CORRESPONDENCE

Comments on "Delayed Effects of Cloud Seeding with Silver Iodide"

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I would like to discuss some aspects of the Bigg and Turton (1986) publication. I do not think that the statement, "Even Rosinski and Parungo's (1966) hypothesis that the iodine stimulates secondary ice nucleus production by a reaction between iodine and the plant oils in vegetation seems inherently unlikely because of the very small quantities of iodine added in comparison with the amount occurring naturally," is entirely correct.

Iodine compounds occurring naturally in the atmosphere over continental United States do not nucleate ice at high temperatures, and quantities are lower than what can be produced locally by the vegetation exposed to seeding with silver iodide. Molecules of iodine from each droplet (or later a dry particle) of spray solution containing silver iodide are available in the presence of light for a chemical reaction with terpenes present in the spots where droplets fell on vegetation. There is, however, an unknown time delay of the release of terpene-iodine compounds after seeding; the mechanism of transferring the chemical compounds into the atmosphere is, on the other hand, simple because they evaporate and recondense on the existing aerosol particles. In case of the release of one of the products of biogenic activity (dimethyl sulfide) into the atmosphere it was shown that there exist variations in its concentration vs time of day. The minimum activity exists at 1400 LST, which is followed by a steady increase throughout the night until the concentration reaches the maximum at 0700 (Andreae and Raemdonck, 1983). It was also shown that the DMS vapor is subsequently oxidized and deposited on existing aerosol particles.

It should be noted that aerosol particles in the 0.1 to 0.3 μm diameter size range collected over the Pacific Ocean near the equator nucleated ice below the temperature of -3.3°C; the mode of ice nucleation was condensation followed by freezing; the number concentrations were $\sim 4 \times 10^4$ m^{-3} and they were independent of temperature for the -4°C to -17°C temperature range. These particles, when placed in the vacuum of 10^{-6} mm Hg, completely lost their ice nucleating ability. If some or even all of these particles were bacteria, then in both cases (filter kept in storage at room temperature and one exposed to the vacuum), they were no longer living organisms. Filter exposed to the vacuum lost volatile organic compounds and ammonium sulfate associated with these particles (Parungo et al., 1986; 1987); IFN, therefore, could not be bacteria or proteins in this case and must be products of biogenic activity released into the atmosphere (Rosinski et al., 1986; 1987). Spraying with solutions of oxytetracycline hydrochloride and streptomycin sulfate reduces the population of bacteria; but it also invariably stops production and release into the atmosphere (bacteria are no longer alive) of different chemical compounds synthesized by the biogenic activity which act as IFN; these compounds also react with iodine molecules released from silver iodide and produce IFN active at even higher temperatures and this brings us back to our publication of 1966; it should be noted here that the ice nucleating particles do not necessarily have to be solid particles; heterogeneous nucleation of ice takes place also at the liquid (e.g., terpene)–liquid (supercooled water) interface (Rosinski, 1980; Rosinski and Lecinski, 1981).

These comments were by no means written to defend our suggestion published in 1966. They were written to encourage research in this field; it is very difficult for the very few people who are still trying to discuss this matter to do so without data obtained from well-designed and instrumented experiments. It should also be pointed out that our studies pertain to the biogenic activity in ocean waters and consequently may not be applicable directly to seeding operations conducted over land.

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