

Why 'cloud seeding' is increasingly attractive to the thirsty West

6 March 2018, by Sophie Quinton, Stateline.org

Machines that prod clouds to make snow may sound like something out of an old science fiction movie. But worsening water scarcity, combined with new proof that "cloud seeding" actually works, is spurring more states, counties, water districts and power companies across the thirsty West to use the strategy.

In January, a study funded by the National Science Foundation proved for the first time that the technology works in nature. That study, combined with other recent research, has helped make [cloud seeding](#) an attractive option for officials and companies desperate to increase the amount of [water](#) in rivers and reservoirs.

In Colorado alone, more than a hundred cloud seeding machines are set up in mountainside backyards, fields and meadows. Some older versions of the contraptions look like a large tin can perched on top of a propane tank. New ones are large metal boxes festooned with solar panels, weather sensors and a slim tower.

Their goal is the same: to "seed" clouds with particles of silver iodide, a compound that freezing water vapor easily attaches to. That makes ice crystals, which eventually become snowflakes.

Colorado's \$1 million-a-year program has been around since the 1970s and is paid for not just by the state, ski resorts, and local water users but also water districts as far away as Los Angeles that want to increase snowmelt into the Colorado River, which sustains over 30 million people across the Southwest. Currently, most of the river basin is experiencing a drought.

"Everyone starts to get nervous when there's no snow in Colorado," said Joe Busto, the scientist who oversees Colorado's cloud seeding program.

Major urban water districts in Arizona, California and Nevada have funded cloud seeding in the

Rocky Mountains for over 10 years and are now close to signing an agreement with officials in Colorado, New Mexico, Utah and Wyoming to split the cost of nine more years of seeding.

Cloud seeding is a relatively cheap tool for bulking up the water supply in Lake Mead and other reservoirs, said Mohammed Mahmoud, a senior policy analyst for the Central Arizona Water Conservation District. The up to \$500,000 annual commitment the district is making to the regional agreement comprises a tiny fraction of its budget, he said.

Yet it's hard to tell how much additional precipitation cloud seeding creates or how much additional snow or rain eventually makes it into city water pipes. Cloud seeding only works when there are freezing, moist clouds in the air. And the technology can be controversial.

"The whole thing is propaganda," said Jamie Kouba, 32, a farmer from Regent, N.D., who argues that cloud seeding is decreasing rainfall in his area, rather than increasing it. He's organizing local farmers in a campaign against the practice.

Scientists discovered in the 1940s that certain molecules make a good foundation for snow. In one famous experiment, a chemist made it snow by dumping 6 pounds of dry ice out of an airplane over western Massachusetts.

It didn't take long for states, localities and ski resorts to start experimenting. Colorado's Vail ski area began cloud seeding in the 1970s, for instance. Today California, Idaho, Nevada, Utah and Wyoming have winter cloud seeding programs, and Texas and North Dakota have summer programs, which aim to increase rain and decrease hail.

Cloud seeding machines are nothing like the "snow guns" used to blast water over ski slopes. Instead,

when they're turned on they generate smoke that floats into the air like incense. Some state programs rely on ground-based machines. Others use airplanes to drop flares that generate silver iodide smoke into clouds, or to fly into a storm with flares strapped to their wings.

The January National Science Foundation-funded study, which was conducted in Idaho, was the first to show real-world observations of silver iodide forming ice crystals inside clouds and falling out as precipitation.

Such research has increased interest in cloud seeding, particularly among private companies and utilities, said Neil Brackin, president of Weather Modification Inc., a North Dakota company that does cloud seeding. "We're able to now really demonstrate the technology, and they can see it's not something conceptual that works in a lab—it's measurable."

Other recent studies have used computer modeling to estimate the increase in snowfall from cloud seeding. A 2014 study across two Wyoming mountain ranges found that cloud seeding could increase snowfall by 5 to 15 percent—but only when the right conditions for seeding were met, or during 30 percent of snow events.

Relatively small increases still matter. "People in the western United States—we're always water-stressed out here," said Frank McDonough, an atmospheric scientist in Nevada who oversees the cloud seeding program at the Desert Research Institute, part of the state university system. Along the Colorado River, more water is promised to people than is available.

Nevada's cloud seeding program can increase the snowpack by up to 10 percent, McDonough said.

That translates into 80,000 more acre-feet a year of water, enough to sustain about 150,000 households.

Still, he said, cloud seeding programs are difficult to evaluate. "Ten percent of additional snowfall is within the natural variation of storms."

Although it's hard for scientists to gauge the effectiveness of cloud seeding, many water districts are willing to take a chance on the technology because cloud seeding is relatively cheap.

Idaho Power, which serves customers in Idaho and Oregon, has been using cloud seeding to boost the volume of water moving through its hydroelectric dams since 2003. The company's representatives say the \$3 million seeding program they oversee—which is partly funded by the state and other water users—generates billions of gallons of additional water for much less than 1 percent of the company's operational budget.

"When you do the math, it turns out to be about \$3.50 per acre-foot," said Shaun Parkinson, water resources leader at Idaho Power. Renting water through a water supply bank—another way for irrigators to access more water—costs \$17-21 an acre-foot, he said.

As the technology advances, cloud seeding could get even better results. In Colorado, Busto is adding more remote-controlled generators that can be driven high on a mountain, closer to [clouds](#), and left there all winter. Currently, most cloud seeding machines in the state are installed on private property and manually operated by homeowners and farmers who are paid to turn them on when a storm comes.

Still, Busto warns that cloud seeding isn't a cure for drought. Take this winter, which has been too warm and too dry for seeding. "We have not been able to run our cloud seeding machines because there's been no storms coming through," he said; the machines have only run a handful of times so far.

State lawmakers can be reluctant to spend money on cloud seeding technology, particularly during tight budget years.

Wyoming's Legislature, for instance, put about \$120,000 to \$160,000 into the state's cloud seeding program each year since it started in 2005. But now the state is running a deficit, and lawmakers want to cut next year's funding to \$80,000.

At a recent meeting at the Wyoming Water

Development Office in Cheyenne, state engineer Patrick Tyrrell told cloud seeding company representatives and state and local officials from around the region that his team hasn't yet found local funders, such as ski resorts, to step in to help pay for the program.

Kansas' cloud seeding program has dwindled almost to nothing since the 1970s because of budget cuts. Nevada's Legislature eliminated funding for cloud seeding during the 2008 budget shortfall, McDonough said. Lawmakers voted last year to resume funding.

Cloud seeding can also face public opposition. State officials who manage the programs are used to explaining the science to lawmakers, their governing boards, reporters and concerned citizens.

"Most people don't understand the science very well, and they don't understand who's doing what and where," Busto said. It's easy to find websites and online videos dedicated to conspiracy theories, such as that cloud seeding caused last year's hurricane and flooding in Houston, or that cloud seeding is part of a government plot that will inevitably poison all life on Earth.

Busto said he has been confronted by people who are worried that exposure to silver iodide will make them sick. But silver is a naturally occurring element that is not inherently harmful, he said. In the 2014 Wyoming study, scientists found that seeding added some [silver iodide](#) to the surrounding water and soil but far too little to pose a known threat to human health.

North Dakota's Kouba is one of the skeptics. He has compiled state rainfall data going back to the 1970s and concluded that cloud seeding has decreased rainfall, particularly in counties that are downwind of seeding operations. "I'm in a downwind county, and we have lost considerably," he said.

Last summer, when a drought seized western North Dakota, Kouba circulated a petition asking the Hettinger County Commission to file an injunction against a nearby county to stop cloud seeding

there. He managed to get about half the county to sign on, he said. Recently, he presented his rainfall data to the state water commission.

North Dakota officials say there's no evidence that cloud seeding caused last year's drought. If anything, cloud seeding in one place leads to more precipitation downwind, not less, said Darin Langerud, who oversees cloud seeding for the North Dakota Atmospheric Resource Board.

Busto said actual science fiction—such as "Geostorm," a 2017 movie about malfunctioning climate control satellites—fuels misperceptions about what states are really trying to do.

"Every time something like that comes out it feeds more conspiracy theories," he said. "I'm just trying to make more snowflakes at a ski resort."

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APA citation: Why 'cloud seeding' is increasingly attractive to the thirsty West (2018, March 6) retrieved 21 September 2019 from <https://phys.org/news/2018-03-cloud-seeding-increasingly-thirsty-west.html>

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