WRIT 340

Illumin article

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# Controlling the Weather

*Cloud seeding is the most common type of weather modification. The most common type of cloud seeding is static cloud seeding. Although the original intention for cloud seeding is to help stop disaster from damaging weather, such as enhance precipitation in dry area, there are some consequences about cloud seeding, including the environmental damage from the chemical used, and weather warfare due to the misuse of technology. A good balance between what we get from the cloud seeding technology and what we lose from it is needed.*

## I. Introduction:

Indoor clouds were listed as the best invention of the year 2012 by Time Magazine [1]. Berndnaut Smilde, a Dutch artist, has successfully created floating clouds indoors. Imitating the basic formation of a real cloud, he created the clouds using nothing more than a thermostat, a humidifier, and a smoke machine. Although it seems the concept is not that hard, it was not easy to create the indoor cloud successfully. He has to carefully control humidity and temperature in the space [2].

Figure 1 Indoor Cloud by Berndnaut Smilde - Nimbus, 2010

(http://www.berndnaut.nl/images/Nimbusprint1index.jpg)

Smilde created indoor clouds successfully using simple tools and concepts, but how about creating a real cloud in the sky? Creating a cloud, controlling the weather has been a controversial researching topic since the 1940 ’s. Further research on weather modification is still needed as there is not only potential gains from the technology but also potential losses from the technology.

## II. Weather Modification?

Weather modification, referred to the act of intentionally altering the weather by human activity, is usually used for preventing any disaster from damaging weather, such as rain, snow, hail, lightening, and tornadoes. There are many weather modification projects being performed in different countries. The most common form of weather modification is cloud seeding [3].

## III. Cloud Seeding?

Cloud seeding is the technology that increases a cloud’s ability to produce precipitation [4]. This can help increasing precipitation in dry areas throughout the whole year, mitigating hail damage in warm seasons as well as dispersing fog in cold seasons. [5].

## IV. How Natural Clouds Work:

Clouds are collections of tiny water droplets and crystallized water molecules [6]. The atmosphere contains oxygen, nitrogen, water vapor and small amount of other gases. As shown in Figure 2, water evaporates from the ground under the sun's heat. Thus, the percentage of water vapor in the atmosphere increases as the temperature rises [7]. When the water vapor rises, the air temperate drops until reaching a saturation point, then the water vapor will condense to ice crystals and appear as a cloud [6]. When the cloud is large and heavy enough, precipitation occurs.

In addition, condensation nuclei, such as dust particles, sea salt particles, soot from wildfires and certain plant bacteria, also help increase the efficiency of cloud formation because when water vapor clinging to condensation nuclei, water droplets or ice crystals form around them. [6].

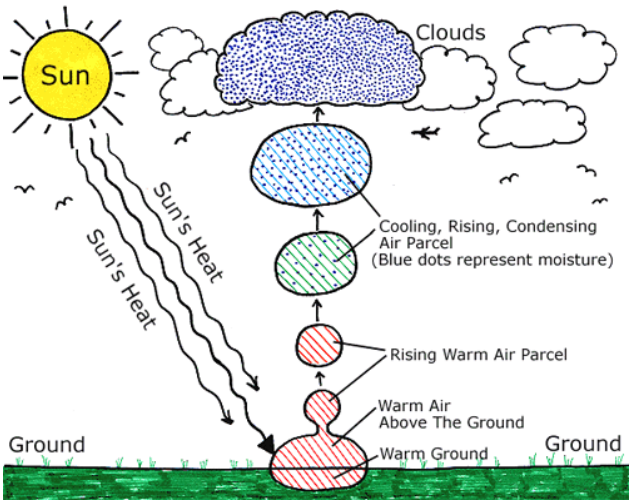


Figure 2 Formation of natural cloud

(http://www.nc-climate.ncsu.edu/secc_edu/images/WhatMakesClouds1.GIF)

## V. How Cloud Seeding Works:

There are different methods of cloud seeding. Static cloud seeding is the most common cloud seeding method. As shown in Figure 3a and 3b, static cloud seeding works by spreading a chemical like silver iodide and dry ice into the cloud. They can help cool down the air to increase the number of ice particles in the cloud. When the cold droplets surround the ice particles, the ice particles will grow rapidly and become large enough to fall to the ground, thus enhance the efficiency of precipitation when the crystal reach the melting level [7]. On the other hand, silver iodide can serve as the condensation that provides more crystal around the cloud to let water vapor condense on, which also make clouds more effective at dispensing rain by increasing the amount of rain drops [8]. Silver iodide can be spread by using a ground generator or by a device on a plane, while dry ice is usually dropped by a device on a plane [7].


Figure 3a Cloud Seeding Process

(http://www.blueplanet.nsw.edu.au/SiteFiles/blueplanetnsweduau/cloud_seeding1.gif)

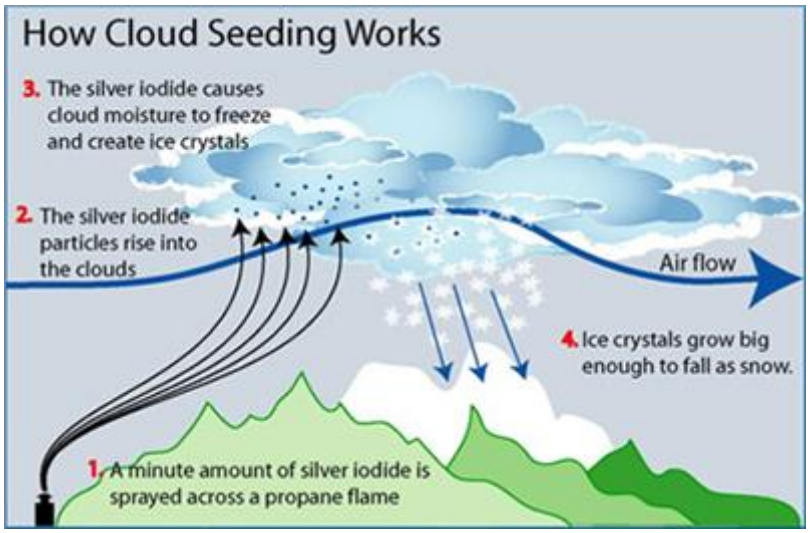


Figure 3b Static Cloud Seeding

(http://www.blueplanet.nsw.edu.au/SiteFiles/blueplanetnsweduau/cloud_seeding2.jpg)

The other cloud seeding method is dynamic cloud seeding. As shown in Figure 4, the intention of dynamic cloud seeding is to enhance the vertical air currents in clouds when dropping silver iodide directly into the high supercool water molecules layer, and therefore encourage more water to pass through the clouds. Thus, more ice crystals can be formed, resulting in increased precipitation [9]. However, the dynamic method is more complex and needs up to 100 times more seeding material than in the static method [8].

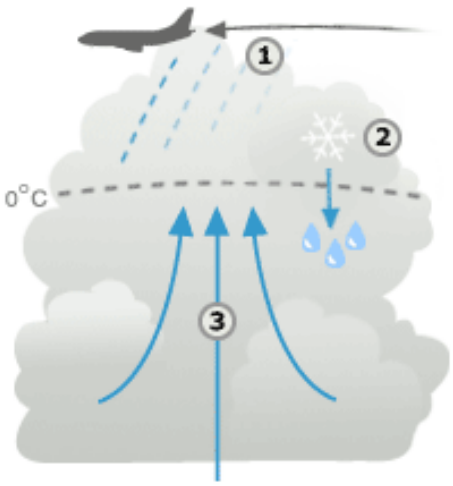


Figure 4 Dynamic Cloud Seeding

(http://www.just-clouds.com/images/glaciogenic_seeding.gif)

Another cloud seeding method is hygroscopic (salt) cloud seeding. As shown in Figure 5, hygroscopic cloud seeding involves dispersing salts through the lower portions of the clouds. The salts attract the water to crystalize on it and thus the salt crystal will grow in size. The salt dissolves when the crystals form with enough water molecules and thereby increase the efficiency of rain dropping. However, this cloud seeding method still needs more research [8].

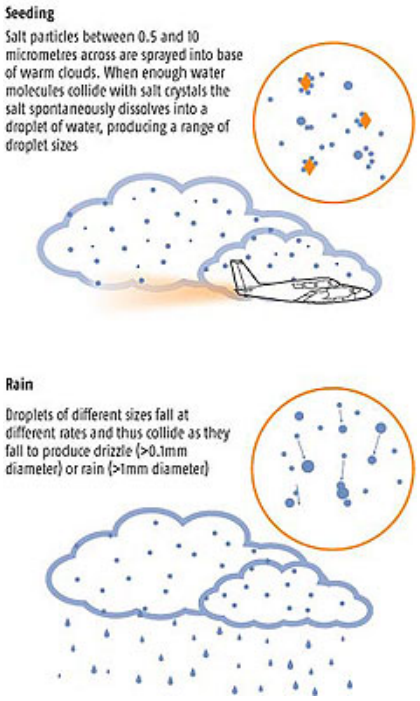


Figure 5 Hygroscopic Cloud Seeding

(http://www.just-clouds.com/images/hygroscopic_seeding2.jpg)

## VI. Examples of Cloud Seeding:

A wide variety of countries have tried their hand at cloud seeding, including United States, Russia, China, Australia, Israel, Thailand, South Africa and Caribbean nations [8].

One of the most recent examples about cloud seeding is about the 2008 Beijing Olympics. In order to have a well opening ceremony for the Olympics, China claimed that they seeded threatening clouds outside the city to make the clouds to release their rain before they reaches the city [10].

The United States started weather control research in 1940 ’s. They intentionally used cloud seeding to increase precipitation levels or prevent crop-damaging hail. However, as the cost for cloud seeding is too high and controversial issue of the practices increases, number of research decreased start from early 1970 ’s [8]. Nowadays, most of the cloud-seeing projects are executed in the middle and west area. In California, the projects are mainly using static cloud seeding for precipitation augmentation [4].

## VII. Controversial Issue:

Although most of the cloud seeding projects intentionally help weather control, and reduce aridity, there are many debates about cloud seeding.

The first consequence is that people are still doubt about if cloud seeding really works. There is no monitor about the success rate of clouding seeding in different projects. In 2003, The National Research Council reported that there was no evidence to prove the technique works, but the panel's scientists acknowledged the potential and encourage more study [11].

Another issue includes silver iodide toxicity. In 1997, The Office of Environment, Health and Safety, UC Berkeley, rated silver iodide as a hazardous chemical that pollutes water and soil. Moreover, silver iodide is toxic to fish, livestock and humans [12]. However, the Weather Medication Association published a study in 2008 concluding that years of research have shown no “environmentally

harmful effects" from silver iodide [11]. Thus, it is still a question about whether silver iodide is safe to be using.

Moreover, there is some evidence showing that the United States and Soviet Union tried to use cloud seeding to create a weather war. The United States admits that they used cloud seeding during the Vietnam war to create heavy rainfall to destroy enemy crops and break supply routes on Ho Chi Minh trail. According to Michel Chossudovsky, professor at the University of Ottawa in Canada, the Russians are thought to try prolonging the drought in California in the 1980 's by using their own "weather steering" system by blocking the warm, moist air [13].

## VIII. Summary:

The original intention for cloud seeding was to make people's living better. If cloud seeding technology works fine, it can help stop different disasters due to damaging weather. However, there are still lots of consequences about the cloud seeding technology being used now. Further research on weather control is needed as well as a good balance between the advantage of cloud seeding and the side effects due to the technology.

Reference:


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