



WET International

*Hydro-meteorology
for the 21st century*

[Home](#)

[About Us](#)

[Tailored Weather
Forecasts](#)

[Cloud Seeding](#)

[Winter Cloud Seeding FAO](#)

[Documents & Links](#)

[Solutions](#)

[Ground-based vs Aircraft
Seeding?](#)

[Silver Iodide vs Liquid
Propane Seeding?](#)

[Cost Comparison](#)

How Winter Cloud Seeding Works

When moist air is lifted over mountains, the water vapor condenses and forms clouds composed of tiny water droplets. In winter, even if temperatures are well below freezing, these droplets frequently remain in the liquid state. These droplets make up *supercooled liquid water or SLW*. It is this amazing quality of water gives cloud seeding its window of opportunity.

If nothing acts to alter this SLW, it remains as tiny droplets that eventually evaporate as they accompany the sinking, drying airmass on the far (lee) side of the mountain range. In fact, this is what happens to about 90% of the SLW on average. To alter this situation, the droplets must freeze to form ice crystals. This is where cloud seeding intervenes in the process, by artificially freezing droplets that nature does not. Then another remarkable thing can happen - these ice crystals grow at the expense of the surrounding droplets. If there are enough droplets, the ice crystals grow large enough to fall to the ground as snow. In other words, SLW droplets provide the "fuel" necessary to form snow precipitation.

Cloud seeding cannot provide the requisite SLW fuel. By changing some droplets to ice crystals, however, seeding gives them a chance to grow and precipitate if they encounter enough SLW along their paths. Nevertheless, it is clear that to be successful, *cloud seeding must be done when significant quantities of SLW are present!* Otherwise, the "spark" generated by seeding doesn't have a chance to produce precipitation. Both natural and seeding-initiated precipitation result from the realization of a chain of physical processes. If one link of the chain is broken, precipitation will not occur. The crucial role of this physical chain prompted the American Meteorological Society (see [Links](#) page) to state "Whereas a statistical evaluation is required to establish that a significant change resulted from a given seeding activity, it must be accompanied by a *physical evaluation* to confirm that the statistically observed change was due to the seeding."



Winter Mountain Cloud Seeding with Silver Iodide

As one might expect since 90% of it is not converted to precipitation, SLW is frequently abundant. Unfortunately, research has shown that it is also quite variable in time and space and therefore difficult to forecast. This has been a persistent problem for operational seeding, which in the usual absence of direct measurements must use indirect, related indicators to infer SLW presence. Fortunately, the research also points to where the most abundant SLW may be found. It turns out that most SLW is close to the underlying terrain, within about 3000 feet of it. Also, SLW is usually greatest on the windward slopes of mountain ranges, up to the crests. These locations are not surprising, since they are nearest the source of airmass lift. But before SLW measurements were routinely made in the 1980s, these facts were not confirmed.

Given these facts, how do we develop and deploy cloud seeding technology to maximize additional precipitation? It is essential to have knowledge of SLW, meteorology, cloud physics, and other atmospheric phenomena. But it is equally important to understand cloud seeding *technology*, so as to adapt it to the complexities of the atmosphere. The above figure depicts ground-based generators using silver iodide as the seeding agent. This is the simplest and most common technology, but others exist. You may read about these on our technology page.

WET International, Málaga, Spain; Boulder, Colorado, USA. Email: info@wet-intl.com Phone +34 661 652 645

[Privacy Policy/Terms of Service](#)