CLOUD SEEDING: MY POINT OF VIEW

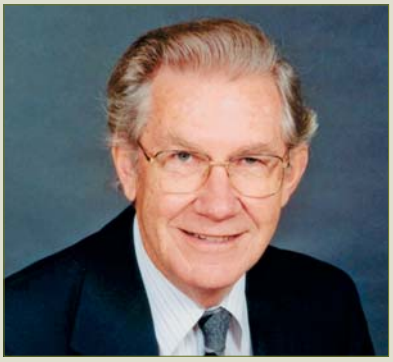
By Neville Fletcher

In these days of water shortages, which will certainly get worse as population grows and the climate changes, all possible solutions should be examined. One of the major contenders is cloud seeding, but how effective is it likely to be in the Australian environment?

Clouds come in two basic types: maritime and continental. Maritime clouds come in from over the sea and have relatively small concentrations of fairly large cloud droplets which can collide with one another to form raindrops. Continental clouds have very many more droplets and each droplet is much smaller, so that they tend not to collide and the clouds fail to rain by this coalescence process. As the clouds rise above the freezing level one would expect the droplets to freeze but this does not happen until about –15°C and then only with the aid of tiny dust particles. There is, however, a magical substance, silver iodide, whose crystal structure is very similar to that of ice, and it can make the droplets freeze at about –4°C. Once the droplet has frozen it collects water from surrounding droplets by evaporation and condensation until it is large enough to fall against the updraft and eventually become a raindrop. This is the essence of cloud seeding, with silver iodide smoke either released from an aircraft flying through the cloud or from ground-based burners on the upwind side of a mountain range.

CSIRO began cloud seeding experiments in Australia in the early 1950s, with experiments in Tasmania, Victoria, northern NSW and the Snowy Mountains, but the resulting increase in precipitation was often controversial because of the statistical variability of rainfall. The Tasmanian experiment went to an operational level, and Tasmanian Hydro has been running it continuously to the present day. Analysis of the rainfall results shows with good confidence that there has been an increase in rainfall of around 10% in the seeded areas and no established decrease in areas downwind.

Of course for cloud seeding to work there have to be good clouds in the first place, and the results suggest that seeding with silver iodide usually – but not always – results in considerable increase of total rainfall from clouds that are going to rain anyway, but is less effective in marginal clouds that rain only a small amount. Cloud seeding is therefore not a magic remedy for drought, but it can be used to increase total water storage in years when the rainfall is good. These general conclusions are supported by similar work in the United States, Israel and South Africa, among other places, but detailed results depend upon the climate, the history of the air mass in which the clouds have grown, and also the topography of the area to be seeded. In some areas cloud seeding will work and in some it won't.



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So what is the future for cloud-seeding in Australia? In addition to the Tasmanian operation we have had a new experimental program in the Snowy Mountains for the past few years and one is about to commence in southern Queensland. The experimental design in each case should have taken into account the results and questions that have been identified over the past fifty years. Since the clouds in most cases have developed in continental air masses, the seeding agent is silver iodide, and this is mostly released from burners at ground level on the up-wind slopes of the mountains. Use of aircraft to release the smoke into good candidate clouds that have been identified by special radar equipment, as is done in Texas, could perhaps be more effective, but is also much more expensive.

Much has been made recently of the effect of human-produced pollution on clouds and hence on rainfall, and there certainly seems good reason for such an effect, since dust or smoke particles will increase the number and reduce the size of cloud droplets. But smoke pollution has been around for a long time – right back to the "fire management" practices of the Aboriginal people – though we produce much more these days from motor exhausts and industrial sites such as power stations. Power stations are suggested as major culprits, and fortunately it should be possible to reduce the emitted smoke particles by filtration at the source. This would be a one-off installation operation without great on-going costs and so much more cost-effective than remedial cloud seeding. Stricter legislation to reduce other forms of pollution could also be introduced, and this would have good side effects on health. Another major culprit could be simply dust from cleared land that previously held trees.

Since I have mentioned health, there has been some concern expressed about the possible bad effects of the silver iodide nano-particles used for cloud seeding and captured in the resulting rainfall. Sunlight would convert these to metallic silver, but this too has been found to have effects on soil-dwelling bacteria. Could it also have a bad effect on humans if it ends up in drinking water? Measurements on precipitation from seeded clouds in the United States have shown that the silver content of the water is about 20 parts per trillion, which is about one-tenth of the limit set by health authorities. This limit, however, is itself about one-tenth of the level that has been found to have any bad effects on bacteria or other animals, so that the silver content of the water is only about 1 per cent of that found to be harmful. This is negligible compared with the levels of harmful substances released from other sources such as factories and motor exhausts.

In summary, cloud seeding in Australia appears to me to present a great opportunity for building up water supplies in good years to alleviate some of the bad effects of drought. There are, however, many detailed questions still to be answered – not just about cloud seeding but also about natural rainfall – and these will require carefully designed experiments running for five to ten years before we can come to reliable conclusions.