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Ice-nucleating particles in Canadian Arctic sea-surface microlayer and bulk seawater

Victoria E. Irish et al.

Correspondence to: Allan Bertram (bertram@chem.ubc.ca)

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Supplemental Information

S1 Corrections for freezing temperature depression

The water activity of the sample was calculated from the salinity of the sample and using the online Extended AIM Aerosol Thermodynamics Model (http://www.aim.env.uea.ac.uk/aim/aim.php; Friese and Ebel, (2010); Wexler and Clegg, (2002)). Then the water activity of a salt solution in equilibrium with ice at the median freezing temperature of the sample was determined. From the difference of these two water activities, the freezing temperature in the absence of salts was calculated. For further details see Fig. 1 in Koop and Zobrist (2009).

Station	Photos	Notes	Station	Photos	Notes
2		Behind iceberg and sheltered from wind. Sunny day, relatively flat sea surface. Macroalgae spotted approx. 75m away from sampling area. Wind speed: 4.6 m/s.	7		A little wavy, close to ice. Wind speed: 6.7 m/s.
4		Very flat, calm, glassy looking open water. No icebergs in sight. Wind speed: 1.4 m/s. Slick	8		Approx. 200m away from ice island. Partly cloudy. Calm and glassy sea surface. Wind speed: 0.7 m/s. Slick
5		Wavy, open water. Foggy. Wind speed: 3.1 m/s.	9		Overcast and raining. ~15m away from ice with brown material (possible animal faeces). Flat, calm and glassy sea surface. Wind speed: 2.4 m/s.
6		Uniform sea surface, near ice. Overcast. Wind speed: 2.4 m/s.	10		Glassy sea surface. Macroalgae floating approximately 5 m away. Partly sunny. Wind speed: 4.6 m/s. Slick

Table S1 - Conditions at sampling stations.

Chemical and physical properties	**T_{50}-value**		
	R	**p**	**n**
Dimethylsulphide concentration	-0.4	0.167	8
Bacterial abundance	-0.2	0.319	6
Phytoplankton abundance	-0.3	0.268	6
Temperature	0.2	0.313	8
pH	-0.2	0.293	8
Salinity	**-0.8**	**0.006**	**8**

Table S2 - Correlation analyses between chemical or physical properties of bulk seawater and T_{50}-values for the bulk seawater samples. Numbers in bold represent correlations that are statistically significant ($p < 0.05$).

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Biological variable	Microlayer T_{10}-value			Bulk seawater T_{10}-value		
	R	**p**	**n**	**R**	**p**	**n**
Phytoplankton abundance	-0.7	0.058	6	-0.5	0.138	6
Bacterial abundance	-0.7	0.071	6	-0.4	0.189	6

Table S3 - Correlation analysis between phytoplankton and bacterial abundance in the microlayer and bulk seawater and T_{10}-values for the microlayer and bulk seawater.

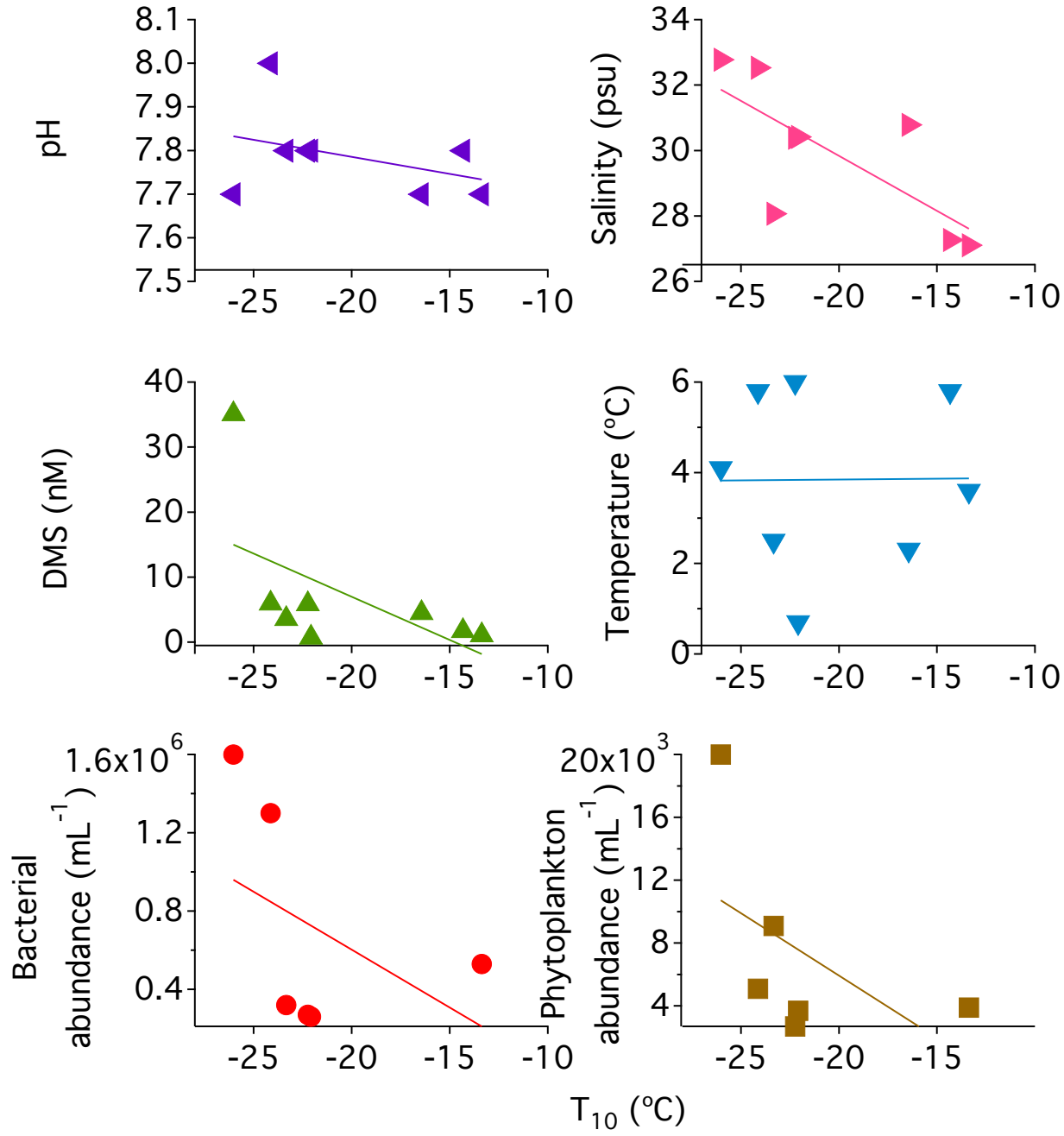

Figure S1 - Correlation plots between chemical and physical properties, and T_{10}-values in the bulk seawater. R and p values can be found in Table 2 in the main text.

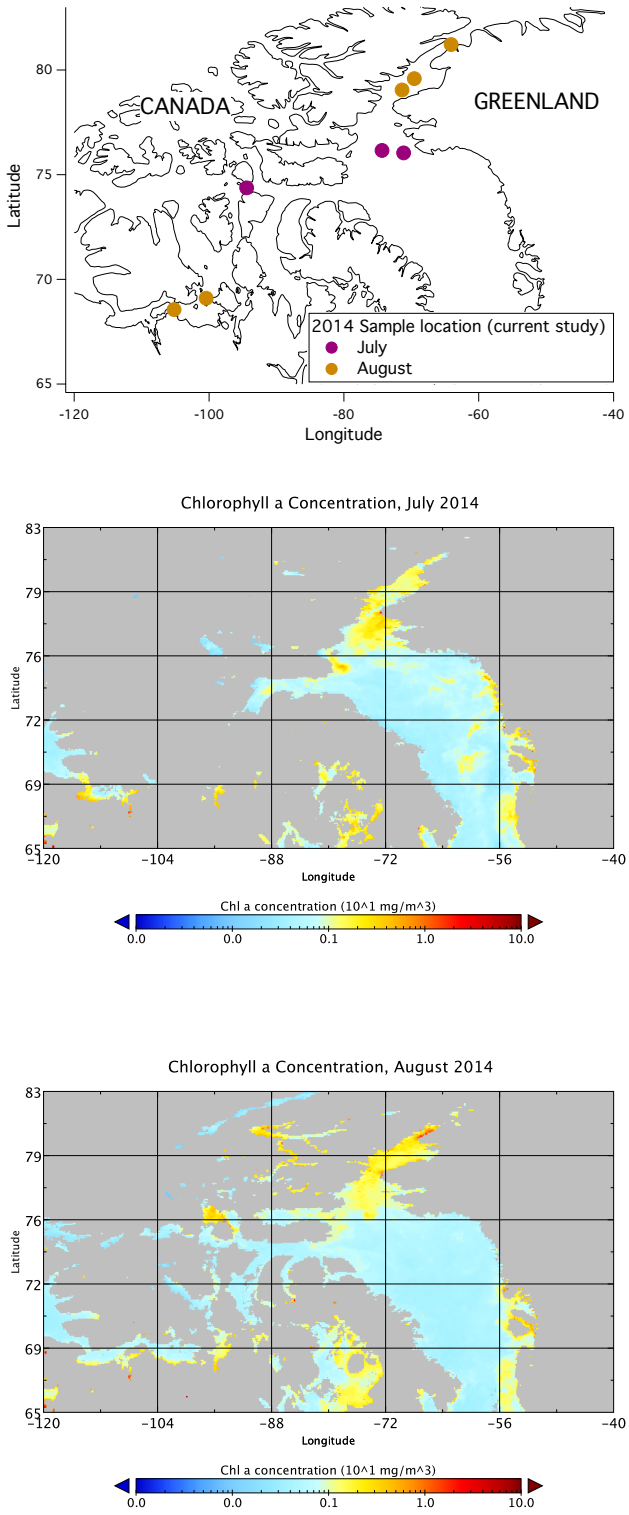

Figure S2 - Sample locations and monthly average chlorophyll *a* concentrations for sampling during the current study. Chlorophyll *a* concentrations were obtained from the NASA Ocean Biology Distributed Active Archive Centre (OB.DAAC).

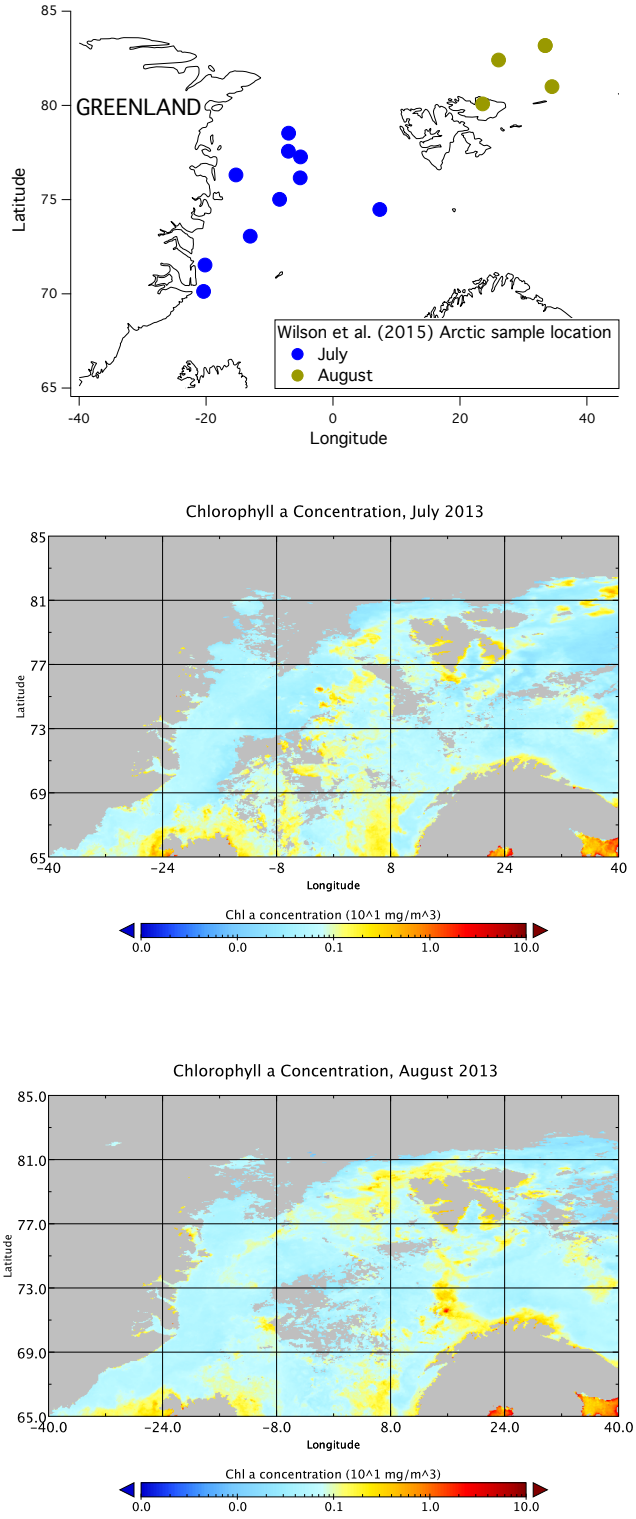

Figure S3 - Sample locations and monthly average chlorophyll *a* concentrations for sampling during the Wilson et al. (2015) study in the Arctic. Chlorophyll *a* concentrations were obtained from the NASA Ocean Biology Distributed Active Archive Centre (OB.DAAC).

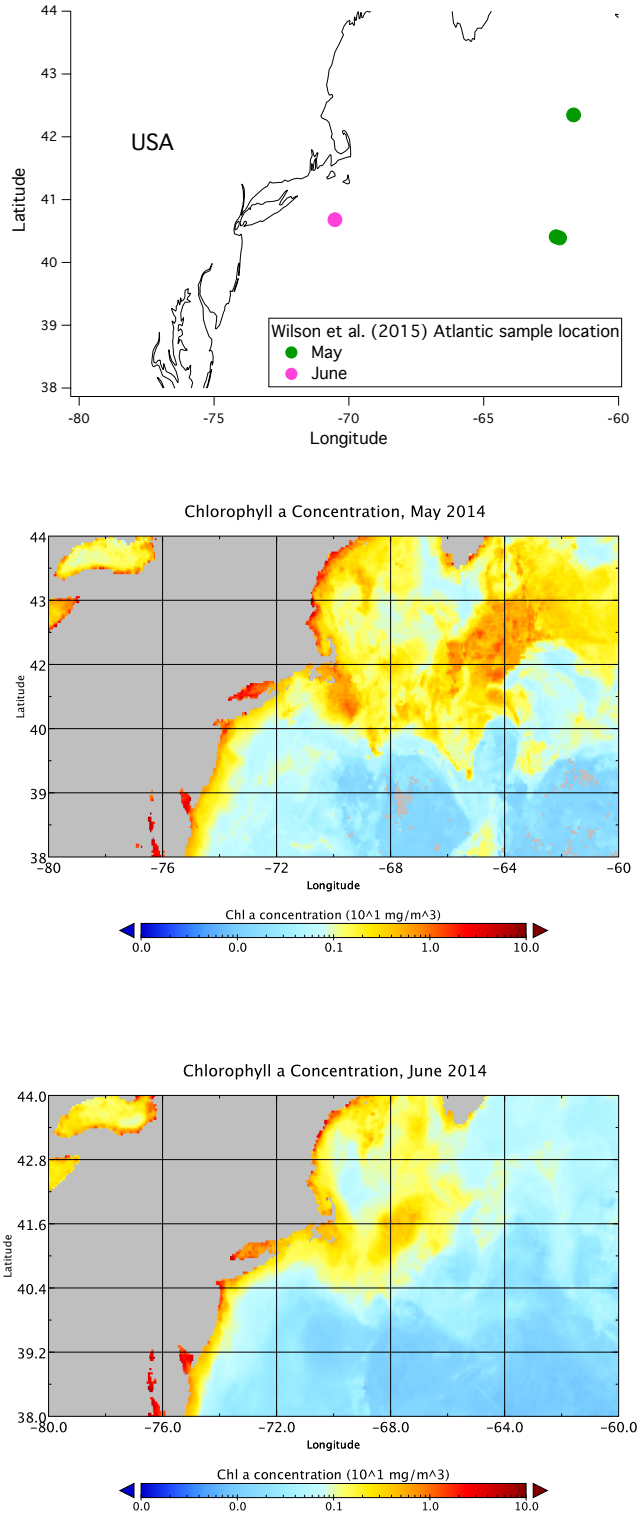

Figure S4 - Sample locations and monthly average chlorophyll *a* concentrations for sampling during the Wilson et al. (2015) study in the Atlantic. Chlorophyll *a* concentrations were obtained from the NASA Ocean Biology Distributed Active Archive Centre (OB.DAAC).

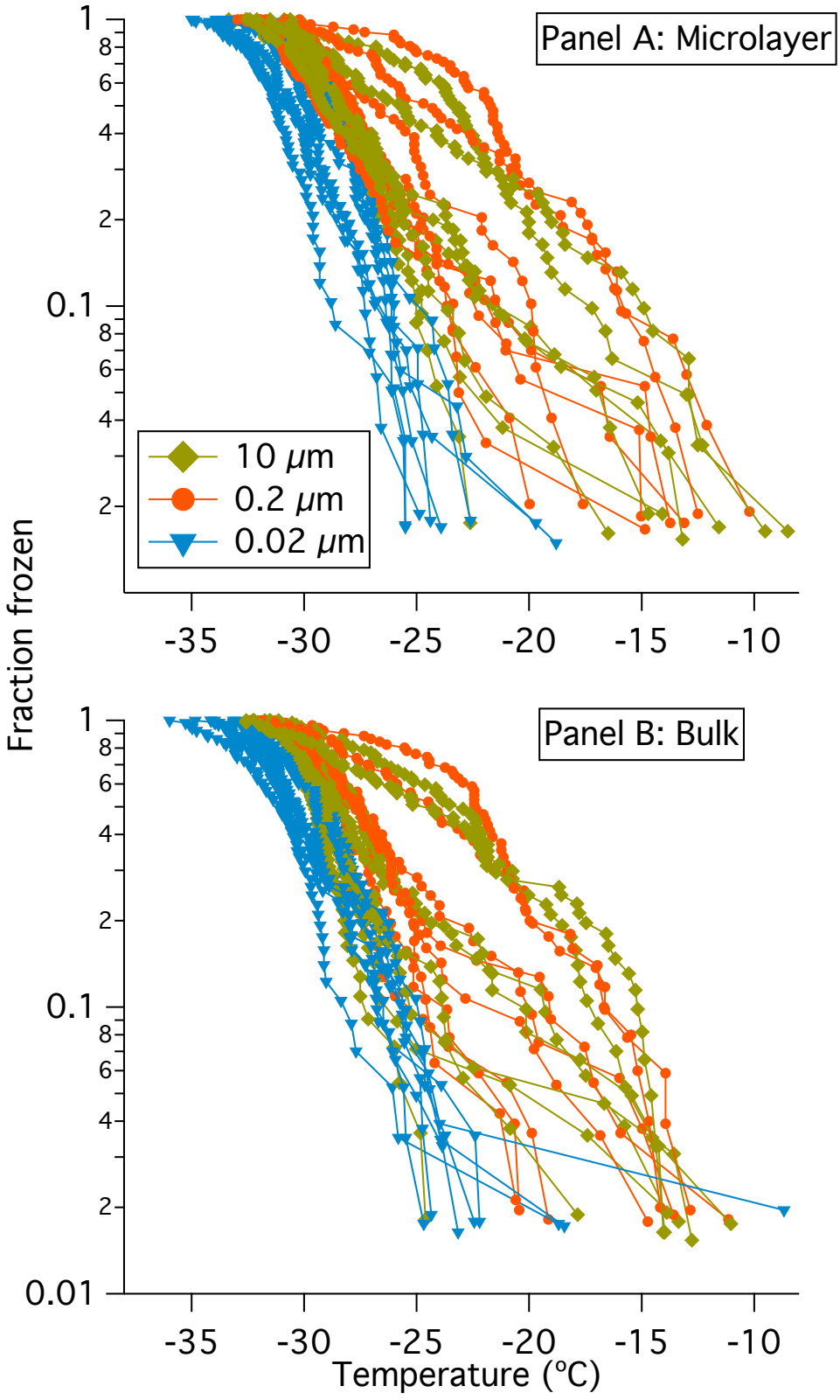

Figure S5 - Plots of the fraction of droplets frozen (in the immersion mode) versus temperature for samples filtered with 10 µm, 0.2 µm and 0.02 µm filters. Panel A and Panel B correspond to the microlayer and bulk seawater, respectively. Each set of line and markers represents results for 3 repeat experiments of each sample or "blank", adding up to a total of between 45 to 60 freezing events in each set. All microlayer and bulk seawater freezing points have been corrected for freezing point depression to account for dissolved salts in seawater (Section 2.2.4). The uncertainty in temperature is not shown but is ± 0.3 °C.

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