SUPPLEMENTARY FIGURES AND TABLES LEGEND

Supplementary Table S1. Identity and characteristics of precipitation and aerosol isolates. Aerosol sampling period labels begin with "A" to distinguish from precipitation sampling periods 1-11 (see Table S3 for precipitation and aerosol sampling times). Taxonomy is denoted by results of BLAST from 16S sequences, percent identity to BLAST assignments, and membership to taxonomic divisions. Isolate identifiers derive from results of multiple sequence alignment analysis (Fig. S2). "IN onset temperature" refers to the first temperature at which isolates exhibited significant IN behavior above the background of the ZoBell media in which they were suspended. Duplicate isolates that were derived from the same sampling period were not featured in Fig. 3a or Fig. 4a and were not counted toward the 14 total identified ice nucleating isolates, but each duplicate was tested for its IN ability and results are shown here.

Supplementary Table S2. Cloud characteristics during 11 precipitation events over the sampling site: SIO Pier (32.8662 °N, 117.2544 °W). Cloud base and top altitudes were estimated using the RH product of the High-Resolution Rapid Refresh real-time atmospheric model, and three altitudes within the cloud were used as particle release points for FLEXPART back-trajectories (see Figure 6.1): cloud top, cloud base, and middle (halfway between). Regions where RH (Relative Humidity) > 95 % were considered for all events except Sampling Period 4 and 5, when a criterion of > 90 % was applied. The hourly products closest in time to the precipitation sampling period were used. When cloud depth and altitudes changed over the sampling period, the lowest cloud base and highest cloud altitude were selected as release points for FLEXPART back-trajectories.

Supplementary Table S3. Sampling periods for precipitation and aerosol samples collected on SIO Pier (32.8662 °N, 117.2544 °W). Synoptic weather conditions for each precipitation event were determined using National Weather Service Weather Prediction Center Surface Analysis Satellite Composite products.

Supplementary Table S4. Summary of ice nucleation behavior of the 9 isolates that were tested for ice nucleation in the absence of media and resuspended in filtered autoclaved seawater (FASW). In comparison with ice nucleation behavior above ZoBell background levels, ice nucleation behavior was generally enhanced in media-free isolates, except in the case of SSA45, *Psychrobacter* sp. The first temperature at which ice nucleation is significant above background was determined by applying the criterion described in Methods. See Methods and Figure S6 for details of media-free freezing experiment.

Supplementary Figure S1. Controls of IN measurements. (a) IN activity of 11 ZoBell media blanks. (b) IN activity of selected media–free isolate with a dilution factor of 1 (undiluted). Filtered autoclaved seawater (FASW) was used for resuspension of the isolates for INP measurement. (c) IN activity of selected media–free isolates with a dilution factor of 5. Some isolates were diluted with FASW to decrease opacity such that freezing events could successfully be detected by the camera, and the IN spectra of the isolates and FASW are scaled by the same dilution factor for analysis of the isolate's ice nucleation ability beyond its media (Methods Sec. 2.4). Only INP concentrations that were significantly enhanced above FASW ($p < 0.005$, see Methods Sec. 2.4) are shown in (b) and (c).

Supplementary Figure S2. IN spectra of the 14 IN isolates and their respective ZoBell media samples, with IN spectra of both ZoBell and isolates scaled by the isolates' dilution factor. All isolates were diluted with additional ZoBell to decrease opacity such that freezing events could be detected with the camera. Only INP concentrations that were significantly enhanced above ZoBell ($p < 0.005$) are shown. See Methods section for description of the criterion applied to determine significant ice nucleation behavior above the background ZoBell levels.

Supplementary Figure S3. INP concentrations per liter air sampled for 7 aerosol samples collected at Ellen Browning Scripps Memorial Pier at Scripps Institution of Oceanography (SIO) (32.8662 °N, 117.2544 °W) between March and May 2016. The blue shaded region represents the composite spectrum of INP concentrations observed in a range of marine and coastal environments including the Caribbean, East Pacific and Bering Sea as well as laboratory-generated nascent sea spray (DeMott et al., 2016)*. INP spectra of the three samples from which IN isolates were derived (A1, A2, A5, see Table 1 and S1) are outlined in black. While the INPs observed in aerosol samples compare with INP concentrations in marine environments at warmer temperatures (DeMott et al., 2016), concentrations are enhanced at moderate to cold temperatures indicating terrestrial sources may have additionally contributed.

*DeMott et al., 2016 data has been updated with a completed dataset for the ICE-T study, as shown in (Yang et al., 2020).

Supplementary Figure S4. 10-day back-trajectories from the SIO Pier (32.8662 °N, 117.2544 °W, 8m above MLLW) during the 3 aerosol sampling periods from which IN isolates originated, A1, A2, and A5 (see Tables 1, S1). FLEXPART back-trajectories were used to estimate potential aerosol sources. Shown are the particle centroids of back-trajectories. Origins of particles in the 10-day simulation are shown to range from 4000 m over Russia to 3000 m over the Northeast Pacific. FLEXPART results suggest a dominance of marine particle sources to aerosol samples.

Supplementary Figure S5. Image of aerosol (red box) and precipitation (yellow box) isolates on agar plates. Isolates derived from cultivation-based isolation.

Supplementary Figure S6. INP concentrations at -20 °C in aerosol collected at the Scripps Institution of Oceanography Pier (32°52'01.4"N 117°15'26.5"W) during and between precipitation events. INP concentrations in aerosol are represented by blue circles, and pink circles indicate background INP levels in field blanks. Dark blue bars indicate cumulative precipitation over a 24-hr period. (a) Highlighted in grey are three sampling days during which aerosol samples were available immediately before, during and after precipitation events. (b) Precipitation events over March 6 and 7, 2016 (left grey region in Fig. S5a) are magnified for better visibility. (c) The precipitation event from May

5 to May 6, 2016 (right grey region in Fig. S5a) is magnified for better visibility. For all three periods, INP concentrations in aerosol decrease during precipitation events, indicating sweepout of INPs by hydrometeors.

Supplementary Figure S7. Taxonomic distributions of precipitation (a) and aerosol (b) isolates. 83% of the unique families and genera identified in aerosol were common to those found in precipitation.

Supplementary Figure S8. Phylogenetic relationships of isolates (in bold) related to Actinobacteria reference sequences. The environmental source of the reference sequences (based on NCBI metadata) is indicated in grey. Isolates with ice nucleating properties are shaded in yellow; bootstrap values (n=500) are indicated at nodes; scale bar represents changes per positions.

Supplementary Figure S9. Phylogenetic relationships of isolates (in bold) related to Firmicutes reference sequences. The environmental source of the reference sequences based on NCBI metadata is indicated in grey. Isolates with ice nucleating properties are shaded in yellow; bootstrap values (n=500) are indicated at nodes; scale bar represents changes per positions.

Supplementary Figure S10. INP concentrations observed in 14 halotolerant isolates derived from precipitation and aerosol samples, normalized to culture OD (590 nm). Sample numbers in the legend indication the precipitation or aerosol sample from which the isolate was derived (see Table S3). Datapoints corresponding to isolates from aerosol are outlines in black. Error bars indicate 95% confidence intervals (see Methods Sec. 2.4). Only freezing activity that was significantly enhanced ($p < 0.005$) above ZoBell growth media is shown.

Supplementary Figure S11. Relationship of isolates within the same OTUs using multiple sequence alignments of 16S sequences. Multiple sequence alignments were used to generate phylogenetic trees. The resulting branch distances were used to label isolates within the same OTU. Distances > 0.1 were given a new number. This division was further subdivided by distances > 0.01 which were given a unique letter. Distances < 0.01 were considered possible duplicates. Freezing temperatures are shown in yellow boxes to indicate isolates with detected ice nucleation activity.

The data set supporting this manuscript is hosted by the UCSD Library Digital Collections (https://doi.org/10.6075/J0GQ6W2Z).

Table S1

Isolate ID	Isolate	Sampling Period	IN Ability	IN Onset Temperature °C	BLAST Identity	% Identity	Phylum	Class	Order	Family
Iso1	Rhodoturula sp.	1	no	n/a	*Rhodotorula mucilaginosa*	99%	Basidiomycota	Urediniomycetes	Sporidiales	Sporiodiobolaceae
Iso2	Cryptococcus sp. 1	1	yes	-9.25	*Cryptococcus aureus*	100%	Basidiomycota	Tremellomycetes	Tremellales	Tremellaceae
Iso3	Arthrobacter sp.	2	no	n/a	*Arthrobacter sp.(A. luteolus, A.citreus)*	100%	Actinobacteria	Actinobacteria	Actinomycetales	Micrococcaceae
Iso5	Brevibacterium sp. 1a	2	no	n/a	*Brevibacterium sp. (B.linens)*	100%	Actinobacteria	Actinobacteria	Actinomycetales	Brevibacteriaceae
Iso4	Curtobacterium sp. 1	2	no	n/a	*Curtobacterium sp. (C. pusillum, C. flaccumfaciens, C. oceanosedimentum)*	100%	Actinobacteria	Actinobacteria	Actinomycetales	Microbacteriaceae
Iso6	Lysobacter sp.	2	no	n/a	*Lysobacter concretionis*	99%	Proteobacteria	Gammaproteobacteria	Xanthomonadales	Xanthomonadaceae
Iso10A	Cryptococcus sp. 2	3	no	n/a	*Cryptococcus sp. (C. flavescens, C. aureus)*	99%	Basidiomycota	Tremellomycetes	Tremellales	Tremellaceae
Iso10B	Paenibacillus sp. 1	3	yes	-14.75	*Paenibacillus sp.*	100%	Firmicutes	Bacilli	Bacillales	Paenibacillus
Iso9	Bacillus sp. 2a	4	no	n/a	*Bacillus sp. (B. baekryungensis, B. hwajinpoensis)*	100%	Firmicutes	Bacilli	Bacillales	Bacilaceae
Iso8	Brevibacterium sp. 1b	4	yes	-2.25	*Brevibacterium sp. (B. luteolum)*	97%	Actinobacteria	Actinobacteria	Actinomycetales	Brevibacteriaceae
Iso20	Bacillus sp. 1b	5	no	n/a	*Bacillus sp. (B. baekryungensis, B. hwajinpoensis)*	100%	Firmicutes	Bacilli	Bacillales	Bacilaceae
Iso12	Microbacterium sp 1	5	no	n/a	*Microbacterium esteraromaticum*	100%	Actinobacteria	Actinobacteria	Actinomycetales	Microbacteriaceae
Iso19	Microbacterium sp 1	5	no	n/a	*Microbacterium esteraromaticum*	100%	Actinobacteria	Actinobacteria	Actinomycetales	Microbacteriaceae
Iso7	Microbacterium sp 2a1	5	no	n/a	*Microbacterium esteraromaticum*	100%	Actinobacteria	Actinobacteria	Actinomycetales	Microbacteriaceae
Iso36A	Citriococcus sp.	6	no	n/a	*Citricoccus sp. (C. muralis)*	97%	Actinobacteria	Actinobacteria	Actinomycetales	Micrococcaceae
Iso40	Curtobacterium sp. 2	6	no	n/a	*Curtobacterium sp.*	100%	Actinobacteria	Actinobacteria	Actinomycetales	Microbacteriaceae
Iso41	Curtobacterium sp. 2	6	no	n/a	*Curtobacterium flaccumfaciens*	100%	Actinobacteria	Actinobacteria	Actinomycetales	Microbacteriaceae
Iso35A	Planococcus sp. 2a2	6	no	n/a	*Planococcus sp.(P. maritimus, P. plakortidis, P. rifietoesis)*	100%	Firmicutes	Bacilli	Bacillales	Planococcaceae
Iso36B	Planococcus sp. 2a2	6	no	n/a	*Planococcus sp.*	100%	Firmicutes	Bacilli	Bacillales	Planococcaceae
Iso37	Pseudomonas sp. 1	6	no	n/a	*Pseudomonas sp. (P. synxantha, P. grimontii, P. extremaustralis)*	100%	Proteobacteria	Gammaproteobacteria	Pseudomondales	Pseudomonadaceae
Iso35B	Pseudomonas sp. 2a1	6	no	n/a	*Pseudomonas veronii*	100%	Proteobacteria	Gammaproteobacteria	Pseudomondales	Pseudomonadaceae
Iso34	Pseudomonas sp. 2a2	6	no	n/a	*Pseudomonas sp. (P. synxantha, P. grimontii, P. extremaustralis)*	100%	Proteobacteria	Gammaproteobacteria	Pseudomondales	Pseudomonadaceae
Iso39	Pseudomonas sp. 2a3	6	no	n/a	*Pseudomonas sp. (P. synxantha, P. mucidolens, P. grimontii,)*	100%	Proteobacteria	Gammaproteobacteria	Pseudomondales	Pseudomonadaceae
Iso38B	Psychrobacter sp. 1b1	6	no	n/a	*Psychrobacter sp. (P. maritimus)*	100%	Proteobacteria	Gammaproteobacteria	Pseudomondales	Moraxellaceae
Iso38A	Psychrobacter sp. 1c1	6	no	n/a	*Psychrobacter sp.*	99%	Proteobacteria	Gammaproteobacteria	Pseudomondales	Moraxellaceae
Iso32Ap	Microbacterium sp 2a2	7	no	n/a	*Microbacterium esteraromaticum*	99%	Actinobacteria	Actinobacteria	Actinomycetales	Microbacteriaceae
Iso33By	Microbacterium sp 2a4	7	no	n/a	*Microbacterium esteraromaticum*	99%	Actinobacteria	Actinobacteria	Actinomycetales	Microbacteriaceae
Iso32B	Planococcus sp. 1	7	yes	-12.25	*Planococcus maritimus*	99%	Firmicutes	Bacilli	Bacillales	Planococcaceae
Iso33A	Planococcus sp. 2a1	7	no	n/a	*Planococcus sp.*	99%	Firmicutes	Bacilli	Bacillales	Planococcaceae
Iso33Bp	Unknown Microbacterium	7	no	n/a	Unknown *Microbacterium sp.*	89%	Actinobacteria	Actinobacteria	Actinomycetales	Microbacteriaceae
Iso31	Bacillus sp. 1a1	8	yes	-14.5	*Bacillus halmapalus*	100%	Firmicutes	Bacilli	Bacillales	Bacilaceae
Iso29	Pantoea sp. 1a	8	yes	-17	*Pantoea sp. (P. agglomerans, P. ananatis)*	100%	Proteobacteria	Gammaproteobacteria	Enterobacteriales	Enterobacteriaceae
Iso30	Pantoea sp. 1a	8	yes	-16.75	*Pantoea sp. (P. agglomerans, P. ananatis)*	100%	Proteobacteria	Gammaproteobacteria	Enterobacteriales	Enterobacteriaceae
Iso21	Cellulosimicrobium sp. 1a1	9	yes	-14	*Cellulosimicrobium sp. (C. funkei, C.cellulans, C. marinum)*	100%	Actinobacteria	Actinobacteria	Actinomycetales	Promicromonosporaceae
Iso22	Cellulosimicrobium sp. 1a2	9	yes	-15	*Cellulosimicrobium sp. (C. funkei, C.cellulans, C. marinum)*	99%	Actinobacteria	Actinobacteria	Actinomycetales	Promicromonosporaceae
Iso24B	Cellulosimicrobium sp. 1a3	9	no	n/a	*Cellulosimicrobium sp. (C. funkei, C.cellulans, C. marinum)*	100%	Actinobacteria	Actinobacteria	Actinomycetales	Promicromonosporaceae
Iso24A	Metschikowia sp.	9	yes	-16.5	*Metschikowia sp. (M. zobellii, M. krissii, M. reukaufii)*	99%	Ascomycota	Saccharomycetes	Saccharomycetales	Metscnikowiaceae
Iso23	Unknown Arthrobacter	9	yes	-13.25	Unknown *Arthrobacter sp.*	86%	Actinobacteria	Actinobacteria	Actinomycetales	Micrococcaceae
Iso27	Cellulosimicrobium sp. 1a3	10	yes	-14.75	*Cellulosimicrobium sp. (C. funkei, C.cellulans, C. marinum)*	100%	Actinobacteria	Actinobacteria	Actinomycetales	Promicromonosporaceae
Iso28	Cellulosimicrobium sp. 1a3	10	yes	-14.5	*Cellulosimicrobium sp. (C. funkei, C.cellulans, C. marinum)*	100%	Actinobacteria	Actinobacteria	Actinomycetales	Promicromonosporaceae
Iso49	Psychrobacter sp. 1b2	11	yes	-13.75	*Psychrobacter sp. (P. pulmonis, P. faecalis)*	99%	Proteobacteria	Gammaproteobacteria	Pseudomondales	Moraxellaceae
SSA42	Idiomarina sp.	A1	yes	-14.25	*Idiomarina fontislapidosi*	100%	Proteobacteria	Gammaproteobacteria	Alteromonadales	Idiomarinaceae
SSA14	Bacillus sp. 1a2	A2	no	n/a	*Bacillus sp. (B. aquimaris, B. vietnamensis)*	100%	Firmicutes	Bacilli	Bacillales	Bacilaceae
SSA15	Pantoea sp. 1b	A2	no	n/a	*Pantoea sp. (P. ananatis, P. stewartii, P. agglomerans)*	100%	Proteobacteria	Gammaproteobacteria	Enterobacteriales	Enterobacteriaceae
SSA17	Pantoea sp. 1b	A2	no	n/a	*Pantoea sp. (P. ananatis, P. stewartii, P. agglomerans)*	100%	Proteobacteria	Gammaproteobacteria	Enterobacteriales	Enterobacteriaceae
SSA18	Pantoea sp. 1b	A2	no	n/a	*Pantoea sp. (P. ananatis, P. stewartii, P. agglomerans)*	100%	Proteobacteria	Gammaproteobacteria	Enterobacteriales	Enterobacteriaceae
SSA16	Psychrobacter sp. 2a	A2	yes	-17.5	*Psychrobacter sp.*	93%	Proteobacteria	Gammaproteobacteria	Pseudomondales	Moraxellaceae
SSA43	Bacillus sp. 2b2	A3	no	n/a	*Bacillus sp. (B. muralis)*	100%	Firmicutes	Bacilli	Bacillales	Bacilaceae
SSA44A	Paenibacillus sp. 1	A4	no	n/a	*Paenibacillus sp. (P. tundrae, P. amyloyticus, P. agarideverons, P. taichungensi*	100%	Firmicutes	Bacilli	Bacillales	Paenibacillus
SSA46	Bacillus sp. 2b1	A5	no	n/a	*Bacillus halmapalus*	100%	Firmicutes	Bacilli	Bacillales	Bacilaceae
SSA45	Psychrobacter sp. 1c2	A5	yes	-14	*Psychrobacter sp.*	100%	Proteobacteria	Gammaproteobacteria	Pseudomondales	Moraxellaceae
SSA47	Bacillus sp. 2b1	A6	no	n/a	*Bacillus halmapalus*	100%	Firmicutes	Bacilli	Bacillales	Bacilaceae
SSA48	Psychrobacter sp. 1a	A6	no	n/a	*Psychrobacter sp. (P. pulmonis, P. faecalis)*	96%	Proteobacteria	Gammaproteobacteria	Pseudomondales	Moraxellaceae
SSA26	Microbacterium sp 1	A7	no	n/a	*Microbacterium esteraromaticum*	99%	Actinobacteria	Actinobacteria	Actinomycetales	Microbacteriaceae
SSA25	Psychrobacter sp. 2b	A7	no	n/a	*Psychrobacter sp. (P. pulmonis, P. faecalis)*	100%	Proteobacteria	Gammaproteobacteria	Pseudomondales	Moraxellaceae

Table S2

Period	Local date	Local time start	Local time stop	UTC date	UTC time	RH criteria	Temp (K)	Pressure (mb)	Geopotential height (m)
1	3/6/2016	9:07	10:07	3/6/2016	17:07 – 18:07	>95%	283 – 274	950 – 750	800 – 2000
2	3/7/2016	18:30	19:30	3/8/2016	2:30 – 3:30	>95%	275 – 268	850 – 750	1700 – 3000
3	3/11/2016	16:20	17:20	3/12/2016	00:20 – 1:20	>95%	282 – 275	950 – 800	500 – 2200
4	3/12/2016	8:20	9:14	3/12/2016	16:20 – 17:14	> 90%	280 – 278	925 – 900	1000 – 1100
5	3/29/2016	23:35	0:35	3/30/2016	6:35 – 7:35	> 90%	270, 275	800, 900	2000, 700
6	4/7/2016	8:15	11:00	4/7/2016	15:15 – 18:00	> 95%	278 – 270	1000, 750 – 650	2200 – 4000
7	4/7/2016	12:07	13:07	4/7/2016	19:07 – 20:07	> 95%	275 – 265	750 – 600	2000 – 4000
8	5/5/2016	22:59	23:59	5/6/2016	6:00 – 7:00	> 95%	275 – 273	825 – 750	1100 – 2100
9	5/6/2016	2:59	3:59	5/6/2016	10:00 – 11:00	>95%	282 – 270	875 – 700	1000 – 3000
10	5/6/2016	4:59	5:59	5/6/2016	13:00 – 14:00	> 95%	275 – 273	825 – 675	2000 – 3000
11	5/6/2016	8:59	9:59	5/6/2016	17:00 – 18:00	> 95%	275 – 270	825 – 750	1800 – 2800

Table S3

Precipitation

Sampling Period	Local Date	Local Time	UTC Date	UTC time	Number of Isolates	General characteristics
1	3/6/2016	9:07 – 10:07	3/6/2016	17:07 – 18:07	2	frontal rain
2	3/7/2016	18:30 – 19:30	3/8/2016	2:30 – 3:30	4	convective, local updraft rain
3	3/11/2016	16:20 – 17:20	3/12/2016	00:20 – 1:20	2	frontal rain from decaying atmospheric river
4	3/12/2016	8:20 – 9:14	3/12/2016	16:20 – 17:14	2	warm, low cloud rain
5	3/29/2016	23:35 – 0:35	3/30/2016	6:35 – 7:35	4	scattered, low coastal clouds, lack of dynamical system
6	4/7/2016	8:15 – 11:00	4/7/2016	15:15 – 18:00	7	frontal rain from tropical moisture source
7	4/7/2016	12:07 – 13:07	4/7/2016	19:07 – 20:07	4	frontal rain from tropical moisture source
8	5/5/2016	22:59 – 23:59	5/6/2016	6:00 – 7:00	2	pre-frontal rain, meso-scale system
9	5/6/2016	2:59 – 3:59	5/6/2016	10:00 – 11:00	3	post-frontal rain, meso-scale system
10	5/6/2016	4:59 – 5:59	5/6/2016	13:00 – 14:00	1	post-frontal rain, meso-scale system
11	5/6/2016	8:59 – 9:59	5/6/2016	17:00 – 18:00	1	post-frontal rain, meso-scale system

Aerosol

Sampling Period	Local Date	Local Time	UTC Date	UTC time	Number of Isolates
A1	3/5/2016	10:40 – 12:15	3/5/2016	18:40 – 20:15	1
A2	3/7/2016	14:58 – 16:52	3/7/2016	22:58 – 23:52	5
A3	3/8/2016	11:34 – 14:42	3/8/2016	19:34 – 22:42	1
A4	3/28/2016	09:09 – 12:22	3/28/2016	16:09 – 19:22	1
A5	4/28/2016	11:45 – 13:22	4/28/2016	18:45 – 20:22	2
A6	5/5/2016	12:00 – 14:23	5/5/2016	19:00 – 21:23	2
A7	5/6/2016	14:15 – 16:37	5/6/2016	21:15 – 23:37	2

Table S4

Isolate	Species	ZoBell		FASW	
		Ice nucleation above background?	First Significant Freezing Temperature (°C)	Ice nucleation above background?	First Significant Freezing Temperature (°C)
Iso3	Arthrobacter sp. (A. luteolus, A.citreus)	no	n/a	yes	-15.25
Iso4	Curtobacterium sp. (C. pusillum, C. flaccumfaciens, C. oceanosedimentum)	no	n/a	yes	-13
Iso5	Brevibacterium sp. (B.linens)	no	n/a	yes	-11.75
Iso30	Pantoea sp. (P. agglomerans, P. ananatis)	yes	-16.75	yes	-15.5
SSA42	Idiomarina fontislapidosi	yes	-14.25	yes	-9.75
SSA16	Psychrobacter sp.	yes	-17.5	yes	-15.5
SSA18	Pantoea sp. (P. ananatis, P. 7tewartia, P. agglomerans)	no	n/a	yes	-11.5
SSA45	Psychrobacter sp.	yes	-14	no	n/a
SSA26	Microbacterium esteraromaticum	no	n/a	no	n/a

Figure S1

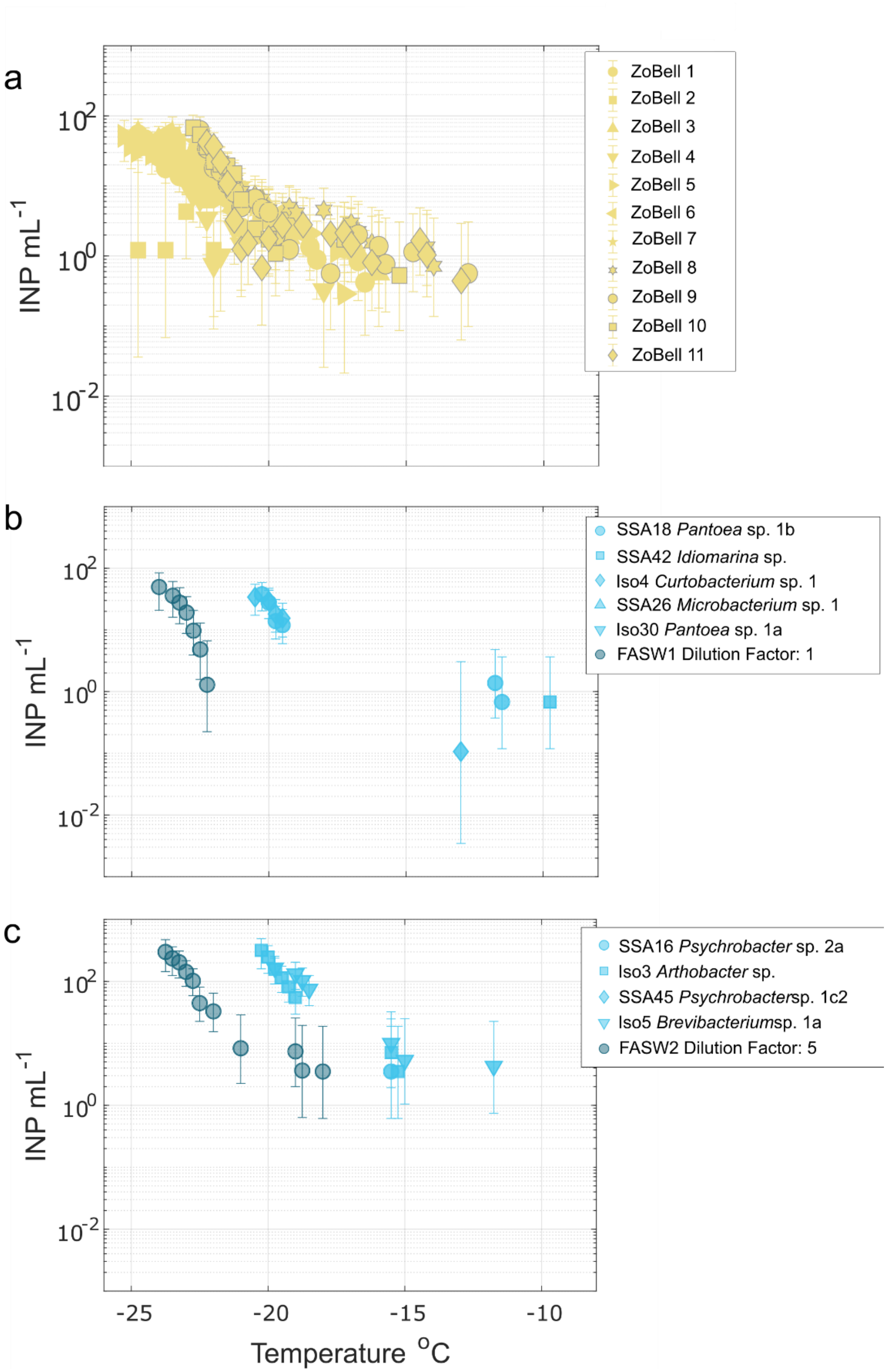

a
b
c
INP mL-1
Temperature °C
-25
-20
-15
-10
ZoBell 1
ZoBell 2
ZoBell 3
ZoBell 4
ZoBell 5
ZoBell 6
ZoBell 7
ZoBell 8
ZoBell 9
ZoBell 10
ZoBell 11
SSA18 Pantoea sp. 1b
SSA42 Idiomarina sp.
Iso4 Curtobacterium sp. 1
SSA26 Microbacterium sp. 1
Iso30 Pantoea sp. 1a
FASW1 Dilution Factor: 1
SSA16 Psychrobacter sp. 2a
Iso3 Arthobacter sp.
SSA45 Psychrobactersp. 1c2
Iso5 Brevibacteriumsp. 1a
FASW2 Dilution Factor: 5

Figure S2

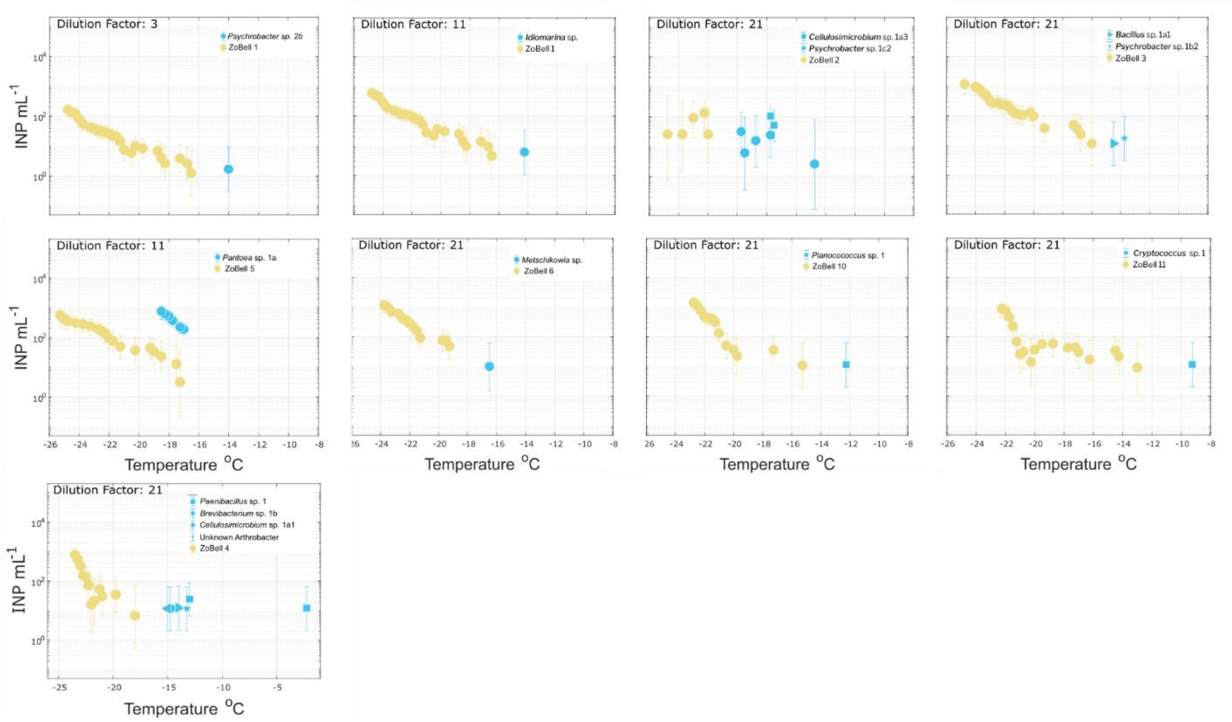
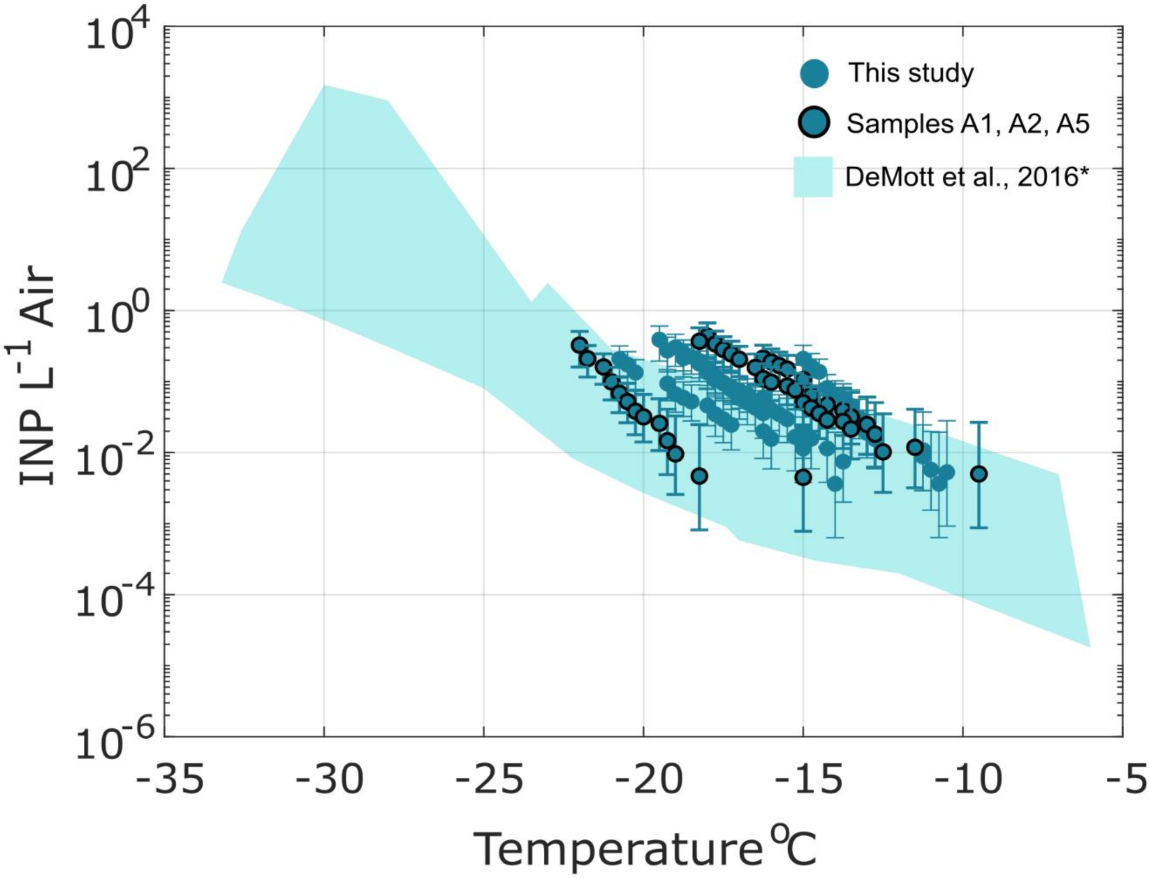
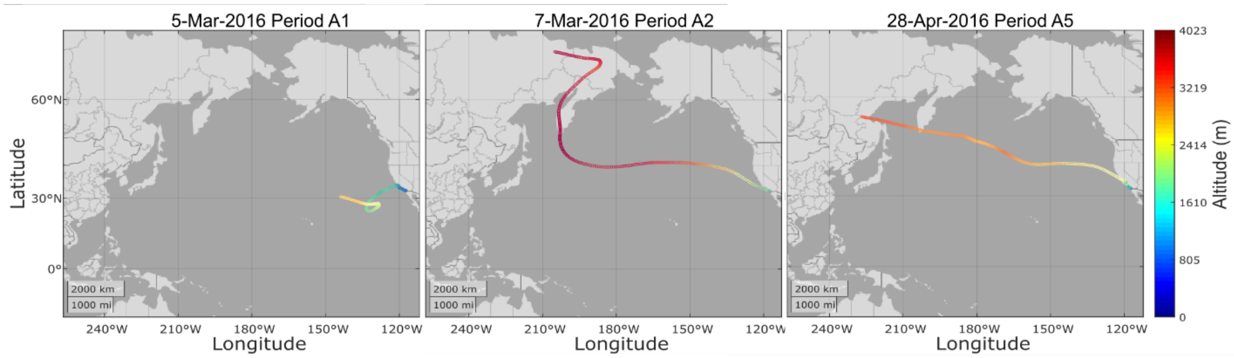

Dilution Factor: 3
Psychrobacter sp. 2b
ZoBell 1
Dilution Factor: 11
Idiomarina sp.
ZoBell 1
Dilution Factor: 21
Cellulosimicrobium sp. 1a3
Psychrobacter sp. 1c2
ZoBell 2
Dilution Factor: 21
Bacillus sp. 1a1
Psychrobacter sp. 1b2
ZoBell 3
Dilution Factor: 11
Pantoea sp. 1a
ZoBell 5
Dilution Factor: 21
Metschikowia sp.
ZoBell 6
Dilution Factor: 21
Planocococcus sp. 1
ZoBell 10
Dilution Factor: 21
Cryptococcus sp. 1
ZoBell 11
Dilution Factor: 21
Paenibacillus sp. 1
Brevibacterium sp. 1b
Cellulosimicrobium sp. 1a1
Unknown Arthrobacter
ZoBell 4
INP mL-1
Temperature °C

Figure S3



10^4
10^2
10^0
10^{-2}
10^{-4}
10^{-6}
INP L^{-1} Air
-35
-30
-25
-20
-15
-10
-5
Temperature °C
This study
Samples A1, A2, A5
DeMott et al., 2016*

Figure S4



5-Mar-2016 Period A1
7-Mar-2016 Period A2
28-Apr-2016 Period A5
Latitude
60°N
30°N
0°
2000 km
1000 mi
240°W
210°W
180°W
150°W
120°W
Longitude
Altitude (m)
4023
3219
2414
1610
805
0

Figure S5

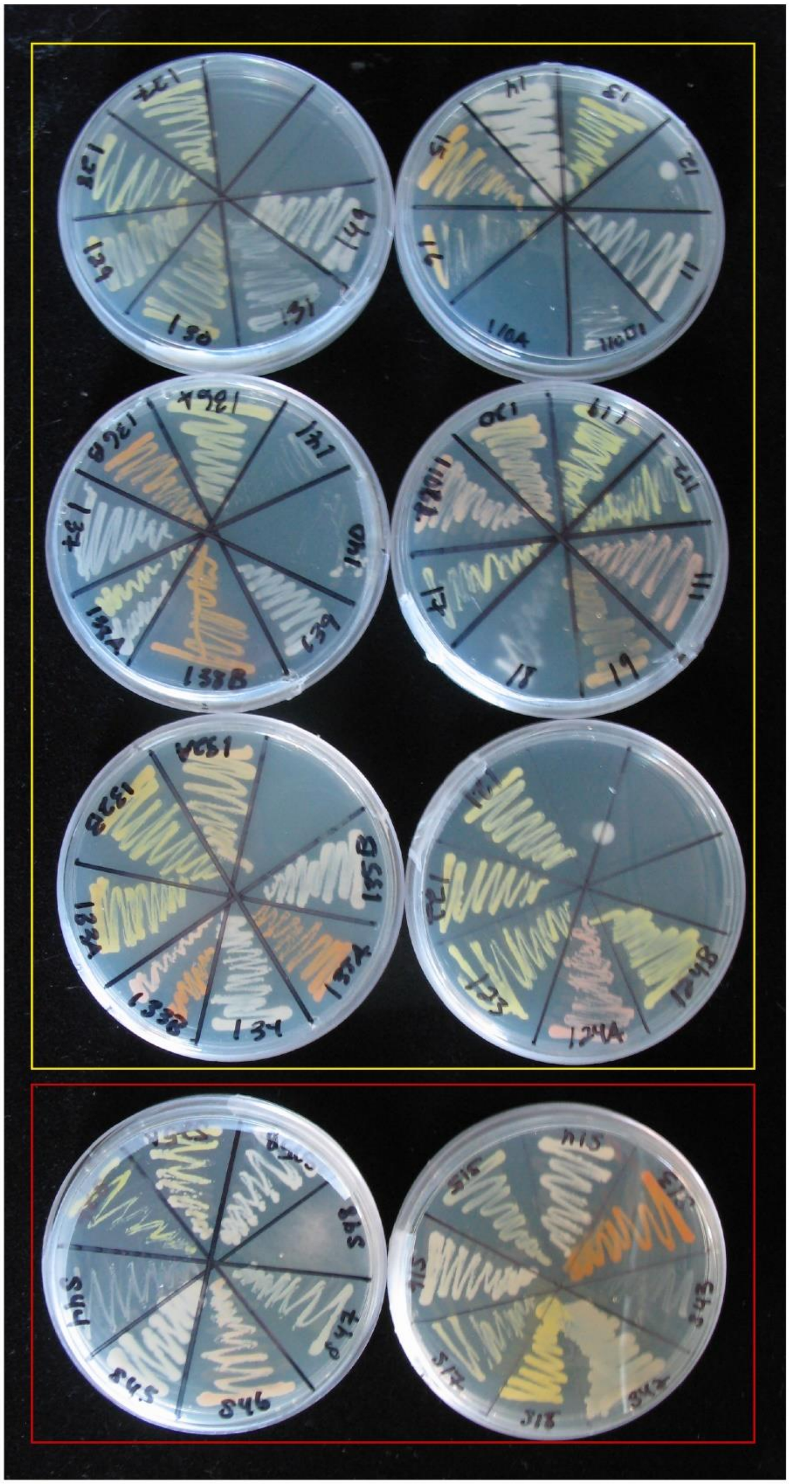
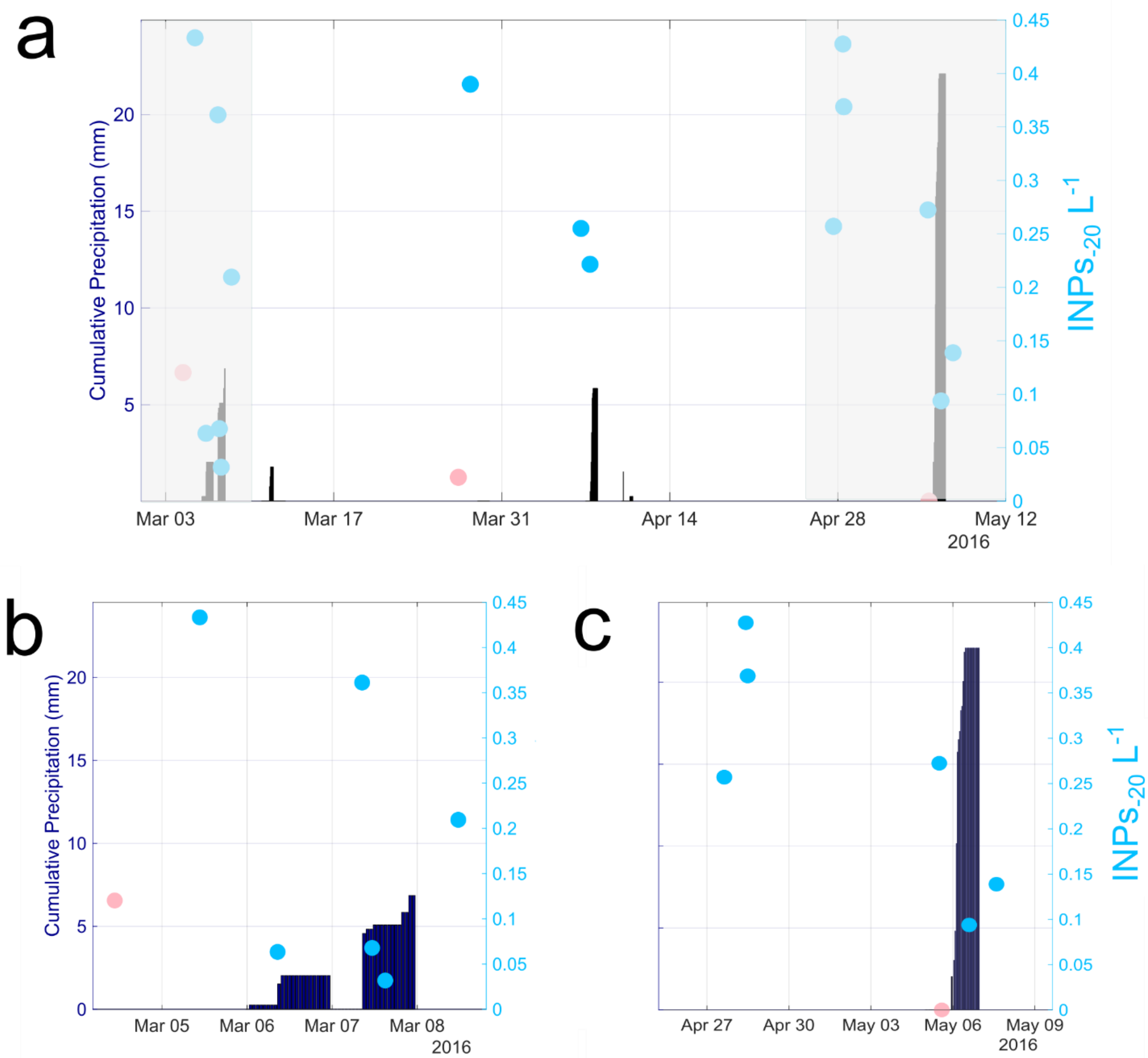


Figure S6



a
b
c
Cumulative Precipitation (mm)
INPs-20 L-1
0
5
10
15
20
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
Mar 03
Mar 17
Mar 31
Apr 14
Apr 28
May 12
2016
Mar 05
Mar 06
Mar 07
Mar 08
2016
Apr 27
Apr 30
May 03
May 06
May 09
2016

Figure S7

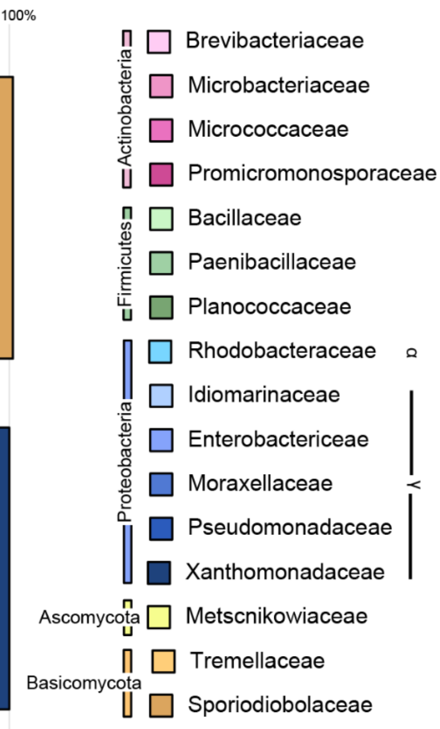
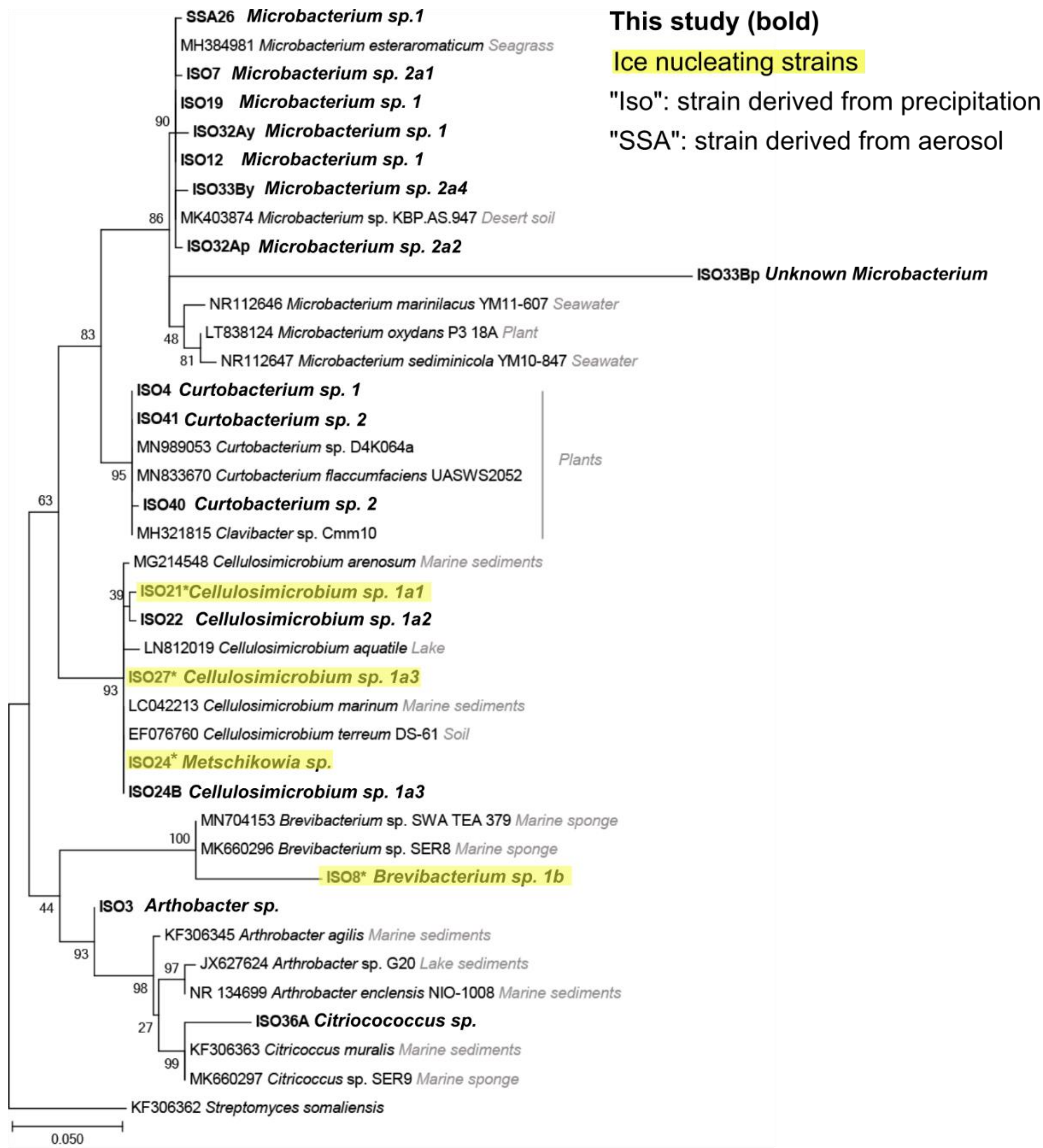
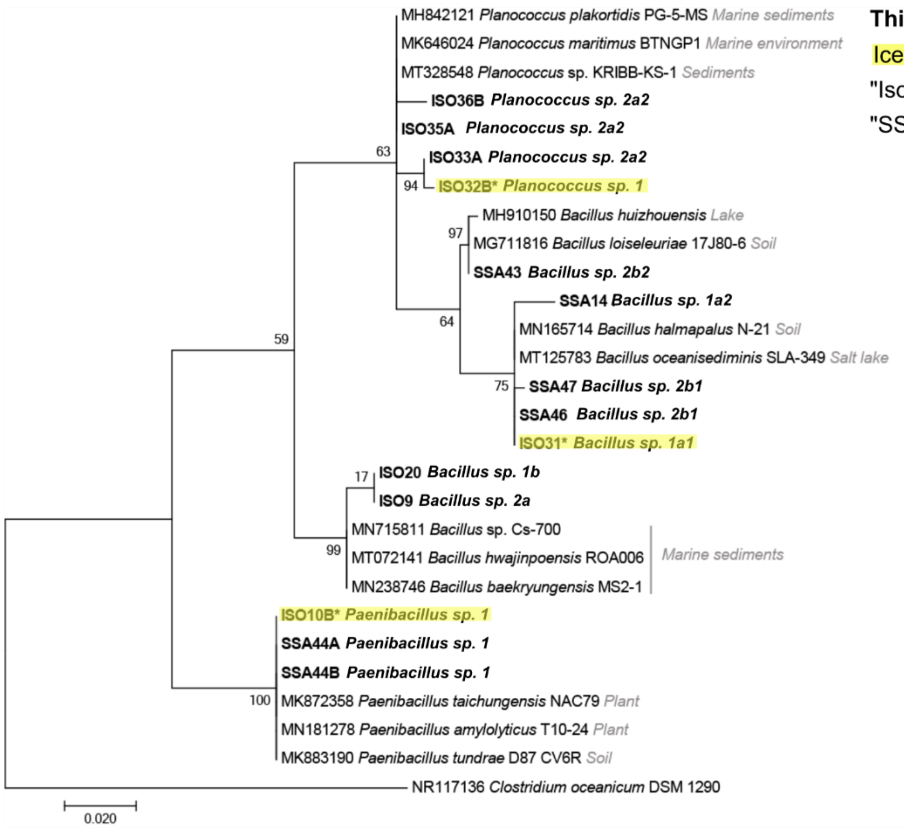

0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
a
b
Actinobacteria
Firmicutes
Proteobacteria
Ascomycota
Basicomycota
Brevibacteriaceae
Microbacteriaceae
Micrococcaceae
Promicromonosporaceae
Bacillaceae
Paenibacillaceae
Planococcaceae
Rhodobacteraceae
Idiomarinaceae
Enterobactericeae
Moraxellaceae
Pseudomonadaceae
Xanthomonadaceae
Metscnikowiaceae
Tremellaceae
Sporiodiobolaceae
α
γ

Figure S8



This study (bold)
Ice nucleating strains
"Iso": strain derived from precipitation
"SSA": strain derived from aerosol
SSA26 Microbacterium sp.1
MH384981 Microbacterium esteraromaticum Seagrass
ISO7 Microbacterium sp. 2a1
ISO19 Microbacterium sp. 1
ISO32Ay Microbacterium sp. 1
ISO12 Microbacterium sp. 1
ISO33By Microbacterium sp. 2a4
MK403874 Microbacterium sp. KBP.AS.947 Desert soil
ISO32Ap Microbacterium sp. 2a2
ISO33Bp Unknown Microbacterium
NR112646 Microbacterium marinilacus YM11-607 Seawater
LT838124 Microbacterium oxydans P3 18A Plant
NR112647 Microbacterium sediminicola YM10-847 Seawater
ISO4 Curtobacterium sp. 1
ISO41 Curtobacterium sp. 2
MN989053 Curtobacterium sp. D4K064a
MN833670 Curtobacterium flaccumfaciens UASWS2052
ISO40 Curtobacterium sp. 2
MH321815 Clavibacter sp. Cmm10
Plants
MG214548 Cellulosimicrobium arenosum Marine sediments
ISO21*Cellulosimicrobium sp. 1a1
ISO22 Cellulosimicrobium sp. 1a2
LN812019 Cellulosimicrobium aquatile Lake
ISO27* Cellulosimicrobium sp. 1a3
LC042213 Cellulosimicrobium marinum Marine sediments
EF076760 Cellulosimicrobium terreum DS-61 Soil
ISO24* Metschikowia sp.
ISO24B Cellulosimicrobium sp. 1a3
MN704153 Brevibacterium sp. SWA TEA 379 Marine sponge
MK660296 Brevibacterium sp. SER8 Marine sponge
ISO8* Brevibacterium sp. 1b
ISO3 Arthobacter sp.
KF306345 Arthrobacter agilis Marine sediments
JX627624 Arthrobacter sp. G20 Lake sediments
NR 134699 Arthrobacter enclensis NIO-1008 Marine sediments
ISO36A Citriocococcus sp.
KF306363 Citricoccus muralis Marine sediments
MK660297 Citricoccus sp. SER9 Marine sponge
KF306362 Streptomyces somaliensis
90
86
83
48
81
95
63
39
93
100
44
93
97
98
27
99
0.050

Figure S9



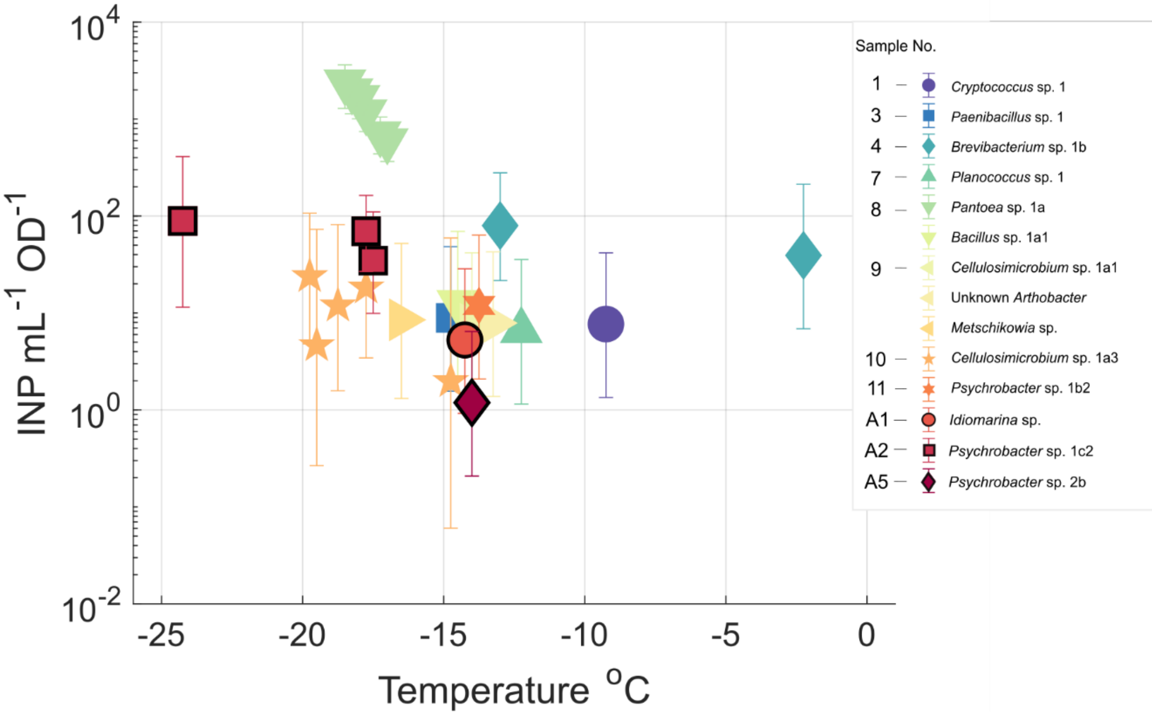
This study (bold)

Ice nucleating strains

"Iso": strain derived from precipitation

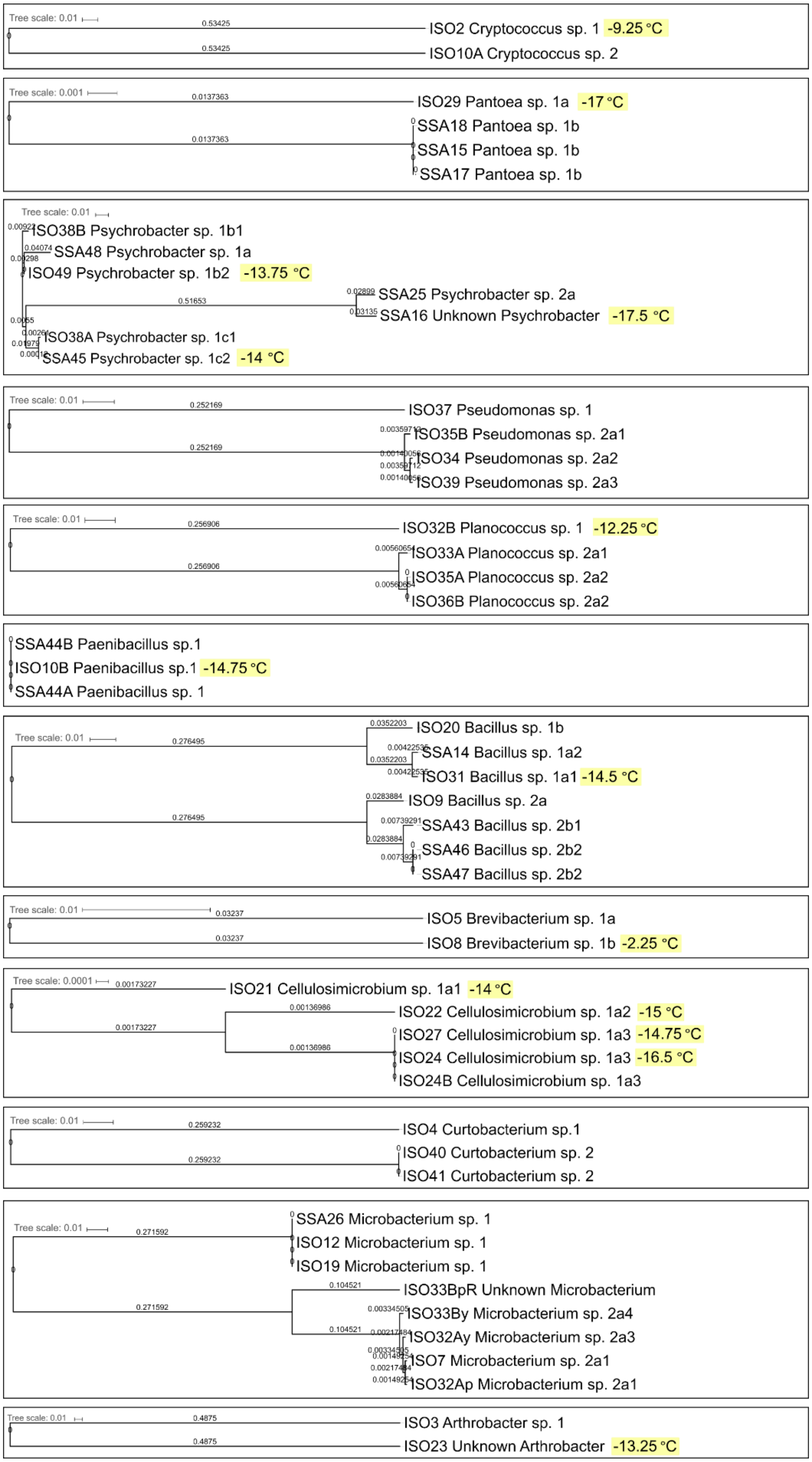
"SSA": strain derived from aerosol

Figure S10



INP mL^{-1} OD^{-1}
10^4
10^2
10^0
10^{-2}
-25
-20
-15
-10
-5
0
Temperature ^{o}C
Sample No.
1 — Cryptococcus sp. 1
3 — Paenibacillus sp. 1
4 — Brevibacterium sp. 1b
7 — Planococcus sp. 1
8 — Pantoea sp. 1a
Bacillus sp. 1a1
9 — Cellulosimicrobium sp. 1a1
Unknown Arthobacter
Metschikowia sp.
10 — Cellulosimicrobium sp. 1a3
11 — Psychrobacter sp. 1b2
A1 — Idiomarina sp.
A2 — Psychrobacter sp. 1c2
A5 — Psychrobacter sp. 2b

Figure S11


ISO2 Cryptococcus sp. 1 -9.25 °C
ISO10A Cryptococcus sp. 2
ISO29 Pantoea sp. 1a -17 °C
SSA18 Pantoea sp. 1b
SSA15 Pantoea sp. 1b
SSA17 Pantoea sp. 1b
ISO38B Psychrobacter sp. 1b1
SSA48 Psychrobacter sp. 1a
ISO49 Psychrobacter sp. 1b2 -13.75 °C
SSA25 Psychrobacter sp. 2a
SSA16 Unknown Psychrobacter -17.5 °C
ISO38A Psychrobacter sp. 1c1
SSA45 Psychrobacter sp. 1c2 -14 °C
ISO37 Pseudomonas sp. 1
ISO35B Pseudomonas sp. 2a1
ISO34 Pseudomonas sp. 2a2
ISO39 Pseudomonas sp. 2a3
ISO32B Planococcus sp. 1 -12.25 °C
ISO33A Planococcus sp. 2a1
ISO35A Planococcus sp. 2a2
ISO36B Planococcus sp. 2a2
SSA44B Paenibacillus sp.1
ISO10B Paenibacillus sp.1 -14.75 °C
SSA44A Paenibacillus sp. 1
ISO20 Bacillus sp. 1b
SSA14 Bacillus sp. 1a2
ISO31 Bacillus sp. 1a1 -14.5 °C
ISO9 Bacillus sp. 2a
SSA43 Bacillus sp. 2b1
SSA46 Bacillus sp. 2b2
SSA47 Bacillus sp. 2b2
ISO5 Brevibacterium sp. 1a
ISO8 Brevibacterium sp. 1b -2.25 °C
ISO21 Cellulosimicrobium sp. 1a1 -14 °C
ISO22 Cellulosimicrobium sp. 1a2 -15 °C
ISO27 Cellulosimicrobium sp. 1a3 -14.75 °C
ISO24 Cellulosimicrobium sp. 1a3 -16.5 °C
ISO24B Cellulosimicrobium sp. 1a3
ISO4 Curtobacterium sp.1
ISO40 Curtobacterium sp. 2
ISO41 Curtobacterium sp. 2
SSA26 Microbacterium sp. 1
ISO12 Microbacterium sp. 1
ISO19 Microbacterium sp. 1
ISO33BpR Unknown Microbacterium
ISO33By Microbacterium sp. 2a4
ISO32Ay Microbacterium sp. 2a3
ISO7 Microbacterium sp. 2a1
ISO32Ap Microbacterium sp. 2a1
ISO3 Arthrobacter sp. 1
ISO23 Unknown Arthrobacter -13.25 °C