## CURRENT TEXAS WEATHER MODIFICATION PERMITS

**December 2019**

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- **R-E** Rain enhancement only using cloud-seeding techniques and materials
- **H-S** Hail suppression and rain enhancement using cloud-seeding techniques and materials
- **H-S** Hail suppression *only* using hail-cannons

## CURRENT TEXAS WEATHER MODIFICATION LICENSES

All licenses valid until September 1, 2020

- Belding Farms Inc. (Fort Stockton)
- Panhandle Groundwater Conservation District (White Deer)
- Seeding Operations & Atmospheric Research (Plains)
- South Texas Weather Modification Association (Pleasanton)
- Trans Pecos Weather Modification Association (Pecos)
- West Texas Weather Modification Association (San Angelo)
Caprock Chronicles: West Texas rainmaking and hail suppression

By Dr. Richard Peterson
Posted Oct 12, 2019 at 12:04 AM

Caprock Chronicles is edited by Jack Becker a librarian at Texas Tech University Libraries. This week’s article is by Dr. Richard Peterson, professor emeritus, Geoscience Department. This is his second article on the Caprock’s often unpredictable weather.

Folks in West Texas are accustomed to unusual and variable weather, and most certainly-rain and hail. There is a long history of attempts to improve the precipitation situation, especially to the benefit of agriculture. Over time, there have been two approaches to affecting the clouds: disruption by concussion and injection of minute particles in the cloud to alter their precipitation growth.

For the most part these initiatives have been private and peaceful in nature. At times, however, the human reaction to these efforts has turned violent and the Federal Government stepped in to restore order.

Beyond imploring the gods to bring rain or dissipate storms before they dropped hail, human efforts go back to the Middle Ages in Europe. Northern Italy for example is prone to damaging hail across the fertile Po river agricultural area. When clouds grew to frightening proportions church bells were rung. It was believed that the sound vibrations could break up the storm organization before hail could form.

During the Napoleonic wars in the early nineteenth century, observers noted an apparent development of rain after a battle; similar anecdotes accompanied clashes during the US Civil War. In 1871 a former Union general, Ed Powers, published a book, “War and the Weather: The Artificial Production of Rain. The main idea was that the rain was spawned by the disruption of the atmosphere by battlefield explosions.
A retired Union officer, Robert G. Dyrenforth, inspired by Powers’ book, conducted rainmaking experiments funded by the Federal Government. The trials were conducted during August 1893 in Gaines County, Texas using dynamite, kites and balloons. Success in generating rain was claimed but amounts were scant.

Over a period of several decades other rainmakers worked on the High Plains, going from one community to another. Even the railroads promoted the rainmaking business. Between 1910 and 1914, under the sponsorship of the Post cereal company, attempts to enhance rain were carried out in Garza County near the town of Post. Four-pound dynamite charges were detonated every four minutes over a period of several hours. The results however, were inconclusive.

In the 1800s, ideas came forth about the growth of droplets and the formation of hail. The notion that dust or smoke particles could have a role in the formation of precipitation led to experimentation. Finally, it was recognized that while miniscule droplets could grow to a size large enough to fall, most precipitation in the middle latitudes of the United States, even in summer, started off as ice. Silver iodide particles were found to be the most effective way to seed clouds.

Cloud seeding mostly involves dispersing particles into growing clouds to stimulate the growth of ice particles. These particles attract moisture from the air and grow larger. Eventually becoming sufficiently large enough to overcome rising currents in the cloud. As they fall, they melt and fall as rain.

This “cold-rain” mechanism occurs in non-seeded clouds as well. On occasion the cloud environment can be so rich in available moisture that the falling ice particles grow very large. In this case, melting at lower levels may be incomplete, resulting in hail.

Scientist experimented with hail suppression by adding an abundance of artificial particles into growing cloud so that the competition for available moisture would result in none becoming too large as they fall.

In the early 1970s weather modification was attempted in Hale and Lamb Counties with the suppression of large hail as its objective. In 1970 farmers organized to sponsor a project to reduce large hail by cloud seeding. Three years later a similar program began in Hockley County. The project got underway in 1974 and continued through 1976.
Portions of Castro, Swisher, Hockley, Floyd, Lubbock, Parmer and Lamb counties were included in the operations. Each year hearings were held at one of the county seats. But resistance developed among farmers as it was believed the cloud seeding yielded particles so small that the resulting rain evaporated.

With each successive year, the frustration among the farmers mounted. With this came claims that cloud-seeding aircraft were being shot at. Eventually there were threats of destroying the radars used to monitor the storms and direct the aircraft, as well as concerns that the runways would be plowed up.

Ultimately the FBI was called in to investigate. The State set up a referendum; the result of the vote was to curtail the seeding operations along with a multiyear field study on hail suppression (NHRE) conducted by the National Center for Atmospheric Research.

Later research concluded that thunderstorms capable of yielding hail are so inefficient at processing the inflow of moist air that seeding might make them more prolific hail producers.
Capital Weather Gang

Bacteria from the ocean floor could be influencing Arctic weather

There’s more to clouds than you might think.

By Maddie Stone
November 15

Scientists have identified a surprising new mechanism that could be affecting cloud formation and weather patterns in the Arctic: bacteria from the ocean floor.

When tiny, plantlike ocean microbes known as phytoplankton die, their bodies sink to the bottom of the sea, becoming food for bacteria residing there. New observations made in the Bering and Chukchi seas off the coast of Alaska suggest that under the right conditions, these algae eaters are sloshed to the surface and from there are wafted into the air.

Once airborne, seafloor bacteria may become seeds that promote the growth of ice crystals, an important step in the formation of Arctic clouds.

“Clouds are super important in the Arctic,” said Jessie Creamean, an atmospheric scientist at Colorado State University and lead author of new research published in mid-July in Geophysical Research Letters.

“They regulate the surface and atmospheric temperatures, affecting sea ice, ecology, shipping, Arctic climate and weather. And we just have a really poor understanding of how they form,” Creamean said.

Prior research from the Southern Ocean as well as laboratory experiments suggest that ocean microbes can enhance cloud formation. To investigate whether that holds true in the Arctic, Creamean and several of her co-authors embarked on a NOAA-funded research cruise through the Bering and southern Chukchi seas from late August to mid-September 2017. Over the course of several weeks, the researchers collected samples of seawater and aerosols suspended about 20 meters (66 feet) above the ship.
They measured the abundance of what are known as ice-nucleating particles, which seed clouds. They also took stock of seawater chemistry and chlorophyll concentrations, an indicator of phytoplankton abundance.

At first, Creamean said, she simply was hoping to get a baseline sense of the distribution of cloud-seeding particles in the ocean and atmosphere. But on Aug. 29, as their ship passed through the Bering Strait, the researchers measured particularly high levels of them. Through a combination of DNA analysis and microbial culturing, they determined that the airborne particles were mostly bacteria.

The researchers knew there was a big late-summer phytoplankton bloom underway about 150 miles to the south, and that they were in a region where phytoplankton that are transported north via currents tend to die, sink and become food for hungry bacteria.

After examining a number of oceanographic measurements and running their data through computer models, the researchers concluded that powerful winds associated with recent storm activity had stirred up the ocean, bringing some of these bacterial grazers to the surface, where they could be kicked up into the air.

The study doesn’t demonstrate that bacteria are forming clouds — simply that they’re making it into the atmosphere. But Creamean believes it’s a distinct possibility that some oceanic bacteria are reaching high enough altitudes to play a role in cloud formation.

“In the Arctic, clouds can be very low — down to 100 meters,” she said. “It’s very possible these things can interact with clouds.”
This is hardly the first paper to suggest Earth’s smallest organisms may have an impact on the weather — in fact, research into bioprecipitation dates back to at least the 1980s. Over the years, studies have suggested that microbes and their debris can brighten clouds, supercharge snowstorms and help create some of the biggest hail events.

With the advent of new genomic tools, scientists are learning that there are entire microbial ecosystems wafting through the lower atmosphere and that some hardy bugs are even eking out a living in the stratosphere. It’s possible we’re just scratching the surface of their weather-making potential.

As far as Creamean’s new Arctic observations go, the regional weather in late August 2017 supports her explanation for the bacteria-spiked air, said Xiangdong Zhang, an atmospheric scientist at the International Arctic Research Center who wasn’t involved with the new study.

At that time, he said, there was a well-developed high-pressure system over the East Siberian Sea, complemented by a low-pressure system over Alaska.

“The short distance between these systems results in large pressure gradients and then large northerly and northeasterly winds to blow over the Chukchi Sea and the Bering Strait,” Zhang wrote in an email. “The large winds definitely increase ocean mixing and bring bottom materials to the surface.”

It’s still early days for this research. But if ocean microbes do play a role in Arctic cloud formation, Creamean wonders how climate change could impact it.
Longer ice-free periods and warmer ocean waters are favoring the proliferation of phytoplankton in many parts of the Arctic. At the same time, some research suggests the Arctic could become stormier as sea ice recedes, perhaps enhancing Creamean's seafloor-to-sky microbial pump.

Creamean is now collecting more data aboard the German icebreaker Polarstern as part of the year-long MOSAiC mission to the Arctic Ocean.

Given the rapid changes the Arctic is undergoing, it's more important than ever to tease out the complex interactions between biology, oceans, ice and the atmosphere, she said.

After all, what happens in the Arctic doesn't necessarily stay there.
Materials for Item E.2.b of the Dec. 12 tentative agenda:

Weather modification in the media


https://www.dailystar.co.uk/news/weird-news/china-filmed-using-weather-control-19768147