



Can marine microorganisms influence the melting of the arctic pack ice?

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There is no place on earth where the climate change faster than it does in the Arctic with an observed warming about twice the global average during the past two decades causing enhanced melting of snow and sea-ice. The melting of the sea-ice will not only have dramatic consequences for society but also strongly influence the feedback mechanisms between the ocean, sea-ice, clouds and radiation and not least marine ecosystems. So, can marine microorganisms influence the melting of the Arctic pack ice?

The answer is contending with many unknown factors. For example, will biological activity and production of cloud condensation nuclei (CCN) necessary for cloud formation increase or decrease with melting of the pack ice, and will resultant changes in warmer oceans oppose or reinforce the Arctic changes?

One proposed biological influence on radiation suggests that dimethyl sulfide (DMS) produced by marine phytoplankton is oxidized in the atmosphere to sulfuric acid, aiding the nucleating of particles that grow to become CCN. Sulfate-containing aerosols are ubiquitous in the atmosphere and usually the most numerous particles capable of acting as CCN, so that the theory seems very reasonable. But does DMS alone control the number of CCN? Could there be other biological controls on CCN in remote marine air? To help answering these questions three Arctic Ocean summer Experiments to the area north of 80°N in 1991, 1996 and 2001 on the Swedish icebreaker *Oden* were launched.

The observations have presented us with a new picture of the evolution of the remote Arctic aerosol. DMS will determine the mass of sulfate produced but will have only a minor influence on the number of CCN and thus cloud droplets, which will be dictated by the number of airborne particles originating in the surface microlayer of the open

leads. This invalidates the DMS hypothesis and poses a stronger possible link between marine biology, cloud properties and climate than is provided by DMS alone.