If cannons cannot fight hail, what else?

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Abstract

Hail suppression is an uncertain meteorological subject in premature agricultural servitude. Commonly known is the method of seeding menacing cumulonimbus clouds with silver iodide by means of rockets or aircraft flares. Less discussed but widely practised alternatives are also reviewed here, in particular the useless but still quite popular practice to attempt destroying hailstones with explosives or with sound blasts from so-called hail cannons. The state of the art of hail formation detection with radar, and of hailfall probability nowcasting, is briefly reviewed.

Zusammenfassung


1 Introduction – Generation and occurrence of hail

Hail is a disaster for everybody, but particularly for farmers. We can try using magic or prayer to keep it away (MORGAN, 1973), or else consider it as an occasional stroke of fate. Because hail is incidental in space and time, we can spread the risk and insure ourselves against its damage. However, for farmers of soft crops the damage is already noticeable for relatively small-sized hail, so their risk is relatively large and their insurance premiums are high. This spurs those farmers to action.

The zero option of action is to cover low crops with nets. That influences the crop climate, though not as badly as rumoured. Also there are problems of mounting the nets and of reduced accessibility to the crop (VAN ARKEL, 2003). However, using nets means that hail occurrence is passively accepted as a fact of nature. But many do not accept this and try to prevent hailfall.

If we want to try preventing the falling of large hail, we first must see how and when such hail is formed. The following simplified description of hail generation contains most major basic features, referring for more extensive information to more complete reviews such as RAKOVEC (1989) and KNIGHT and KNIGHT (2001).

Hailstones develop in high cumulonimbus clouds, which form if the temperature difference between the earth and the upper air is very large. Then the air at the surface is unstable and will rise in an updraft, and it cools while rising so that the water vapour in the air will condense on any suitable tiny nucleus of matter. However, at temperatures above −40°C cloud water drops will not freeze unless also particles with an ice-like surface structure are present, so-called freezing or ice-forming nuclei, either natural, or PbI₂ or AgI. Then at temperatures below −4°C the freezing can begin.

A newly formed piece of ice cannot become a large hailstone unless it is carried in the cloud by an updraft which is just a little bit stronger than its falling speed. If the updraft is too strong, the young hailstone will be blown out of the cloud top into the “anvil” of the cloud, and if the updraft is too weak the hailstone will fall before it has grown. But if the ice can remain at a temperature level of −10°C or less, typically around 5 km height, the ice lump will attract the water from the liquid drops around, either by collision or by differential vapour transport.

So for generating hailstones, which are large enough to reach the warm earth without melting while falling, a cloud must have both weak updrafts for the just-formed small hail and also a strong updraft to carry the stones of grown size. Large hail is only formed when cumulonimbus clouds are large enough to have a complex cell structure of the right strength. The diameter of a hail-forming