WYOMING WATER DEVELOPMENT OFFICE

Wyoming Cloud Seeding Activities

The Wyoming Water Development Office (WWDO) became interested in cold season cloud seeding (a form of weather modification) in the early 2000's. The Office spent more than ten years conducting extensive research on the science and effectiveness of the technology to help determine whether seeding over certain parts of the state would be a valuable and affordable investment. WWDO's ten-year Wyoming Weather Modification Pilot Study showed positive results, indicating that cloud seeding over certain mountain ranges would incrementally augment snowpack and increase spring runoff. Since then, several other studies have been conducted to analyze cloud seeding opportunities across the state, all with positive results indicating seeding is a viable technology.

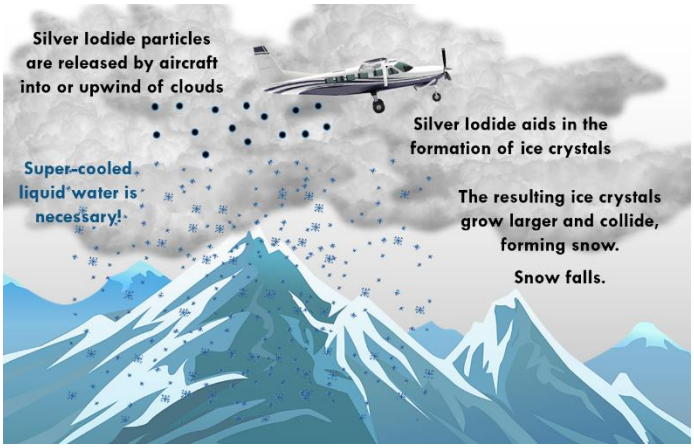
Seeding clouds continues to be proven as a safe and environmentally-friendly technology for increasing precipitation in small amounts.

WHAT IS CLOUD SEEDING?

Cold season seeding, and how it works

Cold season cloud seeding is conducted during the winter season (generally Nov. 15 through Apr. 15), over mountains to assist in a cloud's natural precipitation process by enhancing ice crystal production. When ice crystals grow sufficiently, they turn into snowflakes and fall to the ground. The presence of clouds and the potential for precipitation are pre-existing conditions needed for cloud seeding to be effective.

Silver iodide is a natural compound used during the cloud seeding process, chosen for its environmental safety and unique molecular structure, as it is very similar to the structure of naturally forming ice crystals. Silver iodide initiates the freezing process of water in a cloud, which increases the number of ice crystals, ultimately leading to the production of snow.



The process of seeding clouds can be conducted by either aircraft or ground-based generators. It is estimated that the production of snow can occur within 30 minutes from the start of seeding. In some cases, high performance radar imagery has documented snow development in less time.

CLOUD SEEDING FACTS:

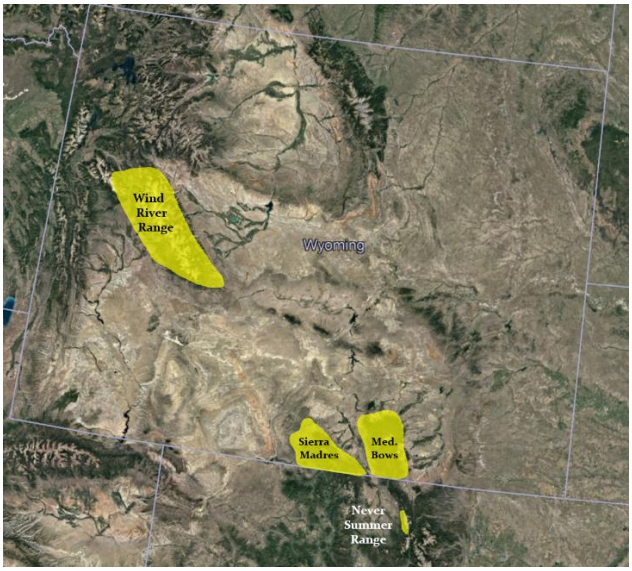
- Silver iodide enhances the freezing of liquid water that already exists within a cloud.
- Cloud seeding is not a large-scale process, but rather microscale, and does not significantly impact precipitation downwind.
- Operational programs include a strict suspension criteria

OPERATIONAL PROGRAMS

A summary of Wyoming's ground-based and aerial cloud seeding programs

Currently, the WWDO manages two programs across the state:

1. Wind River Mountains Weather Modification (ground)
2. Medicine Bow/Sierra Madre Mountain Ranges Weather Modification (aerial)



Wind River Mountains

A Ground-Based Cloud Seeding Program over the Green and Wind River Basins

Beginning in 2014, the Wind River Mountains has been the State's longest operational cloud seeding program. Cloud seeding is conducted with ten remote controlled, ground-based generators located on the western and southern flanks of the range. Seeding activities for this program generally take place mid-November through mid-April.

The program is funded in part by the Wyoming State Legislature, with additional funding from regional water users:

- Southern Nevada Water Authority
- Central Arizona Water Conservancy District
- Colorado River Board of California – Six Agency
- Genesis Alkali (Green River, WY)
- Solvay Minerals (Green River, WY)
- TATA Chemicals (Green River, WY)
- Ciner Wyoming (Green River, WY)
- Rocky Mountain Power (Green River, WY)

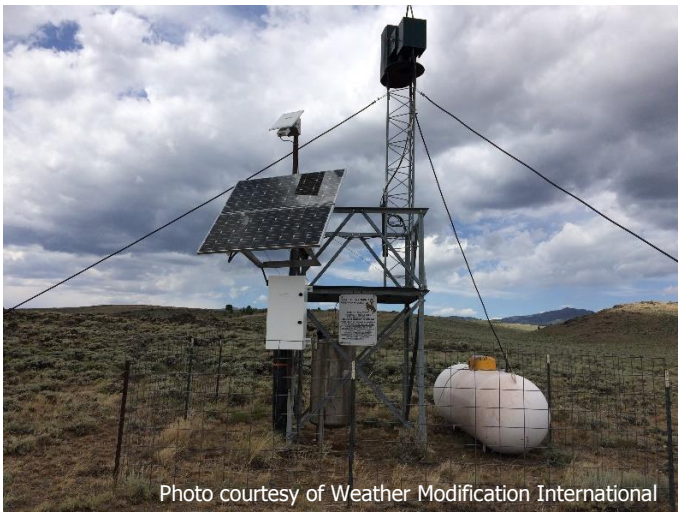


Photo courtesy of Weather Modification International

During the 2019 Legislative Session, the program budget was approved at a 37% (State of Wyoming: $170,000) / 63% (other funding partners: $290,000) funding split for the 2019-2020 winter season, totaling $460,000.

Colorado River Basin Programmatic Funding Agreement

Wyoming is one of seven states taking part in a formal cost-share agreement (between Upper Basin and Lower Basin parties) to continue the use of weather modification efforts as a way to contribute additional water into the system for Colorado River Basin users. Collective contributions have the potential to reach $1,500,000 in a single Water Year. This agreement allows the Upper Basin States flexibility and possible additional funding to expand programs.

Medicine Bow/Sierra Madre Mountain Ranges

Aerial seeding over the North Platte Basin

The winter season of 2018-2019 was the first time the State of Wyoming conducted a cloud seeding program strictly with aircraft. The Medicine Bow and Sierra Madre Mountain Ranges will continue to be a target area for aerial cloud seeding during this next winter season (2019-2020). Cloud seeding by aircraft is cost-effective, especially for this region and terrain area. The program's high-performance King Air Turbo Prop C-90A aircraft can achieve greater accuracy at targeting favorable seeding areas within clouds, rather than targeting from a fixed location (ground-based generators).

Seeding activities generally take place mid-November through March, with the aircraft based at the Cheyenne Regional Airport.

Photo courtesy of Weather Modification International

The program is funded in part by the Wyoming State Legislature ($589,000), with the City of Cheyenne Board of Public Utilities as funding partner ($45,000). The project cost for upcoming winter 2019-2020 operations is $634,000. Expansion is planned to include the Laramie Range.

Seeding Colorado's Never Summer Mountains

Colorado's Never Summer Mountain Range is an "add-on" to Wyoming's airborne program (contingent upon permitting). This additional cloud seeding effort is paid for and sponsored by Colorado's Jackson County Water Conservancy District.

OTHER CLOUD SEEDING ACTIVITIES:

- **> Colorado Water Conservation Board**
- **> Idaho Power Company**
- **> North Dakota Atmospheric Resource Board**
- **> Utah Division of Water Resources**
- **> Desert Research Institute of Nevada**
- **> California Department of Water Resources**