Weather Modification

Cloud seeding—a form of weather modification—is a safe, scientific, time-tested, and proven set of technologies used to enhance rain and snow, reduce hail damage, and alleviate fog. The benefits of cloud seeding can be measured in additional water for cities and agriculture, as well as the reduction of damage from severe weather.

Burn-in-place flares are mounted on the aircraft wing to disperse silver iodide in a cloud.

Warm Season Cloud Seeding

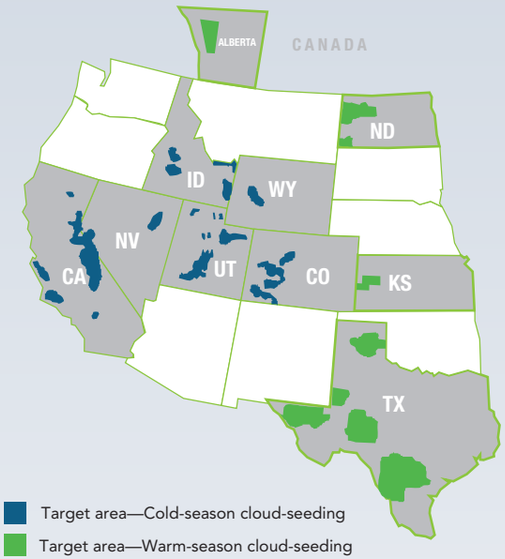
When the top of a growing cumulus cloud cools below freezing, water droplets don't immediately freeze. Instead, they become "super cooled". Windblown dust and soil particles provide the "seeds"—ice nuclei—for the development of ice crystals. Many times, however, these dust particles are either too inefficient or too few in number to provide sufficient nucleation. Summer cloud seeding provides an opportunity to increase the number of efficient ice nuclei in the seeded cloud increasing the amount, frequency, and distribution of rain.

Cumulonimbus (thunderstorm) clouds can also generate damaging hail. Cloud seeding can be used to reduce a storm's severity by adding efficient nuclei and increasing competition for cloud water, altering energy transfer in the cloud, changing the trajectory of cloud particles, and ultimately modifying the size of ice particles.

Who Conducts Cloud Seeding?

In North America, cloud-seeding programs are conducted in California, Colorado, Idaho, Nevada, Utah, Wyoming, Kansas, North Dakota, and Texas, as well as Alberta, Canada.

Cloud seeding is also conducted through major programs in the countries of Australia, Chile, China, France, Greece, India, Israel, Saudi Arabia, and Spain.



Target area—Cold-season cloud-seeding

Target area—Warm-season cloud-seeding

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UNDERSTANDING WARM SEASON Cloud Seeding

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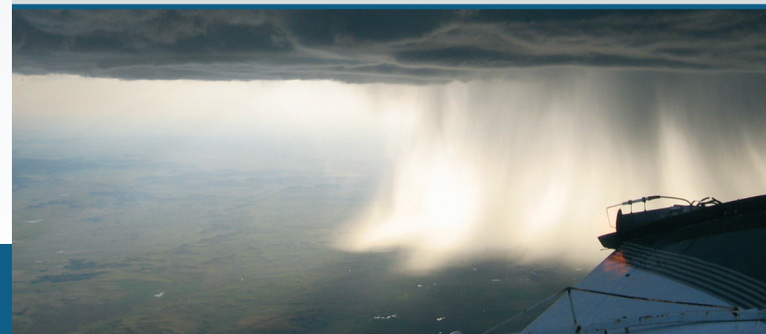
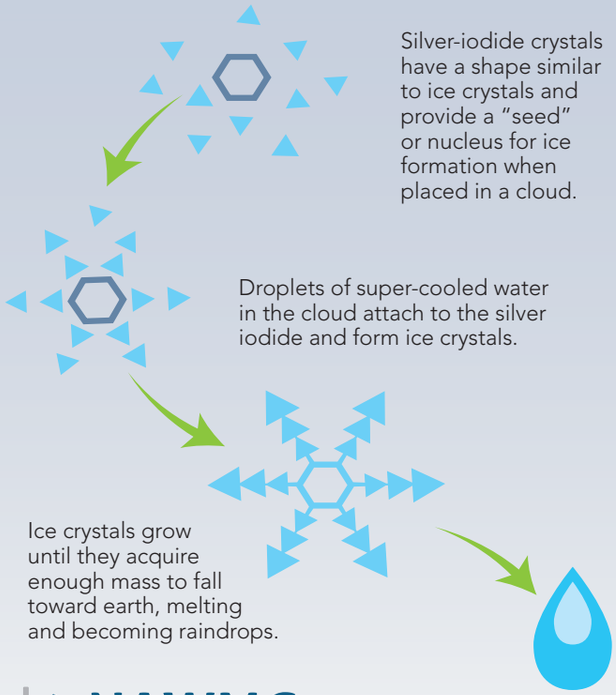


Inducing the formation of ice crystals in a cumulus cloud



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WEATHER MODIFICATION

Warm Season Cloud Seeding

Rain Enhancement

Hail Suppression

Fog Dispersion

The Science

The cloud-seeding process aids precipitation formation by enhancing ice crystal or raindrop production in clouds. This is accomplished by using glaciogenic (ice-forming) agents, such as silver iodide or dry ice, or hygroscopic (water attracting) agents such as salt. As seeding accelerates the precipitation process, the seeded cloud becomes a more efficient producer of precipitation.

Silver iodide and dry ice (solid carbon dioxide) have been selected for their environmental safety and superior efficiency in producing ice in clouds. Ground-based and aircraft-borne technologies can be used to add the particles to the clouds.

Various salt compounds comprise another class of substances known as hygroscopic (water attracting) that serve as optimal condensation nuclei for cloud water. These are released over a spectrum of different size particles to enhance the cloud's ability to produce raindrops.

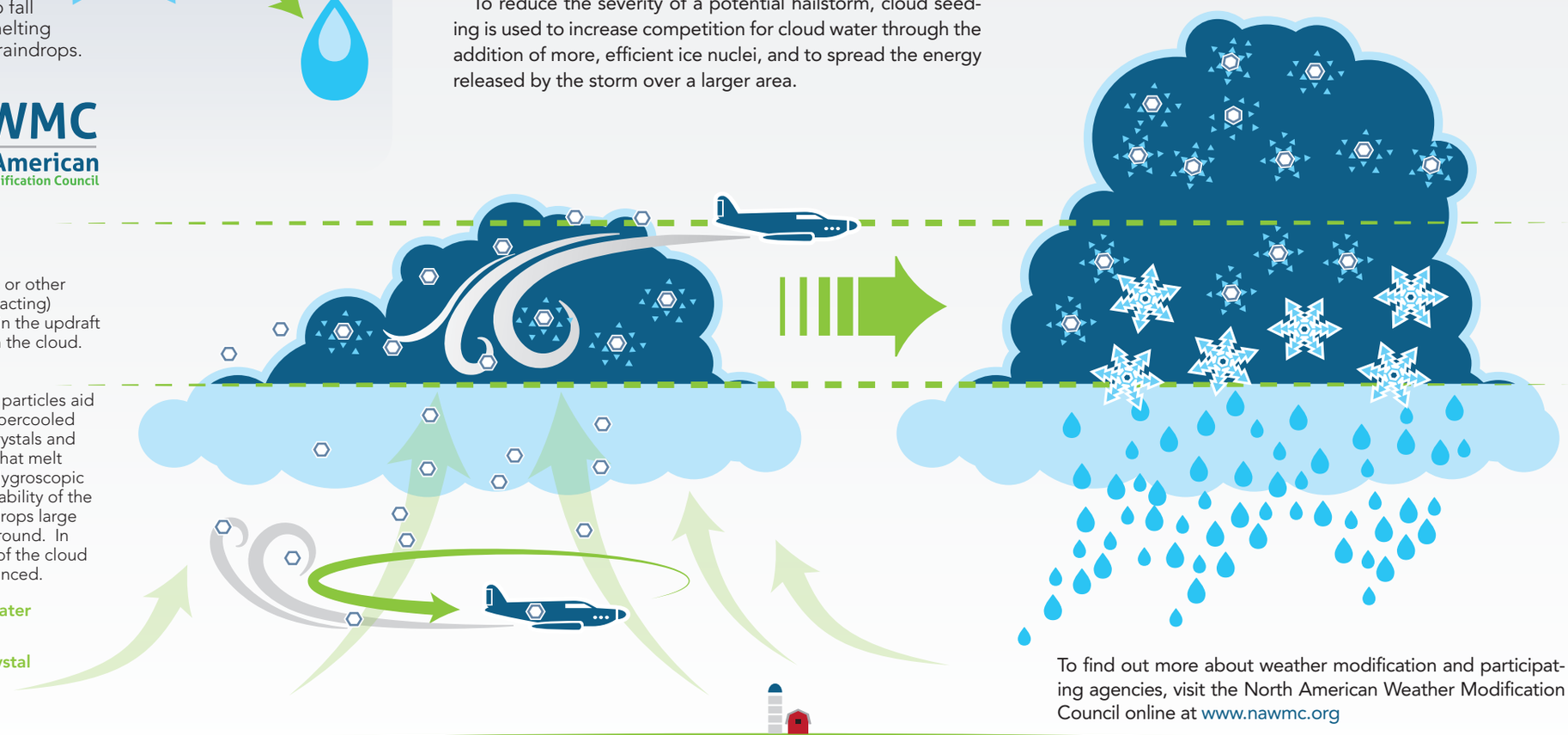
To reduce the severity of a potential hailstorm, cloud seeding is used to increase competition for cloud water through the addition of more, efficient ice nuclei, and to spread the energy released by the storm over a larger area.

Effectiveness

For cloud seeding to be effective, super-cooled droplets—moisture and clouds—must be present. Studies have documented cloud seeding's ability to increase the frequency and amount of rainfall to reduce the severity of hailstorms, given the right atmospheric conditions. The effects of cloud seeding can sometimes be seen within 30 minutes, but more generally between 30 minutes and an hour.

Safety

Research has clearly documented that cloud seeding with silver iodide aerosols shows no environmentally harmful effect.



1. Silver iodide, dry ice or other hygroscopic (water attracting) materials are released in the updraft or **(2)** placed directly in the cloud.

3. Silver iodide/dry ice particles aid in the conversion of supercooled water droplets to ice crystals and eventually snowflakes that melt and become rain **(4)**. Hygroscopic materials enhance the ability of the cloud to produce raindrops large enough to fall to the ground. In both cases, the ability of the cloud to produce rain is enhanced.

Super-cooled water

Silver-iodide crystal

Ice crystal

To find out more about weather modification and participating agencies, visit the North American Weather Modification Council online at www.nawmc.org