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Glucose may serve as a potential chemical marker for ice nucleating activity in Arctic seawater samples

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The sea surface microlayer (SML) is the uppermost layer of the oceanic water column. As the direct interface between the ocean and the atmosphere, it may serve as an important source of organic substances in marine aerosol particles and of effective ice nucleating particles (INP) for the formation of ice crystals in clouds. As the most abundant free monosaccharide, dissolved free glucose was quantified in Arctic SML and bulk water samples by applying high performance anionic exchange chromatography (HPAEC) with prior desalination via electrodialysis. A positive correlation could be observed between the concentration of free glucose and the ice nucleating (IN) activity in several Arctic water samples collected in the ice-free ocean, in open leads within the ice pack, in the marginal ice zone, and in melt ponds. This finding supports the assumption that the IN activity in Arctic seawater is strongly coupled to microbiological processes. Clustering water samples using hierarchical cluster analysis with the phytoplankton pigment composition as input data showed very strong correlations between the free glucose concentration and IN activity within the individual clusters. This indicates that the correlation between the IN activity and free glucose is linked to the specific composition and the physiological state of a phytoplankton community. Since free glucose did not show significant potential to nucleate ice itself, we propose that free glucose may serve as an “easy-to-measure” tracer for IN activity in Arctic water samples.

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