THE ATMOSPHERIC RESERVOIR
Examining the Atmosphere and Atmospheric Resource Management

Seeding Clouds in the Arctic

By Mark D. Schneider

Blue-green algae blooms in several of North Dakota's lakes made unwelcome headlines last summer. A different type of bloom that involves phytoplankton is being studied for its potential to seed clouds above the Arctic Ocean. Scientists from eight universities and institutions published research in July of last year explaining how microorganisms might become ice nucleating particles (INPs) that influence cloud and precipitation formation. Clouds are especially important to the Arctic region's energy balance and one of the keys to understanding why Arctic temperatures have increased twice as quickly as the rest of our planet. Warmer conditions in the Arctic Ocean create an ice-albedo feedback where more land is uncovered due to melting ice and this land warms by absorbing more sunlight.

Depending on their height and thickness, clouds influence how much of the sun's energy reaches the land or ocean surface, how much energy is absorbed before reaching the surface, and the amount of energy that's "trapped" in the Earth's atmosphere. Arctic clouds can be mixed-phase, meaning that they consist of both water droplets and ice crystals. When water droplets are supercooled (at temperatures below 0°C but still in liquid form) marine bio-INPs can freeze these droplets at temperatures of -3°C, when ice would ordinarily form closer to -15°C from terrestrial INPs.

Last summer's research focused on how INPs from a phytoplankton bloom in the Bering and Chukchi Seas could be transported into the lower Arctic atmosphere. This transportation process involves a combination of both ocean currents and atmospheric winds. Findings of the research included measuring significant concentrations of INPs at 20 meters above the ocean's surface. For this to occur, bacteria from under the ocean's surface needed to not only reach the water's surface, but also become lofted into the air by wind. This initial observation could lead to additional research that more precisely measures the amount of bacteria and its locations within the Arctic region.

Photo courtesy of Dr. Jennifer Graham, USGS.

When the air temperature falls below 0°C or 32°F here in North Dakota, we're typically thinking about snow instead of supercooled liquid water (SLW) droplets. However, clouds containing SLW are increasingly important for determining both rain and snow precipitation formation and identifying hazardous areas of aircraft icing. On a hot summer afternoon, SLW droplets are suspended inside the towering cumulus clouds of developing thunderstorms. Here, through cloud seeding, we induce freezing of SLW through the use of silver iodide or dry ice, starting the ice formation process at warmer temperatures, earlier in the cloud's lifecycle.

As we now better understand, INPs from naturally occurring sources may play an important role in precipitation processes; both in warm and cold seasons. With further research and exploration, we will continue to uncover many more secrets of our atmosphere.

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