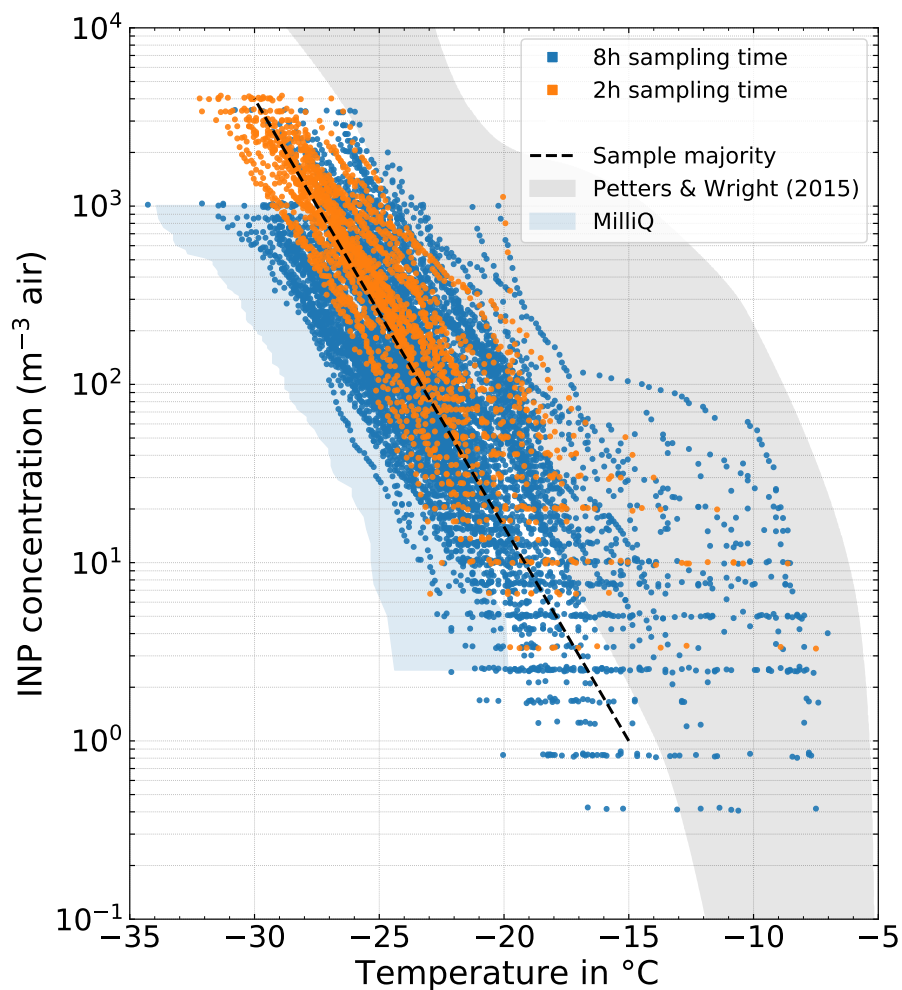


Figure S8. All cumulative INP spectra derived from atmospheric filter samples measured with LINA. The color code shows whether it is a sample with 8 h (blue) or 2 h (orange) collection time. The range of N_{INP} for mid-latitudes by Petters and Wright (2015) is shown as gray shaded area for reference. The blue area depicts the 10% to 90% percentile range of all pure MilliQ measurements with LINA (scaled to atmospheric concentrations with the average sampled air volume of the 8 h samples).

S9 Fog derived N_{INP} for SS=0.02%

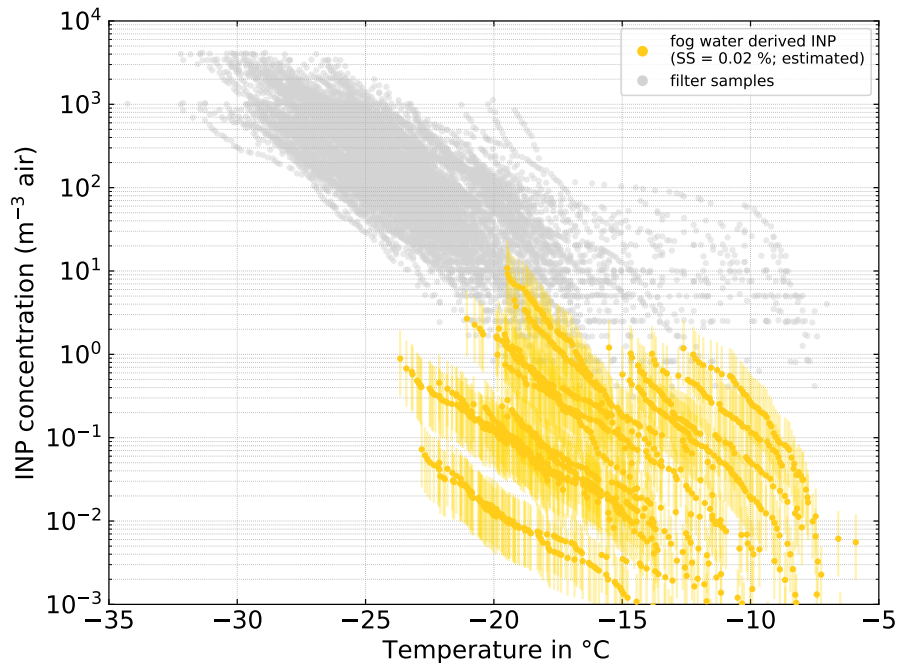


Figure S9. Fog water derived N_{INP} in air. N_{INP} was derived from Eq. 4 and 5 in the main manuscript with the extrapolated $N_{\text{CCN}}(\text{SS}=0.02\%)$ during the time of each fog sample and an average droplet diameter (d_{drop}) of $17 \mu\text{m}$. The error bars show the range with d_{drop} of $12 \mu\text{m}$ and $22 \mu\text{m}$ respectively.

35 In Fig. S9 the fog water derived N_{INP} for an estimated SS of 0.02% is shown. Here, we derived the factor by which the average N_{CCN} decreases from 0.3%SS to 0.2%SS. We then use that factor to estimate the decrease in N_{CCN} from 0.3%SS to 0.02%SS. With that estimated N_{CCN} at 0.02%SS we then again calculate the INP concentration as described in the main manuscript. A linear extrapolation to such low supersaturations has large uncertainties, but gives an estimate for the lower boundary of the presented N_{INP} derivation.

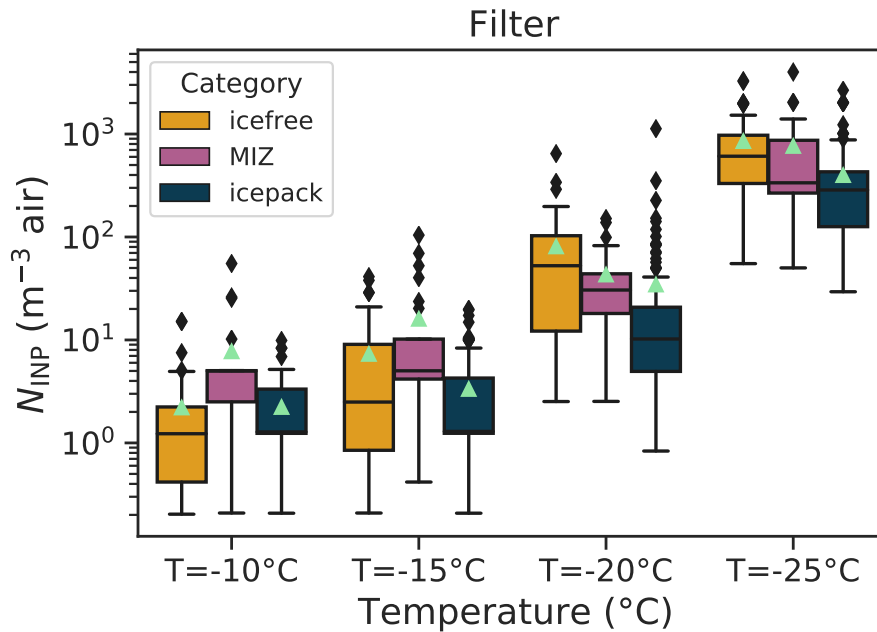


Figure S10. Box plot of N_{INP} at selected temperatures for the filter samples. The horizontal line represents the median and the green triangle the mean. The whiskers have the length of $1.5 * \text{IQR}$ and data points outside the range of the whiskers is shown with diamond markers.

Fig. S10 shows a box plot of the filter derived N_{INP} shown in Fig. 3 of the main manuscript. The horizontal line represents the median and the green triangle the mean. The whiskers have the length of $1.5 * \text{IQR}$ and data points outside the range of the whiskers is shown with diamond markers. It should be noted that for samples whose value was outside the detectable range at the selected temperature, the value was substituted in order to minimize the over- and underestimation of the summary statistics needed to create the box plot. If at the selected temperature a sample had an N_{INP} value below the detectable range, the value was substituted as $\text{LLOD}/2$ ($\text{LLOD} = \text{lower limit of detection}$). Analogous values above the detectable range were substituted with $\text{ULOD}*2$ ($\text{ULOD} = \text{upper limit of detection}$). Box plots for the SML and BSW samples were created in the same manner as described before (Fig. S11 and S12; same data as in Fig. 5 in the main manuscript).

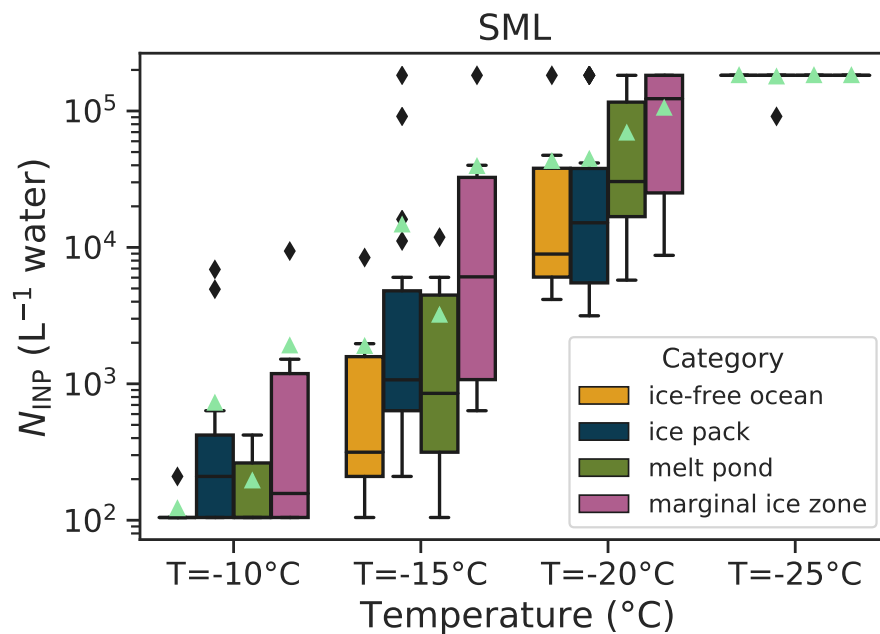


Figure S11. Box plot of N_{INP} at selected temperatures for SML samples. The horizontal line represents the median and the green triangle the mean. The whiskers have the length of $1.5 * IQR$ and data points outside the range of the whiskers is shown with diamond markers.

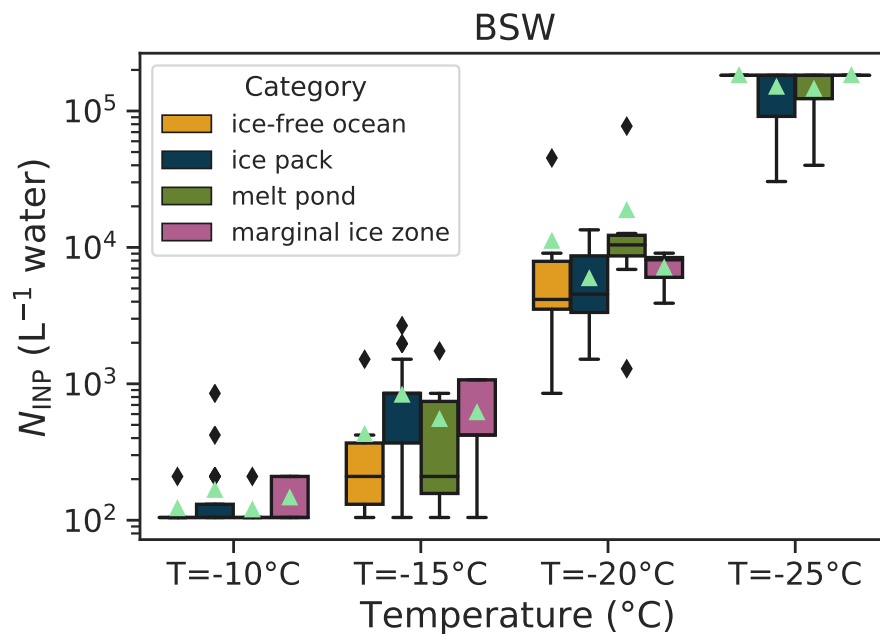


Figure S12. Box plot of N_{INP} at selected temperatures for BSW samples. The horizontal line represents the median and the green triangle the mean. The whiskers have the length of $1.5 * IQR$ and data points outside the range of the whiskers is shown with diamond markers.

References

- 50 Petters, M. D. and Wright, T. P.: Revisiting ice nucleation from precipitation samples, *Geophysical Research Letters*, 42, 8758–8766, <https://doi.org/10.1002/2015GL065733>, 2015.
- Schmithüsen, H.: Continuous meteorological surface measurement during POLARSTERN cruise PS106/1 (ARK-XXXI/1.1), <https://doi.org/10.1594/PANGAEA.886302>, <https://doi.org/10.1594/PANGAEA.886302>, 2018.
- Schmithüsen, H.: Continuous meteorological surface measurement during POLARSTERN cruise PS106/2 (ARK-XXXI/1.2),
55 <https://doi.org/10.1594/PANGAEA.901179>, <https://doi.org/10.1594/PANGAEA.901179>, 2019.