

The Emerging Industry of Cloud Seeding

Updated on January 18, 2018



[watergeek](#)
[more](#)

Susette has a Masters degree in Sustainable Development. She leads her local Green Council and writes for The Sustainable Business Review.

[Contact Author](#)

There is an unobtrusive industry growing in controversy that has powerful potential for environmental health and public well being world wide. This is the industry of cloud seeding - making it rain where it normally does not or at a time when it normally would not. Although humans have been affecting weather patterns for millenia with the way we've cut down forests and with uncontrolled growth of cities, this is the first time we know of that an actual industry has developed to change the weather directly.

Cloud seeding is widespread and growing, with some 150 ongoing projects counted worldwide in 2012 (according to the government of Australia). Unregulated, the industry could be inadvertently (or deliberately) destructive, but some dangers have already been experienced, and government and international agencies are watching carefully. Some restrictive legislation has already been passed. There are cases in US courts that will help define limits further. Careful testing on public health is already being carried out. It remains to be seen what more will be needed as this emerging industry grows.



The flare at the end of the wing is releasing silver iodide into the clouds to create rain.

What Is Cloud Seeding?

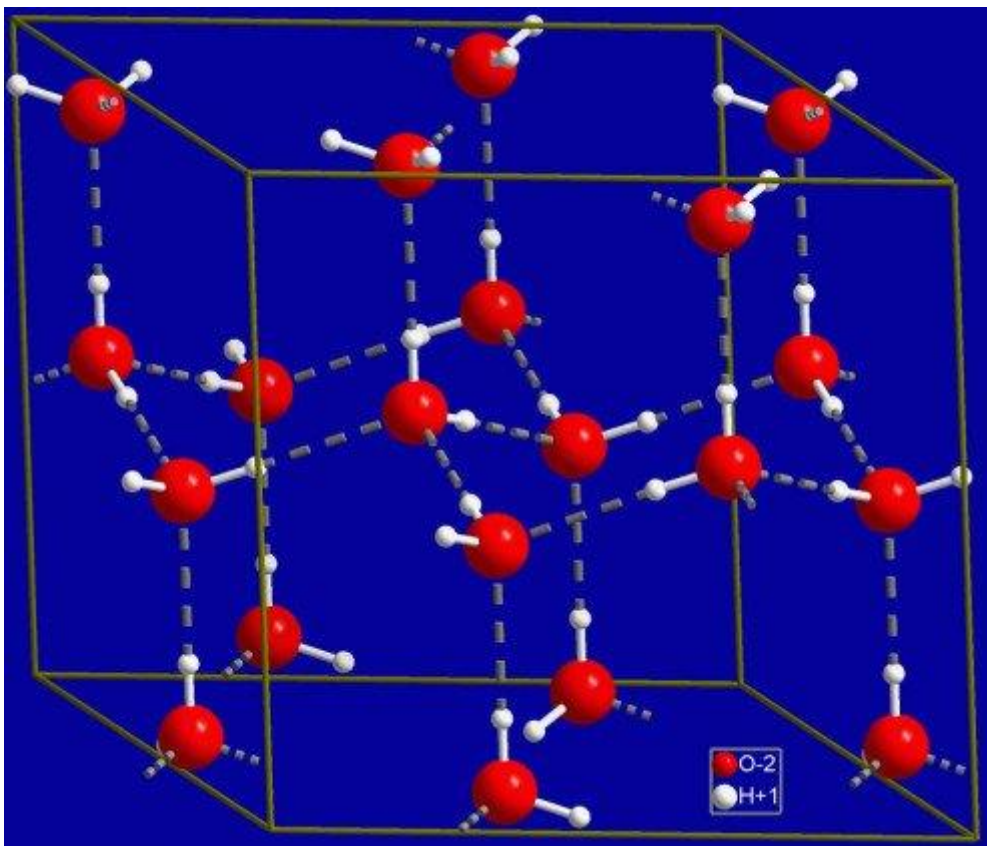
Cloud seeding is the process of throwing chemical agents into an already existing cloud mass that causes the cloud to thicken and/or water vapor to condense and fall as rain or snow. The chemicals can be thrown from the ground or the air. In the air they are known as chemtrails.

Some of the ways in which this technique is currently being used are:

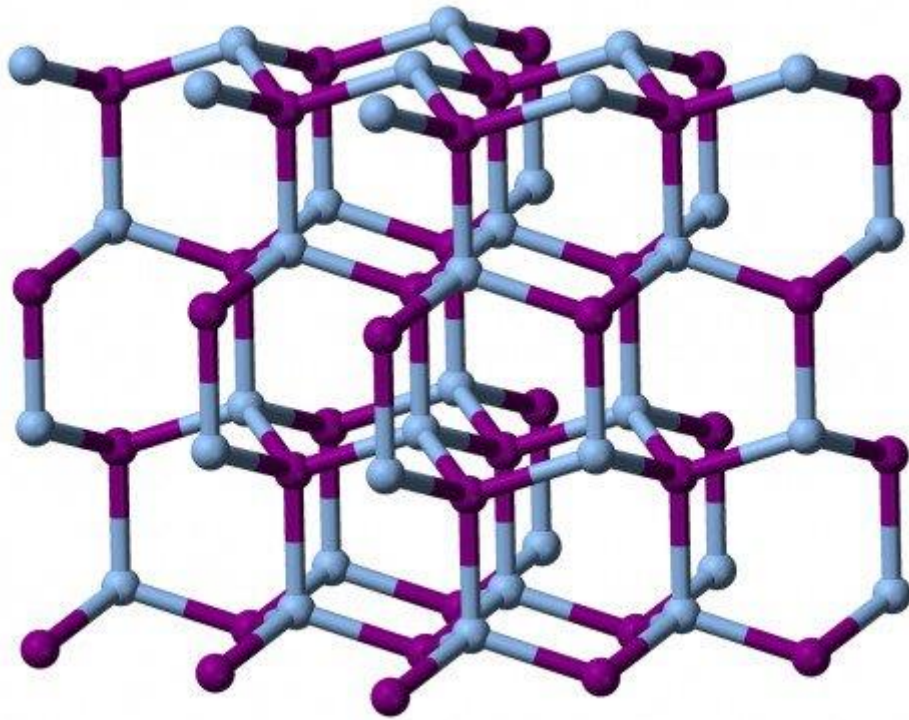
- To increase rainfall where it doesn't rain much.
- To clean or cool the air for outdoor events.
- To clear airports of fog.
- To add snowpack for skiing or water supply.
- To prevent hailstorms or reduce hurricanes by inducing rain early on.
- To reduce heat from the sun by increasing cloud mass.

Government bodies, utilities, and private companies all use cloud seeding for projects such as these. Agents commonly used are sodium iodide (underneath a cloud), dry ice (above a cloud), sea salt (in warmer climates), liquid propane (to reduce fog), and desiccated ice-nucleating bacteria.

Results vary. According to a recent [article](#) in the Denver Post, cloudseeding results in a 0-25% increase in precipitation, depending on cloud cover and how the seeding is carried out.



Molecular Matrix - Ice. Look beyond the dark blue background and notice the similarity of the ice matrix with the one below. | Source



Molecular Matrix - Silver Iodide. Its similar hexagonal shape gives this compound a similar ability to precipitate water vapor. | Source

Cloud Seeding Experiments

In 1946, researchers connected with the General Electric Research Laboratory in New York discovered the possibility for using both dry ice and silver iodide to trigger precipitation. In November of that year they tested in real time, causing snow to fall near Mount Greylock in Western Massachusetts.

In the 1960s, the United States Bureau of Reclamation and the National Oceanic & Atmospheric Administration (NOAA) agencies started supporting the development of further research. California was one of the country's early experimenters, starting in 1948, according to Wikipedia.

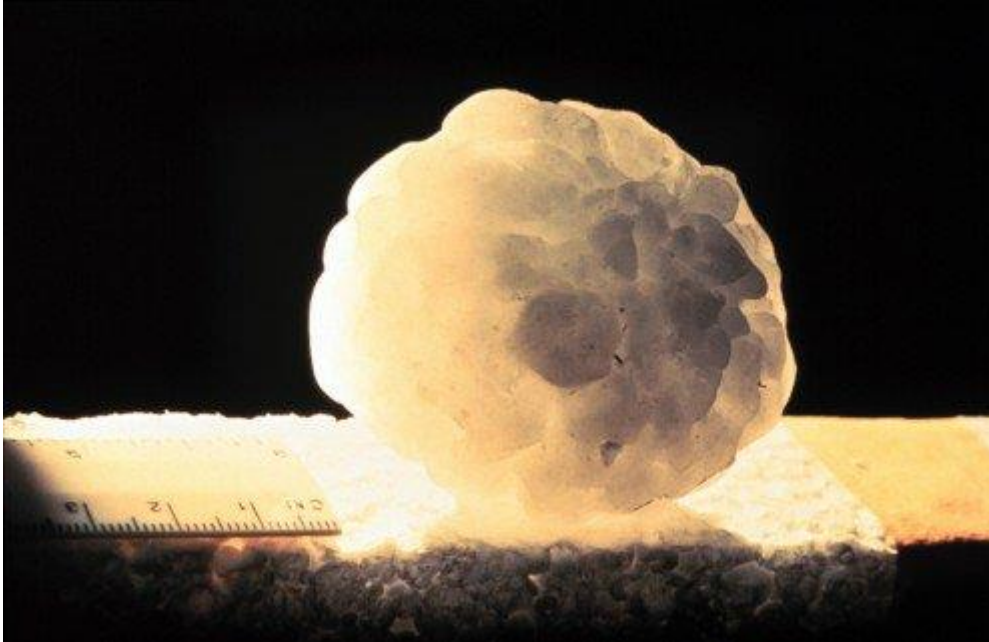
Later in that decade, the U.S. military used rain creation technology to gain an advantage over their enemies—flooding supply routes in VietNam. Weather manipulation for purposes of warfare was quickly banned by international treaty.

Although the military still experiments, it is heavily restricted to weather measurement and enhancement projects only. The U.S. Bureau of Reclamation carried out experiments in the U.S. and also in Thailand and Morocco until government funding declined in 2006.

Out of nearly 150 countries that have experimented with and are using cloud seeding on a regular basis there are Australia, Austria, Canada, China (the world's heaviest user), England, France, India, Jordan, Mali, Mexico, Niger, Russia, South Africa, Spain, the United Arab Emirates, the United States, and more. China spends over \$90 million per

year in cloud seeding projects, while the US spends \$15 million and growing. Other than the international ban against warfare use, all regulation of the industry is local.

Using Cloud Seeding for Hail Suppression



Hailstone - If left to its own, hailstorms don't precipitate until the temperature is freezing cold, creating large hailstones like this that destroy crops. | Source



Ice Pellets - Dry ice forces an impending hailstorm to precipitate as tiny ice pellets, instead of waiting until the ice clumps together to drop as hailstones. | Source

Companies That Seed Clouds

To give you an idea of what cloud seeding projects look like, here are some of the 14 U.S. companies that reported projects in 2011. These projects were registered with the National Oceanic & Atmospheric Administration (NOAA), which does weather tracking for the United States.

Franklin Soil & Water Conservation District - In the winter months of 2007 and 2011 this government entity seeded an area in Idaho, USA covering 184,000 square miles to encourage precipitation the following August.

North American Weather Consultants - In 2011 this company reported a total use of 96,047 grams of silver iodide to seed eight projects for local government agencies in Utah, Colorado, Idaho, and California. The projects lasted an average of 19 days each and covered a total area of 22,075 square miles. All projects but one were to increase snowfall. That one, in Santa Barbara County, CA was to increase winter rain. NAWC has over 60 years of experience in five continents worldwide.

Western Weather Consultants - This company carried out five projects in 2011, seeding a total of 10,000 acres in Colorado, all to increase snowfall. Two of those projects were for the Vail and Telluride ski resorts, the other three to enhance water supply for the SW Water Conservation District (2) and the Denver Water Department.

Weather Modification - This North Dakota company flies 35 planes that execute atmospheric research projects in 19 countries, including the U.S. In 2011 their six U.S. cloud seeding projects covered a distance of 13,495 square miles in Wyoming, California, and North Dakota. The company charges from \$500,000 to \$20 million for a cloud seeding operation.

Western Kansas Groundwater - This public company seeded a 6,766 square mile area in Kansas during the months of Apr-Sep, 2011 to prevent hailstorms and enhance groundwater supplies. It's an annual program that has gone on for almost 40 years in a particularly dry part of Kansas, and has been filled with controversy about its efficacy. The company used dry ice for the first several years as its seeding agent, then switched to silver iodide, and now uses both. Recently the state of Kansas cut its supplemental funding in half, at the same time that the cost of silver iodide increased dramatically, necessitating a decrease in services provided.

Cloud Seeding in Texas

Texas has been cloud seeding for around 50 years. In the video the announcer states that the silver iodide used in cloud seeding has been proven safe, which is not exactly true. There is no strong evidence that it causes harm yet, but testing continues. Meanwhile, there is speculation that cloud seeding exacerbates droughts by removing the "seed moisture" needed for the next batch (like making sourdough bread or kombucha tea).

Cloud Seeding Projects

Looking from a project point of view, here are several sample projects that show the value of cloud seeding to enhance the water cycle:

Desert Research Institute, based in Reno, Nevada runs a wintertime research program that is renowned worldwide. They were established in the 1970s, when they pioneered the development of modern generators and equipment. By 2009 they had 300 research projects operating on several continents, and had helped establish similar research institutes in 25 countries to study the effects of cloud seeding.

Metropolitan Water District of Southern California - This major water supplier has been financing water districts in Colorado for several years to increase snow pack in the Colorado Mountains. The end result has been an increase of water flowing down the Colorado River, from which Southern California draws 1/3 of its water supply. The project benefits MWD's customer water districts and neighboring states who also draw from the Colorado River, and who also contribute money to the project.

The Government of India - The government is experimenting with seeding clouds on the leeward (rain shadow) side of mountains during the monsoon season. As a cloud is blown across the land by wind, it is caught by cold mountains, where it drops some of its rain or snow. The rest is blown over the mountain to the leeward side, where it usually dissipates in the warmer air. The government is hiring aircraft with specialized instruments from South Africa and Israel to seed these clouds before they evaporate completely.

Government of China - China has the biggest ongoing cloud seeding program of any country in the world, spending about \$90 million per year to increase rainfall throughout the country for farmers, and clear the air of pollutants over major cities. In 2007 they started "selling clouds" to private companies holding outdoor events, who wanted to seed for fresh air. In 2012 the government developed plans to expand the program yet further to seed drought-ridden areas across the Qilian and Tian Shan Mountains.



Cloud Seeding Plans - China is preparing to seed in the beautiful Tian Shan Mountains to increase snow pack. | Source

Chemtrail Suppliers & Service Providers

In addition to governments and their contractors, there are numerous private companies supporting the industry. These include raw materials and equipment suppliers, service providers like mechanics and meteorologists, researchers like universities and government agencies, and financiers who pay for experimental runs. Here are some examples of supporting companies.

Seeding Media - The most common seeding medium used is silver iodide, often mixed with indium trioxide. Other media used, depending on weather conditions, are liquid and frozen carbon dioxide (dry ice), liquid propane, and sea salt. Sulfur hexafluoride is often used as a tracer ahead of time to determine in what direction and how fast the air might be moving.

Larger cloud seeders purchase raw materials in powder form directly from leading chemical companies, like Deepwater Chemicals, to assemble themselves. Others purchase already assembled and packaged media from the larger seeders.

Applicators - Applicators come in the form of hollow metal attachments to the wings of aircraft, ground-based generators that shoot media upward, or canisters that shoot liquid through a ground vehicle or aircraft's exhaust. Ice Crystal Engineering is one company that makes flares (applicators) for aerial application of silver iodide. (Silver iodide needs to be burned in order to stabilize its structure for cloud seeding.)

Aircraft - In India the private company Agni Aero Sports Adventure Academy manufactures microlight aircraft, trains pilots, and operates a rain creation program. In the United States, Weather Modification, Inc., operates and rents out a fleet of several models of more than 35 twin-engine aircraft.

Training - The University of North Dakota has a training program for young pilots to learn how to seed clouds as part of the university's accredited weather modification program. By the end of 2012 they had trained over 325 pilots. North Dakota started seeding in the 1950s, primarily to reduce the size of hail in hailstorms.



Air-Spraying Equipment - This is a wing mounted generator for spraying silver iodide. | Source

New Cloud Seeding Technology

Sea Salt Spray - Microsoft's Bill Gates is financing an interesting project to reduce the heat of the planet by increasing cloud cover over the oceans. The video at right shows San Francisco inventors funded by him who have created an unmanned, floating sprayer that would throw sea salt specks into the sky to condense moisture. Some of the technology uses principles discovered by Anton Flettner from Germany.

Laser Seeding - German, Swiss, and French researchers have meanwhile developed a new laser technique for increasing raindrop size, which they have started testing over the skies of Berlin. The laser, with a potential power greater than 1,000 power plants, fires into the atmosphere, reconstituting atoms in the air into components that could seed bigger and better water droplets - assuming there is enough water vapor in the air to respond accordingly.

Increasing Cloud Cover

Cloud Seeding Costs

On the surface of it, cloud seeding appears to satisfy a number of public needs, but it does not come without a cost. One of the concerns is the cumulative public health and environmental effects of the types of chemicals used in the process. Another is the potential danger of taking rain away from an area that might need it more, or drying the air faster than it's able to rehumidify, resulting in subsequent years of droughts and/or fires (which seems to be happening in Texas right now). Yet a third is the potential for

creating floods, either from seeding too much or from strong winds that carry seeded clouds further than expected. Some of these concerns are being addressed already. Others are yet to come.